ORNL/EIS-124

Thermal Effects on Aquatic Organisms

Annotated Bibliography of the 1976 Literature

OAK RIDGE NATIONAL LABORATORY
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Printed in the United States of America. Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road, Springfield, Virginia 22161
Price: Printed Copy $10.75; Microfiche $3.00

ORNL/EIS-124

Contract No. W-7405-eng-26

Information Division

THERMAL EFFECTS ON AQUATIC ORGANISMS — AN ANNOTATED BIBLIOGRAPHY OF THE 1976 LITERATURE

Compiled and edited by
Sylvia S. Talmage

Ecological Sciences Information Center
Information Center Complex

Work sponsored jointly by the Electric Power Research Institute under agreement RTS-76-37 and the Division of Environmental Impacts, U.S. Department of Energy.

Date Published: May 1978

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C. C. Coutant, H. A. Pfuderer, and B. N. Collier, *Thermal Effects on Aquatic Organisms — Annotated Bibliography of the 1973 Literature*, ORNL/EIS-74/28 (October 1974).

C. C. Coutant, S. S. Talmage, R. F. Carrier, and B. N. Collier, *Thermal Effects on Aquatic Organisms — Annotated Bibliography of the 1974 Literature*, ORNL/EIS-75/28 (June 1975).

C. C. Coutant, S. S. Talmage, R. F. Carrier, B. N. Collier, and N. S. Dailey, *Thermal Effects on Aquatic Organisms — Annotated Bibliography of the 1975 Literature*, ORNL/EIS-88 (October 1976).

H. A. Pfuderer, S. S. Talmage, B. N. Collier, W. Van Winkle, and C. P. Goodyear, *Striped Bass — A Selected, Annotated Bibliography*, ORNL/EIS-75/73 (March 1975).

J. S. Mattice, H. A. Pfuderer, and B. N. Collier, *Chemistry and Effects of Chlorine in Aquatic Systems — A Selected, Annotated Bibliography*, ORNL/EIS-82 (March 1976).

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ABSTRACT

This bibliography, containing 784 annotated references on the effects of temperature on aquatic organisms, is part of an assessment of the literature on the effects of thermal power plants on the environment. The effects of thermal discharges at power plant sites are emphasized. Laboratory and field studies on temperature tolerance and the effects of temperature changes on reproduction, development, growth, distribution, physiology, and sensitivity to other stresses are included. Indexes are provided for author, keywords, subject category, geographic location of the study, taxon, and title (alphabetical listing of keywords-in-context of nontrivial words in the title).

INTRODUCTION

This publication is the sixth in a series of annotated bibliographies on the effects of heat on aquatic organisms. It contains 784 entries from the 1976 literature including field, laboratory, and power plant site studies. Topics covered include reviews; site studies; producers; consumer reproduction and development, morphology, distribution, temperature tolerance, physiology, oxygen consumption, growth, feeding, reaction to combined stresses, temperature selection, activity, and predator-prey relations; decomposers; diseases; and beneficial uses of waste heat. References in the bibliography are divided into three subject categories: marine systems, freshwater systems, and estuaries. The references are arranged alphabetically by first author.

The bibliographic information is available for computer searching through the Ecological Sciences Information Center of the Information Center Complex at Oak Ridge National Laboratory or through the Department of Energy Technical Information Center's RECON system. The entries in this data base have been merged with a data base of unpublished literature on power plant effects compiled by the Ecological Sciences Information Center and the Atomic Industrial Forum. This combined data base on power plant cooling systems effects was created for the Electric Power Research Institute and is available for searching through the Atomic Industrial Forum, Washington, D.C.

The literature on thermal effects has been reviewed annually for several years in the *Journal of the Water Pollution Control Federation*. The literature indexed in this bibliography forms the basis of the 1976 literature review compiled by C. C. Coutant and S. S. Talmage.

Citation Form

The bibliographic data are arranged according to the Ecological Sciences Information Center format. As a result of computer limitation in indicating superscripts and subscripts in the standard manner, certain conventions have been established in the bibliography:

1. For subscripts, X sub t is used for X_t.

2. In chemical compounds and elements, NaIO3 is used for $NaIO_3$.
3. In exponential functions, 10(E+3) or X(E-2) is used for 10^3 or X^{-2} respectively.
4. For units of measurement such as cubic centimeters or square feet, X3 is used for X^3.

Indexes

Indexes are provided for (1) author, (2) keywords, (3) subject category, (4) geographic location, (5) taxon, and (6) title (alphabetical listing of keyword-in-context of nontrivial words in the title).

ACKNOWLEDGMENTS

Charles C. Coutant of the Environmental Sciences Division, Oak Ridge National Laboratory (ORNL), provided guidance and support for this project. Opal Russell of the ORNL Central Research Library ordered documents by interlibrary loan. Susan Richardson of the Information Sciences and Operations Section, Information Center Complex, managed the computer production of this document.

<1>
Abolmasova, G.I., The Black Sea Amphipoda GAMMARUS OLIVII: Dependence of Amounts of Day Ration on the Body Weight.

1975. Biologiya Morya (USSR), 5, 45-48 (Institute of Biology of the Southern Seas, Department of Physiology, Ukraine, Sevastopol, USSR)

The amount of food consumed (day ration) by the black sea amphipod, GAMMARUS OLIVII, increased as temperature increased. At 5 C the average ration of the smallest group was 40% of the body weight. At 10 C it was 44.8%; at 20 C it increased to 77.8%. Equations describing the daily food intake dependence on body weight at different temperatures are given. Food assimilation was fairly stable, averaging 65%. Temperature did not influence the assimilation of food. (ST)

<2>
Abolmasova, G.I., Energy Losses in Respiration and Egg Production in GAMMARUS OLIVII from the Black Sea.

1975. Biol. Morya (USSR), 33, 68-73 (Institute of Biology of the Southern Seas, Kiyev, Ukraine, USSR)

Equations expressing the relation between respiration (Q, in ml O2/hr) and body weight (W, in mg) are Q = 0.036 W(E+0.69) at 5 C and Q = 0.347 W(E=0.740) at 10 C. (Auth)

<3>
Acker, T.S., and A.M. Muscat, The Ecology of CRASPEDACUSTA SOWERBII Lankester, A Freshwater Hydrozoan.

1976. Amer. Midland Naturalist, 95, 323-336 (University of Detroit, Department of Biology, Detroit, MI)

The life history of the freshwater cnidarian, CRASPEDACUSTA SOWERBII, is reviewed. The suggested possible course of events in the life history in a temperate region are given. In winter at 4 C, the cnidarian survives as a resting body. With increasing temperatures in spring, the resting bodies grow to polyps and asexual reproduction takes place. With increasing warmth and food supply frustule production predominates. When the temperature increases sharply, especially in the 20 C range, medusa buds are produced. Medusal budding continues as long as temperatures are increasing and generally high. As temperature decreases polyp and frustule production again take place and when cold weather sets in again, the colonies are contracted to resting bodies. (ST)

<4>
Adams, J.R., The Influence of Thermal Discharges on the Distribution of Macroflora and Fauna, Humboldt Bay Nuclear Power Plant, California.

1975. Ph.D. Thesis, University of Washington, 381 p. (University of Washington, Seattle, WA)

Populations of benthic and epifaunal macro-organisms in the area influenced by the thermal discharge of the steam-electric power plant at Humboldt Bay, Calif., were analyzed in 1971 and 1972 to determine if differences in distribution could be attributed to the effluent. A total of 103 species representing 1745 individuals were recovered in the benthic samples from the bay. Stepwise multiple regression compared the variations in benthic species diversity with median particle size, percent organic matter, water depth, and temperature increase above ambient. Nine species, which represented over half of all animals counted, were analyzed by the regression program. Three species were not correlated with any parameter. Five species were positively correlated with water depth for one or more periods, while three of these five species were also negatively correlated with water temperature. One species was positively correlated with water temperature for one period. A total of 132 species were identified in the intertidal surveys. Species richness in the intertidal was positively correlated with increased temperature in 13% of the possible combinations of tide level and diversity. Individual species were positively correlated with increased temperatures for 19% of the plant comparisons and for 16.3% of the animal comparions. Comparisons of populations of individual species in the heated intertidal zone with those in a control zone indicated differences in 26.2% of the plant surveys, and 23.2% of the animal surveys. Differences were positively related to the increased temperature in 90.5% of the comparisons. Proportions of eurythermal plants or animals in the heated areas of the intertidal zone did not differ significantly from proportions in other areas in four different survey periods. With the possible exception of one species, there was no conclusive evidence that any of the 132 species found in the intertidal area was eliminated from the heated area surrounding the discharge of the power plant. (Auth) (ST)

<5>
Aho, J.M., J.W. Gibbons, and G.W. Esch, Relationship Between Thermal Loading and Parasitism in the Mosquitofish.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (Wake Forest University, Department of Biology, Winston-Salem, NC; Savannah River Ecology Laboratory, Aiken, SC)

The relationship between thermal loading and parasitism was examined in 980 mosquitofish, GAMBUSIA AFFINIS, taken from areas of varying thermal conditions at the Savannah River Plant (SRP) near Aiken, S.C. Collections were made at 2-week intervals from May to August 1974 and again from January to February 1975. The metacercaria of two strigeid trematodes, ORNITHODIPLOSTOMUM PTYCHOCHEILUS and DIPLOSTOMUM SCHEURINGI were the only species of parasites recovered. ORNITHODIPLOSTOMUM PTYCHOCHEILUS was always found encysted in the brain and eyes, whereas D. SCHEURINGI was restricted exclusively to the body cavity. The density of the body-cavity parasite was highest in fish from areas of ambient temperatures and declined in fish from areas with higher water temperatures. The density of the brain parasite, on the other hand, was higher in fish from areas directly receiving thermal effluent than in fish from ambient-temperature areas. The body-cavity parasite was absent from mosquitofish from Pond C, but the infection percentages were relatively consistent in fish from other areas in the Par Pond system regardless of water temperature. The brain metacercaria were recovered from 95% of fish from Pond C. There were higher infection percentages of

. <5>

<5> CONT.
brain parasites in fish from thermally altered areas of Par Pond than in those from other parts of the Par Pond system. Three different hypotheses can be formulated to account for the relationship between thermal loading and the observed abundance and distribution patterns for these two species of parasites: (1) a direct differential influence of temperature on the physiological tolerance of the various life-cycle stages of the parasite; (2) a direct differential impact of temperature on the distribution of the molluscs that serve as the first intermediate hosts; and (3) an effect of tempetature on the abundance and distribution of the potential definitive hosts within the study area. (Auth)

<6>
Akesson, B., Reproduction in the genus OPHRYOTROCHA (Polychaeta, Dorvilleidae).

1975. Pubbl. Staz. Zool. Napoli 39 Suppl., 377-398 (University of Gothenburg, Department of Zoology, Sweden)

The reproduction of 12 species of the marine polychaete, OPHRYTROCHA sp., is described. The effects of temperature on parasite development and the relationships between reproduction and temperature, salinity, and food are described in detail for OPHRYOTROCHA LABRONICA. Reproduction took place within the temperature range 12 to 28 C. Egg masses of maximum size were produced at 20 C and the reproductive rate was maximal at 23 C. (ST)

<7>
Akesson, B., Temperature and Life Cycle in OPHRYOTROCHA LABRONICA (Polychaeta, Dorvilleidae).

1976. Ophelia, 15, 37-47 (University of Gothenburg, Department of Zoology, Gothingburg, Sweden)

Under experimental laboratory conditions the life cycle of OPHRYOTROCHA LABRONICA was completed within the temperature range of 12 to 28 C. The cycle lasted 83 days at 14.5 C and 16.5 days at 28 C. The maximum growth rate occurred at 28 C. Maximum fecundity and reproduction occurred at 20 and 23 C, respectively. Adults survived best at the lower end of the temperature range; larvae and juveniles survived best at 25 C. (ST)

<8>
Akulin, V.N., E.P. Karedin, and T.A. Pervuninskaya, Fatty Acid Composition of Lipids in Big Pacific Zooplankters.

1975. Gidrobiol. Zh. (USSR), 11, 45-49 (The Pacific Research Institute of Fishery and Oceanography, Vladivostok, USSR)

Studies in the fatty acid composition of lipids of euphausiids and salps caught in different areas of the Pacific showed variations caused by differences in the ecology of these zooplankters. In euphausiids inhabiting the tropical zone, the level of fatty acid of the omega-6 type was higher compared with those inhabiting the cooler waters. The abyssal species NEMATOBRACHION BOOPIS is distinguished by a high olein acid content. The fatty acid composition in SALPA FUSIFORMIS exhibited some traits typical of lipids of zooplankton and phytoplankton, while the fatty acid composition of S. ASPERA inhabiting cooler waters was usual for marine zooplankton. (Auth)

<9>
Alcorn, S.R., Temperature Tolerances and Upper Lethal Limits of SALMO APACHE.

1976. Trans. Amer. Fish. Soc., 105, 294-295 (Midwest Research Institute, Kansas City, MO)

Fingerlings of the endangered trout species SALMO APACHE Miller were subjected to increasing temperatures to determine upper lethal temperature limits. Most fish refused to take food at temperatures above 20 C. Equilibrium loss occurred between 21.2 and 22.3 C. Death occurred when temperatures exceeded 23 C. (Auth)

<10>
Alden, R.W., III, F.J.S. Maturo, Jr., and W. Ingram, III, Interactive Effects of Temperature, Salinity, and Other Factors on Coastal Copepods.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (University of Florida Marine Laboratory, Gainesville, FL)

Studies at the power generating plant at Crystal River, Florida, examined the effects of entrainment on the major species of copepods, including ACARTIA TONSA, OITHONA COLCARVA, PARACALANUS CRASSIROSTRIS, and EUTERPINA ACUTIFRONS. Experimental field treatments employing circulating-system drift-bottle devices were set up to test the relationships between entrainment mortality and such variables as temperature, salinity, length of exposure to the heated effluent, mechanical damage, seasonal factors, density (numbers per cubic meter) and sex or age class of the various species. Temperature, salinity, and temperature-salinity interactions were seen to be among the most important factors influencing mortality. Although each species exhibited its own response patterns to temperature-salinity effects, as well as to combinations of the other variables, estuarine forms displayed a higher fitness with respect to the stresses of entrainment. Delayed thermal shock is seen as the most important aspect of entrainment which may be influenced by design criteria. (Auth)

<11>
Alderdice, D.F., Some Concepts and Descriptions of Physiological Tolerance: Rate-Temperature Curves of Poikilotherms as Transects of Response Surfaces.

1976. Jour. Fish. Res. Bd. Can., 33, 299-307 (Department of the Environment, Fisheries and Marine Service, Pacific Biological Station, Nanaimo, British Columbia, Canada)

Precht rate curves may be considered as transects across a rate surface bounded by a Fry temperature polygon. Changes in metabolic or active capacity within the tolerance polygon approximate capacity changes within Precht's normal range of temperatures. Precht's resistance adaptations are consequences of change in capacity occurring in the zone of resistance of Fry. The turning-point axis of Precht rate curves is assumed analogous to the axis of maximum rate at acute temperatures

<11> CONT.
(test-temperature axis), using an activity surface as a model. Parallelism is suggested between this axis and the upper incipient lethal temperature boundary where the latter may be unknown. In the standard comparison of cold-adapted and warm-adapted rates, Precht compensation types can depend on the nature of the capacity surface and on the choice of acclimation temperatures. Reasonable and paradoxical resistance adaptations reflect characteristics of the capacity surface, in particular the turning-point axis, in relation to the acclimation and acute temperature axes of measurement. Resistance adaptations appear directly related to the course of the incipient lethal boundaries on a rate surface. Further understanding of capacity surfaces probably requires that a minimum of five transects be made across a surface, rather than the two generally made for warm-adapted and cold-adapted comparisons. In such studies, meaningful measures of acute response require extended understanding of the nature and time course of thermal acclimation, and of the potential biases embedded in a response arising from other temperature-dependent compartments of metabolic demand. The need is demonstrated for a quantitative distinction between thermal resistance and tolerance in cells and microorganisms, equivalent to the incipient lethal temperature boundaries of Fry. Such determinations, above all, require that temperature level and exposure time not be confounded. (Auth)

<12>
Alikin, Yu.S., Environmental Temperature and Standard Metabolism in Fishes (Carbon Dioxide Output).

1976. Akademiya Nauk SSSR (USSR), 37, 127-133; Zh. Obshch. Biol., 37, 127-134 (Institute of Physiology, Novosibirsk, USSR)

The standard metabolism, as measured by carbon dioxide output, of three species of freshwater fish, LEUCISCUS IDUS, THYMALLUS ARCTICUS, and COREGONUS AUTUMNALIS was measured at various environmental temperatures. An equation for the exponential dependence of carbon dioxide output on environmental temperature is given. The temperature coefficient (Q10) in the eurytherm L. IDUS (3.28) was higher than in the stenotherms T. ARCTICUS and C. AUTUMNALIS (2.34 and 2.18). The respiratory quotient (RQ) appeared to be closely related to the natural mobility of these fish and was higher in the active T. ARCTICUS and C. AUTUMNALIS than in the less active L. IDUS. The respiratory quotients in these species at rest did not depend on the ambient temperature. An extrapolatory evaluation of the basal metabolism showed that in T. ARCTICUS it can constitute up to 40 to 60% of the standard metabolism as determined from carbon dioxide output. (Auth) (ST)

<13>
Allardi, J., C. Duguet, and G. Laynaud, Study of the Fish Population of an Artificially Heated Riverine Habitat.

1975. EIFAC Tech. Papers No. 23, 209-224; In Symposium on the Methodology for the Survey, Monitoring and Appraisal of Fishery Resources in Lakes and Large Rivers (FAO European Inland Fisheries Advisory Commission, Rome, Italy)

Sampling to determine the effects of the warm water discharge of the Montereau Power Station was carried out by electric fishing and by traps. A variety of types of current were used and, although differences between them were not conclusive, electric gear was effective for most species. Some species were, however, caught in larger quantities by the traps. Differences in number and in specific composition correlated with variations in temperature were noted. (Auth)

<14>
Amend, D.F., Prevention and Control of Viral Diseases of Salmonids.

1976. Jour. Fish. Res. Bd. Can., 33, 1059-1066 (U.S. Fish and Wildlife Service, Western Fish Disease Laboratory, Seattle, WA)

Methods for preventing or controlling infectious pancreatic necrosis (IPN), viral hemorrhagic septicemia (VHS), and infectious hematopoietic necrosis (IHN) in salmonid fish are reviewed. The successful control of IHN by environmental manipulation (elevated water temperature) was noted. (ST)

<15>
Amende, L.M., Osmotic Response of the Blue Crab, CALLINECTES SAPIDUS, to Temperature and Salinity Stress.

1974. Md. Water Resources Res. Cent. Tech. Rep., 26, 139-146 (College of William and Mary, Department of Biology, Williamsburg, VA)

Blue crabs, collected from Maryland waters at temperatures of 25 to 28 C and salinities of 15 to 18 ppt were tested in the laboratory to determine effects of size and sex on osmotic response to temperature and salinity stress. Large and small immature crabs were tested at temperatures of 4, 15, and 30 C and salinities of 1.5, 13, and 25% seawater. Both large and small crabs were hyperosmotic regulators in diluted seawater. No sex differences were found in osmoregulatory ability. Temperature stress (4 C) affected the osmoregulatory ability of the crabs: smaller crabs died while larger ones showed an osmoregulatory breakdown. The 15 C temperature caused osmotic stress in the low salinity. Smaller crabs showed a greater tolerance to thermal stress at high salinities than did larger crabs. (ST)

<16>
Amiard, J.C., Effects of Various Ecological Factors on Radiostrontium Uptake in Two Euryhaline Teleosts: MUGIL AURATUS Risso and PLEURONECTES PLATESSA L..

1975. CEA-R-4706 (Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, France)

The effects of various ecological, biotic and abiotic factors (age, species, salinity, temperature, sediment, calcium overload, food) on the accumulation of Sr-85 were studied in two euryhaline teleosts. Generally, all the physico-chemical and biotic factors tending to activate metabolism, slightly increased radiostrontium uptake. Concentration factors were seldom above one for animals measured in toto. According to the concentration kinetics of Sr-85, three types of organs were distinguished: bone-type tissues, soft tissues and digestive tract. (Auth)

<17>
Amor, A., The Spawning of THEMISTRE PETRICOLA (Sipuncula, Golfingiidae) in the Laboratory.

1975. Physis Secc. A (Arg.), 34, 185-192 (Carrera del Investigador, Consejo Nacional Investigaciones Cientificas y Technicas)

In the laboratory spawning of the marine worm, THEMISTE PETRICOLA, began in November and increased to reach a maximum in January-February. There was a positive correlation between spawning and increasing water temperature. (ST)

<18>
Ananthakrishanan, K.R., and M.N. Kutty, Mortality and Breathing Rate at High Ambient Temperatures in the Cichlid Fish, TILAPIA MOSSAMBICA Peters.

1974. Indian Jour. Exp. Biol., 12, 55-59 (Madura College, Department of Zoology, Madurai, India)

Mortality and breathing rate of TILAPIA MOSSAMBICA, acclimated to 30, 32, 38, and 39 C in freshwater, were studied at high ambient temperatures. The median resistance time (survival) increased with acclimation temperature at any one test temperature. Fish acclimated to 32 and 38 C showed median resistance times of 1200 and 1700 min at 40 C, 850 and 1350 min at 41 C, and 300 and 690 min at 42 C, respectively. A single group of fish acclimated to 39 C in freshwater and tested at 40 C showed median resistance time of 1900 min. In 10% seawater, the fish of the same acclimations always showed longer resistance time. Better survival in dilute seawater may be due to lesser osmotic stress of the fish in saline media. The breathing rate (opercular beats/min) decreased with increase in test temperature. Acclimated fish, however, had a higher breathing rate than those acutely exposed to the same temperature. In all cases exposure to 10% seawater increased the breathing rate under the same test conditions. On acute exposure to greater than 30 C, breathing rate decreased sharply, picking up again and maintaining a steady level (within the tolerance range) or dropping again when death set in (lethal zone). It is suggested that there is a change in the permeability characteristics of the gill epithelium on exposure to high temperature preventing salt loss from the fish in freshwater. (Auth)

<19>
Ancellin, J., M. Eustache, and A. Vilquin, Effects of Environment Temperature Rise on Marine Life. Bibliographic Study.

1973. INIS-mf-3045, 101 p. (CEA Centre de La Hague, Cherbourg, France; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, Department de Protection, France)

The effects of increased temperature from the release of thermal wastes to the marine environment are reviewed. In addition, effects associated with the use of cooling systems, drag effects of pumping, consequences of the use of anti-fouling agents, and the potential use of thermal effluents are covered. (ST)

<20>
Anders, A.S., Pilchard and Anchovy Spawning along the Cape East Coast.

1975. S. Africa Ship. News Fish. Ind. Rev., 30, 53-55 (Council for Scientific and Industrial Research, Sea Fisheries Branch, Cape Town, South Africa)

During the period late winter to mid-summer, egg abundance along the South African cape east coast increased as water temperature increased from 15.4 to 22.7 C. The higher summer value was apparently not above the level of tolerance of incubating eggs. There was a difference of about 2 C between temperatures of surface water in August (18 C) in an area where Pilchard egg production was heaviest and December (20 C) when anchovy egg production was heaviest. Egg distribution data for fall and spring were not available. (ST)

<21>
Andreoli, C., and N. Rascio, The Algal Flora in the Thermal Baths of Montegrotto Terme (Padua). Its Distribution Over One-Year Period.

1975. Intl. Revue Gesamten Hydrobiol. (Ger.), 60, 857-871 (Universita di Padova, Istituto de Botanica e Fisiologia Vegetale, Italy)

The algal microflora of a thermal spring and of the thermal baths of Padua, Italy were studied over a one year period. Temperatures in the thermal spring ranged from 65 to 75 C; temperatures of the mud cisterns ranged from 13 to 60 C. The three species of blue-green alga, ANABAENA sp., SPIRULINA sp., and OSCILLATORIA TEREBRIFORMIS, were quantitatively more abundant than the 64 species of diatoms. MELOSIRA SOL, M. GRANULATA, COCCONEIS PLACENTULA, NITZSCHIA DENTICULA, DENTICULA ELEGANS, and D. TENUIS were the most frequent species of diatoms. (ST)

<22>
Andronikov, V.B., Heat Resistance of Gametes of Marine Invertebrates in Relation to Temperature Conditions under Which the Species Exist.

1975. Marine Biol. (W. Ger.), 30, 1-11 (Institute of Cytology, Laboratory of Comparative Cytology, Leningrad, USSR)

A study of gametes of invertebrates belonging to different populations of the same species collected in different seasons and on invertebrates maintained under different temperatures showed that the heat resistance of gametes did not undergo any recognizable changes even in the presence of significant fluctuation in temperature. The heat resistance of gametes was correlated with the different temperature conditions under which the species lived. The thermal limits for gametes of several species of STRONGYLOCENTROTUS (sea urchins) were investigated. The upper thermal limit for the normal development of eggs and embryos of these species and several other marine invertebrates were 1 to 3 C higher than the temperatures encountered under natural conditions. (ST)

<23>
Anwarul Islam, M., and R.K. Strawn, The Effect of Temperature on the Growth of the Red Shiner, NOTROPIS LUTRENSIS (Baird and Girard).

1975. Bangladesh Jour. Zool., 3, 145-152 (Bangladesh Agricultural University, Department of Aquiculture and Management, Mymensingh, Banglaiesh)

Temperature was found to be an important ecological factor affecting the growth of the

<23> CONT.
red shiner, NOTROPIS LUTRENSIS. The average weekly increase in length from hatching to maturity was highest at 29 C and lowest at 31 C. After maturity the growth was inversely related to temperature. (Auth)

<24>
Armstrong, G.C., Potential for Use of Condenser Cocling Waters from Fossil Fuel and Nuclear Power Generating Stations for Freshwater Aquaculture in Cold Climates.

1975. AECL-5322/1, In Low-Grade Heat: A Resource in Cold Climates, Proceedings of a Workshop held at the Chalk River Nuclear Laboratories October 6-10, 1975, B. Gay et al. (Eds.). Atomic Energy of Canada Limited (Ontario Ministry of Natural Resources, Toronto, Ontario, Canada)

Some limiting factors to the future development of freshwater aquaculture are considered. The most important of these are the need for new and improved technology for the production of better quality products at lower cost and for the promotion and establishment of new markets. The use of relatively small amounts of heated effluent water from power generating stations to optimize water temperatures is one feasible method for increasing growth and lowering the cost of production. (Auth)

<25>
Aronovich, T.M., S.I. Doroshev, L.V. Spectorova, and V.M. Makhotin, Egg Incubation and Larval Rearing of Navaga (ELEGINUS NAVAGA Pall.), Polar Cod (BOREOGADUS SAIDA Lepechin) and Arctic Flounder (LIOPSETTA GLACIALIS Pall.) in the Laboratory.

1975. Aquaculture, 6, 233-242 (VNIRO, Moscow State University, Moscow USSR)

The embryonic and larval development of three White Sea cold-water fish species, rate of yolk sac absorption, age at first feeding and their survival and growth when fed different food organisms, were studied. Eggs were obtained from spawners in the Bay of Kandalaksha, White Sea, and incubated in troughs and aquaria at a mean temperature of 1.5 C, slightly above that of the sea. The incubation period for polar cod eggs lasted 35 days, for arctic flounder, 42 days and for navaga eggs, 48 days. Emergent larvae were 5.5 to 6.0 mm long and began feeding at 2 to 4 C, 5 to 6 days (navaga) and 12 to 14 days (polar cod) after hatching, when their yolk sac was still fairly large. They were fed day-old ARTEMIA nauplii and zooplankton taken from the sea and consisting of CALANUS and PSEUDOCALANUS nauplii 400 to 600 u in length. The period of establishing first feeding is the most critical for larvae. (Auth)

<26>
Aster, P.L., Seasonal Changes in Glucose-6-Phosphate Dehydrogenase Activity in Two Species of Freshwater Fish.

1975. Amer. Zool., 15, 809 (University of Alberta, Edmonton, Alberta, Canada)

Seasonal changes in NADPH production via the pentose shunt were examined in two species of fish, the white sucker, CATOSTOMUS COMMERSONII, and the northern pike, ESOX LUCIUS. No kinetic differences in glucose-6-phosphate dehydrogenase (G6PD) were observed in summer as compared to winter caught fish. Species differences were noted: Sucker enzyme preparations showed ten to twenty times higher activity per gram liver compared to pike preparations. Sucker Km(G-6-P) showed extensive positive thermal modulation, while pike enzyme-substrate affinity was relatively unmodified. In response to low temperatures, pike G6PD exhibited a slightly decreased sensitivity to NADPH inhibition and activity per gram liver was 20% higher in winter fish. Sucker G6PD exhibited a slightly increased NADPH sensitivity and no seasonal changes in activity per gram liver. Arrhenius plots for both enzymes were non-linear, with sharply increased Ea values at lower temperatures. Based on G6PD activity and lipid content of tissues, white suckers appear to rely on de novo fatty acid synthesis to a greater extent than do northern pike. (Auth)

<27>
Astrauskas, A.S., and LA. Rachyunas, Hydrobiological Condition in the Reservoir Cooler of the Lithuanian State Regional Electric Power Station.

1975. Gidrobiol. Zh. (USSR), 11, 19-27 (Institute of Zoology and Parasitology, Lithuanín SSR, Vilnius, USSR)

Under the influence of heating, a complex interaction of hydrodynamic factors influencing the formation of washout zones and suspension accumulation was created in the reservoir. The sediments underwent reconstruction. In the heated zone algae and higher water plants grew year round. Zooplankton was less abundant, due to the movement of the organisms into the open part of the water body. After passing through the cooling system the number of organisms and their biomass were reduced by as much as half. The number and biomass of benthic invertebrates were reduced, but species diversity was greater. Divergences in time and duration of spawning in different thermal zones were detected for certain fish species. The spawning for most species in the heated area started earlier and proceeded in shorter periods of time. (Auth)

<28>
Austin, H.M., Distribution and Abundance of Ichthyoplankton in the New York Bight during the Fall in 1971.

1976. N.Y. Fish & Game Jour., 23, 58-72 (New York Ocean Science Laboratory)

Sampling for phytoplankton, zooplankton, water chemistry and physical parameters was conducted at a series of stations in the New York Bight in September and November of 1971. The relationships of the finfish eggs and larvae collected to the associated oceanographic conditions are discussed in terms of the sources of the parent stocks and the time and place of spawning. The bulk of the spawning that occurs in coastal New York water is by migratory stocks, the principal species in the New York Bight being the menhaden, anchovy, weakfish, mackerel and searobin. Water temperatures during egg collection cruises in September are given. (Auth) (ST)

<29>
Avent, R.M., The Effects of Hydrostatic Pressure on Living Aquatic Organisms. VIII. Behavioral and Metabolic Responses of UCA PUGILATOR to Variations in Hydrostatic Pressure and

<29>

<29> CONT.
Temperature.

1974. Int. Rev. Gesamten Hydrobiol. (Ger.), 59, 219-238 (Florida State University, Department of Oceanography, Tallahassee, FL)

Temperature affected the behavioral and lethal responses of fiddler crabs, UCA PUGILATOR, to high pressure stress. Pressure resistance was greatest at 25 C, lowest at 9 and 14 C, and reduced below maximum at 30 C. (CCC)

<30>
Ayles, G.B., Comments on the Current Status of Aquaculture in Heated Effluents in North America.

1975. AECL-5322/1, In Low-Grade Heat: A Resource in Cold Climates, Proceedings of a Workshop held at the Chalk River Nuclear Laboratories October 6-10, 1975, B. Gay et al. (Eds.). Atomic Energy of Canada Limited (Environment Canada, Freshwater Institute, Winnipeg, Manitoba, Canada)

The current status of aquaculture in heated effluents in the United States and Canada is reviewed under the headings: current status of fish culture in North America, the effects of temperature on fish production, current status of low-grade waste heat aquaculture in North America, biological problems specific to the use of thermal effluents, and additional comments. The slow development of commercial aquaculture in low-grade waste-heat effluents is pointed out. (ST)

<31>
Bachmann, P., P. Kornmann, and K. Zetsche, Regulation of Development and Metabolism of the Green Algae UROSPORA by Temperature.

1976. Planta (W. Ger.), 128, 241-245 (Botanisches Institut der Justus-Liebig-Universitat, Giessen, West Germany)

Development and morphology of the life cycle stages of UROSPORA WORMSKIOLDII and UROSPORA VANCOUVERIANA are regulated by temperature. Unbranched monosiphonous filaments (less than 5 C) alternate with microscopic dwarf plants (10 to greater than 14 C) and a unicellular Codiolum stage (approximately 10 C). The cell wall of the Codiolum stage is composed primarily of mannans. Glucose-containing polysaccharides predominate in the cell wall of the dwarf plants and xylose-containing polysaccharides are abundant in the cell wall of the filamentous plants. Differences in metabolism between dwarf plants and filamentous plants were detected by C-14-labelled CO2-incorporating experiments. (ST)

<32>
Backiel, T., Fish Culture in Heated Effluents (Eastern Europe).

1975. AECL-5322/1, In Low-Grade Heat: A Resource in Cold Climates, Proceedings of a Workshop held at the Chalk River Nuclear Laboratories October 6-10, 1975, B. Gay et al. (Eds.). Atomic Energy of Canada Limited (University of Tromso, Institute of Biology and Geology, Tromso, Norway)

Dependence of growth and reproduction of cultivated fishes on temperature are briefly reviewed. Experiments with and commercial-size operations of various methods of fish culture with the use of heated effluents are exemplified. Cage culture, earthen ponds, and flowing water culture have demonstrated possibilities of growth increase in carp and rainbow trout and of controlled reproduction of the former. Problems involved in utilization of various systems and several points of view on the use of low-grade heat for fish culture are considered. (Auth)

<33>
Bahr, L.M., Jr., Energetic Aspects of the Intertidal Oyster Reef Community at Sapelo Island, Georgia.

1976. Ecology, 57, 121-131 (Louisiana State University, Center for Wetland Resources, Baton Rouge, LA)

The total daily O2 consumption rate of the intertidal oyster reef community in Georgia was found to range between 0.6 x 10(E+4) and 5.0 x 10(E+4) mg O2/m2 of reef surface, corresponding to a seasonal range of ambient water temperature from 9 to 30 C. Oysters, nonoyster macrofauna, microbiota and chemical oxidation were estimated to account for 48.1, 10.0, 21.9 and 20.0% respectively, of total O2 consumed. Reef macrofaunal biomass averages 1108 g/m2 (ash-free dry weight) of which CRASSOSTREA VIRGINICA comprises 87.5%. Growth of individual reef oysters and, therefore, entire reefs, appears to be extremely slow, probably due to high maintenance costs and limited inundation time characteristic of the intertidal zone. The oyster reef community occupies only 0.06% of total marsh-water surface area in a salt marsh estuary unit (the Duplin River marsh-estuary system), but it can theoretically degrade 1% of the estimated excess of annual net primary production in the system. (Auth)

<34>
Bailey, J.E., B.L. Wing, and C.R. Mattson, Zooplankton Abundance and Feeding Habits of Fry of Pink Salmon, ONCORHYNCHUS GORBUSCHA, and Chum Salmon, ONCORHYNCHUS KETA, in Traitors Cove, Alaska, with Speculations on the Carrying Capacity of the Area.

1975. Fish. Bull., 73, 846-861 (NOAA, National Marine Fisheries Service, Northwest Fisheries Center, Auke Bay Laboratory, Auke Bay, AK)

Juvenile pink salmon, ONCORHYNCHUS GORBUSCHA, and chum salmon, O. KETA, 28 to 56 mm long (fork length) from Traitors River in southeastern Alaska, fed little in freshwater but fed heavily in the estuary, mainly on pelagic zooplankters. Fry did not feed on cloudy moonless nights. The rate of evacuation of pink salmon stomachs ranged from 6 hr at 12.8 C to 16 hr at 8.5 C. The abundance of zooplankton ranged from 9 to 154 organisms per liter and quantitatively did not change noticeably while fry were in the estuary. In 1964, 1965, and 1966, the estimated numbers of fry in Traitors Cove was 7, 1, and 4 million, respectively. An attempt was made to estimate the carrying capacity of Traitors Cove, using food consumption and evacuation rates in conjunction with estimates of standing crop of zooplankton. It was concluded that 50 to 100 million additional fry from hatcheries would probably exceed the carrying capacity of the estuary. (Auth)

<35>
Bailey, R., K.W. Able, and W.C. Leggett, Seasonal

<35> CONT.
Distribution, Reproduction and Behaviour of Schools of Capelin, MALLOTUS VILLOSUS, Juvenile and Adult, in the Estuary and Gulf of Saint Lawrence.

1975. Can. Inf. Serv. Rech. (Can.), No 65, 51 (Ministry of Industry and Commerce, Division Peches Marine, Quebec, Canada)

The behavior and distribution of capelin in the Gulf of St. Lawrence were studied from May to November 1974. Spawning began in the upper estuary at the beginning of May and moved successively down to the Gulf. Juveniles were found in the northwestern part of the Gulf and in the Saguenay River in spring, corresponding to the distribution of peaks of abundance of larvae of autumn and early winter. Juveniles inhabited the lower estuary at the beginning of winter. (ST)

<36>
Baird, R.C., and J.A. Watson, Thermal Effluent in Coastal Rivers: A Contribution to the Location of Power Plants.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (University of South Florida, St. Petersburg, FL; Geo-Marine, Inc., Richardson, TX)

A study of possible environmental impact was made at a fossil-fueled power-generating plant at Port Wentworth, on the Savannah Front River near the city of Savannah, Ga. A major contribution of this study to future site planning concerns the potential advantages of locating power plants in the vicinity of the freshwater-saline interface of a large river system. Evidence is presented which indicates that the Port Wentworth plant is near the region of maximum faunal change from a predominantly freshwater biological community to one dominated by marine and estuarine forms. Individuals found in such regions are in or near physiologically marginal habitats and are not likely to contribute significantly to resident populations either upriver or downriver. The region from 1 to 3 ppt salinity appears to be near the tolerance minimum of most euryhaline estuarine-marine forms. Most of the freshwater organisms passing downriver will likely be lost to reproducing populations. A discussion of potential damage to populations of anadromous or freshwater-tolerant nektonic species is presented along with some ecological considerations of riverine ecosystems in general. (Auth)

<37>
Baldwin, J., and K.C. Reed, Effect of Temperature on the Properties of Cytoplasmic NADP Malate Dehydrogenases from Liver of Warm and Cold Acclimated Rainbow Trout.

1976. Comp. Biochem. Physiol., 54B, 531-535 (Australian National University, Genetics Department, Canberra, Australia)

Cytoplasmic NADP-MDH enzymes were isolated from the livers of warm and cold acclimatized rainbow trout (SALMO GAIRDNERI). The enzymes from the two acclimatization groups differed in the ratio of the rates of the decarboxylation to carboxylation reactions, and in their sensitivity to inhibition by NADPH at low temperature. It is proposed that the production of NADPH by cytoplasmic NADP-MDH in different thermal acclimation states may be controlled by changes in the occurrence of two forms displaying different and adaptive regulatory properties. (Auth)

<38>
Balek, R.W., and M.A. Ellis, The Effect of Temperature Adaption on Deformability and Lipid Composition of Erythrocytes in the Goldfish.

1975. Amer. Zool., 15, 808 (University of Detroit, Detroit, MI)

The relative deformability of erythrocytes from goldfish acclimated to various temperatures (5 C, 17 C, 29 C) was determined by a differential micro-hematocrit (H) technique, i.e. centrifuging each blood sample at 200g, 600g, and 900g at each of the acclimation temperatures. The cells acclimated at 5 had the same H at 5 C, 17 C and 29 C whereas the cells acclimated at 29 C showed a larger H (decreased deformability) at 5 C than at 29 C. Quantitative analysis of cholesterol, TLC of the phospholipid fraction, and GLC of the fatty acids of the phospholipid fraction showed a complex relationship of these parameters with acclimation temperature of the cells. The maintenance of optimal cell deformability was effected through the alteration in content of cholesterol and several phospholipid species as well as that of saturated/unsaturated fatty acids. (Auth)

<39>
Banus, M.D., and S.E. Kolehmainen, Rooting and Growth of Red Mangrove Seedlings from Thermally Stressed Trees.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (Puerto Rico Nuclear Center, College Station, Mayaguez, Puerto Rico)

At Guayanilla, on the south coast of Puerto Rico, a fossil-fueled electric generating station of 1100 Mw(e) discharges its cooling water into a nearly enclosed lagoon of about 25-ha area. The plume and lagoon typically have water temperatures 10 and 8 C above ambient; so the winter and summer lagoon temperatures are 34 and 39 C, respectively. The shores of this lagoon have extensive stands of red mangrove trees which are visibly stressed by the elevated temperatures. The critical temperature is between 37 and 38 C. Ripe red mangrove seedlings from the bearing trees are significantly smaller than those from nonthermally stressed trees in Guayanilla Bay and from trees in unpolluted bays from western Puerto Rico. Seedlings from thermally stressed trees developed negative buoyancy and initial roots faster, but the first pair of leaves developed slower than seedlings from control areas. Compared to seedlings from nonstressed areas, these smaller seedlings have a very low probability for survival and growth. No young rooted and growing seedlings have been found in the thermal lagoon. (Auth)

<40>
Barbier, B., and P. Champ, GAMMARUS Resistance to Rises in Temperature in the Seine River.

1974. Bull. Fr. Piscic., 255, 67-72 (Centrale

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<40> CONT.
Thermique EDF, Laboratory Hydrobiologie, Montereau, France)

The mean upper lethal temperatures for Seine River gammarids (RIVULOGAMMARUS ROESELII 85%; RIVULOGAMMARUS PULEX 15%) acclimatized in their natural environment at 5, 14, and 21 C were determined. The mean lethal temperatures over 96 hr were 24.9, 27.7, and 28.4 C, respectively. (Auth)

<41>
Barbier, B., and M. Pascal, Resistance of Roach (RUTILUS RUTILUS L.) to Sudden Temperature Change.

1976. Cah. Lab. Hydrobiol. Montereau (Fr.), No. 3, 25-34 (C.T.G.R.E.F., Division Qualite des Eaux, Peche & Pisciculture Paris, France; Laboratoire d'Hydrobiologie, Centrale Thermique, Montereau, France)

Temperature resistance tests were performed on roach (RUTILUS RUTILUS L.) which were submitted for 48 hours to temperature steps. It was found that the lethal temperature increased with the temperature at which the roach were acclimated. The theoretical higher limit of acclimation is 36.2 C with a mortality of 50%. A graph of the accepted temperature steps for 10, 50, and 90% mortality for roach is given. (English summary)

<42>
Barnes, H., and M. Barnes, The General Biology of VERRUCA STROEMIA (O.F. Muller). V. Effect of Feeding, Temperature, and Light Regime on Breeding and Moulting Cycles.

1975. Jour. Exp. Mar. Biol. Ecol. (Neth.), 19, 227-232 (Dunstaffnage Marine Research Laboratory, Oban, Argyll, Scotland)

The absence of breeding in natural populations of the barnacle, VERRUCA STROEMIA, during the autumn and early winter was due to the absence of food. Animals brought into the laboratory and held under ambient light and temperature conditions produced viable egg masses throughout this period when liberally fed. Breeding was not inhibited in either constant light or dark. A temperature of 20 C was lethal even over moderate periods. There was no increase in molting frequency between 10 and 15 C. (Auth)

<43>
Barnes, H., and M. Barnes, The Rate of Development of the Embryos of BALANUS BALANOIDES (L.) from a Number of European and American Populations and the Designation of Local Races.

1976. Jour. Exp. Mar. Biol. Ecol. (Neth.), 24, 251-269 (Dunstaffnage Marine Research Laboratory, Oban, Scotland)

A summary is given of the distribution of BALANUS BALANOIDES and of earlier work on differences - racial and otherwise. The variation in the date at which different populations are fertilized is considered. Data are given on the time required for the development of the embryos of this species in vitro at 10 C, with eggs from a number of populations from the eastern and western Atlantic and examined soon after collection, and also after transplantation and maintenance under ambient laboratory conditions over the next breeding season. Both aspects of reproduction are under genetic control. There is no correlation between the date of fertilization and the time required for development. Oocyte and egg size appear to be largely controlled by temperature. On both sides of the Atlantic there is a general tendency for the time of development to decrease with decreasing latitude. The population at Millport, Scotland appears unusual. The southernmost populations on European shores resemble those at the extreme south in North America. A study of the effect of temperature has shown that at lower temperatures the time of development of the embryos in vitro from all populations tends to be the same; the difference lies in the Q10 values. The results are discussed relative to palaeontological data and the existence of clines in other features. (Auth)

<44>
Barnes, H., and W. Klepal, The General Biology of VERRUCA STROEMIA (O.F. Muller). IV. Effect of Salinity and Temperature on Survival, Behaviour, and Osmotic Relations.

1974. Jour. Exp. Mar. Biol. Ecol. (Neth.), 14, 37-46 (Dunstaffnage Marine Research Laboratory, Oban, Argyll, Scotland; Universitat Wien, Zoologisches Institut, Austria)

The survival and osmotic behavior of the cirripede (barnacle), VERRUCA STROEMIA, was studied over a wide range of salinities (4.7 to 121 ppt) and temperatures (0 to 20 C). The barnacle is an osmoconformer over a wide range of salinities, but the hemolymph was maintained slightly hypertonic to the medium. Large changes in salinity could be withstood only at moderate temperatures (5 to 10 C). (ST)

<45>
Barnett, P.R.O., Ecological Effects of a Power Station.

1974. Part of Proceedings of the Challenger Society, 4, Part 6 (Dunstaffnage Marine Research Laboratory, Oban, Scotland)

During most of the year body weights of the lamellibranch, TELLINA TENUIS, were lower at a beach warmed by cooling water from Hunterston Generating Station (England) than at a control beach. The lower body weights may reflect higher metabolic rates of the power plant site population. Average beach temperatures at the site are about 2 to 3 C above normal. In fall the site population showed an increase in weight not seen in the control population. The higher mean temperatures may have induced greater feeding activity and a build-up of food reserves as a result of the late summer to autumn phytoplankton blooms. Suspended silt and clay in the Hunterston area due to construction work may also have depressed feeding during the remainder of the year. (ST)

<46>
Basch, R.E., and J.G. Truchan, Toxicity of Chlorinated Power Plant Condenser Cooling Waters to Fish.

1976. EPA-600/3-76-009; U.S. EPA, Office of Research and Development, Environmental Research Laboratory, Duluth, MN (Michigan Water Resources Commission, Bureau of Water Management, Lansing, MI)

Studies were conducted during 1972 at five Michigan power plants in which caged brown

<46> CONT.
trout (SALMO TRUTTA) and fathead minnows (PIMEPHALES PROMELAS) were held for 96 hr in the intake and condenser cooling water discharge channels. Caged fish were also held in condenser cooling water dechlorinated with sodium thiosulfate at the same time that fish held in the discharge channel were subjected to 30-min chlorination periods. The 96-hr residual chlorine intermittent concentration lethal to 50% of the caged brown trout at two plants ranged from 0.02 to 0.05 and 0.17 to 0.18 mg/liter for fish exposed to three and six 30-min chlorinations, respectively. Fathead minnow deaths in all studies could not be attributed to the total residual chlorine because of excessive numbers of deaths among control fish. Resident fish were observed in distress at two plants during 1972. These behavioral symptoms were noted at maximum total residual chlorine concentrations ranging from 0.2 to 0.5 mg/liter. Studies were repeated in 1973 at one plant with brown trout and other salmonid species. No deaths of test fish occurred during these tests that could be attributed to chlorine concentrations. The inconsistent results may be related to interactions between chlorine, temperature, and dissolved oxygen saturation in the discharge channel. A laboratory bioassay conducted during 1973 in which brown trout were held for 96 hr at 17 C and 21 C after being subjected to one 30-min chlorine dosage showed a greater than 50% increase in lethality with the 4 C temperature increase. The LC-50's were 1.19 mg/liter and 0.56 mg/liter for fish held at 17 C and 21 C, respectively. (Auth) (ST)

<47>
Bass, M.L., A Study of Lethality and Toxic Mechanisms of Intermittent Chlorination to Freshwater Fish.

1975. Ph.D. Thesis, Virginia Polytechnic Institute and State University (Virginia Polytechnic Institute and State University, Blacksburg, VA)

Groups of juvenile bluegill, LEPOMIS MACROCHIRUS, were exposed to four intermittent exposures of chlorine (peak concentrations of 0.21, 0.31, 0.42, and 0.52 mg/l) at four temperatures (6, 15, 25, and 32 C) for seven days with each group being exposed to only one concentration and at one temperature. There was a definite effect of temperature on the median lethal time (LT50). This was especially pronounced at the highest concentration of 0.52 mg/l peak total chlorine where 50% mortality occurred in less than 75 hr at 6 C and in less than 21 hr at 32 C. There was little temperature effect on the lethal concentration (LC50). The 96-hr LC50 was approximately 0.40 to 0.45 mg/l peak total chlorine at all four temperatures. The physiological effects of intermittent chlorination on rainbow trout and the histological changes in bluegill and rainbow trout were also reported. (ST)

<48>
Bauer, J.C., Growth, Aggregation, and Maturation in the Echinoid, DIADEMA ANTILLARUM.

1976. Bull. Marine Sci., 26, 273-277 (University of Miami, Rosenstiel School of Marine and Atmospheric Science, Miami, FL)

The young of the urchin, DIADEMA ANTILLARUM, at a site off Boca Raton, Fl. increased in test diameter from 9 mm in April to 35 mm in October. Adults grew from 45 to 50 mm over the same period. Active gametogenesis began at Indian Key in the fall with decreasing water temperatures. The major spawning in November occurred during a period of low temperatures. A similar spawning occurred at Key West. At Indian Key there was a statistical correlation between the release of gametes and the phases of the moon. (ST)

<49>
Bayne, B.L., C.J. Bayne, T.C. Carefoot, and R.J. Thompson, The Physiological Ecology of MYTILUS CALIFORNIANUS Conrad. I. Metabolism and Energy Balance.

1975. Oecologia (Ger.), 22, 211-228 (Institute of Marine Environmental Research, Plymouth, England)

The rate of oxygen consumption by MYTILUS CALIFORNIANUS was relatively independent of temperature change over the range of 13 to 22 C, with a Q10 of 1.20. The frequency of heart beat was temperature dependent between 13 and 22 C. Filtration rate showed intermediate dependence on temperature change up to 22 C and declined at 26 C. The utilization efficiency for oxygen was approximately 4% between 13 and 22 C, but increased to 10% at 26 C. The scope for growth was highest at 17 to 22 C and declined at 26 C. (ST)

<50>
Beck, J.T., and B.C. Cowell, Life History and Ecology of the Freshwater Caridean Shrimp, PALAEMONETES PALUDOSUS (Gibbes).

1976. Amer. Midland Naturalist, 96, 52-65 (University of South Florida, Department of Biology, Tampa, FL)

The life history and ecology of the freshwater caridean shrimp, PALAEMONETES PALUDOSUS, was determined from monthly collections for one year in the Hillsborough River near Tampa, Florida. Numerical abundance increased from May (95.3/m2) to August (662.6/m2) and then decreased to 121.6/m2 by April of the following year. Ovigerous females ranging from 20 to 40 mm long occurred from early February to mid-October at water temperatures of 18 to 33 C. The incubation period in the laboratory was 12 to 14 days at 26 to 28 C. Growth to maturity took two to three months when water temperaturess exceeded 26 C and four to five months when temperatures were lower. (Auth) (ST)

<51>
Becker, C.D., and M.J. Schneider, Direct Effects of Cold Shock: Bioassays with Three Columbia River Organisms.

1975. BNWL-SA-5435; CONP-750985; Presented at the American Fisheries Society Meeting held in Las Vegas, Nevada, September, 1975. (Abstract only) (Battelle Pacific Northwest Laboratories, Richland, WA)

Results of studies of the direct effects of cold shock on the pumpkinseed sunfish (representing a warmwater fish), the rainbow trout (representing a coldwater fish), and the common crayfish showed that resistance to cold shock varies between species, is dependent on acclimation temperature, and resistance to temperature declines is dependent on the decline rate. Severe cold shock at a sublethal level is accompanied by

<51> CONT.
disorientation, loss of equilibrium, and immobilization. Pumpkinseed, the warm water species, are most susceptible. Rainbow, the cold water species, are less susceptible; at an acclimation of 10 C, rainbow survive abrupt shock to levels slightly above freezing. Crayfish, the decapod crustacean, are most resistant; at an acclimation of 15 C, crayfish survive abrupt shock to the point just above freezing. (Auth)

<52>
Beeton, A.M., Problems in Determining the Impact of Power Plants on Large Freshwater Systems.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (University of Wisconsin, Center for Great Lakes Studies, Milwaukee, WI)

A study of the Oak Creek Power Plant located on Lake Michigan was cited as an example of the problems encountered in determining the environmental effects of power plants on large freshwater systems. A major problem in attempting to evaluate the effects of the plant was the water quality in the vicinity of the plant. An effect of the plant discharge on water quality could not be detected. The primary variable affecting zoo- and phytoplankton distribution was distance from shore. The greater numbers of plankters in the vicinity of the plant was apparently the result of greater nutrient concentrations. The only direct effect of the power plant appeared to be the stimulation of primary production of algae entrained through the plant. (ST)

<53>
Beeton, A.M., and J.M. Barker, Investigation of the Influence of Thermal Discharge from a Large Electric Power Station on the Biology and Nearshore Circulation of Lake Michigan--Part A: Biology.

1974. COO-2160-9; Center for Great Lakes Studies Special Report No. 18 (University of Wisconsin, Center for Great Lakes Studies, Milwaukee, WI)

Environmental effects on Lake Michigan of a long-existent thermal discharge from the Oak Creek Power Plant were studied. Monthly sampling for temperature, chemicals, and plankton was conducted near the plant and in a reference area. Thermal discharge had little effect on plankton distribution. Difference between inshore and offshore stations were much greater than differences between study areas. The primary variable was distance from shore. Chemical data analysis did not produce any useful relationships. Two extensive synoptic and four near-plant surveys showed water quality in the plant vicinity was a consequence of outflow from Milwaukee Harbor, sewage outfalls, and other point sources. These discharges resulted in high concentrations of chemicals nearshore. The power plant had no obvious influence on water quality or chlorophyll a distributions. Net C-14 entrainment resulted in a 64% increase in phytoplankton uptake. Increased temperatures and mechanical stress resulted in 20% and 9% increases in uptake. (Auth)

<54>
Beitinger, T.L., Behavioral Thermoregulation by Bluegill Exposed to Various Rates of Temperature Change.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (University of Wisconsin, Laboratory of Limnology, Madison, WI)

Thermoregulatory behavior of bluegill (LEPOMIS MACROCHIRUS) exposed to three different combinations of temperature rate changes (heating rate twice the cooling rate; heating rate one-half the cooling rate; heating and cooling rates equal) was determined in a two-chambered, modified temporal temperature-preference system. During three-day experimental periods, bluegill partitioned their time between the cooler and warmer tank halves relative to the ratio of heating and cooling rates. Variations in the rates of tank temperature change produced no significant differences in the preference or avoidance temperatures of bluegill compared with control fish, which experienced equal heating and cooling rates. These findings indicate that bluegill will respond behaviorally to variations in the magnitude of thermal reinforcement to maintain temperatures at selected levels. (Auth)

<55>
Belk, D., and M.S. Belk, Hatching Temperatures and New Distributional Records for CAENESTHERIELLA SETOSA (Crustacea, Conchostraca).

1975. Southwestern Naturalist, 20, 409-420 (Arizona State University, Department of Zoology, Tempe, AZ)

The optimum hatching temperature for eggs of the clam shrimp, CAENESTHERIELLA SETOSA, maintained at temperatures from 5 to 40 C at 5 C invervals, was 25 C. There was no statistical difference between the results at 20 and 35 C. (ST)

<56>
Bell, L.J., Notes on the Nesting Success and Fecundity of the Anemonefish AMPHIPRION CLARKII at Miyake-Jima, Japan.

1976. Japanese Jour. Ichthyol., 22, 207-211 (Tatsuo Tanaka Memorial Biological Station, Toga Farm, Ako, Miyake-jima, Tokyo, Japan)

AMPHIPRION CLARKII spawned from May to September in Igaya Bay, Japan. Nesting frequency was six to eight times a year. Egg incubation periods varied from six and one-half to thirteen and one-half days depending on water temperature. During the six and one-half day incubation periods temperatures ranged from 26.5 to 27.5 C. Water temperature stayed below 24 C during the thirteen and one-half day periods. Cold temperature appeared to retard development; all eggs hatched after waters warmed again. (ST)

<57>
Belman, B.W., and M.S. Gordon, Respiration and the Effects of Temperature and Pressure in the Mesoplagic Fish MELANOSTIGMA PAMMELAS.

1975. Amer. Zool., 15, 809 (University of California, Los Angeles, CA)

<57> CONT.
The mesopelagic zooarcid MELANOSTIGMA PAMMELAS is apparently a permanent resident of midwater (500 to 800+ meters) oxygen minimum layers off Southern California. Measurements of the rate of oxygen consumption at 1 atm of both freshly collected and laboratory maintained fish indicated routine metabolic rates of: 0.85 ul02/mg (wet wt)/hr at 3 C, 1.90 ul02/mg/hr at 7 C, and 2.41 ul02/mg/hr at 10 C. At 7 C this fish regulates its rate of oxygen consumption to 4 to 8 mmHg p02's, levels comparable to that found in the 02-minimum layer. Regulatory ability is diminished at higher and lower temperatures. The effect of increased pressure on oxygen consumption is insignificant (up to 170 atm) at 7 C while there is a slight depression of oxygen consumption by increased pressure at both 3 C and 10 C. (Auth)

<58>
Bench, V., Donnees sur la Croissance de CITHARINUS CITHARUS (Poissons, Characiformes) dans le Basin Tchadien.

1974. Cah. O.R.S.T.O.M., ser Hydrobiol., 8, 23-33 (O.R.S.T.O.M.)

Growth of the fish, CITHARINUS CITHARUS, in Lake Chad, Africa, stopped from November to March, a period during which the water temperature was below 25 C. (ST)

<59>
Benda, R.S., Growth and Movement of Fish in the Vicinity of a Thermal Discharge.

1974. Proc. Indiana Acad. Sci., 83, 185-191 (Aquinas College, Grand Rapids, MI)

The paper summarizes two years of study on the growth and movement of fish above, next to, and below a power plant thermal effluent into the White River at Petersburg, Indiana. With both units operating, the temperature increase through the plant was 11 C and the heated effluent reached temperatures over 37.8 C during the summer months. As a group, the centrarchids remained for extended periods in the section of the river where captured and released. Less movement was shown away from the heated water than towards it. Spotted bass, bluegill and white crappie showed more movement toward the heated water than the longear sunfish which showed greater movement away. No significant differences could be determined in the growth rates from separate areas of the river. The seven species of fish studied displayed average growth rates when compared to fish from other areas in the midwest. (ST)

<60>
Benda, R.S., and J. Gulvas, Effect of the Palisades Nuclear Power Plant on Lake Michigan.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (Aquinas College, Natural Science Division, Grand Rapids, MI; Consumers Power Company, Jackson, MI)

An 18-month study (May 1972 to October 1973) was undertaken to determine the effects of once-through cooling water from the Palisades nuclear power plant on the biota of Lake Michigan. From May 16, 1972, to Oct. 25, 1973, a total of 651,712 fish weighing 19,842.2 kg were impinged on the traveling screens. Alewife (ALOSA PSEUDOHARENGUS), slimy sculpin (COTTUS COGNATUS), spottail shiner (NOTROPIS HUDSONIUS), and yellow perch (PERCA FLAVESCENS) made up 58.6, 27.5, 7.2 and 4.4%, respectively, of the total number. Coregonids and salmonids and smelt (OSMERUS MORDAX) made up 0.2 and 1.0% of the total, respectively. They appeared seasonally on the screens, with none of the 37 recorded species being collected regularly. In addition, 4768 crayfish (ORCONECTES PROPINQUIS) were counted, mostly during late spring and early summer. No significant change in the abundance of prominent species in lake populations occurred after the introduction of the thermal discharge, but the spawning period for one-third of the yellow perch collected was advanced by approximately 3 weeks in 1973. Fifty-two sets of C-14 samples were collected on 25 separate days. The average loss in primary productivity for a heated discharge was 32.7% and for a nonheated discharge, 17.9%, indicating that mechanical stress caused approximately one-half of the decrease. Live-to-dead ratios were established for groups of zooplankters in 119 sets of samples for the intake and discharge. All groups studied showed that the discharge samples usually had a higher percentage of dead organisms than did the intake samples. Below a discharge temperature of 34 C, the average loss of the discharge over the intake was 6.1 to 14.9% for all groups. However, once discharge temperatures exceeded 34 C, losses were 75 to 90% indicating that lethal levels had been reached. Seining, gill netting, and trawling data revealed that the heated water attracted fish species (including salmonids) according to their temperature preferenda. This attractant provided an active sport fishery during several weeks of the year. In general, the operation of the Palisades plant with the once-through cooling system did not have a significant impact on the lake. (Auth)

<61>
Bennett, D.H., Effects of Pumped Storage Project Operations on the Spawning Success of Centrarchid Fishes in Leesville Lake, Virginia.

1976. Ph.D. Thesis, Virginia Polytechnic Institute and State University (Virginia Polytechnic Institute and State University, Blacksburg, VA)

Laboratory and field studies were conducted to evaluate hatching success of bluegill (LEPOMIS MACROCHIRUS) eggs under controlled water temperatures and exposures to air. Average hatching success increased as hatching temperatures increased from 16 to 28 C. Hatching success of naturally spawned eggs exposed during night and daytime hours in natural spawning nests decreased with increased exposure to air. (ST)

<62>
Benziger, D.P., Effects of Thermal Acclimation on Glycogenolytic Enzymes and Carbohydrate Reserves in Teleost Fishes.

1974. Ph.D. Thesis, University of Cincinnati (University of Cincinnati, Cincinnati, OH)

The effects of low temperature acclimation on carbohydrate metabolism, as reflected by changes in two hepatic enzymes, was investigated in goldfish, brown bullhead, and two species of killifish. In the common killifish, FUNDULUS HETEROCLITUS, cold exposure resulted in a marked hyperglycemia

<62>

<62> CONT.
which was accompanied by a depletion of hepatic glycogen, an increase in total phosphorylase activity, and no change in glucose-6-phosphatase activity. The brown bullhead, ICTALURUS NEBULOSUS, showed a slight increase in serum glucose and no change in glucose-6-phosphatase activity. No changes in phosphorylase activity were observed in different acclimation temperatures. It was concluded that changes in total phosphorylase activity are responsible for alterations in hepatic glycogenolysis during low temperature acclimation. Glucose-6-phosphatase appears unimportant in regulating the rate of hepatic glycogen breakdown. The direction of change in phosphorylase activity at low temperatures is species sepcific: an increase in phosphorylase activity is associated with a depletion of hepatic glycogen and a marked hyperglycemia, while a decrease or no change in phosphorylase activity is associated with an increase in hepatic glycogen and a slight hyperglycemia. (Auth) (ST)

<63>
Bertness, M.D., and D.E. Schneider, Temperature Relations of Puget Sound Thaids in Reference to Their Intertidal Distribution.

1976. Veliger, 19, 47-58 (Western Washington State College, Bellingham, WA)

The lethal thermal limits, activity, and metabolic rate responses to temperature fluctuations of two intertidal gastropods, THAIS LAMELLOSA and THAIS EMARGINATA were investigated. LD50 values were determined at 29, 30, 31, 32, 33, 34, and 35 C under conditions of 100% humidity. THAIS EMARGINATA showed significantly higher thermal limits than large and small T. LAMELLOSA at each test temperature. Humidity was shown to be an important factor in the thermal limits. The respiratory response to temperature increase (0 to 30 C) indicated that the higher intertidal T. EMARGINATA and smaller individuals within each species displayed the most pronounced temperature independence. The highest temperature at which both species remained active, over a 0 to 30 C temperature range, correlated to their natural distribution and consequential temperature regimes of their habitats. All groups tested (submerged) were relatively inactive at 0 C. Between 5 and 20 C T. EMARGINATA's activity was temperature independent. Within this range, large and small T. LAMELLOSA responded differently to the temperature changes. Small T. LAMELLOSA activity did not differ significantly at any one temperature from T. EMARGINATA; whereas the large T. LAMELLOSA activity dropped to zero at 25 C. At 25 C both species showed drastically reduced activity and at 30 C T. EMARGINATA was the only group showing activity. (ST)

<64>
Beuchat, L.R., Environmental Factors Affecting Survival and Growth of VIBRIO PARAHAEMOLYTICUS. A Review.

1975. Jour. Milk & Food Tech., 38, 476-480 (University of Georgia Agricultural Experiment Stations, Experiment, GA)

Effects of temperature, salinity, water activity, and pH on survival and growth of VIBRIO PARHAEMOLYTICUS are reviewed. Maximum and minimum tolerances to these environmental factors are summarized, with special emphasis on conditions which exert stress or lethal effects on the organisms. Behavior of V. PARAHAEMOLYTICUS as influenced by the interaction of environmental parameters is discussed. (Auth)

<65>
Blahm, T.H., and G.R. Snyder, Effect of Increased Water Temperatures on Survival of Adult Threespine Stickleback and Juvenile Yellow Perch in the Columbia River.

1975. Northwest Sci., 49, 267-270 (National Marine Fisheries Service, Northwest Fisheries Center, Seattle, WA)

Flow-through bioassay tests on the effects of temperature increases on yellow perch (PERCA FLAVESCENS) and threespine stickleback (GASTEROSTEUS ACULEATUS) were conducted on the lower Columbia River near Prescott, Oregon. The on-site tests of two weeks' duration were performed on control samples of fish at a water temperature of 19 C and on test samples of fish at water temperatures of 20 to 26 C, on one-degree increments, and at 29, 32, and 38 C. Samples of threespine stickleback reached 50% mortality at 26 C. Juvenile yellow perch reached 50% mortality at 32 C. (Auth) (ST)

<66>
Blake, N.J., L.J. Doyle, and T.E. Pyle, The Macrobenthic Community of a Thermally Altered Area of Tampa Bay, Florida.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (University of South Florida, Department of Marine Science, St. Petersburg, FL)

An ecological study in the vicinity of the P.L. Bartow Power Plant (482 Mw, maximum delta T = 7.2 C) included surveys of physical and chemical parameters at approximately monthly intervals. Assuming that seagrasses were originally present on the discharge side of the plant, as they are now on the intake side, over 81 ha of seagrasses have been destroyed. Only small patches of HALODULE WRIGHTII now grow near the outer edges of the thermal plume (delta T = 3 C). THALASSIA TESTUDINUM transplanted to the discharge area failed to survive for 30 days where mean water temperature was 31 C or greater. A summer survey of the benthic invertebrates yielded 104 species of polychaetes, molluscs, crustaceans, and echinoderms from the intake side of the plant and 60 species from the discharge side. The difference was not attributable to detectable variations in sediments. (Auth)

<67>
Blankley, W.F., and R.A. Lewin, Temperature Responses of a Coccolithophorid, CRICOSPHAERA CARTERAE, Measured in a Simple and Inexpensive Thermal-Gradient Device.

1976. Limnol. & Oceanog., 21, 457-462 (Duke University, Durham, NC; Duke University Marine Laboratory, Beaufort, NC; Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA)

An illuminated thermal-gradient device is described which is of simple construction, very low cost, and wide adaptability to various culture vessels. It can be readily

<67> CONT.
adapted for use in crossed gradients with temperature along one axis. The thermal gradient produced depends on several factors including the heat source (one or more incandescent lamps), heat sink (cold air in a refrigerated box or room), and type of culture vessel. By use of the device, the temperature range for growth of CRICOSPHAERA CARTERAE was found to be 10 to 26 C, with a maximal growth rate at 20 C. (Auth)

<68>
Boddeke, R., The Seasonal Migration of the Brown Shrimp CRANGON CRANGON.

1976. Neth. Jour. Sea Res., 10, 103-130 (Netherlands Institute for Fishery Investigations, Ijmuiden, Netherlands)

Fall-winter and spring migrations of the brown shrimp along the Netherlands coast were highly variable processes in time, duration, distance and participation. Relative differences in water temperature caused the migrations. Sensitivity to the temperature stimulus depended on the sex and physiological condition, including molting state, of the animals. (ST)

<69>
Bogdanova, L.K., Sexual Maturation of Female Carp Raised in Warm Waters of the Kirish Electric Power Plant.

1975. Rybokhoz. Izuch. Vnutr. Vodoemov, No. 15, 38-43 (GosNIORKh, Leningrad, USSR)

A study was made of the effect of high water temperature (25 to 30 C) on gonad development in female carp reared in cages in the heated discharge from the electric power plant for three years. The fish were placed in the heated waters at the age of one year. The duration of sexual maturation was one year and three months. The protoplasmatic growth period (maturity stage two) was as short as 10 months. The duration of the trophoplasmatic growth period was reduced to three months. The females produced viable progeny. It is concluded that the use of heated discharge can reduce the duration of sexual maturation in carp by over one year. (Auth)

<70>
Boge, G., A. Rigal, and Peres, G., Comparison between Results Obtained with in vitro and in vivo Methods for Studying the Effects of Thermal Variations on Intestinal Absorption of Glycine by Rainbow Trout (SALMO GAIRDNERI R.).

1976. Cah. Lab. Hydrobiol. Montereau (Fr.), No. 3, 15-20 (Institute Michel Pacha, Laboratoire Maritime de Physiologie, Tamaris sur Mer, France)

A comparative study of thermal effects on intestinal absorption of C-14 labeled glycine (0.5 mM) was undertaken using in vitro and in vivo techniques. An "in situ" original intestinal perfusion method was used for the work. In vitro, the action of temperature on total absorption of C-14 labeled glycine was effective after 10 C, particularly on midgut. In vivo, this action was stronger at low temperatures. The existence of a blood control which is dependent on a medium temperature modification was proposed to explain the differences. (English summary)

<71>
Bondar, R.L., Neurofibrillar and Neurofilamentous Changes in Goldfish (CARASSIUS AURATUS L.) in Relation to Temperature.

1974. Ph.D. Thesis, University of Toronto (University of Toronto, Ontario, Canada)

To examine the effects of prolonged exposure to cold temperatures on the central nervous system of goldfish, 25 CARASSIUS AURATUS were maintained on a 12-hr photperiod for 177 days at 5 C. Perfusion and immersion fixed brains of cold acclimated goldfish were examined by light microscopy and electron microscopy, and compared to brains of goldfish maintained at 15 C. Argyrophilic ring images were observed in paraffin sections of the lateral lobe, hypophysis, optic tectum, and corpora mammillare of 5 C fish but not in fish kept at 15 C. Electron microscopic changes consisting of accumulations of neurofilaments in synaptic endings were present only in 5 C fish. (Auth) (ST)

<72>
Bongers, L.H., T.T. Polgar, A.J. Lippson, G.M. Krainak, L.R. Moran, A.P. Holland, and W.A. Richkus, The Impact of the Morgantown Power Plant on the Potomac Estuary: An Interpretive Summary of the 1972-1973 Investigations.

1975. PPSP-MP-15 (Martin Marietta Corporation, Environmental Technology Center, Baltimore, MD)

During passage through the condenser system of the Morgantown cooling system, an abrupt rise in water temperature of 5.6 C occurs. Zooplankton mortalities greater than 50% were measured only under the most severe thermal and experimentally-applied chlorine stress conditions. Up to 97% reductions in phytoplankton productivity, measured by C-14 uptake, occurred under the same conditions. Productivity and levels of live zooplankton abundance were reduced at the outfall in comparison to the intake, particularly during summer months and when cooling water was chlorinated. In spring experimental chlorine levels still damaged phyto- and zooplankton significantly, but thermal doses alone had negligible effects. No deleterious thermal, chlorine, or mechanical effects were evident on large crustaceans collected in sufficient numbers after cooling system passage. Thermal, mechanical, and chlorine stresses were all significant in affecting survival of ichthyoplankton of non-commercial species. Changes attributable to plant operation were estimated to extend over 10% of the river cross-sectional area at the plant site. Under the most stressful conditions (total entrainment mortality), 2% of the plankton transported past the plant in the river cross-section were estimated to be destroyed by entrainment. Since most of the planktonic forms are distributed over a broad segment of the river and also have high reproductive rates, no adverse impact could be assigned to the observed plant operation. (ST)

<73>
Bouche, G., J.P. Parnet, and A. Serfaty, Effect of Two Rearing Conditions on Growth and Body Composition in Carp (CYPRINUS CARPIO L)..

1975. Jour. Physiol. (Fr.), 70, 659-668 (Universite Paul Sabatier, Laboratoire d'Ecophysiologie Animale, Toulouse Cedex, France)

A comparative study was made of the growth and of the influence of seasonal changes on nitrogen and carbohydrate metabolism of carp

<73> CONT.
kept in batches in natural ponds. Growth was active only in natural ponds. In batches where only industrial dried foods were used, no growth was measured. Activity of ribonucleic and protein metabolism was correlated with seasonal variations of water temperature in both conditions. (Auth)

<74>
Bovbjerg, R.V., Dispersal and Dispersion of Pond Snails in an Experimental Environment Varying to Three Factors, Singly and in Combination.

1975. Physiol. Zool., 48, 203-215 (University of Iowa, Iowa City, IA)

In a temperature gradient system ranging from 25 to 35 C, LYMNAEA STAGNALIS congregated in the cooler region of the gradient. Within 1 hr, 87% of the snails were within the cooler half of the device. When temperature selection was tested in combination with the presence of vegetation and animal carrion, vegetation tended slightly to mask the aggregations on carrion and in the cooler water. A strong synergism was evident in aggregation on carrion in cooler water. (ST)

<75>
Bowen, M., Effects of a Thermal Effluent on the Ostracods of Par Pond, South Carolina.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (University of Rhode Island, Zoology Department, Kingston, RI; Virginia Institute of Marine Science, Department of Invertebrate Ecology, Gloucester Point, VA)

The effects of a thermal effluent on the distribution and abundance of freshwater ostracods were investigated. Hot and cold water and thermal recovery sites were sampled for their ostracod fauna, using both tow and core methods. An unusual assemblage of both tropical and temperate ostracods was collected. Neither high maximum nor high minimum temperatures had an effect on total numbers of ostracods per sample, but high minimum temperatures were correlated with low species diversity. Variations in the seasonal cycles of ostracods were related to temperature differences. Thermal stresses may have indirectly affected the ostracod population by eliminating rooted vegetation. (Auth)

<76>
Bowles, R.R., J.S. Griffith, and C.C. Coutant, Effects of Water Velocity on Activity of Juvenile Striped Bass.

1976. ORNL/TM-5368, 73 pp. (Oak Ridge National Labcratory, Environmental Sciences Division, Oak Ridge, TN)

Area and distance traveled by juvenile striped bass (MORONE SAXATILIS) decreased as water velocity increased from 0 to 30 cm/sec. Area and distance traveled increased with increasing temperature up to 20 C, and declined at higher temperatures. Both results had a maximal value near 20 C. Distance traveled and area occupied reached maximal mean values of 231 cm and 2350 cm2, respectively. (ST)

<77>
Boyle, P.J., and R.D. Turner, The Larval Development of the Wood Boring Piddock MARTESIS STRIATA (L.) (Mollusca: Bivalvia: Pholadidae).

1976. Jour. Exp. Mar. Biol. Ecol. (Neth.), 22, 55-68 (Harvard University, Museum of Comparative Zoology, Cambridge, MA)

In the laboratory, adult wood boring bivalves, MARTESIA STRIATA, collected from Sanibel Island, Florida, released eggs and spermatozoa spontaneously at 21 C. Larvae were reared at 26 C and 31 ppt salinity. (ST)

<78>
Boytsov, M.P., The Morphology of Underyearling Fishes in the Zone Affected by Warm Waters Discharged from the Konakovo Power Station into Ivan'kovskoye Reservoir.

1974. Jour. Ichthyol., 14, 904-910 (State Research Institute for Lake and River Fisheries, Upper Volga Department, Konakova, USSR)

The meristic and morphological characters of underyearling roach, bream, perch, and pike in Moshkovichskiy Bay, which is affected by warm discharge waters of the Konakovo power station, and a control bay were compared. In the spring and summer of 1971 water temperature in the bay differed from the control by 5.4 to 7.7 C. There were no significant differences between the meristic characters of roach, bream, perch and pike underyearlings from the zone heavily affected by the discharge waters. This was correlated with the earlier spawning time of the fish, as a result of which embryogeny and development of the young occurred at temperatures similar to those in the control and around the optimum for each species. The morphological characters of the roach and bream underyearlings from the warm water zone and the control area differed. There were differences in the size of the paired and unpaired fins and in the ventroanal distance. In addition, greatest and least body depth were increased in roach underyearlings of the warm water zone, while the depth of the head at the occiput, the length of the caudal peduncle and the base length of the anal fin were increased in the bream. There were no significant differences in perch and pike underyearlings. The divergence of the morphological characters of roach and bream underyearlings was correlated with the different conditions under which their development took place, such as current velocity, which is considerably higher in the warm water zone. (ST)

<79>
Bradley, B.P., The Measurement of Temperature Tolerance: Verification of an Index.

1976. Limnol. & Oceanog., 21, 596-599 (University of Maryland, Department of Biological Sciences, Catonsville, MD)

A shock-recovery assay for temperature tolerance is demonstrated to predict survival of the copepod EURYTEMORA AFFINIS at high temperature. The assay can be modified to allow comparison between widely divergent treatment groups. Average longevities of males at 20, 25, 30, 32, and 33 C were 82.7, 70.7, 25.9, 11.1, and 6.2 hours. The corresponding values for females were 162.0, 75.6, 20.1, 8.5, and 2.8 hours. All test animals succumbed before the temperature reached 35 C in experiments demonstrating the time to succumb to a slowly changing

<79> CONT.
temperature. (Auth) (ST)

<80>
Braune, H.J., and G. Gronow, Temperature as a Stressor in IDUS IDUS L. (Teleostei).

1975. Zool. Anz., 194, 22-34 (University of Kiel, Zoology Institute, Kiel, German Federal Republic)

Effects of temperature stimuli on substrate contents of the epaxial muscle of IDUS IDUS (6-7 cm) were studied. Glucose and glucose-6-phosphate content and the lactate:pyruvate ratio at constant temperatures were similar in fish acclimated to 15 or 20 C. Both increase and decrease of acclimation temperature from this range generally raised the contents of the substrates and of the lactate:pyruvate ratio. Pyruvate, however, showed a minimum both at 6 and 30 C. The effects of the acclimation temperature of 30 C generally exceeded those of 6 C, indicating a permanent stress caused by the high constant temperature. An abrupt transfer in a stage of light anaesthesis from 20 C both to 6 and 30 C for 30 min caused an increase of the lactate:pyruvate ratio of approximately 100%. The values remained high for several hours even after return to a normal temperature of 20 C, indicating stress effects. Alternating temperatures (15/25 C; 12 hr/12 hr) generally raised the substrate contents of I. IDUS, following acclimation at 15 C, in the first 10 days. The significant increase of the lactate:pyruvate ratio indicates a situation of stress, which was caused mainly by the periodical change of temperature and not by the absolute values of the two alterniating temperatures. After 10 days alternating temperatures the values decreased and showed a tendency to reach a constant lower level. The fish appeared to be accustomed to the alternating temperature change. The data showed that changes in the substrate contents of the epaxial muscle in I. IDUS are an indicator of stress as caused by constant temperatures and abrupt or alternating temperature changes. (Auth)

<81>
Brehmer, M.L., Power Production on Estuaries and Tidal Rivers.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Virginia Electric and Power Company, Richmond, VA)

Environmental concerns relative to the impact of electrical generating stations on estuaries and tidal rivers are briefly discussed. Results of studies indicate that the generating facilities on Chesapeake Bay have not had an adverse effect on indigenous organisms at any trophic level. Power station operation did not adversely affect either the composition or population of phytoplankton or zooplankton outside the 5 C isotherm and did not appear to affect fish eggs and larvae. The effect of fish egg and larvae entrainment mortality on subsequent adult population levels is impossible to evaluate at present. (ST)

<82>
Breton, B., B. Jalabert, A. Fostier, and R. Billard, Reproductive Cycle of Trout and Tench: Effect of Experimental Variations of the Temperature.

1975. Jour. Physiol. (Fr.), 70, 561-564 (INRA, Laboratorie de Physiologie des Poissons, Jouy-en-Josas, France)

In the rainbow trout (SALMO GAIRDNERI) and the tench (TINCA TINCA) at the time of spermatogonia divisions a rise in the plasma gonadotropin levels was observed. Just before or during the spawning period, estradiol-17-B and plasma gonadotropin reached their maximum levels. When the effects of raising the natural cycle temperature of the tench were studied (temperature increment of +3 C and +6 C), in conditions where nycthemeral and seasonal rhythmicity were maintained, a significant increase in fertility was observed with the increase in temperature (the first spawning period was earlier and there was a rise in the number of spawnings). This effect of temperature seems to act at the level of the hypothalamo-pituitary system. (Auth)

<83>
Brett, J.R., Scope for Metabolism and Growth of Sockeye Salmon, ONCORHYNCHUS NERKA, and Some Related Energetics.

1976. Jour. Fish. Res. Bd. Can., 33, 307-313 (Department of the Environment, Fisheries and Marine Service, Pacific Biological Station, Nanaimo, British Columbia, Canada)

The extent of metabolic and feeding requirements for fingerling sockeye salmon (ONCORHYNCHUS NERKA) are compared over the tolerable range of temperature. Scope for growth, derived from the difference between maximum and maintenance rations, is shown to relate to temperature in a manner similar to that for maximum growth rate. Metabolic scope is compared with scope for growth, supporting the general concept of scope for activity developed by Fry. (Auth)

<84>
Brewer, G.D., Thermal Tolerance and Resistance of the Northern Anchovy, ENGRAULIS MORDAX.

1976. Fish. Bull., 74, 433-445 (University of Southern California, Allan Hancock Foundation, University Park, Los Angeles, CA)

Thermal tolerance was determined for juvnile and adult northern anchovy, ENGRAULIS MORDAX, acclimated to six constant temperatures between 8 and 28 C. Thermal resistance (minutes until death for fish exposed to a lethal temperature) was independent of photoperiod and fish size; however, females proved more resistant than males, and resistance decreased at night. Fish subjected to fluctuating water temperatures between 12 and 20 C proved less resistant to cold than a 12 C (constant) acclimated group and less resistant to heat than a 20 C (constant) acclimated group. Thermal tolerance was determined for larvae in the yolk-sac stage, acclimated to four constant temperatures between 12 and 24 C. Although hatching occurred at temperatures as high as 29.5 C and as low as 8.5 C, the percentage of normally developed larvae equaled that of controls (incubated at 16 C) only between temperatures of 27.0 and 11.5 C. Embryos in the blastodisc stage proved most sensitive to acute temperature increases when compared to embryos in the blastopore closure stage and larvae in the yolk-sac stage. These same three stages proved insensitive to acute

<84> CONT.
temperature decreases to 0.5 C for 60-min exposure periods. (Auth) (ST)

<85>
Brewer, G.D., The Biology of the Northern Anchovy (ENGRAULIS MORDAX) in Relation to Temperature.

1975. Ph.D. Thesis, University of Southern California (University of Southern California, Los Angeles, CA)

Juvenile and adult fish, acclimated to six constant temperatures between 8 and 28 C, had upper lethal temperatures between 23.7 and 29.4 C; lower lethal temperatures were between 6.8 and 12.4 C. Maximum tolerance limits of juveniles and adults were estimated to be 6.5 and 29.5 C. Thermal resistance was independent of photoperiod and fish size; however, females were more resistant than males. Acclimation from 12 to 20 C was nearly complete after six days exposure to the higher temperature; acclimation from 20 to 12 C was nearly complete after six days exposure. Larvae in the yolk-sac stage had upper lethal temperatures between 29.5 and 30.7 C and lower lethal temperatures between 8.2 and 10.1 C when acclimated to temperatures between 12 and 24 C. Maximum tolerance limits of yolk-sac larvae were estimated to be 7.0 to 30.2 C. Hatching occurred over the temperature range of 8.5 to 29.5 C. Field and laboratory data suggested that spawning occurred when surface water temperatures were between 13 and 18 C. (Auth) (ST)

<86>
Briand, F.J.-P., Effects of Power-Plant Cooling Systems on Marine Phytoplankton.

1975. Marine Biol. (W. Ger.), 33, 135-146 (University of California, Department of Population and Environmental Biology, Irvine, CA)

The large quantities of marine phytoplankton passing through the cooling systems of two Southern California coastal power plants were found to be greatly reduced in number (41.7%) and in volume (33.7%). The biomass killed from June, 1972 to May, 1973 amounted to approximately 1,700 tons of organic carbon. Phytoplankton mortalities were most pronounced from October to December when intake waters of 17 to 20 C were subjected to temperature elevations of 9 to 11 C, and were lowest from January to March when cooler ambient temperatures prevailed. There was no apparent reduction in phytoplankton stocks when the intake water was cooler than 15 C. Surviving cells in 25 and 26.5 C effluent waters were growing three times faster than influent populations, which suggests that power-plant effects on phytoplankton stocks are often short-lived. However, entrainment effects appear very disruptive, in changing the structure of phytoplankton communities and in constantly reducing species diversity. Passage through the condenser tubes affected algal species differentially, killing diatoms in greater numbers (45.7%) than dinoflagellates (32.8%), and reinforcing the dominance of the two major species, ASTERIONELLA JAPONICA and GONYAULAX POLYEDRA, that were the most tolerant. The severity of the impact appears to be controlled by two interacting factors: intake water-temperature and magnitude of temperature increase. On this basis, use by coastal power plants of deep-sea water for cooling is strongly advocated. (Auth)

<87>
Bridges, D.W., J.J. Cech, Jr., and D.N. Pedro, Seasonal Hematological Changes in Winter Flounder, PSEUDOPLEURONECTES AMERICANUS.

1976. Trans. Amer. Fish. Soc., 105, 596-600 (Research Institute of the Gulf of Maine (TRIGOM), South Portland, ME)

Normal ranges of hematological values in healthy winter flounder were established. Hemoglobin, blood oxygen capacity, hematocrit, red blood cell number, immature red blood cell number, mean corpuscular volume, mean corpuscular hemoglobin, leukocytes, lymphocytes, thrombocytes, neurophils, condition factor, and apparent health showed significant seasonal variation. Fish held in aquaria with continuously flowing seawater stopped feeding when the water temperature dropped to 4 C. (ST)

<88>
Brittain, J.E., The Temperature of Two Welsh Lakes and Its Effect on the Distribution of Two Freshwater Insects.

1976. Hydrobiologia (Den.), 48, 37-49 (University College of North Wales, Bangor, Wales)

Temperature data are presented for two lakes in North Wales, Llyn Coron and Llyn Dinas, in an effort to explain the absence of the insects NEMOURA AVICULARIS and LEPTOPHLEBIA VESPERTINA from Llyn Coron. In the laboratory NEMOURA AVICULARIS was unable to complete its life cycle at a constant temperature of 20 C, although egg hatching and early growth were normal. Eggs of NEMOURA AVICULARIS hatched in 12 to 16 days at 20 C and in 26 days at 15 C. Emergence of both species was advanced by keeping the nymphs at higher temperatures than those prevailing in Llyn Dinas. The LD50s of N. AMICULARIS at 20 and 25 C were 73 and 31 days, respectively. For L. VESPERTINA, the equivalent periods were 159 and 37 days. When the temperature was raised 1 C/day, the LD50 for L. VESPERTINA was 32 C. Differences in the thermal conditions of Llyn Dinas and Llyn Coron were considered insufficient to account for the absence of both species from Llyn Coron. (ST)

<89>
Brooks, A.S., Phytoplankton Entrainment Studies at the Indian River Estuary, Delaware.

1974. PB-240 758; EPRI-74-049-00-5; Electric Power Research Institute Cooling Water Studies Report No. 15; In Jensen, L.D. (Ed.), Proceedings of the Second Entrainment and Intake Screening Workshop held at Johns Hopkins University, Baltimore, Maryland, February 5-9, 1973. National Technical Information Service, Springfield, VA (University of Wisconsin, Center for Great Lakes Studies, Milwaukee, WI)

The effects of the Indian River power plant on entrained phytoplankton were seasonal. Chlorophyll a concentrations were diminished after passage through the plant when fragile phytoplankton were present. Entrainment effects on C-14 uptake were primarily the result of temperature elevation. Mechanical factors influenced rates only slightly depending on the presence of fragile phytoplankton species. Rates of C-14 uptake were stimulated by 6.5 C temperature rise when ambient temperatures were below 22 C. Uptake rates were depressed from June through September while they were stimulated the

<89> CONT.
remainder of the year. The length of exposure to elevated temperatures had little effect on uptake rates during the cooler months of the year but long exposures during the summer altered uptake rates significantly. (ST)

<90>
Brooks, A.S., and G.L. Seegert, The Toxicity of Chlorine to Freshwater Organisms Under Varying Environmental Conditions.

1975. CONF-751096; Part of Jolley, R.L. (Ed.), Proceedings of the Symposium on the Environmental Impact of Water Chlorination held in Oak Ridge, Tennessee, October 22-24, 1975, (p. 277-298), 443 p. (University of Wisconsin-Milwaukee, Center for Great Lakes Studies, Milwaukee, WI)

The toxicity of chlorine to freshwater organisms under various environmental conditions is reviewed. Included in the review are experiments run in relatively clean waters and sewage effluents. Studies are also included which involved continuous and intermittent chlorine applications and tests conducted under a wide range of temperatures. Data from these studies are reviewed in light of the conditions under which the tests were conducted. A synthesized view is presented of the toxicity of chlorine to freshwater biota in terms of the level and duration of exposure, temperature, and the chemical nature of the water in which the experiments were conducted. (Auth) (ND)

<91>
Brown, H.A., The Time-Temperature Relation of Embryonic Development in the Northwestern Salamander, AMBYSTOMA GRACILE.

1976. Can. Jour. Zool., 54, 552-558 (Western Washington State College, Department of Biology, Bellingham, WA)

Laboratory data of embryonic development of AMBYSTOMA GRACILE at constant temperatures showed that the limits of temperature tolerance are 5 to 22.5 C. Rates of development from first cleavage (stage 2) to gill circulation (stage 37) were 12.7 days at 20 C, 27 days at 12 C, and 89 days at 7 C. Duration of embryonic development (stages 1 to 46) in the field was 62 days at an average water temperature of 8.5 C (range 4.4 to 14.3 C). Spawning began in March. (ST)

<92>
Bryan, P.G., B.B. Madraisau, and J.P. McVey, Hormone Induced and Natural Spawning of Captive SIGANUS CANALICULATUS (Pisces: Siganidae) Year Round.

1975. Micronesica, 11, 199-204 (Micronesian Mariculture Demonstration Center, Koror, Palau, W. Caroline Islands)

Captive SIGANUS CANALICULATUS reared and held in three-meter diameter circular tanks with running sea water were induced to spawn each month during 1974 by one or two intramuscular injections of human chorionic gonadotropin at dosages of 500 units per treatment. Natural spawnings occurred, without the use of hormone, only during the months of April, June, July, and August. (Auth)

<93>
Bryne, P., and E.B.G. Jones, Effect of Salinity on Spore Germination of Terrestrial and Marine Fungi.

1975. Trans. Brit. Mycol, Soc., 64, 497-503 (Portsmouth Polytechnic, Department of Biological Sciences, Portsmouth, England)

The five marine fungi examined exhibited a wide tolerance to salinity and temperature conditions (5, 10, 15, and 20 C). Reduction in temperature had little effect on the germination of the conidia of ASTEROMYCES CRUCIATUS in distilled water. However, at higher salinities, temperature had an effect on spore germination. The optimum temperature for germination of the conidia of DENDRYPHIELLA SALINA was 15 C. In ZALERION MARITIMUM, spore germination was significantly reduced by low temperatures and 100% seawater. (ST)

<94>
Buck, J.D., Distribution of Aquatic Yeasts - Effect of Incubation Temperature and Chloramphenicol Concentration on Isolation.

1975. Mycopathologia, 56, 73-79 (University of Connecticut, Marine Research Laboratory, Noank, CT)

River, estuarine, and marine waters in and along the coastline of Connecticut were cultured by the membrane filter technique at 20 and 37 C on a complex medium containing 0 to 1000 mg/l of chloramphenicol. A total of 209 white yeasts were isolated from all platings; no pink yeasts were noted in any sample incubated at 37 C. The genera CANDIDA and TORULOPSIS were most frequently recovered and represented 60 to 100% of the total number of isolates from given waters. At 20 C, TORULOPSIS species were only 17% of freshwater isolates while they represented 54% and 41% of estuarine and marine yeasts, respectively, at the same temperature. At 37 C a similar increase was noted: TORULOPSIS species accounted for 74% of the marine isolates. CANDIDA species showed a reverse trend, decreasing in percent of the population at both 20 and 37 C from fresh to estuarine to marine waters. CRYPTOCOCCUS species were isolated from all waters but only at 20 C. Members of TRICHOSPORON were recovered from fresh and estuarine waters but only at 20 C for the former and at 37 C for the latter. This may indicate a terrestrial sewage source of TRICHOSPORON species which do not survive well in seawater. (ST)

<95>
Buckingham, M.J., and D.E. Freed, Oxygen Consumption in the Prosobranch Snail VIVIPARUS CONTECTOIDES (Mollusca: Gastropoda). II. Effects of Temperature and pH.

1976. Comp. Biochem. Physiol., 53A, 249-252 (University of Michigan, Department of Biology, Flint, MI)

The oxygen consumption of VIVIPARUS CONTECTOIDES increased with increasing temperatures of 12, 17, 22, 27, and 32 C. Males had a rectilinear relationship between weight-adjusted oxygen consumption and temperature; females had a curvilinear relationship. There was a significant sexual difference in the relationship of weight-adjusted oxygen consumption and temperature, with the mean value for males being higher than for females at 22 and 27 C. Q10 values for males decreased with increasing temperature and for females they increased with increasing temperature.

<95>

<95> CONT.
Metabolic rate of V. CONTECTOIDES was dependent on pH, with two pH optima at 7.1 and 8.9 with an intervening trough. (Auth)

<96>
Bulnheim, H.P., Respiratory Metabolism of IDOTEA BALTHICA (Crustacea, Isopoda) in Relation to Environmental Variables, Acclimation Processes and Moulting.

1974. Helgolander Wiss. Meeresunters (Ger.), 26, 464-480 (Biology Institute Helgoland, Hamburg, Germany)

The oxygen uptake of the euryhaline isopod, IDOTEA BALTHICA, obtained from the Baltic Sea, was determined by means of flow-through polarography. The rates of respiration were studied in relation to body size, temperature, sand salinity. Measurements were made at 5, 10, 15, and 20 C and in 10% salinity. Metabolic rates increased with increasing temperature. Compensatory responses following thermal and salinity stress were recorded in relation to the time courses of acclimation and the magnitudes of the physiological adjustments. Sudden alterations of temperature led to new steady states of metabolic rates within 3 hr following a change from 15 to 5 C and approximately within 15 hr following a transfer from 5 to 15 C. (Auth)(ST)

<97>
Burky, A.J., and K.A. Burky, Seasonal Respiratory Variation and Acclimation in the Pea Clam, PISIDIUM WALKERI.

1976. Comp. Biochem. Physiol., 55A, 109-114 (Case Western Reserve University, Department of Biology, Cleveland, OH)

Seasonal respiratory variation at field temperatures and at 10 and 20 C are presented for shell-free acclimated clams. Values are presented as Q(02'S) based on shell-free tissue dry weight and shell-free tissue N2. Q10 values are presented for all seasons with winter and summer values of about one and three respectively. No size rate differences were found for measurements of oxygen consumption. The seasonal acclimation pattern is complex with the data of early spring indicating Precht's Type I pattern of over-compensation for the over-wintering generation and some of the summer-fall data suggesting Precht's Type V "reverse" acclimation for the summer generation. Seasonal acclimation is discussed in an ecological-environmental context. (Auth)

<98>
Burns, J.R., Seasonal Changes in the Respiration of Pumpkinseed, LEPOMIS GIBBOSUS, Correlated with Temperature, Day Length, and Stage of Reproductive Development.

1975. Physiol. Zool., 48, 142-149 (University of Massachusetts, Department of Zoology, Amherst, MA)

Seasonal changes in the respiratory rate of pumpkinseed, LEPOMIS GIBBOSUS, measured at environmental temperature and photoperiod indicated that temperature, day length, and reproductive state affected respiration. In general, respiration increased with temperature increase and decreased with temperature decrease. A zone of relative temperature independence of the respiratory rate was observed between 14.2 and 19.7 C. During the reproductive season, respiration remained high in contrast to the expected effect of long day lengths, suggesting an influence of reproductive hormones on the respiratory rate. An effect of photoperiod was seen only for a short interval following spawning. Seasonal acute respiration at 17.5 C showed the expected inverse relationship between acclimatization temperature and respiratory rate. This relationship was not observed at the onset of the reproductive season when respiration increased sharply. (ST)

<99>
Burns, J.R., The Reproductive Cycle and Its Environmental Control in the Pumpkinseed, LEPOMIS GIBBOSUS (Pisces: Centrarchidae).

1976. Copeia, No. 3, 449-455 (University of Massachusetts, Department of Zoology, Amherst, MA)

The seasonal cycle of gonadal development was studied in pumpkinseed, LEPOMIS GIBBOSUS, subject to natural temperatures and day lengths in a local pond. During late May, 1972, gonadal recrudescence in both males and females occurred, as indicated by an increase in the gonosomatic index and the appearance of spermatocytes in the testes and active vitellogenesis in the ovaries. During this time the pond temperature rose above 12.5 C, while the day length was near 15 hours. Laboratory experiments with fish exposed to controlled temperatures and photoperiods were performed. The results showed that a minimal temperature between 11.5 and 14.0 C was necessary for recrudescence in males, while one between 14.0 and 16.5 C was necessary for the females. However, the seasonal study indicated that the critical temperature for females is probably lower than 14.0 C. The critical photoperiod for both males and females was probably between 12.0 and 13.5 hrs. Since the critical day length was reached sooner than the increase in pond temperature above the critical level, it appears that temperature is the environmental factor controlling the timing of recrudescence in the spring. During the early post-spawning period temperatures and day lengths were still above the critical levels. However, no renewed gonadal activity was observed at this time, suggesting the existence of a post-spawning refractory period. (Auth)

<100>
Burton, D.T., S.L. Margrey, and L.B. Richardson, Effects of Power-Plant Entrainment Temperatures on Oxygen Consumption Patterns of Amphipods and Grass Shrimp.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Academy of Natural Sciences of Philadelphia, Benedict Estuarine Research Laboratory, Benedict, MD)

Oxygen-consumption patterns of the amphipod, GAMMARUS, and the grass shrimp, PALAEMONETES, were used to evaluate the potential effects of exposure to time-temperature changes simulating power-plant condenser entrainment. Base-line metabolism was determined at 5-min intervals for 90 min before thermal exposure. Exposure consisted in (1) a rapid 5 deg C thermal increase, (2) a 4-min exposure at the elevated temperature, and (3) a 15-min decay back to ambient temperatures. Oxygen-consumption measurements were then

<100> CONT.
continued at 15-min intervals for 90 min to evaluate the organism's response to the thermal exposure. Oxygen-consumption patterns of GAMMARUS were studied at acclimation temperatures of 5, 15, and 25 C and of PALAEMONETES at 5, 15, 25, and 30 C. Oxygen consumption (Q02) of GAMMARUS at all acclimation temperatures was significantly higher than pre-exposure levels for 30 min following thermal exposure but returned to initial levels within 45 min. No changes occurred in (Q02) patterns of PALAEMONETES at any acclimation temperature. Although differences in species response patterns occurred, this study shows that both species should be able to tolerate the time-temperature exposure used in the study during entrainment through a once-through low-delta T steam electric generating plant. (Auth)

<101>
Burton, D.T., L.B. Richardson, S.L. Margrey, and P.R. Abell, Effects of Low Delta T Powerplant Temperatures on Estuarine Invertebrates.

1976. Jour. Water Poll. Control Fed., 48, 2259-2272 (Academy of Natural Sciences of Philadelphia, Benedict Estuarine Research Labcratory, Benedict, MD)

The study was initiated to access thermal impact that may occur to estuarine macroinvertebrates entrained through low delta T (5 C maximum) steam-electric generating stations with once-through cooling systems designed for rapid mixing in receiving streams. The macrocrustaceans studied were the gammarid amphipod, GAMMARUS sp.; grass shrimp, PALAEMONECTES sp.; opossum or mysid shrimp, NEOMYSIS AMERICANA; juvenile blue crab, CALLINECTES SAPIDUS; and mud crab, RHITHROPANOPEUS HARRISII. The time-temperature model used in this study did not cause any immediate or latent mortality of any species at the seasonal temperatures studied; therefore, the question of sublethal thermal stress was addressed by using changes in whole animal oxygen consumption patterns as an indicator of stress. Although some species responded by a significant increase in oxygen consumption when exposed to the time-temperature model, the response was determined to be a normal physiological temperature compensation response and not a response indicative of thermal stress. This study suggests that thermal impact to estuarine macroinvertebrates entrained through low delta T power plants with once-through cooling systems designed for rapid mixing in receiving streams should be minimal and should therefore allow utilities to meet many current federal and state discharge temperature regulation requirements. (Auth) (ST)

<102>
Busdosh, M., and R.M. Atlas, Response of Two Arctic Amphipods, GAMMARUS ZADDACHI and BOECKOSIMUS (ONISIMUS) AFFINIS, to Variations in Temperature and Salinity.

1975. Jour. Fish. Res. Bd. Can., 32, 2564-2568 (University of Louisville, Department of Biology, Louisville, KY)

GAMMARUS ZADDACHI and BOECKOSIMUS AFFINIS were capable of tolerating a wide range of temperatures and salinities. They were tolerant to both abrupt changes, as would occur in crossing a thermocline, and to gradual changes, as would occur seasonally. GAMMARUS ZADDACHI could survive lower salinities and higher temperatures than BOECKOSIMUS AFFINIS. At 5 and 15 C B. AFFINIS survived sudden salinity changes from the maintenance condition of 30 ppt up to 50 ppt and down to 4 ppt. BOECKOSIMUS AFFINIS tolerated the abrupt temperature change from 5 up to 15 C, but not to 25 C. BOECKOSIMUS AFFINIS also survived freezing at -2 C for 36 hr; longer periods of freezing resulted in complete mortality. At 5 and 15 C G. ZADDACHI survived abrupt salinity changes from the maintenance 10 ppt up to 30 ppt and down to 2 ppt. At 25 C the upper limit for survival was also 30 ppt, but the lower limit was 4 ppt. GAMMARUS ZADDACHI C survived sudden temperature changes from 5 up to 25 C. When salinities were gradually changed at 5 ppt per day at 5.4 C, both species of amphipods were able to survive higher salinities than in the sudden change experiments. Both species were tolerant of higher temperatures when change was a gradual 3 C/12 hr. At salinities of 5 to 30 ppt, B. AFFINIS survived temperatures up to 28 C, at 40 ppt up to 23 C, and at 50 ppt up to 15 C. GAMMARUS ZADDACHI tolerated temperatures up to 33 C at salinities of 5 to 20 ppt, up to 30 C at 30 ppt, and up to 12 C at 40 to 50 ppt. Both species were thus able to tolerate higher temperatures at lower salinities. The respiration rate of G. ZADDACHI increased as temperature increased, but temperature had no significant effect on the respiration rate of B. AFFINIS. The ecological distribution of these amphipods appears to be in part determined by their ability to tolerate fluctuations in salinity and temperature. (ST)

<103>
Buss, D.F., An Environmental Study of the Ecological Effects of the Thermal Discharge from the Point Beach Nuclear Plant.

1975. Trans. Amer. Nuclear Soc., 22, 640 (Summary) (Limnetics, Inc., Milwaukee, WI)

From November 1972 through October 1974 the Point Beach Nuclear Power Plant was studied to determine its impact on Lake Michigan. Thermal plumes were characterized with respect to size, direction, temperature gradients, heat dissipation, entrainment, and dissolved gas concentrations. Thirty-seven chemical parameters were analyzed to determine if once-through cooling affected natural lake conditions. The natural lake variability of chemical parameters among areas was usually high on a monthly basis. Copper concentrations were generally higher in the discharge than at the intake and iron, manganese, and aluminum concentrations were generally higher at the control area than at the discharge. Biological data were interpreted in conjunction with physical and chemical data and the following major conclusions were drawn: (1) There was a high variability in plankton numbers between the plume and control areas. Differences in plankton distribution are indicative of the high natural variability in the inshore zone of Lake Michigan. (2) The average net percent mortality of total zooplanton passing through the condensers ranged from 6 to 11%. (3) Fish in the Point Beach area were in average or better than average condition than fish in other areas of the Great Lakes. (4) During the 1972-1973 study, brown trout were attracted to the plume in spring and summer. More brook and brown trout were collected in the plume during November 1973 through October 1974. (5) No external signs of gas bubble disease were observed on any fish.

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<103> CONT.
(6) White sucker eggs in the eyed stage were not adversely affected by condenser passage with a temperature increase of 8.9 C. (7) Alewife and smelt were the predominant species of fish impinged on debris screening devices. Following extensive empirical and statistical analysis of the data, it was concluded that there were no effects of ecological importance caused by the cooling water discharge from the Point Beach Nuclear Plant. (Auth) (ST)

<104>
Butler, P.J., and E.W. Taylor, The Effect of Progressive Hypoxia on Respiration in the Dogfish (SCYLIORHINUS CANICULA) at Different Seasonal Temperatures.

1975. Jour. Exp. Biol., 63, 117-130 (University of Birmingham, Department of Zoology and Comparative Physiology, Birmingham, England)

Dogfish were acclimated to 7, 12 or 17 C and exposed to progressive hypoxia at the temperature to which they had been acclimated. During normoxia, the Q10 values for oxygen uptake, heart rate, cardiac output and respiratory frequency over the full 10 C range were: 2.1, 2.1, 2.1 and 2.5 respectively. Increased acclimation temperature had no effect on cardiac stroke volume or systemic vascular resistance, although there was a decrease in branchial vascular resistance, pHa and pHv. Progressive hypoxia had no effect on heart rate or oxygen uptake at 7 C, whereas at 12 C and 17 C there was bradycardia, and a reduction in O2 uptake, with the critical oxygen tension for both variables being higher at the higher temperature. Cardiac stroke volume increased during hypoxia at each temperature, such that cardiac output did not change significantly at 12 and 17 C. Neither pHa nor pHv changed significantly during hypoxia at any of the three temperatures. The influence of acclimation temperatures on experimental results from poikilotherms is pointed out. Previously-published results show quantitative differences. (Auth)

<105>
Cable, W.D., and W.S. Landers, Development of Eggs and Embryos of the Surf Clam, SPISULA SOLIDISSIMA, in Synthetic Seawater.

1974. Fish. Bull., 72, 247-249 (NOAA, National Marine Fisheries Service, Middle Atlantic Coastal Fisheries Center, Milford Laboratory, Milford, CT)

The development of eggs and embryos of the surf clam, SPISULA SOLIDISSIMA, was observed at salinities of 25 and 30 ppt and at 10, 15, and 20 C. Within these ranges 20 C was found to be the optimum temperature for development with almost 100% survival. At 20, 15, and 10 C development to the straight-hinge stage took less than 24 hr, more than 24 hr, and more than 96 hr, respectively. At 10 C the rate of development of all stages was greatly retarded and many abnormal embryos were present. Clams conditioned at 15 C in the laboratory spawned when the temperature was raised to 18 to 20 C. (ST)

<106>
Cadwallader, P.L., Breeding Biology of a Non-Diadromous Galaxiid, GALAXIAS VULGARIS Stokell, in a New Zealand River.

1976. Jour. Fish Biol., 8, 157-177 (University of Canterbury, Zoology Department, Christchurch, New Zealand)

GALAXIAS VULGARIS spawned in the Glentui River, New Zealand, in late winter and early spring. Onset of spawning appeared to be temperature-dependent, with spawning occurring first in the warmer parts of the river. Spawning occurred when both water temperatures and photoperiod were increasing. (ST)

<107>
Cain, R.L., and J.M. Dean, Annual Occurrence, Abundance and Diversity of Fish in a South Carolina Intertidal Creek.

1976. Marine Biol. (W. Ger.), 36, 369-379 (University of South Carolina, Belle W. Baruch Institute for Marine Biology and Coastal Research and the Department of Biology, Columbia, SC)

An intertidal creek in North Inlet Estuary, South Carolina was sampled monthly for one year to determine the occurrence, abundance, and diversity of fish species. Analysis of variance revealed that season had a highly significant effect on all indices and the number of species, but had no effect on the number of individuals caught. Diversity appeared to be correlated with annual temperature cycles. Six of the most numerous species (white mullet, spot, silver perch, spotfin mojarra, and two species of anchovies) disappeared or were sharply reduced in number by November, when the temperature dropped below 20 C. (ST)

<108>
Cairns, J., Jr., Heated Waste-Water Effects on Aquatic Ecosystems.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (Virginia Polytechnic Institute and State University, Biology Department and Center for Environmental Studies, Blacksburg, VA)

Subtle perturbations of aquatic ecosystems caused by heated waste-water discharges are difficult to document; but the prospects for determining acute gross changes in aquatic community structure are excellent. Three case histories are discussed, including an example where corrective action "reversed" a structural change. Use of cluster analysis and other techniques should allow the detection of long-term chronic changes in structure despite natural variability and successional processes. Although functional assessments are available (e.g., nutrient and energy transfer), more studies of the effects of pollution on function are needed to increase their utility. Examination of biological and ecological information redundancy is also essential to increase the cost effectiveness of the datagathering process. Three criteria important in determining whether a system can assimilate heated waste-water discharges without being degraded are: (1) elasticity, the ability to recover from damage, (2) inertia, the ability to resist displacement, and (3) resiliency, the number of times a system can snap back after displacement. (Auth) (ST)

<109>
Cairns, J., Jr., and K.L. Dickson, Ecological Design Parameters for Assessing the Impact of

<109> CONT.
Heated Waste Water Discharges.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Virginia Polytechnic Institute and State University, Biology Department and Center for Environmental Studies, Blacksburg, VA)

Ecological design parameters for assessing the impact of heated waste water discharge on aquatic systems are discussed. Preliminary site evaluations should include the determination of the ability of the ecosystem to resist pollutional stress, determination of the ability to recover from pollutional displacement, an ecological baseline survey and evaluation of heated discharge effects on community structure, and evaluations of the temperature requirements of important aquatic species based on both laboratory and field studies. (ST)

<110>
Cairns, J., Jr., A.G. Heath, and B.C. Parker, The Effects of Temperature upon the Toxicity of Chemicals to Aquatic Organisms.

1975. Hydrobiologia (Den.), 47, 135-171 (Virginia Polytechnic Institute and State University, Department of Biology and Center for Environmental Studies, Blacksburg, VA)

Little information on the effects of temperature changes on chemical toxicity to aquatic organisms is available. Field data on this relationship is almost non-existent. Laboratory studies are reviewed in order to help develop water quality management programs for steam-electric power plants. Types of organisms and toxicants (ammonia, cyanide, trace metals, pesticides, chlorinated hydrocarbons, organophosphorus compounds, herbicides, phenols, chlorine, and synthetic detergents) are considered individually. (ST)

<111>
Cairns, J., Jr., D.I. Messenger, and W.P. Calhoun, Invertebrate Response to Thermal Shock Following Exposure to Acutely Sub-Lethal Concentrations of Chemicals.

1976. Arch. Hydrobiol. (Ger.), 77, 164-175 (Virginia Polytechnic Institute and State University, Biology Department, Blacksburg, VA)

Three species of snails (GONIOBASIS LIVESCENS, PHYSA INTEGRA, and LYMNAEA EMARGINATA) were exposed to acutely sub-lethal concentrations (0.2 x 48 hour LC50) of chromium, chlorine, cyanide, copper, lead, phenol, zinc, and acetic acid. They were then exposed to heat shock (temperature raised from 24 to 36.5 C for G. LIVESCENS and P. INTEGRA and 24 to 38 C for L. EMARGINATA) both (1) in water with no sub-lethal concentration of the aforementioned chemicals and (2) water with sub-lethal concentration. Controls were also set up in the same fashion. All three snail species tested had significantly higher heat shock mortality when they had been exposed to certain chemicals. However, the degree of response may vary considerably both among species and among toxicants. (Auth)

<112>
Campbell, E., and J.N.R. Grainger, The Effect of Temperature on Size and Structure. II. The Body Musculature of CYCLOPS AGILIS (Koch, Sars).

1975. Proc. Royal Irish Acad., 75, 391-399 (Trinity College, Department of Zoology, Dublin, Ireland)

Different rearing temperatures (10, 15 C and 25 C) affected the diameter of the body muscle fibres of adult CYCLOPS AGILIS. Minimum fibre diameter, fibre cross-sectional area and minimum mitochondrial width were largest in CYCLOPS grown at 15 C and smallest in CYCLOPS grown at 25 C. The fibres from 15 C- reared CYCLOPS contained proportionally more myofibrils than those reared at 25 C and also the myofibrils had a larger cross sectional area. The spacing of the myofilaments was remarkably constant at all rearing temperatures which means that there is most contractile material in muscles from the 15 C- reared CYCLOPS. Sarcomere length and A-band length were constant. No difference in fibre number was found in leg muscles of 15 and 25 C reared CYCLOPS. Muscle nuclei from 10 C- reared animals were significantly smaller than at other rearing temperatures. The ratio of mitochondrial cross sectional area to fibre cross sectional area was similar in muscles from 15 and 25 C-reared CYCLOPS. (Auth)

<113>
Carpenter, E.J., B.B. Peck, and S.J. Anderson, Summary of Entrainment Research at the Millstone Point Nuclear Power Station, 1970-1971.

1974. PB-240 758; EPRI-74-049-00-5; Electric Power Research Institute Cooling Water Studies Report No. 15; In Jensen, L.D. (Ed.), Proceedings of the Second Entrainment and Intake Screening Workshop held at Johns Hopkins University, Baltimore, Maryland, February 5-9, 1973. National Technical Information Service, Springfield, VA (Woods Hole Oceanographic Institution, Woods Hole, MA)

Copepod mortality at the Millstone Point plant was affected primarily by the mechanical or hydraulic stresses of entrainment. About 70% of the copepods entering the power plant were not returned to Long Island Sound. This could represent a loss of approximately 0.1% to 0.2% of the secondary productivity over a 333 km3 area of the Sound. During the cooler months phytoplankton productivity was usually increased by 5 to 25% over that at the intakes due to warming during entrainment. When intake water temperatures were above 10 to 15 C, productivity decreased by about 50 to 95%. Chlorination, when applied, decreased primary productivity by about 80%. Chlorine concentrations too low to kill fouling organisms produced essentially the same decrease in production as normal dosages. Preliminary data on fish larvae showed that 18 species are entrained. (ST)

<114>
Catlett, R.H., and D.R. Millich, Intracellular and Extracellular Osmoregulation of Temperature Acclimated Goldfish: CARASSIUS AURATUS L..

1976. Comp. Biochem. Physiol., 55A, 261-269 (University of Colorado, Department of Biology, Colorado Springs, CO)

Goldfish were acclimated to temperatures ranging from 21.5 to 1 C. Acclimation to near freezing temperatures caused a reduction

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<114> CONT.
in plasma osmolality due to decreased organic solutes as well as reduced plasma inorganic ions. Plasma Na+ concentration decreased in lower temperatures; plasma Cl- did not. Red blood cell response to decreased plasma osmolality included phases: osmotic swelling followed by cellular shrinkage. Cellular shrinkage resulted from efflux of KCl and water. The overall response is an example of isosmotic intrcellular regulation achieved by adjusting osmotically active particles. (Auth)

<115>
Caulton, M.S., Diurnal Movement and Temperature Selection by Juvenile and Sub-Adult TILAPIA RENDALLI Boulenger (Cichlidae).

1975. Trans. Rhod. Sci. Assoc., 56, 51-56 (University of Rhodesia, Hydrobiology Research Unit, Salisbury, Rhodesia)

The diurnal inshore movement of young TILAPIA RENDALLI was investigated on an exposed gradient shoreline. The juvenile and sub-adult fish moved from the homothermal 2 m deep lake water (temperature 22 C) into shallow margins (10 cm deep) when this water exceeded a temperature of 22 to 23 C. A peak, shallow water, fish population density was reached at midday or at a temperature of 28 to 31 C. Similarly, at night when the marginal waters become cooler than the homothermal lake water, the fish again move in a response to this temperature change seeking the warmest water, which at night was in excess of 2 m deep. Rain, cloud or wind was sufficient stimulus to initiate a temporary movement away from the shore. TILAPIA RENDALLI had a temperature preferendum of 37 C and the sub-adults a preferendum between 35 and 36.5 C. Fry of the same species showed no distinct temperature preference and were present in water up to 41 C. This work is briefly discussed in terms of this movement being food or predator induced and a physiological adaptation to growth. (Auth)

<116>
Cech, J.J., Jr., and D.E. Wohlschlag, Summer Growth Depression in the Striped Mullet, MUGIL CEPHALUS L..

1975. Contrib. Marine Sci., 19, 91-99 (University of Texas Marine Science Institute, Port Aransas, TX)

Growth rates by scale analysis of MUGIL CEPHALUS taken from south Texas coastal waters throughout one year showed two major periods of slow growth. The period of slowest growth, followed by annulus formation, occurred during the colder late autumn and winter months. Another major growth depression occurred during the summer when food availability to the mullet should be maximal. Optimal growth rates for Age I and older fish were in spring and briefly in early autumn. The optimal temperature range for maximum growth and metabolism appeared to be about 20 to 25 C; however, the thermal acclimatizational history of the fish was unknown. (Auth) (ST)

<117>
Chadwick, H.E., Entrainment and Thermal Effects on a Mysid Shrimp and Striped Bass in the Sacramento-San Joaquin Delta.

1974. PB-240 758; In Jensen, L.D. (Ed.), Proceedings of the Second Entrainment and Intake Screening Workshop held at Johns Hopkins University, Baltimore, Maryland, February 5-9, 1973. National Technical Information Service, Springfield, VA (California Department of Fish and Game, Stockton, CA)

Experimental studies designed to evaluate the effect of thermal discharges in terms of short-term temperature shock and long-term exposure to elevated temperatures on NEOMYSIS and striped bass are described. At ambient temperatures of 7.8 and 10 C, temperature shocks (delta T's) of 15 and 18.8 C resulted in a maximum mortality of 12% for NEOMYSIS. For striped bass survival was 90% at delta T's up to 10 C when the maximum temperature did not exceed 32.2 C. Thus NEOMYSIS and striped bass entrainment losses due to thermal shock would appear to be minimized when maximum temperatures were below 30 C for the 0- to 6- min exposure durations tested. Long-term experiments indicated that the estimated upper lethal temperatures for NEOMYSIS and striped bass estimated as percentage of control survival, were 25.4 C and greater than 29.4 , respectively. (Auth) (ST)

<118>
Chansang, H., Growth Physiology and the Glucose Transport System of a Pennate Diatom, AMPHORA COFFEAFORMIS var PERPUSILLA.

1975. Ph.D. Thesis, University of Miami (University of Miami, Coral Gables, FL)

Effects of temperature, pH, growth factors and organic compounds on AMPHORA COFFEAEFORMIS were investigated. Cells grew best at 27 C and at a pH between 7.7 and 8.4. (ST)

<119>
Charenkova, H.A., A.A. Mihailov, V.V. Pinevitch, and N.N. Verziline, Effect of Extreme Temperatures on Growth of the Blue-Green Alga SPIRULINA PLATENSIS (Gom) Geitler.

1975. Dokl. Bolg. Akad. Nauk, (Bulg.), 28, 799-802 (University of Leningrad, Institute of Biology, Leningrad, USSR)

The reactions of SPIRULINA PLATENSIS to exposures to the superoptimal temperatures, 45 and 50 C, and the subsequent growth of the cultures were studied. The cultures were exposed to a temperature of 45 C for 10, 20, 30 min and 2, 12, and 24 hr periods and to 50 C for 2,5,10 and 20 min. Growth was not affected by exposures to 45 C. However, exposures of 5, 10 and 20 min duration to 50 C resulted in irreversible inhibition of growth and mass disintegration of the trichomes into groups of cells took place. After a few hrs, they were completely destroyed. When exposed to 50 C for 2 min only, some of the trichome cells were ruptured and growth was suspended for 12 hr. During the subsequent 12 hr, growth continued at a reduced rate. Twenty-four hrs after the treatment, growth was again normal. (ST)

<120>
Cheetham, J.L., C.T. Garten, Jr., C.L. King, and M.H. Smith, Temperature Tolerance and Perference of Immature Channel Catfish (ICTALURUS PUNCTATUS).

1976. Copeia, No. 3, 609-612 (Savannah River Ecology Laboratory, Aiken, SC)

<120> CONT.
Hatchery-reared immature channel catfish were acclimated to temperatures of 12, 16, 20, 24, 28, and 32 C and tested for thermal tolerance by estimating the critical thermal maximum (CTM) and death Point (DP). Temperature preference in a gradient apparatus was also measured. Acclimation temperature was the only significant source of variation in an analysis of variance of CTM, DP, and thermal preference data among the different acclimation temperature groups. A graph of mean CTM versus acclimation temperature suggests a curvilinear relationship, but a linear relationship between these variables was highly significant. In the thermal gradient, fish consistently chose temperatures higher than their acclimation temperature if they were acclimated at 12, 16, 20, or 24 C. At 28 C fish selected a temperature of 26 C and at 32 C they selected 30 C. Attempts to acclimate fish at 36 C resulted in 100% mortality. (ST)

<121>
Cherry, D.S., R.K. Guthrie, J.H. Rodgers, Jr., J. Cairns, Jr., and K.L. Dickson, Responses of Mosquitofish (GAMBUSIA AFFINIS) to Ash Effluent and Thermal Stress.

1976. Trans. Amer. Fish. Soc., 105, 686-693 (Virginia Polytechnic Institute and State University, Center for Environmental Studies, Blacksburg, VA; University of Texas, School of Public Health, Houston, TX)

Mosquitofish, the only fish species inhabiting a drainage system that received high coal ash concentration at one end and thermal discharges at the other, appeared to successfully function in this environment with no apparent deterimental effects. Temperature conditions (44.5 C) were more limiting to the species' functional capacity than was coal ash turbidity (275 JTU) with high metal concentrations. Laboratory preference, avoidance, and lethal temperature trials supported the field observations. Mosquitofish had a final temperature preferendum at 34.7 to 35.1 C (both individual and group response), an upper temperature avoidance at 39 C when acclimated at 30 and 36 C, and an upper lethal temperature limit at 38 C. The species survived in this aquatic system in which elemental concentrations, determined by neutron activation analysis, were sufficiently high to be lethal to other fish species according to values from the literature and by in situ toxicity tests. Of the 40 elements measured, five (calcium, chlorine, selenium, zinc, and bromine) appeared to be concentrated by the mosquitofish, while the others were most highly accumulated in the benthic sediments. (Auth)

<122>
Chesney, E.J., Jr., and J.I. Estevez, Energetics of Winter Flounder (PSEUDOPLEURONECTES AMERICANUS) Fed the Polychaete, NEREIS VIRENS, under Experimental Conditions.

1976. Trans. Amer. Fish. Soc., 105, 592-595 (Woods Hole Oceanographic Institution, Department of Biology, Woods Hole, MA; Instituto Espanol de Oceanografia, Laboratorio de Vigo, Vigo, Spain)

Age class I and II winter flounder, PSEUDOPLEURONECTES AMERICANUS, were fed the polychaete, NEREIS VIRENS, under experimental temperatures of 10 and 20 C in a filtered, temperature-regulated seawater system for periods of 40 days. All the fish grew and there was no significant difference in growth between fish at 10 C and those at 20 C, but growth was significantly different between age classes at both temperatures. Age I fish had the higher growth efficiency. Mean gross growth efficiencies based on calories were 23.7% and 20.2% for age I and II, respectively. Calculated efficiencies were lowest based on wet weight and generally increased when based on dry weight, carbon, and caloric content. (Auth)

<123>
Chew, R.L., Early Life History of the Florida Largemouth Bass.

1974. Fish. Bull., 72, 76 p. (Florida Fish and Game Commission, Tallahassee, FL)

The early life history of the Florida largemouth bass, MICROPTERUS SALMOIDES FLORIDANUS, was investigated in two environmentally different lakes, Lakes Weir and Hollingsworth, over a three year period. The initial bass spawn in Lake Weir occurred during late January and early February at temperatures of 15 to 15.5 C. Peak spawning activity occurred during March at 15.5 to 18 C. The more eutrophic, shallower, warmer Lake Hollingsworth had little or no bass reproduction from 1965 through 1968. Most rapid growth occurred in late summer and fall and was related to both temperature and feeding habits. Fast and slow growth periods in the two lakes were comparable. (ST)

<124>
Chiang, Y.M., R. Huang, and H.M. Su, The Uptake of Zn-65 by Marine Benthic Algae.

1974. Acta Oceanogr. Taiwan, No. 4, 241-248 (National Taiwan University, Institute of Oceanography, Taipei, Taiwan, China)

Three species of marine benthic algae, ULVA sp., ENTEROMORPHA LINZA, and SARGASSUM sp. collected from the coast of Taiwan were studied for their uptake of Zn-65. The uptake rate of Zn-65 varied with light intensity, temperature, and species. The maximum rate of uptake was during the first hour of study in light intensity of greater than 2600 lux, but the rate decreased gradually with time. The concentration factor was higher in ENTEROMORPHA LINZA than in SARGASSUM sp. The concentration factor also varied with salinity. (Auth) (ST)

<125>
Chin, P., Acclimation and Metabolic Attitude of NEOMYSIS AWATSCHENSIS.

1974. Publ. Mar. Lab. Pusan Fish. Coll. (Kor.), 7, 1-20 (Pusan Fisheries College, Marine Laboratory, Pusan, Korea)

The oxygen consumption of the mysid shrimp, NEOMYSIS AWATSCHENSIS, was studied at different temperatures and temperature-salinity combinations, and at different seasons of the year. Acclimation temperatures of 5 and 25 C affected the respiratory rate of male shrimp, but an intermediate temperature of 15 C had little effect. Cold temperature (7 C) affected the respiratory rate of females, but temperatures of 15 and 23 C had little affect. Oxygen consumption drastically decreased above 23 to 25 C. Respiratory rate and body chemical composition varied seasonally. (ST)

<126>

<126>
Chittenden, M.E., Jr., Present and Historical Spawning Grounds and Nurseries of American Shad, ALCSA SAPIDISSIMA, in the Delaware River.

1976. Fish. Bull., 74, 343-352 (Texas A&M University, Department of Wildlife and Fisheries Sciences, College Station, TX)

Spawning occurs from late May into July but mainly in a 3-wk period from late May to mid-late June. Spawning ends progressively later proceeding upstream. Light intensity seemed to regulate when spawning began each day. Fish selected shallow riffle areas in preference to pool habitat for spawning. Spawning behavior is described. Except for the most grossly polluted tidal water, spawning and nursery areas now extend throughout fresh water of the main Delaware and into the East and West branches. The most important spawning grounds and nurseries are now located from Port Jervis, N.Y., to Hancock, N.Y., and extend into the lower East Branch; this has probably been the case since 1910-20. There has been a fundamental upstream shift in the chief spawning grounds and nurseries since the decline of the Delaware River shad runs, because these historically extended downstream from about Delaware Water Gap, Pa., and included tidal water. Reasons for this shift suggest intrastream homing. Only a small proportion of the historical nursery now contributes to production. Nursery and spawning areas now contribute to production of adults in proportion to their distance from Philadelphia, Pa. The extent of the spawning and nursery area since about 1910-20 has probably expanded and contracted around a core area in the upper Delaware near Hancock. Future prospects of Delaware River shad are discussed. They depend upon water quality in the tidal area and the proposed Tocks Island dam. Extirpation of the remnant runs is a distince possibility. (Auth)

<127>
Christiansen, M.E., and J.D. Costlow, Jr., The Effect of Salinity and Cyclic Temperature on Larval Development of the Mud-Crab RHITHROPANOPEUS HARRISII (Brachyura: Xanthidae) Reared in the Laboratory.

1975. Marine Biol. (W. Ger.), 32, 215-221 (University of Oslo, Zoological Museum, Oslo, Norway; Duke University Marine Labcratory, Beaufort, NC)

Larvae of RHITHROPANOPEUS HARRISII were reared from hatching to the first or second crab stages in 11 combinations of salinities and cyclic temperatures (5, 20, and 30 ppt at 20 to 25 C, 25 to 30 C, and 30 to 35 C; 25 ppt at 20 to 25 C and 30 to 35 C). The larvae survived to the megalops and first crab stages in all salinities and cycles of temperature other than 5 ppt at 30 to 35 C. The best survival to the megalops (94%) and first crab (90%) stages occurred in 20 ppt, 20 to 25 C. In all combinations of salinities and temperatures there was a reduction in survival to the first crab stage. The duration of the larval stages was affected significantly by temperature, whereas the effect of salinity on the mean days from hatching to the first crab stage was not consistent at the different temperature cycles. Development to the first crab stage required the shortest time in 20 ppt, 30 to 35 C (mean 12.3 days), and the longest time in 5 and 35 ppt, 20 to 25 C (mean 22.6 days and 21.6 days, respectively). Megalops larvae reared in 35 ppt at all cycles of temperature, as well as larvae in 20 and 25 ppt, 30 to 35 C, showed a high percentage of abnormality, with the highest percentage occurring in 35 ppt, 30 to 35 C. It appears that larval development of R. HARRISII is strongly influenced by environmental factors and not solely related to genetic differences. (Auth)

<128>
Churikov, A.A., Features of the Downstream Migration of Young Salmon of the Genus ONCORHYNCHUS from the Rivers of the Northeast Coast of Sakhalin.

1975. Jour. Ichthyol., 15, 963-969 (All-Union Research Institute for Sea Fisheries and Oceanography (VNIRO), Moscow, USSR)

The downstream migration of coho salmon in the Bogataya River (USSR) began on June 26 and ended on August 5; the downstream migration of masu began on July 8 and ended on August 5. Migration began following the spring flood. Prevailing water temperatures during the migration were 9 to 12 C. (ST)

<129>
Clady, M.D., Influence of Temperature and Wind on the Survival of Early Stages of Yellow Perch, PERCA FLAVESCENS.

1976. Jour. Fish. Res. Bd. Can., 33, 1887-1893 (Cornell University, Department of Natural Resources, Ithaca, NY)

Survival from the egg to larval stage was estimated for the 1969-75 year-classes of yellow perch, PERCA FLAVESCENS, in Oneida Lake. Egg production was determined from mark-and-recapture estimates of adult stock and measurements of fecundity, and abundance of the resulting cohort was estimated from annual larval surveys. Early survival, which varied from 1.6 to 18.4% was correlated positively with temperature and negatively with wind. Two variables, mean daily air temperature during the 3 wk prior to the date the larvae attained a mean length of 8 mm and mean daily wind velocity for 4 wk prior to this date, accounted for 87% of the variability in survival of perch. Physical destruction and movement of eggs by high winds and greater mortality of prolarvae caused by low temperature could account for the 80% base mortality that occurred in all years. The low year-to-year variation in survival suggests that temperature and wind influenced year-class size through a complex of many relatively minor mortality factors, rather than through one catastrophic event. (Auth)

<130>
Claridge, P.N., and I.C. Potter, Oxygen Consumption, Ventilatory Frequency and Heart Rate of Lampreys (LAMPETRA FLUVIATILIS) During Their Spawning Run.

1975. Jour. Exp. Biol., 63, 193-206 (University of Bath, School of Biological Sciences, Claverton Down, Bath, England)

The standard rate of oxygen consumption, ventilatory frequency, and heart rate of adult LAMPETRA FLUVIATILIS were measured during the light phase of the photoperiod and at times correspondig to various stages in the upstream migration. All three parameters increased during the spawning run and at temperatures of 5, 9.5, and 16 C, but only in mature individuals were significant

<130> CONT.
differences found between sexes. The approach of sexual maturation was delayed at the lower temperature (5 C) and hastened by the higher temperature (16 C). Lampreys kept at 9.5 C in the laboratory from January developed secondary sexual characters in mid-April at approximately the same time as those found in the field. (ST)

<131>
Clark, P., J. Nybakken, and L. Laurent, Aspects of the Life History of TRESUS NUTTALLII in Elkhorn Slough.

1975. Calif. Fish & Game, 61, 215-227 (Moss Landing Marine Laboratories, Moss Landing, CA)

A two-year study of the reproductive cycle and growth rate of the gaper clam, TRESUS NUTTALLII, in Elkhorn Slough, Calif. indicated that the primary spawning time is from February to April, but that some reproduction probably occurs during every month of the year. Based on remeasurement of individually marked clams, a growth curve for clams up to 55 mm in shell lengths was also established. (Auth)

<132>
Clausen, C.D., and A.A. Roth, Effect of Temperature and Temperature Adaptation on Calcification Rate in the Hermatypic Coral PCCILLOPORA DAMICORNIS.

1975. Marine Biol. (W. Ger.), 33, 93-100 (Loma Linda University, Department of Biology, Loma Linda, CA)

Using Ca-45 incorporation into the coral skeleton as a measure of calcification rate, the effect of temperature on calcification rate was studied in the hermatypic coral, POCILLOPORA DAMICORNIS. Both immediate and long-term (adaptation) effects were investigated. Temperature has a marked effect on rate - an effect that varies depending on the temperature history of the coral (temperature adaptation occurs). POCILLOPORA DAMICORNIS showed both 27 and 31 C temperature optima, one or the other being dormant depending on the natural water temperature to which the coral was adapted. The two optimum temperatures may indicate two isoenzymes or two alternate metabolic pathways involved in the calcification process. (Auth)

<133>
Clayton, M.N., Complanate SCYTOSIPHON LOMENTARIA (Lyngbye) J. Agardh (Scytopiphonales: Phaeophyta) from Southern Australia: The Effects of Season, Temperature, and Daylength on the Life History.

1976. Jour. Exp. Mar. Biol. Ecol. (Neth.), 25, 187-198 (Monash University, Botany Department, Clayton, Victoria, Australia)

Cultures of the complanate form of the brown alga, SCYTOSIPHON LOMENTARIA, were initiated at different times of year and maintained in several temperature-daylength regimes to determine whether the progeny showed any seasonally-related pattern of morphological variation. The effects of temperatures between 11 and 20 C were subtle, and principally related to the rate of growth of cultured plants and not to the determination of particular stages in the life history. The relationship between the seasonal occurrence of complanate S. LOMENTARIA, its seasonal pattern of reproduction, and the effects of daylength on the life history are discussed. (ST)

<134>
Cloern, J.E., The Survival of Coho Salmon (ONCORHYNCHUS KISUTCH) Eggs in Two Wisconsin Tributaries of Lake Michigan.

1976. Amer. Midland Naturalist, 96, 451-461 (Washington State University, Department of Zoology, Pullman, WA)

Natural reproduction of coho salmon (ONCORHYNCHUS KISUTCH) in Little Scarboro and Fischer Creeks is limited by an unusually high mortality of eggs and preemergent embryos. Of approximately 1800 coho salmon eggs planted in six study redds within Fischer Creek (November 1972), none survived to hatching. The 1500 eggs planted in five study redds within Little Scarboro Creek produced 21 sac fry. Egg mortality was attributed to the low dissolved oxygen concentration and low velocity of the water and the extremely low mean water temperatures (2.83 and 2.67 C) of the creeks. Gravel shifts caused by variable stream flow in Fischer Creek may also be responsible for killing naturally deposited eggs there. (ST)

<135>
Colijn, F., and G. van Burrt, Influence of Light and Temperature on the Photosynthetic Rate of Marine Benthic Diatoms.

1975. Marine Biol. (W. Ger.), 31, 209-214 (University of Groningen, Biological Centre, Haren, Netherlands)

The influence of light and temperature on photosynthetic rate of marine benthic diatoms was investigated. Within a range of 0 to 20 C, the photosynthetic rate of AMPHIPRORA ALATA increased 10%/C. (ST)

<136>
Collins, N.C., R. Mitchell, and R.G. Wiegert, Functional Analysis of a Thermal Spring Ecosystem, with an Evaluation of the Role of Consumers.

1976. Ecology, 57, 1221-1232 (University of Toronto, Department of Zoology and Erindale College, Mississauga, Ontario, Canada; Ohio State University, Department of Zoology, Columbus, Ohio; University of Georgia, Department of Zoology, Athens, GA)

Low temperature (less than 40 C) alkaline thermal spring effluents in Yellowstone National Park support a benthic algal-bacterial mat fed upon by a single herbivorous brine fly (PARACOENIA TURBIDA), which in turn is consumed by a number of arthropod predators such as water mites, spiders, and a predaceous fly. A census of the entire spring ecosystem provided a framework upon which to integrate present knowledge of this system. It was found that consumers in the thermal spring ecosystem increased the net primary production of the system and increased the efficiency of energy transfer between the first and second trophic levels. They affected process but not prey densities in this system. (ST)

<137>
Colt, J., and G. Tchobanoglous, Evaluation of the Short-Term Toxicity of Nitrogenous Compounds to Channel Catfish, ICTALURUS PUNCTATUS.

<137>

<137> CONT.
1976. Aquaculture, 8, 209-224 (University of California, Department of Civil Engineering, Davis, CA)

The acute toxicity of un-ionized ammonia, nitrite, and nitrate to 50 to 76-mm fingerling channel catfish was investigated using a static bioassay system at 22, 26, and 30 C. The toxicity of un-oxidized ammonia appeared to decrease with increasing temperature. The toxicity of nitrous acid increased with increasing temperature while the toxicity of nitrite appeared to be independent of temperature. The incipient LC50 values for nitrate appeared to be independent of temperature, although the LT50 values were found to depend on temperature. The 96-hr LC50 values at 30 C for un-ionized ammonia, nitrite, and nitrate were 3.8, 44, and 6200 mg/l. (Auth) (ST)

<138>
Connell, J.H., On the Recovery of Perturbed Ecosystems.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (University of California, Department of Biological Sciences, Santa Barbara, CA)

The recovery of the species composition of an ecosystem, following different scales of perturbation, is discussed. Although a forest ecosystem is used as an example, the principles are applicable to benthic aquatic systems. (ST)

<139>
Cook, T.M., and C.K. Goldman, Bacteriology of Chesapeake Bay Surface Waters.

1976. Chesapeake Sci., 17, 40-49 (University of Maryland, Department of Microbiology, College Park, MD)

Selected bacterial counts were monitored at two sites in Chesapeake Bay. During autumn cooling (September 1971 through December 1971) at the off-shore site, the total viable count of the heterotrophic bacterial population fell only slightly, but the population changed in composition. The proportion of some fermentative organisms, H2S producers, and VIBRIO PARAHAEMOLYTICUS decreased markedly while coliform densities did not. The spring warm-up (March 1972 through June 1972) was accompanied by rising total viable counts that peaked at a water temperature of 19 C on May 30. H2S producers remained constant during early spring and then also increased to maximum levels at 19 C. The fermenter population increased greatly during the warm-up and reached maximum densities on May 5 before the total viable count peak. VIBRIO PARAHAEMOLYTICUS remained undetectable until the water temperature reached 21 C on June 12. Results at the in-shore site were similar. (Auth) (ST)

<140>
Corkett, C.J., and E.J. Zillioux, Studies on the Effect of Temperature on the Egg Laying of Three Species of Calanoid Copepods in the Laboratory (ACARTIA TONSA, TEMORA LONGICORNIS and PSEUDOCALANUS ELONGATUS).

1975. Bull. Plankton Soc. Jap., 21, 13-21 (Dalhousie University, Department of Biology, Halifax, Nova Scotia, Canada; Rosentiel School of Marine and Atmospheric Science, University of Miami, Miami, FL)

A study of egg production in artificial sea salt over a range of temperature showed that the rate of egg production in the sac-carrying copepod PSEUDOCALANUS ELONGATUS was lower than that found in ACARTIA TONSA and TEMORA LONGICORNIS, which lay single eggs. It is suggested that carrying eggs attached to the females in sacs may limit the maximum egg production rate since a new sac cannot be laid until the old one hatches. Temperatures ranging from 1.3 to 16.2 C did not significantly affect the number of eggs in sacs laid by PSEUDOCALANUS ELONGATUS. Average number of eggs produced per female per day ranged from 0.7 to 3.4. At temperatures of 4.1, 9.5 and 15.4 C, TEMORA LONGICORNIS females laid an average of 4.7, 7.6, and 17.3 eggs per day, respectively. At temperatures of 0.2, 3.9, 10.5, and 20.2 C, ACARTIA TONSA females laid an average of 0, 1.6, 15.6, and 18.4 eggs per day, respectively. (Auth) (ST)

<141>
Cossins, A.R., and K. Bowler, Resistance Adaptation of the Freshwater Crayfish and Thermal Inactivation of Membrane-Bound Enzymes.

1976. Jour. Comp. Physiol., 111, 15-24 (University of Durham, Department of Zoology, Durham City, England)

The inactivation at high temperatures of a membrane-bound enzyme, the Ca(+2)-stimulated ATPase of crayfish (AUSTROPOTAMOBIUS PALLIPES) abdominal muscle sarcoplasmic reticulum, and the effect of thermal acclimation upon the inactivation kinetics were investigated. In the absence of KCl, the Ca(+2)-stimulated ATPase was irreversibly inactivated with pseudo-first order kinetics at temperatures that cause heat death in the whole animal. 0.1 to 10.0 mM KCl resulted in slower inactivation, while 100 mM KCl activated the enzyme to 120 to 180% of its original activity. Enzyme activation by KCl and heat involved a shift in the enzyme concentration/activity curve. Thermal acclimation (4 and 25 C) had no significant effect upon the kinetics or Arrhenius activation energy for enzyme inactivation. (Auth) (ST)

<142>
Coste, M., The Proliferation in the Seine of a Tropical Benthic Diatom: NAVICULA CONFERVACEA (Kutz.) Grunow.

1975. Ann. Limnol., 11, 111-123 (Laboratoire d'Hydroecologie, Division Qual. Eaux, P. Pisc. C.T.G.R.E.F., Paris, France)

This study of the benthic populations in the Seine was based on more than 250 samples taken at 39 stations which were regularly distributed between the source and Rouen. It was possible to locate the site at which there was proliferation of a benthic diatom, usually considered as endemic to the tropics, and this site was immediately downstream from a thermal power station. The morphology, ultrastructure and geographical distribution of this species are briefly examined. The ecological data and the information in the literature suggests that NAVICULA CONFERVACEA is a saprophytic species which is resistant to pollution and a stenotherm in hot water (25 to 31 C). (Auth)

<143>
Courtois, L.A., Respiratory Responses of GILLICHTHYS MIRABILIS to Changes in Temperature, Dissolved Oxygen and Salinity.

1976. Comp. Biochem. Physiol., 53A, 7-10 (Water Pollution Control Laboratory, Department of Fish and Game, Rancho Cordova, CA)

The respiratory rate of the goby, GILLICHTHYS MIRABILIS, increased with increasing temperature (11.0, 15.0, 20.0, 24.4, and 28.6 C), decreased with decreasing ambient oxygen, and remained relatively constant over a wide range of salinities (14.8, 26.0, 55.8, and 65.2 ppt). (Auth) (ST)

<144>
Courtois, L.A., Hematology of Juvenile Striped Bass, MORONE SAXATILIS (Walbaum), Acclimated to Different Environmental Conditions.

1976. Comp. Biochem. Physiol., 53A, 1-3 (Department of Fish and Game, Water Pollution Control Laboratory, Rancho Cordova, CA)

The physiological acclimation of striped bass to the environmental variables of temperature and salinity were studied. Increased temperature appeared to cause reverse effects in fresh- and saltwater-acclimated fish. Freshwater-acclimated bass at 17.5 C displayed significantly lower plasma protein levels compared to bass acclimated to 10.5 C. The reverse situation occurred in saltwater-acclimated fish. Cold-acclimated saltwater fish displayed significantly lower plasma protein levels than the group acclimated to 17.5 C saltwater. The 10.5 C freshwater-acclimated fish had significantly reduced serum Na+ compared to the warm-acclimated fish. The cold salt water-acclimated fish displayed an elevated serum Na+ compared to the warm saltwater fish. These physiological adaptations to environmental influences were discussed in the light of osmoregulation, preparation for migration, and reproduction. (ST)

<145>
Coutant, C.C., How to Put Waste Heat to Work.

1976. Environ. Sci. & Technol., 10, 868-871 (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

Technical and social issues associated with the cooling process of power plants are discussed. In addition to thermal pollution, sources of ecological damage are entrainment and impingement and cooling towers. Impact assessment of damage to ecosystems encompasses several successive steps: Identification of the source of potential biological damage, probability of involvement, probability of direct biological damage, probability of population damage, probability of community and ecosystem damage, and probability of social impact. In developing regulatory restrictions an understanding of the local conditions of the receiving system is necessary. Multipurpose cooling lakes, thermal aquaculture, and greenhouse heating are suggested productive uses of waste heat. (ST)

<146>
Coutant, C.C., Physiological Considerations of Future Thermal Additions for Aquatic Life.

1974. In Institute de la Vie World Conference, "Toward a Plan of Actions for Mankind: Needs and Resources - Methods of Prevision", Session on "Biological Balance and Thermal Modifications: Strategy for the Future", held in Paris, France, September 9-14, 1974. (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

This paper summarizes some of the known physiological responses of aquatic organisms, especially fish, to temperature and temperature changes. These responses can provide a basis for future actions regarding thermal effluents in three areas: (1) providing suitable water quality in natural environments to sustain populations of desirable wild species, (2) developing multiple-use power plant cooling reservoirs that can provide intensive fishing for warm-water species, and (3) intensifying food production through productive use of power plant waste heat for aquaculture. Particularly important are those physiological measures which define the optimum and and limiting conditions for survival, reproduction, growth and development. (Auth)

<147>
Coutant, C.C., Impact of Power Plants on Aquatic Systems: A Social Perspective.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

The current legal aspects concerning the aquatic effects of power plants are characterized and some conclusions concerning planning for aquatic research are drawn. The difficulty in complying with Public Law 92-500 and EPA provisions with the present level of technical data on aquatic effects is pointed out. (ST)

<148>
Coutant, C.C., and D.K. Cox, Growth Rates of Subadult Largemouth Bass at 24 to 35.5 C.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

Subadult largemouth bass, MICROPTERUS SALMOIDES, weighing 26 to 243 g were held at 13 temperatures from 24.0 to 35.5 C Bass were fed live adult fathead minnows, PIMEPHALES PROMELAS, ad libitum and weighed at weekly intervals to determine growth rates. Growth was fastest at 25 to 28 C, and zero growth was near 35.5 C. The temperature of zero growth was about 1.0 C less than the ultimate incipient lethal temperature reported in the literature. (Auth)

<149>
Coutant, C.C., D.K. Cox, and K.W. Moored, Jr., Further Studies of Cold-Shock Effects on Susceptibility of Young Channel Catfish to Predation.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at

<149> CONT.
Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

Previous experiments indicated that rapid temperature decreases of greater than approximately 6 C tend to increase the susceptibility of juvenile channel catfish (ICTALURUS PUNCTATUS) to predation by adult largmouth bass. This report presents confirmatory results with another stock of catfish and different predators. The rate of cooling is also shown to influence this measure of temperature stress. Cooling rates slower than 1.5 C/min did not induce selective predation on test fish, but rates of 2 C/min and instantaneous cooling resulted in significant selective predation over controls. (Auth)

<150>
Coutant, C.C., and R.J. Kedl, Survival of Larval Striped Bass Exposed to Fluid-Induced and Thermal Stresses in a Simulated Condenser Tube.

1975. ORNL-TM-4695, Oak Ridge National Laboratory (Oak Ridge National Laboratory, Environmental Sciences and Reactor Divisions, Oak Ridge, TN)

Single passage of approximately two week old larval striped bass, MORONE SAXATILIS, through a laboratory mock-up of a power plant condenser tube (not including a pump) resulted in mortalities no greater than for controls, when only mechanical stresses were exerted. When temperature stress was added, mortalities were comparable to thermal bioassay results. The experiments were conducted using different combinations of turbulent shear, pressure change and temperature rise. The condenser tube is unlikely as the locus of mechanical damages to fish larvae seen at operating power plants. Further research with pumps is recommended. (Auth)

<151>
Coutant, C.C., and S.S. Talmage, Thermal Effects.

1976. Jour. Water Poll. Control Fed., 48, 1486-1544 (Oak Ridge National Laboratory, Oak Ridge, TN)

The 1975 literature on thermal effects was reviewed under the following categories: reviews; power plant studies; producers; consumer reproduction, development, morphology, distribution, thermal tolerance, growth, feeding, activity, oxygen consumption, and temperature and other stresses; decomposers including diseases; and beneficial uses. Many of the studies are summarized in tabular form. (ST)

<152>
Coutant, C.C., S.S. Talmage, R.F. Carrier, B.N. Collier, and N.S. Dailey, Thermal Effects on Aquatic Organisms - Annotated Bibliography of the 1975 Literature.

1976. ORNL/EIS-88; 235 p. (Oak Ridge National Laboratory, Oak Ridge, TN)

The bibliography contains 716 scientifically indexed references on thermal effects on aquatic organisms. The articles are indexed by title, author, keywords, taxonomic name, subject category, and geographic location. This bibliography forms the basis of the thermal effects review by C.C. Coutant and S.S. Talmage in the Journal of the Water Pollution Control Federation. (ST)

<153>
Cowell, B.C., and C.H. Resico, Jr., Life History Patterns in the Coastal Shiner, NOTROPIS PETERSONI, Fowler.

1975. Florida Sci., 38, 113-121 (University of South Florida, Department of Biology, Tampa, FL)

Spawning of NOTROPIS PETERSONI in the upper Hillsborough River drainage, Florida, occurred over a six month interval, March through September, at water temperatures of 19 to 27 C. Growth rate was rapid and the life cycle lasted one year. (ST)

<154>
Cox, D.K., and C.C. Coutant, Acute Cold-Shock Resistance of Gizzard Shad.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

Groups of 10 adult gizzard shad (DOROSOMA CEPEDIANUM) were given acute cold shocks at 1, 2, 4, 6, 6.5, or 7 C after acclimating for at least 2 weeks to 15, 17.5, or 20 C. Time to loss of equilibrium and to cessation of opercular movement was determined. Shad acclimated between 15 and 20 C had a 10% lethal threshold of about 6 to 7 C for acute cold shock. Time to death (cessation of opercular movement) was much longer than time to equilibrium loss and would appear to have little ecological significance. Test temperatures of 1, 2, 4, and 6 C yielded mean time to loss of equilibrium and cessation of opercular movement. Regression lines from these data illustrate the time-dependent cold shock response of gizzard shad populations when acclimated to temperatures of 15 to 20 C. (Auth)

<155>
Cox, G.J., S.M. Naylor, and D.E. Thomson, A Study of Some Effects of the Waikato Geothermal Power Station upon the Waikato River.

1975. Tane (N.Z.), No. 21, 131-142 (University of Auckland, Department of Zoology, Auckland, New Zealand)

The effects of heated discharges from the Waikato geothermal power plant upon the Waikato River were investigated. Water temperature, oxygen content, and mercury concentration were measured at a number of points above and below the station and aquatic life was studied. Marked local effects on both the aquatic life and parameters of water quality were observed. However, although further investigation is warranted, particularly of the discharge rates of heavy metals such as mercury, the scheme does not appear to contribute significantly to the pollution of the Waikato River. (Auth)

<156>
Craddock, D.R., Effects of Increased Water Temperature on DAPHNIA PULEX.

1976. Fish. Bull., 74, 403-408 (NOAA, National

<156> CONT.
Marine Fisheries Service, Northwest Fisheries Center, Seattle, WA)

Techniques were developed to study the effects of increased water temperature on certain zooplankters; specific studies were conducted on DAPHNIA PULEX, an abundant and important zooplankter of the lower Columbia River. Study methods simulated prolonged exposure to constant high temperatures in thermal discharges and short exposures to increased temperatures in condensers of cooling systems. Effects were evaluated on the basis of survival and reproduction for periods ranging from 34 to 90 days. The time to death of 50% of the D. PULEX, both mature and young, was less than 24 hr at temperatures above 27 C. Temperatures of 27 C and below required an exposure of at least 192 hr to cause 50% mortality. The young females were more tolerant of temperature increases than older females. The greatest reproduction by older females was at the control temperature (15 C), whereas reproduction by the young females was low at lower temperatures. No reproduction occurred above 27 C. Two groups of D. PULEX (one from the Seattle, Wash., area and the other from the Columbia River) studied at increased temperatures for prolonged periods revealed similar patterns of survival and reproduction, but the Columbia River group appeared less tolerant of increased temperatures. A short exposure (15 min) to increased temperatures up to 30 C had little effect on survival and reproduction. It was concluded that temperatures should not exceed 26 or 27 C for prolonged periods or 30 C for more than 15 min to protect D. PULEX populations in the river. (Auth)

<157>
Craig, P.C., and J. Wells, Life History Notes for a Population of Slimy Sculpin (COTTUS COGNATUS) in an Alaskan Arctic Stream.

1976. Jour. Fish. Res. Bd. Can., 33, 1639-1642 (Aquatic Environments Ltd., Calgary, Alberta, Canada)

The spawning season of an Alaskan population of slimy sculpin appeared to be shortly after spring ice breakup in late May. Water tempterature was 3.5 C. Growth appeared to be very slow. (ST)

<158>
Crane, J.M., Jr., L.G. Allen, and C. Eisemann, Growth Rate, Distribution, and Population Density of the Northern Quahog MERCENARIA MERCENARIA in Long Beach, California.

1975. Calif. Fish & Game, 61, 68-81 (Cerritos College, Department of Biology, Norwalk, CA)

A population of MERCENARIA MERCENARIA unique to the West Coast was shown to be well established in a lagoon in Long Beach, California. Breeding time is from June through August when the surface temperatures are greater than 23 C. (ST)

<159>
Crawshaw, L.I., Attainment of the Final Thermal Preference in Brown Bullheads Acclimated to Different Temperatures.

1975. Comp. Biochem. Physiol., 52A, 171-173 (John B. Pierce Foundation Laboratory and Yale University School of Medicine, New Haven, CT)

Brown bullheads acclimated to temperatures of 7, 15, 24, and 32 C for 10 to 20 days selected temperatures of 16, 21, 26, and 31 C, respectively, immediately after placement in a thermal graident. After 10 hr, the fish acclimated to 7 and 15 C selected 25 C water, and within one day selected water of 29 to 30 C. The final thermal preferendum of the brown bulllhead appeared to be between 29 and 31 C. (ST)

<160>
Crim, L.W., and D.M. Evans, Gonadotropic Hormone Treatment of Rainbow Trout (SALMO GAIRDNERI): Plasma Hormone Profile Following a Single Injection.

1976. Jour. Fish. Res. Bd. Can., 33, 2841-2844 (Memorial University of Newfoundland, Marine Sciences Research Laboratory, St. John's, Newfoundland, Canada)

Immature rainbow trout (SALMO GAIRDNERI) were treated with salmon gonadotropic hormone to determine the presence of this hormone in circulation, to describe the plasma profile with time after exogenous hormone treatment, and to determine the difference in plasma gonadotropin levels resulting from treatment with two different hormone doses. The effect of three selected temperatures on the plasma hormone profile was also studied. The plasma concentration of the injected hormone following a low dose (0.02 ug/g) and a high dose (0.2 ug/g) suggested that plasma hormone levels were directly related to the hormone quantity injected. For fish maintained at 6 C, plasma gonadotropin values declined over a period of seven days reaching low but detectable levels. Lower plasma gonadotropin profiles were observed for fish held at 6 and 15 C compared with fish at 2 C ambient temperature. These data suggest the plasma gonadotropin levels and ambient temperature are related in an inverse manner. (Auth)

<161>
Cunningham, P.A., and M.R. Tripp, Factors Affecting the Accumulation and Removal of Mercury from Tissues of the American Oyster CRASSOSTREA VIRGINICA.

1975. Marine Biol. (W. Ger.), 31, 311-319 (University of Delaware, Department of Biological Sciences, Newark, DE)

Following accumulation of mercury (mercuric acetate) in seawater containing 10 or 100 ppb mercury, clearance of mercury from tissues of adult oysters was studied in a constant temperature regime (25 C) for 25 days and in a declining temperature regime (25 to 5 C) for 80 days by exposing them to estuarine water with no mercury added. The biological half-life of mercuric acetate was 16.8 and 9.3 days in the 25 C regime and 35.4 and 19.9 days in the declining regime, for the 10 and 100 ppb groups, respectively. (ST)

<162>
Curtis, E.H.T., The Influence of Temperature and Methyl Mercury Chloride Concentration on the Direct Uptake of Methyl Mercury Chloride from Water in Bluegill Sunfish (LEPOMIS MACROCHIRUS).

1974. Ph.D. Thesis, Northwestern University (Northwestern University, Evanston, IL)

The effect of temperature (9, 21, 28, and 33 C) and CH3HgCl concentration (0.2, 0.5, 5, and 50 ppb) on the direct uptake of Hg-203-tagged CH3HgCl from water in fasting

<162>

<162> CONT.
bluegill was examined. An empirical model having the form of a rectangular hyperbola best described the methyl mercury uptake data for each fish and each group of fish. Methyl mercury uptake rate increased from 9 to 28 C then dropped off at 33 C in a manner that is similar to the efficiency of growth curves for poikilotherms at similar temperatures. The uptake of CH3HgCl in bluegill was also affected by size, diet, season, disease and general state of health. Bluegill and catfish which were fed had two to three times the methyl mercury uptake of fasting fish. Smaller fish had a higher uptake than larger fish. (ST)

<163>
Cvancara, V.A., Studies on the Tolerance of Young of the Year Mississippi River Fish to Heated Waters.

1975. OWRT-C-4251(9037), 121 p. (Not given)

The following young of the year freshwater fish taken and tested in Mississippi River water exhibited an apparent 50% survival and an upper lethal temperature maxima, respectively, during peak summer water temperatures: largemouth bass, 35.6 and 36.2 C; gizzard shad, 28.5 and 31.0 C; bluegill, 28.5 and 35.0 C; black bullhead, 35.7 and 37.5 C; white bass, 33.5 and 36.1 C; northern pike, 30.8 and 34.0 C; freshwater drum, 32.8 and 36.0 C; and river carpsucker, 35.2 and 36.5 C. Maximum river temperatures reached at the research site during the two summers of the study was 33 C. This temperature was above the thermal maximum of gizzard shad. The study indicated that the young of the year of the species studied are in little thermal danger under present river conditions. (ST)

<164>
Dadswell, M.J., Distribution, Ecology, and Postglacial Dispersal of Certain Crustaceans and Fishes in Eastern North America.

1974. National Museum of Natural Sciences (Canada), Publications in Zoology No. 11 (The Huntsman Marine Laboratory, New Brunswick, Canada)

As part of a study on the distribution, ecology, and postglacial dispersal of certain eastern North American crustaceans and fish, the temperature and salinity tolerances of the crustaceans, MYSIS RELICTA and SENECELLA CALANOIDES, were studied. Upper lethal temperatures of MYSIS and SENECELLA were 20.3 C and 14.5 C, respectively. MYSIS was able to acclimate and survive over a wide thermal range (2 to 17 C) and its thermal tolerance rose significantly with acclimation to higher temperatures. SENECELLA had a narrow thermal range. A 10 C increase in acclimation temperature raised its upper lethal limit by 2 C. In salinity experiments MYSIS survived up to almost full seawater concentrations (30 ppt) and its salinity LD50 rose with an elevation of acclimation level. SENECELLA showed no acclimation to rising salinities and had an upper lethal limit of 17.5 ppt. The salinity tolerance of MYSIS was reduced by high temperatures, particularly at low salinities. At higher salinity acclimation levels this effect was negligible. Rising temperatures lowered the salinity resistance of SENECELLA, but prior acclimation to higher salinities did not raise the tolerance level. General observations in the field and during experiments indicated that immature mysids were more tolerant than adults to high temperatures but less tolerant to high salinities. (ST)

<165>
Dame, R.F., Day Degree Growth Models for Intertidal Oysters.

1975. Contrib. Marine Sci., 19, 107-112 (University of South Carolina, Belle W. Baruch Institute for Marine Biology and Coastal Research, Georgetown, SC)

Linear and polynomial day degree models are shown to be capable of predicting oyster growth in terms of height or weight. Polynomial models predict growth more accurately than linear models, but are less meaningful biologically. A general linear model for predicting oyster growth in terms of weight is developed for the North Inlet, South Carolina area. (Auth)

<166>
Danielssen, D.D., and S.A. Iversen, Mortality and Growth in Heated Seawater of Group I Sole (SOLEA SOLEA L.) and a Cross of Plaice (PLEURONECTES PLATESSA L.) and Flounder (PLATICHTHYS FLESUS L.).

1974. Fisk. Havet (Nor.), Ser. B, No. 23 (Marine Research Institute, Fisheries Adminstration, Flodevigen State Biological Station, Norway)

Sole and plaice-flounder hybrids were raised in aquaria in which the temperature was raised from ambient (8 C) at the rate of 1 C/day to 12, 15, 18, and 21 C and at variable temperatures corresponding to natural temperatures at 20 m ocean depth. For the sole, mortality was highest during the temperature adjustment and later at both the 21 C level and in the ambient tank. Average length increased with increasing temperature. Hybrid mortality was highest at 18 and 21 C and lowest at 15 C and ambient. Growth increased with increasing temperature throughout the experiment. In both series of experiments, the mortality was highest among small individuals. (ST)

<167>
Danilov, N.N., Conditions of Reproduction and Prerequisites for Biological Differentiation in the Kuybyshev Reservoir Population of Bream ABRAMIS BRAMA.

1975. Jour. Ichthyol., 15, 196-202 (Kazan' University, USSR)

The reproductive process of the bream, ABRAMIS BRAMA, at the upper end of the impounded water zone of Kuybyshev Reservoir during different temperature and water level regimes in the year was investigated. Data on the nature of the spawning, substrate, survival of eggs and larvae and their distribution in relation to environmental conditions are given. The difference between bream spawners spawning at a different temperature and on a different substrate is established. (Auth)

<168>
Davies, R.M., C.H. Hanson, and L.D. Jensen, Entrainment of Estuarine Zooplankton into a Mid-Atlantic Power Plant: Delayed Effects.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National

<168> CONT.
Technical Information Service, Springfield, Va. (Johns Hopkins University, Baltimore, MD; Ecological Analysts, Inc., Baltimore, MD)

Zooplankton collected from the intake and discharge of the Crane Power Plant, located on a tributary of the Chesapeake Bay, were incubated under continuous-flow ambient and experimental conditions in netted containers. No difference in survival was noted among zooplankton held at ambient water temperatures, those which passed through the plant and were subsequently exposed to 1.0 and 2.0 delta T, and the intake zooplankton that were transferred directly to 1.0 delta T water. Similarly, no significant effect was observed in a comparison of the resident zooplankton communities in the vicinity of the discharge canal, the intake, and a control station. These data suggest that microzooplankton survival after exposure to condenser cooling-system effects is relatively high for copepod species and population structures tested in these studies. Further attempts to refine evaluations of macrozooplankton, meroplankton, and ichthyoplankton organisms appear to be warranted. (Auth)

<169>
Davies, R.M., and L.D. Jensen, Entrainment of Zooplankton at Three Mid-Atlantic Power Plants.

1974. PB-240 758; EPRI-74-C49-00-5; Electric Power Research Institute Cooling Water Studies Report No. 15; In Jensen, L.D. (Ed.), Proceedings of the Second Entrainment and Intake Screening Workshop held at Johns Hopkins University, Baltimore, Maryland, February 5-9, 1973. National Technical Information Service, Springfield, VA (Johns Hopkins University, Baltimore, MD)

The response of zooplankton to the combined entrainment effects of temperature rise, rapid pressure change, mechanical abrasion and biocidal action at three mid-Atlantic power plants was examined. Zooplankton survival during passage through the condenser cooling system was found to be dependent upon both ambient temperatures of intake water and the thermal elevations characteristic of each power plant. (Auth)

<170>
Davis, K.B., and B.A. Simco, Salinity Effects on Plasma Electrolytes of Channel Catfish, ICTALURUS PUNCTATUS.

1976. Jour. Fish. Res. Bd. Can., 33, 741-746 (Memphis State University, Ecological Research Center, Memphis, TN)

Plasma sodium and chloride levels of channel catfish (ICTALURUS PUNCTATUS) increased after a 5-day exposure to 10 and 12 g/liter sodium chloride. Exposure of fish to 4 and 8 g/liter for 5 days resulted in plasma electrolyte levels higher than those of fish kept in aged tap water, but were not different from values usually found in freshwater fish. These observed differences may have been due to handling. Tests were performed during several months and no effect due to season was observed. When fish in July (27 C) were exposed to 10 g/liter sodium chloride, the plasma electrolyte concentration increased for 48 hr and then stabilized. Exposure to the same concentration in March (9 C) resulted in a slow increase of plasma electrolytes throughout the 13 days of the experiment. Injection of 100 ug/kg cortisol had no effect on plasma electrolyte increase during 48 hr after transfer to 12 g/liter sodium chloride. (Auth)

<171>
Davis, W.P., and D.P. Middaugh, A Review of the Impact of Chlorination Processes Upon Marine Organisms.

1975. CONF-751096; Part of Jolley, R.L. (Ed.), Proceedings of the Symposium on the Environmental Impact of Water Chlorination held in Oak Ridge, Tennessee, October 22-24, 1975, (p. 299-325), 443 p. (Gulf Breeze Environmental Research Laboratory, Bears Bluff Field Station, Wadmalaw Island, SC)

A theoretical degradation model of chlorine added to marine waters is presented. Literature reporting laboratory or ecological effects of chlorine to marine organisms is summarized. Studies include chlorine toxicity to marine phytoplankton, invertebrates, and estuarine fish. Current EPA research on effects of chlorination upon marine organisms is presented. (ND)

<172>
Dawes, C.J., J.W. LaClaire, and R.E. Moon, Culture Studies on EUCHEUMA NUDUM J. Agardh, a Carrageenan Producing Red Alga from Florida.

1976. Aquaculture, 7, 1-9 (University of South Florida, Department of Biology, Tampa, FL)

Optimum growth conditions for mariculture of EUCHEUMA NUDUM, a Florida species of the economically important pantropical red algal genus, were investigated in laboratory culture. Manometric techniques were utilized to monitor plant responses to 108 combinations of light, temperature and nutrient (nitrate and phosphate) levels. Comparison of rates of apparent photosynthesis after 3, 10 and 17 days in culture indicated that the plants gave highest responses when grown at 20 to 24 C, 1076 to 3228 lumen/m2 and in sea water containing 5.0 ppm nitrate and 3.0 ppm phosphate. Results of the culture studies are examined in view of previous studies on ecology and physiology of Florida EUCHEUMA, as well as proposed mariculture practices. (Auth)

<173>
Dawley, E.M., and W.J. Ebel, Effects of Various Concentrations of Dissolved Atmospheric Gas on Juvenile Chinook Salmon and Steelhead Trout.

1975. Fish. Bull., 73, 787-796 (National Marine Fisheries Service, Northwest Fisheries Center, Seattle, WA)

Bioassays in shallow tanks (25 cm deep) with dissolved nitrogen and argon gas concentrations ranging from 100 to 125% of saturation in water at 15 C were conducted to determine lethal and sublethal effects on juvenile chinook salmon, ONCORHYNCHUS TSHAWYTSCHA, and steelhead trout, SALMO GAIRDNERI. Significant mortality of both species commenced at 115% saturation of nitrogen and argon (111% saturation of total dissolved atmospheric gas pressure). Over 50% mortality of both steelhead and chinook occurred in less than 1.5 days in water at 120 and 125% of saturation. Significant differences in swimming performance, growth, and blood chemistry were measured in groups of fish tested at sublethal exposures in

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<173> CONT.
various concentrations of dissolved gases. Sublethal stress for 35 days at 110% dissolved nitrogen (106% total atmospheric gas) decreased normal swimming ability of chinook. Growth of both steelhead and chinook was affected by sublethal exposures in water saturated with atmospheric nitrogen and argon at 105, 110, and 115%. Blood chemistry was affected at sublethal exposures in water at 115% saturation. (Auth)

<174>
de Ciechomski, J.A., and G. Weiss, Characteristics of Gillrakers of Anchovy, ENGRAULIS ANCHOITA Hubbs and Marine Postlarvae Developed in Different Seasons and at Different Temperatures.

1975. Physis Secc. A Oceanos. Org., 34, 1-11 (Institute of Marine Biology, Playa Grande, Mar del Plata, Argentina)

The results of investigations on the number and characteristics of gillrakers in anchovy postlarvae and its relationship to the sea temperature at which these larvae developed are presented. The study is based on 680 postlarvae 35 to 50 mm in total length, collected at different seasons of the year in the area of Mar del Plata, Argentina. The mean sea water temperatures of 10.5, 12.0, 19.5, and 20.0 C, calculated from actual field data, were used in the establishment of relations between them and morphological measurements. Body length, head length, number and length of gillrakers, and distance between rakers were considered. In all cases straight regression lines were obtained. Gillrakers of postlarvae developed at higher temperature were longer and more numerous than in larvae from colder waters. No significant differences in the distance between the apophyses of gillrakers in larvae developed at different temperatures were observed. It is assumed that larvae developed in summer, which were found to have more and longer gillrakers, stand a better chance in food competition with other species. (Auth)

<175>
de Silva, P.K., The Factors Affecting the Feeding of DENDROCOELUM LACTEUM (Muller) (Turbellaria, Tricladida) on ASELLUS AQUATICUS (L.) (Crustacea, Iscpoda).

1976. Arch. Hydrobiol. (Ger.), 77, 347-374

Temperatures within the range of 15 to 17 C were optimum for feeding of the planarian, DENDROCOELUM LACTEUM. At high and low temperatures feeding was reduced. (ST)

<176>
de Vlaming, V.L., Effects of Photoperiod-Temperature Regimes and Pinealectomy on Body Fat Reserves in the Golden Shiner, NOTEMIGONUS CRYSOLEUCAS.

1976. Fish. Bull., 73, 766-776 (Marquette University, Biology Department, Milwaukee, WI)

Various photoperiod-temperature regimes were examined for their effects on total fat content (excluding gonads) in NOTEMIGONUS CRYSOLEUCAS; experiments were conducted during several different phases of the reproductive cycle. In NOTEMIGONUS fattening normally occurred in fall and early winter concomitant with the early phases of gonadal development. Body fat stores are progressively depleted during the prespawning and spawning seasons. Warm temperature (25 C) normally favored body fat depletion in NOTEMIGONUS. Short photoperiod (9L/15D) accentuated the lipid depleting effects of warm temperatures. Low temperatures (12 to 15 C) usually promoted lipid deposition. Short photoperiods complimented the lipid anabolic effects of low temperatures. Thus, a given photoperiod can have opposite effects on body fat levels depending on temperature. A long photoperiod, in combination with warm temperature, is required for final gonadal maturation and results in a reduction of lipid reserves. Short photoperiod-warm temperature regimes had similar effects on fat levels, but bring about gonadal regression. Thus, the effects of photoperiod-temperature regimes on lipid metabolism are apparently not totally dependent on the effects of these environmental factors on reproduction. The effects of pinealectomy on lipid reserves varied depending on the phase of the natural reproductive cycle when the organ was removed, as well as, with the photoperiod-temperature regime under which the experimental animals were maintained. (Auth) (ST)

<177>
de Vlaming, V.L., and M.J. Vodicnik, Effects of Photoperiod-Temperature Regimes on Pituitary Gonadotrophs, Pituitary Gonadotropin Potency and Hypothalmic Gonadotropin Releasing Activity in the Teleost NOTEMIGONUS CRYSOLEUCAS.

1975. Jour. Thermal Biol., 1, 119-125 (Marquette University, Department of Biology, Milwaukee, WI)

The effects of various photoperiod-temperature regimes on gonadal activity, hypothalamic gonadotropin releasing activity, pituitary gonadotropin potency and pituitary gonadotrophs were examined in the teleost, NOTEMIGONUS CRYSOLEUCAS. In fish maintained on a long photoperiod-high temperature regime final gonadal maturation occurred. Under these conditions hypothalamic gonadotropin releasing activity was high, stainable gonadotrophs made up a low percentage of pituitary area and pituitary gonadotropin potency was relatively low. Gonadotrophs made up a relatively large area of the pituitary and adenophyophyseal gonadotropin activity was high in fish exposed to long photoperiod-low temperature regimes. Long photoperiod-low temperature regimes did not stimulate final gonadal maturation. Short photoperiod-high temperature conditions retarded gonadal development or caused gonadal regression. The areas of the pituitary occupied by gonadotrophs and hypothalmic gonadotropin releasing activity were low in fish exposed to these conditions. Pituitary gonadotropin potency, however, was relatively high in fish maintained on short photoperiod-high temperature regimes. Gonadotrophs were infrequent in the pituitary and pituitary gonadotropin potency was low in animals maintained on short photoperiod-low temperature regimes. These conditions did not promote the final stages of gonadal maturation in NOTEMIGONUS. Light intensities of below 15 lux were insufficient to induce spawning in NOTEMIGONUS. Light intensities above 15 lux increased the incidence of spawning. (Auth)

<178>
de Vooys, C.G.N., The Influence of Temperature and Time of Year on the Oxygen Uptake of the Sea

<178> CONT.
Mussel MYTILUS EDULIS.

1976. Marine Biol. (W. Ger.), 36, 25-30 (Institute of Fisheries Research, Department of Shellfish Culture, Texel, Netherlands)

In MYTILUS EDULIS, the influence of temperature on oxygen uptake was studied under conditions as natural as possible, with avoidance of temperature adaptation, individual variation, and the feeding of algal monocultures. The density and composition of the phytoplankton used for feeding the mussels was that of coastal water. In the period July-March a linear correlation between oxygen uptake and the sea-water temperature from 3 to 20 C was found. From this, a Q10 of 2.36 was calculated. In the period March-July, when spawning and recovery occur, oxygen uptake was higher than in the autumn at the same water temperatures. In contrast with other studies, a clearly higher oxygen uptake was noted in summer compared with that in winter. This difference is explained by the avoidance of temperature adaptation and acceleration of gametogenesis in this study. (Auth)

<179>
de Wilde, P.A.W., Influence of Temperature on Behaviour, Energy Metabolism, and Growth of MACOMA BALTHICA (L.).

1974. In Barnes, H. (Ed.), Ninth European Marine Biology Symposium held in Oban, Scotland, October 2, 1974 (Netherlands Institute of Sea Research, Texel, Netherlands)

The influence of temperature on growth and condition, mortality, behavior, activity, and oxygen consumption of MACOMA BALTHICA maintained in experimental micro-ecosystems was studied. Growth and condition were best in the lower temperature range, 0 to 15 C. Spawning took place in spring at a water temperature of 10 C. At higher temperatures deposit feedings and food intake slowed down. At temperatures greater than 15 C the energy balance between food uptake and energy expenditure became negative, resulting in emaciation and increased mortality. (ST)

<180>
Dean, J.M., Temperature of Tissues in Freshwater Fishes.

1976. Trans. Amer. Fish. Soc., 105, 709-711 (University of South Carolina, Belle W. Baruch Institute for Marine Biology and Coastal Research and Department of Biology, Columbia, SC)

A thermistor probe was used to study deep (white) muscle temperature of five species of freshwater fish at rest as well as that of exercising and resting trout. The resting deep muscle temperatures were 0.1 to 1.1 C higher than the water temperature. In exercising trout, temperatures of the deep muscle were the same as the temperature of the water. (Auth)

<181>
Denis, F., J.-F. Brisou, and T. Dupuis, Survival of Enteric Viruses in Seawater.

1975. C.R. Hebd. Seances Acad. Sci., Paris, 281, 471-474 (Charles Nicolle, Laboratory of Bacteriology-Virology, Poitiers, France)

Virus survival in the laboratory was examined in non-sterile and sterile seawater. Five enteric viruses were studied (Poliovirus, Coxackie A and B) at four temperatures: 4, 12, 22, and 37 C. Thirty to forty days were required for a 99.9% reduction in sterile seawater at 22 C, without regard to the virus type. Survival times were longer at lower temperatures, but shorter in non-sterile seawater. A correlation between virus inactivation and particles of natural seawaters was suggested. (Auth)

<182>
Denton, J.E., and M.K. Yousef, Seasonal Changes in Hematology of Rainbow Trout, SALMO GAIRDNERI.

1975. Comp. Biochem. Physiol., 51A, 151-153 (University of Nevada, Department of Biological Sciences, Las Vegas, NV; University of Nevada, Desert Research Institute, Boulder City, NV)

Although water temperature was maintained constant at 11 to 13 C in the laboratory, seasonal changes in hemoglobin of rainbow trout occurred. Diet, metabolic adaptations and activity were suggested as probable causes of seasonal changes. (ST)

<183>
Desmukh, R.S., The Rate of Water Filtration in an Estuarine Bivalve MERETRIX MERETRIX.

1975. Broteria, 44, 101-111 (Marathwada University, Department of Zoology, Aurangabad, India)

The neutral red technique was used to measure the rate of water filtration of the clam, MERETRIX MERETRIX, in relation to body size, temperature, salinity, and suspended matter. The rate of filtration increased with a temperature increase from 27 to 33 C. It was appreciably affected by the presence of suspended matter. (ST)

<184>
Devyatkin, V.G., Effect of Pollution on the Growth of Phytoplankton in a Zone Influenced by the Heated Water of the Konakovo Thermal Electric Power Station.

1973. ORNL-tr-2785; Biol. Vnutr. Vod Inform. Byull. No. 17, 11-13 (Not given)

A series of experiments designed to investigate the role of both temperature and chemical changes due to heated effluents and domestic sewage on increased phytoplankton production in the region of discharge of heated water from the Konakovo (USSR) power station are described. The results indicated that pollution from the power station and domestic sewage did not substantially influence the growth of phytoplankton in the heated area in the time observed. (ST)

<185>
Dew, C.B., A Contribution to the Life History of the Cunner, TAUTOGOLABRUS ADSPERSUS, in Fishers Island Sound, Connecticut.

1976. Chesapeake Sci., 17, 101-113 (Lawler, Matusky and Skelly, Engineers, Tappan, NY)

Cunners in Fishers Island Sound showed a well-defined spawning period occurring primarily in June. Activity decreased in the fall until a state of dormancy was reached at 7 to 8 C, with larger fish becoming dormant first. Cunners overwintered in the same inshore areas where they were found during

<185>

<185> CONT.
other times of the year. (ST)

<186>
Dickson, K.L., J. Cairns, Jr., D.S. Cherry, and J.R. Stauffer, An Analysis of the Applicability of EPA's Draft Water-Temperature Criteria: A Site-Specific Case-History Evaluation.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (Virginia Polytechnic Institute and State University, Biology Department and Center for Environmental Studies, Blacksburg, VA)

The applicability of the Environmental Protection Agency's draft water-temperature criteria in evaluating the impact of thermal discharges from Appalachian Power Company's Glen Lyn Power Plant on the New River in Virginia is analyzed. The draft water-temperature criteria was applied to important representative fish species in New River. Since field studies have been conducted at the site, it is possible to analyze the predicted impact using the draft water-temperature criteria and the actual impact as documented by the field studies. No data on water-temperature criteria were available for some important representative fish species at the plant site, but, for species for which data were available, the predicted impact was corroborated by the field studies. It was not possible, however, to make a realistic impact assessment using the draft water-temperature criteria at the Glen Lyn site. Field data on the aquatic community and on fish preference and avoidance temperatures proved more useful in evaluating the impact of the thermal discharges. (Auth)

<187>
Dimock, R.V., Jr., and K.H. Groves, Interaction of Temperature and Salinity on Oxygen Consumption of the Estuarine Crab PANOPEUS HERBSTII.

1975. Marine Biol. (W. Ger.), 33, 301-308 (Wake Forest University, Department of Biology, Winston-Salem, NC)

The combined effects of temperature and salinity on the rate of oxygen consumption by the estuarine crab PANOPEUS HERBSTII were studied. Crabs were acclimated to all combinations of 10 and 23 C and 5 and 30 ppt S. The rate of oxygen consumption was measured at 10 and 25 C in experimental salinities of 5, 15, 30, and 40 ppt. Following acclimation to 23 C and 5 ppt S, the rate of oxygen consumption by female crabs was significantly lower than that of males. No other experimental treatments resulted in significant rate differences between males and females. The anticipated response of an increase in oxygen consumption upon exposure of this euryhaline crab to low salinity occurred. Similarly, compensatory adjustment to low temperature following acclimation was evidenced. However, unpredictable patterns of response were elicited by specific experimental manipulations of temperature and salinity. Thermal sensitivity of oxygen uptake as reflected by Q10 was also influenced by experimental conditions and further substantiated the occurrence of interactions between temperature and salinity. (Auth)

<188>
Dires, M., and D. Adelung, New Results on the Rearing of CARCINUS MAENAS in the Laboratory.

1976. Marine Biol. (W. Ger.), 38, 17-24 (Universitat Kiel, Institut fur Meereskunde, Kiel, Germany)

The shore crab CARCINUS MAENAS was reared in the laboratory from egg deposition to sexual maturity. Special enclosures were developed for cultivation of the larvae. Food and temperature proved to be the most important exogenous factors for rearing success. Fresh ARTEMIA SALINA nauplii were the only food suitable for all larval stages. The following rearing temperatures proved most successful during larval development: (1) embryonic development, 10 C; (2) zoea stages, 15 C; (3) megalopa stage, 17.5 C. The larvae hatch preferably in darkness when reared under short-day conditions. (Auth)

<189>
Diwan, A.D., and R. Nagabhushanam, Studies on Heat Tolerance in the Freshwater Crab, BARYTELPHUSA CUNICULARIS (Westwood, 1936).

1976. Hydrobiologia (Den.), 50, 65-70 (Marathwada University, Department of Zoology, Aurangabad, India)

The effect of laboratory acclimation on the heat tolerance of the freshwater crab, BARYTELPHUSA CUNICULARIS was determined at various temperature and salinity combinations. High temperature acclimation generally increased resistance to lethal temperatures whereas acclimation to salinity, either at high or low temperature, decreased it. A combination of high temperature and normal freshwater was the most favourable combination for high temperature tolerance. After acclimation to low temperature, gain in heat tolerance was rapid both at high temperature and freshwater as well as high temperature and 0.5% salinity combinations. The water content in the whole animal as well as in the hepatopancreas increased on warm acclimation. Hepatopancreas glycogen and blood sugar level were also found to be increased with the rise in temperature. The fat and protein content of the hepatopancreas were found to be increased on cold acclimation. The reverse occurred on warm acclimation. (Auth)

<190>
Dolinin, V.A., Main Parameters of the Respiratory Function in Fishes during Alteration in Respiratory Activity.

1975. Jour. Ichthyol., 15, 124-131 (Institute of Physiology, Siberian Department, Novosibirsk, USSR)

The dependence of ventilation volume, coefficient of uptake of oxygen from the water and frequency of respiratory movements in the ide, LEUCISCUS IDUS, the pike, ESOX LUCIUS, and the pike-perch, LUCIOPERCA LUCIOPERCA, on the degree of their motor activity, assessed on the rate of respiratory metabolism, was determined at different temperatures and oxygen concentrations. On the basis of the results obtained, a method of indirect assessment of the maximum possible values of the rate of respiratory metabolism and the maximum continuous swimming speed of fishes is proposed. (Auth)

<191>
Dorgelo, J., Comparative Ecophysiology of Gammarids (Crustacea: Amphipoda) from Marine, Brackish and Fresh-Water Habitats, Exposed to the Influence of Salinity-Temperature Combinations. I. Effect on Survival.

1974. Hydrobiol. Bull. (Neth.), 8, 90-108 (University of Amsterdam, Department of Experimental Ecology, Amsterdam, Netherlands)

The influence of temperature on salt tolerance was unimportant for mature male amphipods, GAMMARUS TIGRINUS, G. FOSSARUM, and CHAETOGAMMARUS MARINUS, in the natural salinity ranges of these species. Increasing temperature (5, 15, and 25 C) reduced survival of all three species. GAMMARUS TIGRINUS was most susceptible in spring to both salinity and temperature. The results are discussed with regard to the evolutionary migration from the marine environment to freshwater. (ST)

<192>
Doudoroff, P., Toxicity to Fish of Cyanides and Related Compounds. A Review.

1976. EPA-600/3-76-038; 155 p. (Oregon State University, Department of Fisheries and Wildlife, Corvallis, OR)

As part of a critical review of the literature on the toxicity to fish of cyanides and related compounds, the variation of limits of toxicant concentrations with temperature are compared. At relatively high cyanide concentrations, linear to logarithmic relationships have been observed between temperature and the reciprocal of overturning or final immobilization of the fish. However, at lower concentrations (less than 0.25 mg/l as CN), and primarily with rainbow trout, no appreciable change to longer survival at the highest temperature were observed. The resistance of fish to cyanide poisoning at a given temperature can be markedly influenced by acclimation temperature. The author concluded that much remains to be learned about the influence of temperature on the resistance of fish to cyanide. (ST)

<193>
Dresco-Derouet, L., The Respiratory Metabolism of Two Species of Porcellanidae (Crustacea, Decapoda) of the Intertidal Zone.

1974. Cah. Biol. Marine, 15, 567-570 (Station Biologique de Roscoff et Laboratoire de Zoologie, Paris, France)

The oxygen consumption of PISIDIA LONGICORNIS at 10, 14, and 18 C was higher and more markedly affected by temperature fluctuations than that of PORCELLANA PLATYCHELES. (Auth)

<194>
Drobysheva, S.S., Yu.P. Aseev, On the Life Cycle of PENAEUS SEMISCULCATUS (Decapoda, Penaeidae) from the Persian Gulf.

1976. Zool. Zh. (USSR), 55, 769-771 (AzcherNIRO, Kerch', USSR)

The population of PENAEUS SEMISULCATUS in the Persian Gulf was represented by shrimp belonging to the same generation. Juveniles of a given year spawned in November and December. Spawning continued into March. (ST)

<195>
Drysdale, F.R., and M.G. Barbour, Response of the Marine Angiosperm PHYLLOSPADIX TORREYI to Certain Environmental Variables: A Preliminary Study.

1975. Aquatic Botany, 1, 97-106 (University of California, Department of Botany, Davis, CA)

In laboratory cultures, optimum growth of PHYLLOSPADIX TORREYI occurred in full strength seawater, under 9.29 lm/m2 light intensity, and at a water temperature of 12 to 14 C. Growth declined in lower salinities, under lower light intensities, and at higher temperatures. Tolerance ranges for salinity, light, and temperature appeared to be relatively broad. (ST)

<196>
Dugan, C.C., R.W. Hagood, and T.A. Frakes, Development of Spawning and Mass Larval Rearing Techniques for Brackish-Freshwater Shrimps of the Genus MACROBRACHIUM (Decapoda Palaemonidae).

1975. Florida Marine Research Publications No. 12, Florida Department of Natural Resources, Marine Research Laboratory, St. Petersburg, FL (Farm Fresh Shrimp, Fort Lauderdale, FL; Caribe King Shrimp, Inc., Aguada, Puerto Rico; Neptune's Nurseries, Inc., St. Petersburg, FL)

Experiments were conducted on controlled spawning, mass larval rearing, and optimum rearing conditions of MACROBRACHIUM ROSENBERGII, M. CARCINUS, M. ACANTHURUS, M. OHIONE, and M. OLFERSII. Year-round spawning was achieved by maintaining a constant temperature of 27.5 C and photoperiod of 14 hours light. Simultaneous spawning by most females was accomplished by lowering temperature to 24 C, holding it for two weeks, and raising it again. Optimum temperature for larval rearing was 28 to 32 C. Optimum salinity varied between species. Maintaining a photoperiod of 12 to 14 hours light produced better results than continuous lighting. (Auth) (ST)

<197>
Duval, W.S., and G.H. Green, Diel Feeding and Respiration Rhythms in Zooplankton.

1976. Limnol. & Oceanog., 21, 823-829 (Simon Fraser University, Department of Biological Sciences, Burnaby, British Columbia, Canada)

Diel rhythms in respiration and feeding of zooplankton from three British Columbia lakes were examined in laboratory experiments conducted at constant temperature and in the absence of light. Endogenous rhythms in respiration and feeding were demonstrated at temperatures from 10-22 C and were typically bimodal with maximum rates found at dawn and dusk and lowest values near midday. Dawn and dusk respiration rates were an average of 2.3 times higher than during midday; the corresponding diel difference in feeding was 6.6 times. (Auth)

<198>
Dwyer, W.P., and R.H. Kramer, The Influence of Temperature on Scope for Activity in Cutthroat Trout, SALMO CLARKI.

1975. Trans. Amer. Fish. Soc., 104, 552-554 (Utah State University, Cooperative Fishery Unit, Logan, UT)

One hundred eleven active and 71 standard metabolic rate estimates were made on 90 g

<198>

<198> CONT.
cutthroat trout SALMO CLARKI at five temperatures. Active metabolism was lowest at 5 C (363 mg 02/kg-hr) and highest at 15 C (597 mg 02/kg-hr). At 20 C and 24 C it was 559 and 491 mg 02/kg-hr, respectively. Scope for activity ranged from a low of 316 mg 02/kg-hr at 5 C to a high of 486 mg 02/kg-hr at 15 C then down to 374 mg 02/kg-hr at 24 C. Standard metabolisms at 5, 10, 15, 20, and 24 C were 47, 73, 111, 129, and 117 mg 02/kg-hr respectively. (Auth)

<199>
Ebsary, B.A., and G.F. Bennett, Studies on the Bionomics of Mermithid Nematode Parasites of Blackflies in Newfoundland.

1975. Can. Jour. Zool., 53, 1324-1331 (Memorial University of Newfoundland, Department of Biology, St. John's, Newfoundland, Canada)

NEOMESOMERMIS FLUMENALIS is a univoltine nematode infecting the simuliids PROSIMULIUM FUSCUM/MIXTUM during the winter months and the early spring generations of the summer simuliids, primarily SIMULIUM VENUSTUM, in May and early June. Infection of simuliid larvae occurred when water temperatures were 4 to 12 C. Temperatures above 12 C tend to be lethal to preparasitic mermithids; simuliid species developing in the summer are thus not infected by this species. (ST)

<200>
Eckelbarger, K.J., Larval Development and Population Aspects of the Reef-Building Polychaete PHRAGMATOPOMA LAPIDOSA from the East Coast of Florida.

1976. Bull. Marine Sci., 26, 117-132 (Harbor Branch Foundation, Inc., Fort Pierce, FL)

The larval development and population biology of the reef-building polychaete, PHRAGMATOPOMA LAPIDOSA, were investigated during 28 mo of observations at two reef localities on the central east coast of Florida. Growth rate was estimated by measuring body lengths and tube diameters of specimens collected monthly, following larval settlements on the reefs. Larval settlement under laboratory conditions occurred 14 to 30 days after fertilization. Temperature studies indicated that optimal larval development occurred at 24 to 26 C with only 50% of the larvae developing at 15.5 C and 29.5 C. Larval settlements were observed only on four occasions in the field during the study period and three types of settlement patterns were observed. Juveniles developed sex products about 6 to 8 wk after settlement and artificially-fertilized eggs shed from juveniles 4 months after settlement produced normal larvae. Data from laboratory spawnings and fertilizations, observations of field settlements, and the presence of larvae in the plankton suggest that some segments of the population may spawn during most of the year in southern Florida. (Auth)

<201>
Edelstein, T., and J. McLachlan, Autecology of FUCUS DISTICHUS ssp. DISTICHUS (Phaeophyceae: Fucales) in Nova Scotia, Canada.

1975. Marine Biol. (W. Ger.), 30, 305-324 (Atlantic Regional Laboratory, National Research Council of Canada, Halifax, Nova Scotia, Canada)

FUCUS DISTICHUS L. ssp. DISTICHUS observed at several sites on the Atlantic Coast of Nova Scotia was confined to high-littoral rock pools at exposed sites where water temperatures went up to 25 C in summer and as low a -4.5 C in winter and where considerable seasonal and short-term variations occurred also in salinity, dissolved oxygen and hydrogen-ion concentrations. Receptacles, formed in winter, were cast by late spring. Sporelings first visible in September, developed slowly to become reproductive the second year. Rapid increases in length and bulk occurred February to May in new fronds. Mature fronds elongated slowly through summer and into autumn forming receptacles in winter. New fronds regenerated from frequently damaged wounded surfaces. (RPC)

<202>
Edmundson, E.H., Jr., Effects of Gamma Radiation and Temperature on Growth of Juvenile Rainbow Trout (SALMO GAIRDNERI).

1976. Northwest Sci., 50, 183-188 (Environmental Protection Agency, Boise, ID)

Effects of gamma radiation and temperature on growth of juvenile rainbow trout (SALMO GAIRDNERI) were studied in continuous flow aquaria. Fish fingerlings acclimated to 10 C were exposed to various doses of gamma radiation up to 1,000 rads and placed into filtered tap water at 10, 15, and 20 C. They were reared in one of these water temperatures for four weeks and fed 4% of their body weight in commercial fish food once per day. Survivors were weighed weekly and counted daily in the basic experiment. There were no statistically significant effects of temperature, radiation, or temperature-radiation interaction on growth. It was concluded that the combined action of gamma radiation less than 1,000 rads and temperature regimes studied did not noticeably affect growth of juvenile rainbow trout within the first four weeks. (Auth)

<203>
Edsall, T.A., and D.V. Rottiers, Temperature Tolerance of Young-of-the-Year Lake Whitefish, COREGONUS CLUPEAFORMIS.

1976. Jour. Fish. Res. Bd. Can., 33, 177-180 (U.S. Fish and Wildlife Service, Great Lakes Fishery Laboratory, Ann Arbor, MI)

The ultimate upper lethal temperature of young-of-the-year lake whitefish acclimated at 22.5 C was 26.65 C. The ultimate upper lethal temperature is defined as "the temperature beyond which no increase in lethal temperature results from further increase in acclimation temperature." The upper incipient lethal temperatures at acclimation temperatures of 5, 10, 15, and 20 C were 20.62, 22.67, 25.78, and 26.65 C, respectively. (ST)

<204>
Edwards, T.J., An Ecological Evaluation of a Thermal Discharge, Part VIII: Some Effects of Initial Operation of Detroit Edison's Monroe Power Plant on Fish Populations of Lake Erie's Western Shore Area.

1973. Institute of Water Research Technical Report No. 32.2, 59 p. (Michigan State University, Institute of Water Research, Department of Fisheries & Wildlife, East Lansing, MI)

Post-operational data from a study designed to assess the effects of operation of Detroit

<204> CONT.
Edison's Monroe power plant on fish populations found along the western shore of Lake Erie near Monroe, Michigan is presented and compared with pre-operational data. Fish distributions at the lake trawling stations showed occasional significant changes after plant operation began; these changes were considered to the result of natural seasonal variation or sampling error. Fish distributions at the plant's intake and discharge showed highly significant and consistent changes in the post-opeational period. In the discharge the number of species, number of individuals, and biomass decreased. Changes in the discharge canal were attributed to thermal instability and a general decrease in water quality of the discharge canal environment. Increased oxygen concentrations near the intake, which resulted from cooling water drawn into the area from the lake, is considered an important factor which led to increased fish use in the river intake area. Growth characteristics for yellow perch, gizzard shad, and spottail shiners collected at lake stations appeared to be unaffected by power plant operation. Coefficients of condition for carp and gizzard shad, but not goldfish, collected in the discharge canal were significantly lower than fish of these species collected at the lake stations. (Auth) (ST)

<205>
Edwards, T.J., W.H. Hunt, L.E. Miller, and J.J. Sevic, An Evaluation of the Impingement of Fishes at Four Duke Power Company Steam-Generating Facilities.

1976. CONF-750425; ERDA Symposium Series 40: In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA. (Duke Power Company, Environmental Sciences Unit, Charlotte, NC)

Fish impingement data were collected at four generating facilities representing river intake, epilimnetic reservoir intake, and hypolimnetic reservoir (skimmer-wall) intake designs. The study sites included both traveling and stationary intake-screen systems. At all sites fewer species were represented in impingement samples than were collected during concurrent field investigations in the study areas. Significant differences in impingement rates among seasons were established and were caused primarily by large numbers of threadfin shad impinged during the coldest months. Intake velocities did not determine relative rates of impingement at the sites studied. Certain characteristics of intake design appeared to influence impingement rates significantly, however. Skimmer walls, prsesent at two sites, did not provide a deterrent to fish impingement. (Auth)

<206>
Elizarova, V.A., Influence of Heating on the Condition of Photosynthetic Pigments of Phytoplankton in the Discharged Waters of the Konakovo Thermal Electric Power Station.

1973. ORNL-tr-2786; Biol. Vnutr. Vod, Inform. Byull No. 17, 13-18 (Not given)

Results of spectrophotometric studies of chlorophyll and green and yellow pigments of algae passing through the cooling system of the power plant indicated that there were no substantial changes of concentration of chlorophyll or of the condition of the photosynthetic system of the algae. Temperatures in the cooling system varied from 13 to 32 C. (ST)

<207>
Ellgaard, E.G., K.S. Bloom, A.A. Malizia, Jr., G.E. Gunning, and R.E. Jensen, The Locomotor Activity of Fish: An Analogy to the Kinetics of an Opposed First-Order Chemical Reaction.

1975. Trans. Amer. Fish. Soc., 104, 752-754 (Tulane University, Department of Biology, New Orleans, LA; Gustavus Adolphus College, Department of Chemistry, St. Peter, MN)

The kinetic behavior of a laboratory population of bluegill, LEPOMIS MACROCHIRUS, under defined laboratory conditions was shown to be analogous to the reaction kinetics described by a population of molecules engaged in an opposed (reversible) first-order reaction. Thus the locomotor activity of fish can be described quantitatively in the form of rate constants. Using this method fish exposed to temperatures of 14, 22, and 29 C described rate constants of 0.106, 0.121, and 2.452 respectively. (Auth) (ST)

<208>
Elliott, J.M., The Growth Rate of Brown Trout (SALMO TRUTTA L.) Fed on Maximum Rations.

1975. Jour. Animal Ecol., 44, 805-821 (Freshwater Biological Association, Windermere Laboratory, Ambleside, England)

Brown trout weighing 5 to 281 g were fed to satiation at 15 different water temperatures ranging from 3.8 to 21.7 C. Both the weight of the trout and the water temperature affected the mean specific rate of increase in weight, and the relationship between the three variables was described by an equation which can be used to estimate the value of the rate of increase in weight for trout in the weight range of 10 to 300 g at temperatures between 3.8 and 19.5 C. The growth rate decreased markedly as the weight of the trout increased. The growth rate increased with increasing temperature from 3.8 to 12.8 C, was maximum between 12.8 and 13.6 C, and decreased with increasing temperature from 13.6 to 19.5 C. An equation for describing the growth of both wild and hatchery-reared trout feeding on a variety of food organisms in both the field and laboratory was developed. This equation was applicable to trout in the weight range of 5 to 300 g at both constant and fluctuating temperatures between 3.8 and 19.5 C. (Auth) (ST)

<209>
Elliott, J.M., The Energetics of Feeding, Metabolism and Growth of Brown Trout (SALMO TRUTTA L.) in Relation to Body Weight, Water Temperature and Ration Size.

1976. Jour. Animal Ecol., 45, 923-948 (Freshwater Biological Association, Windermere Laboratory, Ambleside, England)

Energy budgets were calculated for 5 to 281 g brown trout fed on various ration sizes ranging from zero to maximum rations at different water temperatures (3.8 to 21.7 C). Both the weight of the trout and the water temperature affected the five components of the energy budget: daily intake, losses in

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<209> CONT.
feces and excretory products, change in total energy content of the fish, and metabolism. Equations were developed to estimate these components for trout on maximum rations. Of the three components of metabolism, the energy required for activity and for the apparent specific dynamic action could not be separated, but the energy required for standard metabolism was estimated from equations developed from the data for trout on zero rations. Energy budgets were also constructed for trout on reduced rations. As energy intake decreased, the optimum temperature for maximum values of the mean change in energy content (growth) also decreased, and the temperature range over which growth occurred also decreased. Equations were developed to estimate the maintenance energy intake and the energy required for maintenance metabolism. Estimates of maintenance metabolism provided close estimates of the metabolic requirement of trout on reduced rations at temperatures below 13 C. All these equations were applicable to trout feeding on a variety of food organisms. The gross efficiency of energy utilization exceeded 33% in a narrow zone of energy intake and a temperature range of 8 to 11 C. It then decreased with both increasing and decreasing temperature, energy intake and change in the total energy content of the trout. Equations were developed to estimate the optimum energy intake, i.e. the most efficient energy intake which produces the greatest increase in growth for the least energy intake, and the 'scope for growth' between the maintenance and maximum energy intakes. (Auth)

<210>
Elliott, J.M., Number of Meals in a Day, Maximum Weight of Food Consumed in a Day and Maximum Rate of Feeding for Brown Trout, SALMO TRUTTA L..

1975. Freshwater Biol., 5, 287-303 (Freshwater Biological Association, Ambleside, England)

Brown trout, weight 9 to 302 g, were fed to satiation in each of four meals at seven different water temperatures ranging from 3.8 to 18.1 C. The number of meals per day ranged from one at approximately 4 C to three at approximately 18 C. The maximum weight of food eaten in a day was positively correlated with both weight and temperature. The maximum rate of feedings was not significantly affected by weight, but increased from 3.8 to 6.8 C, was fairly constant from 6.8 to 19.3 C, and decreased markedly above 19.3 C. It was concluded that the upper limit of the daily energy intake determines the optimum temperature for growth. (Auth) (ST)

<211>
Elliott, J.M., Body Composition of Brown Trout (SALMO TRUTTA L.) in Relation to Temperature and Ration Size.

1976. Jour. Animal Ecol., 45, 273-289 (Freshwater Biological Association, Windermere Laboratory, Ambleside, England)

Analyses were made of the body composition of brown trout (live weight 9 to 13 g) fed on various ration sizes ranging from zero to maximum rations at nine different water temperatures (3.8 to 21.7 C). Ash content remained fairly constant in the feeding experiments and can be estimated from the wet weight of the trout. The percent water content decreased and the percent fat, percent protein and energy values all increased with increasing ration size and usually with increasing body weight. Temperature affected the rate of change in body weight. Temperature affected the rate of change in body constitutents in relation to ration size and time. The rates were very low below 6 C, increased progressively above 6 C with maximum values at abont 13 C, remained high for trout on zero rations in the range 13 to 20 C but decreased to very low values for trout on maximum rations. They were also high above 20 C but changes associated with zero rations also occurred in trout on maximum rations. Equations were developed to estimate body constitutents and the energy value of the trout. (Auth) (ST)

<212>
Elvin, D.W., Seasonal Growth and Reproduction of an Intertidal Sponge, HALICLONA PERMOLLIS.

1976. Biol. Bull., 151, 108-125 (Oregon State University, School of Oceanography, Marine Science Center, Newport, OR)

Methods for quantifying gamete production of an encrusting intertidal sponge and for estimating the true tissue temperature during the period of tidal exposure are presented. Reproductive output and growth rates are described for a population of HALICLONA PERMOLLIS located on the Central Oregon Coast. In the field the maximum rate of egg formation occurred in late March to early April when there is an increase in time spent above 10 C; there was no correlation between rate of egg production and average tissue temperature over a period of years. Sperm masses first appeared in April when impinging light and the length of time spent above 10 C threshold increased. No correlation was found between the rate of embryo production and the average air and seawater temperatures, but a positive relation between rate of embryogenesis and the amount of oxidizable particulates in the water did exist. In the laboratory sperm were formed between 7 and 13 C, although sperm packet density was much greater at 13 C. Eggs were produced at the rates of 0.04 and 0.16 eggs/mm3/day at temperatures of 7 and 9.5 C, respectively. A temperature of 4 C was lethal for adults. (ST)

<213>
Elwood, J.W., and R.A. Goldstein, Effects of Temperature on Food Ingestion Rate and Absorption, Retention, and Equilibrium Burden of Phosphorus in an Aquatic Snail, GONIOBASIS CLAVAEFORMIS Lea.

1975. Freshwater Biol., 5, 397-406 (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

The effects of sublethal temperatures on feeding rates and phosphorus dynamics of a freshwater snail, GONIOBASIS CLAVAEFORMIS Lea, were determined and feeding rates were measured at four temperatures. The food source was aufwuchs labelled with radioactive phosphorus. A model was developed to elucidate the results of this type of study. Food ingestion rate increased with increasing temperature up to 14 C and then decreased at temperatures above 14 C. The elimination rate of absorbed phosphorus increased with increasing temperature throughout the entire range of experimental temperatures, 10 to 19.3 C. Mean retention times of absorbed phosphorus in GONIOBASIS were estimated to be 34, 24, 10, and 6 days at 10, 13.8, 15, and

<213> CONT.
19.3 C, respectively. Mean retention time of unabsorbed P-32 in the gut of this species as a function of temperature followed the same temperature relationship as that of ingestion rate. The absorption efficiency of phosphorus was estimated to be constant at about 39% for all experimental temperatures, although the data suggest that the absorption efficiency may have been related inversely to the rate of gut clearance or directly to the residence time of food in the gut. The equilibrium body load of phosphorus at each experimental temperature was estimated based on concentrations of stable phosphorus in the food source and the kinetics of P-32 in GONIOBASIS. The equilibrium body burden of phosphorus in GONIOBASIS increased with increasing temperatures up to a maximum at 11 to 12 C and then decreased at temperatures above 12 C. (Auth)

<214>
Enami, L., and I. Fukuda, Mechanisms of the Acido- and Thermophily of CYANIDIUM CALDARIUM Geitler. I. Effects of Temperature, pH and Light Intensity on the Photosynthetic Oxygen Evolution of Intact and Treated Cells.

1975. Plant Cell Physiol. (Jap.), 16, 211-220 (Scientific University of Tokyo, Department of Biology, Tokyo, Japan)

Photosynthetic oxygen evolution of CYANIDIUM CALDARIUM was measured under various conditions, using a Clark-type oxygen electrode. Maximm Hill reaction activity with p-benzoquinone as the Hill oxidant was obtained at 45 C over a pH range of 1.0 to 7.0. (ST)

<215>
Eriksson, S., S. Evans, and B. Tallmark, On the Coexistence of Scavengers on Shallow Sandy Bottoms in Gullmar Fjord (Sweden): Adaptations to Substratum, Temperature, and Salinity.

1975. Zoon, 3, 65-70 (Uppsala University, Institute of Zoology, Uppsala, Sweden; Uppsala University, Klubban Biological Station, Tiskebackskil, Sweden)

Tests combining salinities of 0 to 60 ppt and temperatures of 0 to 40 C on bottom scavengers in Gullmar Fjord, Sweden, after acclimation at 18 C and 25 ppt gave the following ranking according to temperature tolerance (100% survival): NASSARIUS RETICULATUS (0 to 33 C) more than CARCINUS MAENAS (0 to 33 C) more than CRANGON VULGARIS (0 to 28 C) more than PAGURUS BERNHARDUS (0 to 24 C) more than ASTERIAS RUBENS (0 to 22 C). In LD50 tests performed following acclimation at 7 C and at the normal salinity of 25 ppt, all species reached 100 % survival at 0 C. This reversed the order of A. RUBENS and P. BERNHARDUS. At upper lethal temperatures, hyperactivity and feeding rates were observed as long as good condition continued. At lower lethal temperatures, the animals became sluggish and below 5 C, few fed. NASSARIUS RETICULATUS, with the widest temperature survival range failed to feed below 5 C. PAGURUS BERNHARDUS and A. RUBENS were not tolerant to high temperatures. NASSARIUS RETICULATUS, C. MAENAS, and C. VULGARIS are eurythermic but became sluggish at low temperatures. (RFC)

<216>
Eriksson, S., S. Evans, and B. Tallmark, On the Coexistence of Scavengers on Shallow, Sandy Bottoms in Gullmar Fjord (Sweden): Activity Patterns and Feeding Ability.

1975. Zoon, 3, 121-124 (Institute of Zoology, Uppsala, Sweden)

The activity patterns, locomotory speed, and successions at carrion of CARCINUS MAENAS, PAGURUS BERNHARDUS, CRANGON VULGARIS, NASSARIUS RETICULATUS, and ASTERIAS RUBENS in a shallow, sandy-floored fjord were investigated. In March at 3 C, activity was low with N. RETICULATUS virtually inactive. During April and August at 7 and 20 C, respectively, the animals showed a higher level of activity. CRANGON VULGARIS was nocturnal year round while C. MAENAS and N. RETICULATUS displayed nocturnal movements when adapted to summer conditions. (ST)

<217>
Escaffre, A.M., and R. Billard, Spermatogenesis in Gardon RUTILUS RUTILUS.

1976. Cah. Lab. Hydrobiol. Montereau (Fr.), No. 3, 43-46 (I.N.R.A. Laboratoire de Physiologie des Poissons, Jouy en Josas, France; I.N.R.A., Station d'Hydrobiologie Lacustre, Thonon les Bains, Frances)

A descriptive study of spermatogenesis in Gardon (roach) RUTILUS RUTILUS showed that the cycle began in September and ended in May. Spermatogonia B were developing between September and March, spermatocytes between January and April, and spermatids in April and May. While spermatocytes were formed in April, the maximum number was attained in May but diminued during June. Radioimmunoassay of the concentration of gonadotropin in the pituitary (equivalent to c-GtH) showed peaks coincident with the phase of multiplication of spermatogonia (November), meiosis (February) and spermation (June). The relationship of these results with environmental changes (temperature and photoperiod) is discussed. (English summary)

<218>
Esch, G.W. (Ed.), and R.W. (Ed.) McFarlane, Thermal Ecology II.

1976. CONF-750425; ERDA Symposium Series 40; Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Wake Forest University, Winston-Salem, NC; Savannah River Ecology Laboratory, Aiken, SC)

Fifty-seven papers on various aspects of thermal ecology were published in the symposium proceedings. Invited papers presented the power park concept and reviewed thermal ecology at the individual, population, and ecosystems levels. Contributed papers were grouped under the headings: temperature and physiological parameters; thermal tolerance; temperature and fish behavior; populations, communities, and ecosystems; environmental impact of electric power facilities; and impingement, entrainment, and electric facilities. (ST)

<219>
Faber, D.J., Hyponeustonic Fish Larvae in the Northumberland Strait during Summer 1962.

1976. Jour. Fish. Res. Bd. Can., 33, 1167-1174 (National Museum of Natural Sciences, Canadian Oceanographic Identification Centre, Ottawa, Ontario, Canada)

<219>

<219> CONT.
Larvae of eight abundant species of fish were collected from the surface water of Northumberland Strait, Canada. Greatest larval abundance was in July. The regular appearance of the eight species resulted from unique combinations of spawning and hatching times for each species. The larvae of spring spawners. Seasonal occurrence of the eight species and associated surface temperatures in the north basin of the Northumberland Strait, 1962, were sand lance, 12 to 13.5 C; radiated shanny, 12 to 16 C; lumpfish and fourbeard rockling, 12 to 17 C; Atlantic mackerel, 13 to 17 C; cunner, 16 to 17 C; white hake, 14 to 17 C; Atlantic herring (spring), 12 to 13.5 C; Atlantic herring (fall), 14 to 16 C. The surface temperature at which particular larvae began to occur were sand lance and radiated shanny, less than 12 C; lumpfish and fourbeard rockling, 12 C; Atlantic mackerel, 13 C; cunner, 16 C; white hake, 17 C; Atlantic herring (spring), less than 12 C; Atlantic herring (fall), 16 C. (ST)

<220>
Fahy, W.E., The Morphological Time of Fixation of the Total Number of Vertebrae in FUNDULUS MAJALIS (Walbaum).

1976. Jour. Const. Intl. Explor. Mer, 36, 243-250 (University of North Carolina, Institute of Marine Sciences, Morehead City, NC)

Three lots of embryos with epiboly about one-third complete were reared continuously in different fluctuating temperature regimes (16 to 20, 22 to 26, and 28 to 32 C). At certain somite-number stages (3 to 6, 9 to 12, 15 to 23, 24 to 28, and 29 to 32) paired lots of embryos were transferred from the intermediate temperatures to the warmer and cooler regimes simultaneously. Mortalities were low (7.0%) to moderate (28.6%) in the 13 treatments. Embryos reared continuously in the three temperature regimes developed mean vertebral numbers showing a linear inverse relationship between temperature and mean vertebral count; on the average decreasing temperature induced an increased number of vertebrae. Among the transferred embryos only the 3 to 6 and 9 to 12 somite lots transferred to the cold regime responded to temperature changes. The response of presumptive vertebral tissue to cold temperature begins to decrease during the formation of the fifth and sixth somites and continues gradually until fixation occurs during formation of the tenth through twelfth somites. Cold temperatures influenced vertebral number more than warm and it is suggested that vertebral number in fishes spawning on rising water temperatures may be influenced more by cold water than by warm; conversely, fishes spawning on falling water temperatures may be influenced more by warmer than by colder water. (Auth)

<221>
Faust, M.A., A.E. Aotaky, and M.T. Hargadon, Effect of Physical Parameters on the In Situ Survival of ESCHERICHIA COLI MC-6 in an Estuarine Environment.

1975. Appl. Microbiol., 30, 800-806 (Chesapeake Bay Center for Environmental Studies, Smithsonian Institution, Edgewater, MD)

Survival of ESCHERICHIA COLI MC-6 of fecal origin in an estuarine environment as affected by time, water temperature, dissolved oxygen, salinity, and montmorillonite in diffusion chambers was studied. Survival of the bacteria varied seasonally. Survival was closely and negatively correlated with increasing water temperature between 5 and 30 C. It is suggested that water temperature is the most important factor in predicting fecal coliform survival from point and nonpoint sources in assessing water quality in an estuarine ecosystem. (ST)

<222>
Fell, P.E., The Reproduction of HALICLONA LOOSANOFFI and Its Apparent Relationship to Water Temperature.

1976. Biol. Bull., 150, 200-210 (Connecticut College, Department of Zoology, New London, CT)

The reproductive period of HALICLONA LOOSANOFFI in the Mystic Estuary, Conn. is from late May or early June to late July or early August. Water temperature rises rapidly in the late spring and is usually above 20 C by early June. Specimens with small eggs or spermatic cysts may be found until late September. The reproductive period at Mystic, Conn. is about two months earlier than at Milford, Conn. and occurs at about the same time of year as the major reproductive period at Hatteras Harbor, N.C. Water temperature appears to be a major factor determining the reproductive period. (ST)

<223>
Ferguson, R.L., A. Collier, and D.A. Meeter, Growth Response of THALASSIOSIRA PSEUDONANA Hasle and Heimdal Clone 3H to Illumination, Temperature and Nitrogen Source.

1976. Chesapeake Sci., 17, 148-158 (National Marine Fisheries, Atlantic Estuarine Fisheries Center, Beaufort, NC; Florida State University, Departments of Biological Sciences and Statistics, Tallahassee, FL)

The exponential phase division rate of the diatom, THALASSIOSIRA PSEUDONANA, was studied in response to illumination intensity, day length, temperature, and nitrogen sources and concentrations. An optimal temperature range which always included 21 C, but which varied in size with illumination intensity and with nitrogen source and concentration was observed. Growth rate was affected by interactions among illumination intensity, temperature, and nitrogen sources and concentrations. (ST)

<224>
Ferrari, I., and A. Ascolini, Life Cycle of EUDIAPTOMUS INTERMEDIUM (Steuer) (Copepoda, Calanoida) in a Mountain Lake.

1975. Bool. Zool. (It.), 42, 39-47 (Universita de Parma, Laboratorio de Ecologia, Parma, Italy)

The life cycle of EUDIAPTOMUS INTERMEDIUS was studied by analyzing 28 zooplankton samples collected from Lake Santo Parmense, Italy. EUDIAPTOMUS INTERMEDIUS is a univoltine species. At the end of the ice-cover season only adults were present in the population; they reproduced from May to July. In late August the whole population was represented by individuals of the new generation. The duration of each copepodite stage during the two year study was calculated and differences were analyzed in relation to the thermal variations of the lake. (ST)

<225>
Fetterolf, C.M., Jr., The Need to Assess Cooling Water Use on a Waterbody Basis.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Great Lakes Fishery Commission, Ann Arbor, MI)

The concept of biological value allocation of individual waterbodies is suggested. This concept should limit the loss of biological value of a waterbody and maintain and protect the ecosystem structure and function in line with management objectives, while taking into account responsibility to the environment, industry, and people. Nine basic components of the mechanism are outlined. (ST)

<226>
Flemer, D.A., The Effects of Entrainment on Phytoplankton at the Morgantown Steam Electric Station, Potomac River Estuary, September 5-8, 1972.

1974. PB-240 758; EPRI-74-049-00-5; Electric Power Research Institute Cooling Water Studies Report No. 15; In Jensen, L.D. (Ed.), Proceedings of the Second Entrainment and Intake Screening Workshop held at Johns Hopkins University, Baltimore, Maryland, February 5-9, 1973. National Technical Information Service, Springfield, VA (Chesapeake Biological Laboratory, Solomons, MD)

The effects of chlorination and augmentation pumping on entrained phytoplankton were examined individually and in combination. Chlorophyll a concentration was used as an index of phytoplanktonic standing crop, and the rate of C-14 uptake an estimate of the phytosynthetic rate for samples collected at the intake, the condensers and near the end of the effluent canal. The Morgantown plant had an adverse effect on entrained phytoplankton. Carbon-14 uptake was reduced at the ambient temperatures and temperature rise observed. (Auth) (ST)

<227>
Fliermans, C.B., R.W. Gorden, T.C. Hazen, and G.W. Esch, AEROMONAS Distribution and Survival in a Thermally Altered Lake.

1976. DP-MS-75-115; Part of Proceedings of the Annual Meeting of the American Society for Microbiology held in Atlantic City, New Jersey, May 2-7, 1976; Appl. Environ. Microbiol., 33, 114-122 (Savannah River Laboratory, Aiken, SC; University of Southern Colorado, Pueblo, CO; Wake Forest University, Winston-Salem, NC)

Distribution and population densities of AEROMONAS in the water column of Par Pond on the Savannah River Plant, SC, were measured along an oxygen and temperature gradient. Greater population densities of AEROMONAS occurred below the oxygen chemocline when the lake was stratified. Survival of A. HYDROPHILA under in situ conditions in both epilimnetic and hypolimnetic waters was determined using polycarbonate membrane diffusion chambers, during two separate reactor operating conditions. Survival levels of pure cultures of A. HYDROPHILA corresponded to the distribution patterns of the naturally occurring AEROMONAS-like populations. The greater survival of A. HYDROPHILA below the chemocline when the reactor was in full operation suggests that the fish populations may be exposed to AEROMONAS for a longer period of time than when the reactor is not operating. (Auth)

<228>
Foda, A., Seasonal Variations in Proximate Composition of Hatchery-Reared Atlantic Salmon (SALMO SALAR).

1974. MAR/T-74-2, 12 p. (Department of the Environment, Fisheries and Marine Service, Resource Development Branch, Halifax, Nova Scotia, Canada)

Proximate analysis was determined for hatchery-reared Atlantic salmon (SALMO SALAR) on a monthly basis throughout a period of one year (July 1971-June 1972). Indirect relationship between fat and moisture content, accompanied with a slight change in protein level, was observed. Differences in fat and moisture, due to state of maturation, were also recorded. The pattern of seasonal variation and changes during parr-smolt transformation are discussed. (Auth)

<229>
Foda, A., Seasonal Variation in Blood Parameters and Muscle and Liver Glycogen of Hatchery-Reared Atlantic Salmon (SALMO SALAR).

1974. MAR/T-74-3, 18 p. (Department of the Environment, Fisheries and Marine Service, Resource Development Branch, Halifax, Nova Scotia, Canada)

A study was made of the changes occuring in a number of blood constituents and in liver and muscle glycogen of Atlantic salmon (SALMO SALAR L.) during the second year of hatchery rearing. The study reflects the change in water temperature and its effect on most of the parameters. Smoltification was accompanied by an increase in blood glucose level. Muscle and liver glycogen, and blood lactic acid were higher during the summer season, whereas blood hematocrit, hemoglobin and specific gravity were higher during the winter. The effect of prolonged exposure to low water temperatures on the different parameters is discussed. (Auth)

<230>
Fontaine, M., J.C. Lacaze, Y.Le. Pemp, and O. Villedon de Naide, Some Interactions between Thermal Pollution and Pollution by Hydrocarbons.

1974. Illes Journees Etud. Pollutions, Part of Proceedings of the Work of the Committee for the Fight against Marine Pollution held in Monaco December 6-7, 1974 (p. 115-122). C.I.E.S.M., Monaco, 1975 (Institute Oceanographique, Laboratoire de Physiologie des Etres Marins, Paris, France)

Several studies on the interactions between oil and thermal pollution are reviewed. Seasonal influences and the direct affect of temperature on the interactions are discussed. An apparatus for the combined study of thermal and chemical pollution is discribed. The effect of seasonal temperatures, temperatures other than adaptation temperatures, and the length of pollution duration are noted. Experimental conditions for the study of the influence of season and the direct effect of temperature on oil extract toxicity are tabulated. (ST)

<231>
Forsyth, M.A., and R.C. Fox, The Influence of

<231>

<231> CONT.
Substrate and Heated Effluent from Oconee Nuclear Station on Populations of Fresh Water Insects in Lake Keowee - Littoral Zone.

1976. Jour. Georgia Entomol. Soc., 11, 138-150 (Clemson University, Department of Entomology and Economic Zoology, Clemson, SC)

A study was conducted in Lake Keowee, South Carolina from July 1973 to December 1974 to determine the effects of the thermal effluent from the Oconee Nuclear Station upon aquatic insect populations. Biweekly sampling in three major natural inlets and the heated water discharge cove indicated that 99% of the aquatic insects were Diptera. The water temperature differences between the discharge cove and the streams were not great enough to disrupt or accelerate insect population cycling. The discharge cove yielded only 5% of the total number of insects collected from the four sampling stations. Substrate preference appeared to have more influence than water temperature in determining population densities. Low numbers in the discharge cove were attributed to fish predation, the sand substrate, and insufficient organic detritus. (Auth)

<232>
Fournier, P., and E. Magnin, Reproduction du Petit Barre de l'est FUNDULUS DIAPHANUS DIAPHANUS (Le Sueur).

1975. Naturaliste Can., 102, 181-188 (Service de la Faune du Quebec, Station Piscicole, Saint-Faustin, Quebec, Canada; Universite de Montreal, Department des Sciences Biologiques, Montreal, Canada)

The relationship between gonad weight and total body weight for the female banded killifish FUNDULUS DIAPHANUS indicated that postspawning egg development is slow until spring. With increasing water temperatures in early June, the weight of ovaries and testicles increased rapidly until the spawning season which occurred six weeks later. All males and most females in lakes Saint-Louis and Renaud were mature when two years old. Sexual maturity appeared to be a function of size rather than age. The minimum lengths at which female banded killifish produced mature eggs, in lakes Saint-Louis and Renaud, were found to be 42 mm and 47 mm respectively. Data indicated females comprise 75% of the population in Lake Saint-Louis and 55% in Lake Renaud. Spawning occurred in both lakes over the month of July lasting a minimum of three weeks when water temperatures range from 21 C to 23 C. (Auth)

<233>
Fowler, S.W., and G. Benayoun, Influence of Environmental Factors on Selenium Flux in Two Marine Invertebrates.

1976. Marine Biol. (W. Ger.), 37, 59-68 (International Laboratory of Marine Radioactivity, Musee Oceanographique, Principality of Monaco)

The influence of certain environmental factors on the flux of selenium through marine biota was studied using the mussel (MYTILUS GALLOPROVINCIALIS) and shrimp (LYSMATA SETICAUDATA) as test organisms. Over a selenium concentration range spanning three orders of magnitude (1, 10, and 100 ug Se/l) uptake by mussels was dependent upon the selenium concentration in sea water. Mussels accumulated Se (+4) to a much greater extent than Se (+6) and bioaccumulation was dependent upon temperature and mussel size. Increasing the temperature from 13 to 24 C approximately doubled the selenium concentration factor after 13 days uptake; the same temperature range had no apparent effect on selenium uptake by shrimp. The difference was due to the large amount of sorbed isotope lost with shrimp molts. Temperature affected the loss of Se-75 from mussels but did not significantly alter the loss rate in shrimp. There was a faster loss at the higher temperature in mussels. (ST)

<234>
Fox, J.L., and M.S. Moyer, Effect of Power Plant Chlorination on Estuarine Productivity.

1975. Chesapeake Sci., 16, 66-68 (University of Florida, Department of Environmental Engineering Sciences, Gainesville, FL)

Primary production values of cooling water passing through a power plant at Crystal River, Florida, decreased an average of 57% due to plant passage and chlorination. In the absence of chlorine, the average decrease was 13%. A decrease in primary production occurred when the intake temperature exceeded 27 C. The average temperature increase through the plant was 5.5 C. (ST)

<235>
Foy, R.H., C.E. Gibson, and R.V. Smith, The Influence of Daylength, Light Intensity and Temperature on the Growth Rates of Planktonic Blue-Green Algae.

1976. Brit. Phycol. Jour., 11, 151-163 (Department of Agriculture, Freshwater Biological Investigation Unit, Antrim, Northern Ireland)

The temperature maxima for growth of four dominent blue-green algae from Lough Neagh (Ireland) were low. No growth was observed for OSCILLATORIA AGARDHII, OSCILLATORIA REDEKEI, and APANIZOMENON FLOSAQUAE at 35 C while ANABAENA FLOSAQUAE was severely inhibited at 25 C. (ST)

<236>
Fraizier, A., and J. Ancellin, Influence of Temperature on the Contamination of Marine Species by Iron-59.

1975. IAEA-SM-197/15; Part of Proceedings of a Symposium on the Combined Effects of Radioactive, Chemical and Thermal Releases to the Environment held in Stockholm, Sweden, June 2-5, 1975. International Atomic Energy Agency, Vienna (CEA, Department de Protection, Laboratoire de Radioecologie Marine, Centre de La Hague, Cherbourg, France)

The interactions between a marine mollusc (MYTILUS EDULIS) and fish (BLENNIUS PHOLIS) and iron-59 were investigated in relation to the physicochemical states of the radionuclide in marine water and to the environmental temperature. Contamination appeared to be dependent on temperature which partly influenced in the physicochemical state of the radionuclide and the metabolic activity of the animals. A rise in temperature resulted in a much greater accumulation of the soluble form of iron than the insoluble forms. Thus accumulation appeared to be relatively non-dependent on biological uptake processes. (Auth) (ST)

<237>
Freadman, M.A., and C.P. Mangum, The Function of Hemoglobin in the Arcid Clam NORTIA PONDEROSA. I. Oxygenation in Vitro and in Vivo.

1976. Comp. Biochem. Physiol., 53A, 173-179 (College of William and Mary, Department of Biology, Williamsburg, VA)

The oxygen affinity (P50) of hemoglobin in intact cells of the arcid clam, NORTIA PONDEROSA, in the pH range of 6.6 to 7.4 was 5.30 mm Hg at 10 C and 6.25 mm Hg at 23 C. (ST)

<238>
Freed, J.M., and C.R. Kirk, Phosphofructokinase Activity of Temperature-Acclimated Crayfish.

1976. Comp. Biochem. Physiol., 54B, 515-517 (Ohio Wesleyan University, Department of Zoology, Delaware, OH)

Phosphofructokinase activity of abdominal muscles of ORCONECTES VIRILIS acclimated to 5, 15, and 25 C, did not differ significantly. The effect of substrate concentration, 5'AMP, and assay temperature were noted. (ST)

<239>
Friedlander, M.J., N. Kotchabhakdi, and C.L. Prosser, Effects of Cold and Heat on Behavior and Cerebellar Function in Goldfish.

1976. Jour. Comp. Physiol., 112, 19-45 (University of Illinois, Department of Physiology and Biophysics, Urbana, IL)

Behavioral effects of cooling and heating of goldfish are described. On moderate heating and cooling, fish were hyperexcitable and spontaneously hyperactive; on further heating or cooling swimming was uncoordinated. Similar effects were observed when the cerebellum was cooled or heated locally with a thermode. At 6 to 7 C fish lost equilibrium and swam on one side; at 4 C spinal reflexes were lost and fish went into a state of coma. Upon heating, equilibrium loss and cessation of breathing depended upon acclimation temperature. Electrical activity of Purkinje neurons changed in the same thermal range as behavior. (ST)

<240>
Fry, F.E.J., Thermal Physiological Effects in Aquatic Systems.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (University of Toronto, Institute for Environmental Studies, Toronto, Ontario, Canada)

Thermo-physiological studies published since 1972 are reviewed. Emphasis is on the response of fish to temperature change. Discussed are the response to acclimation, the interaction between temperature and toxic substances, lethal effects, and effects on activity. The lack of laboratory studies using a fluctuating temperature regime is noted. (ST)

<241>
Fryer, J.L., K.S. Pilcher, J.E. Sanders, J.S. Rohovec, J.L. Zinn, W.J. Groberg, and R.H. McCoy, Temperature, Infectious Diseases, and the Immune Response in Salmonid Fish.

1976. EPA-600/3-76-021; 80 p. (Oregon State University, Microbiology Department, Corvallis, OR)

Investigations of the effect of temperature on infections of salmonid fish were conducted. AEROMONAS SALMONICIDA infection was studied in chinook salmon and steelhead trout; AEROMONAS LIQUEFACIENS infection in chinook and coho salmon. In all cases mortality rates were high at 18 to 20.6 C; usually moderate at 12 to 15 C; and low or zero at 3.9 to 9.3 C. Progress of the infections was accelerated at higher temperatures, and retarded at lower temperature levels. Bacterial kidney disease (CORYNEBACTERIUM sp.) was studied in coho salmon and steelhead trout. The temperature range of 6.7 to 12 C was optimal for the development of fatal infection, as indicated by mortality rates of 78 to 100%. Higher temperatures had a suppressing effect, which was marked at 20.6 C. Temperatures of 15 to 20.6 C were optimal for the formation of agglutinating antibody when juvenile coho salmon were injected with a killed suspension of A. SALMONICIDA. At lower temperatures less antibody was formed, and no significant amount was produced at 3.9 C 60 days after injection of antigen. Oral immunization of juvenile coho salmon with a vaccine consisting of formalin killed VIBRIO ANGUILLARUM cells incorporated in their diet protected them against fatal infection when the fish were held at temperatures from 3.9 to 20.6 C during immunization. (Auth)

<242>
Fuziwara, T., On the Reproduction of CORBICULA LEANA Prime.

1975. Japanese Jour. Malacol., 34, 54-56 (Sankasho Junior High School, Gokase-cho, Miyazaki-ken, Japan)

Ovulation of a freshwater clam, CORBICULA LEANA, occurred year round in an aquarium with water temperature above 19 C. (ST)

<243>
Galkina, Z.I., High Water Temperature and Oxygen Deficiency Tolerance in Larval Carp.

1976. Rybokhoz. Izuch. Vnutr. Vod. (USSR), No. 15, 44-47 (GosNIORKh, Leningrad, USSR)

The resistance of cultured carp to high water temperature and oxygen deficiency was determined. Resistance of larvae to high temperature was independent of the age of the larvae, but was related to rearing temperatures. Larvae reared at 19 to 27 C suffered heat shock at 38.8 C while those reared at 16 to 21 C showed shock at 36.4 C. Lethal oxygen concentrations were 1.05 mg/l for summer-hatched larvae and 0.99 mg/l for fall- and winter-hatched larvae. (Auth) (ST)

<244>
Gallaway, G.J., and K. Strawn, Seasonal and Areal Comparisons of Fish Diversity Indices at a Hot-Water Discharge in Galveston Bay, Texas.

1975. Contrib. Marine Sci., 19, 79-89 (Texas A&M University, College Station, TX)

Trawl and hydrological samples were taken at 11 stations once each month, January 1968 through December 1969, in an area of

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<244> CONT.
Galveston Bay receiving a discharge of heated water from the P.H. Robinson Generating Station. Fish species diversity in the sampled area exhibited seasonal trends and was strongly affected by the monthly abundance patterns of the three dominant species, MICROPOGON UNDULATUS, ANCHOA MITCHILLI, and ARIUS FELIS. Comparison of the discharge area to two control areas in terms of diverstiy indices did not indicate significant differences. Temporary reductions in diversity were observed when mean surface water temperatures exceeded 35 C. The species richness aspect of diversity appeared to have been higher in the discharge area than in either of the control areas during both years. (ST)

<245>
Gallepp, G., Temperature as a Cue for the Periodicity in Feeding of BRACHYCENTRUS OCCIDENTALIS (Insecta: Trichoptera).

1976. Animal Behaviour, 24, 7-10 (University of Wisconsin, Laboratory of Limnology, Madison, WI)

Filtering behavior of two groups of BRACHYCENTRUS OCCIDENTALIS larvae exposed to a diel temperature cycle and a 12:12 light:dark photoperiod was observed for five days of continuous light; diel temperature pattern was maintained for one group. The larvae showed a diel periodicity under the initial conditions that was quickly lost in continuous light and constant temperature. Under continuous light and daily fluctuating temperatures, larvae could maintain a diel periodicity. However, the amplitude of the periodicity was moderated. (Auth)

<246>
Gallup, D.N., and M. Hickman, The Limnology of Lake Geraldine, Frobisher Bay, N.W.T. V. Man-Made Lakes.

1975. Verh. Intl. Ver. Limnol. (Ger.), 19, 1746-1757 (University of Alberta, Departments of Zoology and Botany, Edmonton Alberta, Canada)

The physical, chemical, and primary productivity aspects of the addition of heated effluent to Lake Geraldine, a cold northern lake, located at Frobisher Bay on Baffin Island, Canada, were assessed. Water temperature in the lake ranged from 1.5 to a high of 9 C in August. Heated water from a diesel operated power generating station is discharged at a temperature ranging from 20 to 29 C, with a mean discharge temperature of 26 C at the rate of 1,324.8 m3/day. Dissolved oxygen, and other chemical parameters were not significantly different between control and the thermal site. Primary productivity and chlorophyll a values, when compared over the ice-free period between the thermal and control stations, were not significantly different, thereby indicating that the heated effluent did not alter the trophic state of the lake. (ST)

<247>
Gallup, D.N., and M. Hickman, Effects of the Discharge of Thermal Effluent from a Power Station on Lake Wabamun, Alberta, Canada - Limnological Features.

1975. Hydrobiologia (Den.), 46, 45-69 (University of Alberta, Departments of Zoology and Botany, Edmonton, Alberta, Canada)

The physical and chemical aspects of Lake Wabamun have been described. Modifications to the thermal and dissolved oxygen regimes through the discharge of thermal effluent into the eastern region of the lake are discussed. This discharge has changed the environmental conditions under which the biota exists in the eastern portion of the lake. It was also shown that this discharge of heater water had no effect upon the water chemistry while the power station itself contributed silica, in the form of fly ash, to the system. Tables of the phytoplankton, zooplankton, aquatic macrophytes, and fish were provided. From a biological and limnological standpoint the lake can be classified as moderately eutrophic lake, especially in the eastern portion. (Auth)

<248>
Gallup, D.N., M. Hickman, and J. Rasmussen, Effects of Thermal Effluent and Macrophyte Harvesting on the Benthos of an Alberta Lake.

1975. Verh. Intl. Ver. Limnol. (Ger.), 19, 552-561 (Not given)

A general survey of the benthic animals of Lake Wabamun showed that there were differences within the heated bay and also between it and the open lake. These differences were attributed to water temperatures (as high as 30 C) and fluctuations in water temperature, current, and sediment type. A molluscan community associated with the vegetation and an oligochaete community in the sediments of the heated area were observed. The predominance of aquatic insects and crustaceans in the heated bay in general distinguished this area from the open lake where standing crops of these two groups were lower. The cutting and harvesting of aquatic plants produced a significant decrease in the numbers of PHYSA GYRINA; the populations of chironimids and amphipods were reduced to a lesser degree. (ST)

<249>
Garten, C.T., Jr., and J.B. Gentry, Thermal Tolerance of Dragonfly Nymphs. II. Comparison of Nymphs from Control and Thermally Altered Environments.

1976. Jour. Physiol. Zool., 49, 206-213 (Savannah River Ecology Laboratory, Aiken, SC)

Dragonfly nymphs were collected from ponds and streams thermally altered by reactor cooling water and from control ponds and streams (Savannah River Plant). The critical thermal maxima of seven species of dragonfly nymphs were estimated at acclimation temperatues of 12, 16, 20, 24, 28, and 32 C. Within each environment, species with greater mean body length exhibited a higher thermal tolerance than smaller species. Species differences in critical thermal maximum (CTM) were statistically significant within each environment examined, but those differences were trivial relative to the much greater influence of acclimation temperature. Mean CTM was significantly regressed against acclimation temperature in each species. Nymphs from a thermally elevated pond exhibited a greater increase in CTM per degree rise in acclimation temperature than nymphs from other habitats. Mean thermal tolerances of dragonfly nymphs from the four environments increased in the following order: control stream, control pond, thermal stream, and thermal pond. (Auth)

<250>
Gaudy, R., Study of Respiration in some Mediterranean Pelagic Copepods (Occidental Basin and Ionian Sea) and of its Variations in Relation to the Bathymetric Character and the Geographic Origin of Species.

1975. Marine Biol. (W. Ger.), 29, 109-118 (Station Marine d'Endoume et Centre d'Oceanographie, Marseille, France; Centre Universitaire de Luminy, Marseille, France)

Respiration rates of pelagic copepods collected from two Mediterranean stations were determined at 10, 14, 18 and 22 C. In all cases oxygen consumption increased with increasing temperature. The metabolism-temperature curves revealed varying degrees of thermal sensibility of copepod respiration related to their respective habitats. Bathypelagic species proved most sensitive. Vertically migrating species appeared to be more tolerant to temperature variation. Comparison of the respiration-weight relation of specimens from the two Mediterranean stations with those from a previously studied Atlantic station indicated that observed differences are related to the average temperature of the mesopelagic waters in each sampling area. (ST)

<251>
Gay, B. (Ed.), M.J.B. (Ed.) La Croix, and I.L. (Ed.) Ophel, Low-Grade Heat: A Resource in Cold Climates.

1975. AECL-5322/1, Proceedings of a Workshop held at the Chalk River Nuclear Laboratories October 6-10, 1975. Atomic Energy of Canada Limited (Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada)

An international workshop conference on the prospects for the utilization of some of the low-grade heat at present being rejected to the environment, with particular emphasis on its application in cold climates, was held. The subject was examined in terms of its implications for aquaculture, agriculture, environmental enhancement, industrial applications, district heating, economics, demonstration projects, and the long-range future. The proceedings include the recommendations that were an outcome of these meetings. (Auth) (ST)

<252>
George, C.J., and J.H. Gordan, II, Observations on the Rainbow Smelt in Lake George, New York.

1976. N.Y. Fish & Game Jour., 23, 13-19 (Rensselaer Polytechnic Institute, Troy, NY)

Observations on spawning runs of rainbow smelt, OSMERUS MORDAX, in Smith Bay Brook and Hague Brook, tributaries of Lake George, during April 1974 are presented. Water temperature in Smith Bay Brook at the start of the run on April 23-24 was 7.5 C. (ST)

<253>
Gerald, V.M., The Effect of Temperature on the Consumption, Absorption and Conversion of Food in OPHIOCEPHALUS PUNCTATUS Bloch.

1976. Hydrobiologia (Den.), 49, 87-93 (Madura University, Department of Biological Science, Madurai, India)

The feeding rate of the fish, OPHIOCEPHALUS PUNCTATUS, was maximum at 28 C and decreased at 20 and 33 C for all sizes. Smaller fish were cold sensitive. At 28 and 33 C the time course rate showed the same decline; at 20 C the response was anomalous. Absorption efficiency was independent of size and temperature. Rate of absorption and hence rate of conversion was primarily conditioned by rate of feeding. At 20 C the conversion efficiency was directly related to size whereas at 28 and 33 C it was inversely related to size. (Auth)

<254>
Gerloff, G.C., and G.P. Fitzgerald, The Nutrition of Great Lakes CLADOPHORA.

1976. EPA-600/3-76-044; USEPA, Office of Research and Development, Environmental Research Laboratory, Duluth, Minn. (University of Wisconsin, Department of Botany and Water Resources Center, Madison, WI)

As part of a study of the great Lakes CLADOPHORA, experiments on the response of CLADOPHORA GLOMERATA to variations in temperature, light, and several other physical factors were carried out. The temperature under which C. GLOMERATA has been routinely cultured, 22 to 23 C, was found to be optimum. The alga appeared relatively insensitive to high temperature with optimum yields maintained at 30 to 31 C. Growth was reduced to 63% of optimum at temperatures of 16 to 17 C. (ST)

<255>
Gibbons, J.W., Thermal Alteration and the Enhancement of Species Populations.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Savannah River Ecology Laboratory, Aiken, SC)

The environmental energy supplement resulting from thermal loading is examined as a potential enhancement to plant and animal populations. Example are given to show that the energy surplus is often converted into positive returns for populations. Establishing the conditions under which populations respond positively to artificial thermal elevation should be given equal importance with considering negative effects. (Auth)

<256>
Gibson, C.I., T.O. Thatcher, and C.W. Apts, Some Effects of Temperature, Chlorine, and Copper on the Survival and Growth of the Coon Stripe Shrimp.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Batelle Pacific Northwest Laboratories, Ecosystems Department, Marine Research Laboratory, Sequim, WA)

A series of bioassay and growth-rate experiments were conducted on coon stripe shrimp, PANDALUS DANAE, to determine the LC50 value for heat, the LC50 values for chlorine and copper, and the effects of sublethal concentrations of these materials on their growth rate. The critical thermal maxima for three size groups, 1 to 2g, 4 to 7g, greater than 9g, ranged from 26.3 to 31.8 C depending on shrimp size and rate of temperature

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increase. Bioassays (96 hr) at 10, 15, and 20 C were conducted using chlorine or copper as the toxicant. Growth was measured for one month at temperatures between 10 and 25 C. The greatest growth occurred at 16 C. Growth of the shrimp held at 16 C while being exposed to sublethal concentrations of both copper and chlorine was studied. (Auth)

<257>
Gilbert, J.J., Field Experiments on Gemmulation in the Fresh-Water Sponge SPONGILIA LACUSTRIS.

1975. Trans. Amer. Micros. Soc., 94, 347-356 (Dartmouth College, Department of Biological Sciences, Hanover, NH)

For several successive years gemmulated sponge was collected in November from a New Hampshire bog pond, stored at 2 to 4 C in the dark, and then implanted back into the pond at different times during the following spring and summer. Sponges developing from implants set out after mid-June gemmulated later than sponges implanted during May and early June. Sponges implanted in late August and September either failed or just began to initiate gemmule formation by the end of the first week in November, the approximate time of surface ice formation and when the natural population in the pond had completed gemmule development. Clearly, gemmulation is not regulated entirely by environmental factors characteristic of a particular time of year. The implications of these findings, regarding the control and adaptive significance of gemmulation, are discussed. At water temperatures between 10 to 12 C, the development of gemmules with a single coat takes approximately two weeks. (Auth)

<258>
Giles, M.A., and W.E. Vanstone, Ontogenetic Variation in the Multiple Hemoglobins of Coho Salmon (ONCORHYNCHUS KISUTCH) and Effect of Environmental Factors on Their Expression.

1976. Jour. Fish. Res. Bd. Can., 33, 1144-1149 (Concordia University, Sir George Williams Campus, Department of Biological Sciences, Montreal, Quebec, Canada; Department of the Environment, Fisheries and Marine Service, Vancover Laboratory, West Vancover, British Columbia, Canada)

Hemolyzates from the blood of coho salmon (ONCORHYNCHUS KISUTCH) at various stages of development were subjected to micro-starch-gel electrophoresis. Three distinct electrophoretic patterns composed of different combinations of 18 hemoglobin tetramers were observed. Embryonic and yolk-sac alevins possessed 1 cathodic and 12 anodic components while fry retained only 3 of the 12 anodic polymorphs. During smolitification, 4 new cathodic components appeared and 2 of the anodic and the cathodic components of alevin hemolyzates reappeared. This latter pattern was retained until the fish spawned and died. Attempts to induce changes in the pattern of development of these hemoglobins by exposing fry and pre-smolts to extreme variations in dissolved oxygen, temperature, and salinity were completely unsuccessful. (Auth)

<259>
Ginn, T.C., W.T. Waller, and G.J. Lauer, Survival and Reproduction of GAMMARUS spp. (Amphipoda) Following Short-Term Exposure to Elevated Temperatures.

1976. Chesapeake Sci., 17, 8-14 (New York University Medical Center, Institute of Environmental Medicine, New York, NY)

GAMMARUS sp. (GAMMARUS DAIBERI and GAMMARUS TIGRINUS) experienced no increased latent mortalities for periods up to 10 days after being exposed to an 8.3 C temperature increment above an ambient temperature of 25.5 C for periods up to 60 min. An 11.1 C temperature increment above an ambient temperature of 26.5 C resulted in significant reductions in survival in groups of GAMMARUS sp. exposed for 30 and 60 min. No significant mortalities were observed, however, following a five-minute exposure to the 11.1 C increment. At an ambient temperature of 11.7 C GAMMARUS sp. exposed to 16.7 C temperature increments for periods up to 180 min. displayed no increased mortalities 10 days after exposure. A sustained 17-day exposure of GAMMARUS sp. to a 15.6 increment at ambient temperatures of 11.2 to 7.1 C resulted in no increased mortalities and stimulated reproductive behavior. Subsequent reproductive activities were not affected by up to 60-min exposures of mature GAMMARUS sp. to an 8.3 increment at an ambient temperature of 26.0 C. The same exposure also did not affect the release of young by ovigerous female GAMMARUS sp. An 11.0 C increment for 30 min resulted, however, in almost no release of young from ovigerous females. (Auth)

<260>
Gittelman, S.H., Physical Gill Efficiency and Winter Dormancy in the Pigmy Backswimmer, NEOPLEA STRIOLA (Hemiptera: Pleidae).

1975. Ann. Entomol. Soc. Amer., 68, 1011-1017 (University of Connecticut, Biological Sciences Group, Storrs, CT)

Laboratory studies indicated that the backswimmer, NEOPLEA STRIOLA, emerges in spring at about 12 C (range 8 to 18 C) despite variations in light intensity or oxygen content of the water. Long term studies and field surveys support this conclusion. Temperatures below 12 C led to the submergence of pleids in fall. Pleids survived submergence for months at 8 and 4 C, but died in less than 21 days when kept under water at 12 C and above. Pleids apparently changed their physical gill size to adjust for different metabolic and buoyancy requirements at different temperatures. This coordination between gill size and temperature allowed temperature to control overwintering. (Auth) (CCC)

<261>
Gjosaeter, J., and O. Martinsen, Investigations at the Spawning Grounds of Capelin in 1975.

1976. Fisk. Havet. (Nor.), No. 1, 3-5 (University of Bergen, Fiskeribiologisk Avdeling, Bergen, Norway)

Investigations at the spawning grounds of capelin, MALLOTUS VILLOSUS, in the north Atlantic were carried out from April to May 30. Spawning took place between Slettnes and Grease Jakobselv. The greatest quantities of eggs were found on coarse substrate, such as gravel and shell gravel. The depth of most spawning grounds was between 25 and 50 m. The temperature varied between 2.8 and 4.3 C. Hatching started about April 30 and reached a maximum in the middle of May. (Auth) (ST)

<262>
Glenn, C.L., Seasonal Growth Rates of Mooneye (HIODON TERGISUS) from the Assiniboine River.

1976. Jour. Fish. Res. Bd. Can., 33, 2078-2082 (Brandon University, Department of Zoology, Brandon, Manitoba, Canada)

Length increments, calculated from fish measured at capture and from estimates of back-calculated lengths at time of formation of the most peripheral scale annulus, were used to determine the growing season and seasonal growth rates of mooneye (HIODON TETERGISUS). Data from 670 fish indicated that mooneye grow rapidly from June to mid-August with little or no growth occurring during other months. Length increased as a linear function during summer. Summer growth rates of 0.89, 0.58, 0.49, 0.44, 0.23, and 0.16 mm/day were estimated for fish aged I to VI, respectively. (Auth)

<263>
Glenn, C.L., and R.R.G. Williams, Fecundity of Mooneye, HIODON TERGISUS, in the Assiniboine River.

1976. Can. Jour. Zool., 54, 156-161 (Brandon University, Department of Zoology, Brandon, Manitoba, Canada)

Age at sexual maturity, seasonal gonadal development, and fecundity estimates of mooneye were determined from 695 samples captured in the Assiniboine River between November 17, 1972 and November 2, 1973. During 1973 spawning began after May 8 and was completed by June 12. The peak spawning activity occurred during mid-May when water temperature ranged from 10 to 13 C. All age groups of sexually mature females had rapid ovarian development during the summer months with about 80% of maximum ovarian weight present by October 17. (Auth) (ST)

<264>
Goff, L.J., and K. Cole, The Biology of HARVEYELLA MIRABILIS (Cryptonemiales, Rhodophyceae). IV. Life History and Phenology.

1976. Can. Jour. Bot., 54, 281-292 (University of British Columbia, Department of Botany, Vancouver, British Columbia, Canada)

Gametogenesis of HARVEYELLA MIRABILIS, a red alga parasitic on ODONTHALIA FLOCCOSA, occurred within the narrow temperature range of 9 to 11 C. (ST)

<265>
Gold, K., and E.A. Morales, Seasonal Changes in Lorica Sizes and the Species of Tintinnida in the New York Bight.

1975. Jour. Protozool., 22, 520-528 (Osborn Laboratories of Marine Science, New York Aquarium, New York Zoological Society, Brooklyn, NY)

The lorica length of TINTINNOPSIS LEVIGATA varied seasonally, being shorter in the fall when temperature was high (14 to 20 C) and longer in the winter during a time of low temperature (3 to 11 C). A similar bimodal size distribution was detected for the morphologically less distinctive species T. TUBULOSOIDES. Loricae of cultivated T. TUBULSOIDES (10 C) compared with specimens from the plankton (5.5 C) were smaller. (ST).

<266>
Goldstein, B., and L.L. De Cidre, The Cycle of Sexual Maturation and Preliminary Studies on the Spawning of the Freshwater Shrimp PALAEMONETES ARGENTINUS (Nobili, 1901) (Crustacea, Caridea Palamonidae). 1. Female.

1974. Physis, 33, 165-176 (University of Buenos Aires, Department of Cienc. Biology, Buenos Aires, Argentina)

The reproductive cycle of female PALAEMONETES ARGENTINUS began in June and July. Reproduction occurred in spring (August to February); there was a direct relation between the first ovigerous females and a rise in water temperature. The first spawning period reached a maximum in October; a second occurred in January. Incubation time varied with temperature, lasting 40 days at 20 to 21 C. Egg disintegration and resorption occurred from February to July, when a new cycle began. (ST)

<267>
Gonzalez, J.G., and P. Yevich, Responses of an Estuarine Population of the Blue Mussel MYTILUS EDULIS to Heated Water from A Steam Generating Plant.

1976. Marine Biol. (W. Ger.), 34, 177-189 (Environmental Research Laboratory, Narragansett, RI)

An entire bed of the blue mussel MYTILUS EDULIS, consisting of 5,000 individuals/m2, died during June, 1971 in the effluent canal of a steam generating plant when the temperature increased above 27 C. Similarly, the population in the intake canal disappeared when temperatures rose above 27 C in August. Laboratory studies showed that M. EDULIS could not tolerate continuous temperatures above 27 C, and feeding stopped shortly after the mussels were exposed to 25 C. Histopathological studies indicated that the cause of death of this bivalve was associated with degeneration of the frontal and laterofrontal cilia of the columnar epithelium of the gill filaments. In conjunction with this, there was necrosis and sloughing of the epithelium of the intestinal diverticula. Extensive amoebocytic infiltration was noted in the byssogenous cavity, gill filaments and stomach wall. (Auth)

<268>
Gophen, M., Temperature Dependence of Food Intake, Ammonia Excretion and Respiration in CERIODAPHNIA RETICULATA (Jurine) (Lake Kinneret, Israel).

1976. Freshwater Biol. 6, 451-455 (Kinneret Limnological Laboratory, Tiberias, Israel)

The abundance of the cladoceran, CERIODAPHNIA RETICULATA, peaked in May at a water temperature of 20 to 22 C. Abundance was restricted to the period March to June. The study examined the influence of temperature on respiration, food ingestion, and ammonia excretion and attempted to clarify whether high epilimnion temperatures (27 to 28 C) lead to a decrease in the population in summer. Temperature increase accelerated the rates of ammonia excretion and food ingestion. This acceleration was greater in the lower temperature range (15 to 22 C) than in the higher one (22 to 27 C). Respiration rate was more enhanced in the upper temperature range. The resulting deficit of energy at high temperatures caused a

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reduction in body size and a significant diminution of egg production, which led to a progressive decline of the population. (Auth) (ST)

<269>
Gorbunova, N.P., The Life cycle of MASTIGOCLADUS LAMINOSUS Cohn.

1975. Vestn. Mosk. Univ., Ser VI Biol. Pochvoved, (USSR), 30, 57-64 (Moscow University, Biology Faculty, Moscow, USSR)

The life cycle of MASTIGOCLADUS LAMINOSUS was studied in culture. Intensive formation of hormogonia and their development into trichomes was observed for the first time. Optimal temperature for the formation of hormogonia was 45 C. Hormogonia were used as inoculum. M. LAMINOSUS may retard its development, exist a cosiderable time and even propogate by hormogonia at various stages of life cycle (status). MASTIGOCLADUS LAMINOSUS may exist in the following status: st. oscillatorioideus, st. phormidioideus, st. plectonematoideus, st. hammatoideus, st. loefgrenioideus, st. anabaenoideus, st. aphanizomenoideus, st. scytonematoideus, st. hapalosiphonoideus and st. nostochopsioideus. In aging cultures the formation of spores was observed. (Auth)

<270>
Gordon, J.A., Waste Characterization Studies for Raceway Production of Catfish.

1975. Ind. Wastes, 28-31 (Tennessee Valley Authority, Chattanooga, TN)

As part of a study of the production of edible catfish using heated condenser discharge water from the Gallatin Steam Plant (Tenn.), the biochemical oxygen demand, solids content and nutrient content of the water were assessed. The metabolic BOD production was related to catfish weight and temperature by a given formula. (ST)

<271>
Goryajnova, L.I., The Effect on Zooplankton of Heated Discharge from the Novorossijsk Power Station.

1975. Gidrobiol. Zh. (USSR), 11, 28-33 (Kuban Univerity, Biological Station, Novorossijsk, USSR)

An analysis was made of species composition and abundance of zooplankton in the areas influenced by heated discharge from the Novorossijsk Power Station. Average annual water temperature in the studied area was 0.7 to 4.0 C higher than at the control station. The average annual abundance and biomass of zooplankton in the warmed area was twice as high as that at the control station; copepod nauplii and larval bottom organisms were most abundant. (Auth) (ST)

<272>
Goss, L.B., and D.L. Bunting, Thermal Tolerance of Zooplankton.

1976. Water Res. (G.B.), 10, 387-398 (Tennessee Valley Authority, Power Research, Chattanooga, TN; University of Tennessee, Department of Zoology, Knoxville, TN;

First immature instar DAPHNIA PULEX acclimated at 5, 10, 15, 20, 25 and 30 C, and DAPHNIA MAGNA Straus acclimated at 10, 15, 20, 25 and 30 C, were instantaneously immersed at the specified temperatures which differed from acclimation temperatures by 10 C or more. Observations for mortality were made at regular intervals for 48 hr or longer until at least one molting had occurred. Organisms acclimated at the same temperatures were also instantaneous ly immersed at 35 C, an ultimately lethal temperature, and followed to 95% mortality. DAHNIA PULEX acclimated at 20 C were stepped over varying rates of temperature change to 35 C and observed for mortality over a 48 hr period. Thirty first immature instar organisms were used in each test, and tests were carried out in temperature controlled water baths and incubators. Filtered pond water was used for culture and testing. Both species survived instantaneous temperature changes over the entire normal tolerance ranges tested. Animals succumbed more rapidly upon instantaneous immersion at 35 C as the temperature which they were acclimated decreased, with D. MAGMA succumbing more rapidly than D. PULEX from all acclimation temperatures. DAPHNIA PULEX acclimated at 20 C and stepped to 35 C at varying rates of temperature chanes exhibited a decreasing 48-hr mortality percentage as rates decreased from 6 C/hr to 1.33 C/hr. Shortcomings in methodologies of previous thermal tolerance studies on zooplankton were discussed, and recommendations were made as to how these methods can be improved. (Auth)

<273>
Grace, J.B., and L.J. Tilly, Distribution and Abundance of Submerged Macrophytes, including MYRIOPHYLLUM SPICATUM L. (Angiospermae), in a Reactor Cooling Reservoir.

1976. Arch. Hydrobiol. (Ger.), 77, 475-487 (Clemson University, Department of Botany, Clemson, SC; Savannah River Laboratory, Aiken, SC)

The distribution of aquatic macrophytes, including MYRIOPHYLLUM SPICATUM, in a reactor cooling reservoir was analyzed by biomass removal. Samples were collected by use of a corer from hot, warm, and cold stations at progressive distances from a thermal effluent. Standing crop was doubled at the warm station as compared to the cold station due to the enhancement of MYRIOPHYLLUM SPICATUM. However, M. SPICATUM was least abundant at the hot station where NAJAS GUADALUPENSIS predominated. Possible causes for the restriction of M. SPICATUM from the hot station are given. Maximum rooting depth of vegetation was reduced near the effluent apparently due to a combination of decreased light penetration and a higher photosynthesis-respiration compensation level at higher temperatures. (Auth)

<274>
Gray, J.S., The Effects of Salinity, Temperature and Mercury on Mortality of the Trochophore Larvae of SERPULA VERMICULARIS L. (Annelida: Polychaeta).

1976. Jour. Exp. Mar. Biol. Ecol. (Neth.), 23, 127-134 (University of Washington, Friday Harbor Laboratories, Friday Harbor, WA; University of Leeds, Wellcome Marine Laboratory, Robin Hood's Bay, England)

Using response surface methods four-day old larvae of SERPULA VERMICULARIS L. were shown to be more euryplastic with respect to salinity and temperature than were gastrulae and one-day old larvae. Significant interaction was found between the effects of

<274> CONT.
temperature and reduced salinity on mortality of the larvae at each age tested. Four-day old trochophore larvae were more resistant to reduced salinity at low temperatures than were gastrulae and one-day old larvae. The change in tolerance with age was in resistance rather than capacity adaptation and, since the larvae were acclimated at 16 C, this change was genetic. Mercuric ions did not show synergistic effects with reduced salinity but merely acted additively. The concentrations of mercury found to be toxic were much higher than those that are likely to be found in coastal waters where S. VERMICULARIS occurs. (Auth)

<275>
Green, J.D., Feeding and Respiration in the New Zealand Copepod CALAMOECIA LUCASI Brady.

1975. Oecologia (Ger.), 21, 345-358 (University of Waikato, School of Science, Hamilton, New Zealand)

The filtering rates of CALAMOECIA LUCASI increased with increasing temperature up to 20 C, and from nauplius to adult. The effect of temperature on the rate of oxygen consumption of CALAMOECIA LUCASI, BOECKELLA DELICATA and B. SYMMETRICA was measured using the micro-Winkler technique, and the regression relationships between log oxygen uptake, temperature and log weight was calculated for the three species. Oxygen consumption increased with increasing temperatures of 10, 15, 20, and 25 C. (ST)

<276>
Green, J.D., Population Dynamics and Production of the Calanoid Copepod CALAMOECIA LUCASI in a Northern New Zealand Lake.

1976. Arch. Hydrobiol. (Ger.), 50, 313-396

The development times of eggs, nauplii and copepodites of CALAMOECIA LUCASI were determined in the laboratory and the relationship between development time and temperature was found to be described by Belehradek's temperature function. These development times were used in calculating recruitment and mortality in the various developmental stages and the population as a whole. In the field development from the egg to the adult took about one month in summer and about two months in winter. (ST)

<277>
Gregg, B.C., The Effects of Chlorine and Heat on Selected Stream Invertebrates.

1974. Ph.D. Thesis, Virginia Polytechnic Institute and State University (Virginia Polytechnic Institute and State University, Department of Zoology, Blacksburg, VA)

The chlorine sensitivity of both STENONEMA ITHACA, the least sensitive mayfly species tested, and IRON HUMERALIS, the most sensitive, was affected by temperature. Heat shock tests with a number of invertebrates including the mayflies, ISONYCHIA sp., STENONEMA ITHACA, and IRON HUMERALIS, the stonefly, PELTOPERLA MARIA, and the snail, NITOCRIS CARINATA, showed a positive correlation between an increase in acclimation temperature and thermal resistance, indicated by either an increase in LT50 at the same shock temperature or an increase in the shock temperature causing the same LT50. Reacclimation to a lower temperature caused increased heat shock sensitivity. Size differences within the same species did not cause significant differences in sensitivity to heat shock. NITOCRIS CARINATA was more resistant to heat shock than ISONYCHIA sp. and STENONEMA ITHACA. ISONYCHIA and S. ITHACA were about the same in resistance to heat shock, while IRON HUMERALIS was more sensitive. Heat plus chlorine shock tests were performed with ISONYCHIA sp. and PELTOPERLA MARIA at an acclimation temperature of 14 C at nine shock temperatures and a number of chlorine concentrations. Combining chlorine exposure tests LT50's to 15 C, with the heat shock LT50's above 14 C acclimation and the heat plus chlorine shocks above 14 C acclimation indicated a synergistic effect of heat and chlorine. Above certain heat shock temperature, chlorine additions were not more toxic. Below these shock temperature, added chlorine was significantly more toxic. ISONYCHIA held for prolonged periods after heat shock exhibited significant death, but control organisms did also. PELTOPERLA MARIA similarly held did not seem to experience the same delayed mortality. (RFC)

<278>
Griffith, J.S., and D.A. Tomljanovich, Susceptibility of Threadfin Shad to Impingement.

1975. Proc. 29th Ann. Conf. S.E. Asso. Game & Fish Comm., 223-234; ORNL Environmental Sciences Division Publication No. 789 (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN; Tennessee Valley Authority, Division of Forestry, Fisheries, and Wildlife Development, Norris, TN)

Threadfin shad impingement at 13 Tennessee Valley Authority electric generating plants from August 1974 through July 1975 was analyzed to assess mortality resulting from low water temperature. Concurrent laboratory experiments were conducted to evaluate the ability of cold-stressed threadfin shad to avoid impingement. Temperatures of 12 C stressed fish in the laboratory, while those below 8 C caused high impingement mortality. At 5 of 12 fossil-fuel plants, 90 percent or more of the annual threadfin impingement occurred when water temperatures were below 10 C. At four plants, impingement was not related to low temperatures. Impingement at the Browns Ferry Nuclear Plant generally coincided with low water temperatures, but individual impingement peaks were not consistently associated with cold shocks. (Auth)

<279>
Griffiths, R.J., The Larval Development of PYURA STOLONIFERA (Tunicata).

1976. Trans. Roy. Soc. S. Africa, 42, 1-9. (University of Cape Town, Zoology Department, C.S.I.R. Oceanographic Research Unit, South Africa)

A description is given of the larval development of the ascidian, PYURA STOLONIFERA. Rate of development increased over the temperature range of 15 to 25 C. Development did not take place at 10 C or 30 C. (ST)

<280>
Grigo, F., To What Extent Effects Temperature as Stressor in Carps (CYPRINUS CARPIO L.)? 2. Activities of Lactate-dehydrogenase and Glutamate-oxaloacetate-transaminase in Muscle and

<280>

<280> CONT.
Serum.

1975. Zool. Anz., 194, 234-242 (University of Kiel, Zoology Institute, Kiel, German Federal Republic)

An increase of lactate dehydrogenase and glutamate oxaloacetate transaminase enzyme activities in carp serum could be measured when animals were subjected to an abrupt temperature change from 15 C to 30 C or in case of a gradual change into a sublethal temperature from an acclimation temperature of 15 C to 32 C. Serum protein remained unchanged. Change from a 15 C acclimation temperature of 32 C resulted in an increase of LDH activity in the epaxial muscle, reflecting a stress situation. No changes in LDH and GOT activities could be measured in the serum following temperature changes from 15 C up to 25 C or 32 C to 15 C. A comparison between 15 C acclimated and 38 C acclimated carp showed that LDH activity was lower in 38 C acclimated animals while GOT activity was higher. In the epaxial muscle both LDH and GOT activities were lower in the 15 C acclimated animals. (Auth)(ST)

<281>
Grigo, F., To What Extent Effects Temperature as Stressor in Carps (CYPRINUS CARPIO L.)? 1. Compositon of Blood with Special Reference to Serum Electrolytes.

1975. Zool. Anz., 194, 215-233 (University of Kiel, Zoology Institute, Kiel, German Federal Republic)

The influence of a change in temperature on osmoconcentration, blood glucose, concentration of hemoglobin and ions in the serum of carp was examined. A gradual transfer of carp into sublethal high temperatures produced no serum osmoconcentration changes. An abrupt transfer from an acclimation temperature of 15 C to 30 C resulted in death with osmotic values increasing just before death. A gradual change from an acclimation temperature of 15 C to 32 C was followed by a longterm increase in blood glucose. This increase did not occur following transfer from 15 to 25 C or 32 to 15 C. Results are noted for hemoglobin and serum ion concentrations following increases and decreases in temperature. (ST)

<282>
Grimas, U., and U. Ehlin, Swedish Studies on Combination Effects of Thermal Discharges in the Aquatic Environment.

1975. IAEA-SM-197/24; Part of Proceedings of a Symposium on the Combined Effects of Radioactive, Chemical and Thermal Releases to the Environment held in Stockholm, Sweden, June 2-5, 1975. International Atomic Energy Agency, Vienna (Swedish Environment Protection Board, Stockholm, Sweden; Swedish Meterological and Hydrological Institute, Norrkoping, Sweden)

Combination effects of thermal discharges in the aquatic environment are discussed under the headings: general aspects of siting policy; relevant properties of the thermal discharge; and consequences such as the direct effect of heat on organisms, the accumulation of toxic matter in organic material, and mineralization and transport. Three examples are given which illustrate cases where cooling water discharges in polluted areas of Sweden appear to produce negative effects: the discharge in the innermost part of a long series of semi-enclosed basins, in the mouth of a large estuarine basin, and due to combination effects with certain toxic metals such as mercury. (ST)

<283>
Grimes, C.B., Entrapment of Fishes on Intake Water Screens at a Steam Electric Generating Station.

1975. Chesapeake Sci., 16, 172-177 (University of North Carolina, Institute of Marine Sciences, Morehead City, NC)

To investigate entrapment of fish, traveling intake water screens were sampled monthly in 1969 and 1970 at a steam electric power station near Crystal River, Florida. Samples contained 73 species representing 41 families; the majority of individuals were juveniles or weak-swimming species. There was an inverse relationship between intake water temperature and catch. Highest mortalities occurred with the first cold temperatures of winter and later with lowest water temperatures. Comparison of catch-per-unit-effort during daylight and darkness in 1970 showed monthly catch-per-hour for dark sampling approximately equal to or greater than for light. Greatest disparities between day and night sampling occurred simultaneously with coldest water temperatures. (Auth)

<284>
Grischkowsky, R.S., and J. Liston, Bacterial Pathogenicity in Laboratory-Induced Mortality of the Pacific Oyster (CRASSOSTREA GIGAS, Thunberg).

1974. Proc. Natl. Shellfish Assn., 64, 82-91 (University of Washington, College of Fisheries, Seattle, WA)

Mortality of Pacific oysters (CRASSOSTREA GIGAS) was monitored in four trials with low-temperature control (10 C), high-temperature control (20 C), high-temperature + UV (20 C), high-temperature + VIBRIO sp. or VIBRIO ANGUILLARUM (20 C), and high-temperature + oxytetracycline (TM-50) (20 C) treatment groups. Mortality was highest in the bacteria-inoculated treatments and lowest in low-temperature control troughs. Computer analysis, using contingency table analysis, substantiated observed mortality results by testing the independence of trial number, treatment, time, and temperature. High temperature was a substantial contributing factor to mortalities. TM-50 successfully decreased bacterial counts of water and oysters, as well as decreasing mortality. UV treatment decreased water counts but not mortality. Moribund or dead oysters previously held at elevated temperatures, compared with normal low-temperature control, Puget Sound (Eld Inlet), and Humboldt Bay oysters, consistently had higher bacterial counts in all media tested. Bacteria associated with normal and moribund or dead oysters were isolated and identified as V. ANGUILLARUM, VIBRIO ALGINOLYTICUS, VIBRIO PARAHAEMOLYTICUS, VIBRIO sp., PSEUDOMONAS sp., and AEROMONAS sp. V. ANGUILLARUM and V. ALGINOLYTICUS were implicated as facultative pathogens for Pacific oysters at elevated temperatures. (Auth)

<285>
Gupta, S., The Development of Carp Gonads in Warm

<285> CONT.
Water Aquaria.

1975. Jour. Fish Biol., 7, 775-782 (Rembertising 22, Bremen, Germany)

The development of carp (CYPRINUS CARPIO) gonads in warm water (23 C) aquaria under controlled conditions is described. Under these conditions males matured at six months of age and females matured at 14 months of age. By 15 months 25% of the females had started to spawn. Under natural conditions in Europe female carp ripen at four years of age. (Auth)

<286>
Gurtz, M.E., and C.M. Weiss, Response of Phytoplankton to Thermal Stress.

1974. In Jensen, L.D., Proceedings of the Second Workshop on Entrainment and Intake Screening, Report Number 15, held at Johns Hopkins University, Baltimore, Maryland, February 5-9, 1973. National Technical Information Service, Springfield, VA (University of North Carolina, Department of Environmental Sciences and Engineering, Chapel Hill, NC)

Investigations of the effects on phytoplankton passing through the condensers of a power plant on Lake Wylie, North Carolina are reported. Emphasis was on the immediate influence of thermal stress on primary productivity as measured by rates of C-14 uptake; mechanical stress and algal growth subsequent to condenser passage were also studied. A relationship between the initial temperature, the magnitude of the temperature rise and the primary productivity of the cooling water was determined. Implications of findings for power plant design were also discussed. (Auth)

<287>
Guthrie, R.K., D.S. Cherry, and F.L. Singleton, Alteration of Microbial Populations in Thermal Stress.

1976. Jour. Water Poll. Control Fed., 48, 962-965 (University of Texas Health Science Center, School of Public Health, Houston, TX; Virginia Polytechnic Institute and State University, Center for Environmental Studies, Blacksburg, VA)

Addition of the chromogenic, natural aquatic bacterium, FLAVOBACTERIUM LUTESCENS, and thermal stress (31 C) increased the die-off rates of ESCHERICHIA COLI, STREPTOCOCCUS FAECALIS, and SALMONELLA TYPHIMURIUM in waste water effluent. The percentage of chromogens of the bacterial population varied depending on temperature. By day 12 the chromogens stabilized at well below 10% at 24 C and ranged between 15 and 20% of the population at 31 C. Die-off rates of E. COLI, S. FAECALIS, and S. TYPHIMURIUM at 31 C and in the presence of F. LUTESCENS occurred at days 17 through 27, with the enteric pathogen S. TYPHIMURIUM surviving longer in waste water than the fecal pollution indicator bacteria. All three survived at the end of the five-week period, at 24 C. The results indicated that the use of a naturally occurring aquatic bacterial species in combination with thermal stress offers a potential control of undesirable or pathogenic bacteria contaminants in aquatic systems. (ST)

<288>
Haefner, P.A., Jr., Seasonal Distribution and Abundance of Sand Shrimp CRANGON SEPTEMSPINOSA in the York River-Chesapeake Bay Estuary.

1976. Chesapeake Sci., 17, 131-134 (Virginia Institute of Marine Science, Gloucester Point, VA)

Sand shrimp, CRANGON SEPTEMSPINOSA, were collected during monthly trawl surveys of the Chesapeake Bay and York-River estuary from January 1971 to April 1972. Over 9000 shrimp were captured within wide ranges of temperature (0.5 to 24.1 C), salinity (10.3 to 31.1 ppt) and dissolved oxygen concentration (2.1 to 12.7 mg/liter). Relative abundance of shrimp in the channels varied seasonally. Maximum concentrations occurred in winter when bottom water temperatures were between 5 C and 11 C. The concentration of shrimp was reduced in spring when the temperature exceeded 15 C. Salinity limited the upstream penetration of the species. Occasionally shrimp were found in salinities as low as 10 to 12 ppt, but they were usually collected when salinities exceeded 16 ppt. Low levels of dissolved oxygen concentration (2 to 5 mg/liter) in summer coincided with reduced catches and absence of shrimp. Males (22-61 mm, total length) comprised less than 30% of the catch in 855 of the samples. Twenty-five percent of the samples consisted entirely of females (26-76 mm). Ovigerous females (31-78 mm) were the most numerous entity from January through June. No juveniles were taken in these collections. (Auth)

<289>
Haefner, P.A., Jr., and W.A. van Engle, Aspects of Molting, Growth and Survival of Male Rock Crabs, CANCER IRRORATUS, in Chesapeake Bay.

1975. Chesapeake Sci., 16, 253-265 (Virginia Institute of Marine Science, Gloucester Point, VA)

Progression of male rock crabs through the intermolt cycle was dependent on temperature. Crabs held at 17.5 C advanced from hardshell to papershell intermolt stages in one-third the time required for crabs held at 7 C. Temperature-salinity tolerance experiments showed that more crabs survived in 7 C water than in 17.5 C. Maximum survival occurred within the salinity range of 14 to 21 ppt. Papershell crabs were isomotic to polyhaline salinities but were hyperosmotic at lower salinities. Those acclimated at 7 C approached isomoticity near 28 to 30 ppt. Warm acclimated crabs were isomotic near 24 to 26 ppt but showed limited hyper-regulation at salinities less than 20 ppt. (ST)

<290>
Haines, M.L., The Reproductive Cycle, Larval Development, Culture, and Tolerances of the Sunray Venus Clam MACROCALLISTA NIMBOSA (Lightfoot 1786).

1975. Ph.D. Thesis, Florida State University (Florida State University, Tallahassee, FL)

Histological study of an annual reproductive cycle of clams from St. Joseph Bay, Florida, indicated that the sunray venus clam is a fall spawner. Females began spawning in August and continued through November, with greatest spawning activity occurring during October and November. Males began spawning earlier, starting in July and continuing through December, with greatest activity occurring from October to early December. The seasonal changes in the glycogen content

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showed a definite cycle related to that of gonadal development and spawning, with highest annual values occuring during the winter and lowest values occurring during summer and fall. Study of the combined effect of temperature and salinity on adult clams showed that both salinity and temperature significantly affect survival. The adults were stenohaline, but had a wider salinity tolerance than embryos. Within a suitable temperature range, 13 to 20 C, adult survival was most affected by salinity, with ranges between 25 and 35 ppt permitting 100% survival. Temperatures of 5.5 and 31 C were beyond the thermal tolerance limits of MACROCALLISTA NIMBOSA under laboratory conditions. The adults could not tolerate consistently high temperatures for extended periods of time. (Auth) (ST)

<291>
Hakonson, T.E., A.F. Gallegos, and F.W. Whicker, Cesium Kinetics Data for Estimating Food Consumption Rates of Trout.

1975. Health Phys., 29, 301-306 (Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO)

The data from a cesium kinetics experiment in a natural semi-drainage bog lake were used in estimatng the rate of food consumption and the rate of cesium excretion by rainbow trout (SALMO GAIRDNERI) which inhabit the lake. Estimates of the Cs-133 retention half-time and food intake were shown to vary greatly throughout the year. For example, based on observed data and theoretical considerations, trout consumed only about 0.5% of their body weight daily in mid-winter but up to 8% in early summer. In addition, cesium retention half-times ranged from about 100 days in summer to 850 days in mid-winter, based upon water temperature, body weight and growth. (Auth)

<292>
Hamby, R.J., Heat Effects on a Marine Snail.

1975. Biol. Bull., 149, 331-347 (Rhonda Drive, Millville, NJ)

LITTORINA LITTOREA entered a reversible state of heat coma at temperatures below the lethal temperature of the species. The threshold of heat coma was shifted by as much as 8.5 C by acclimation. A linear relation existed between heat coma temperature and acclimation temperature over the experimental range. Lethal temperature showed a shift of 1 to 2 C as a result of temperature acclimation. Results of studies on the tissue (muscle and nerve) level are reported. (ST)

<293>
Hamor, T., and E.T. Garside, Developmental Rates of Embryos of Atlantic Salmon, SALMO SALAR L., in Response to Various Levels of Temperature, Dissolved Oxygen, and Water Exchange.

1976. Can. Jour. Zool., 54, 1912-1917 (Dalhousie University, Department of Biology, Halifax, Nova Scotia, Canada)

Embryos of Atlantic salmon, SALMO SALAR, were incubated from fertilization to completion of hatching at 5 and 10 C, at 20, 50, and 100% air-saturation , and at several rates of water exchange from 0.2 to 15 ml/s. Developmental rate to various structural stages, expressed as the reciprocal of time units, and hatching time were significantly controlled by temperature, oxygen supply, and rate of water exchange. Survival during embryogenesis and during the hatching period were limited primarily by oxygen supply and secondarily by water exchange, both having highly significant effects. The effect of temperature ranked third but was also statistically significant. Lower temperature reduced the rate of development and enhanced survival through hatching. Developmental rate and survival increased directly with increasing concentration of dissolved oxygen and with increasing rate of water exchange. (Auth)

<294>
Hancock, R.S., J.W. Jones, and R. Shaw, A Preliminary Report on the Spawning Behaviour and Nature of Sexual Selection in the Barbel, BARBUS BARBUS (L.).

1976. Jour. Fish Biol., 9, 21-28 (University of Liverpool, Department of Zoology, Fisheries Unit, Liverpool, England)

Barbels were observed spawning in the Driffield Beck (England) during June 1973. The water temperature in early June was 13.5 C. (ST)

<295>
Harder, J.A., The Reaction of Small Fish to Perforated Plates.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (University of California, Berkeley, CA)

A proposal to install a perforated plate screen along the banks of the Sacramento River, Calif., as a means of excluding small fish from a power plant intake structure is discussed. The observed response of fish to river banks, turbulence, and water velocity is considered and a testing program for the study of the behavior of fish to perforated plates based on these responses is outlined. No results are reported. (ST)

<296>
Harleman, D.R.F., Hydrothermal Modeling.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Massachusetts Institute of Technology, R.M. Parsons Laboratory for Water Resources and Hydrodynamics, Cambridge, MA)

The development of hydrothermal models for the prediction of water temperature distributions associated with waste heat emissions is traced over the past decade. Both mathematical and physical models have evolved in response to the changing requirements for the licensing and operation of electric generating stations. Mathematical models may be classed as zone models or complete models. Three zone models developed at the Massachusetts Institute of Technology are discussed. Steps to develop a biologically based temperature criteria, relating hydrothermal models to predicted biological impact, are reviewed. It is felt

<296> CONT.
that in the future, discharge designs will be imcreasingly determined by site specific biological requirements rather than by arbitrary temperature standards. (ST)

<297>
Harrington, R.W., Jr., and R.A. Crossman, Jr., Effects of Temperature and Sex Genotype on Meristic Counts of the Gonochoristic Cyprinodontid Fish RIVULUS CYLINDRACEUS Poey.

1976. Can. Jour. Zool., 54, 245-254 (Florida Division of Health, Medical Entomology Laboratory, Vero Beach, FL)

Eggs of RIVULUS CYLINDRACEUS were reared at constant temperatures of 19, 25, and 31 C. Highest mean vertebrae counts occurred at 19 C and lowest at 31 C. Mean counts of caudal and anal fin rays were lowest at 19 C and highest at 31 C, with only a slight difference between 25 and 31 C. The response curves for pectoral and dorsal fin rays were inverted-V shape, with highest counts at the midpoint temperature of 25 C. The pelvic fin ray counts showed little change with temperature. Mean counts of males were higher for all meristic traits at 19 C and for vertebrae and rays of pectoral and caudal fins at all three temperatures. Those of females were higher for dorsal, anal, and pelvic fins at 25 and 31 C. The lower lethal limit of developmental tolerance was close to 19 C. Abnormalities occurred at all three temperatures but were most numerous and varied at 19 C, and the least so at 25 C. Thus meristic variability in heterogametic R. CYLINDRACEUS is thermally influenced. The switch mechanism determining sex is chromosomal, with apparent side effects on meristic counts. (ST)

<298>
Harrington, R.W., Jr., and R.A. Crossman, Jr., Temperature-Induced Meristic Variation among Three Homozygous Genotypes (Clones) of the Self-Fertilizing Fish RIVULUS MARMORATUS.

1976. Can. Jour. Zool., 54, 1143-1155 (Florida Medical Entomology Laboratory, Vero Beach, FL)

Embryos of clones DS, NA, and M were reared at sustained temperatures of 19, 25, and 31 C. Diverse evidence indicates a closer genetic affinity between DS and NA than between either and M. DS and NA converged and M diverged regarding responses of pectoral, caudal, and dorsal rays. For vertebrae and pectoral rays, response curves were declivous; for caudal rays, inverted-V shaped; for anal rays, upright-V shaped (NA), inverted-V shaped (DS), declivous (M); for dorsal rays, declivous (NA), upright-V shaped (DS and M); for pelvic rays, subhorizontal (DS and NA), inverted-V shaped (M). The vertebral response curves of DS and NA diverged at 25 C, converging at 19 and 31 C. Caudal counts increased between 31 and 25 C, caudal and precaudal, between 25 and 19 C. Vertebral differences (as percentage of the midpoint count) exceeded any of previous experiments on species other than R. MARMORATUS. At 19 and 31 C pelvic fins are often lacking, but never in outbreeding R. CYLINDRACEUS. Response curves except vertebral ones differed qualitatively between these species. Many kinds of variations, and proportions of phenotypic differences due to genotypic and environmental differences and their interactions are compared. (Auth)

<299>
Harvey, R.S., Thermal Effects on Growth and Respiration Rates of the Mayfly DOLANIA AMERICANA (Ephemeroptera).

1975. DP-MS-75-12; Submitted to the Annual Meeting of the Ecological Society of America with the American Institute of Biological Sciences held at Corvallis, Oregon (Savannah River Laboratory, Aiken, SC)

The mayfly DOLANIA AMERICANA, common in the sand of Upper Three Runs Creek, was studied to determine the effects of seasonal changes in temperature on population growth rates and to determine the effects of slight elevations in water temperature on respiration rates of this benthic species. Growth of the population increased with stream temperature until peak emergence of adults in June and July. Oxygen consumption rates increased for all weight classes as the water temperature in the creek increased from 7 to 21 C. There was a strong inverse correlation between body weight and respiration rates of immature nymphs. Respiration rates at 2.5, 5, and 10 C above ambient creekwater temperatures were not significantly higher than those measured at ambient creekwater temperatures. (Auth) (ST)

<300>
Hassan, K.C., and J.R. Spotila, The Effect of Acclimation on the Temperature Tolerance of Young Muskellunge Fry.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (State University College at Buffalo, Department of Biology, Buffalo, NY)

Temperature tolerances of newly hatched muskellunge fry (ESOX MASQUINONGY) were determined in the laboratory. Three groups of fry were reared in a closed tank system under controlled environmental conditions for 31 days at 7, 15, and 25 C. Critical thermal maximum (CTM) was used to indicate temperature tolerance. Experimental fish reared at 25 C exhibited the highest temperature tolerance (33.2 to 36.1 C) throughout their development. The CTM values for the 15 C experimental fish ranged from 29.8 to 34.4 C. These fish exhibited a decrease in temperature tolerance during their swim-up stage, followed by a slow recovery period indicated by a general increase in CTM values. Two days after the experiment began, 7 C experimental fry entered a torpid state that lasted for 10 days and was followed by a general decrease in thermal tolerance and a high mortality rate. The CTM values for this group ranged from an initial high of 34.0 C on the first day to 27.2 C at the termination of the experiment. Development never reached the free-swimming stage. (Auth)

<301>
Hastings, R.W., L.H. Ogren, and M.T. Mabry, Observations on the Fish Fauna Associated with Offshore Platforms in the Northeastern Gulf of Mexico.

1976. Fish. Bull., 74, 387-402 (Rutgers University, Department of Biology, Camden, NJ)

The fish fauna associated with two U.S. Navy research platforms in the northeast Gulf of Mexico was studied at irregular intervals from 1970-1974. Seasonal changes in the fish

<301> CONT.
fauna were apparently correlated with temperature. Species numbers were greatest during the summer and fall and lowest during the winter and spring when temperatures were below 20 C. The number of species gradually increased with rising water temperature in spring. (ST)

<302>
Hata, M., and Y. Yokohama,
Photosynthesis-Temperature Relationships in Seaweeds and Their Seasonal Changes in the Colder Region of Japan.

1976. Bull. Jap. Soc. Phycol., 24, 1-7 (Niigata University, Department of Biology, Niigata, Japan)

Photosynthesis-temperature relationships were studied in classes of algae located in a colder region of Japan and compared with those of seaweeds from a temperate region where the seawater temperatures were approximately 5 C higher. The optimum temperature for photosynthesis was higher than the water temperature by less than 5 C in summer and by approximately 10 C or more in other seasons. Green algae were generally heat resistant, whereas the brown algae were more heat susceptible. The optimum temperatures for photosynthesis in the colder region were generally lower than those of the temperate area, the differences being 2 to 4 C. (ST)

<303>
Hawke, S.D., Respiratory Response of Hepatopancreas Tissue in the Lined Shore Crab, HEMIGRAPSUS NUDUS (Dana).

1975. Sci. Biol. Jour., 1, 93-101 (University of British Columbia, Department of Zoology, Vancouver, Canada)

The respiratory rate of excised hepatopancreas from HEMIGRAPSUS NUDUS was determined with tissue taken from crabs held 24 hours in the laboratory at their seasonal temperature and salinity (acclimatized) or crabs held ten days in the laboratory at various other combinations of temperature and salinity (acclimated). The thermal acclimation response of hepatopancreas to temperature (5 or 20 C) was dependent on the salinity (35, 75, or 125% seawater) to which the crabs were exposed before tissue excision. No temperature compensation was demonstrated in hepatopancreas tissue taken from winter and summer-adapted crabs held 24 hours or ten days at their seasonal salinity of 75% seawater (winter) or 35% seawater (summer). Partial temperature compensation was demonstrated in hepatopancreas tissue from winter and summer adapted crabs held 24 hour or ten days at nonseasonal salinities. Tissue from crabs acclimated to a cold (5 C) temperature had a higher respiratory rate than tissue from crabs acclimated to a warm (20 C) temperature in non-seasonal salinities. Seasonal comparison of tissue respiration showed that laboratory acclimation to temperature and salinity may reverse or obscure differences in hepatopancreas respiration due to field adaptation. Q10 values of tissue from summer animals showed no consistent change over the temperature range of measurement (5 to 20 C), with values generally between 2.0 and 3.0. Q10 values from winter animals followed a consistent pattern with most less than 2.0 or greater than 3.0. (Auth)

<304>
Hayden, J.B., J.J. Cech, Jr., and D.W. Bridges, Blood Oxygen Dissociation Characteristics of the Winter Flounder, PSEUDOPLEURONECTES AMERICANUS.

1975. Jour. Fish. Res. Bd. Can., 32, 1539-1544 (Research Institute of the Gulf of Maine, South Portland, ME)

Oxygen dissociation curves were determined for winter flounder (PSEUDOPLEURONECTES AMERICANUS) blood at 5, 10, and 15 C, and PCO2 = less than 1.8 and 24 mm Hg. Half-saturation tensions P50's and blood oxygen capacities were measured and showed significant Bohr and Root effects. Calculations of Hill's constant, n, implied no heme-heme interaction in the flounder hemoglobin. The apparent heat of oxygenation, delta H, was calculated to be smaller than that in most teleostean hemoglobins. This small temperature effect, together with the modest slope of the hyperbolic oxygen dissociation curves, indicate a capacity to live in waters exhibiting a fairly broad range of temperatures and dissolved oxygen concentrations. (Auth)

<305>
Hayward, R.S., and D.N. Gallup, Feeding, Filtering and Assimilation in DAPHNIA SCHOEDLERI Sars as Affected by Environmental Conditions.

1976. Arch. Hydrobiol. (Ger.), 77, 139-163 (University of Alberta, Department of Zoology, Edmonton, Alberta, Canada)

Feeding and filtering rates of DAPHNIA SCHODLERI were measured at different temperatures, light intensities, food concentrations, crowding conditions, and with different diet species. The rates were compared as well for different sizes, sexes, and reproductive states of the experimental animals. All of the above factors were found to affect feeding rates in a significant fashion in single variate experiments. However, when two or more environmental parameters were varied simultaneously, the previously defined relationships did not hold, and indeed were obscured as extremes of temperatures or cell concentrations were approached. The effects of those parameters which most dramatically altered feeding rates were then determined for assimilation rates and digestive efficiency estimates using C-14 as a radioactive tracer. Three environmental parameters: temperature, food concentration, and diet species, were found to alter responses to other parameters in a measureable manner. (Auth) (ST)

<306>
Hazel, J.R., and V.L. Schuster, The Effects of Temperature and Thermal Acclimation upon the Osmotic Properties and Nonelectrolyte Permeability of Liver and Gill Mitochondria from Rainbow Trout (SALMO GAIRDNERI).

1976. Jour. Exp. Zool., 195, 425-438 (University of Nebraska, School of Life Sciences, Lincoln, NB)

Rainbow trout were maintained in aquaria at constant water temperatures of either 7 or 20 C. Mitochondria from the liver and gills were employed to study the effects of temperature and thermal acclimation on the osmotic properties and nonelectrolyte permeability of the freshly isolated intact membranes. Thermal acclimation induced alterations in the osmotic properties of the gill and nonelectrolyte permeability of liver

<306> CONT.
mitochondria in such a way as to counteract the direct effects of temperature on these parameters. (ST)

<307>
Heinle, D.R., Effects of Passage through Power Plant Cooling Systems on Estuarine Copepods.

1976. Environ. Poll., 11, 39-58 (University of Maryland, Center for Environmental and Estuarine Studies, Chesapeake Biological Laboratory, Solomons, MD)

Vital staining techniques were used to measure mortalities of copepods pumped through three electric power plants located at low-salinity sites (Vienna, Chalk Point, and Morgantown, Maryland power plants). Elevated temperatures and pumping caused little mortality, while the use of chlorine as a biocide caused extensive mortalities. The three species of copepods (SCOTTOLANA CANADENSIS, EURYTEMORA AFFINIS, ACARTIA TONSA) sampled appeared to have different sensitivies to the perturbations examined. (Auth)

<308>
Heins, D.C., and G.H. Clemmer, The Reproductive Biology, Age and Growth of the North American Cyprinid, NOTROPIS LONGIROSTRIS (Hay).

1976. Jour. Fish Biol., 8, 365-379 (Mississippi State University, Department of Zoology, State College, MS)

Spawning of the longnose shiner, NOTROPIS LONGIROSTRIS, in Catahoula Creek, Jourdan River, Miss., occurred from late March into October. Water temperatures recorded during the reproductive season ranged from 17-29 C. (ST)

<309>
Heip, C., and N. Smol, Influence of Temperature on the Reproductive Potential of Two Brackish-Water Harpaticoids (Crustacea: Copepoda).

1976. Marine Biol. (W. Ger.), 35, 327-334 (State University of Ghent, Department of Zoology, Ghent, Belgium)

The influence of temperature on the reproductive potential of the copepods TACHIDIUS DISCIPES and PARONYCHOCAMPTUS NANUS was studied. Values of the intrinsic rate of natural increase varied between 0.039/day at 5 C and 0.239/day at 25 C for T. DISCIPES, and between 0.028/day at 5 C and 0.142/day at 25 C for P. NANUS. The corresponding times needed to double the population numbers were 17.8 days at 5 C and 2.9 days at 25 C for T. DISCIPES and 24.8 days at 5 C and 4.9 days at 25 C for P. NANUS. (ST)

<310>
Helly, J.J., Jr., The Effect of Temperature and Thermal Distribution on Glycolysis in Two Rockfish Species (SEBASTES).

1976. Marine Biol. (W. Ger.), 37, 89-95 (Occidental College, Department of Biology, Los Angeles, CA)

The study reports the effects of short-term reductions in temperature on Embden-Meyerhof (EM) and hexose monophosphate shunt (HMP) activity in two closely related species of temperate fish and its possible relation to the thermal distribution of the species. Thermal distribution data were collected by SCUBA for SEBASTES MYSTINUS and S. SERRANOIDES in King Harbor, Redondo Beach, Calif. Activities of the pathways were determined in liver-tissue studies, using C-14 labeled glucose and liquid scintillation techniques. The data were analyzed by distribution-free methods. Tissue studies indicated HMP activity in both species at lowered temperature (5 C), but only in S. SERRANOIDES at 15 C. Results indicate that S. MYSTINUS is capable of instantaneous temperature compensation, possibly related to its tendency to occupy cold waters. (Auth) (ST)

<311>
Helms, D.R., Variations in the Abundance of Channel Catfish Year Classes in the Upper Mississippi River and Causative Factors.

1975. Iowa Fisheries Research Technical Series No. 75-1 (Iowa State Conservation Commission, Des Moines, IA)

Vital statistics for channel catfish were described for several pools in the Mississippi River (Iowa) to determine differences in year class abundance and causative factors. The 1970 year class was the most abundant. Very poor year classes occurred in 1971 and 1972. The 1973 year class was slightly better than 1974. Year class abundance of channel catfish was established in the first year of life during spawning or hatching. No cause and effect relationship could be correlated with pesticides in eggs, ovarian parasites, fecundity or water level fluctuations. Spawning time and intensity was correlated to water temperature, but had no direct association to establishment of year class strength. Spawning activity began when water temperature reached about 18 C. Turbidity also influenced spawning, but was not adequately measured to determine its total effect. Factors that were suspected to be involved, but not evaluated in this study, were adult population density, abundance of predator and competator species, food availability, and the quality of spawning habitat. More than a single factor obviously affects year class abundance. Trawling in the main channel of the stream during August was determined to be the most satisfactory method of surveying year class strength of 0-age channel catfish. (Auth) (ST)

<312>
Herrick, S.F., Jr., and W.J. Baldwin, The Commercial Production of Topminnows. A Preliminary Analysis.

1975. UNIHI-SEAGRANT-AR-75-02; Hawaii Institute of Marine Biology Contribution No. 464; 18 p. (University of Hawaii, Hawaii Institute of Marine Biology, HI)

The optimal temperature range for production of topminnows (POECILIA VITTATA) was 28 to 30 C. Successful growth and reproduction were attained in a range from 23 to 34 C. Other water quality and biological parameters conducive to optimum production of topminnows are given. (ST)

<313>
Hess, L., The Summer Catch, Vertical Distribution and Feeding Habits of Trout in Spruce Knob Lake.

1974. Proc. W. Va. Acad. Sci., 46, 255-264 (West

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<313> CONT.
Virginia Department of Natural Resources, Elkins, WV)

A creel census conducted at Spruce Knob Lake, W. Va., from July through October 1973 revealed that trout fishing was poor in mid-summer when 33 hr of effort were needed to creel a trout. The catch rate increased eleven fold in early fall, though no trout were stocked. Fifty-one percent of the trout taken in verticle gill nets were caught in the top meter of water and 83% were caught in the upper 2 m. Vertical distribution was most restricted in late August and early September when no fish were caught below a depth of 2 m. Ninety-five percent of the trout were caught in water with a dissolved oxygen concentration of 5 mg/l or more and 93% of the trout were caught in water 23 C or less in temperature. Trout adapted to the adverse temperature conditions by moving into deeper waters during the day and shallower waters at night when temperatures decreased. A study of the feeding habits revealed that during the summer trout fed only one quarter as much as during the fall. Poor summer feeding was attributed to lack of suitable habitat. (ST)

<314>
Hesthagen, I.H., Seasonal Occurrence and Length Variation in the Sand Goby, POMATOSCHISTUS MINUTUS (Pallas), in the Shore Zone of the Inner Oslofjord.

1975. Nor. Jour. Zool., 23, 235-242 (University of Oslo, Department of Marine Zoology and Marine Chemistry, Blindern, Oslo, Norway)

Seven hundred and eight sand gobies collected by shore seining from May 1972 to June 1973 in five localities of the inner Oslofjord form the basis for this study. The gobies migrated away from the littoral in October/November at a water temperature slightly highter than 6.5 to 8.0 C, and returned in April at a temperature of 3 to 4 C presumably to breed. Females were always more abundant than males, save in August when the 0-group fish was first caught. The growth and maximum length attained were found to be higher than in other populations of similar latitudes. This is suggested to be due to the eutrophication of the Oslofjord. Relatively more gobies reached an age of two years than in more southern populations. (Auth)

<315>
Hettler, W.F., Influence of Temperature and Salinity on Routine Metabolic Rate and Growth of Young Atlantic Menhaden.

1976. Jour. Fish Biol., 8, 55-56 (National Marine Fisheries Service, Atlantic Estuarine Fisheries Center, Beaufort, NC)

Routine metabolic rates of schooling juvenile Atlantic menhaden, BREVOORTIA TYRANNUS, were measured in flowing-water respirometers to study the effects of body weight, temperature (10 to 25 C), salinity (5 to 10 ppt and greater than 28 ppt), time since last feeding, and darkness. The effect of salinity on growth of menhaden larvae into juveniles was also measured. At high salinities oxygen consumption of juveniles increased with increasing temperature. (ST)

<316>
Hidu, H., W.H. Roosenburg, K.G. Drobeck, A.J. McErlean, and J.A. Mihursky, Thermal Tolerance of Oyster Larvae, CRASSOSTREA VIRGINICA Gmelin, as Related to Power Plant Operation.

1974. Proc. Natl. Shellfish Assn., 64, 102-110 (University of Maryland, Chesapeake Biological Laboratory, Solomons, MD)

The upper thermal tolerance of Chesapeake oyster larvae (fertilized eggs, ciliated gastrulae, and two-day veliger larvae) was determined for 10-sec to 16-hr exposures. A biphasic temperature tolerance curve was noted with time of exposure, the inflection point coming at two hr. Considering all life stages tested, at two hr significant mortality (LDIO) came at just greater than 30 C, with slight increases in effect noted up to 16 hr of exposure. Tolerance levels increased with decreasing exposures less than two hr, until at 10 sec significant reduction came at approximatley 40 C . The relevance of these findings to power plant design and operation on estuaries is discussed. (Auth)

<317>
Hien, D.S., Biology of AEDES AEGYPTI (L., 1792) and AEDES ALBOPICTUS (Skuse, 1895) (Diptera, Culicidae): III. Effect of Certain Environmental Conditions on the Development of Larvae and Pupae.

1975. Acta Parasitol. Pol., 23, 41-51 (Institute of Malarial Parasitology and Entomology, Hanoi, Vietnam)

Under laboratory conditions the development of early stages of AEDES AEGYPTI and A. ALBOPICUTS lasted 6 to 8 days at 30 C, 8 to 11 days at 25 C, and 10 to 17 days at 20 C. Larvae and pupae of a wild strain of A. AEGYPTI obtained from Vietnam developed more quickly than those of A. ALBOPICTUS also from Vietnam. Larvae of the two species were highly resistant to lack of food; larvae starved during the three early instars could develop and imagines could emerge if the larvae were given food at the fourth larval stage. AEDES AEGYPTI and A. ALBOPICTUS larvae developed normally at high population density. In all experiments, A. ALBOPICTUS larvae proved more resistant to starvation and high population density than A. AEGYPTI larvae. (Auth)

<318>
Hien, D.S., Biology of AEDES AEGYPTI (L., 1762) and AEDES ALBOPICTUS (Skuse, 1895) (Diptera, Culicidae): II. Effect of Environmental Conditions on the Hatching of Larvae.

1975. Acta Parasitol. Pol., 23, 537-552 (Institute of Malarial Parasitology and Entomology, Hanoi, Vietnam)

The optimum temperature for the hatching of AEDES ALBOPICTUS larvae was 25 C. AEDES AEGYPTI larvae hatched in greatest numbers at 30 C. The optimum hatching temperature for a laboratory strain of A. AEGYPTI was higher than the optimum temperature for a strain living in natural conditions. Cold shock stimulated hatching, but a gradual reduction of water temperature did not. (ST)

<319>
Hines, A.H., Effects of a Thermal Outfall on Reproduction in Mussels and Barnacles.

1975. Amer. Zool., 15, 788 (Summary only) (University of California, Berkeley, CA)

<319> CONT.
Reproduction in two species of mussels (MYTILUS CALIFORNIANUS, M. EDULIS) and four species of barnacles (BALANUS GLANDULA, CHTHAMALUS FISSUS, TETRACLITA SQUAMOSA, POLLICIPES POLYMERUS) was studied at a power plant at Morro Bay, Calif. Monthly comparisons of gonad indices and brooding frequencies of outfall and control populations show a variety of effects of the heated water on the six species. Gonad output of M. CALIFORNIANUS is enhanced in the outfall; in M. EDULIS it is reduced. In B. GLANDULA brooding is delayed and repressed in the outfall; in T. SQUAMOSA it is earlier than normal. Brooding in C. FISSUS and P. POLYMERUS is unaffected by the outfall. Laboratory experiments testing the role of temperature, light and food in regulating brooding in two of the barnacle species show: B. GLANDULA requires cold temperatures for brooding, warm temperatures inhibit it; food availability limits reproduction in C. FISSUS, while light and temperature are unimportant. Although field data suggest T. SQUAMOSA requires warm temperature for reproduction, it did not brood in the laboratory. (Complete text)

<320>
Hodson, P.V., Temperature Effects on Lactate-Glycogen Metabolism in Zinc-Intoxicated Rainbow Trout (SALMO GAIRDNERI).

1976. Jour. Fish. Res. Bd. Can., 33, 1393-1397 (University of Guelph, Department of Zoology, Guelph, Ontario, Canada)

Acute, lethal exposures of fish to zinc cause gill damage and subsequent death through tissue hypoxia. This experiment showed that lactic acid production and glycogen utilization in dorsal white muscle of rainbow trout (SALMO GAIRDNERI) increased with time of exposure to a lethal concentration of zinc. Exposure of trout to zinc at 3, 11, and 19 C did not affect the timing or percentage change of lactic acid production or utilization of glycogen. Therefore, the previously observed high tolerance of zinc by warm-acclimated fish is not due to increased resistance to the tissue hypoxia caused by gill damage. (Auth)

<321>
Hodson, P.V., Zinc Uptake by Atlantic Salmon (SALMO SALAR) Exposed to a Lethal Concentration of Zinc at 3, 11, and 19 C.

1975. Jour. Fish. Res. Bd. Can., 32, 2252-2256 (University of Guelph, Department of Zoology, Guelph, Ontario, Canada)

Atlantic salmon (SALMO SALAR) acclimated to 3, 11, and 19 C took up high concentrations of zinc in gill tissues during exposures to a nominal 14 mg/liter of zinc. The rate of zinc uptake, as shown by Zn-65 tracer, increased from a minimum at 3 C to a maximum at 19 C. In fish killed by zinc exposure, zinc concentrations in gills were highest at 19 C and lowest at 3 and 11 C. (Auth)

<322>
Holbrook, J.A., II, The Distribution of Fishes as Related to Spatial, Temporal, and Environmental Variables.

1975. Ph.D. THesis, University of Georgia (University of Georgia, Athens, GA)

Area, total depth, distance from shore, temperature, oxygen, distance from the bottom, light intensity, and seasonal distributions of nine species of fish found in Lake Russell, Georgia, were determined using gillnets and experimental trotlines. Brook and rainbow trout avoided water temperatures above 20 C and did not survive the high temperature and/or low oxygen conditions present during Septembers of both sampling, years, 1970 and 1971. Rainbow trout were found in shoreline (0 to 10 m from shore), shallow (0 to 4.0 m total depth) waters during spring but were restricted to the deepest area of the reservoir during summer. Brown bullheads were also found in deep cool waters during summer. During all seasons brown bullheads were found near the bottom (within 1.0 m). Redbreast, redear, and green sunfish were most abundant in the shallow, shoreline, near-the-bottom portions of the reservoir. Yellow bullheads were also found in these waters but at night. No yellow bullheads were captured during daylight sampling periods. Differences in the distributions of two size classes of largemouth bass and three size classes of bluegill were also significant. Small (less than 120 mm) bass were found in shallow water but not at the bottom while larger bass were found in deeper water and near the bottom. Large (greater than 139 mm) bluegill were found farther from shore, in deeper water, and at cooler temperature than small (less than 100 mm) bluegills. Bluegill was the only species which was not closely associated with the bottom. Evaluation of the experimental trotline suggests that the line can be a useful fish sampler, particularly in fish distribution studies. (Auth)

<323>
Holland, D.A., and K.K. Chew, Reproductive Cycle of the Manila Clam (VENERUPIS JAPONICA), from Hood Canal, Washington.

1974. Proc. Natl. Shellfish Assn., 64, 53-58 (University of Washington, College of Fisheries, Seattle, WA)

Seasonal gonadal changes were observed histologically in samples of the Manila clam (VENERUPIS JAPONICA) collected from Misery Point and Big Beef Harbor in Hood Canal, Washington between October 1970 and November 1971. With few exceptions, ripe clams first appeared in May-June and most active spawning occurred in July. Spawning was nearly completed by October. Sexual maturation began at a shell length of 5 mm and spawning at 20 mm and over. (Auth)

<324>
Holmberg, B., Fish Culture Using Cooling Water from Thermal Power Plants.

1975. AECL-5322/1, In Low-Grade Heat: A Resource in Cold Climates, Proceedings of a Workshop held at the Chalk River Nuclear Laboratories October 6-10, 1975, B. Gay et al. (Eds.). Atomic Energy of Canada Limited (National Board of Fisheries, Goteborg, Sweden)

The special problems of using heated effluents for aquaculture are briefly reviewed. These are the relationship between temperature, food utilization, and growth; the effects of changes in water temperature; the influences of temperature on diseases and parasitism; tolerances of organisms to substances added to the cooling water; and gas supersaturation in the heated water. A pilot fish farm using cooling water from a

<324>

<324> CONT.
nuclear power plant in Oskarshamn, Sweden, is described. The purpose of the farm is to compare traditional farming with farming in heated effluents. The species farmed will be salmon, sea trout, rainbow trout, and eel. (ST)

<325>
Holt, G.J.D., Community Structure of Macro-Zooplankton in Trinity and Upper Galveston Bays, with Special Reference to the Cooling Water System of Cedar Bayou Electric Generating Station.

1976. Ph.D. Thesis, Texas A&M University; 105 p. (Texas A&M University, College Station, TX)

Changes in macro-zooplankton distribution and abundance in Trinity and upper Galveston Bays were correlated with natural and man made changes in the ecosystem. No major changes during the study period, October 1969 through May 1973, were attributed to the cooling water system of the Cedar Bayou electric generating station. The presence of two major seasons in each year based on taxon composition and abundance was revealed by cluster analysis. Sites were more similar to each other within a year than they were between years. Differences between years correlated with variation in salinity and fresh water inflow. (ST)

<326>
Homer, M., Seasonal Abundance, Biomass, Diversity, and Trophic Structure of Fish in a Salt-Marsh Tidal Creek Affected by a Coastal Power Plant.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (University of Florida, Department of Environmental Engineering Sciences and Department of Zoology, Gainesville, FL)

Monthly measurements were made of the seasonal abundance, biomass, species diversity, and trophic composition of fish inhabiting the tidal creeks of salt marshes receiving thermal discharge near Crystal River, Fla. In the warm months (May through September 1974), mean abundance in the creek receiving thermal discharge was 0.46 individuals/m 2 and mean biomass was 2.2 g (preserved weight)/m 2. In a control area, creek values in the warm months were 6.77 individuals/m2 and 9.1 g (preserved weight) /m 2, respectively. During the cold months (October 1974 through February 1975) there were 0.48 individuals/m 2 and 8.3g (preserved weight)/m 2 in the discharge area and 0.58 individuals/m 2 and 7.4 g preserved weight/m 2 in the control area. In all months except May 1974 and February 1975, species diversity as species per 1000 individuals was higher in the control creek than in the discharge creek. No apparent differences in fish trophic structure were observed. (Auth)

<327>
Horkel, J.D., and W.D. Pearson, Effects of Turbidity on Ventilation Rates and Oxygen Consumption of Green Sunfish, LEPOMIS CYANELLUS.

1976. Trans. Amer. Fish. Soc., 105, 107-113 (North Texas State University, Department of Biological Sciences, Denton, TX)

Ventilation and oxygen consumption rates of green sunfish exposed to bentonite clay suspensions were measured at 5, 15, 25, and 35 C. Ventilation rates were not affected by bentonite clay suspensions below 2,125 FTU (Formazin Turbidity Units) at 5 C, 1,012 FTU at 15 C, and 898 FTU at 25 C. At turbidity levels exceeding 1,012 FTU at 15 C and 898 FTU at 25 C ventilation rates increased 50 to 70%. Tests were inconclusive at 35 C due to high mortality. Oxygen consumption rates were not affected by turbid suspensions of up to 3,500 FTU at any of the four temperatures. Evidence suggests that increased ventilation rates under highly turbid conditions are a means of compensating for reduced respiratory efficiency and a strategy for maintaining a constant oxygen uptake. The costs of increased ventilation rates were probably met by a reduction in activity. (Auth)

<328>
Houston, A.H., and R. Rupert, Immediate Response of the Hemoglobin System of the Goldfish, CARASSIUS AURATUS, to Temperature Change.

1976. Can. Jour. Zool., 54, 1734-1741 (Brock University, Department of Biological Sciences, St. Catharines, Ontario, Canada)

Goldfish acclimated to 3 and 23 C were characterized by two- and three-component hemoglobin systems, respectively. After acclimation to a diurnally cycling temperature regime (3 to 12 C), specimens sampled at 23 C and 3 C were identical in terms of hemoglobin system complexity with those held at equivalent constant temperatures. Abrupt transfer of fish acclimated at constant 23 C to 3 C, and vice versa, led to appearance or disappearance of the minor component within 3 hr. In vitro cooling and warming the whole blood and hemolyzate samples indicated that hemoglobin system modification occurred under cell-free as well as cell-intact conditions. These observations suggest that previously observed quantitiative variations in the hemobglobin systems of thermally acclimated teleosts may represent, in part at least, altered aggregation of preexisting subunits rather than de novo hemoglobin synthesis and raise the possibility that teleostean hemoglobin systems may possess a capacity for rapid, adaptative reorganization after environmental temperature variation. (Auth)

<329>
Huang, C.-C., K.-H. Chang, H.-A. Ng, and I.-M. Shaw, Maturation and Breeding Season of the Red Sea Bream.

1975. Bull. Inst. Zool., Academia Sinica (Taiwan), 14, 47-53 (Academia Sinica, Institute of Zoology, Taipei, Taiwan; National Taiwan University, Department of Zoology, Taipei, Taiwan)

The red sea bream, CHRYSOPHRYS MAJOR, spawned in February and March in the Keelung (northern Taiwan) area. (ST)

<330>
Hughes, G.M., J.G. O'Neill, and W.J. van Aardt, An Electrolytic Method for Determining Oxygen Dissociation Curves using Small Blood Samples: The Effect of Temperature on Trout and Human Blood.

1976. Jour. Exp. Biol., 65, 21-38 (University of Bristol, Research Unit for Comparative Animal Respiration, Bristol, England)

<330> CONT.
A detailed account is given of an electrolytic method for determining the oxygen dissociation curve of fish blood using a single sample of 50 to 100 ul for the whole curve. The accuracy and some of the problems arising from its uses are discussed. Oxygen dissociation curves were determined for trout blood at temperatures of 15 and 37 C. The relationship between P(sub 50) and temperature was similar to that obtained by other methods. The effect of P(CO2) and pH on the oxygen dissociation curve of trout blood was tested and it is shown that P(CO2) has a more marked effect than pH when the other factor is maintained at a constant level. The Bohr factor appeared to be approximately the same and independent of the P(CO2). (Auth) (ST)

<331>
Hughes, J.R., T.H. Blahm, and D.R. Craddock, A Mobile Laboratory with Flow-Through Capability for Thermal Tolerance Studies of Aquatic Organisms.

1976. Marine Fish. Rev., 38, 24-27 (National Marine Fisheries Service, Northwest Fisheries Center, Seattle, WA)

A mobile laboratory, designed for studies to determine the temperature tolerance of certain aquatic animals, is described. The laboratory is equipped with the apparatus and control systems necesary to supply water of controlled temperature for flow-through bioassay tests. The laboratory has been used to determine the upper lethal temperature levels for crab and flatfish at one site on Puget Sound in northwestern Washington State. It could be used at other sites in studies to determine the effect of either existing or proposed discharges of waste heat on resident species of fish and shellfish. (Auth)

<332>
Huh, H.T., Bioenergetics of Food Conversion and Growth of Yellow Perch (PERCA FLAVESCENS) and Walleye STIZOSTEDION VITREUM VITREUM) Using Formulated Diets.

1975. Ph.D. Thesis, University of Wisconsin (University of Wisconsin, Madison, WI)

The feeding, bioenergetics, and growth of yellow perch and walleye fed with formulated diets was studied in the laboratory. The effects of temperature and photoperiod on growth were similar in both species with maximum growth occurrring at 22 C and 16 hours of photoperiod, when fed the 3% daily ration of the wet body weight. The temperatures ranges for favorable growth were 20 to 24 C for yellow perch and 19 to 27 C for walleye. (ST)

<333>
Huh, H.T., H.E. Calbert, and D.A. Stuiber, Effects of Temperature and Light on Growth of Yellow Perch and Walleye Using Formulated Feed.

1976. Trans. Amer. Fish. Soc., 105, 254-258 (University of Wisconsin, Marine Studies Center and College of Agriculture and Life Sciences, Madison, WI)

Growth of age group 0 yellow perch (PERCA FLAVESCENS) and walleye (STIZOSTEDION VITREUM VITREUM) was studied when temperature and light conditions were varied. Fish, fed formulated dry pellets, were kept for 14 weeks at 16 and 22 C in combination with 8- and 16-hour photoperiods. Growth ranged from 151 to 539% in the walleye and from 79 to 343% in the perch during the 14-week period. Best growth for both species was found at 22 C with a 16-hour photoperiod. The temperature of 22 C is similar to the optimal temperature for growth of both fish in natural water. Growth of young walleye appeared to be temperature-dependent, whereas that of yellow perch was more photoperiod-dependent. The influence of temperature on the walleye growth was highly significant for all photoperiods used, whereas it was not significant for yellow perch. The effects of photoperiod on growth of walleye were not significant but they were for yellow perch. (Auth)

<334>
Hulbert, W.C., D.E. Schneider, and T.W. Moon, Temperature and Salinity Adaptation in the Purple Shore Crab HEMIGRAPSUS NUDUS: An in Vitro Physiological Study with Excised Gills.

1976. Marine Biol. (W. Ger.), 36, 217-222 (University of Ottawa, Department of Biology, Ottawa, Ontario, Canada; Western Washington State College, Department of Biology, Bellingham, WA)

The oxygen consumption of excised gill tissue from HEMIGRAPSUS NUDUS was determined in crabs acclimated to two temperatures (5 and 20 C) and two different salinities (30 and 11 ppt). The effects of acute shifts from one acclimation condition to another were also measured. An acute decrease in salinity (30 to 11 ppt) or an acute increase in temperature (5 to 20 C) resulted in an increase in oxygen consumption. Increase in oxygen consumption resulting from an acute decrease in salinity appears to be (1) independent of the crabs' thermal history, and (2) linear, following a 20 min equilibration period. The significance of isolating acute osmotic responses from temperature control is discussed. (Auth)

<335>
Hulbert, W.C., D.E. Schneider, and T.W. Moon, Temperature and Salinity Adaptation in the Purple Shore Crab HEMIGRAPSUS NUDUS: An in Vitro Metabolic Flux Study with Excised Gills.

1976. Marine Biol, (W. Ger.), 36, 223-231 (University of Ottawa, Department of Biology, Ottawa, Ontario, Canada; Western Washington State College, Department of Biology, Bellingham, WA)

The effects of temperature and salinity acclimation on intermediary metabolism in excised gill homogenates from HEMIGRAPSUS NUDUS were examined. In general, a decrease in salinity was followed by an increase in the oxidation of the substrates glucose-1-C-14, acetate-1-C-14 and glycine-C-14 to C-14 labelled CO2. Also, there was an increase in amino acid incorporation into the protein fraction. Both of these metabolic parameters were differentially temperature-sensitive. An enzymic model which may explain the increase in respiration rate observed in several intertidal invertebrates meeting an hypo-osmotic stress is proposed, using data from these experiments and also from the literature. (Auth)

<336>
Hutcheson, S.M., The Respiratory Adaptations of the Stout Razor Clam, TAGELUS PLEBEIUS Solander, to Environmental Factors Prevalent in the Intertidal Zone of a South Carolina Estuary.

<336>

<336> CONT.
1975. Ph.D. Thesis, University of South Carolina (University of South Carolina, Columbia, SC)

As part of a study of the acclimation of TAGELUS PLEBEIUS to environmental conditions in the North Inlet, SC, seasonal respiratory adaptation to temperature was determined. Excised gills showed seasonal metabolic adaptation to temperature which corresponded to Prosser's Type IIA, with slight clockwise rotation of the M-T curve for colder acclimated animals. Gills were less metabolically sensitive to higher temperatures than lower ones. The relationship of weight to metabolic rate, varied primarily with temperature and, to a lesser extent, season in the gills. An equation is given for the mean rates of weight specific oxygen consumption of the gills throughout the year. Intact clams had a metabolic rate that was temperature dependent in response to a 5 C increase in temperature above an acclimation temperature of 25 C. They were extremely insensitive to a 5 C increase above that. The ability to regulate the rate of oxygen consumption in the face of declining oxygen conditions was lost when summer acclimated (25 C) clams were exposed to 30 and 35 C. (ST)

<337>
Hutchison, V.H., Factors Influencing Thermal Tolerances of Individual Organisms.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (University of Oklahoma, Department of Zoology, Norman, OK)

The diversity of experimental methods and terminology employed by investigators to measure the effects of high temperatures on individual organisms, plus the often overlooked complexities of the holocoenotic environment has often led to disconcerting conclusions. A plea is made for standardization of testing methods and for a wider appreciation of factors that may alter thermal tolerances. The influence of elevated temperature is grouped into three categories, lethal effects, controlling effects, and directive effects, all of which should be considered in assessing the impact of thermal effluent on organisms. In addition, the terminology (acclimation, acclimatization, adaptation, habituation, lethal temperature, critical thermal maximum, etc.) needs standardized definitions. The important factors influencing thermal effects on organisms include photoperiod, seasonal and daily cycles, geographic variation, diet, sex, breeding condition, age, life-cycle stage, salinity, chemicals, body water content and partitioning, oxygen supply, pH, innate and learned behavior, history of thermal exposure, sublethal exposure to limiting factors, and experimental methods. Examples of most of these are given to illustrate the role of temperature in the holocoenotic environmental complex of individual organisms. (Auth)

<338>
Hylleberg, J., The Effect of Salinity and Temperature on Egestion in Mud Snails (Gastropoda: Hydrobiidae). A Study on Niche Overlap.

1975. Oecologia (Ger.), 21, 279-289 (University of Aarhus, Department of Ecology, Aarhus, Denmark)

A comparative study of egestion in three species of mud snails under controlled conditions of salinity (10 to 30 ppt), and temperatures (5 to 35 C), showed that HYDROBIA ULVAE has maximal egestion at the combination of high salinity (30 ppt) and high temperature (30 C). In HYDROBIA NEGLECTA a peak of egestion occured at the combination of 25 ppt salinity and 25 C. HYDROBIA VENTROSA showed a small maximum at 20 ppt and 30 C. However, in contrast to the former two species the egestion was rather uniform over the range of salinities and temperatures tested. (ST)

<339>
Hyodo-Taguchi, Y., and N. Egami, Cell Population Change in Initiation of Spermatogenesis Following Exposure to High Temperature during Sexually Inactive Seasons in the Teleost, ORYZIAS LATIPES.

1976. Annot. Zool. Jap., 49, 96-104 (National Institute of Radiological Sciences, Division of Biology, Chiba, Japan; University of Tokyo, Zoological Institute, Tokyo, Japan)

During winter at ambient temperatures of 0 to 5 C, the testes of ORYZIAS LATIPES are inactive. Four to six days after transfer of the fish to 25 C, spermatogenesis was observed. (ST)

<340>
Icanberry, J.W., and J.R. Adams, Zooplankton Survival in Cooling Water Systems of Four Thermal Power Plants on the California Coast - Interim Report. March 1971-January 1972.

1974. PB-240 758; EPRI-74-049-00-5; Electric Power Research Institute Cooling Water Studies Report No. 15; In Jensen, L.D. (Ed.), Proceedings of the Second Entrainment and Intake Screening Workshop held at Johns Hopkins University, Baltimore, Maryland, February 5-9, 1973. National Technical Information Service, Springfield, VA (Pacific Gas and Electric Company, Department of Engineering Research, Emeryville, CA)

Zooplankton survival after passage through the cooling systems of four California coastal power plants is described. A linear regression analysis of the monthly percentage of mortality differences (intake mortality minus discharge mortality) and discharge temperatures, ranging seasonally from 9.2 to 29.4 C, of all the plants showed a linear relationship. The mortality differences between power plant intake and discharges averaged 5.82% for the 6-month study. The adult copepod group was most abundant in the samples and experienced the highest overall mortality. Soft-bodied forms were least abundant and incurred the lowest mortality. In 24-hr delayed mortality tests, there was no significant mortality difference between control organisms and discharge organisms exposed to normal temperature decay regimes. Discharge organisms kept at discharge temperatures for 24 hr had increased mortalities compared to the other two groups. The immature forms experienced statistically significant mortality increases after the first 6-hr. Between 12 and 24 hr, mortalitites in all samples were sustained by immature forms and adult copepods. Soft-bodied forms, polychaete larvae, trochophore larvae and phoronid larvae were resistant to both the test and temperature effects. Hard bodied forms were not present in the majority of the samples. (ST)

<341>
Ignat'eva, G.M., Dependence of Egg Cleavage Rate on Temperature in the Carp, Pike and Peled.

1974. Ontogenez, 5, 27-32 (Not given)

The duration of the first four cleavage divisions of eggs of CYPRINUS CARPIO, ESOX LUCIUS and COREGONUS PELED was determined at different temperatures. Within the limits of the spawning temperatures the cleavage rate was characterized by Q10 values greater than two to three. (ST)

<342>
Ikusemiju, K., Aspects of the Ecology and Life History of the Sculpin, COTTUS ALEUTICUS (Gilbert), in Lake Washington.

1975. Jour. Fish Biol., 7, 235-245 (University of Washington, College of Fisheries, Seattle, WA)

The spawning season of the pelagic sculpins from Lake Washington extended from February to April. The water temperature during the spawning period ranged between 6.0 and 8.4 C. (ST)

<343>
Ingram, B.R., Diapause Termination in Two Species of Damselflies.

1975. Jour. Insect Physiol., 21, 1909-1916 (Clemson University, Department of Zoology, Clemson, SC)

Larvae of two species of damselflies, ENALLAGMA HAGENI and E. ASPERSUM, were collected in southwestern North Carolina and subjected to different combinations of daylength and temperature to determine the factor critical in the determination of diapause. Diapause termination was affected by long-day, 21 C conditions preceded by exposure to either low temperatures (10 C), during which the photoperiod was not important, or short daylengths at 21 C. (ST)

<344>
Ingram, B.R., Effects of Photoperiod and Temperature on Abnormal Wing-Pad Development in Two Species of Odonata.

1976. Can. Jour. Zool., 54, 1103-1110 (Clemson University, Department of Zoology, Clemson, SC)

Nymphs of the damselfies, ENALLAGMA HAGENI and ENALLAGMA ASPERSUM were collected in North Carolina from August or September to March and subjected to long- and short-day photoperiods at 16 and 21 C. Abnormal wing pads were formed only at the higher temperature, primarily under short-day conditions, where extra molts were common; growth was also slow under these conditions. Mortality was considerably higher in nymphs with abnormal wing pads than in those undergoing normal development. The absence of abnormal wing pads at 16 C compared with 21 C suggests that even small temperature alterations, such as those resulting from discharges of heated water, may have adverse effects on the development of some aquatic insects. (Auth)

<345>
Ivanova, M.B., The Effect of Temperature on the Time of Embryonal and Postembryonal Development of Freshwater Planktonic Copepoda (Diaptomidae, Cyclopidae).

1975. Gidrobiol. Zh. (USSR), 11, 116-123 (Zoology Institute, AN SSSR, Leningrad, USSR)

Studies on the rate of development of various copepod species in relation to water temperature are reviewed. Equations and curves are cited showing the relation-ships between water temperature, survival and development time. Examples of estimating the initial efficient temperature and tabulated material on these temperatures for eggs, nauplii and copepodites by species is presented. A consideration is given to temperature effects with references to diets fed to copepods. (Auth)

<346>
Iwasaki, T., Reproductive Patterns of ARTEMIA with Special Regard to Food and Temperature.

1976. Zool. Mag. (Jap.), 85, 229-236 (National Institute of Radiological Sciences, Chiba, Japan)

Two strains of brine shrimp were reared at 15, 25, or 32 C. A marked decrease in fecundity of females was observed at 32 C. Females produced both ovoviviparous and oviparous broods during their reproductive periods. (ST)

<347>
Jenkins, R.E., and N.M. Burkhead, Distribution and Aspects of Life History and Morphology of the Cyprinid Fish NOTROPIS SEMPERASPER Endemic to the Upper James River Drainage, Virginia.

1975. Chesapeake Sci., 16, 178-191 (Roanoke College, Department of Biology, Salem, VA)

The geographic and ecologic distribution of the roughhead shiner are documented. This species is known only from nine streams of the upper James River drainage, Virginia. The authors suggest monitoring of this species because of environmental modifications completed, under construction, and proposed for occupied streams. Spawning begins in May and extends into June but not later than late August. (ST)

<348>
Jennison, B.L., The Effect of Increased Temperature on Reproduction in the Sea Anemone ANTHOPLEURA ELEGANTISSIMA.

1975. Amer. Zool., 15, 787 (University of California, Berkeley, CA)

Reproductive cycles of ANTHOPLEURA ELEGANTISSIMA were compared for populations in a power plant thermal outfall and at a control site at Morro Bay, California. Gonad maturation state was assessed from live material and by histological and biochemical methods. Ova were present in the mesenteries as early as February, and mean egg size increased until July, when both populations spawned. Gonads were then resorbed, and eggs did not appear again until the following February. In males, active tailed sperm were visible through-out the summer. Total lipid composition paralleled the gametogenic cycle in both populations; however, control anemones stored more lipid than did outfall animals, implying that they have more energy available for reproduction. The apparent reduced reproductive ability of outfall anemones may reflect the increased metabolic demands imposed by the outfall temperature, which is commonly 10 C above ambient. (Auth)

<349>
Jensen, K., Food Preference and Food Consumption in Relation to Growth of LIMAPONTIA CAPITATA (Opisthobranchia, Sacoglossa).

1975. Ophelia, 14, 1-14 (Marine Biological Laboratory, Helsingor, Denmark)

A positive correlation between food consumption and growth at various temperatures was established for the snail, LIMAPONTIA CAPITATA. Regression lines of growth vs algal cells consumed at 6, 10, and 15 C were parallel lines, indicating that the proportion of metabolism used for growth at these temperatures is the same. At 20 to 23 C a greater proportion of food was used for standard metabolism and less for growth than at the lower temperatures. (ST)

<350>
Jensen, L.D., Environmental Responses to Thermal Discharges from the Chesterfield Station, James River, Virginia.

1974. EPRI-74-049-00-6; Cooling Water Studies for Electric Power Research Institute Report No. 13, 180 pp. (Johns Hopkins University, Department of Geography and Environmental Engineering, Baltimore, MD)

Field studies relative to the impact of the Chesterfield Power Station of the Virginia Electric and Power Company on the tidal James River between spring of 1968 and November, 1971 are reported. The purpose of the studies was to determine the effects of the introduction of waste heat into the upper James River on the number and species composition of resident and migratory aquatic organisms. Biological and essential concurrent physical and chemical data were collected in the vicinity of the station. The primary effect of using river water for cooling purposes was to raise the temperature of the river water with associated seasonal changes in dissolved oxygen values. No significant change was detected in the levels of other water quality parameters. Relatively high photosynthetic rates were observed in both intake and discharge samples during the warmer months of the year. During this period, intake rates were higher than those measured at the discharge. In the fall and winter months the rates measured at the discharge became higher than those at the intake As temperatures rose in the spring the discharge rates approached the intake levels and by mid-June they were normally depressed below that of the intake rates. Zooplankton effects were limited to the summer periods from late June through September. These effects, loss of motility and death, appeared to be related to the maximum ambient intake water temperature. The cooler periods of the year did not produce ambient water temperatures that, when elevated through use in condenser systems produced lethal conditions. Both the amplitude of temperature and duration of exposure affected the survival of zooplankton and phytoplankton populations examined in the entrainment studies. During chlorination procedures both zooplankton and phytoplankton organisms were either seriously affected or killed by applications sufficient to produce a 0.5 mg/1 residual in the discharge area. Benthic populations downstream of the mouth of the discharge canal were not seriously affected by the heated discharge. Fish appeared to avoid the uppermost areas of the discharge system and were increasingly more abundant at stations further down the discharge system especially during the summer when ambient water temperatures are near the annual maxima. Conversely there was some attraction to the warm water effluent during the colder months. The James River in this area supports a large, relatively diversified fisheries population. The overall impact of entrainment of fish eggs and larvae did not appear to have a detrimental effect on populations of those species present, but the need for more research is indicated. (ST)

<351>
Jensen, L.D., Effects of Entrainment, Entrapment and Impingement.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Ecological Analysts, Inc., Baltimore, MD)

The paper suggests areas of data collection effort that are relevant to both research and monitoring programs for entrainment and entrapment at stream electric generating stations. General comments are made regarding the nature of sampling efforts and research problems in these areas. Site-specific features of each generating station warrant a detailed review of data requirements and sampling protocol before initiating the extensive and inherently costly studies that appear to be suggested by various regulatory guideline documents. Because of the complexity of these studies, utility personnel should consult and develop specific sampling programs in concert with various regulatory scientists in order to prevent misunderstandings and conflicts that may be anticipated as a result of the development of these research and monitoring programs. A summary of research needs is given. (Auth) (ST)

<352>
Jensen, L.D. (Ed.), Entrainment and Intake Screening; Proceedings of the Second Entrainment and Intake Screening Workshop held February 5-9, 1973.

1974. PB-240 758; EPRI-74-049-00-5; Electric Power Research Institute Cooling Water Studies Report No. 15; Proceedings of the Second Entrainment and Intake Screening Workshop held at Johns Hopkins University, Baltimore, Maryland. National Technical Information Service, Springfield, VA (Johns Hopkins University, Department of Geography and Environmental Engineering, Baltimore, MD)

The papers represent a summary of state-of-the-art information relative to both the effects of entrainment of planktonic organisms into cooling water systems and hydraulic entrapment of fish into intake and screening structures of power plants located in a variety of geographic settings throughout the United States. Fourteen papers were selected and abstracted separately for the data base. (ST)

<353>
Johnson, C.R., Diel Variation in the Thermal Tolerance of GAMBUSIA AFFINIS AFFINIS (Pisces: Poeciliidae).

1976. Comp. Biochem. Physiol., 55A, 337-340 (University of California, Division of Biological Control, Berkeley, Albany, CA)

<353> CONT.
Thermal limits varied over a 24 hr period for male and female fish and significant differences were found among the testing periods for both sexes. Female GAMBUSIA AFFINIS were more heat tolerant than males. No significant difference was found between the mean thermal lethals of gravid and non-gravid females. A daily rhythm in heat resistance is evident in G. AFFINIS but its significance is unknown; some evidence suggests that it may have survival value. (Auth)

<354>
Johnson, W.C., II, and E.D. Schneider, The Effect of Subtle Temperature Changes on Individual Species and Community Structure.

1976. EPA-600/3-76-079; Part of Proceedings of a Symposium on Water Quality Criteria Research of the U.S. Environmental Protection Agency (U.S. Environmental Protection Agency, Environmental Research Laboratory, Narragansett, RI)

By applying available modeling tools to completely different existing data sets, appreciable effects of long-term, low level temperature change on species abundance and community structure and composition were demonstrated. On the species level of organization marked changes in population abundances with subtle 1 C temperature shifts may occur, a beneficial or adverse effect may be seen in resident biota, and sensitive early life history with narrow temperature ranges may be adversely affected. Entire communities have undergone significant change when prolonged low level warming occurs because of the discharge of heated effluents. However community changes are difficult to predict because of interactions between species. Species diversity changes with ambient temperature for certain community types. Diversity in foraminiferal communities respond appreciably to temperature change with an apparent maximum at 18.5 C summer-winter average. (ST)

<355>
Johnston, I.A., W. Davison, and G. Goldspink, Adaptations in Magnesium (+2)-Activated Mycfibrillar ATPase Activity Induced by Temperature Acclimation.

1976. FEBS Letters, 50, 293-295 (University of Bristol, Research Unit for Comparative Animal Respiration, Bristol, England; University of Hull, Department of Zoology, Hull, England)

ATPase activity of cold acclimated (1C) goldfish (CARASSIUS AURATUS) was 2.8 times higher than that of the warm acclimated (26 C) fish assayed at the same temperature. The apparent energies of activation for the reaction over the temperature range 0 to 18 C calculated from Arrhenius plots were 14.3 Kcal/mol and 21.9 Kcal/mol for cold and warm acclimated fish were found to have different thermostabilities, the myofibrils from warm acclimated fish being more thermostable at 37 C. (ST)

<356>
Johnston, I.A., N.J. Walesby, W. Davison, and G. Goldspink, Temperature Adaptation in Myosin of Antarctic Fish.

1975. Nature, 254, 74-75 (University of Bristol, Research Unit for Comparative Animal Respiration, Bristol, England; British Antarctic Survey, Monks Wood Experimental Station, Huntingdon, England; University of Hull, Department of Zoology, Hull, England)

The properties of myofibrils and myosin from the white muscle of an Antarctic fish, NOTOTHENIA ROSSII, were compared with homologous preparations from a tropical species, AMPHIPRION SEBEA. It is suggested that the thermal ability of cold-adapted fish myosins arises from differences in the higher order in the structure of the molecule; this is probably an evolutionary response to attain high catalytic efficiency at low temperatures. (ST)

<357>
Jolley, R.L., (Ed.), The Environmental Impact of Water Chlorination.

1975. CONF-751096; 443 p. (Oak Ridge National Laboratory, Oak Ridge, TN)

The conference was held to review the state of the knowledge of major aspects of water chlorination with particular emphasis on chlorinated organic compounds and associated biomedical and environmental effects. Two papers reviewing the toxicity of chlorine to freshwater and marine organisms, including the combined effects of temperature and chlorine, were selected and abstracted separately for the data base. (ST)

<358>
Jones, R.S., R.H. Randall, and M.J. Wilder, Biological Impact Caused by Changes on a Tropical Reef.

1976. EPA-600/3-76-027, U.S. Environmental Protection Agency, Environmental Research Laboratory, Narragansett, R.I. (University of Guam, Marine Laboratory, Agana, Guam)

A biological study was conducted on a fringing coral reef adjacent to the Tanguisson Power Plant on Guam before and after release of plant effluent. Release of plant effluent resulted in a mean temperature increase of 7.0 C (27.7 C at the intake compared to 34.7 C at the outfall). The effluent also contained potentially harmful chemicals such as chlorine and heavy metals. Introduction of the effluent was found to be responsible for recent destruction of reef margin corals. Coral transect studies showed an increase in recent coral re-colonization on the reef front, terrace and slope since a starfish (ACANTHASTER PLANCI) infestation. No recovery was evident in benthic habitats of the reef margin exposed to effluent. Thermal simulation experiments, performed on a series of reef corals in the laboratory, suggested mean upper tolerance limits for corals between 30 and 33 C. Sublethal elevation of temperature was shown to reduce growth rate in some of the coral species. Recommendations are made to release the effluent in deeper water in order to provide a greater mixing zone and to relieve present stress on reef margin organisms. (Auth)(ST)

<359>
Jordan, F.J., and L.M. Ramorino, Reproduction of LITTORINA (AUSTROLITTORINA) PERUVIANA (Lamarck, 1822) and LITTORINA (AUSTROLITTORINA) ARAUCANA (Orbigny, 1840).

1975. Rev. Biol. Mar. Dept. Oceanol. Univ. Chile, 15, 227-261 (University of Chile, Department of Oceanology, Valparaiso, Chile)

Spawning activity of the gastropod, LITTORINA

<359>

<359> CONT.
PERUVIANA, occurred throughout the year in the intertidal zone at Montemar, Chile. Spawning increased from February to July, coinciding with a drop in water temperature. In the laboratory embryonic development of both L. PERUVIANA and L. ARAUCANA took seven to eight days at 14 C, five days at 18 C, and three to four days at 20 to 22 C. (ST)

<360>
Joy, J.E., Incidence and Intensity of SPIROCAMALLANUS PEREIRAI (Nematoda: Camallanidae) Infestations in the Croaker, MICROPOGON UNDULATUS (Linneaus) and Spot, LEIOSTOMUS XANTHURUS Lacepede, from Texas.

1974. Contrib. Marine Sci., 18, 1-6 (Texas A&M University, College of Veterinary Medicine, College Station, TX)

During a one year period the nematode, SPIROCAMALLANUS PEREIRAI, was found in the digestive tracts of 266 of 516 (51.5%) croaker, MICROPOGON UNDULATUS, and 172 of 512 (33.6%) spot, LEIOSTOMUS XANTHURUS. Seasonal patterns in incidence and mean number of S. PEREIRAI per host for both host species were evident. The incidence of infestation in the croaker paralleled temperature conditions and the incidence in the spot was inverse to temperature. Incidence of S. PEREIRAI females exceeded that of males in every monthly sample for both host species. The incidence of parasitization declined as the length of croaker and spot increased. (ST)

<361>
Kadlec, V., The Effects of Some Factors on the Growth and Morphology of NAEGLERIA sp. and Three Strains of the genus ACANTHAMOEBA.

1975. Folia Parasitologica (Czech.), 22, 317-321 (State Institute of Veterinary Medicine, Terezin, Czechoslovakia)

The effects of various biophysical and chemical factors on the cytology of vegetative stages of NAEGLERIA sp., Vitek strain, ACANTHAMOEBA CULBERTSONI, ACANTHAMOEBA CASTELLANII, Neff strain, and ACANTHAMOEBA POLYPHAGA, No. 1289, were studied. The amoebas were cultued in a liquid medium under axenic conditions. The optimum temperature for pathogenic strains of NAEGLERIA sp. and ACANTHAMOEBA CULBERTSONI was 37 C and for A. CASTELLANII was 20 C. No differences were noticed in the growth of A. POLYPHAGA at 20 and 37 C. All strains grew at pH values of 5.6 to 7.7. At the limit values the growth was inhibited and the morphology of the cells was markedly changed. The three strains of ACANTHAMOEBA grew in liquid axenic medium with 0.89% NaCl. (Auth) (ST)

<362>
Karim, M., Survival of Brine Shrimp, ARTEMIA Nauplii under Controlled Conditions of Temperature and Salinity.

1974. Bangladesh Jour. Zool., 2, 65-69 (Plann. Comm., Agricultural Division, Dacca, Bangladesh)

The combined effects of salinity and temperature on survival of ARTEMIA nauplii were studied under controlled conditions. Test salinity ranged from 5 to 80 ppt and temperature from 5 to 36 C. With no acclimation, the nauplii withstood wide changes in both temperature and salinity for 24 hr. (Auth)

<363>
Kasahara, S., T. Onbe, and M. Kamigaki, Calanoid Copepod Eggs in Sea-Bottom Muds. III. Effects of Temperature, Salinity and Other Factors on the Hatching of Resting Eggs of TORTANUS FORCIPATUS.

1975. Marine Biol. (W. Ger.), 31, 31-35 (Hiroshima University, Faculty of Fisheries and Animal Husbandry, Fukuyama, Japan)

The resting eggs of a marine neritic copepod, TORTANUS FORCIPATUS, recovered from sea-bottom sediment were hatched in the laboratory. Hatching occurred at temperatures of 13 to 30 C; no eggs hatched at 10 C. Temperatures near 25 C were found to be optimal for hatching, although the range of optimal temperature for hatching was approximately 5 C lower in eggs stored for 14 to 15 months than in those stored for one to two months. A wide range of salinity, from 18 to 54 ppt, was favourable for hatching. Eggs failed to hatch within the sediment mud, suggesting that they are in a state of dormancy in the mud. Hatching was successful under both light and dark conditions. (Auth)

<364>
Kasahara, S., S. Uye, and T. Onbe, Calanoid Copepod Eggs in Sea-Bottom Muds. II. Seasonal Cycles of Abundance in the Populations of Several Species of Copepods and Their Eggs in the Inland Sea of Japan.

1975. Marine Biol. (W. Ger.), 31, 25-29 (Hiroshima University, Faculty of Fisheries and Animal Husbandry, Fukuyama, Japan)

The seasonal cycles of abundance of populations of dominant calanoid copepods in the water column and of their eggs recovered from the bottom sediment in the central part of the Inland Sea of Japan are described. The numbers of both copepods and eggs fluctuated markedly with season in an essentially similar pattern among the six species studied (TORTANUS FORCIPATUS, CALANOPIA THOMPSONI, ACARTIA ERYTHRAEA, A. CLAUSI, CENTROPAGES ABDOMINALIS, and C. YAMADAI). Laboratory studies indicated that eggs of TORTANUS FORCIPATUS, CALANOPIA THOMPSONI, and ACARTIA ERYTHRAEA hatch at temperatures of 15 to 30 C, and those of A. CLAUSI can hatch at 5 to 20 C. The eggs of CENTROPAGES ABDOMINALIS AND C. YAMADAI hatch at 10 to 25 C. Since C. ABDOMINALIS is a winter-spring species and C. YAMADAI is a summer-fall species it can be expected that eggs of the former species hatch at the lower end of the temperature range and eggs of the latter at the higher temperatures. It was concluded that the resting eggs of T. FORCIPATUS, A. ERYTHRAEA, CALANOPIA THOMPSONI, and CENTROPAGES YAMADAI may hatch during the period from May to November when the water temperature in the bottom sediment is higher than 15 C, while the resting eggs of A. CLAUSI and CENTROPAGES ABDOMINALIS may hatch in the colder months between November and June, when the temperature is below 20 C. (Auth) (ST)

<365>
Kedl, R.J., and C.C. Coutant, Survival of Juvenile Fishes Receiving Thermal and Mechanical Stresses in a Simulated Power-Plant Condenser.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National

<365> CONT.
Technical Information Service, Springfield, Va. (Oak Ridge National Laboratory, Reactor Division, Oak Ridge, TN; Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

Six species of larval fish and one species each of frog, tadpole, and zooplankton were subjected to fluid-induced stresses (i.e. turbulence, pressure, and vacuum) developed in the condenser portion (excluding the pumps) of a steam power plant. Results are presented for three species (MORONE SAXATILIS, LEPOMIS MACROCHIRUS, and DAPHNIA MAGNA). Results for all larval fish species were similar. Fluid-induced stresses were examined separately and in combination with thermal stresses. Fluid-induced stresses were generally not fatal to larval fish at velocities up to 5.8 m/sec. Sublethal effects were observed for CYPRINUS CARPIO. DAPHNIA MAGNA had 10 to 30% mortality at 4.2 m/sec loop water velocity. When larval MORONE SAXATILIS were exposed to combined thermal and fluid-induced stresses, the resulting mortalities were equivalent to those from thermal stresses alone. (Auth)

<366>
Keen, W.H., and E.E. Schroeder, Temperature Selection and Tolerance in Three Species of AMBYSTOMA Larvae.

1975. Copeia, No. 3, 523-530 (Eastern Kentucky University, Department of Biological Sciences, Richmond, KY)

Temperature selection and critical thermal maxima (CTM) were determined during larval development for AMBYSTOMA TEXANUM and A. MACULATUM and CTM for A. OPACUM. Larvae of A. TEXANUM and A. MACULATUM maintained body temperatures in a gradient within a range of approximately 13 to 29 C with an overall mean of 22 C. AMBYSTOMA MACULATUM larvae selected both the lowest and highest mean temperatures. High temperatures were more precisely avoided in the gradient than cold. CTM was positively correlated with acclimation histories and size, and some interspecific differences were found. CTM values ranged from 28.1 to 37.9 C with A. MACULATUM having the lowest and highest CTM. Larvae of A TEXANUM and A. MACULATUM had significantly higher CTM than larvae of A. OPACUM; these differences are correlated with thermal conditions normally encountered by the individual species during larval development. It is suggested that increases in CTM are probably due in part to seasonal acclimatization in addition to stage of larval development. (Auth) (ST)

<367>
Kelly, J.E., and R.A. Cole, The Distribution and Abundance of Benthic Macroinvertebrates near the Western Shore of Lake Erie.

1976. Michigan State University, Institute of Water Research, Technical Report No. 32.7 (Michigan State University, Institute of Water Research, Department of Fisheries and Wildlife, East Lansing, MI)

Benthic macroinvertebrate populations were studied from May, 1970 to June, 1975, in the vicinity of the Monroe power plant on western Lake Erie. Samples were collected with a Ponar dredge and subsequently washed free of sediments in a 0.5 mm diameter wire screen tub. One-way analysis of variance and Tukey's multiple range comparison tests were used to assess apparent differences in densities, mean sizes, and age ratios. Although eight major taxonomic groups were collected during the study, two groups (Tubificidae and Chironomidae) comprised 99% of the total organisms. Some ramification of power plant operation depressed benthic macroinvertebrate abundances in the plant's discharge canal and an adjacent, shallow tributary, but appeared to have no effect at the lake stations. Benthic macroinvertebrate densities and diversities, otherwise, seemed to be related to sediment size and other related environmental factors. (Auth)

<368>
Kelso, J.R.M., Movement of Yellow Perch (PERCA FLAVESCENS) and White Sucker (CATOSTOMUS COMMERSONI) in a Nearshore Great Lake Habitat Subject to a Thermal Discharge.

1976. Jour. Fish. Res. Bd. Can., 33, 42-53 (Canada Centre for Inland Waters, Department of the Environment, Fisheries and Marine Service, Great Lakes Biolimnology Laboratory, Burlington, Ontario, Canada)

The thermal discharge from the Nanticoke Generating Station (Ontario, Canada) caused both yellow perch (PERCA FLAVESCENS) and white sucker (CATOSTOMUS COMMERSONI) to increase sharpness of turns, decrease distance between turns and to orient into the current generated by the discharge. Conversely, fish released in thermally unaffected habitats referenced movement to the shoreline, turned less sharply and swam greater distances between turns. The tendency for localization of movement was increased for both species when in the influence of the discharge; however, these fish had to contend with currents generated by the effluent thus making comparisions anomalous. Exposure of fish to elevated temperatures was brief and ranged from a few excursions into thermally elevated areas to approximately nine hr. Fish transplanted from unaffected areas to the discharge area showed behavior similar to fish caught and released at the discharge site. Two fish tracked when cooling water was discharged at ambient temperature suggested that current had a role in causing the observed changes in behavior. (Auth)

<369>
Kelso, J.R.M., Diel Movement of Walleye, STIZOSTEDION VITREUM VITREUM, in West Blue Lake, Manitoba, as Determined by Ultrasonic Tracking.

1976. Jour. Fish. Res. Bd. Can., 33, 2070-2072 (Department of the Environment, Fisheries and Marine Service, Great Lakes Biolimnology Laboratory, Burlington, Ontario, Canada)

Movement of eight walleye fitted with temperature-sensing ultrasonic transmitters is described during late summer stratification in West Blue Lake. At all times fish remained above the thermocline in the upper 10 m of water. Temperatures obtained from transmitters were stable and consistently in the range of 10.6 to 11.2 C. No excursions into colder waters were seen for any of the eight fish followed. Fish stayed within 100 m of shore and rarely crossed the midbasin of the lake. Water shallower than 10 m was essentially homothermous, generally between 10.7 and 14.7 C. Below the thermocline (10 to 15 m), temperatures ranged from 7.0 to 3.7 C. (ST)

<370>

<370>
Kenaga, D.E., and R.A. Cole, Food Selection and Feeding Relationships of Yellow Perch PERCA FLAVESCENS (Mitchell), White Bass MORONE CHRYSOPS (Rafinesque), Freshwater Drum APLODINOTUS GRUNNIENS (Rafinesque), and Goldfish CARASSIUS AURATUS (Linneaus) in Western Lake Erie.

1975. Michigan State University, Institute of Water Research, Technical Report No. 32.5 (Michigan State University, Institute of Water Research, Department of Fisheries and Wildlife, East Lansing, MI)

The study was conducted along the western shore of Lake Erie near the Monroe power plant at the mouth of the Raisin River. The study was undertaken as part of an investigation of the impact of a once through cooling power plant on western Lake Erie and is an attempt to assess the relationship among fish in a highly altered aquatic environment based on size and types of foods consumed. Potential food organisms and stomach contents of yellow perch, white bass, freshwater drum and goldfish were sampled and compared over a two year period. On the basis of differences in food size alone, young of the year fish did not appear to be in competition but as they became larger, all but goldfish consumed the same mean size foods. Within a fish species, mean prey size varied little in fish older than age class zero. Goldfish differed markedly by lacking the prey size selectivity demonstrated by the other fish species. Perch, drum, and white bass preferred large organisms, specifically LEPTODORA KINDTII and CHIRONOMUS sp. while goldfish consumed smaller species, particularly cyclopoid copepods. Some ramifications of food size and prey selectivity in relation to trophic dynamics, feeding efficiency, composition and distribution of fish species, and the use of cooling water by large power plants and their possible impact upon prey size were discussed. (Auth) (ST)

<371>
Kennedy, V.S., Desiccation, Higher Temperatures and Upper Intertidal Limits of Three Species of Sea Mussels (Mollusca: Bivalvia) in New Zealand.

1976. Marine Biol. (W. Ger.), 35, 127-137 (University of Canterbury, Department of Zoology, Christchurch, New Zealand)

Distribution, abundance, and resistance adaptations to higher temperatures and desiccation of three species of intertidal mussels (MYTILUS EDULIS AOTEANUS, PERNA CANALICULUS, and AULACOMYA MAORIANA) were studied in New Zealand. Median lethal levels (LC50) of tolerance to higher temperatures after acclimation at 12 and 20 C, respectively, were 35 to 36 C and 36 to 37 C for MYTILUS EDULIS AOTEANUS, 32 to 33 C and 33 to 34 C for PERNA CANALICULUS, and about 32 C and 32 to 33 C for AULACOMYA MAORIANA. (ST)

<372>
Kent, J.D., and R.G. Hart, The Effect of Temperature and Photoperiod on Isozyme Induction in Selected Tissues of the Creek Chub SEMOTILUS ATROMACULATUS.

1976. Comp. Biochem. Physiol., 54B, 77-80 (Slippery Rock State College, Department of Biology, Slippery Rock, PA)

Isozyme induction was demonstrated for the enzymes glucose-6-phosphate dehydrogenase and lactic dehydrogenase in the liver of the creek chub, SEMOTILUS ATROMACULATUS, acclimated to varying conditions of temperature and photoperiod. Other tissues examined, including gill, muscle, brain, and heart, reflected tissue-specific patterns, but no instances of isozyme induction. Electrophoretic analysis of liver G-6-PDH indicated that, regardless of photoperiod, warm acclimation (20 C) induced two isozymes which were only negligibly present under conditions of cold acclimation (5 C). Liver LDH isozymes did not vary with acclimation temperatures, but varied with photoperiod. The results suggested that isozyme induction as a molecular mechanism of thermal compensation, may be limited to specific enzymes in specific tissues, such as liver. Photoperiod also appeared to affect thermal compensation at the molecular level. (Auth) (ST)

<373>
Khalanski, M., Relationship between Lethal and Acclimitization Temperatures for Freshwater Fish: A Data-Plotting Method.

1976. Cah. Lab. Hydrobiol. Montereau (Fr.), No. 3, 35-42 (E.D.F. Department Environment Aquatique et Atmospherique, Chatou, France)

The experimental data on the variation of the lethal temperature (TL50) as a function of acclimatization temperature are represented in a chart. The chart enables one to compute with a known deviation range the temperature step over the acclimatization temperature value for a 50% mortality for three freshwater species of fish (SALMO FARIO, RUTILUS RUTILUS, and PERCA FLUVIATILIS). (English summary)

<374>
Khorram, S., Determination of Effects of Temperature, Salinity, and Toxicity of Kelthane to an Estuarine Organism (CRANGON FRANCISCORUM, Stimpson) under Static and Continuous-Flow Bioassay Techniques.

1975. Ph.D. Thesis, University of California (University of California, Davis, CA)

Standard static bioassay tests were used to determine the effects of temperature, salinity, and their interaction on grass shrimp, CRANGON FRANCISCORUM, survival after 24, 48, 72, and 96-hr exposure periods. Temperature and salinity had highly significant effects on survival and responses to changes in temperature and salinity were strongly interdependent. The optimal ranges of temperature and salinity for 99% survival at 96-hr were 14.5 to 17.00 C and 18.0 to 20.0 ppt. Both elevated temperature and Kelthane concentration had significant inverse effects on CRANGON survival. (ST)

<375>
King, F.D., and T.T. Packard, Respiration and the Activity of the Respiratory Electron Transport System in Marine Zooplankton.

1975. Limnol. & Oceanog., 20, 849-854 (University of Rhode Island, Graduate School of Oceanography, Kingston, RI)

Respiratory oxygen consumption and respiratory electron transport activity were measured for 15 species (TOMOPTERIS SEPTENTRIONALIS, SAGITTA ELEGANS, PARATHEMISTO PACIFICA, CALANOIDES CARINATUS, CALANUS PACIFICUS, CALANUS sp., EPILABIDOCERA

<375> CONT.
AMPHITRITEES, PLEURONCODES PLANIPES, EUPHAUSIA PACIFICA, NEMATOSCELIS ATLANTICA, PLEURONBRACHIA BACHEII, LEUCKARTIARA OCTONA, PHIALIDIUM GREGARIUM, STOMOTOCA ARTRA, BARCHYURAN MEGALOPS larvae) and several mixed populations of marine zooplankton. A high correlation was found that was only weakly affected by size of the animals and temperature. Regression equations are given for the calulation of respiration from electron transport activity. (Auth)

<376>
King, J.R., and E.R. Mancini, Effects of Power Plant Cooling-Water Entrainment on the Drifting Macroinvertebrates of the Wabash River (Indiana).

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (DePauw University, Department of Zoology, Greencastle, IN)

The drifting macrobenthic community of the Wabash River was quantitatively sampled at the intake and discharge of the Wabash Generating Station from June to November 1973. Weekly samples were dominated by the insects POTAMYIA FLAVA and Chironomidae. These and other abundant taxa were examined for preentrainment and postentrainment viability and physical condition. The mean percent survival was lowest for BAETIS spp. and STENONEMA spp. Deterioration of physical condition during entrainment was also greatest for BAETIS spp. Other abundant taxa (P. FLAVA, TRICORYTHODES sp., PENTAGENIA VITTIGERA, HYDROPSYCHE spp., and Chironomidae) apparently suffered little overall mortality or condition loss during entrainment. For most taxa differences in viability and physical condition between intake and discharge were greatest during periods of high discharge temperature (high delta T). (Auth)

<377>
Kircheis, F.W., Reproductive Biology and Early Life History of the Sunapee Trout of Floods Pond, Maine.

1976. Trans. Amer. Fish. Soc., 105, 615-619 (Maine Department of Inland Fisheries and Wildlife, Bangor, ME)

The Sunapee trout (SALVELINUS ALPINUS) of Floods Pond, Maine, spawned in October and November when surface water temperatures dropped below 15 C. In hatchery tests eggs eyed in about 50 days as temperatures dropped from 11 C to 3 C. Total time for hatching at the same temperature was from 79 to 122 days. (ST)

<378>
Klein Breteler, W.C.M., Oxygen Consumption and Respiratory Levels of Juvenile Shore Crabs, CARCINUS MAENAS, in Relation to Weight and Temperature.

1975. Neth. Jour. Sea Res., 9, 243-254 (Netherlands Institute for Sea Research, Texel, Netherlands)

Oxygen consumption of freshly collected juvenile crabs, CARCINUS MAENAS was measured at various temperatures (5, 10, 15, 20 C) in a continuous flow respirometer. Two levels of respiration could be distinguished; in one the oxygen consumption fluctuated around a relatively high level (routine consumption), in the other the oxygen consumption remained very constant and relatively low (low consumption), probably as a result of ceased gill ventilation. The number of crabs showing an alternation of low and high level consumption, the fregency of the alterations, the duration of individual low level periods and the difference between the two levels all appeared to depend on temperature. Overall oxygen consumption increased with higher temperature. Values in spring were 1.5 to 2.2 times higher than in summer and fall when measured at the same temperatnre. At 20 C unfed wild crabs consumed less oxygen than well-fed specimens raised in the laboratory. It is suggested that the higher oxygen consumption found by other workers may be ascribed to disturbance of the experimental animal by the measuring technique. (ST)

<379>
Klekovski, R.Z., I.V. Kukina, and N.I. Tumantseva, Metabolic Rates in Zooplankton.

1975. Tr. Inst. Okeanol. (USSR), 102, 379-383 (Not given)

A total of 405 measurements of metabolic rates in nauplii, copepodite stages and adult copepods mainly from surface water were made in the tropical Atlantic and eastern Pacific using a constant volume gasometric manometric respirometer. Metabolism against weight regression parameters were calculated in energy units for in situ temperatures of 20 to 27 C and adjusted to 20 C. The data showed that within the temperature range of 20 to 27 C the metabolic rates in copepods were relatively temperature-independent. The respiration rate in phytophagous copepods from the equatorial eastern Pacific was found to be close to that of all copepods from the tropical western Pacific and of crustaceans in general while the respiration rate of predatory copepods (and copepods in general) was considerably lower than that of copepods from tropical western Pacific and crustceans in general. A likely explanation is that in the equatorial upwelling area which is extremely rich in phytoplankton, predatory copepods have to change over to feeding on phytoplankton, which reduces their metabolism. The position of the metabolism-weight regression curve for nauplii differs greatly from that for copepodities and adult copepods. (Auth)

<380>
Klyashtorin, L.B., and A.A. Yarzhombek, Some Aspects of the Physiology of the Striped Bass, MORONE SAXATILIS.

1975. Jour. Ichthyol., 15, 985-989 (All-Union Research Institute for Sea Fisheries and Oceanography (VNIRO), Moscow, USSR)

The dependence of metabolic changes of young striped bass, MORONE SAXATILIS, on temperature, salinity and oxygen content of the water was studied. The relationship between the rate of respiration and temperature is quite consistent with the "normal curve" common to poikilothermal animals. An increase in salinity up to 10 ppt produces a short-term increase in oxygen consumption which is normalized as the fish adjust to the increased salinity. The size of the maintenance rations for young striped bass was calculated in relation to temperature and weight. Data are given on the critical and threshold concentrations of

<380>

<380> CONT.
oxygen. (Auth)

<381>
Knight, A.W., R.L. Lippson, and M.A. Simmons, The Effect of Temperature on the Oxygen Consumption of Two Species of Fairy Shrimp.

1975. Amer. Midland Naturalist, 94, 236-240 (University of California, Department of Water Science and Engineering, Hydrobiology Laboratory, Davis, CA; National Marine Fisheries Service, Oxford, MD)

The oxygen consumption of two fairy shrimp, CHIROCEPHALOPSIS BUNDYI (Forbes) and EUBRANCHIPUS VERNALIS (Verill), was measured over a range of temperatures (respectively, 5 to 25 C and 10 to 20 C). The metabolic response of both species to a rise in test temerature was similar and dependent on the sex. Thus, while the respiration of both sexes increased over the lower portion of the temperature range, at higher temperatures (20 C) male respiration decreased, whereas female respiration was unchanged. Further, over at least part of the temperature range the oxygen consumption of male and female C. BUNDYI and female E. VERNALIS exhibited a respiratory plateau, suggesting the presence of regulation. (Auth)

<382>
Knutsson, S., and T. Grav, Seawater Adaptation in Atlantic Salmon (SALMO SALAR L.) at Different Experimental Temperatures and Photoperiods.

1976. Aquaculture, 8, 169-187 (Institute of Marine Research, Directorate of Fisheries, Bergen, Norway)

A study was made of the effect of gradually increasing day length at different temperatures on the smolting process and on growth of Atlantic salmon during smolting. The experiment consisted of ten experimental groups: a combination of three photoperiod-with three temperature-groups and a tenth control group. Size was found to be the most important factor in seawater adaptation of underyearling Atlantic salmon. Optimal growth in the experimental temperature and photoperiod regimes occurred at 15 C and at the photoperiod with the longest period of increasing day length. At the time for seaward migration, the most pronounced effect of photoperiod on seawater adaptation occurred at 11 C. At this temperature there was a significantly higher percentage of survivors at the photoperiod with the longest period of increasing day length. (Auth)

<383>
Kock, K.H., Keeping of Cod (GADUS MORHUA L.) in Net Cages.

1975. Arch. Fischereiwiss. (Ger.), 26, 35-48 (Institute Kuesten-Binnenfisch., Bundesforschungsanst. Fisch., Hamburg, Germany)

Cod kept in net cages stopped feeding when the water temperature rose above 19 C. Losses were high above this temperature. It is suggested that water temperature be kept below 15 C for the culture of cod. (ST)

<384>
Koeman, R.P.T., and A.M. Cortel-Breeman, Observations on the Life History of ELACHISTA FUCICOLA (Vell.) Aresch. (Phaeophyceae) in Culture.

1976. Phycologia, 15, 107-117 (University of Groningen, Department of Systematic Botany, Haren, Netherlands)

The life history of the brown alga, ELACHISTA FUCICOLA, comprises two heteromorphic stages, a macrothallus phase and a microthallus phase. The conversion from the macro- to the microthallus stage phase took place by formation of unilocular zoidangia which was promoted by 12 and 16 C conditions. Conversion from the micro- to the macrothallus phase was by sprouting and increased with temperature increase from 12 to 20 C. (ST)

<385>
Koenst, W.M., and L.L. Smith, Jr., Thermal Requirements of the Early Life History Stages of Walleye, STIZOSTEDION VITREUM VITREUM, and Sauger, STIZOSTEDION CANADENSE.

1976. Jour. Fish. Res. Bd. Can., 33, 1130-1138 (University of Minnesota, Department of Entomology, Fisheries, and Wildlife, St. Paul, MN)

Walleye (STIZOSTEDION VITREUM VITREUM) and sauger (STIZOSTEDION CANADENSE) eggs were exposed to temperatures ranging from 6 to 21 C to determine temperature effects on fertilization, incubation, and fry survival. Optimum fertilization temperatures were 6 to 12 C for walleye and 9 C for sauger. Optimum incubation temperatures were 9 to 15 C for both walleye and sauger. A sharp drop or rise in temperature had no great effect on walleye fry and juvenile survival. Optimum temperature for juvenile walleye and sauger growth was 22 C. When acclimated at 8 to 26 C 96-hr upper lethal temperatures for walleye juveniles were 27.0 to 31.6 C with the lower acclimation temperatures producing the lower upper lethal limits and intermediate acclimation producing intermediate upper lethal limits in order as acclimation temperatures increased. When acclimated at 10 to 26 C, the 96-hr upper lethal temperatures for sauger juveniles was 26.6 to 30.4 C in order as with the walleye. (Auth)

<386>
Kogan, A.V., Seasonal and Size-Age Differences in the Diet of the Tyulka, CLUPEONELLA DELICULATA, of Kuybyshevskoe Reservoir.

1975. Jour. Ichthyol., 15, 683-687 (Institute of the Biology of Inland Waters, Kubyshev Station, USSR)

Seasonal changes in the diet of tyulka were examined by age groups in 1973. In spring tyulka yearlings were caught in bays. In mid-May at a water temperature of 11.2 C, the index of filling was 149%, the primary food being Cylopoida and copepod crustaceans. In one area, the index of filling increased with water temperature in summer up to 24 C. The previous summer, under very warm conditions (23 to 29 C), the indices of filling of yearlings was lower than in spring. At 14 to 15 C in fall, the index of filling was still high, 95%. Food selection by young-of-the-year in different areas and at various water temperatures is also discussed. (ST)

<387>
Kohlhorst, D.W., Sturgeon Spawning in the Sacramento River in 1973, as Determined by Distribution of Larvae.

<387> CONT.
1976. Calif. Fish & Game, 62, 32-40 (California Department of Fish and Game, Bay-Delta Fishery Project)

To determine the time and location of sturgeon spawning in the Sacramento River, California, sampling was conducted three times per week from March 5 to June 17, 1973 at six locations from the mouth at the Feather River to above Red Bluff. A total of 246 larvae and nine eggs was collected at the mouth of the Feather River, at river km 180 (river mile 112), and at Colusa. Spawning probably occurred from the vicinity of Knights Landing to just above Colusa. Spawning occurred from mid-February to late May, although the majority (93%) was in March and April. Water temperatures during those two months ranged from 7.8 to 17.8 C. Spawning peaked from April 8 to 17 at a temperature of approximately 14.4 C. Mean size of larvae increased each month, probably because the growth rate increased with water temperature. Both white sturgeon (ACIPENSER TRANSMONTANUS) and green sturgeon (ACIPENSER MEDIROSRTIS) occur in the Sacramento-San Joaquin Estuary. While the larvae could not be identified, most were probably white sturgeon since that species dominates the Sacramento River sturgeon fishery. (Auth)

<388>
Koop, H.-U., Germination of Cysts in ACETABULARIA MEDITERRANEA.

1975. Protoplasma (Aus.), 84, 137-146 (Freie University of Berlin, Institute of Pflanzenphysiology and Zelbiology, Berlin, Germany)

Germination of cysts of ACETABULARIA MEDITERRANEA, a green alga, was accelerated as temperature increased from 15 to 21 C, but was delayed in light at higher temperatures. Rates of germination were not altered within the temperature range of 15 to 25 C in continuous light; but in darkness there was a decrease at temperatures greater than 21 C. (ST)

<389>
Korovin, V.A., Metabolic Rate of the Underyearling Carp, CYPRINUS CARPIO, Adapted to Different Water Temperatures.

1976. Jour. Ichthyol., 16, 168-172 (Siberian Research and Technical Planning Institute for Livestock Breeding, Novosibirsk, USSR)

The metabolic rate of carp acclimated to low (4 C) and high (16 to 18 C) water temperatures was measured over the temperature range 2 to 36 C. In both groups the rate of oxygen consumption increased with an increase in water temperature. At low temperatures (2 to 4 C) the cold-acclimated carp consumed more oxygen than warm-acclimated ones. In the test temperature range of 6 to 24 C no significant differences were observed. In the 26 to 28 C range a marked increase in the rate of oxygen consumption was observed in the cold-acclimated fish, after which a drop occurred followed by death at 34 C. An increase in metabolic rate of the warm-acclimated fish also occurred, but death occurred at 38 C. Thus the metabolic rate in young carp depended on previous thermal history or the thermal regime of its habitat. (ST)

<390>
Kotaiah, K., and B.S. Rajabai, Starvation Stress on Metabolism of the Tropical Fresh Water Crab PARATELPHUSA HYDRODROMUS (Herbst), with Reference to Size, Sex, and Sudden Changes of Temperature.

1975. Indian Jour. Exp. Biol., 13, 180-184 (CSRS College, Department of Zoology, Ongole, India)

Oxygen consumption of fed and starved PARATELPHUSA HYDRODROMUS was studied in relation to size, sex and sudden temperature change. Test temperatures were 20, 25, 30, 35, and 40 C. Oxygen consumption increased with increasing body size and temperature, but the unit metabolism (02 ml/hr/g) decreased with increasing body size and increased with increasing temperature in both sexes. Male crabs showed higher oxygen consumption than females. Smaller crabs were more affected by temperature than by starvation while larger crabs were more affected by starvation than by thermal stress. (ST)

<391>
Kraus, M.G., and B.W. Pound, Preliminary Observations on the Salinity and Temperature Tolerances and Salinity Preferences of DEROCHEILOCARIS TYPICA Pennak and Zinn 1943.

1975. Cah. Biol. Marine, 16, 751-762 (University of Rhode Island, Department of Zoology, Kingston, RI)

The general limits of temperature tolerance and a range of preferred salinities were determined for the mystacocarid crustacean DEROCHEILOCARIS TYPICA. When tested at 15, 31, and 47 ppt salinity and 7, 22, and 29 C, survival was longest at 31 ppt and 7 and 22 C. The combination of low salinity and high temperature was rapidly lethal. Under some conditions D. TYPICA exhibited definite salinity preferences. (ST)

<392>
Krebs, F., The Influence of Oxygen Tension on the Temperature Adaptation in Gibel Carp (CARASSIUS AURATUS GIBELIO Bloch).

1975. Arch. Hydrobiol. (Ger.), 76, 89-131 (Institut Universitat Kiel, Lehrstuhl fur vergleichende Physiologie und Tierpsychologies, Kiel, Germany)

Oxygen consumption of the lateral white muscles and gills of gibel carp showed a capacity adaption (compensation) in oxygen consumption with a change in adaptation temperature. When the fish were transferred from normoxic to hypoxic conditions, no change in the respiration rate occurred. Heat resistance of whole fish acclimated to normoxia or hypoxia did not differ. After an increase of adaptation temperature, both groups showed a reasonable resistance adaptation. (ST)

<393>
Kreh, R.V., and J.E. Derwort, Effects of Entrainment through Oconee Nuclear Station on Carbon-14 Assimilation Rates of Phytoplankton.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (Duke Power Company, Environmental Sciences Unit, Charlotte, NC)

<393>

<393> CONT.
Carbon assimilation rates of phytoplankton communities extrained through Oconee Nuclear Station were measured on six dates during 1974. Thermal, mechanical, condenser, and multiple entrainment effects on uptake rates were compared by incubating samples in vitro in controlled temperature water baths. Duplicate light and dark bottles containing water from four cooling-system locations were exposed to temperatures approximating intake and discharge temperatures. The relationships were variable, but exposure of the hypolimnetic intake water at near-discharge temperatures (thermal effect) stimulated primary productivity in four of six experiments. Multiple entrainment and mechanical effects caused no consistent change in assimilation rates. (Auth)

<394>
Kuennemann, H., V. Poeggel, and H. Precht, Is It Possible to Inhibit the Increase in Heat Resistance of IDOTEA BATHICA Pall. (Isopoda) Caused by Heat Shocks by Blocking Protein Synthesis?.

1975. Zool. Anz. (Ger.), 195, 265-275 (University of Kiel, Zoology Institute, Kiel, Germany)

Heat Resistance of male isopods, IODTEA BALTHICA, adapted to 8 C, increased when the animals were treated with heat shocks twice a day. The stress effect was suppressed by injection of cycloheximide, an inhibitor of protein synthesis. (ST)

<395>
Kuhlmann, H., The Influence of Temperature, Food, Size and Origin on the Sexual Differentiation of Elvers (ANGUILLA ANGUILLA).

1975. Helgolander Wiss. Meeresunters (Ger.), 27, 139-155 (University of Hamburg, Institute of Hydrobiology and Fischereiwiss., Hamburg, Germany)

The effects of rearing and feeding conditions, body size and origin on sexual differentiation were examined in elvers collected on the Atlantic coast and in the Tyrrhenian Sea. Elvers were raised at 17, 20, 23, 26, and 29 C. Eels from the Tyrrhenian Sea developed primarily into males. In the Atlantic eels, at temperatures optimal for growth (26 C) and a cod-roe diet, there was a slight shift in sex ratio in favor of females. (ST)

<396>
Kuznetsov, V.A., The Reproduction, Distribution and Growth of Juvenile Fish of Some Uncommon Species from Sviyaga Bay, Kuybyshev Reservoir.

1975. Jour. Ichthyol., 15, 950-962 (Kazan State University, Department of Vertebrate Zoology, USSR)

Data are presented on spawning times, sites and conditions and on the distribution and growth of young of the chub, LEUCISCUS CEPHALUS; the rudd, SCARDINIUS ERYTHROPHTHALMUS; the tench, TINCA TINCA; the undermouth, CHONDROSTOMA NASUS, the crucian carp, CARASSIUS CARASSIUS, the wild carp, CYPRINUS CARPIO; and the sheatfish, SILURUS GLANIS; in Sviyaga Bay, Kuybyshev reservoir. Some questions of the ecology of the wild goldfish, CARASSIUS AURATUS, and the burbot, LOTA LOTA, are considered. (Auth)

<397>
Kyushin, K., The Embryonic and Larval Development, Growth, Survival and Changes in Body Form, and the Effect of Temperature on These Characteristics of the Smooth Lumpsucker, APTOCYCLUS VENTRICOSUS (Pallas).

1975. Bull. Fac. Fish. Hokkaido Univ. (Jap.), 26, 49-72 (Hokkaido University, Laboratory of Biology of Fish Population, Hokkaido, Japan)

Eggs and larvae of the smooth lumpsucker were reared at 6 and 10 C to determine the effects of temperature on the development, growth, survival, and morphology of this species. The higher temperature accelerated the growth of the anteanal length, the head length, and the diameter of the sucking disk, and decreased the growth in length of the tail during the 116 day experiment. Among the body parts examined, the diameter of the sucking disk was most influenced by temperature. In experiments in which the water temperature was raised from 6 to 10 C at the midpoint of the experiment, only the relative growth of the sucking disc was influenced. Survival of fish with a deformed sucking disk was lower than that of controls. (ST)

<398>
Labat, J.P., Growth of PENAEUS JAPONICUS Bate in the Lagoon of Bates-Sigean (Aude) in Captivity in its Natural Environment (Summer 1973).

1974. Vie Milieu, 24, 301-308 (Laboratoire Arago, Banyuls-sur-Mer, France)

PENAEUS JAPONICUS was raised during the summer in floating enclosures in the lagoons of Bages-Sigean, France. Maximum growth of the prawns was observed at a temperature of 26 C; the animals did not grow at temperatures below 14 C. (ST)

<399>
Lackey, J.B., Entrainment Studies at Turkey Point on Biscayne Bay: Have Thermal Effects Affected the Plankton of Biscayne Bay?.

1974. In Jensen, L.D., Proceedings of the Second Workshop on Entrainment and Intake Screening, Report Number 15, held at Johns Hopkins University, Baltimore, Maryland, February 5-9, 1973. National Technical Information Service, Springfield, VA (Air and Water Research, Incorporated, Gainesville, FL)

A four-year plankton study was initiated to examine the effects of thermal discharges from power generating plants on the Biscayne Bay. It was thought that the plankton kills would cause overfertilization in the waters adjacent to Turkey Point, but no evidence to support this has been found. The growth of dense beds of seagrass in the warmed waters appears to be the only change in the ecosystem of Biscayne Bay. (Auth)

<400>
Laird, C.E., and P.A. Haefner, Jr., Effects of Intrinsic and Environmental Factors on Oxygen Consumption in the Blue Crab, CALLINECTES SAPIDUS Rathbun.

1976. Jour. Exp. Mar. Biol. Ecol. (Neth.), 22, 171-178 (Virginia Institute of Marine Science, Gloucester Point, VA)

The effect of weight, sex, temperature, and salinity on oxygen consumption in intact CALLINECTES SAPIDUS was determined.

<400> CONT.
Weight-specific oxygen consumption decreased with increasing wet weight from 20 to 200 g; sex had no effect over this weight range. Oxygen consumption was little affected by experimental salinities from 10 to 30 ppt. Crabs acclimated to cold (10 C) consumed more oxygen when acclimated to low salinity (10 ppt) than when acclimated to high salinity (30 ppt). Crabs acclimated to low salinity consumed more oxygen when cold acclimated than when warm acclimated (20 C). Oxygen consumption increased with experimental temperature from 10 to 25 C and was higher in cold acclimated crabs, except at the intermediate temperature (17.5 C), where there was no apparent effect of acclimation temperature. (Auth)

<401>
Landers, W.S., Reproduction and Early Development of the Ocean Quahog, ARCTICA ISLANDICA, in the Laboratory.

1976. Nautilus, 90, 88-92 (National Marine Fisheries Service, Middle Atlantic Coastal Fisheries Center, Milford, CT)

Gametogenesis in the ocean quahog could be accelerated experimentally in the laboratory by simulating summer temperatures only at certain times of the year. The eggs developed to the veliger larval stage best at a temperature of about 15 C. The larvae were reared to metamorphosis at about 12 C. (ST)

<402>
Lang, B.Z., and S.A. Edson, Parasites of the Western Speckled Dace from Eastern Washington.

1976. Jour. Parasitol., 62, 93 (Eastern Washington State College, Department of Biology, Cheney, WA; Turnbull Laboratories for Ecological Studies, Cheney, WA)

A total of 470 of 505 (93%) of the western speckled dace collected from eastern Washington were infected with at least one of the following parasites: RHABDOCHONA CASCADILLA, GYRODACTYLUS RHINICHTHIUS, CUCULLANUS TRUTTAE, and LEPTORHYNCHOIDES THECATUS. The latter two species were present only as larval stages. The incidence of infection with G. RHINICHTHIUS increased during colder months (November through March) and the incidence of infection with R. CASCADILLA decreased significantly during these months. (ST)

<403>
Lang, W.H., The Larval Development and Metamorphosis of the Pedunculate Barnacle OCTOLASMIS MULLERI (Coker, 1902) Reared in the Laboratory.

1976. Biol. Bull., 150, 255-267 (University of South Carolina, Belle W. Baruch Institute for Marine Biology and Coastal Research, Columbia, SC)

The larval phase of OCTOLASMIS MUELLERI, collected from the gills of blue crabs, consisted of six naupliar stages and one cyprid stage. Descriptions and distinguishing characteristics are given for each stage. Based on field observations and initial laboratory results, the breeding season is probably restricted to summer months in temperate regions. Larvae appeared unable to effectively feed and thus develop at 15 C or below. Larval development from newly-hatched nauplii to cyprid ranged from 10 to 18 days at 24 to 29 C in laboratory culture. (ST)

<404>
Lang, W.H., and E.A. Dennis, Morphology and Seasonal Incidence of Infection of PROCTOECES MACULATUS (Looss, 1901) Odhner, 1911 (Trematoda) in MYTILUS EDULIS L..

1976. Ophelia, 15, 65-75 (University of South Carolina, Belle W. Baruch Coastal Research Institute, Columbia, SC)

The morphology of adult PROCTOECES MACULATUS from the mussel, MYTILUS EDULIS, is described and compared to previous descriptions of the worm from fish and the bivalve, SCROBICULARIA PLANA. Stages in the mussel include two generations of sporocysts, cercariae and progenetic adults. Both sporocysts and adults exhibited seasonal variation in the incidence of infection during one year of sampling at two sites. Sporocysts were most common in late summer and the incidence of infection increased with increase in the size class of the host. The incidence of adult trematode infection peaked in early winter and rapidly declined with no worms being recovered by late May. Sporocysts appeared to persist until host death whereas adults matured, released eggs, and died during late winter. The mussel appears to represent an alternative final host of this trematode, perhaps replacing tropical fish hosts in temperate waters. (Auth)

<405>
Lanza, G.R., G.J. Lauer, T.C. Ginn, P.C. Storm, and L. Zubarik, Biological Effects of Simulated Discharge Plume Entrainment at Indian Point Nuclear Power Station, Hudson River Estuary USA.

1975. IAEA-SM-197/25; Part of Proceedings of a Symposium on the Combined Effects of Radioactive, Chemical and Thermal Releases to the Environment held in Stockholm, Sweden, June 2-5, 1975. International Atomic Energy Agency, Vienna (New York University Medical Center, Institute of Environmental Medicine, New York, NY)

Laboratory and field simulations of the discharge plume entrainment of phytoplankton, zooplankton and fish were carried out at the Indian Point Nuclear Station, Hudson River estuary. Phytoplankton assemblages studied on two dates produced different response patterns measured as photosynthetic activity. Chlorophyll-a levels did not change following simulated entrainment. Possible explanations for the differences are discussed. The two abundant copepods ACARTIA TONSA and EURYTEMORA AFFINIS appear to tolerate exposure to discharge plume temperature elevation without adverse effects. Copepods subjected to plume entrainment may suffer considerable mortality during periods of condenser chlorination. In general, the amphipod GAMMARUS sp. did not appear to suffer significant mortality during simulated entrainment. Juvenile striped bass, MORONE SAXATILIS, were not affected by simulated plume transit before and during plant condenser chlorination; however, a simulated worst possible case plume temperature elevation produced statistically significant mortalities. (Auth)

<406>
Lapointe, B.E., L.D. Williams, J.C. Goldman, and J.H. Ryther, The Mass Outdoor Culture of Macroscopic Marine Algae.

1976. Aquaculture, 8, 9-21 (Woods Hole Oceanographic Institution, Woods Hole, MA)

<406>

<406> CONT.
Two species of maroscopic marine red algae, GRACILARIA sp. and HYPNEA MUSCIFORMIS were grown and harvested in large tanks in Florida. HYPNEA MUSCIFORMIS cultures could not be maintained in summer when tank temperatures reached 30 C, but GRACILARIA grew year round. (ST)

<407>
Lascombe, C., E. Pattee, and C. Bornard, Temperature as an Ecological Factor in the Distribution of Two Closely Related Freshwater Triclads: An Experimental Study.

1975. Hydrobiologia (Den.), 47, 59-80
(Universite Claude Bernard, Department de Biologie Animale, Villeurbanne, France)

The influence of temperature on the ecophysiology of two closely related limnophilic Triclads, POLYCELIS TENUIS and P. NIGRA, in the Lyons (France) region was investigated. Both species had the same physiological rate in the middle zone of the temperature range, but P. TENUIS prevailed at both ends of the range. It tolerated higher temperatures and its reproduction rate was higher in the cold. Because of the existence of physiological races, it appeared adapted to a greater diversity of situations. It appeared to be a true eurytherm. These different points contributed an explanation for the habitat of both species in the region. (Auth)

<408>
Latimer, D.L., A.S. Brooks, and A.M. Beeton, Toxicity of 30-Minute Exposures of Residual Chlorine to the Copepods LIMNOCALANUS MACRURUS and CYCLOPS BISUSPIDATUS THOMASI.

1975. Jour. Fish. Res. Bd. Can., 32, 2495-2501
(University of Wisconsin, Center for Great Lakes Studies, Milwaukee, WI)

Laboratory bioassays were conducted at 5, 10, 15 and 20 C to determine the toxicity of residual chlorine exposures of 30 min to the copepods LIMNOCALANUS MACRURUS and CYCLOPS BICUSPIDATUS THOMASI. The 30-min TL-50 was 1.54 mg/1 for L. MACRURUS at both 5 and 10 C. For C. B. THOMASI, the 30-min TL-50 values for exposures at 10, 15, and 20 C were 14.68, 15.61, and 5.76 mg/liter, respectively. The concentrations of residual chlorine causing mortality (30-min TL-5) were used to predict safe levels for 30-min exposures. The predicted safe concentrations were 0.9 mg/1 for L. MACRURUS and 0.5 mg/1 for C. B. THOMASI. These concentrations roughly coincide with the maximal chlorine levels characteristic of most power plant effluents. (Auth)

<409>
Lattimore, R.E., and J.W. Gibbons, Body Condition and Stomach Contents of Fish Inhabiting Thermally Altered Areas.

1976. Amer. Midland Naturalist, 95, 215-219
(Savannah River Ecology Laboratory, Aiken, SC)

Body condition and stomach contents in three species of sunfish (Centrarchidae) were compared in natural and thermally influenced streams in South Carolina. The thermal stream was divided for sampling purposes into four zones variously affected by the heated water. Individuals of each species collected from the normal temperature adjacent to the heated water had higher condition factors than those from any other area. Also, the largest individuals collected in the thermal stream were from the area of high temperatures. Large body size may allow tolerance to sudden changes in water temperature. Although higher percentages of the fish from the natural stream had food in their stomachs, their diet was more herbivorous than that of thermal stream fish. (Auth)

<410>
Laudien, H., and R. Foh, On the Influence of Different Factors on the Extent of Temperature Adaptation in IDUS IDUS L. (Pisces, Cyprinidae).

1975. Zool. Anz. (Ger.), 194, 376-386
(University of Kiel, Zoology Institute, Kiel, Germany)

Temperature adaptation of the succinate oxidase system of white or red dorsal muscle of IDUS IDUS was measured after addition of succinate. Capacity adaptation varied between 1 and 59% in 10 and 25 C acclimated fish. Adaptation depended on velocity and extent of temperature change. Following rapid transfer of fish from 20 to 5 C, extent of adaptation was 15% in 40 days. (ST)

<411>
Lauer, G.J., W.T. Waller, D.W. Bath, W. Meeks, D. Heffner, T.C. Ginn, L. Zubarik, P. Bibko, and P.C. Storm, Entrainment Studies on Hudson River Organisms.

1974. PB-240 758; EPRI-74-049-00-5; Electric Power Research Institute Cooling Water Studies Report No. 15; In Jensen, L.D. (Ed.), Proceedings of the Second Entrainment and Intake Screening Workshop held at Johns Hopkins University, Baltimore, Maryland, February 5-9, 1973. National Technical Information Service, Springfield, VA (New York University Institute of Environmental Medicine, Tuxedo, NY)

Information obtained from the first two years of a five-year entrainment effects study at the Indian Point nuclear generating plant on the Hudson River estuary is summarized. Representatives of all trophic levels, including microbial decomposeres, phytoplankton, herbivorous and carnivorous zooplankton, small eggs and larvae of fish and invertebrates were considered. Both laboratory thermal tolerance and field studies are described. The studies indicated that most major groups of organisms subject to entrainment are patchy and zoned in distribution. The distribution patterns changed on diel, tidal, seasonal and annual time scales. The tolerance of organisms to temperature elevations varied among species, with life-stage of a species, and among organisms of the same species and life-stage. Temperature tolerance was determined by ambient (acclimation) temperature and duration of exposure. Pumped entrainment exposures at Indian Point ranged from five to 60 min. Thirty-minute TL50's during summer ambient temperatures of two Hudson River macroinvertebrates tested varied from 33.0 C (NEOMYSIS AMERICANA) to 37.8 C (GAMMARUS sp.). For a selected exposure time, a 2C reduction of temperature below the TL50 generally resulted in a sublethal temperature. However, some macroinvertebrates such as BOSMINA sp. and HALICYCLOPS sp. had TL95's about 3 to 5 C less than the TL50 for the same exposure time. The complexity of the problem of determining entrainment effects and biological problems is emphasized. (ST)

<412>
Lauer, G.J., W.T. Waller, and G.R. Lanza, Interfaces of Steam Electric Power Plants with Aquatic Ecosystems.

1975. Environ. Lett., 9, 405-430 (New York University Medical Center, Laboratory for Environmental Studies, New York, NY)

Adverse effects of steam electric power plant operation on aquatic ecosystems are reviewed under the headings: impingement of biota on intake screens, pumped and plume entrainment impacts, temperature stress, chemical stress, and mechanical stress. Laboratory and field studies supporting these effects are cited. Other factors that may cause power plants to impact on aquatic ecosystems include construction, spillage of coal and oil during unloading operations, scouring by tug boat traffic, leaching from coal piles, discharges from fly ash ponds, and discharge of chemical and sanitary wastes. Cooling water requirements and the two basic types of cooling water systems are discussed. (ST)

<413>
Laurence, G.C., Laboratory Growth and Metabolism of the Winter Flounder PSEUDOPLEURONECTES AMERICANUS from Hatching through Metamorphosis at Three Temperatures.

1975. Marine Biol. (W. Ger.), 32, 223-229 (National Marine Fisheries Service, Narragansett Laboratory, Narragansett, RI)

Growth and metabolism of the winter flounder PSEUDOPLEURONECTES AMERICANUS were studied in the laboratory at 2, 5 and 8 C. Dry-weight determinations of growth demonstrated significant direct regressions of growth on temperature. Mean, daily specific growth rates were 10.1%/day at 8 C, 5.8%/day at 5 C, and 2.6%/day at 2 C. Time to metamorphosis was 49 days at 8 C and 80 days at 5 C. Larvae did not survive to metamorphosis at 2 C. Absolute values of routine metabolism expressed in ul of oxygen consumed regressed on body weight were best described by a third-degree polynomial. Larval routine metabolism increased from hatching to metamorphosis, at which time it declined before again increasing. Temperature directly affected routine metabolism. Metabolism on a unit-weight basis decreased with increasing size and was also directly influenced by temperature. (Auth)

<414>
Laurence, G.C., and C.A. Rogers, Effects of Temperature and Salinity on Comparative Embryo Development and Mortality of Atlantic Cod (GADUS MORHUA L.) and Haddock (MELANOGRAMMUS AEGLEFINUS (L.)).

1976. Jour. Const. Intl. Explor. Mer, 36, 220-228 (National Marine Fisheries Service, Northeast Fisheries Center, Narragansett, RI)

Embryos of Atlantic cod (GADUS MORHUA) and haddock (MELANOGRAMMUS AEGLEFINUS) were incubated from fertilization to hatching in 36 different combinations of temperature (2 to 12 C) and salinity (26 to 36 ppt). Mortality was independent of temperature for cod, while haddock had lower mortalities at intermediate temperatures. There was an inverse relationship between salinity and mortality for both species. Mean total mortality over the combination of all temperatures and salinities was greater for haddock than cod. Highest mortalities occurred in the gastrula stage for haddock and just prior to hatching for cod. In general, cod embryos were more eurythermal and euryhaline than haddock. Highest percentages of viable hatches occurred in the ranges of 2 to 10 C and 28 to 36 ppt for cod as compared with 4 to 10 C and 30 to 36 ppt for haddock. Mean length at hatching was variable over the range of temperatures for cod, while the largest haddock larvae hatched at intermediate temperatures. A direct relationship was observed between salinity and mean hatching length for cod, whereas there was no association between haddock hatching length and salinity. Time to 50% hatching was inversely related to temperature and salinity for cod, and inversely related to temperature only for haddock. Haddock hatching time was less than that for cod at all combinations of temperature and salinity. Abnormalities appeared during development of both species and were independent of temperature and salinity. Experimental results are interpreted with respect to natural survival and differences between the two species. (Auth)

<415>
Lavery, M.A., and R.R. Costa, Life History of PARARGYRACTIS CANADENSIS Munroe (Lepidoptera: Pyralidae).

1976. Amer. Midland Naturalist, 96, 407-417 (State University of New York College at Brockport, Department of Biological Sciences, Brockport, NY)

A yearlong study of the life history of the aquatic lepidopteran, PARARGYRACTIS CANADENSIS was conducted. Larval growth was arrested in winter months when water temperatures remained near 0 C. Growth resumed in the spring when the temperature rose to 13.5 C and was rapid in summer over the temperature range of 13.5 to 29 C. In fall when the temperature again dropped below 13.5 C, growth stopped. (ST)

<416>
Laybourn, J., Respiratory Energy Losses in STENTOR COERULEUS Ehrenberg (Ciliophora).

1975. Oecologia (Ger.), 21, 273-278 (University of Stirling, Department of Biology, Stirling, England)

The respiratory energy losses of STENTOR COERULEUS are described in relation to cell size at 15 and 20 C. Values of 0.6736 at 20 C and 0.6013 at 15 C were found. The rate of increase in metabolism between 15 and 20 C represents a Q10 of between 2.02 and 2.89. A maximum rate of O2 uptake in the region of 3.5 x 10(E-4) ul/hr for ciliates of over 1100 ng dried weight was recorded at 20 C and 1.5 x 10(E-4) to 1.8 x 10(E-4) ul/hr for ciliates weighing 500 to 860 ng at 15 C. The results are discussed in relation to other protozoa. (Auth)

<417>
Leffler, C.W., Ionic and Osmotic Regulation and Metabolic Repsonse to Salinity of Juvenile CALLINECTES SAPIDUS Rathbun.

1975. Comp. Biochem. Physiol., 52A, 545-549 (University of Florida, Department of Zoology, Gainesville, FL)

Temperature affects osmoregulation in juvenile blue crabs. Below an external concentration of 650 mOsm/l the hemolymph concentrations of crabs acclimated to 16 C

<4417> CONT.
were higher than those of crabs acclimated to 25 C. Part of the hemolymph concentration increase in cool water is due to a hemolymph Na+ concentration. Chloride and K+ are not affected by temperature. Juvenile blue crabs could not tolerate low temperature (16 C) and low salinity (76 mOsm/l) combinations. (ST)

<4418>
Lehman, J.T., Ecological and Nutritional Studies on DINOBRYON Ehrenb.: Seasonal Periodicity and the Phosphate Toxicity Problem.

1976. Limnol. & Oceanog., 21, 646-658 (University of Washington, Department of Zoology, Seattle, WA)

As part of ecological and nutritional studies on DINOBRYON spp., it was found that DINOBRYON SERTULARIA was dominent in a pond only during periods when the temperature was below 20 C. In the laboratory growth curves of axenic cultures showed that the maximum temperature for growth lies between 16 and 20 C. The alga grew less well at 24 C than at 16 or 20 C. (ST)

<4419>
Lei, C., and H.F. Clifford, Field and Laboratory Studies of DAPHNIA SCHODERI Sars from a Winterkill Lake of Alberta.

1974. National Museum of Natural Sciences of Canada Publications in Zoology, No. 9 (University of Kansas, Lawrence, KS; University of Alberta, Edmonton, Alberta, Canada)

Field and laboratory data on the biology of DAPHNIA SCHODERI from a winterkill lake in Canada were collected. At 18 C the total embryonic period was about 57 hr. Each of the eight embryonic stages at 5 C had about the same relative duration as those at 20 C. The total duration was 401.2 hr at 5 C and 53.4 hr at 20 C. The female offspring of D. SCHODERI when cultured in the laboratory at 5, 20, and 25 C, had four to seven preadult instars; males had three to four preadult instars. At 25 C the average longevity was 36 days for females and 41 days for males; at 20 C the average longevity for females was 52 days. At 20 C most of the growth of females was achieved by day 10, whereas the growth curves for 5 C females did not level off until day 40. At 25 C the mean number of young per brood was greatest in the fourth adult instar; at 20 C there were two peaks of young production, one in the eighth adult instar and another in the thirty-first adult instar. For a 110 day unit of time, mean total young production was 48 at 5 C, 378 at 20 C, and 234 at 25 C. In the laboratory sexual eggs were produced only at 5 C. All females producing sexual eggs had a sterile instar immediately following the ephippial instar. In Big Island Lake the ex ephippio generation appeared in late spring, and by May parthenogenetic reproduction was taking place. There were two periods of sexual reproduction, a major period in June and July and a minor one in September. Water temperatures are given in graphical form. (ST)

<4420>
Lett, P.F., and W.G. Doubleday, The Influence of Fluctuations in Recruitment on Fisheries Management Strategy, with Special Reference to Southern Gulf of St. Lawrence Cod.

1976. Intl. Comm. Northwest Atlantic Fish. Selected Papers. No. 1 (1976) (Department of the Environment, Fisheries and Marine Service, Biological Station, St. Andrews, New Brunswick, Canada)

The effect of temperature and parent stock biomass as forcing functions of the stock recruitment mechanism for Atlantic cod were analysed. Sea surface temperature and estimated parent stock size were found to be major factors affecting the catch of cod eggs during a May survey. An equation describing the general relationship among these variables is given. Adult stock biomass was demonstrated to be more important than environmental fluctuations in determining year-class size of southern Gulf of St. Lawrence cod. (ST)

<4421>
Lett, P.F., and A.C. Kohler, Recruitment: A Problem of Multispecies Interaction and Environmental Perturbations, with Special Reference to Gulf of St. Lawrence Atlantic Herring (CLUPEA HARENGUS HARENGUS).

1976. Jour. Fish. Res. Bd. Can., 33, 1353-1371 (Department of the Environment, Fisheries and Marine Service, Biological Station, St. Andrews, New Brunswick, Canada)

A stochastic model was developed to study effects of temperature perturbations, predation, and competition from Atlantic mackerel (SCOMBER SCOMBRUS) on the recruitment process for Gulf of St. Lawrence Atlantic herring (CLUPEA HARENGUS HARENGUS). Multivariate statistics were used to determine the structural equation for portions of the life history of herring. Temperature and the abundance of age group 0 mackerel affected the herring growth rate, but neither total herring biomass nor total pelagic biomass had any measurable effect on herring growth rate. Herring growth rate coupled with adult stock size and environmental effects mediated through temperature were the prime determinants of larval abundance less than 10 mm. Density-dependent growth was found in the first year of life stage but is argued as being anomalous in relation to age-group 0 herring maximizing their production to simultaneously stabilize both the first yr of life and year-class size. Predation, tempered by available food density, is discussed as a major population stabilizing and a fine-tuning mechanism for year-class formation. The ramifications of variation in recruitment are discussed in relation to the Beverton and Holt and the Schaefer models. In addition, the Ricker recruitment curve is confirmed as being a viable fisheries managmenet tool. (Auth)

<4422>
Lewis, G.E., Observations on the Chain Pickerel in West Virginia.

1974. Progressive Fish-Culturist, 36, 33-37 (West Virginia Department of Natural Resources, Romney, WV)

Ripe female chain pickerel (ESOX NIGER) were collected from Patterson Creek, West Va., when water temperatures ranged from 11 to 13 C. Ripe males were collected over a longer period than females. Four specimens that were released and later recaptured showed formation of a winter annulus. (ST)

<4423>
Lewis, T.C., and R.W. Yerger, Biology of Five

<423> CONT.
Species of Searobins (Pisces, Triglidae) from the Northeastern Gulf of Mexico.

1976. Fish. Bull., 74, 93-103 (Florida State University, Department of Biological Science, Tallahassee, FL)

Temperatures of distribution of 13 species of searobins from the northeastern Gulf of Mexico are given. PRIONOTUS STEARNSI appeared to spawn from late summer to late fall or early winter. The remaining twelve species, including BELLATOR sp., spawned from fall to spring or early summer. (ST)

<424>
Lillehammer, A., Norwegian Stoneflies. IV. Laboratory Studies on Ecological Factors Influencing Distribution.

1975. Nor. Jour. Entomol., 22, 99-108 (University of Oslo, Zoological Museum, Oslo, Norway)

Nymphal growth and emergence of the spring emerging Norwegian stoneflies, CAPNIA BIFRONS, CAPNOPSIS SCHILLERI, and LEUCTRA HIPPOPUS, was greatly dependent on temperature. The growth period was shortened by 30 to 40% using a constant temperature of 8 C which is 6 to 7 C above the usual field temperature during November and December. A shortage of food was shown to lengthen the nymphal period in two species investigated. The study also showed that nymphs could complete their life cycle when given only fallen leaves to eat. (ST)

<425>
Lind, O.T., Effects of Thermal Circulation on Phytoplankton Photosynthesis.

1975. Verh. Intl. Ver. Limnol. (Ger.), 19, 1829-1833 (Not given)

The direct effect of heated circulation through a fossil fueled steam electric station upon the photosynthetic capacity of natural phytoplankton populations was determined at Tradinghouse Creek Reservoir, Texas. Control samples were collected and incubated at the intake. The effect of heated circulation (samples collected and incubated at the discharge) through the power plant generally was an immediate stimulatory effect on phytoplankton photosynthesis. This relationship did not hold at the high summer temperatures of 42 and 45 C. The effect of heating only was determined by comparing samples collected from the intake but incubated at the discharge with controls. The stimulatory effect was much less than for samples that were both heated and circulated. Heated circulation followed by cool incubation had a pronounced negative effect. Photosynthesis was never greater than in the controls. (ST)

<426>
Lindenberg, J.G., Seasonal Depth Distribution of Landlocked Alewives, ALOSA PSEUDOHARENGUS (Wilson), in a Shallow, Eutrophic Lake.

1976. Trans. Amer. Fish. Soc., 105, 395-399 (Commonwealth of Massachusettss, Division of Fisheries and Wildlife, Westboro, MA)

Seasonal depth distribution of landlocked alewives, ALOSA PSEUDOHARENGUS, was determined in Congamond Lake, Mass. In spring fish were concentrated in the deepest and coldest water, or less commonly near the warmer surface waters. During summer, alewives were evenly distributed above the anoxic hypolimnion. Night electrofishing in July, August, and September revealed the presence of both young-of-the-year and adult alewives in surface waters which ranged up to 25.5 C and in one case 32.2 C. In October when surface temepratures went below 16 C, alewives moved into deeper waters. Their fall and winter actions were pelagic, being characterized by avoidance of both surface and bottom waters. (Auth) (ST)

<427>
Lippson, R.L., The Distribution of the Crayfishes of Michigan with Aspects of Their Life Cycle and Physiology.

1976. Ph.D. Thesis, Michigan State University (Michigan State University, East Lansing, MI)

Thermal tolerance experiments demonstrated that the median tolerance level (TLm) of ORCONECTES PROPINQUUS acclimated at 25 and 32 C was 34.5 and 35.7 C, respectively. The TLm of O. VIRILIS, acclimated at 32 C was 35.7 C. The TLm of O. RUSTICUS, acclimated at 33 C was 36.2 C. The TLm of O. IMMUNIS acclimated at 7 and 30 C was 34.3 and 36.2 C, respectively. Oxygen consumption rates were determined for O. PROPINQUUS, O. RUSTICUS, O. VIRILIS, and CAMBARUS ROBUSTUS over a temperature range of 10 to 35 C. The rate of oxygen consumption of O. PROPINQUUS and C. ROBUSTUS was higher than that of O. RUSTICUS and O. VIRILIS up to 20 C. ORCONECTES PROPINQUUS and C. RUSTICUS showed a decrease in oxygen consumption beyond 20 C, while O. RUSTICUS and O. VIRILIS showed an increase in oxygen consumption above 20 C. (Auth) (ST)

<428>
Liu, R.K., B.E. Leung, and R.L. Walford, Effect of Temperature-Transfer on Growth of Laboratory Populations of a South American Annual Fish CYNOLEBIAS BELLOTTII.

1975. Growth, 39, 337-343 (University of California School of Medicine, Department of Pathology, Los Angeles, CA)

Previous observation had shown that annual fish living at 15 C grow faster and live longer than those at 20 C. The authors now demonstrate that when populations of these fish undergo reciprocal transfer between these two temperatures, their growth rates change to that of animals living at the temperature into which they have been transferred. These growth rates do not entirely correlate with the longevity patterns observed in annual fish subjected to temperature-transfer, nor to certain other observations of the relationships among growth, temperature and longevity as reported in the literature. (Auth)

<429>
Lo, S., Gilbert J., and F. Hetrick, Stability of Human Enteroviruses in Estuarine and Marine Waters.

1976. Appl. Environ. Microbiol., 32, 245-249 (University of Maryland, Department of Microbiology, College Park, MD)

Studies of the effects of temperature and salinity on the survival of three enteric viruses (poliomyelitis type 1, echovirus-6, and coxsackievirus B-5) under controlled laboratory conditions and in situ indicated

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<429> CONT.
that temperature rather than salinity is the critical factor affecting their stability, in that the higher the temperature the more rapid was the loss of viral infectivity. In the laboratory studies all three viruses were quite stable at 4 C, with infectious virus still detectable after 46 weeks of incubation. In situ studies on virus survival in freeflowing estuarine or marine waters showed that, although the viruses were more labile in natural waters than in the laboratory studies, they persisted for several months, in some cases during the winter months. At all temperatures and salinities, coxsackievirus B-5 was the most stable, echovirus-6 was intermediate, the poliovirus 1 was the least stable of the viruses tested. (Auth)

<430>
Long, W.L., and W.W. Ballard, Normal Embryonic Stages of the White Sucker, CATOSTOMUS COMMERSONI.

1976. Copeia, No. 2, 342-351 (Western Maryland College, Biology Department, Westminister, MD; Dartmouth College, Biology Department, Hanover, NH)

The embryonic period of life of the white sucker was divided into 26 stages, from fertilization to exhaustion of yolk supply. Diagnostic structural characteristics are cited for each stage. The embryos developed in circulating unchlorinated water at 10 to 20 C in the laboratory. Embryonic stage 8 (morula flattening) was reached 12 hr after fertilization at 21 C, 42 to 48 hr at 10 C, and 4 to 5 days at 5 C. Hatching first took place after 17 to 19 days at 10 C. About 60 days at 10 C were required for development of the fully formed postlarva (stage 26). (ST)

<431>
Lund, W.A., Jr., and B.C. Marcy, Jr., Early Development of the Grubby, MYOXOCEPHALUS AENAEUS (Mitchell).

1975. Biol. Bull., 149, 373-383 (University of Connecticut, Marine Research Laboratory, Noank, CT)

The grubby spawned over the four month period of December through March in the Mystic River, Connecticut. Water temperature during this time varied from 1 to 4 C. The early development of this species is described. (ST)

<432>
Lykkeboe, G., K. Johansen, and G.M.O. Maloiy, Functional Properties of Hemoglobins in the Teleost TILAPIA GRAHAMI.

1975. Jour. Comp. Physiol., 104, 1-11 (University of Aarhus, Department of Zoophysiology, Aarhus, Denmark; University of Nairobi, Department of Animal Physiology, Nairobi, Kenya)

TILAPIA GRAHAMI lives in conditions of high alkalinity (pH 9.6 to 10.5), high temperature (maximum temperature of 43 C), and variable O2 concentration. Studies showed that the hemoglobin possesses a high O2 affinity at relatively high temperatures (30 to 35 C). At 40 to 42 C and high oxygen concentration the high temperature sensitivity of the hemoglobin reduces the oxygen affinity. (ST)

<433>
Mackay, W.C., Effect of Temperature on Osmotic and Ionic Regulation in Goldfish, CARASSIUS AURATUS L..

1974. Jour. Comp. Physiol., 88, 1-19 (Case Western Reserve University, Department of Biology, Cleveland, OH)

The effects of temperature on the mechanisms of osmotic and ionic regulation in goldfish were determined. The effects of acute changes in temperature on water permeability, Na and Cl uptake, and renal excretion of Na, K, Cl, and water were evaluated. An attempt was made to determine whether the osmotic and ionic regulatory mechanisms of goldfish showed temperature acclimation. Plasma concentration of Na and Cl was constant in goldfish acclimated to temperatures between 10 and 30 C but decreased at acclimation temperatures below 10 C. Urine flow, a measure of net water influx, increased with acute temperature increases and showed temperature acclimation. Urine osmolality and urine Na, K, and Cl concentrations also showed temperature acclimation. Both passive and active components of renal tubular function showed nearly perfect temperature compensation. The rate of uptake of Na and Cl was inversely related to the plasma concentration of these ions and did not show temperature acclimation. (ST)

<434>
MacKinnon, C.N., and E.M. Donaldson, Environmentally Induced Precocious Development in the Male Pink Salmon (ONCORHYNCHUS GORBUSCHA).

1976. Jour. Fish. Res. Bd. Can., 33, 2602-2605 (Department of the Environment, Fisheries and Marine Service, Vancouver Laboratory, Vancouver, British Columbia, Canada)

Nine males within a group of approximately 200 pink salmon (ONCORHYNCHUS GORBUSCHA) reared in heated seawater became sexually mature in October of the year of hatching. These mature males (average weight = 119.44g; average length = 19.8 cm) were larger than the immature males (average weight = 92.22g; average length = 18.9 cm), but not significantly so. This is the first record of precocious development in pink salmon other than as a result of the use of exogenous gonadotropin. (Auth)

<435>
Majima, T., and F. Oosawa, Response of CHLAMYDOMONAS to Temperature Change.

1975. Jour. Protozool., 22, 499-501 (Osaka University, Department of Biophysical Engineering, Osaka, Japan)

The response of the alga, CHLAMYDOMONAS to temperature change was investigated. When the temperature of the medium was suddenly increased an abrupt rise in swimming velocity was observed. When the temperature was suddenly decreased, an abrupt velocity drop was observed. The velocity change was induced immediately after the temperature change. The new velocity level was maintained for several minutes. Finally the velocity decreased or increased, coming to a stationary level at the new temperature with a decay time of a few minutes. The temperature change rate determined the magnitude of response. The threshold value of the temperature change rate that produced a velocity change was 0.2 C/sec. (Auth)(ST)

<436>
Mane, U.H., A Study on the Rate of Water Transport of the Clam KATELYSIA OPIMA in Relation to Environmental Conditions.

1975. Hydrobiologia (Den.), 47, 439-451 (Marathwada University, Department of Zoology, Aurangabad, India)

The neutral red technique was used to study the filtration rate of KATELYSIA OPIMA. The rate of water filtration increased with increasing temperature, reaching a maximum at 35 C. It decreased sharply at 39 C. (ST)

<437>
Mann, R.H.K., Observations on the Age, Growth, Reproduction and Food of the Pike ESOX LUCIUS (L.) in Two Rivers in Southern England.

1976. Jour. Fish Biol., 8, 179-197 (Freshwater Biological Association, River Laboratory, East Stoke, Wareham, Dorset, England)

Water temperatures in the River Stour during the peak spawning period of the pike in April ranged between 7.9 and 14.5 C. Water temperatures during the entire spawning period (March through May) ranged from 4.4 to 18.7 C. (ST)

<438>
Mann, R.H.K., Observations on the Age, Growth, Reproduction and Food of the Chub SQUALIUS CEPHALUS (L.) in the River Stour, Dorset.

1976. Jour. Fish Biol., 8, 265-288 (Freshwater Biological Association, River Laboratory, East Stoke, Wareham, Dorset, England)

Spawning of chub, SQUALIUS CEPHALUS occurred from late May into June. Annuli were laid down through the period mid-April to mid-June. Growth in length was minimal between October and March. Year-class strengths and degree days greater than 12 C in the year of hatching were positively correlated. (ST)

<439>
Marcello, R.A., Jr., and R.B. Fairbanks, Gas Bubble Disease Mortality of Atlantic Menhaden, BREVOORTIA TYRANNUS, at a Coastal Nuclear Power Plant.

1976. CONF-741033; In Pickeisen, D.H. and Schneider, M.J. (Eds.), Gas Bubble Disease, Proceedings of a Workshop held at Richland, Wash., October, 8-9, 1974. National Technical Information Center, Springfield, VA (Boston Edison Co., Engineering Department, Boston, MA; Massachusetts Department of Natural Resources, Division of Marine Fisheries, Sandwich, MA)

A substantial mortality of Atlantic menhaden, BREVOORTAI TYRANNUS, occurred in the discharge channel and discharge plume area of the Pilgrim Nuclear Power Station Unit 1 (Mass.) during the period April 8 through April 24, 1973. Gas bubble disease was implicated as the cause of death. Measurements of dissolved gas concentration of the station's intake and discharge water during the fish mortality are presented. Observations on the behavior and results of the pathological examination of menhaden afflicted with gas embolism are discussed. It is suggested that preference for above ambient temperatures within the discharge channel and thermal plume may have negated a menhaden avoidance of the gas-supersaturated cooling water discharge. (Auth) (ST)

<440>
Marcy, B.C., Jr., Vulnerability and Survival of Young Connecticut River Fish Entrained at a Nuclear Power Plant.

1974. PB-240 758; EPRI-74-049-00-5; Electric Power Research Institute Cooling Water Studies Report No. 15; In Jensen, L.D. (Ed.), Proceedings of the Second Entrainment and Intake Screening Workshop held at Johns Hopkins University, Baltimore, Maryland, February, 5-9, 1973. National Technical Information Service, Springfield, VA (NUS Corporation, Pittsburg, PA)

Survival of young fish entrained in the condenser cooling system of the Connecticute Yankee nuclear power plant was examined. Sampling of the nonscreenable fish during June and July showed that approximately 80% of the mortality in the canal was caused by mechanical damage and 20% was attributed to heat shock and prolonged exposure to temperatures elevated above 28 C. There was no measurable mortality due to the injection of sodium hypochlorite into the system as a biocide. (Auth)

<441>
Markel, R.P., Some Biochemical Responses to Temperature Acclimation in the Limpet, ACMAEA LIMATULA Carpenter (1864).

1976. Comp. Biochem. Physiol., 53B, 81-84 (Stanford University, Hopkins Marine Station, Pacific Grove, CA)

Kinetic behavior and thermostability characteristics of malic dehydrogenase extracted from viscera of limpets acclimated to 8 and 18 C were compared. Results suggested that cellular responses to cold acclimation (8 C) in ACMAEA include synthesis of a new MDH isozyme and activation of the pentose shunt pathway. (Auth) (ST)

<442>
Marking, L.L., and L.E. Olson, Toxicity of the Lampricide 3-Trifluormethyl-4-nitrophenol (TFM) to Nontarget Fish in Static Tests.

1975. USFWS Investigations in Fish Control No. 60 (Fish Control Laboratory, La Crosse, WI)

The lampricide 3-Trifluoromethyl-4-nitrophenol is toxic to 15 species of coldwater and warmwater nontarget fish; the 96-hr LC50's ranged from 1.39 to 16.2 ul/l of field grade TFM (35%). The toxicity was influenced by temperature, water hardness, and pH. The most influencial factor was pH. Purified TFM was more toxic to rainbow trout in warm than in cold water. The 96-hr LC50's were significantly different at temperatures of 7, 12, and 17 C. This influence was more consistent for coldwater species than for warmwater species. The 96-hr LC50's for carp were not significantly different at 12, 17, and 22 C. The toxicity of field grade TFM to fish was influenced by temperature, water hardnes and pH in patterns similar to those observed with purified TFM. (SF)

<443>
Markle, D.F., The Seasonality of Availability and Movements of Fishes in the Channel of the York River, Virginia.

1976. Chesapeake Sci., 17, 50-55 (Virginia Institute of Marine Science, Gloucester Point, VA)

<443> CONT.
Monthly trawl collections from a five-year period (1967-1971) were analyzed to determine the distribution of fishes in the channel of the Chesapeake-York-Pamunkey estuary. The relative availability of twelve major species showed spatial and temporal interspecific differences. In winter four resident species, MORONE SAXATILIS, MORONE AMERICANA, ICTALURUS CATUS and ICTALURUS PUNCTATUS were most abundant. In the spring and fall several resident and nonresident species were abundant, while in summer only two nonresident species, CYNOSCION REGALIS and LEIOSTOMUS XANTHURUS, and one resident species, OPSANUS TAU, were abundant in the channel. The combined effect of different distribution patterns was that total numbers of individuals and species increased in spring, declined in summer, and reached their greatest magnitude in fall. (Auth)

<444>
Marliave, J.B., Seasonal Shifts in the Spawning Site of a Northeast Pacific Intertidal Fish.

1975. Jour. Fish. Res. Bd. Can., 32, 1687-1691 (University of British Columbia, Institute of Animal Resource Ecology, Vancouver, British Columbia, Canada)

In Barkley Sound, Vancouver Island, Canada, the spawning of the black prickleback, XIPHISTER ATROPURPUREUS, occurs during winter on rocky beaches protected from wave action. However, during spring, spawning occurs on rocky beaches of increasing exposure. This species spawns only under boulders with pebble, small rock, or shell substrates. Coincident reduction of wave action and increases in temperature probably cause the seasonal shift in the spawning site of this stichaeid. (Auth)

<445>
Marsden, I.D., Effect of Temperature on the Microdistribution of the Isopod SPHAEROMA RUGICAUDA from a Saltmarsh Habitat.

1976. Marine Biol. (W. Ger.), 38, 17-128 (Queen Mary College, Department of Zoology and Comparative Physiology, London, England)

The saltmarsh isopod SPHAEROMA RUGICAUDA is subjected to widespread diurnal and seasonal temperature fluctuations under natural conditions. Laboratory studies on its activity and oxygen consumption show that there is a relationship between these two parameters and exposure temperature between 2.5 and 25 C. At temperatures below 4 C the majority of isopods were inactive, but above 3.7 C there was a transition into a walking phase. Between 14.5 and 30 C, all isopods showed either walking or swimming activity. Generally there was an increase in swimming activity up to 30 C, above which some of the isopods became inactive. Peak activity occurred at 22 C. The response was similar following both direct and gradual transfer to a new temperature regime and was similar throughout a 30-min exposure period. There was a gradual increase in the rate of oxygen consumption with increased exposure temperature. (ST)

<446>
Martin, W.J., C.T. Garten, Jr., and J.B. Gentry, Thermal Tolerances of Dragonfly Nymphs. I. Sources of Variation in Estimating Critical Thermal Maximum.

1976. Jour. Physiol. Zool., 49, 200-205 (Savannah River Ecology Laboratory, Aiken, SC)

Thermal tolerance was determined for two species of dragonfly nymphs, LIBELLULA AURIPENNIS from a thermal effluent stream, and MACROMIA ILLINOIENSIS from a thermal recovery stream (Savannah River Plant). Tolerances were measured at acclimation temperatues of 16, 24, and 32 C under different laboratory conditions. The major source of variation in thermal tolerance was acclimation temperature, which accounted for approximately one-third of the overall variation. Body size, investigator, rate of heating, species, time of day, and number of individuals per test flask had significant effects on thermal tolerance. Aeration of the test water was not a significant variable. Increasing acclimation temperature increased thermal tolerance in both species. LIBELLULA nymphs acclimated at 16 and 24 C exhibited a daily cycle in thermal tolerance with a peak during midafternoon (1400-1600 h). LIBELLULA nymphs acclimated at 32 C, and MACROMIA nymphs at all acclimation temperatures exhibited no daily cycle in thermal tolerance. (Auth)

<447>
Martinez, E.A., Sensitivity of Marine Ciliates (Protozoa, Ciliophora) to High Thermal Stress.

1975. Ph.D. Thesis, University of New Hampshire (University of New Hampshire, Durham, NH)

The range of sensitivity of 12 species of marine ciliates to temperatures near lethal maxima was determined under a variety of biotic and abiotic factors. Heat resistance was influenced by cultivation temperature, salinity, and nutrition. Temperatures of LD50 ranged from 31.5 for URONEMA MARINUM to 39.3 for DEXIOTRICHA sp. Salinity influenced heat shock survival, with greater resistance at high salinities. Temperature also had some effect on food competition between species. (ST)

<448>
Maru, K., Studies on the Reproduction of a Scallop, PATINOPECTEN YESSOENSIS (Jay). 1. Reproductive Cycle of the Cultured Scallop.

1976. Sci. Rep. Hokkaido Fish. Exp. Station (Jap.) No. 18, 9-26 (Hokkaido Abashiri Fisheries Experimental Station, Japan)

The maturation and reproductive period of the scallop, PATINOPECTEN YESSOENSIS, coincided with increasing temperatures (0 to 9 C) and lengthening of the daylight period in spring. Maturation occurred from April to June and the breeding period lasted from May to June. (ST)

<449>
Mason, J.C., Seaward Movement of Juvenile Fishes, Including Lunar Periodicity in the Movement of Coho Salmon (ONCORHYNCHUS KISUTCH) Fry.

1975. Jour. Fish. Res. Bd. Can., 32, 2542-2547 (Department of the Environment, Fisheries and Marine Service, Pacific Biological Station, Nanaimo, British Columbia, Canada)

Seaward movement of 51,000 coho salmon fry and threespine sticklebacks in British Columbia was timed by lunar rhymicity, and not by temperature. Peaks of movement coincided with the new moon and declined progressively through four lunar cycles.

<449> CONT.
(CCC)

<450>
Mathieson, A.C., and T.L. Norall, Physiological Studies of Subtidal Red Algae.

1975. Jour. Exp. Mar. Biol. Ecol. (Neth.), 20, 237-247 (University of New Hampshire, Department of Botany and the Jackson Estuarine Laboratory, Durham, NH)

The net photosynthesis of the subtidal red algae EUTHORA CRISTATA, PHYCODRYS RUBENS, PHYLLOPHORA TRUNCATA, and PTILOTA SERRATA were determined under a variety of different light and temperature regimes. The optimal light requirements for net photosynthesis of the species are relatively low, mostly ranging from 465 to 747 ft-c at 5 and 15 C. Seasonal and spatial differences were found in the photosynthesis-light responses of PHYLLOPHORA TRUNCATA and PTILOTA SERRATA; winter plants exhibited lower light optima for net photosynthesis than spring plants. Deep-water populations of PTILOTA showed lower light optima and reduced net photosynthesis as compared with shallow subtidal populations. Summer plants of EUTHORA CRISTATA, PHYCODRYS RUBENS and PHYLLOPHORA TRUNCATA showed a greater tolerance to high temperatures and higher temperature optima than winter plants. It is suggested that optimal temperature and light requirements of seaweeds are adjusted in an adaptive fashion to the environmental regimes of their habitats. The temperature requirements of the four species are discussed in relation to their local estuarine distributions Cystocarpic and tetrasporic plants of EUTHORA CRISTATA and PTILOTA SERRATA show differential physiological responses and vertical distributions. The significance of higher rates of net photosynthesis and lower light optima are discussed in relation to vertical stratification of different generations. (Auth)

<451>
Mathieson, A.C., and T.L. Norall, Photosynthetic Studies of CHONDRUS CRISPUS.

1975. Marine Biol. (W. Ger.), 33, 207-213 (University of New Hampshire, Department of Botany and the Jackson Estuarine Laboratory, Durham, NH)

The net photosynthesis of intertidal, subtidal, carposporic, tetrasporic, and winter versus summer acclimiatized plants of CHONDRUS CRISPUS were evaluated under different temperatures and quantities of light. The optimum temperature and light conditions for net photosynthesis of C. CRIPSUS were seasonally and spatially variable, and there was an adaptive shift in the photosynthetic capacity at different seasons and positions on the shore. Plants collected during the fall and winter had lower light optima for net photosynthesis than spring and summer specimens. Intertidal populations exhibited a higher rate of net photosynthesis between 250 and 2819 ft-c than subtidal plants. Summer materials had a greater tolerance to high temperatures and a higher temperature optimum than winter materials. Shallow subtidal populations exhibited a higher temperature optimum than deep subtidal plants. Tetrasporic plants (diploid) showed a higher rate of net photosynthesis than carposporic plants (haploid). It is suggested that the diploid plants of C. CRISPUS may extend deeper in the subtidal zone, because they have a higher rate of net photosynthesis than carposporic plants. The results of the present studies are compared with previous physiological studies of C. CRISPUS. (Auth)

<452>
Mattice, J.S., Effect of Temperature on Growth, Mortality, Reproduction, and Production of Adult Snails.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

Shell lengths and egg production were measured weekly under constant (K; 10, 15, 20, 25 C) and varying temperature regimes during the reproductive period. Varying regimes included field temperature in a pond (F; diurnal and seasonal), mean daily field temperature (mean F; seasonal), and 5 and 10 C above mean F. Groups of snails at regime F were exposed to both diurnal and seasonal temperature variation, and groups at mean F, F plus 5, and mean F plus 10 were exposed to seasonal variation alone (i.e., temperatures were changed once every 24 hr). Growth rate of large snails (greater than 10mm) was unaffected by temperature, but small snails (6 to 10mm) grew fastest at 15 C(K). Growth and reproductive periods were longest, production was highest, and mortality rate was lowest at 15 C(K). Rate (per snail) of egg production increased with temperature. At equal mean temperature, regime affected growth rate only at mean F. Regime affected the following values as shown: mortality rate, F greater than mean F = K; rate of reproduction, F greater than K greater than mean F; and total production, K greater than mean F = F. The validity of extrapolation of energetic data from laboratory to field is discussed. Data relating production and temperature are valuable in thermal-impact analysis. (Auth)

<453>
Mattice, J.S., Effect of Constant and Varying Temperature on Egg Production of LYMNAEA OBRUSSA Say (Mollusca: Gastropoda).

1975. Verh. Intl. Ver. Limnol. (Ger.), 19, 3174-3178 (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

Reproduction of LYMNAEA OBRUSSA, a freshwater snail, was measured to determine if it was differentially affected by varying versus constant (10, 15, 20, 25, and 30 C) temperature regimes. Eggs were produced by snails at temperatures ranging from 10 to about 26 C. Snails held at 30 C died by the end of three weeks without producing eggs. Number of eggs per number of adults (E/A) was maximum at 15 C. Periods of egg production varied from four (25 C) to 26 weeks (15 C). Egg production rate by snails at natural field temperature was significantly greater and by a group at the mean daily field temperature was significantly less than that predicted for the 17 C constant temperature. Egg production rates for groups at the mean daily field temperature plus 5 C were also significantly lower than at equal mean constant temperatures, but this was not true for groups at the mean daily field temperature plus 10 C. Snails at the natural

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<453> CONT.
field temperature were exposed to both diurnal and seasonal temperature variation while groups at the mean daily field temperature and groups exceeding this by 5 and 10 C were exposed to seasonal variation alone. (ST)

<454>
Mattice, J.S., A Method for Estimating the Toxicity of Chlorinated Discharges.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

A recently developed procedure for site-specific analysis of chlorine toxicity both within a plant facility and its discharge is summarized. The method involves setting toxicity thresholds and comparing dose-times for both areas with the thresholds. Existing data regarding chlorine toxicity to 54 freshwater species is presented in graph form. Acute and chronic toxicity threshold lines indicate that for concentrations greater than 0.0015 mg/l, an increase in time of exposure generally increases the toxicity of chlorine. Three hypothetical examples showing the chlorine concentration in discharge plumes of power plants and three different rates of dilution are used to demonstrate the procedures involved in the proposed analytical technique and to indicate the efficient way in which the time variable is treated. The advantages and deficiencies of the method are discussed. (ST)

<455>
Mattice, J.S., and L.L. Dye, Thermal Tolerance of the Adult Asiatic Clam.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

Aspects of high- and low-temperature tolerance of the Asiatic clam, CORBICULA MANILENSIS Philippi, acclimated to temperatures ranging from 5 to 32 C were studied. Groups of 20 adult clams were exposed (1) continuously to high temperatures (24 to 39 C), (2) continuously to lower temperatures (2 to 20 C), or (3) for 30 min to temperatures between 37 and 43 C. Mortality was determined by lack of response to prying open the valves. Exposure to temperatures between 40 C (5C acclimation) and 43 C (30 C acclimation) for 30 min caused 100% mortality. For continuous exposures, upper tolerance limits (50%) were between 24 C (5 C acclimation) and 34 C (30 C acclimation) and lower tolerance limits were between 2 C (15 C acclimation) and 12 C (30 C acclimation). Relationships between acclimation and resistance temperatures were linear. The upper incipient lethal temperature was 34 C. Use of results at 24 and 48 hr (and 96 hr for long-term heat stress) yielded significant overestimates of tolerance limits. (Auth)

<456>
Mauck, W.L., L.E. Olson, and L.L. Marking, Toxicity of Natural Pyrethrins and Five Pyrethroids to Fish.

1976. Arch. Environ. Contam. Toxicol., 4, 18-29 (Fish Pesticide Research Unit, La Crosse, WI; Fish Control Laboratory, La Crosse, WI)

The toxicity of natural pyrethrins (insecticides) and five pyrethroids was determined with coho salmon, steelhead trout, fathead minnow, channel catfish, bluegill, and yellow perch. The 96-hr LC50's in static tests at 12 C ranged from 24.6 to 114 microg/l of natural pyrethrins and from 0.110 to 1,140 microg/l of pyrethroids. Coldwater species of fish were more sensitive than warmwater species to all the compounds. Temperature (12 to 22 C) affected the biological activity of all the compounds tested. Pyrethrum extract, dimethrin, RU-11679, and SBP-1382 were significatnly more toxic at 12 C than at 17 C. Dimethrin and SBP-1382 were more toxic at 17 C than at 22 C, but the toxicity of the natural pyrethrins and RU-11679 was not influenced in this temperature range. The biological activity of dimethrin, RU-11679, and SBP-1382 was two to three times greater at 12 C than at 22 C. However, d-trans allethrin was more toxic at 22 C than at 17 C and was about one and a half times more toxic at 22 than at 12 C. Water hardness had little influence on the toxicity of the pyrethroids, but the toxicity of the natural extract increased slightly as water hardness increased. (ST)

<457>
Maulbetsch, J.S., and R.W. Zeren, Technology of Power Plant Cooling.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Electric Power Research Institute, Fossil Fuel & Adanced Systems Department, Palo Alto, CA)

The technology of power plant cooling is discussed under the headings: the thermodynamics of power generation; constraints on cooling system design-technical, economic, and legislative; alternative cooling systems; environmental impacts-thermal; and environmental impacts-chemical. (ST)

<458>
McBee, J.T., Jr., Species Composition, Distribution, and Abundance of Macrobenthic Organisms in the Intake and Discharge Areas Before and After the Construction and Operation of the Cedar Bayou Electric Power Station.

1975. Ph.D. Thesis, Texas A&M University, 205 p. (Texas A&M University, College Station, TX)

The species composition, distribution, and abundance of macrobenthic organisms in the intake and discharge areas of the Cedar Bayou Electric power station, Baytown, Texas, were investigated from October 1969 through May 1973. Little elevation of temperature occurred in the discharge area of Trinity Bay following completion of a cooling pond before summer of 1972. The plant was off-line during most of summer of 1971. Changes in species composition, distribution, and abundance determined by cluster analysis were correlated with natural and plant-induced

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changes in the ecosystem. Periods of relatively low and high salinity in 1970 and 1971, respectively, were related to abundance and frequency of occurrence of some species. In the discharge area there was a change in species composition associated with scouring of the substrate by the discharge effluent. The abundance of NEANTHES SUCCINEA, POLYDORA LIGNI, POLYDORA WEBSTERI, LEPTOCHELIA DUBIA, and gammarid amphipods increased at that location. A change in Cedar Bayou below the plant intake was related to the removal of low quality water and the ingress of bottom organisms created by the reversed flow in the bayou. A slight increase in abundance of MEDIOMASTUS CALIFORNIENSIS, MACOMA MITCHELLI, STREBLOSPIO BENEDICTI, and a rhynchocoel in lower Cedar Bayou corresponded to the pumping of cooling water by the plant. (Auth) (ST)

<459>
McCain, J.C., Fouling Community Changes Induced by the Thermal Discharge of a Hawaiian Power Plant.

1975. Environ. Poll., 9, 63-83 (Hawaiian Electric Company, Environmental Department, Honolulu, HI)

An examination of the epifauna collected on fifty fouling panels was made to determine the influence of the thermal discharge from the Waiau Steam-Electric Generating Station on these organisms. Many of the organisms were found to differ significantly in abundance, biomass and percent cover between the thermally affected and non-affected areas. Three species clusters or communities were identified on the panels which correspond to intertidal, subtidal thermally affected, and subtidal non-thermally affected communities. The latter are roughly separated by the 3 C isotherm of temperature above ambient which corresponds to a summer maximum of approximately 32 C. (Auth)

<460>
McCain, J.C., S.L. Coles, and J.M. Peck, Jr., The Marine Biological Impact of the Honolulu Generating Station.

1975. UNIHI-SEAGRANT-TR-76-01; University of Hawaii Sea Grant Technical Report, U.S. Dept. of Commerce, NOAA (Not given)

Studies of the effects of the Hawaiian Electric Generating Station on the zooplankton, reef corals, and fish of Honolulu Harbor, Oahu, Hawaii were made during 1971-1973. No distinct detrimental effects attributable to the generating station were revealed by the studies. (ST)

<461>
McCarthy, J.F., A.N. Sastry, and G.C. Tremblay, Thermal Compensation in Protein and RNA Synthesis during the Intermolt Cycle of the American Lobster, HOMARUS AMERICANUS.

1976. Biol. Bull., 151, 538-547 (University of Rhode Island, Graduate School of Oceanography and Department of Biochemistry, Kingston, RI)

The effect of the molt cycle stage of HOMARUS AMERICANUS upon the metabolic response to acclimation temperature was studied. The in vitro rates of incorporation of precursors into protein and RNA and the concentration of RNA were measured in tissues of intermolt and premolt lobsters acclimated to 5 and 20 C. Midgut gland, abdominal muscle and gill of intermolt lobsters responded to temperature acclimation by a compensatory translation of the rate-temperature (R-T) curves with respect to the rates of incorporation of H-3-labeled leucine and H-3-labeled uridine into the acid-insoluble fraction. Midgut gland and muscle of premolt animals exhibited either no compensation or inverse compensation; gill tissue exhibited a rotation of the R-T curve. The existence of the complete de novo pathway of pyrimidine biosynthesis was demonstrated in the class Crustacea. C-14-labeled NaHCO2 was incorporated into orotic acid and C-14-labeled orotic acid was incorporated into the acid-insoluble fraction. Both the concentration of RNA and the rates of incorporation of precursors of both the salvage and de novo pyrimidine pathways were enhanced in the midgut gland of premolt lobsters, relative to intermolt tissue, under conditions of warm-acclimation. (Auth) (ST)

<462>
McCauley, R.W., and N. Huggins, Behavioral Thermal Regulation by Rainbow Trout in a Temperature Gradient.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Wilfrid Laurier University, Waterloo, Ontario, Canada)

This study compares the fluctuations of body temperature of fish selecting temperature in a laboratory gradient with the temperature of the fish's changing surroundings. Temperature preferences were determined for large (150- to 250-g) rainbow trout (SALMO GAIRDNERI), which had been induced to swallow miniature radio thermometers in their food. Positions of individual fish in the horizontal temperature gradient apparatus were noted, and continuous records were made of the gut temperature by monitoring the pulse frequency of the radio thermometer. Body temperature fluctuated within considerably narrower limits than did the environmental temperatures encountered by the fish. It is concluded that this form of behavioral thermoregulation is aided by the relatively slow rates of heat exchange between a fish and the surrounding water. (Auth)

<463>
McCauley, V.J.E., Further Observations on Coelomomyces (Blastocladiales, Coelomomycetaceae) Parasitic in Chironomidae (Diptera) in Marion Lake, British Columbia.

1976. Hydrobiologia (Den.), 48, 3-8 (University of British Columbia, Institute of Animal Resource Ecology, Vancouver, British Columbia)

Infection levels of COELOMOMYCES BEIRNEI and of COELOMOMYCES CHIRONOMI variety CANADENSE in chironomids in Marion Lake, British Columbia are reported. All infections were recorded in larvae. COELOMOMYCES BEIRNEI was found only during the fall, winter and spring at temperatures between 2.5 and 10.8 C. COELOMOMYCES CHIRONOMI infected larvae only during the summer. All but one of the parasitized larvae were collected at temperatures higher than 13 C. (ST)

<464>
McCormick, J.H., Temperature Effects on Young

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<464> CONT.
Yellow Perch, PERCA FLAVESCENS (Mitchill).

1976. EPA-600/3-76-057; 19 p. (Environmental Research Laboratory, Duluth, MN)

The effect of temperature on growth of young-of-the-year yellow perch was determined over an 8-week period at constant temperatures from 8 to 34 C. Absolute growth rates peaked at 28 C, but were not significantly less over the range from 26 to 30 C. Little or no growth occurred at 8 C. Deformities occurred at 32 C but at no lower temperatures, and all fish died within 7 days at 34 C. Temperatures should be from 26 to 30 C for rapid growth of young of the year yellow perch fed unlimited rations. When food is limited, the lower temperatures of the range are more desirable, because of less efficient food conversion at higher temperatures. (ND)

<465>
McCormick, J.H., and C.F. Kleiner, Growth and Survival of Young-of-the-Year Emerald Shiners (NOTROPIS ATHERINOIDES) at Different Temperatures.

1976. Jour. Fish. Res. Bd. Can., 33, 839-842 (U.S. Environmental Protection Agency, Environmental Research Laboratory, Duluth, MN)

Young-of-the-year emerald shiners (NOTROPIS ATHERINOIDES) were exposed to mean constant temperatures of 6.9, 11.9, 16.0, 19.8, 24.0, 26.9, 28.9, 31.0, 32.8, 34.9, and 36.7 C for six wk. Maximum rates of growth and net biomass gain occurred at 28.9 C, but these rates were not statistically greater than those at 26.9 and 24.0 C. Death rates were low at test temperatures up to 32.8 C but high at 34.9 C and above. The upper incipient seven-day TL50 was estimated to be 35.2. The one-day TL50 of fish taken from the natural habitat, where peak daily temperatures ranged between 20 and 25 C during the preceding few days, was 32.6 C. Natural production of this important forage species would probably be best where temperatures are at least 19 C but not above 29 C for extended periods. (Auth)

<466>
McFarlane, R.W., Fish Diversity in Adjacent Ambient, Thermal, and Post-Thermal Freshwater Streams.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (Savannah River Ecology Laboratory, Aiken, SC)

The Savannah River Plant area is drained by five streams of various sizes and thermal histories. One has never been thermally stressed, two presently receive thermal effluent, and two formerly received thermal effluent from nuclear production reactors. Sixty-four species of fishes are known to inhabit these streams; 55 species is the highest number obtained from any one stream. Thermal effluent in small streams excludes fish during periods of high temperatures, but the streams are rapidly reinvaded when temperatures subside below lethal limits. Some cyprinids become extinct in nonthermal tributaries upstream from the thermal effluents after extended periods of thermal stress. This extinction is similar to that which follows stream impoundment. Post-thermal streams rapidly recover their fish diversity and abundance. The alteration of the streambed and removal of overhead canopy may change the stream characteristics and modify the post-thermal fish fauna. (Auth)

<467>
McFarlane, R.W., B.C. Moore, and S.E. Williams, Thermal Tolerance of Stream Cyprinid Minnows.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Savannah River Ecology Laboratory, Aiken, SC; Birmingham-Southern College, Birmingham, AL)

The responses to thermal stress of three cyprinid minnows (NOTROPIS LUTIPINNIS, N. CUMMINGSAE and SEMOTILUS ATROMACULATUS), which inhabit tributaries of the Savannah River but are excluded from thermally stressed streams, were determined for fish tested individually and in groups. All species exhibited the same precipitous response, with excellent survival at five rates of heating, but rapid mortality occurred at 33 to 34 C. Slow heating rates did not elevate the upper limits of tolerance. Acclimation did not occur when temperature was continuously raised but did occur when the fish were subjected to constant sublethal temperatures. (Auth)

<468>
McKeown, B.A., and R.E. Peter, The Effects of Photoperiod and Temperature on the Release of Prolactin from the Pituitary Gland of the Goldfish, CARASSIUS AURATUS L..

1976. Can. Jour. Zool., 54, 1960-1968 (Simon Fraser University, Department of Biological Sciences, Burnaby, British Columbia, Canada; University of Alberta, Department of Zoology, Edmonton, Alberta, Canada)

A number of experiments were conducted to investigate the effects of photoperiod and temperature on prolactin release from the goldfish pituitary gland. Fish were acclimated to different photoperiods (16L:8D, 8L:16D) and temperatures (10 and 20 C), and also were subjected to a change in either of these two parameters after different acclimation conditions. Serum and pituitary samples were collected and analyzed by radioimmunoassay for prolactin levels. In other experiments samples for prolactin analysis were taken every 3 hr intermittently over a period of 3 days from fish that were acclimated to different photoperiod and temperature conditions. Longer photoperiods and higher temperatures caused pituitary prolactin release. Serum prolactin changed on a circadian rhythm and the rhythm was modified depending on the length of the photoperiod. (Auth)

<469>
McKim, J.M., D.A. Benoit, K.E. Biesinger, W.A. Brungs, and R.E. Siefert, Effects of Pollution on Freshwater Fish.

1975. Jour. Water Poll. Control Fed., 47, 1711-1768 (National Water Quality Laboratory, Environmental Protection Agency, Duluth, MN)

The effects of water pollution on freshwater fish is reviewed. Information on methodology (chemical and biological), water quality

<469> CONT.
(oxygen, salinity, and pH), pesticides (insecticides, herbicides, and piscicides), industrial pollutants (organic, inorganic, polychlorinated biphenyls, pulp and paper), domestic and chlorinated pollutants, and radioactive pollutants is reported. A summary of the acute and chronic toxicity of inorganic and organic pollutants to freshwater fish, providing information on species, exposure time, exposure type, temperature, effect endpoint, and concentration, is provided. (ND)

<470>
McLaren, I.A., Inheritance of Demographic and Production Parameters in the Marine Copepod EURYTEMORA HERDMANI.

1976. Biol. Bull., 151, 200-213 (Dalhousie University, Department of Biology, Halifax, Nova Scotia, Canada)

Heritabilities (h2, the ratio of additive genetic variance to total phenotypic variance) were estimated for a number of traits of EURYTEMORA HERDMANI from families of known parents reared with excess food at 10, 12.5, and 15 C. Age of maturity was strongly heritable only among female offspring at 15 C and size only among male offspring at 15 C. There were strong maternal (nongenetic) effects on age of maturity of males and on size, especially of females. Adult size and age of maturity were negatively correlated. (Auth) (ST)

<471>
McLean, R.I., Chlorine and Temperature Stress on Estuarine Invertebrates.

1973. Jour. Water Poll. Control Fed., 45, 837-841 (Academy of Natural Sciences of Philadelphia, Benedict Estuarine Laboratory, Benedict, MD)

Five species of estuarine invertebrates subject to entrainment in the cooling water system of a steam electric station were exposed experimentally to chlorine and temperature stresses simulating plant operations. Estuarine water was injected with chlorine gas to achieve a final concentration of 2.5 mg/l total chlorine residual. This concentration effected as high as 80 percent population mortality in the barnacle nauplii BALANUS sp. and 90 percent in the copepod ACARTIA TONSA during a 5-min exposure. Temperature elevations of 5.5 C and 11 C for 3 hr had no significant effect on population mortality. Two amphipods, GAMMARUS sp. and MELITA NITIDA, and one species of shrimp, PALAEMONETES PUGIO, exhibited greater tolerance to the same stress conditions. (Auth)

<472>
McLeay, D.J., Sensitivity of Blood Cell Counts in Juvenile Coho Salmon (ONCORHYNCHUS KISUTCH) to Stressors Including Sublethal Concentrations of Pulpmill Effluent and Zinc.

1975. Jour. Fish. Res. Bd. Can., 32, 2357-2364 (British Columbia Research, Division of Applied Biology, Vancouver, British Columbia, Canada)

Transfer of juvenile coho salmon from optimal (12 C) to high-temperature (20 C), crowded holding conditions decreased white blood cell thrombocyte counts markedly for exposures up to 96 hr. Red blood cell counts were increased only slightly at 12 and 48 hr. Following transfer to simulated stream compartments, white blood cell thrombocyte counts returned to stock values within two to four days, following an initial decline. Red blood cell counts were not altered appreciably. (ST)

<473>
McLeay, D.J., Variations in the Pituitary-Interrenal Axis and the Abundance of Circulating Blood-Cell Types in Juvenile Coho Salmon, ONCORHYNCHUS KISUTCH, during Stream Residence.

1975. Can. Jour. Zool., 53, 1882-1891 (University of British Columbia, Department of Zoology, Vancouver, British Columbia, Canada)

According to histological and histometric indices, the pituitary-interrenal axis of juvenile coho salmon residing in a natural stream was inactive in postalevin fry sampled in the spring, and in summer and fall samples of fingerlings, compared with a December sample or with smolts captured the next spring. Interrenal nuclear diameters, interrenal cell size, and epsilon (adrenocorticotropin) cell nuclear diameters were highly positively correlated. The numbers of circulating small lymphocytes and thrombocytes were highest in summer samples. Numbers of circulating large lymphocytes and neutrophils (per thousand cells of all types) were small and did not differ from sample to sample. Histometric indices of pituitary-interrenal axis activity were negatively correlated with numbers of circulating small lymphocytes but were unrelated to thrombocyte counts. Water temperature during sampling was highly negatively correlated with interrenal number and cell size and epsilon-cell nuclear diameters, and positively correlated with small lymphocyte and thrombocyte counts. It was concluded that the pituitary-interrenal axis in juvenile coho salmon was activated by both cold-temperature acclimation (4 C) and smoltification. Unlike thrombocytes, the seasonal variations in numbers of circulating small lymphocytes were attributed to adrenocortical secretory activity. (Auth)

<474>
McLeese, D.W., Toxicity of Copper at Two Temperatures and Three Salinities to the American Lobster (HOMARUS AMERICANUS).

1974. Jour. Fish. Res. Bd. Can., 31, 1949-1952 (Department of the Environment, Fisheries and Marine Service, Biological Station, St. Andrews, New Brunswick, Canada)

The time to 50% mortality (LT50) for lobsters at a particular lethal concentration of copper was longer at 5 C than at 13 C but was not affected by salinities of 20 to 30 ppt. The lethal threshold of copper for lobsters at temperatures of 5 and 13 C and at salinities of 20 to 30 ppt was close to 56 ug/l. (Auth)

<475>
McLusky, D., and A. Stirling, The Oxygen Consumption and Feeding of DONAX INCARNATUS and DONAX SPICULUM from Tropical Beaches.

1975. Comp. Biochem. Physiol., 51A, 943-947 (University of Stirling, Department of Biology, Stirling, England)

The oxygen consumption and feeding rates of the bivalve molluscs, DONAX INCARNATUS and

<475>

<475> CONT.
DONAX SPICULUM, were determined at 25 and 30 C. The results are discussed in relation to other temperate species. (ST)

<476>
McMahon, R.F., Growth, Reproduction and Life Cycle in Six Texan Populations of Two Species of Fresh-Water Limpets.

1976. Amer. Midland Naturalist, 95, 174-185 (University of Texas, Department of Biology, Arlington, TX; Marine Biological Laboratory, Woods Hole, MA)

The life cycles of two species of freshwater limpets, HEBETANCYCLUS EXCENTRICUS and LAEVAPEX FUSCUS were studied in north-central Texas. The start of egg laying in the spring for both species appeared to be correlated with the rise in ambient water temperature. The mean water temperature at spring oviposition for three populations of HEBETANCYCLUS was 15 C; for three populations of LAEVAPEX it occurred at a mean of 15.8 C. In both species oviposition ceased in the fall when temperatures dropped below 15 or 16 C. Population growth rates were similar to those reported for more northern freshwater limpets, which usually have a simple annual pattern of one generation per year. Texas limpet populations achieved two and sometimes three generations per year because of a greatly extended season for growth and reproduction. (ST)

<477>
McMahon, R.F., Effluent-Induced Interpopulation Variation in the Thermal Tolerance of PHYSA VIRGATA Gould.

1976. Comp. Biochem. Physiol., 55A, 23-28 (University of Texas, Department of Biology, Arlington, TX; Marine Biological Laboratory, Woods Hole, MA)

Seasonal variation and acclimation of thermal tolerance limits were investigated in two partially isolated populations of the common fresh water pulmonate snail PHYSA VIRGATA Gould from Lake Arlington in North Central Texas, one of which occurs in an area receiving heated effluent from a steam-electric power plant. In both populations summer-conditioned specimens had thermal tolerance limits 8.4 C higher than winter-conditioned specimens. Specimens of P. VIRGATA from the area receiving heated effluent had significantly higher mean heat coma temperatures than snails from the unaffected area after two weeks laboratory acclimation to 10, 20, and 30 C. The possible occurrence of thermal effluent-induced physiological race formation in P. VIRGATA is discussed in regard to the effects of thermal pollution on freshwater invertebrates. (Auth)

<478>
McVicar, A.H., Infection of Plaice PLEURONECTES PLATTESSA L. with GLUGEA (NOSEMA) STEPHANI (Hagenmuller 1899) (Protozoa: Microsporidia) in a Fish Farm and under Experiment Conditions.

1975. Jour. Fish Biol., 7, 611-619 (D.A.F.S., Marine Laboratory, Torry, Aberdeen, Scotland)

The course of infection of plaice with the protozoan GLUGEA STEPHANI in fish farm tanks was observed over a two year period. Plaice experimentally infected with GLUGEA and held at 11 C revealed no trace of infection up to 218 days after placement in the aquaria. All fish which died up to 80 days after infection were at a temperature of 16 C and all but two held at this temperature had GLUGEA cysts. (ST)

<479>
Merriman, D., The Connecticut River Ecological Study: A Synopsis.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (Yale University, Department of Biology, New Haven, CT)

This paper recounts some salient features of an extensive study of the thermal effects of the Connecticut Yankee Atomic Power Company's electric generating plant on biota of the lower Connecticut River. The work includes a description of the plume, an examination of the anadromous shad population, a discussion of the affected ichthyofauna and entrainment, and an account of alterations in benthic fauna. This study has several distinctive attributes, among them that it was begun before the Water Quality Act (1965) and that it has a long-term before-and-after character, beginning in 1965 before the plant began operating and continuing during operation (1968-1973). Ecological alterations observed to date appear to be well within the limits of acceptability, and in large measure, wrought by mechanical rather than thermal factors. (Auth)

<480>
Meth, F.F., The Use of Low-Grade Heat in Cold Climates for Aquaculture: A Perspective in the Western Hemisphere and Japan.

1975. AECL-5322/1, In Low-Grade Heat: A Resource in Cold Climates, Proceedings of a Workshop held at the Chalk River Nuclear Laboratories October 6-10, 1975, B. Gay et al. (Eds.). Atomic Energy of Canada Limited (Montreal Engineering Co., Ltd., Resources Department, Fredericton, New Brunswick, Canada)

The present demonstrable use of heated effluents from U.S. and Japanese thermal generating stations for the culture of finfish, shellfish and seaweeds is reviewed. Studies in Canada are summarized. An examination of the relationship between the species selected for study and the operating regimes of the plants, in terms of optimum growing temperatures and discharge temperatures, indicates that maximum utilization of available heat will not be achieved. A strategy to improve heat utilization is presented involving the use of exotic species during warm seasons as part of a multicrop system to more fully exploit discharge temperatures. The following criteria for species selection are proposed: (1) all stages of its life history must be absolutely controllable; (2) potential diseases and parasites must be known and be treatable; (3) a market opportunity must be identified; (4) realizable return must justify investment. A list of some 10 suitable species is presented. Site criteria are also given. The future of aquaculture in Canada is examined, and suggestions for the stimulation of thermal aquaculture are put forth. (Auth) (ST)

<481>
Meyer-Bornsen, E., The Influence of Adaptation

<481> CONT.
Temperature on the Respiration of PLANORBARIUS CORNEUS L. (Gastropoda: Pulmonata).

1976. Arch. Hydrobiol. (Ger.), 77, 176-204 (University of Kiel, Zoology Institute, Kiel, German Federal Republic)

The effect of acclimation temperatures of 12 and 22 C on the duration of submergence, time of ventilation, and cutaneous and pulmonary respiration of PLANORBARIUS CORNEUS was studied. Pulmonary respiration following submergence was lower in warm-aclimated than in cold acclimated animals. Cutaneous and total respiration was lower in the warm-acclimated animals. Experimental temperatures were 7, 12, 17, 22, and 27 C. (ST)

<482>
Middaugh, D.P., W.R. Davis, and R.L. Yoakum, The Response of Larval Fish, LEIOSTOMUS XANTHURUS, to Environmental Stress Following Sublethal Cadmium Exposure.

1975. Contrib. Marine Sci., 19, 13-19 (National Marine Water Quality Laboratory, John's Island, SC)

The critical thermal maximum (CTM) of larval spot, LEIOSTOMUS XANTHURUS, exposed to concentrations of 0.5 and 0.8 mg/l cadmium for 96 hr was significantly less than that of controls. A slight decrease in the thermal resistance of larvae exposed to 0.09 mg/l cadmium was also observed but was not significant. Fish were acclimated at 20 C and the heating rate was 1.0 C/5 min. (ST)

<483>
Middaugh, D.P., and P.W. Lempesis, Laboratory Spawning and Rearing of a Marine Fish, the Silverside MENIDIA MENIDIA MENIDIA.

1976. Marine Biol. (W. Ger.), 35, 295-300 (U.S. Environmental Protection Agency, Gulf Breeze Environmental Research Laboratory, Bears Bluff Field Station, John's Island, SC)

Adult silversides maintained under increasing water temperature (from 14 C to 22 C) and daylength regimes in the laboratory ripened and viable gametes were striped from them. Techniques for maintaining eggs from field-ripened adults in the laboratory were developed and the effect of salinity on the percentage emergence of larvae determined. Larvae fed immediately after emergence showed better survival than those fed 48 hr after emergence. (ST)

<484>
Miller, M.C., G.R. Hater, T.W. Federle, and J.P. Reed, Effects of Power Plant Operation on the Biota of a Thermal Discharge Channel.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (University of Cincinnati, Department of Biological Sciences, Cincinnati, OH)

Phytoplankton productivity and bacterial heterotrophic uptake potential for glucose were measured monthly for four years at the James Stuart Generating Station on the Ohio River. Over a three-year period, the plant opened four new units and a cooling tower. The average annual delta T was 8.5, 15.0, 11.2, and 9.5 C for the years 1971 to 1974. The response of phytoplankton production and bacterial heterotrophy as a function of ambient temperatures and the delta T were determined. Temperatures greater than 34 C were inhibitory regardless of ambient temperature. Any combination of delta T and ambient temperature not exceeding 25 C was usually stimulatory for algal production. The inhibition, where it occurred, was reduced as the discharge water moved down the 1.57-km channel to the Ohio River. Once the warm water was mixed with river water, primary production was stimulated 60% of the time by the mild temperature increase (2.4 to 3.6 C). Mortality increased significantly with prolonged exposure of the zooplankton to elevated temperatures for one to two hr in the discharge channel after passing through the plant. Benthic and drift invertebrates were eliminated from the discharge channel in the summer and autumn of 1973 when temperatures exceeded 40 C; however, both returned in 1974 and persisted throughout the summer, when temperatures did not exceed 37 C. The release of once-through condenser cooling water to a discharge channel allowed an analysis of the time delayed effects of temperature elevation that simply cannot be resolved when the heated waters are returned directly to the river. (Auth)

<485>
Mironova, N.V., Changes in the Energy Balance of TILAPIA MOSSAMBICA in Relation to Temperature and Ration Size.

1976. Jour. Ichthyol., 16, 120-129 (Zoological Institute, Leningrad, USSR)

The energy balance of TILAPIA MOSSAMBICA of different age groups maintained with inadequate food and with food in excess, and under diverse temperature conditions, was calculated for the purpose of studying the dependence of growth rate on environmental conditions. Changes in the consumption and assimilation of food, expenditure on metabolism and increment and the coefficient of utilization of food for growth in relation to these factors were followed up. It was found that assimilability of food increases with the increase in the age of the fish and with an increase in temperature; when the fish are fed to excess, assimilability decreases by comparison with assimilability in the case of restricted feeding. The temperature most favorable for growth changes with the age of the fish. A stimulation in growth is observed prior to the onset of sexual maturity at an increase in temperature from 22 to 31 C. In fish which have attained sexual maturity, the temperature most favorable for growth decreases gradually. With a deficiency of food the decrease in the temperature most favorable for growth occurs at an earlier age. (Auth)

<486>
Mitton, J.B., and R.K. Koehn, Morphological Adaptation to Thermal Stress in a Marine Fish, FUNDULUS HETEROCLLITUS.

1976. Biol. Bull., 151, 548-559 (State University of New York at Stony Brook, Department of Ecology and Evolution, Stony Brook, NY)

Populations of FUNDULUS HETEROCLITUS (Cyprinodontidae), a coastal marine fish, were studied in control and artificially heated environments on the north shore of Long Island to determine patterns of variations in morphology and the extent to

<486> CONT.
which this variation reflected adaptation to environmental characteristics. Principal components and discriminant function analyses were used to analyze variation in and among seventeen morphological characters. Fish living in water artificially heated by a power plant exhibited marked divergence from control populations in head morphology, and convergence with a population sampled at more southern latitudes. Hence, these differences were interpreted as adaptations to warm environments. Greater morphological variation is detected at the heated locality than at control localities, and this may be partially due to a breakdown in developmental homeostasis, and partially due to selection favoring phenotypes that are rare in this environment. (Auth)

<487>
Miyamoto, S., and K. Kuroda, Lethal Effect of Fresh Sea Water on VIBRIO PARAHAEMOLYTICUS and Isolation of BDELLOVIBRIO Parasitic Against the Organism.

1975. Jap. Jour. Microbiol., 19, 309-317 (Osaka City, Institute of Public Health & Environmental Science, Osaka, Japan)

Halophilic BDELLOVIBRIO, which is parasitic and lytic to VIBRIO PARAHAEMOLYTICUS, was isolated from fresh seawater in winter. It had a lethal effect on V. PARAHAEMOLYTICUS. The optimum temperature for multiplication ranged from 25 to 30 C; growth was not observed at 35 C.. Plaque numbers reached a maximum in 17 hr under conditions of shaking at 25 C in autoclaved seawater supplemented with V. PARAHAEMOLYTICUS cells. (Auth) (ST)

<488>
Miyoshi, H., and K. Nakamoto, Factors Influencing Bacterial Distribution in the Sea of Hiuchi-Nada Area.

1975. Bull. Jap. Soc. Sci. Fish., 41, 645-652 (Kochi University, Faculty of Agriculture, Nangoku, Japan)

Results of a study of the distribution of bacteria in the Sea of Hiuchi-Nada showed that the log bacterial count correlated directly with the temperature and the ultraviolet absorption value of the water and inversely with the depth of the water and the temperature difference between sample and surface water. (ST)

<489>
Moffett, S., and H. Wachtel, Correlations between Temperature Effects on Behavior in APLYSIA and Firing Patterns of Identified Neurons.

1976. Marine Behaviour Physiol., 4, 61-74 (Duke University, Departments of Biomedical Engineering and Physiology and Pharmacology, Durham, NC)

During recovery from short-term exposure to a temperature which produced cold inactivation, facets of APLYSIA's behavioral repertoire reappeared in the following sequence: local reflexes reappeared first (4 to 5 C), general withdrawal reflexes involving responses of unstimulated regions reappeared next (7 to 9 C), and coordinated whole animal responses such as locomotion were recovered upon further warming (9 to 11 C). Intracellular recordings from identified neurons in the abdominal ganglion showed that the cells had characteristic temperature ranges in which they are active. Comparisons of behavioral responses and the thermal sensitivity of central neurons suggested that local withdrawal reflexes can be elicited at a temperature below the thermal cut-off for central neuronal activity. Recovery of general withdrawal behaviors correlated well with the onset of responsiveness of motoneurons in the gill-withdrawal pathway. Whole animal behavior could be elicited at temperatures at which the nervous system showed a higher general level of activity and bursting pacemakers had become active. (Auth)

<490>
Moore, J.W., The Role of Algae in the Diet of ASELLUS AQUATICUS L. and GAMMARUS PULEX L..

1975. Jour. Animal Ecol., 44, 719-730 (Environmental Protection Service, Yellowknife Canada)

ASELLUS AQUATICUS and GAMMARUS PULEX were collected from rocks and growth of CLADOPHORA GLOMERATA in three rivers of southwestern England. The relative abundance of most of the ingested algal species reflected relative abundance in the environment. ASELLUS required approximately 25 hr to empty its gut of algae and plant detritus at 15 C and 75 hr at 5 C; the corresponding values for GAMMARUS were 18 and 40 hr, respectively. (ST)

<491>
Moore, R.H., Observations on Fishes Killed by Cold at Port Aransas, Texas, 11-12 January 1973.

1976. Southwestern Naturalist, 20, 461-466 (University of Texas Marine Science Institute, Port Aransas, TX)

The effects of a cold front, which decreased water temperatures to freezing, on estuarine fish near Redfish Bay and Port Aransas, Texas are noted. Most Texas estuarine fish appear able to tolerate 6 to 7 C; torpidity and death occur below this level. A few species, notably the pinfish, LAGODON RHOMBOIDES, and the spotted seatrout, CYNOSCION NEBULOSUS, can tolerate lower temperatures. (Auth)

<492>
Moore, R.H., Occurence of Tropical Marine Fishes at Port Aransas, Texas 1967-1973, Related to Sea Temperatures.

1975. Copeia, No. 1, 170-172 (University of Texas Marine Science Institute, Port Aransas, TX)

The greater than usual abundance of six species of tropical marine fish at Port Aransas, Texas, during the summer of 1972 was correlated with longer and warmer than usual sea water temperatures. (ST)

<493>
Moore, R.H., Seasonal Patterns in the Respiratory Metabolism of the Mullets MUGIL CEPHALUS and MUGIL CUREMA.

1976. Contrib. Marine Sci., 20, (University of South Carolina, Coastal Carolina College, Department of Biology, Conway, SC)

Respiratory metabolism of striped mullet, MUGIL CEPHALUS, and white mullet, MUGIL CUREMA, was studied in relation to weight, temperature, and swimming speed. Both species exhibit a general pattern of seasonal acclimatization similar to that seen in other fish species. Likewise, regression coefficients relating oxygen consumption to

<493> CONT.
the other variables were usually within published ranges, except for swimming speed coefficients for white mullet which were exceptionally high. These specific patterns of regression coefficients and metabolic rates are consistent and can be used to partially explain the differences in distribution and ecology observed between the two species of mullet. The seasonal distributions and abundances of the two species as well as their metabolic responses and temperature sensitivities all indicate that the white mullet is a more warm-adapted species than the antitropically distributed, eurythermal striped mullet. (Auth)

<494>
Mordukhai-Boltovskoi, F.D., The Problem of the Effect of Steam and Atomic Power Stations on the Hydrobiological Regime of the Water Bodies (A Review).

1975. Tr. Inst. Vnutr. Vod. Akad. (USSR), No. 27, 7-69 (Not given)

The effect of waste heat from power stations in the USSR, with emphasis on the effects on plankton and benthos, is reviewed. Discussed are the effects of entrainment, including mechanical and heat stress, and changes in cooling water receiving body structure and biota. The paper is supplemented with approximately 300 references on the effect of power station heated discharges on the hydrobiological regime and the micro- and macroflora and fauna of lakes, rivers, and reservoirs. Effects on fish are not included. (ST)

<495>
Morel, F.M.M., and D.M. Anderson, On the Subject of Red Tide Predictions from Temperature Patterns.

1976. Limnol. & Oceanog., 21, 625-627 (Massachusetts Institute of Technology, Civil Engineering Department, Division of Water Resources and Environmental Engineering, Cambridge, MA)

A method has been proposed by H.D. Baldridge which states that the probability of a red tide occurrence along the Florida coast is related to the normalcy of the surface water temperature during a critical period of 2.5 months in the preceeding winter. The basis and derived equation of this predictive method is refuted. (ND)

<496>
Morgan, R.P., II., D.A. Flemer, L.A. Noe, V.J. Raisin, Jr., and R.A. Murtagh, Biochemical Studies of Entrained Phytoplankton at the Morgantown Maryland Power Plant.

1974. PB-240 758; EPRI-74-049-00-5; Electric Power Research Institute Cooling Water Studies Report No. 15; In Jensen, L.D. (Ed.), Proceedings of the Second Entrainment and Intake Screening Workshop held at Johns Hopkins University, Baltimore, Maryland, February 5-9, 1973. National Technical Information Service, Springfield, VA (Chesapeake Biological Laboratory, Solomons, MD)

Power plant effects on entrained phytoplankton total protein and adenosine triphosphate phosphohydrolase (ATPase) activity were determined. The levels of protein entering and leaving the Morgantown plant during a September 1972 study were not significantly different from each other during any given sampling period. The activity of ATPase was significant with both time and treatment, with no interaction present between the two factors. ATPase activity was 39% greater in the condenser water compared with the intake water. There was a 5 C rise in temperature after passage through the plant. (ST)

<497>
Morita, R.Y., Psychrophilic Bacteria.

1975. Bacteriol. Review, 39, 144-167 (Oregon State University, Department of Microbiology and School of Oceanography, Corvallis, OR)

Psychrophiles are defined as organisms having an optimal temperature for growth at about 15 C or lower, a maximal temperature for growth at about 20 C and a minimal temperature for growth at 0 C or below. Definitions used by others are reviewed and evaluated. Isolation methods, ecological distribution, ecological significance, growth (temperature characteristics), physiology, effect of temperature on respiration and viability, thermally induced leakage and lysis, permeability, macromolecular synthesis, and ecological factors affecting the psychrophiles are described. (ND)

<498>
Mosser, J.L., and T.D. Brock, Temperature Optima for Algae Inhabiting Cold Mountain Streams.

1976. Arctic Alpine Res., 8, 111-114 (University of Wisconsin, Department of Bacteriology, Madison, WI)

Optimal temperatures for photosynthesis were determined for natural populations of algae inhabiting cold mountain streams in the Beartooth Mountains in Montana and Wyoming. Site temperatures at the time of sampling and the predominant organisms present in the samples were: 1 C, PROTOCOCCUS sp.; 7 C, mixture of PHORMIDIUM and OSCILLATORIA spp.; 12 C, ZYGNEMA sp. Temperatures from 20 to 30 C were optimal for all the samples, regardless of site temperature and the organisms present in the population. PROTOCOCCUS sp. was obtained in culture, and after maintenance at low temperature for two years, the optimal temperature for photosynthesis was identical to that for the natural population. These microorganisms were, therefore, not optimally adapted to the low temperatures of their habitat. (Auth)

<499>
Mosser, J.L., G.M. Herdrich, and T.D. Brock, Temperature Optima for Bacteria and Yeasts from Cold-Mountain Habitats.

1976. Can. Jour. Microbiol., 22, 324-325 (University of Wisconsin, Department of Bacteriology, Madison, WI)

The lowest optimal temperatures for the growth of bacteria and yeasts collected from snow-fed mountain streams and lakes located on the Montana-Wyoming border were 10 to 15 C. Most of the isolates were obtained from sites at or near 0 C. (ST)

<500>
Mountford, K., R.S. Mullen, and R.S. Shippen, Laboratory Simulation of Power Plant Effects: Response of Some Estuarine Phytoplankton to Time Temperature Combinations.

<500>

<500> CONT.
1974. In Jensen, L.D., Proceedings of the Second Workshop on Entrainment and Intake Screening, Report Number 15, held at Johns Hopkins University, Baltimore, Maryland, February 5-9, 1973. National Technical Information Service, Springfield, VA (Academy of Natural Sciences of Philadelphia, Benedict Estuarine Research Labcratory, Benedict, MD)

The response of natural estuarine phytoplankters and unispecific algal cultures to time-temperature exposures is analyzed. A replicated, 4 X 4 factorial matrix design was used to experimentally evaluate the response of phytoplankton to thermal shock (0 to 15 C) at simulated entrainment exposures ranging from 0 to 12 min. (Auth)

<501>
Moyer, J.T., Reproductive Behavior of the Damselfish POMACENTRUS NAGASAKIENSIS at Miyake-jima, Japan.

1975. Japanese Jour. Ichthyol., 22, 151-163 (Tatsuo Tanaka Memorial Biological Station, Toga Farm, Miyake-jima, Japan)

Reproductive behavior of the damselfish began in May in Igawa Bay, Japan when the water temperature reached 22 C. During winter only scattered individuals were seen in 16 to 19 C water and none were observed when temperatures dropped below 15 C. (ST)

<502>
Mulford, R.A., Morgantown Entrainment. Part IV. Phytoplankton Taxonomic Studies.

1974. PB-240 758; EPRI-74-049-00-5; Electric Power Research Institute Cooling Water Studies Report No. 15; In Jensen, L.D. (Ed.), Proceedings of the Second Entrainment and Intake Screening Workshop held at Johns Hopkins University, Baltimore, Maryland, February 5-9, 1973. National Technical Information Service, Springfield, VA (Scientific Cliffs, Port Republic, MD)

The effects of normal operation, chlorination, low ambient temperature and flow augmentation on the survival of pump-entrained phytoplankton at the Morgantown steam electric station are described. Changes in the taxonomic structure of the phytoplankton community are discussed. During September operation approximately 66% of the net phytoplankton was immediately killed upon passage through the plant. The largest mortality was observed among the dinoflagellates and diatoms, but was primarily the result of two species, GYMNODINIUM SPENDENS AND SKELETONEMA COSTATUM. There was a considerably smaller kill of net phytoplankton (15%) as a result of the December operating conditions. (Auth) (ST)

<503>
Mulla, M.S., and L.A. Lacey, Feeding Rates of SIMULIUM Larvae on Particulates in Natural Streams (Diptera: Simuliidae).

1976. Environ. Entomol., 5, 283-287 (University of California, Department of Entomology, Riverside, CA)

Larval feeding rates of SIMULIUM TESCORUM, S. VITTATUM and S. ARGUS in streamlets and that of S. VITTATUM in Colorado River were studied by releasing a water suspension of a fluorescent water dispersable particulate dye. The dye particles were readily ingested, forming a discrete plug in the gut visible to the naked eye. The displacement of the dye plug posteriorly provided an easy assessment of the feeding rate in these filter feeding larvae. Feeding rate in younger larvae was greater than in older larvae. Younger larvae of S. TESCORUM voided the dye plug in anywhere from 10 min (water temperature 30 C) to 35 min (water temperature 13 C), while the older larvae (4 to 6th in stars) voided the dye plug in 20 to 30 min at the high temperature and 55 min at the lower temperature. Larvae of S. VITTATUM and S. ARGUS voided the plug more slowly than the larvae of S. TESCORUM. Larvae of S. TESCORUM and S. VITTATUM showed no rhythmic feeding activity. They fed at essentially the same rates at all hours of the day. The S. VITTATUM larval feeding rate in the Colorado River was essentially the same as that found in small streamlets. (Auth)

<504>
Munawar, M., and I.F. Munawar, Some Observations on the Growth of Diatoms in Lake Ontario with Emphasis on MELOSIRA BINDERANA Kutz During Thermal Bar Conditions.

1975. Arch. Hydrobiol. (Ger.), 75, 490-499 (Canada Center for Inland Waters, Great Lakes Biolimnology Laboratory, Burlington, Ontario, Canada)

The distribution of the diatom MELOSIRA BINDERANA Kutz, a species often associated with eutrophication, was investigated in Lake Ontario during 1970 and 1972 in relation to temperature structure, soluble reactive phosphorus, and silicate during spring when a distinct thermal bar was formed. MELOSIRA BINDERANA showed a marked nearshore to offshore decreasing gradient and maximum densities were observed inside the thermal bar at temperatures higher than 4 C. Its abundance was related to nutrients and indirectly to temperature which controlled the circulation. Excessive growth of M. BINDERANA depleted silicate to extremely low levels (25 SiO2 ug/l) in the nearshore region. (Auth)

<505>
Muravskaya, Z.A., and Yu.S. Belokopytin, Effect of Moving Activity on the Nitrogen Excretion and Oxygen Consumption of the Pickarel.

1975. Biol. Morya (USSR), 5, 39-44 (Institute of Biology of the South Seas, Department of Physiology of Marine Animals, Sevastopol, USSR)

The comparative nitrogen excretion and oxygen consumption of SPICARA SMARIS was studied under conditions of normal metabolism and active swimming in a hydrodynamic tube at 13 and 20 C. Moving activity increased nitrogen excretion 1.3 times at high and 2.3 times at low temperatures. Oxygen consumption increased 2.8 and 3.7 times, respectively. Total protein and energy expenses were compared on the basis of the obtained values. Relative expense of non-protein compounds increased during active swimming. The metabolism under standard conditions, nitrogen excretion and oxygen consumption influenced by temperature, changed proportionally with Q10 values. During active swimming the dependence of these readings on temperature decreased. (Auth)

<506>
Murphy, J.C., C.T. Garten, Jr., M.H. Smith, and

<506> CONT.
E.A. Standora, Thermal Tolerance and Respiratory Movement of Bluegill from Two Populations Tested at Different Levels of Acclimation Temperature and Water Hardness.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Savannah River Ecology Laboratory, Aiken, SC)

Bluegill (LEPOMIS MACROCHIRUS) from two locations were acclimated at 16, 24, and 32 C and at two levels of water hardness (conductivity 77 and 110 MIMHO). Fish from a reservoir receiving thermal effluent had a higher critical thermal maximum (CTM) and lower rates of respiratory movement at each acclimation temperature than those from the control location. Respiratory movement and CTM increased as a function of acclimation temperature. Increased water hardness tended to decrease the CTM but had no consistent effect on respiratory movement. (Auth)

<507>
Musaeva, Eh.L., and Z. Vitek, Respiration in Planktonic Animals from the Equatorial Pacific.

1975. Tr. Inst. Okeanol., 102, 358-364 (Not given)

Three hundred eighty-five determinations of respiration rate in Copepoda, Euphausiacea, Chaetognatha, Ctenophora, Amphipoda, Siphonophora and other invertebrates were made using the Winkler and the polarographic methods. Respiration rate to body weight regressions were calculated for six major zooplankton groups. The respiration rate of Calanoida measured at 20 C was found to be close to that of Calanoida from the western Pacific at 27 C, which suggests that within the temperature range of 20 to 28 C the metabolism in tropical Calanoida is not likely to be temperature-dependent. Experiments with Euchaeta and Pleuromamma showed that the respirometer volume and the density of animals in it do not affect the rate of respiration. (Auth)

<508>
Music, J.L., Jr., Observations on the Spot (LEIOSTOMUS XANTHURUS) in Georgia's Estuarine and Close Inshore Ocean Waters.

1974. Georgia Department of Natural Resources, Game and Fish Division, Contribution Series Number 28; 29 p. (Georgia Department of Natural Resources, Game and Fish Division, Coastal Fisheries Office, Atlanta, GA)

The spot (LEIOSTOMUS XANTHURUS Lacepede) is found throughout Georgia's estuarine environment in great numbers. The chief fishery for spots is the small amount obtained from catches taken in conjunction with shrimp trawling operations. Over 90 per cent of these fish are less than eight inches total length, contributing to their low commercial value. Spots were found in waters with salinities ranging from 0 ppt in upper creeks to 35 ppt in close inshore ocean waters, and at temperatures ranging from to 35 C. The spawning season extends from October through March with November and December as the peak months. Some spawning apparently takes place in close inshore ocean waters of the northern part of the state with the major spawning grounds in deeper offshore waters. There are at least two age groups of spots in the estuaries with many over-wintering spots found in the creeks. Adult spots are most common along the beaches in the spring and summer; in the creeks and sounds in the fall; and in the offshore waters during winter. The growth rate during the first year is rapid with young spots reaching from 0.7 inches in January to 5.6 inches by October. (Auth)

<509>
Muth, S.E., and D.C. Tarter, Reproductive Biology of the Trout Perch, PERCOPSIS OMINCOMAYCYS (Walbaum), in Beech Fork of Twelvepole Creek, Wayne County, West Virginia.

1975. Amer. Midland Naturalist, 93, 434-439 (Department of Natural Resources, McClinitc Wildlife Station, Pt. Pleasant, WV; Marshall University, Department of Biological Sciences, Huntington, WV)

Gonads of the trout perch increased markedly in size from March to April corresponding to a marked increase in water temperature from March (5 C) to April (15.5 C). The first ripe fish were collected in late April. Spawning occurred at night over shallow, gravel riffles at approximately 15. C. Spawning was completed by June. (ST)

<510>
Naiman, R.J., Primary Production, Standing Stock, and Export of Organic Matter in a Mohave Desert Thermal Stream.

1976. Limnol. & Oceanog., 21, 60-73 (Arizona State University, Department of Zoology, Tempe, AZ)

Mean annual primary productivity at several stations of Tecopa Bore, a thermal artesian stream, were similar, although a station near the source with a 45 C water temperature and a constant source of nutrients was the most productive. Warm stations with temperatures from 38 to 45 C had average production rates of about 3.5 g C/M2-day. (ST)

<511>
Nakamura, R., Temperature and the Vertical Distribution of Two Tidepool Fishes (OLIGOCOTTUS MACULOSUS, O. SNYDERI).

1976. Copeia, No. 1, 143-152 (University of British Columbia, Institute of Animal Resource Ecology, Vancouver, British Columbia, Canada)

The relationship between the tide cycle, microhabitat, temperatures, microdistribution patterns and thermal physiology of OLIGOCOTTUS MACULOSUS, and O. SNYDERI, two tidepool cottids, was determined. Upper level tidepools generally are characterized by greater temperature extremes and sudden temperature shifts which are directly related to the periods of emergence and submergence. Lower tidepools tend to be more stable with a lesser extent of temperature extremes. OLIGOCOTTUS SNYDERI, which is restricted to middle and lower tidepools, is less tolerant of wide temperature extremes. Its upper distributional boundaries appear to be governed by tidepool temperature extremes. In the laboratory O. MACULOSUS displayed heat stress symptoms only when the temperature exceeded 20 C. In both field and laboratory experiments O. SNYDERI showed heat stress when the temperature exceeded 18 C. Below an acclimation level of 14 C, O. SNYDERI could not survive exposure for 12 hrs. at 25 C whereas O. MACULATUS could. The critical

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thermal maxima after 12 hr of exposure for this species acclimated at 10 C were within the limits of the maximum temperatures found in the field (23.5 to 25.0 C). (ST)

<512>
Nakamura, R., Experimental Assessment of Factors Influencing Microhabitat Selection by the Two Tidepool Fishes OLIGOCOTTUS MACULOSUS and O. SNYDERI.

1976. Marine Biol. (W. Ger.), 37, 97-104 (Southeastern Massachusetts University, Biology Department, North Dartmouth, MA)

The effect of temperature extremes and fluctuations on OLIGOCOTTUS SNYDERI was tested in the laboratory. Higher temperatures in the upper simulated tidepools of the test apparatus appeared to alter the tidepool distribution. The frequency of occurrence of O. SNYDERI in the lower experimental tidepools with cooler and more stable temperature regimes (11.5 to 13.5 C) increased while that of the upper simulated tidepools with higher, more unstable temperature (cyclic extreme of 23.5 C), decreased. This extreme is characteristic of upper tidepools in nature. (ST)

<513>
Nasar, S.A.K., and J. Datta Munshi, Studies on Primary Production in a Freshwater Pond.

1975. Japanese Jour. Ecology, 25, 21-23 (Bhagalpur University, Ecological Research Laboratory Post-Graduate Department of Zoology, Bhagalpur, Bihar, India)

Primary production studies were conducted in a permanent tropical freshwater pond at Bhagalpur, India from November, 1972 to October, 1973, using the light-dark bottle method. The summer values of net primary production ranged from 2.12 to 3.50 g of carbon assimilated/m2 day. The maximum value of primary net production observed in April, was found to be nearly seven times greater than the minimum value. It is found that respiration, expressed as percentage of gross production, amounted to 22.5 to 78.2 and the net: gross ratio varied from 0.25 to 0.72. Further, it was observed that light intensity and temperature had a direct effect on the productivity of the pond. (Auth)

<514>
Negilski, D.S., Acute Toxicity of Zinc, Cadmium and Chromium to the Marine Fishes, Yellow-Eye Mullet (ALDRICHETTA FORSTERI C. & V.) and Small-Mouthed Hardyhead (ATHERINASOMA MICROSTOMA Whitley).

1976. Aust. Jour. Mar. Freshwater Res., 27, 137-149 (Ministry for Conservation, Fisheries and Wildlife Division, Marine Pollution Studies Group, Melbourne, Victoria, Australia)

In static tests with juvenile mullet, the acute incipient lethal level for zinc was 9 mg/l, the 168-hr LC50 value for cadmium was 16 mg/l, and the 96-hr LC50 values for tri- and hexavalent chromium were 53 and 24 mg/l respectively; in similar tests with pre-adult hardyhead, the acute incipient lethal level for zinc was 33 mg/l and the 168-hr LC50 value for cadmium was 21 mg/l. In continuous-flow tests with mullet the acute incipient lethal level for zinc was 12 mg/l, but incipient lethal levels were not attained for cadmium or chromium; however, the 120-hr LC50 value for cadmium and the 96-hr LC50 value for hexavalent chromium were 14 and 31 mg/l respectively. In similar tests with hardyhead, incipient lethal levels for zinc and chromium were 37 and 36 mg/l respectively. An acute incipient lethal level for cadmium was not attained, but the 168-h LC50 value was 15 mg/l. Generally, mullet and hardyhead were more sensitive to the acute effects of cadmium, chromium and zinc than other marine and estuarine fishes for which toxicological information is available. Increased temperature (25 C compared to 19.5 C) also appeared to increase the sensitivity of mullet to the lethal effects of zinc. (Auth)

<515>
Neill, W.H., Mechanisms of Behavioral Thermoregulation in Fishes.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Texas A&M University, Department of Wildlife and Fisheries Sciences, College Station, TX)

Final temperature preferenda of fish, the point at which acclimation and preferred temperatures are identical, are species-specific and roughly reflect zoogeographic distribution. Season/photoperiod is also a source of variation in temperature preferenda. The possibility of two fundamentally different mechanisms of behavioral thermoregulation in fish, predictive behavioral thermoregulation and reactive behavioral thermoregulation, is discussed. Predictive behavioral thermoregulation is the effective use of knowledge of the environmental structure through either learning or instinct. Reactive behavioral thermoregulation refers to the remaining class of thermoregulatory mechanisms. Research relevant to each of these mechanisms is reviewed. Although temperature tolerances and preferences for many species of fish are known, fish distribution in nature can not be predicted until mechanisms of environmental regulation are understood. (ST)

<516>
Neish, G.A., Observations on the Growth and Morphology of Emerson's SAPROLEGNIA sp. 47-15-a.

1975. Can. Jour. Bot., 53, 1423-1427 (University of British Columbia, Department of Botany, British Columbia, Canada)

Temperature was an important factor in determining the morphology of an isolate of Emerson's SAPROLEGNIA. At 21 C oogonium development was inhibited and gemma production was enhanced. At 14 C or less, oogonia were produced abundantly and gemma production was inhibited. The linear growth rate of the isolate doubled as the temperatures doubled within a temperature range of 3 to 21 C. (Auth) (ST)

<517>
Nelson, D.D., and R.A. Cole, The Distribution and Abundance of Larval Fishes along the Western Shore of Lake Erie at Monroe, MI.

1975. Michigan State University, Institute of Water Research, Technical Report No. 32.4 (Michigan State University, Institute of Water

<517> CONT.
Research, Department of Fisheries and Wildlife, East Lansing, MI)

The species composition, distribution, and abundance of larval fish near the Monroe electric generating station on the western shore of Lake Erie were investigated. Twenty species were identified, but only six species, gizzard shad (DORSOMA CEPEDIANUM), alewife (ALOSA PSEUDOHARENGUS), carp (CYPRINUS CARPIO), yellow perch (PERCA FLAVESCENS), white bass (MONROE CHRYSOPS), and freshwater drum (APLODINOTUS GRUNNIENS) accounted for 90% of the total catch. Estimates of abundance were significantly different between the two sampling years and there was a large variability among replicates, probably related to patchy nonrandom distribution. Recruitment of larvae within the discharge canal prevented a determination of entrainment losses, however, a drop in abundance between two discharge canal stations indicated that mortality may have occurred. Heated water within the discharge canal appeared to lengthen the spawning period of several less desirable species such as gizzard shad, carp, and channel catfish, while reducing or not affecting that of the more valuable sport species such as white bass. Based on fecundity techniques, the number of larval fish entrained was estimated to be from 1 to 10% of the total available larvae, at a hatching success of 100 to 10%, respectively. (ST)

<518>
Neuhoff, H.-G., and H. Theede, Effects of Combination of Temperature and Hydrostatic Pressure on ASTERIAS RUBENS.

1975. Kiel Meeresforsch (Ger.), 31, 32-43 (University of Kiel, Institute Meereskd., Germany)

Small specimens of the starfish, ASTERIAS RUBENS (radius: 5 to 10 mm) tolerated higher hydrostatic pressures than larger ones (radius; 25 to 40 mm). Pressure tolerance of this species increased with rising temperature from 5 to 15 C. Pressure-induced reversible injuries were repaired more quickly at higher temperatures. Irreversible damaged starfish died more quickly at 15 C than at 5 C. With decreasing temperature and augmenting hydrostatic pressure the activity of the enzyme lactate-dehydrogenase was increasingly inhibited. (Auth)

<519>
Newell, R.L., The Effect of Temperature on Growth and Development of the Mayfly TRICORYTHODES MINUTUS Traver.

1976. Ph.D. Thesis, Idaho State University, 136 p. (Idaho State University, Pocatello, ID)

The life history of the mayfly, TRICORYTHODES MINUTUS was investigated at two stations in Deep Creek, Utah-Idaho and one station in Spring Creek, Idaho. Ecclosion and survival were directly dependent upon temperature. Allometric and absolute growth were examined in the field and laboratory at several temperatures. Growth of various size classes was approximately sigmoidal reaching a peak of growth at about 4.0 mm in length. Growth was also sigmoid as temperature increased, reaching an asymptote at 23 C. (ST)

<520>
Nezdoliy, V.K., and V.P. Mitrofanov, Natural Reproduction of the Grass Carp, CTENOPHARYNGODON IDELLA, in the Ili River.

1975. Jour. Ichthyol., 15, 927-933 (Kazakh University, Department of Hydrobiology and Ichthyology, Alma-Ata, USSR)

The spawning of the grass carp in the Ili River (USSR) in 1972 and 1973 took place from mid-May (water temperature 18.7 C) through late June (23.5 C). Peak spawning was noted when the water temperature had reached 19.5 to 19.9 C. The start of spawning was preceded by a rise in the water level and an increase in turbidity. (ST)

<521>
Niemeck, R.A., and A.C. Mathieson, An Ecological Study of FUCUS SPIRALIS L..

1976. Jour. Exp. Mar. Biol. Ecol. (Neth.), 24, 33-48 (University of New Hampshire, Department of Botany and the Jackson Estuarine Laboratory, Durham, NH)

An ecological study of the brown alga, FUCUS SPIRALIS, was made at Jaffrey Point, Newcastle, N.H., and the adjacent Great Bay Estuary. The distribution, growth, reproductive periodicity, attrition, and longevity of the plants are described in relation to a variety of environmental factors. Distribution was correlated with appropriate substrate. FUCUS SPIRALIS is both eurythermal and euryhaline, occurring within a temperature and salinity range of -0.5 to 23.1 C and 3.0 to 32.0 ppt, respectively. Increased growth from April to August was associated with a corresponding increase in temperature and light conditions. Maximum growth occurred when the surface water temperatures were 18 to 19 C and daylength was approximately 15 hr. (ST)

<522>
Nieto Garcia, M., M.J. Bengoechea Pere, and J.G. Maganto Fernandez, The Effect of Acclimation Temperature on Proliferation of Erythropoietic Precursors in CARASSIUS AURATUS and on the Uptake of Triated Thymidine in Haematopoietic and Intestinal Tissue.

1975. IAEA-SM-197/9; Part of Proceedings of a Symposium on the Combined Effects of Radioactive, Chemical and Thermal Releases to the Environment held in Stockholm, Sweden, June 2-5, 1975. International Atomic Energy Agency, Vienna (Junta Energia Nuclear, Division Quimica y Mediio Ambiente, Madrid, Spain)

The cellular proliferation of undifferentiated erythropoietic precursors in the goldfish CARASSIUS AURATUS acclimated at various temperatures: 5, 10, 20, 30 and 35 C, was studied. The combined use of high resolution autoradiography and DNA labelling with H-3-TdR made it possible to study the duration of the cellular cycle from the decrease in the number of grains/nucleus with time. A shortening of the mitotic cycle was found for high acclimation temperatures, together with an increase in the labelled cell fraction and in the number of grains/nucleus in the four erythropoietic celular precursors. The uptake of H-3-TdR in intestinal and haematopoietic tissue was also studied. Increased uptake in the haematopoietic tissue with temperature over the range considered, and a decrease in uptake by the intestine between 25 and 35 C was observed. The number of cells per gram of fish decreased at high acclimation temperatures. (Auth)

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Nishikawa, K., Seasonal Changes in the Histological Activity of the Thyroid Gland of the Medaka, ORYZIAS LATIPES.

1975. Bull. Fac. Fish. Hokkaido Univ. (Jap.), 26, 23-30 (Hokkaido University, Faculty of Fisheries, Laboratory of Fresh-Water Fish-Culture, Japan)

Seasonal changes were observed histologically in the activity of the thyroid gland of the medaka. When fish with supressed thyroid and gonad activity were exposed to long photoperiods at 25 C both organs regained activity within 30 days. The stimulating effect of the long photoperiod was lessened when the fish were kept at 10 C. A short photoperiod at either temperature was without effect in activating both the thyroid gland and gonads. (ST)

<524>
Niwa, S., Effect of Hot Drainage on Marine Lives in the Wakasa Straits.

1974. Genshiryoku Kogyo (Jap.), 20, 28-32 (Fukui Prefectural Fisheries Experimental Station, Tsuruga, Japan)

Prior to operation of a power plant near the Wakasa Straits (Japan), abundance and dominant species of plankton outside and in the bay differed. This difference was not observed after operation of the plant. No clear change in dominant species of fish that comprise the coastal fishery were observed. (ST)

<525>
Nordlie, F.G., Influence of Environmental Temperature on Plasma Ionic and Osmotic Concentrations in MUGIL CEPHALUS Lin.

1976. Comp. Biochem. Physiol., 55A, 379-381 (University of Florida, Department of Zoology, Gainesville, FL)

Plasma Na+ in MUGIL CEPHALUS ranged from a concentration of 158.8 mequiv/l from fish aclcimated to 10 C to 178.0 mequiv/l from fish at 30 C, plasma Cl- ranged from 138.8 mequiv/l at 10 C to 158.2 mequiv/l at 30 C, and plasma osmotic concentration ranged from 323 mOsm/kg to 378 mOsm/kg for the same acclimation temperature range. Plasma K+ remained roughly constant. These patterns of response in inorganic ions and total osmotic concentrations to environmental temperature are opposite to what is expected in fish acclimated to sea water and would seem to involve an additional metabolic expenditure for regulation at lowered temperatures. (Auth)

<526>
Norse, E.A., The Ecology of Blue Crabs, Genus CALLINECTES (Brachyura: Portunidae) in the Caribbean.

1975. Ph.D. Thesis, University of Southern California (University of Southern California, Los Angeles, CA)

As part of a study of the ecology of crabs of the genus CALLINECTES in the Caribbean, high temperature tolerance of six species was determined. Over 78% of individuals of CALLINECTES BOCOURTI, C. DANAE, C. EXASPERATUS, C. MARGINATUS, and C. SAPIDUS survived transfer from 28.8 C to 39.0 C. CALLINECTES ORNATUS was less tolerant of high temperatures, with only 43.5 % survival. Temperature ranges over which eight Jamaican species were found are given. (ST)

<527>
North, W.J., Effects of Heated Effluents on Marine Biota, Particularly in California.

1974. Part of Modifications Termiques et Equilibres Biologiques, Institut de la Vie. Elsevier Publishing Co., Inc., New York, 1974 (California Institute of Technology, W.M. Keck Engineering Laboratories, Pasadena, CA)

Literature on the effects of heated effluents on marine biota is reviewed under the headings: laboratory studies, field studies, effects on benthos, effects on pelagic species, and magnitudes of cooling waters and receiving areas. Suggestions are given for averting or coping with specific biological problems that might arise when heated effluents are discharged to marine environments. (ST)

<528>
Not given, Hudson River Ecological Study in the Area of Indian Point: Thermal Effects Report.

1976. Texas Instruments Ecological Services Report prepared for Consolidated Edison Co. of New York, Inc. (Texas Instruments Incorporated, Ecological Services, Dallas, TX)

Abundance of fish in the Indian Point region was high during late spring and fall when salinities were increasing and decreasing respectively. Peak impingement rates of Atlantic tomcod (MICROGADUS TOMCOD) and white perch (MORONE AMERICANA), the two species comprising the bulk of impinged fish at Indian Point, were strongly associated with passage of the salt front (0.1 ppt salinity) past Indian Point. Increases in impingement of white perch and striped bass (MORONE SAXATILIS) were associated with low ambient temperatures of 0 to 10 C as well as with salt-front movement. No relation among fish abundance, impingement rate and thermal additions was detected. Diversity of benthic organisms was not significantly different between test and control areas or between years. Fouling communities were dominated by the barnacle BALANUS IMPROVISUS, the clam CONGERIA LUECOPHAETA, and the hydroid CORDYLOPHORA LACUSTRIS. Their settling rates and production were directly related to increasing salinity during the summer. The epibenthic community was dominated by crustaceans, the most abundant being calanoid copepods and the amphipod GAMMARUS. Reproduction of the isopod CYATHURA POLITA began in late April and extended through August. In laboratory studies temperatures preferred by white perch and striped bass after extended exposure to a temperature gradient ranged from 3 to 6 C to 10 to 15 C above the acclimation temperature from summer to winter respectively. Immediate preferences were 3 to 7 C above acclimation temperatures during all seasons; acclimation temperatures ranged from 3 to 4 C during winter to 26 C in summer. Striped bass juveniles and, to a lesser extent, white perch were sometimes incapable of avoidance of lethal thermal conditions in the laboratory, especially when acclimation temperatures were less than 8 C. Temperatures above acclimation which elicited avoidance behavior ranged from 5 to 8 C during summer and 6 to 21 C during winter. Juvenile white perch generally avoided lower temperatures for particular acclimation

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temperatures than did juvenile striped bass or adult white perch. Atlantic tomcod avoided temperatures that were 8 to 16 C above acclimation temperatures of 0.5 to 8.9 C. Thermal tolerance limits for striped bass and white perch were 9 to 19 C above acclimation temperatures of 8 to 26 C, the difference being greatest at the lowest acclimation temperatures. The thermal tolerance limit for Atlantic tomcod was 16.3 C for an acclimation temperature of 1 C. Cold shocks of 13 C (15 to 2 C) for striped bass and 18 C (20 to 2 C) for white perch caused 100 and 50% mortality over 96 hr, respectively. Temperature drops of 10 to 2 C at the same rate had no effect. Active metabolic rates at 8 and 24 C for white perch and striped bass are given. Based on the physical, chemical, and biological data collected and the operating conditions of the plant, the investigators concluded that there is little detectable impact on the ecology of the Hudson River at Indian Point relating to the thermal effluents from the Indian Point facilities. (ST)

<529>
Not given, Oceanographic Studies to Assess the Environmental Implications of Offshore Siting of Electric Generation Facilities - New York Field Studies 1973-1974.

1975. Final Report prepared for the New York State Energy Research and Development Authority (Grumman Ecosystems Corp., Bethpage, NY; Lawler, Matusky and Skelly, Engineers, Tappan, NY)

Physical, chemical, and biological data obtained during a one year survey of a broad 800 aquare mile area of the New York Bight are presented. As part of an analyses of the biological impact of power plant siting, significant representative species of each of the major life habitiats (plankton, benthos, and nekton) were selected on the basis of commercial and economic importance, sport and recreational importance, and eclogical importance in the food chain and thermal stress information on these species was reviewed. For most of the economically important species found in the New York Bight, thermal stress information is deficient. (ST)

<530>
Not given, Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments.

1976. CONF-750980; EPRI SR-38; Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volumes I & II) held at Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Electric Power Research Institute, Palo Alto, CA)

Volume I contains the deliberations of the workshop and eleven high priority research recommendations. Volume II contains technical and topical papers. The technical papers provide an overview of the EPRI organization and overviews of the problem of the impact of power plants on aquatic systems from social, technological, and cost-benefit points of view. The topical papers cover a broad spectrum of research interests including the impact of power plants on freshwater and estuarine systems; ecological design parameters for assessing impact; the recovery of perturbed ecosystems; the necessity for site-specific studies; thermal physiological effects; reaction of small fish to perforated plates; hydrothermal modeling; effects of entrainment, entrapment, and impingement; a method for estimating the toxicity of chlorinated discharges; mechanisms of behavioral thermoregulation in fishes; radionuclides in aquatic ecosystems; problems associated with aquatic monitoring and research at operating power stations; effects on fish populations; usefulness of thermal plume prediction; minimizing fish loss; cooling reservoirs; and regulatory considerations of power plant chlorination. (ST)

<531>
Nusenbaum, L.M., and N.A. Lemanova, The State of the Ovaries of the Shad, CASPIALOSA KESSLERI, Passed through the Volgograd Fish Lift.

1975. Jour. Ichthyol., 15, 274-278 (State Research Institute for Lake and River Fisheries (GosNIORKh), Leningrad, USSR)

A large number of female shad, CASPIALOSA KESSLERI, pass through the fish lift following a first spawning in the afterbay of the Volgograd hydroelectric power plant. When the water temperature rose above 20 C, egg resorption was observed in a large number of females collected from the fish-passing device. (ST)

<532>
Nyman, L., Behaviour of Fish Influenced by Hotwater Effluents as Observed by Ultrasonic Tracking.

1975. Institute of Freshwater Res. (Swed.) Rep. No. 54, 63-74 (Institute of Freshwater Research, Drottningholm, Sweden)

Ultrasonic tracking was employed to observe the influence of heated discharges from thermal power stations on fish behavior. Ide (LEUCISCUS IDUS) and silver eel (ANGUILLA ANGUILLA) were studied off the nuclear power station at Oskarshamn (OKG) on the Swedish east coast, sea-run brown trout (SALMO TRUTTA) and yellow eels were studied off Stenungsund thermal power station on the west coast of Sweden. Ide were attracted by hot water, in the autumn, and the duration of the attraction appeared short. Net avoidance was also observed. Yellow eels were attracted by heated discharges in summer, and although silver eels were activated and attracted in winter at 7 to 10 C by a rising temperature gradient, there were indications that they are repelled in the late summer and autumn which is their principal migration period. Sea-run brown trout were attracted by hot water when ambient sea temperatures did not exceed 15 to 16 C. In summer they avoided the heated area. The direct approach of underwater telemetry to study the effects of elevated temperatures on fish behavior has many advantages, including the fact that fish appear uninfluenced both by the internal tags and the tracking system. (ST)

<533>
Nyman, L., Allelic Selection in a Fish (GYMNOCEPHALUS CERNUA (L.)) Subjected to Hotwater Effluents.

1975. Institute of Freshwater Res. (Swed.) Rep. No. 54, 75-82 (National Swedish Environmental Protection Board, Solna, Sweden)

Analyses of samples of ruff (GYMNOCEPHALUS CERNUA) subjected to the hotwater effluents

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of a nuclear power station on the Baltic coast of Sweden demonstrated changes in migratory patterns depending upon the genetic composition of certain individuals better adapted to the new environment. Gene frequency data indicate significant differences between fish attracted by hot water and those trying tc avoid it. Also, the population immediately outside the outlet of the thermally influenced Hamnefjarden Bay was transformed genetically by immigrants from adjacent populations, and in one year the frequency of the most anodal allele had increased from 0.50 to 0.89 at this sampling point. Some biological implications of such artificial temperature changes causing allelic selection are discussed. (Auth)

<534>
O'Connor, S.G., and A.J. McErlean, The Effects of Power Plants on Productivity of the Nekton.

1975. Part of Cronin, L.E. (Ed.), Estuarine Research, Volume I, Chemistry, Biology, and the Estuarine System. Academic Press, Inc., New York, 1974, (p. 494-517) (Chesapeake Biological Laboratory, Department of Environmental Research, Prince Frederick, MD; QLM Laboratories, Nyack, NY; EPA, Office of Technical Analysis, Washington, DC)

Steam electric generating stations, especially those with once-through cooling systems, can cause alterations in the productivity of fish populations through the effects of thermal discharges, chemical discharges, and impingement of adults or entrainment of juveniles at intake structures. These effects cannot be evaluated individually but must be analyzed in terms of changes in productivity, as indicated by standing-crop estimates, and changes in food-web dynamics, as indicated by diversity indices. Diversity, standing crop, and mean biomass estimates of the Patuxent River estuary from 1962 until 1967 bear the common feature of a sinusoidal curve. This data suggests a general environmental degradation as characterized by a decreasing diversity of species and fluctuating estimates of standing crop. This study includes both pre-operational and post-operational data from the Chalk Point Generating Station; however, the generalized degradation cannot be directly attributed to the power plant. (Auth)

<535>
O'Toole, M.J., Distribution and Abundance of Larvae of the Hake MERLUCCIUS spp. off South West Africa 1972-1974.

1976. Collect. Sci. Pap. ICSEAF/Recl. Doc. Sci. CIPASE/Colecc. Doc. Cient. CIPASO, 3, 151-158 (Sea Fisheries Branch, Sea Point, Cape Town, South Africa)

Larvae of the hake, MERLUCCIUS sp. were common in the ichthyoplankton samples collected off South West Africa during a two year egg and larval survey. Ninety-two percent of all larvae were taken during the months of October, November, and December. Most of the larvae were found at surface temperatures and salinities of 15 to 16.5 C and 34.9 to 35.2 ppt. (Auth) (ST)

<536>
O'Toole, M.J., and D.P.F. King, Early Development of the Round Herring ETRUMEUS TERES (De Kay) from the South East Atlantic.

1974. Vie Milieu, 24, 443-452 (Sea Fisheries Branch, Cape Town, South Africa)

The eggs and early larval stages of ETRUMEUS TERES from the Cape Peninsula are described. Eggs measured from 1.32 to 1.47 mm in diameter. Newly hatched larvae measured between 3.85 and 4.50 mm. Eggs were incubated through a series of temperatures ranging from 11.0 to 20.5 C. Hatching occurred after 135 hr at 11.0 C and after 36 hr at 20.5 C. (Auth)

<537>
Odum, E.P., and R.L. Kroodsma, The Power Park Concept: Ameliorating Man's Disorder with Nature's Order.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane, (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (University of Georgia, Institute of Ecology, Athens, GA; Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

The adoption of the power park concept, setting aside natural areas to remain free from human habitation and establishing a reciprocal design coupling man's energy-conservation processes with the natural and seminatural ecosystems so as to ameliorate the inherent disorder associated with any type of energy production, is proposed. The role that Savannah River project can play in developing this new technology is reviewed. (ST)

<538>
Oikari, A., Hydromineral Balance in Some Brackishwater Telecosts after Thermal Acclimation, Particularly at Temperatures near Zero.

1975. Ann. Zool. Fenn. (Fin.), 12, 215-229 (University of Helsinki, Department of Zoology, Helsinki, Finland)

Pike (ESOX LUCIUS) and sculpins (MYOXOCEPHALUS SCORPIUS and M. QUADRICORNIS) from brackish water were acclimated to -0.1 C and higher temperatures. In winter plasma osmolality and Na+ and Cl- concentrations increased at -0.1 in all three species. In summer the effect of low temperature on Na+ and Cl- was the same in the sculpins, but decreased in pike. Changes in plasma K+ inorganic phosphate, and Mg++; brain and muscle water content; and muscle Na+, K+, and Mg++ are also reported. The results indicated that hydromineral balance is well regulated at near-zero temperatures in these fish. (ST)

<539>
Olla, B.L., A.J. Bejda, and A.D. Martin, Activity, Movements, and Feeding Behavior of the Cunner, TAUTOGOLABRUS ADSPERSUS, and Comparison of Food Habitats with Young Tautog, TAUTOGA ONITIS, off Long Island, New York.

1975. Fish. Bull., 73, 895-900 (NOAA, National Marine Fisheries Service, Middle Atlantic Coastal Fisheries Center, Sandy Hook, Highlands, NJ)

Field observations off Long Island, N.Y., using scuba and ultrasonic tracking, showed the cunner, TAUTOGOLABRUS ADSPERSUS, to be active during the day and inactive at night. In late fall, when water temperatures dropped

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to 5 to 6 C, cunner were observed to be inactive and torpid. In spring they became active as the water temperature rose above 6 C. Overwintering fish did not feed. (ST)

<540>
Olla, B.L., and A.L. Studholme, The Effect of Temperature on the Behavior of Young Tautog, TAUTOGA ONITIS (L.).

1975. Part of Barnes, H. (Ed.) Proceedings of the 9th European Marine Biology Symposium: Aberdeen University Press, 1975, (p. 75-93) (National Marine Fisheries Service, Middle Atlantic Coastal Fisheries Center, Sandy Hook Laboratory, Highlands, NJ)

Based on the results of earlier field studies, a series of experiments were conducted to investigate the effect of temperature on the activity, feeding, and shelter dependency of young tautog, TAUTOGA ONITIS, an inshore resident of the Atlantic coast from Nova Scotia to South Carolina. For each experiment, two fish were held under controlled laboratory conditions in one of two experimental systems while observations of activity, time spent in a tile shelter, aggresive encounters, and amounts ingested during feeding were recorded. As temperature was increased (from approximately 20 C to 30.2 C to 33.4 C) the various patterns were modified with activity, aggression, and feeding reduced and association with shelter increased. Five of the experimental fish, including two which had lost equilibrium, resumed normal activity and feeding when temperature was lowered to acclimation levels. The significance of these findings as related to natural populations is discussed. (Auth)

<541>
Olla, B.L., A.L. Studholme, A.J. Bejda, C. Samet, and A.D. Martin, The Effect of Temperature on the Behaviour of Marine Fishes: A Comparison among Atlantic Mackerel, SCOMBER SCOMBRUS, Bluefish POMATOMUS SALTRIX, and Tautog, TAUTOGA ONITIS.

1975. IAEA-SM-197/4; Part of Proceedings of a Symposium on the Combined Effects of Radioactive, Chemical and Thermal Releases to the Environment held in Stockholm, Sweden, June 2-5, 1975. International Atomic Energy Agency, Vienna (National Marine Fisheries Service, Sandy Hook Laboratory, Highlands, NJ)

A comparison was made of the behavioural responses to temperature of Atlantic mackerel, SCOMBER SCOMBRUS, bluefish, POMATOMUS SALTATRIX, and tautog, TAUTOGA ONITIS, held under controlled laboratory conditions. When the temperature was either raised or lowered from normal levels, juvenile and adult bluefish and adult Atlantic mackerel, all pelagic species, responded similarly by increasing swimming speed as much as 61 to 190%. This response was interpreted as a manifestation of behavioural avoidance of a particular level of temperature, indicative of capability for directive movements relative to ambient thermal conditions. Comparing the response of pelagic species to earlier work on tautog, a demersal species, it was clear that avoidance capability is dependent upon the behavioral repertoire of the individual species. The significance of the results, regarding distribution of fish and response potential under thermal stress, is discussed. (Auth)

<542>
Olsen, R.D., and M.F. Sommerfeld, Thermal Ecology of Phytoplankton in a Desert Reservoir.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (Argonne National Laboratory, Argonne, IL; Arizona State University, Tempe, AZ)

The physical-chemical limnology and phytoplankton dynamics of Canyon Lake, Arizona, were investigated from February 1971 to July 1973. The reservoir is a warm monomictic lake with pronounced thermal stratification during the summer months. Chemically the lake is hard water of moderate to high alkalinity and salinity. Annual peaks in the phytoplankton standing crop were recorded during early spring and mid- to late summer, and significant depressions occurred during April-May and November to January. The spring peak was composed primarily of centric diatoms, whereas the summer peak was dominated by filamentous Cyanophyceae. The seasonal appearance and variation in population size of individual species were correlated in varying degrees with one or more physical-chemical parameters. Indications are that physical factors (particularly light and water temperature), rather than water chemistry, were the primary parameters regulating seasonal succession. (Auth)

<543>
Olson, R.E., Laboratory and Field Studies on GLUGEA STEPHANI (Hagenmuller), a Microsporidan Parasite of Pleuronectid Flatfishes.

1976. Jour. Protozool., 23, 158-164 (Oregon State University, Marine Science Center, Newport, OR)

The microsporidan GLUGEA STEPHANI is a common parasite of juvenile English sole (PAROPHRYS VETULUS) in Yaquina Bay, Oregon. Field observations indicated that fish became infected only in the upper estuary where summer temperatures were above 15 C and the incidence of infection reached 79.8% in the late fall. Laboratory infections developed and parasite growth occurred only at or above 15 C. The parasite was successfully transmitted to juvenile English sole by brine shrimp (ARTEMIA SALINA) and amphipod (CORPHIUM SPINICORNE) vectors as well as by direct ingestion of spores by the host. Infections that resulted from ingestion of spore-carrying vectors were much heavier than those resulting from the direct ingestion of spores. The speckled sanddab (CITARICHTHYS STIGMAEUS), a nonpleuronectid flatfish, and chum salmon (ONCORHYNCHUS KETA) were refractory to G. STEPHANI infection in the laboratory. Results of this study suggest that G. STEPHANI is potentially lethal to young pleuronectid flatfishes when heavy infections involve the entire intestine and reduce the capacity to absorb nutrients. Under these circumstances, starvation is probably the direct or indirect cause of death. The restriction of infection to fish that reach the upper estuary very likely mitigates the impact of G. STEPHANI caused mortality on the entire English sole population on the Yaquina Bay nursery ground. (Auth)

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Ott, F.S., and R.B. Forward, Jr., The Effect of Temperature on Phototaxis and Geotaxis by Larvae of the Crab RHITHROPANOPEUS HARRISI (Gould).

1976. Jour. Exp. Mar. Biol. Ecol. (Neth.), 23, 97-107 (Duke University Marine Laboratory, Beaufort, NC; Duke University, Zoology Department, Durham, NC)

Investigations of the effect of sudden temperature change on the phototaxis of Stage I and IV zoeae upon stimulation from horizontal and vertical directions with 500-nm light indicate a temperature-induced geotactic response in larvae of the crab RHITHROPANOPEUS HARRISI (Gould). For the horizontal tests both zoea stages were reared at 20 C. Stage I showed positive phototaxis at temperatures between 15 and 35 C, while Stage IV responded over the range of 10 to 30 C. For the vertical tests, larvae, reared at 25 C, were stimulated with overhead lights. Stage I zoeae ascended at 15, 20 and 25 C and descended at 5, 10, 30 and 35 C. Stage IV zoeae ascended at 20 and 25 C and descended at 5, 10, 15, 30 and 35 C. Although the descent at high temperatures could result from a negative phototaxis, a reversal in phototactic sign at high temperatures was not found in the horizontal experiments, and the same vertical movement pattern is observed in total darkness. Upon exposure to high temperatures near the water surface, larvae would descend by means of a positive geotaxis rather than a negative phototaxis. This response involves active swimming by Stage IV larvae and passive sinking by Stage I. (Auth)

<545>
Otto, C., Factors Affecting the Drift of PCTAMOPHYLAX CINGULATUS (Trichoptera) Larvae.

1976. Oikos, 27, 93-100 (University of Lund, Department of Animal Ecology, Sweden)

Current resistance, distance drifted, activity and downstream movements at different conditions of different larval instars of POTAMAPHYLAX CINGULATUS (Trichoptera) were investigated. Large larvae had a higher current resistance than small ones. In February individual distances drifted were greater than in May, but drift was more continuous in the latter month. Low temperature as well as high availability of high quality food decreased the total diel activity of the larvae. A rich supply of high quality food was found to suppress the drift tendency in February and May. A larger number of individuals drifted in spring than in winter. In winter, low population densities and the provision of adequate shelter inhibited the drift. Larval drift depends on a number of different circumstances, and in winter long distances drifted, low current resistence and population density seemed to be factors of importance. In spring food requirements, habitat changes and an aggregative tendency prior to pupation were identified as significant components in the ecological background of the drifting phenomenon. (Auth)

<546>
Otto, C., Size, Growth, Population Density and Food of Brown Trout SALMO TRUTTA L. in Two Sections of a South Swedish Stream.

1976. Jour. Fish Biol., 8, 477-488 (University of Bergen, Zoological Museum, Bergen, Norway)

Earlier hatching of brown trout occurred in a section of a south Swedish stream with a higher monthly mean water temperature from November to June compared to an upper section of the stream. Size at hatching was larger in the lower, warmer section, but growth rate in terms of length increase per month was the same in both sections. (ST)

<547>
Otto, R.G., Thermal Effluents, Fish, and Gas-Bubble Disease in Southwestern Lake Michigan.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Industrial BIO-TEST Laboratories, Inc., Northbrook, IL; Chesapeake Bay Institute, Johns Hopkins University, Baltimore, MD)

Dissolved oxygen and nitrogen levels determined for intake and discharge waters at the Commonwealth Edison Company's Waukegan Generating Station, Waukegan, IL, during January-March 1972 indicated that heating of Lake Michigan waters during condenser passage at Waukegan and at the nearby Zion Station will result in gas saturation levels as high as 130%. Gas supersaturation tolerance levels were determined in the laboratory for yellow perch and rainbow trout. Yellow perch were unaffected by saturation levels as high as 115%. The 8-day median lethal saturation level was 126%. Trout were unaffected by saturation levels of 110% or below. The estimated 8-day median lethal level was 119%. Fish captured in the vicinity of the Waukegan discharge were examined for symptoms of gas-bubble disease. With the exception of carp, resident to the canal proper, no such symptoms were observed. Absence of symptoms indicates that fish are not remaining in the canal long enough to develop the disease. (Auth) (ST)

<548>
Otto, R.G., M.A. Kitchel, and J.O. Rice, Lethal and Preferred Temperatures of the Alewife (ALOSA PSEUDOHARENGUS) In Lake Michigan.

1976. Trans. Amer. Fish. Soc., 105, 96-106 (Industrial BIO-TEST Laboratories, Inc., Northbrook, IL)

The temperature tolerance and temperature preference of mature and young-of-year alewives from Lake Michigan were studied in the laboratory. Critical thermal maxima and incipient upper lethal temperatures increased with acclimation temperature for both mature and young-of-year fish. Critical thermal maxima at equivalent acclimation temperatures were unaffected by age of the fish. Incipient upper lethal limits for young-of-year fish exceeded those for mature fish by 3 C to 6 C. The ultimate lower lethal temperature for mature alewives appeared to exceed 3 C. Loss of heat tolerance following a 10 C decrease in temperature occured at approximately one-half the rate of heat tolerance following a comparible temperature increase. Preferred temperatures for young-of-year alewives were consistently higher than those of mature fish. Seasonal factors other than lake temperature appear to be of considerable importance in determining preferred temperatures. The results are discussed in terms of potential effects of the heated plume from a nuclear generating station and available field data. (Auth)

<549>
Page, J.W., J.W. Andrews, T. Murai, and M.W. Murray, Hydrogen Ion Concentration in the Gastrointestinal Tract of Channel Catfish.

1976. Jour. Fish Biol., 8, 225-228 (University of Georgia Agricultural Experiment Station and Skidaway Institue of Oceanography, Savannah, GA)

Hydrogen ion concentrations (pH) of the digestive tracts of channel catfish, ICTALURUS PUNCTATUS, were determined for fish of two sizes (892 and 134 g average weight) at two environmental temperatures (28 and 23 C). Acidic conditions (pH 2-4) were present in the stomach contents of all catfish with slightly higher pH values in stomachs of fish at 28 C. The pH increased to slightly alkaline values (pH 7-9) in the duodenum and reached a maximum level (pH 8.6) in the upper intestinal region and then decreased in the lower segments to approach neutrality in the colon. The pH of the bile ranged from 6.1 to 7.5 and was higher in fish maintained at 28 C. Higher environmental temperatures (28 C) resulted in a slightly lower pH throughout the intestinal and colon segments. The larger catfish had lower intestinal length/body weight ratios than smaller catfish. As the result of distension due to increased food consumption, catfish maintained at 28 C had shorter intestial tracts than catfish maintained at 23 C. (Auth)

<550>
Pajunen, V.I., Effect of Temperature on Development in Some Populations of ARCTOCORISA CARINATA (Sahib.) (Hemiptera, Corixidae).

1975. Ann. Zool. Fenn. (Fin.), 12, 211-214 (University of Helsinki, Zoology Department, Helsinki, Finland)

Rates of development of ova and the first three larval stages were determined in some constant-temperature regimes for British, Icelandic South-Swedish, and Swiss populations of ARCTOCORISA CARINATA. Comparison with data for a Finnish rock-pool population revealed poorer tolerance of high temperatures in larvae from the northern and mountain habitats. At lower temperatures no differences could be detected between the populations. The rates of development of the ova of different populations did not differ. (Auth)

<551>
Palmer, B.A., Studies on the Blue Crab (CALLINECTES SAPIDUS) in Georgia.

1974. Georgia Department of Natural Resources, Contribution Series Number 29; 59 p. (Georgia Department of Natural Resources, Game and Fish Division, Coastal Fisheries Office, Atlanta, GA)

In a three year survey of fish, shrimp and blue crabs of the Georgia coast (October 1970 through September 1973), data were obtained on their distribution, seasonal abundance, size composition, maturity stages, sex ratios, total numbers, total weight and various other aspects of their life histories. This report represents findings on the blue crab, CALLINECTES SAPIDUS. Water temperature, air temperature and salinity measurements were recorded. The three sampling sections of the state exhibited the same general water temperature trends with the high in the southern inside waters at 31 C in August while the low was recorded in northern inside waters at 9.2 C in February.

(ND)

<552>
Parent, J.P., G. Bouche, and F. Vellas, Effect of Artificially-Induced Water Temperature Rise on Physiological Parameters of Two members of the Teleostei Group: Roach and Perch.

1976. Cah. Lab. Hydrobiol. Montereau (Fr.), No. 3, 5-14 (Universite Paul Sabatier, Laboratoire d'Ecophysiologie Animale, Toulouse, France; Centrale Termique E.D.F., Laboratoire d'Hydrobiologie, Montereau, France)

The influence of heated effluents from a power station on the physiology of roach (LEUCISCUS RUTILUS L.) and perch (PERCA FLUVIATILIS L.) was studied. Whole body and gonad weights, lipid and protein concentration in blood and lipid, protein and RNA in liver and muscle were determinated. in the experimental conditions (from March to July,) the results suggest that the biological cycle of these species is shortened by an increase of temperature. (English Summary)

<553>
Parker, J.G., Cultural Characteristics of the Marine Ciliated Protozoan, URONEMA MARINUM Dujardin.

1976. Jour. Exp. Mar. Biol. Ecol. (Neth.), 24, 213-226 (University of Leeds, Wellcome Marine Laboratory, Robin Hood's Bay, England)

Experiments on the growth of URONEMA MARINUM at various combinations of temperature (15 to 30 C) and salinity (15 to 45 ppt) were carried out in duplicate cultures. Conditions which gave the maximum growth rate were 35.0 ppt and 25 C. At salinities of 15 ppt and 25 ppt the optimum temperature was 22.5 C; at 45 ppt the optimum temperature was 27.5 C. At a salinity of 35 ppt there was little variation in growth rate within the temperature range of 22.5 to 30 C. (ST)

<554>
Patel, B., M.C. Balani, S. Patel, V.K. Panday, and S.D. Soman, Impact of Thermal and Radioactive Effluents on a Tropical Nearshore Ecosystem.

1975. IAEA-SM-197/2; Part of Proceedings of a Symposium on the Combined Effects of Radioactive, Chemical and Thermal Releases to the Environment held in Stockholm, Sweden, June 2-5, 1975. International Atomic Energy Agency, Vienna (Bhabha Atomic Research Centre, Health Physics Division, Trombay, India)

The effects of heated effluents from a nuclear power station on the bioaccumulation of iodine-131, cesium-137, cobalt-58, and cobalt-60 by the blood clam, ANADARA GRANOSA; the venerid clam, KATELYSIA OPIMA; and the oyster, CRASSOSTREA GRYPHOIDES were studied. Differential bioaccumulation of these radionuclides was observed in the three species. All three species showed partial discrimination against iodine and cesium and specificity for cobalt. The bioaccumulation of cobalt radionuclides was dependent upon the concentration in the effluent; a similar relationship for cesium and iodine nuclides was not evident. The accumulation of cobalt and cesium radionuclides by A. GRANOSA was not significantly affected by temperature in the thermal plume (27 to 35 C) compared to control areas (22 to 24 C). However, the accumulation of iodine-131 was to a certain extent temperature dependent, especially

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after 30 days exposure, with a temperature change from 27 to 35 C. The other species showed variable patterns of uptake for other radionucildes. In the laboratory filtration rates (and thus bioaccumulation) of A. GRANOSA increased with increasing temperature from 21 to 30 C and active/optimum filtration occured between 31 and 35 C. Filtration rates fell sharply above 35 C. The thermal potentiation of the chromium effect (potassium dichromate) on the rate of filtration was discussed in light of the metal's toxic effect. No significant effect of temperature on the distribution patterns of the trace metals, chromium, nickel, cobalt, iron, manganese, copper and zinc, was evident. (ST)

<555>
Pattee, E., Stable and Fluctuating Temperature. I. Comparative Study of Their Effects on the Development of Planarians.

1974. Paper presented at the International Society of Theoretical and Applied Limnology, Winnipeg, Canada, September 1974 (Not given)

The effect of a constant 10 C temperature and a rhymical temperature varying every 24 hr between 5 and 15 C on the planarians, POLYCELIS NIGRA and P. TENUIS was studied. Compared with the 10 C constant temperature, fluctuation accelerated the development of P. NIGRA. In P. TENIUS the duration of egg development remained unchanged but the maturation and generation times were significantly lengthened by these fluctuations. The expected development time, calculated from the hourly proportions of time spent at 5, 10, and 15 C more nearly approximated the actual time than that calculated from the mean level at 10 C. (Auth) (ST)

<556>
Patten, B.C., A Reservoir Cove Ecosystem Model.

1975. Trans. Amer. Fish. Soc., 104, 596-619 (University of Georgia, Department of Zoology, Athens, GA)

A total ecosystem compartment model of a reservoir cove is described with emphasis on the fish submodel. Nominal (unperturbed) annual cycles of selected compartments are presented, and results from three perturbation experiments (thermal pollution, eutrophication, piscivore invasion) are summarized. A rise in temperature resulting from the siting of a nuclear reactor near the cove was simulated by elevating the annual temperature cycle by a constant 3 C. Most producer compartments decreased in mean annual biomass except for blue-green algae and floating algae mats. Effects on zooplankton were negligible. Larval fish showed a mean annual decrease of 27.5% but all other vertebrate compartments increased. Carnivorous fish and the sunfish group were the main benefactors. The ability of fish to influence structure and function of the entire ecosystem (model) is demonstrated, and the role of top trophic levels in controlling the design of ecological communities is discussed. The status and prospects of total ecosystem modeling as a tool for fisheries science are considered. (Auth) (ST)

<557>
Penaz, M., The Locomotor Activity of Larval and Juvenile Minnows (PHOXINUS PHOXINUS).

1975. Zool. Listy, 24, 263-276 (Universitat Umea, Institute fur Wirbeltierforschung, Tschechoslowakische Akademie der Wissenschaftedn, Brno, Czechoslovakia)

Changes in annual temperatures created annual rhythms in activity of the minnow, PHOXINUS PHOXINUS, with highest activity occurring in summer. A diel rhythm was generally synchronized by light intensity. (CCC)

<558>
Pennak, R.W., and W.N. Rosine, Distribution and Ecology of Amphipoda (Crustacea) in Colorado.

1976. Amer. Midland Naturalist, 96, 324-331 (University of Colorado, Department of Biology, Boulder, CO; Augustana College, Department of Biology, Sioux Falls, SD)

Only two species of Amphipoda are abundant in Colorado. HYALELLA AZTECA is common and distributed in a wide variety of standing waters and springs of plains and mountains between 1050 and 3400 m, GAMMARUS LACUSTRIS is less common and generally restricted to mountain ponds and lakes between 2500 and 3400 m where water temperatures do not exceed 20 C. In the laboratory the thermal death point for GAMMARUS was 26 to 28 C; for HYALELLA it was 35 to 37 C. (Auth) (ST)

<559>
Percy, J.A., Ecological Physiology of Arctic Marine Invertebrates. Temperature and Salinity Relationships of the Amphipod ONISIMUS AFFINIS H.J. Hansen.

1975. Jour. Exp. Mar. Biol. Ecol. (Neth), 20, 99-117 (Environment Canada, Arctic Biological Station, Fisheries and Marine Service, Ste Anne de Bellevue, Quebec, Canada)

Effects of temperature and salinity upon the survival, locomotion and metabolism of the Arctic marine amphipod ONISIMUS AFFINIS were investigated. The LD50 for temperature was 18.7 C. The metabolic rate-temperature curve showed a distinct plateau of relative temperature insensitivity, the position of which varied seasonally to include a lower temperature range in winter than in summer. Similar shifts in the plateau could be induced in the laboratory by acclimating the animals at summer- and winter-like temperatures. Optimal locomotory activity was between 5 and 8 C and included a combination of swimming and crawling. Above 12 C the swimming component was increasingly inhibited. ONISIMUS was euryhaline and appeared to be most successful in brackish water habitats. It tolerated elevated salinities better at low temperatures. The metabolic rate varied inversely with salinity during short-term exposures, but if the animals were pre-adapted to the experimental salinities for 10 days, the metabolic rate was essentially independent of salinity between 10 and 25 ppt. The significance of these physiological responses in relation to the general ecology of the species is discussed. (Auth)

<560>
Perry, H.M., The Blue Crab Fishery in Mississippi.

1975. Gulf Research Reports, 5, 39-57 (Gulf Coast Research Laboratory, Ocean Springs, MS)

Analysis of 670 trawl, seine and marsh net

<560> CONT.
samples collected from July 1971 through June 1973 provided data on the distribution and abundance of blue crabs in Mississippi Sound. Highest average catches were associated with salinities between 5.0 and 15.0 ppt and temperatures between 20.0 and 25.0 C. Young crabs congregated in dredged navigational channels and in the marshes that fringe the bays and coastline. Maximum numbers were captured over soft mud bottoms. Peak numbers of zoeae occurred in the summer and fall. Megalopae were collected in all months. Early crab stages appeared throughout the year. Width-frequency distributions suggested rapid growth. Crabs tagged and released in Lake Borgne, La. during the fall of 1971 moved into Mississippi Sound in the vicinity of Cat Island to overwinter. Recoveries of crabs released in the St. Louis Bay, Biloxi Bay and Pascagoula River estuarine systems indicate little movement between estuaries during the spring and summer. Identified parasites included a new microphallid trematode. Commercial landings of blue crabs averaged 1,712,000 pounds for the 20-year period 1953-1972. Catch per unit of effort (pounds/pot day) was low during the spring and fall, peaking in the summer. Rises in the catch per unit of effort closely followed the migration of female crabs into Mississippi Sound. (Auth)

<561>
Peters, D.S., M.T. Boyd, and J.C. DeVane, Jr., The Effect of Temperature, Salinity, and Food Availability on the Growth and Food-Conversion Efficiency of Postlarval Pinfish.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (National Marine Fisheries Service, Atlantic Estuarine Fisheries Center, Beaufort, NC)

Growth rate, feeding rate, and food-conversion efficiency of postlarval pinfish, LAGODON RHOMBOIDES, were measured under various combinations of temperature, salinity, and food availability. Data were analyzed by multiple regression and presented as response surfaces. Temperature accounted for most of the variation in maximum feeding rate. Temperature and feeding rate accounted for over 90% of the observed variation in growth rate. Salinity effects were more important in predicting growth rate. Because a feeding-temperature interaction affects growth and because the effect of thermal effluents on food availability is unknown, it is impossible at this time to predict whether thermal alteration of the environment would increase or decrease growth of pinfish. (Auth)

<562>
Peterson, R.H., Temperature Selection of Juvenile Atlantic Salmon (SALMO SALAR) as Influenced by Various Toxic Substances.

1976. Jour. Fish. Res. Bd. Can., 33, 1722-1730 (Department of the Environment, Fisheries and Marine Service, Biological Station, St. Andrews, New Brunswick, Canada)

Previous exposure to sodium pentachlorophenate (NaPCP), Guthion, malathion, Dursban, and Dibrom lowered the preferred temperature for juvenile Atlantic salmon (SALMO SALAR) tested in a horizontal temperature gradient. Lindane, $CuSO_4$, $ZnSO_4$, $CdSO_4$, Sevin, heptachlor, and fenitrothion did not change the preferred temperature significantly. Comparison with other published results indicates that those substances that increase the preferred temperature are more toxic (based on relevant changes in 24-hr LC50) at low temperatures and vice versa. It is suggested that such shifts in selected temperature may be of potential immediate, short-term survival value to the fish. (Auth)

<563>
Peterson, S.E., and R.M. Schutsky, Some Relationships of Upper Thermal Tolerances to Preference and Avoidance Responses of the Bluegill.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia April 2-5, 1975. National Technical Information Service, Springfield, VA (Ichthyological Associates, Inc., Drumore, PA)

Temperature tolerance, preference, and avoidance studies were conducted on the bluegill (LEPOMIS MACROCHIRUS) in Conowingo Pond, lower Susquehanna River, Pennsylvania. Upper incipient lethal temperatures of 23.3, 29.3, and 35.8 C were determined for bluegill (mean total length 90 mm) acclimated at 1, 13, and 27 C, respectively. The results agree with published information on bluegill. Median resistance temperatures were plotted against linear regressions of preference and avoidance temperatures. Preferred temperatures were 4 to 5 C less than median resistance temperatures. Bluegill acclimated at temperatures greater than or equal to 13 C avoided short-term (96 hr) lethal temperatures. Median resistance time for bluegill acclimated at 13 and 27 C leveled off and exceeded 96 hr near the avoidance temperature. Avoidance temperatures exceeded lethal temperatures at acclimation temperatures less than 13 C. No mortality occurred with bluegill acclimated at 1 C and subjected to a temperature differential less than or equal to 21 C. Low thermal responsiveness was observed most frequently in avoidance studies conducted at acclimation temperatures less than 10 C and in preference studies conducted at acclimation temperatures less than 20 C. (Auth)

<564>
Phillips, D.G., The Biology of the Predatory Calanoid Copepod TORTANUS DISCARDATUS (Thompson and Scott) in a New Hampshire Estuary.

1976. Ph.D. Thesis, University of New Hampshire (University of New Hampshire, Durham, NH)

Plankton tows in a New Hampshire estuary showed that TORTANUS DISCAUDATUS was most abundant during the winter and was rare to absent during the summer. Its appearance coincided with decreasing temperature and seaward migration of planktivorous fish. In the laboratory T. DISCAUDATUS consumed fewer prey (copepods) per day and was more efficient in producing eggs per prey consumed at 4 C than at 10 C. The daily consumption by a pair of T. DISCAUDATUS at 10 C was approximately six prey; at 4 C the rate was 4.5 prey per day. Eggs from females held at 10 C were exposed to various combinations of temperature (4 to 20 C) and salinity (0 to 38 ppt). The hatching success was lower and development rate depresed at low salinity. Increased temperature shortened the development period. (Auth) (ST)

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Phillips, D.J.H., The Common Mussel MYTILUS EDULIS as an Indicator of Pollution by Zinc, Cadmium, Lead and Copper. I. Effects of Environmental Variables on Uptake of Metals.

1976. Marine Biol. (W. Ger.), 38, 59-69 (University of Melbourne, Zoology Department, Melbourne, Australia)

The net uptake of zinc, cadmium, lead and copper by the common mussel MYTILUS EDULIS (L.) exposed to different conditions was investigated with a view to using this species as an indicator of contamination of the marine environment by these metals. The variables studied were season, position of the mussel in the water column, water salinity (35 and 15 ppt), water temperature (10 and 18 C), and the simultaneous presence of all four metals. Each of these five variables affected the net uptake of some or all of the metals studied under some conditions. Low temperatures (10 C) had no effect on the net uptake of zinc or lead; the net uptake of cadmium was unaffected by low temperatures at high salinities but was decreased by low temperatures at low salinities. The presence of the other metals had no effect on the individual net uptake of either zinc, cadmium or lead. In contrast to the other metals, the net uptake of copper by the mussel was extremely erratic, and was affected by salinity and temperature changes and by the presence of the other metals and changes in their relative concentrations. (Auth) (ST)

<566>
Pilati, D.A., Cold Shock: Biological Implications and a Method for Approximating Transient Environmental Temperatures in the Near-Field Region of a Thermal Discharge.

1976. Sci. Total Environ., 6, 227-237 (University of Illinois, Center for Advanced Computation, Urbana, IL)

Biological data on the temperature preferences of fish indicate that, in general, they will be attracted to thermal discharges in the winter. This attraction to warmer temperatures increases their vulnerability to cold shock if the discharge heat source is discontinued. A scheme is proposed to predict the near-field thermal plume environmental temperatures during a power transient. This method can be applied to any jet discharge for which a steady-state model exists. The proposed transient model has been applied to an operating reactor. The predicted results illustrate how very rapidly the maximum temperatures decrease after an abrupt shutdown. This model can be employed to help assess the impact where cold shock may be a problem. Such predictions could also be the basis for restrictions on scheduled midwinter plant shutdowns. (Auth)

<567>
Polderman, P.J.G., and C. Den Hartog, The Seagrasses in the Wadden Sea.

1975. Wet Meded K.N.N.V. (K. Ned. Natuurhist Ver.) (Neth.), 107, 1-32 (Not given)

Two species of seagrass occur in the Wadden Sea, ZOSTERA MARINA and Z. NOLTII. Before 1932 Z. MARINA covered extensive areas in the western part of the Wadden Sea; estimates vary from 5000 to 15000 ha. In 1932 the sublittoral Z. MARINA disappeared due to the wasting disease which destroyed most beds of this species throughout the northern Atlantic. The cause of this disease is still a matter for discussion. Recent studies have shown correlations between the outbreak of the disease and abnormally high summer temperatures. In most areas in Europe and North America, the sublittoral ZOSTERA beds have recovered, but in the Wadden Sea no recovery has taken place. This is largely due to the coincidence of the outbreak of the disease and the closure of the Zuyder Zee. The latter caused considerable hydrobiological changes, resulting in erosion of the substrates formerly occupied by seagrass. Transplant experiments were unsuccessful. Z. NOLTII and the eulittoral and brackish-water populations of Z. MARINA were not affected by the wasting disease. After 1965 a marked decrease of the ZOSTERA beds in the intertidal belt was noticed. From 1970 onwards this decrease was studied, particularly on the Balgzand flats (near Den Helder) and on the tidal flats south of Terschelling. The cause of this general decline has not been established, but it is almost certainly related to the ever increasing pollution of the coastal sea water. At present the only seagrass beds of any importance in the Wadden Sea occur on the Balgzand (mainly Z. NOLTII), the tidal flats south of Terschelling (mainly Z. NOLTII, with relatively many Z. MARINA), the mud-flats south of Ameland (mainly Z. MARINA) and the mud-flat near Usquert (mainly Z. NOLTII), together covering an area of circa 500 ha (according to data of 1972). (ND)

<568>
Polgar, T.T., L.H. Bongers, and G.M. Krainak, Assessment of Power-Plant Effects on Zooplankton in the Near Field.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Center, Springfield, Va. (Martin Marietta Corporation, Environmental Technology Center, Baltimore, MD)

With the use of a simple entrainment model that takes into account tidal recirculation, mixing, and once-through kill rate, theoretical expressions are derived for ratios of densities of live organisms at the intake of a power plant to densities in the far field. Experimental data on the abundances of dead and live stages of EURYTEMORA AFFINIS and ACARTIA TONSA are used to compare to model results. A study of the entrainment of zooplankton near the intake of the Morgantown power plant and a concurrent study of the distribution of zooplankton in the Potomac River provided the biological data. Physical information was derived from extensive hydrographic measurements. Comparing experimental data with model predictions showed that radical depletions occurred in the naupliar stages near the plant site which cannot be accounted for by cooling-system or delayed entrainment mortalties. These near-field changes are attributed to avoidance reactions and to mortalities in the vicinity of the plant. (Auth)

<569>
Popham, J.D., and J.W.T. Dandy, The Specific Activities of Lactic Dehydrogenase and Alpha-Glycerophosphate Dehydrogenase in Acclimated Crayfish, CAMBARUS BARTONI.

1976. Comp. Biochem. Physiol., 53B, 97-99

<569> CONT.
(University of Sydney, Department of Anatomy, New South Wales, Australia; University of Manitoba, Department of Zoology, Winnipeg, Manitoba, Canada)

The specific activity of lactic dehydrogenase (LDH) and alpha-glycerophosphate dehydrogenase (alpha-GDH) in crude extracts of abdominal muscle and hepatopancreas of the crayfish CAMBARUS BARTONI acclimated to simulated winter (9 C) and spring (25 C) conditions was determined. There was an increase in the specific activity of LDH and alpha-GDH in the abdominal muscle following cold acclimation. In the hepatopancreas there was a decrease in the specific activity of the two enzymes. (Auth)

<570>
Possompes, B.P., P. Bergot, and P. Luquet, Description of the Method of Gastrointestinal Transit Study in Trout, SALMO GAIRDNERI Richardson. I. Influence of the Number of Meals, Quantities Ingested, and Temperature of Acclimatization.

1975. Ann. Hydrobiol. (Fr.), 6, 131-143 (I.N.R.A., Centre National de Recherches Zootechniques, Laboratoire de Nutrition des Poisons, Paris, France)

The speed of digestion of trout (SALMO GAIRDNERI) was studied using an indigestable marker (chromic oxide) incorporated into the food. The mean transit time of food through the gastrointestinal tract decreased as acclimation temperature increased. It was 35 hr at 9 C, 22.4 hr at 14 C, and 17 hr at 18 C. (ST)

<571>
Potter, I.C., D. Cannon, and J.W. Moore, The Ecology of Algae in the Moruya River, Australia.

1975. Hydrobiologia (Den.), 47, 415-430 (University of Bath, School of Biological Sciences, Bath, Somerset, England; Metropolitan Water, Sewerage and Drainage Board, Australia)

The standing crop of benthic and planktonic algae in the Moruya River, Australia, was, in general, low compared with values given for northern hemisphere rivers. Water temperatures ranged from a high in February of 33.8 C to a low in July of 4 C. Diatoms always accounted for more than 90% of the algae on the sediments with the most common species being typical of holarctic flora. The relative abundance of each of six predominant taxa was similar at the three sampling localities and did not show marked seasonal variation. However, GOMPHONEMA spp. contributed a relatively greater number in the downstream area whereas COCONEIS PLACENTULA EHR. was comparatively more abundant upstream. The highest standing crop (1.47 x 10(E+6) cell/cm2) was found downstream and in the calmest part of the river between January and March, coincident with maximum water temperatures. A true phytoplankton succession comprising filamentous chlorophytes, SCENEDESMUS, MELOSIRA VARIANS AG., DACTYLOCOCCOPSIS, EUDORINA and MERISMOPEDIA was observed at the most downstream site during the spring and summer, with a maximum standing crop of 126.7 x 10(E+3) cells/litre being attained in December. The gut of larval lampreys greater than 100 mm contained large numbers (44,000-525,000 cells) of algae. SCENEDESMUS and DACTYLOCOCCOPSIS occurred much more frequently in the gut than in either the sediment or water, but the reverse was true for filamentous algae. (Auth)

<572>
Pourriot, R., and Cl. Rougier, The Dynamics of a Laboratory Population of BRACHIONUS DIMIDIATUS (Bryce) (Rotatoria) in Relation to Food and Temperature.

1975. Ann. Limnol., 11, 125-143

The intrinsic rate of natural increase of populations of the rotifer, BRACHIONUS DIMIDIATUS, depended primarily on temperature and food quality. The highest rates of growth were obtained with unicellular blue-green algae (SYNECHOCCUS CEDRORUM) or green algae (DUNALIELLA SALINA). All stages of development and thus generation time decreased with increasing temperatures of 20, 25, and 30 C. Temperature had little effect on the net reproductive rate. (ST)

<573>
Power, M.E., and J.H. Todd, Effects of Increasing Temperature on Social Behaviour in Territorial Groups of Pumpkinseed Sunfish, LEPOMIS GIBBOSUS.

1976. Environ. Poll., 10, 217-223 (Boston University Marine Program, Marine Biological Laboratory, Woods Hole, MA; New Alchemy Institute, Woods Hole, MA)

To study the effect of thermal stress on their social behaviour, ten territorial groups of pumpkinseed sunfish, LEPOMIS GIBBOSUS, were subjected to a 1 C temperature increase every other day until they succumbed. Social behavior remained remarkably unchanged by thermal stress until nearly lethal levels. As temperature rose, ritualised behaviours increased in frequency, then fell off, probably reflecting changes in general activity. Behavioural and physiological signs of stress appeared from 31 to 38 C. Events during these social breakdowns are described and compared with the response of two other freshwater fishes with different social organisations subjected to the same thermal regime. (Auth)

<574>
Powers, L.W., and J.F. Cole, Temperature Variation in Fiddler Crab Microhabitats.

1976. Jour. Exp. Mar. Biol. Ecol. (Neth.),, 21, 141-157 (University of Texas, Marine Science Institute, Port Aransas, TX)

Measurements of the thermal environment at the microhabitat level provided data to evaluate the seasonal, diel, and spatial patterns of activity for non-tidal fiddler crabs (UCA PANACEA and U. VIRENS) on Mustang Island, Texas. Field populations showed nocturnal and diurnal maxima of surface activity during the warm summer months. Temperatures below 20 C inhibited surface activity during the winter. Laboratory populations, exposed to less extreme temperatures, maintained some nocturnal activity throughout the year, but also showed a summer diurnal maximum. Subsurface temperature measurements over a 25 hour period showed that the daily heat wave arrived at burrow terminal depths about 5 hour after the surface maximum and that subsurface temperatures were often high enough to stimulate crab activity during the night. Temperatures of various soil surfaces were measured in several UCA HABITATS. Dense vegetation (SALICORNIA, SPARTINA, and MONATHOCHLOE) provided cooler surfaces of up

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to 10 C higher than that of adjacent barren areas; most burrows and dirunal activities were near plants. Burrow temperatures decreased rapidly with depth (about 0.5 C/cm), providing the major heat refuge for U. PANACEA on open sand flats. Fiddler crabs are either active in areas and at times when temperatures are sub-lethal, or spend short periods of time in areas where temperatures are supra-lethal. Hooded burrows, made by male U. VIRENS, were significantly warmer than non -hooded burrows made by the same species. (Auth)

<575>
Pradeille-Rouquette, M., Role of Temperature in the Reproductive Function of the Females of the Crab PACHYGRAPSUS MARMORATUS (Fabricius).

1975. C.R. Acad. Sci. Paris, 281, 711-713 (Universite des Sciences et Techniques du Languedoc, Laboratoire de Physiologie des Invertebrates, Montepellier Cedex, France)

The ovaries of females maintained at 15 C from the beginning of fall developed in the spring, while those of crabs kept at 25 C were still in the previtellogenesis stage. However, the ovarian development of apedunculate animals was favored by an elevated temperature. The inhibiting peduncular hormone therefore appeared to be controlled by temperature. Thus the appearance of periodic sexual qualities may not be under the control of the ovary. (Auth)

<576>
Pye, V.I., W. Wieser, and M. Zech, The Effect of Season and Experimental Temperature on the Rates of Oxidative Phosphorylation of Liver and Muscle Mitochondria from the Tench, TINCA TINCA.

1976. Comp. Biochem. Physiol., 54B, 13-20 (Universitat Innsbruck, Institut fur Zoophysiologie, Innsbruck, Austria)

The regulation of mitochondrial respiration in muscle and liver of tench was examined over the physiological temperature range in summer (9 to 20 C) and winter (4 to 6 C). Mitochondrial respiration rate was tissue and substrate specific, and depended on season and experimental temperature. At low experimental temperatures, winter rates were higher than summer rates in both tissues; at high experimental temperatures, summer rates were higher. (ST)

<577>
Quetin, L.B., and J.J. Childress, Respiratory Adaptations of PLEURONCODES PLANIPES to Its Environment off Baja California.

1976. Marine Biol. (W. Ger.), 38, 327-334 (University of California, Marine Science Institue, Santa Barbara, CA)

Rates of oxygen consumption (QO2) were measured for PLEURONCODES PLANIPES Stimpson as a function of temperature, size, hydrostatic pressure, and oxygen partial pressure. These rates were independent of hydrostatic pressure and dependent on temperature over environmental ranges normally encountered by P. PLANIPES. The effect of size on QO2 was intermediate between surface area and unity. Q10 values between adjacent temperatures from 10 to 25 C ranged from 1.9 to 2.5. At all temepratures the crustaceans regulated their QO2 down to very low partial pressures of oxygen. The critical partial pressure (P sub c) increased with increasing temperature but the low (P sub c) at 10 C suggests that P. PLANIPES lives aerobically in the oxygen minimum layer. When plotted against a typical hydrographic regime from its environment, the QO2 of P. PLANIPES was found to decrease with increasing depth. (Auth)

<578>
Ramorino, L.M., Ciclo Reproductive de CONCHOLEPAS CONCHOLEPAS en la Zona de Valparaiso.

1975. Rev. Biol. Mar., Valparaiso, 15, 149-177 (Universidad de Chile, Depto. Oceanologia, Valparaiso, Chile)

The reproductive cycle of CONCHOLEPAS CONCHOLEPAS in specimens obtained from a commercial catch in Valparaiso bay was determined. A simple method based on the external appearance of the gonads and reproductive organs was employed. Information on egg-laying in the laboratory, and development of eggs and larvae at constant temperatures was gathered. The maximum ripe condition is between December and June. The previtellogenesis occurs in August and vitellogenesis in October and November. Mature males and females are found throughout the year. The reproductive cycle agrees with the temperature cycle of sea water. A large spawning period occurred between January and July, and a smaller one during October and November. One female lays groups of capsules during several weeks. Capsules measuring 29 mm contained up to 9,450 eggs, and no nurse eggs were present. Eggs developed slowly, hatching at a veliger stage in 60-84 days at temperatures of 12, 13, and 14 C. Veligers hatch at 255 microns, and attempts to rear these larvae through metamorphosis were not successful; even though they were kept in the laboratory in their planktonic stage for 35 days at 17 C. (Auth) (ND)

<579>
Randolph, K.N., and H.P. Clemens, Some Factors Influencing the Feeding Behavior of Channel Catfish in Culture Ponds.

1976. Trans. Amer. Fish. Soc., 105, 718-724 (University of Oklahoma, Department of Zoology, Norman, OK)

Throughout the growing season, from March to October, marked fish usually made a daily trip to the feeding station. In the spring, they did not use the demand feeders until temperatures reached 12 C and they stopped demand feeding in the fall at approximately 22 C. In the spring, intermittent feeding appeared to be primarily temperature related. At cold temperatures fish did not feed daily. After the water had warmed to 22 C fish fed on a daily basis. During summer, low oxygen concentrations often caused fish to adjust or miss their daily feeding period. Feeding was reduced at oxygen values below 5 mg/liter, but fish occasionally fed at values as low as 3 mg/liter. A feeding hierarchy based on size and time of day was established. (Auth) (ST)

<580>
Reddy, S.R., Effect of Water Temperature on the Predatory Efficiency of GAMBUSIA AFFINIS.

1975. Experientia (Switz.), 31, 801-802 (Bangalore University, Department of Zoology, Bangalore, India)

<580> CONT.
In an experimental situation non-gestating female GAMBUSIA AFFINIS predated 12 mosquito larvae in 10 hr at 20 C and 23 larvae at 30 C. Gestating females also increased their predatory efficiency from 16 larvae at 20 C to 24 larvae at 30 C. The differences observed in the predatory efficiency at the three temperatures for these fish were statistically significant. Male GAMBUSIA AFFINIS predated 10.5 larvae at 20 C, while at 30 C the fish predated 15 larvae. The observed increase was not significant. Thus the magnitude of reduction in predatory efficiency depended upon sex and physiological status of the fish. Nongestating and gestating females exhibited an increase in predatory efficiency with a 5 C rise in temperature, while males displayed a similar increase only when there was a 10 C rise in temperature. Predatory efficiency was highest during the first two hr of observation. (ST)

<581>
Rehakova, Z., Diatoms from Thermal Waters and Mud in Piestany Spa (Slovakia).

1976. Arch. Hydrobiol./Suppl. (Ger.), 49, 141-175 (Central Geological Institute, Prague, Czechoslovakia)

Two hundred and fourteen freshwater diatom species, varieties, and forms belonging to 35 genera were observed at different sites in thermal mineral waters and muds in the Piestany Spa. None of the species were thermal or thermophilous. (ST)

<582>
Renfro, W.C., Radionuclides in Aquatic Ecosystems Associated with Power Plants.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Northeast Utilities Co., Environmental Programs Branch, Hartford, CT)

Concentrations of radionuclides in the primary coolant water of a typical boiling water reactor and liquid radionuclide annual releases from U.S. nuclear power reactors are given in tabular form. Thus far releases of radionuclides from operating nuclear power plants have amounted to only small fractions of limits established by Title 10, Code of Federal Regulations, Part 20 (10CFR20). Regulations recently issued by the Nuclear Regulatory Commission (10CFR50, Appendix 1) will further limit the quantities of radioactive effluents from power reactors. From the standpoint of the electric utilities companies, three important issues need further research. These are the radioanalytical sensitivity and accuracy of commercial service companies that monitor the plant sites, the adequacy of concentration (bioaccumulation) factors used for pathway and dose commitment analyses, and the evaluation of the concept of long-term build-up of radionuclides in aquatic ecosystems around nuclear power plants. (ST)

<583>
Rennie, T.H., Zooplankton Studies in the Cox Bay, Texas, Area, Before and During Early Operation of an Electric Power Plant.

1975. Ph.D. Thesis, Texas A&M University, 381 p. (Texas A&M University, College Station, TX)

Zooplankton investigations were conducted in the Cox Bay area from November 1969 through September 1971 before and after initial summer operation of the Ennis S. Joslin Generating Station, Point Comfort, Texas. Using regression analysis, salinity and its interactions were found to have the most significant relationship to total species number and species diversity indices. Hydrographic parameter interactions (temperature-salinity, temperature-chlorophyll a) were generally more significant in relation to standing crop levels than were single parameters. Other possible factors contributing to variations in community structure were discussed. Statistical analyses of before and after data indicated that there were no significant zooplankton community changes that could be attributed to operation of the power plant. However, the inability of the sampling program to measure small changes in zooplankton variety or abundance was noted. (ST)

<584>
Reutter, J.M., and C.E. Herdendorf, Thermal Discharges from a Nuclear Power Plant: Predicted Effects on Lake Erie Fish.

1976. Ohio Jour. Sci., 76, 39-45 (Ohio State University, Center for Lake Erie Research, Columbus, OH)

The Davis-Besse Nuclear Power Station, currently under construction on the south shore of Lake Erie near Locust Point, Ohio, will use water from the lake for cooling purposes. Based on thermal specifications for this plant, laboratory experiments were conducted to try to predict the effects of thermal effluents on the Lake Erie fishery resource. Over 2000 fish representing 24 of the 47 local species were tested to determine their seasonal final temperature preferenda. All final preferenda were above lake temperature during fall, winter and spring, indicating attraction to thermal discharges during these seasons. Summer final preferenda were approximately equal to or slightly higher than lake temperature for all species tested, indicating indifference or slight attraction to thermal plumes. Heat shock tests were conducted on 852 fish of 33 sp. and cold shock tests were conducted on 443 fish of 22 sp. Heat and cold shock results indicated that the absolute temperature to which fish were subjected was more important than the size of the temperature change. Summer heat shocks and winter cold shocks caused the greatest stress. The species most likely to be harmed by thermal effluents were ALOSA PSEUDOHARENGUS (alewife), APLODINOTUS GRUNNIENS (freshwater drum), DOROSOMA CEPEDIANUM (gizzard shad) and MORONE CHRYSOPS (white bass). (Auth)

<585>
Reynolds, J.H., E.J. Middlebrooks, D.B. Porcella, and W.J. Grenny, Effects of Temperature on Oil Refinery Waste Toxicity.

1975. Jour. Water Poll. Control Fed., 47, 2674-2693 (Utah State University, Division of Civil and Environmental Engineering, Logan, UT)

A continuous flow kinetic model was developed to describe and predict the effects of temperature on the toxicity of specific oil

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refinery waste to the alga SELENASTRUM CAPRICORNATUM. The model was based on enzyme inhibition kinetics and was developed by using semicontinuous and continuous flow algal cultures grown at temperatures between 20 and 33 C. Phenol was the controlling toxicant. Continuous flow algal cultures exposed to an actual oil refinery waste were used to apply the model to actual conditions. The toxicity of phenol and oil refinery waste appeared to be greater at 24 C than at any other temperature studied. The effect of temperature on toxicity to SELENASTRUM CAPRICORNUTUM appeared to be similar to the effect of temperature on the maximum specific growth rate. Toxicity increased as the time of exposure to the toxicant increased. (ST)

<586>
Reynolds, J.Z., Problems Associated with Aquatic Monitoring and Research at Operating Power Stations.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Consumers Power Company, Environmental Planning, Jackson, MI)

The paper reviews the problems of fitting aquatic study programs to actual field situations. Some of these problems are: peculiarities of plant design have not made accommodations for representative sampling at critical locations; logistics of programs have not anticipated time, manpower and obstacles in collecting, preparing, and analyzing samples in the field; program designs have not adequately anticipated natural environmental variability and extremes sometimes encountered; and the data, after collection and analysis, do not provide for proper interpretation of impacts being studied. Examples of aquatic studies programs that do not give data related to impact evaluation (thermal plume dimensions, entrainment effects, and thermal effects on fish) are discussed. Research plans that focus on the resource base and are directed at better utilization of field data for interpreting impacts of practical concern should be given high priority. (ST)

<587>
Reynolds, W.W., Rates of Heating, Cooling and Heartbeat in Largemouth Blackbass.

1976. Amer. Zool., 16, 128 (Summary only) (Pennsylvania State University, Wilkes-Barre, PA)

Relative rates of heating and cooling in relation to heartbeat were studied in bass 100 to 460 g in weight, subjected to sudden increases or decreases of 10 to 20 C in ambient water temperature. Telemetry was used to measure gut temperature; heartbeats were monitored by EKG electrodes placed in the water near the fish. Opercular movements, counted visually, were within 2 to 3/min of heart rates. Cooling half-times were shorter than heating half-times due to initially greater heart rates during cooling, but thermal equilibrium was attained more rapidly during heating, reflecting the eventual temperature-dependent change in heart rate. These relative rates may affect the relationship of core temperature to ambient water temperature in behaviorally thermoregulating fish moving back and forth through a thermal gradient, since the fish may reverse direction before reaching equilibrium; thus, mean core temperatures may not equal mean occupied water temperatures in fish moving through heterothermal environments. (Complete text)

<588>
Reynolds, W.W., and M.E. Casterlin, Thermal Preferenda and Behavioral Thermoregulation in Three Centrarchid Fishes.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (Pennsylvania State University, Wilkes-Barre, PA)

By use of a new electronic device that permits a fish to control ambient temperature by its movements, it was found that the modal preferenda of three centrachid species, (bluegill, LEPOMIS MACROCHIRUS; smallmouth bass, MICROPTERUS DOLOMIEUI; and largemouth bass, MICROPTERUS SALMOIDES) differed more between night and day than did mean occupied temperatures; this reflects skewness of distributions. Modal preferenda of bluegills increased from 31.1 C at night to 32.3 C during the day. Some reasons for these differences are advanced. (Auth) (ST)

<589>
Reynolds, W.W., and M.E. Casterlin, Locomotor Activity Rhythms in the Bluegill Sunfish, LEPOMIS MACROCHIRUS.

1976. Amer. Midland Naturalist, 96, 221-225 (Pennsylvania State University, Department of Biology, Wilkes-Barre, PA)

Locomotor activity of bluegill sunfish was monitored electronically as the fish moved between the chambers of an experimental tank. Phototransistors and associated circuitry permitted the fish to control water temperature and/or lights independently along two axes, with no prior training; alternatively, these variables could be exogenously controlled by thermostats and timers. The fish exhibited an endogenous, diurnal (60-75% of total 24-hr activity), locomotory activity pattern which persisted in the absence of an exogenous light cycle (DD), or when the fish controlled the lights, and was unaffected by temperature (17 or 31 C). The diurnal activity pattern persisted when fish controlled the water temperature (mean = 31 C both day and night), indicating that thermoregulatory movements at night did not disrupt the rhythm seen at constant fixed temperatures. (Auth)

<590>
Reynolds, W.W., R.W. McCauley, M.E. Casterlin, and L.I. Crawshaw, Body Temperatures of Behaviorally Thermoregulating Largemouth Blackbass (MICROPTERUS SALMOIDES).

1976. Comp. Biochem. Physiol., 54A, 461-463 (Pennsylvania State University, Wilkes-Barre, PA; Wilfrid Laurier University, Waterloo, Ontario, Canada; John B. Pierce Foundation Laboratory and Yale University School of Medicine, New Haven, CT)

Five largemouth black bass, ranging from 50 to 460 g body weight, were allowed to behaviorally thermoregulate in an electronic device which permitted them to regulate the water temperature. Mean gut temperatures over a 12-hr period did not differ

<590> CONT.
significantly from mean occupied temperatures or from mean water temperatures (30 C). (Auth)

<591>
Reynolds, W.W., D.A. Thomson, and M.E. Casterlin, Temperature and Salinity Tolerances of Larval Californian Grunion, LEURESTHES TENIUS (Ayres): A Comparison with Gulf Grunion, L. SARDINA (Jenkins & Evermann).

1976. Jour. Exp. Mar. Biol. Ecol. (Neth.), 24, 73-82 (Pennsylvania State University, Department of Biology, Wilkes-Barre, PA; University of Arizona, Department of Ecology & Evolutionary Biology, Tucson, AZ)

Temperature and salinity tolerances were determined for larval California grunion, LEURESTHES TENIUS (Ayres), and compared with previous data for Gulf of California grunion, L. SARDINA (Jenkins & Evermann). Larvae of similar age and acclimation history showed little interspecific difference in thermal tolerance, as measured by half-hour LT50 values for 20-30 day old late postlarvae acclimated at various temperatures, and by upper and lower incipient lethal temperatures for 18 C-acclimated prolarvae. The upper incipient lethal temperature differed by 1 deg.-C (32 C for L. TENUIS, 31 C for L. SARDINA), while the lower incipient lethal temperature for the 18 C acclimated prolarvae of both species was 7.5 C. LEURESTHES TENUIS larvae were much less euryhaline than L. SARDINA, with incipient lethal salinities of 4.2-41 ppt for prolarvae and 8.6-38 ppt for 20-day old postlarvae; comparable values for L. SARDINA are 4-67.5 ppt and 5-57.5 ppt. Both species show a decrease in temperature and salinity tolerance with age. The larvae of these disjunct congeners show a significant physiological divergence in euryhalinity but not in overall temperature tolerance. These tolerances are discussed in relation to the respective geographic ranges and behavioral responses of the two species. (Auth)

<592>
Richardson, L.B., D.T. Burton, and S.L. Margrey, A Respirometer Technique for Evaluating the Potential Effects of Rapid Thermal Changes to Small Aquatic Organisms.

1975. Progressive Fish-Culturist, 37, 57-58 (Academy of Natural Sciences of Philadelphia, Benedict Estuarine Research Laboratory, Division of Limnology and Ecology, Benedict, MD)

A 20-channel Gilson differential respirometer was modified to evaluate potential physiological adjustments of small aquatic animals exposed to time-temperature changes. Time-temperature curves typical of large volume steam electric generating stations with once-through cooling systems terminating in submerged discharges were used. In entrainment studies conducted in the laboratory, the modified respirometer was used for determining pre-stress oxygen consumption, simulation of the time-temperature curve and subsequent post-stress oxygen consumption data. The versatility of the apparatus is such that many temperature and decay schemes could easily be reproduced. (ND)

<593>
Richardson, M.Y., and D.C. Tarter, Life Histories of STENONEMA VICARIUM (Walker) and S. TRIPUNCTATUM (Banks) in a West Virginia Steam (Ephemeroptera: Heptageniidae).

1976. Amer. Midland Naturalist, 95, 1-9 (Marshall University, Department of Biological Sciences, Huntington, WV)

Life history studies of the mayflies, STENONEMA VICARIUM and S. TRIPUNCTATUM were made in Beech Fork of Twelvepole Creek, WV. Nymphs grew slowly during the summer. They attained their greatest growth rate, 57.1%, from September (17.5 C) through November (12.3 C). The largest monthly percentage of growth occurred from September to October (35.7%), when the water temperature averaged 16 C. Growth was slower during the winter when the water temperature ranged between 4.2 and 15.0 C. Based on exuviae in the steam, emergence of S. VICARIUM started in early May and reached a peak in late May. The water temperature during this period averaged 16.7 C. In S. TRIPUNCTATUM, emergence started in late April and reached a peak during May; the water temperature in April was 15.0 C. (ST)

<594>
Riel, A., Effect of Trematodes on Survival of NASSARIUS OBSOLETUS (Say).

1975. Proc. Malac. Soc. Lond., 41, 527-528 (Fairfield University, Fairfield, CT)

The effect of digenetic trematodes on the resistance of the intertidal gastropod NASSARIUS OBSOLETUS to high temperature and distilled water stress was studied. The lethal high temperature for the snails was near 41 C. Generally more of the snails infected with ZOOGONUS LASIUS survived high temperatures than did uninfected snails. More of the parasitized snails (52%) survived distilled water stress than unparasitized snails (34%). (ST)

<595>
Rigby, B.J., and C.L. Prosser, Thermal Transitions of Collagen from Fish Recovered from Different Depths.

1975. Comp. Biochem. Physiol., 52B, 89-90 (CSIRO, Division of Textile Physics, Sydney, Australia; University of Illinois, Department of Physiology and Biophysics, Urbana, IL)

Melting temperatures in acid of collagen from skin of fish from 2000 m depth (2 to 4 C) are lower than those from flatfish taken at 200 m (16 to 18 C) and these are lower than melting temperatures of collagen of reef fish (water 24 C). The lower and upper transition temperatures (in 1% NaCl) of deep-water eel are 6 and 18 C and of a moray eel 18 and 28 C respectively. The transition temperatures may correspond to lower and upper temperatures of the thermal preferendum. (Auth)

<596>
Rivard, D., J.-G. Pilon, and S. Thiphrakesone, Effect of Constant Temperature Environments on Egg Development of ENALLAGMA BOREALE Selys (Zygoptera: Coenagrionidae).

1975. Odonatologica, 4, 271-276 (Universite de Montreal, Department des Sciences Biologiques, Montreal, Quebec, Canada)

Eggs of the dragonfly, ENALLAGMA BOREALE, were maintained in the laboratory at experimental temperatures from 15 to 30 C. At 15 C, there was 100% mortality; at 17.5 and 20 C, there was approximately 75%

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mortality. Survival was 100% at 22.5, 25, and 27.5 C. At 30 C a mortality of 3.5% was observed. The developmental-hatching threshold, the lowest constant temperature at which complete development from oviposition to the hatching process will occur was estimated to be 17 C. Hatching occured after 11 days at 27.5 C and after 61 days at 17.5 C. The optimum temperature appeared to be approximately 27.5 C. The equation of the development of eggs in relation to temperature was fitted to transformed data by the method of multiple regression and expressed in theoretical form. (ST)

<597>
Robbins, W.H., Population Dynamics of Potamodromous Smallmouth Bass (MICROPTERUS DOLOMIEUI Lacepede) and Responses to Environmental Stimuli.

1975. Ph.D. Thesis, University of Guelph (University of Guelph, Guelph, Ontario, Canada)

Thhe role of water temperature and flow, overhead illumination and background color in determining survival and behavior of smallmouth bass was investigated by integrated field and laboratory studies between 1968 and 1971. Adult bass from a population that utilize the Pefferlaw River (Canada) for reproduction migrated upriver from Lake Simcoe each May and June. The migration correlated with water temperature and/or river discharge. Spawning occurred, usually in the evening, in warming 18 to 20 C water, periodically for about 18 days after May 20. Egg and sac-fry predation appeared to follow nest desertion by adult males during declining water temperatures (less than 16 C) and high turbidity during freshets. Water temperature and flow and overhead illumination, in controlled laboratory experiments, significantly regulated activity levels and distribution of three- to thirty-month-old bass. Activity increased with temperature while selection of black background and aggregation decreased. Activity increased in lotic water, particularly at 20 C, while aggression increased and territory size decreased and fish sought reduced flow. (Auth) (ST)

<598>
Roberts, M.H., R.J. Diaz, M.E. Bender, and R.J. Huggett, Acute Toxicity of Chlorine to Selected Estuarine Species.

1976. Jour. Fish. Res. Bd. Can., 33, 2525-2528 (Virginia Institute of Marine Science, Gloucester Point, VA)

Two flowing water systems designed to test the acute toxicity of chlorine in estuary water are described, one adapted for microscopic species, the other for larger species. Acute toxicity results for several invertebrate and fish species are presented. Temperature ranged from 17 C in later experiments to 28 C in experiments conducted in midsummer. The most sensitive forms among the invertebrates tested were CRASSOSTREA VIRGINIA and MERCENARIA MERCENARIA larvae and ACARTIA TONSA, with 48-hr TL50 values less than 0.005 ppm. The most sensitive fish species was MENIDIA MENIDIA. (Auth) (ST)

<599>
Robinson, G.D., W.A. Dunson, J.E. Wright, and G.E. Mamolito, Differences in Low pH Tolerance among Strains of Brook Trout (SALVELINUS FONTINALIS).

1976. Jour. Fish Biol., 8, 5-17 (Pennsylvania State University, Department of Biology, University Park, PA)

Bellefonte Open trout were acid stressed (pH 2.50 to 3.50) at either 4, 14, or 21 C. Higher temperatures were associated with decreased survival time at all pH's. However, the rate of reduction in acid tolerance as the pH decreased from 3.50 to 2.50 diminished at higher temperatures. Seasonal differences in acid tolerance were also observed. Brook trout tested at 3.50 in the summer had an increased acid tolerance compared to those tested in January and December even though hatchery water temperature remained relatively constant (9.4 to 10.5 C). Differences in acid tolerance may be related to seasonal changes in the activity of mechanisms of ion balance and respiration which show difference levels of pH sensitivity. (ST)

<600>
Robinson, W.H., and E.C. Turner, Jr., Insect Fauna of Some Virginia Thermal Streams.

1975. Proc. Entomol. Soc. Wash., 77, 391-398 (Virginia Polytechnic Institute and State University, Department of Entomology, Blacksburg, VA)

Warm Springs Pools, Virginia, consists of four individual springs. The water temperature of the springs and the streams flowing from the spring pools is 34 to 35 C. The insect fauna of the three streams includes the orders: Coleoptera (8 species), Diptera (10 species), Hemiptera (1 species), and Odonata (1 species). Other invertebrates collected in the streams included species of Arachnida, Oligochaeta, Gastropoda, and Pelecypoda. The animals associated with the thermal streams are frequently found in nearby cold water streams. The presence of DICTYA TEXENSIS Curran (Diptera: Sciomyzidae) at Warm Springs Pools is the first record of a sciomyzid occurring in thermal waters. (Auth)

<601>
Rochanaburanon, T., and D.I. Williamson, Laboratory Survival of Larvae of PALAEMON ELEGANS Rathke and Other Caridean Shrimps in Relation to Their Distribution and Ecology.

1976. Estuarine & Coastal Marine Sci., 4, 83-91 (University of Liverpool, Department of Marine Biology, Port Erin, Isle of Man)

Survival rates are recorded for the larval and early post-larval stages of PALAEMON ELEGANS reared in seawater (34 ppt) at constant temperatures of 10, 15 and 20 C and in four regimes of varying temperature and in various dilutions of seawater at constant temperatures. CRANGON CRANGON and PROCESSA NOUVELI were reared in seawater at 10, 15 and 20 C. The highest survival rates for each species were in seawater at 20 C. Survival rates of P. ELEGANS in cycles of changing temperature were generally similar to those at the average temperature. Some larvae of P. ELEGANS survived to beyond metamorphosis at 20 C in all salinities from 17 to 34 ppt but not in lower salinities; at 15 C metamorphosis was completed only in a salinity of 34 ppt; no larvae metamorphosed at 10 C in any salinity. C. CRANGON and P. NOUVELI completed metamorphosis in undiluted seawater at 20 and 15 C but not at 10 C. The

<601> CONT.
optimum temeprature for larval survival (20 C) is very high in relation to the local range of sea temperatures (7 to 14 C) in which the larvae would normally develop. Published results on the survival of various caridean larvae at different temperatures are summarized. (Auth)

<602>
Rogers, C.A., Effects of Temperature and Salinity on the Survival of Winter Flounder Embryos.

1976. Fish. Bull., 74, 52-58 (NOAA, National Marine Fisheries Service, Northeast Fisheries Center, Narragansett Laboratory, Narragansett, RI)

A series of experiments was performed to determine the optimum temperature and salinity for incubating winter flounder, PSEUDOPLEURONECTES AMERICANUS, embryos. Eggs in lots of 50 were subjected to a 0.5 to 45 ppt salinity range and a 3 to 14 C temperature range in a total of 67 salinity-temperature combinations. Highest proportion of viable hatches occurred at 3 C over a salinity range of 15 to 35 ppt. At temperatures above 3 C, the optimal range was 15 to 25 ppt. Viable hatch decreased with increasing temperature. (Auth)

<603>
Romanenko, V.I., and E.P. Nikiforova, Growth of Bacteria on Dissolved Organic Matter of Freshwater Reservoirs.

1974. Microbiol. (USSR), 43, 112-115 (M.V. Lomonosov Moscow State University, Institute of Biology of Inland Waters, Soil Biology Faculty, Moscow, USSR)

Water from the Rybinsk Reservoir was almost completely freed of bacterial cells and suspended mineral and organic particles by filtration through an asbestos filter. The content of organic matter in such water was in the range of 15 mg C/liter. After sterilization, flasks containing 100 ml of the water were inoculated with several drops of freshly collected water from the reservoir. The absence of dead bacterial cells in the water allowed for following the growth of bacteria in it by direct count on membrane filters. The bacteria multiplied very rapidly in such water; the generation time was 1 to 3 hours. The number of bacteria determined by direct count and by growth on MPA were about the same. Less and less bacteria were counted on MPA upon prolonged incubation of the water. The rate of multiplication of the bacteria in such medium depends on the content of organic matter and temperature. Bacteria multiplied very rapidly at 26 and 20 C. (Auth)(ND)

<604>
Rosenberg, R., and J.D. Costlow, Jr., Synergistic Effects of Cadmium and Salinity Combined with Constant and Cycling Temperature on the Larval Development of Two Estuarine Crab Species.

1976. Marine Biol. (W. Ger.), 38, 291-303 (Duke University Marine Laboratory, Beaufort, NC)

The developmental stages from hatch to first crab of the mud-crab, RHITHROPANOPEUS HARRISII, were examined in 63 combinations of cadmium (0, 50, and 150 ppb), salinity (10, 20, and 30 ppt), constant temperature (20, 25, 30, and 35 C), and cycling temperature (20 to 25 C, 25 to 30 C, and 30 to 35 C). The results indicated that cycling temperatures may have a stimulating effect on survival of the larvae compared to constant temperatures, both in the presence and in the absence of cadmium. Effects of cadmium and salinity and their interaction on the survival of the larvae from zoeae to megalopa were documented at most of the temperatures by analyses of variance. The zoeal larvae were more susceptible to cadmium than the megalopa. (Auth)(ST)

<605>
Roux, A.L., Stable and Fluctuating Temperature. II. Comparison of the Effect on the Duration of Intermolting of Gammaridae Females.

1974. Part of Proceedings of the International Society of Theoretical and Applied Limnology held in Winnipeg, Canada, September, 1974 (Not given)

Experiments were carried out on two closely related species of freshwater Gammarids, GAMMARUS PULEX and G. FOSSARUM. The intermolt duration of adult females was determined at the constant temperatures of 5, 10, and 15 C and at temperatures which fluctuated rhythmically and daily between 5 and 15 C. Whatever the breeding temperature, the mean intermolt duration of G. FOSSARUM females was always longer than that of G. PULEX females. Under constant conditions, and for each temperature increase of 5 C, the intermolt duration of the two species was approximately twice shorter. When compared with the 10 C constant level, or with the computed time determined from the hourly proportion of development occuring at 5, 10, and 15 C constant levels, fluctuating temperatures have a significant accelerating effect on the molting process. (Auth)

<606>
Rucker, R.R., Gas-Bubble Disease: Mortalities of Coho Salmon, ONCORHYNCHUS KISUTCH, in Water with Constant Total Gas Pressure and Different Oxygen-Nitrogen Ratios.

1975. Fish. Bull., 73, 915-918 (National Marine Fisheries Service, Northwest Fisheries Center, Seattle, WA)

Coho salmon fingerlings were subjected to a total gas pressure of 119% at 13.6 C with the O2/N2 varying from 50%/138% to 229%/90%. Small fish (3.8 to 10 cm) were the most resistant and larger fish (8 to 10 cm) the least resistant to gas-bubble disease at the gas concentrations used. A drastic decrease in lethal effect of individual ratios of O2 to N2 occurred between 159% O2/109% N2 and 173% O2/105% N2 at the same total gas pressure (119%). (ST)

<607>
Rudyakov, Yu.A., Influence of Temperature on the Locomotor Activity of Plankton Crustaceans.

1975. Tr. Inst. Okeanol., 102, 280-287 (Not given)

A study was made of temperature-dependent changes in the locomotor activity of four species of plankton crustaceans (ostracods, copepods). The locomotor activity of an animal at a given moment depended not only on the temperature at that time, but on the thermal regime during the preceeding period also. The logarithm of the frequency of bursts of activity was directly proportional to temperature. These processes approximately compensated each other and were presumably the result of a lowering of the spontaneous

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activity of the nervous system under conditions of cold. Besides these responses to absolute temperature values it was found that the rate of temperature changes had a specific effect on acitivity. The response was obtained only on cooling and manifested itself in a temporary increase in the frequency of bursts of activity. The data obtained are discussed in the light of the existing conceptions of thermoreception in poikilothermic animals. (Auth)

<608>
Buesink, R.G., and L.L. Smith, Jr., The Relationship of the 96-Hour LC50 to the Lethal Threshold Concentration of Hexavalent Chromium, Phenol, and Sodium Pentachlorophenate for Fathead Minnows (PIMEPHALES PROMELAS RAFINESQUE).

1975. Trans. Amer. Fish. Soc., 104, 567-570 (University of Minnesota, Department of Entomology, Fisheries and Wildlife, St. Paul, MN)

Short-term bioassays were conducted with adult fathead minnows and hexavalent chromium, phenol, and sodium pentachlorophenate at 2 temperatures (15 and 25 C) to determine the relationship of the 96-hr LC50 to the lethal threshold concentration. The lethal threshold concentration was less than the 96-hr LC50 in 10 of 12 bioassays, was affected by temperature, and was not a constant multiple of the 96-hr LC50 for any of the toxicants tested. The lethal threshold concentrations for hexavalent chromium and phenol were less at 25 C than at 15 C, and greater at 25 C than at 15 C for pentachlorophenate. (Auth) (ND)

<609>
Ruohtula, M., and J.K. Miettinen, Retention and Excretion of 203-Hg-Labelled Methylmercury in Rainbow Trout.

1975. Oikos, 26, 385-390 (University of Helsinki, Department of Radiochemistry, Helsinki, Finland)

Elimination of 203-Hg-labeled methylmercury by rainbow trout (SALMO GAIRDNERI), studied by whole body counting, followed a bi-exponential equation. The biological half-time of methylmercury varied from 202 to 516 days, depending on the retained dose and water temperature. An increase in the concentration of protein-bound methylmercury caused a significant decrease in the biological half-time. Between 0.5 and 4 C the excretion rate of methylmercury was about 1.5 times longer (516 plus or minus 83 days) than at 16 to 19 C (348 plus or minus 78 days). (Auth)

<610>
Saetre, R., and J. Gjosaeter, Ecological Investigations on the Spawning Grounds of the Barents Sea Capelin.

1975. Fiskdir. Skr. Ser. Havunders. (Nor.), 16, 203-227 (Institute of Marine Research, Bergen, Norway)

Spawning of Barents Sea capelin along the coast of northern Norway began between March 1 and 15, 1971 to 1974. There was a gradual north and east movement of the spawning area during the observation period. Water temperature during egg incubation was 1.5 to 6.5 C. The main spawning depth appeared to be between 25 and 75 m. Eggs were deposited over a gravel or cobble substrate and were buried by sediment due to a strong current in the area. (ST)

<611>
Saila, S.B., The Effects of Power Plants on Fish Populations.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (University of Rhode Island, Narragansett Bay Campus, Kingston, RI)

Two major aspects of fish population dynamics that are important for power plant assessment are identified and discussed. These are stock identification and early life history mortality estimation. The difficulty in estimating entrainment and impingement mortalities and their contributions to the latter aspect is pointed out. (ST)

<612>
Saito, S., and T. Ichimura, Observations of Colonial Multiplication in a Rapidly Growing Alga, GONIUM MULTICOCCUM Pocock (Volvocaceae).

1975. Botan. Mag. (Jap.), 88, 245-247 (Hokkaido University, Institute of Algological Research, Faculty of Science, Muroran, Japan; University of Tokyo, Institute of Applied Microbiology, Tokyo, Japan)

Microphotography was used to determine the growth rate of GONIUM MULTICOCCUM on an agar medium at various temperatures (10 to 36 C). Growth was most rapid at 36 C with a rate calculated as 12 doublings of the cells per day. No significant growth was observed at 14 C. (ND)

<613>
Saksena, V.P., Effects of Temperature and Light on Aerial Breathing of the Shortnose Gar, LEPISOSTEUS PLATOSTOMUS.

1975. Ohio Jour. Sci., 75, 178-181 (Muskingum College, Department of Biology, New Concord, OH)

The rate of aerial breathing of the shortnose gar, investigated at temperatures of 10.0, 15.5, 21.1, and 26.6 C increased with an increase in temperature. Between 10.0 and 15.5 C, the average aerial breathing rate was less than one per hour, but beyond 15.5 C the rate increased markedly. At all experimental temperatures, the larger fish had a significantly higher aerial breathing rate than the smaller fish. The aerial breathing rate was higher during night and periods of darkness than during natural day. (ST)

<614>
Sameoto, D.D., Respiration Rates, Energy Budgets, and Molting Frequencies of Three Species of Euphausiids Found in the Gulf of St. Lawrence.

1976. Jour. Fish. Res. Bd. Can., 33, 2568-2576 (Department of the Environment, Fisheries and Marine Service, Marine Ecology Laboratory, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada)

Respiration rate experiments at different temperatures (0 to 15 C) were conducted on three species of euphausiids, MEGANYCTIPHANES NORVEGICA, THYSANOESSA RASCHII, and T.

<614> CONT.
INERMIS, found in the Gulf of St. Lawrence. The slopes of the respiration regression lines at different temperatures for the same species were were not significantly different. THYSANOESSA INERMIS acclimated to temperature changes with the result that its respiration rates remained relatively stable over most of the temperatures tested. Feeding rates were measured for M. NORVEGICA and T. INERMIS at different temperatures using ARTEMIA nauplii as food. The number of calories ingested, expressed as a percentage of the total body calories of the euphausiid, decreased with body size and water temperature. THYSANOESSA INERMIS ingested fewer calories than M. NORVEGICA in relation to total body calories at all temperatures. Both species showed a liinear relationship between molting frequency and water temperature, T. INERMIS having a shorter intermolt period than M. NORVEGICA. Results were used to estimate the energy consumption of the natural populations of euphausiids in the upper part of the Gulf of St. Lawrence estuary. (Auth)

<615>
Sankurathri, C.S., and J.C. Holmes, Effects of Thermal Effluent on the Population Dynamics of PHYSA GYRINA Say (Mollusca: Gastropoda) at Lake Wabamun, Alberta.

1976. Can. Jour. Zool., 54, 582-590 (University of Alberta, Department of Zoology, Edmonton, Alterta, Canada)

Effects of thermal effluents on the population dynamics of PHYSA GYRINA were studied at Lake Wabamun, Alberta, from May 1971 to August 1973. Thermal effluent increased the rate of development of eggs and the growth of P. GYRINA, and allowed continuous reproductive activity throughout the year. These changes and the increased period of growth of aquatic macrophytes, resulted in increased population densities of P. GYRINA in the heated area during summer. Temperatures below 10 C or small amount of vegetation appear to limit the population of P. GYRINA in winter. (Auth)

<616>
Sankurathri, C.S., and J.C. Holmes, Effects of Thermal Effluents on Parasites and Commensals of PHYSA GYRINA Say (Mollusca: Gastropoda) and Their Interactions at Lake Wabamun, Alberta.

1976. Can. Jour. Zool., 54, 1742-1753 (Department of the Environment, Fisheries and Marine Service, Pacific Biological Station, Nanaimo, British Columbia, Canada; University of Alterta, Department of Zoology, Edmonton, Alberta, Canada)

Effects of thermal effluents on the dynamics of larval helminth parasites and on populations of CHAETOGASTER LIMNAEI LIMNAEI and CHAETOGASTER LIMNAEI VAGHINI (Annelida: Oligochaeta) harbored by PHYSA GYRINA (Mollusca: Pulmonata) were studied at Lake Wabamun, Alberta. Thermal effluents provided the necessary conditions to maintain digenean parasite transmission throughout the year between definitive and intermediate hosts, and increased the prevalence of certain parasites, especially the metacercarial stages. At temperatures above 20 C prevalences of C. L. LIMNAEL and C. L. VAGHINI decreased in the lake, and at these temperatures in the laboratory C. L. LIMNAEI abandoned the snails and perished. Under experimental conditions the number of ECHINOPARYPHIUM RECURVATUM larvae that penetrated PHYSA GYRINA was inversely related to the number of C. L. LIMNAEI present. It was also observed that these oligochaetes actively ingested digenean larvae. Elimination of C. L. LIMNAEI caused by thermal effluents has augmented the metacercarial infactions. An ecological model depicting the interactions of PHYSA GYRINA-Digeneans-CHAETOGASTER L. LIMNAEI is presented. This is a complex system in which water temperature acts as a main regulating factor. The three main components of the system interact with each other and are influenced by various external factors, resulting in a dynamic ecological system. (Auth)

<617>
Santander, H., and O.S. Castillo, Study of the Early Stages of the Life of the Anchoveta.

1973. de Informe, Inst. Mar. Peru, No. 41, 1-30 (Institute del Marine del Peru, Apartado, Lima, Peru)

A study of the spawning, embryonic development, vertical distribution of eggs and larvae, and egg mortality of anchoveta, ENGRAULIS RINGENS, was made off the South American coast during the month of September. The majority of eggs were found at a depth of 30 m in the vicinity of the 16 C isotherm. The duration of embryonic development was estimated to be 50 hr at temperatures between 14.9 and 16.9 C. (ST)

<618>
Santerre, M.T., Effects of Temperature and Salinity on the Eggs and Early Larvae of CARANX MATE (Cur. & Valenc.) (Pisces: Carangidae) in Hawaii.

1976. Jour. Exp. Mar. Biol. Ecol. (Neth), 21, 51-68 (Hawaii Institute for Marine Biology, Kaneohe, HI)

Eggs and larvae of the carangid fish CARANX MATE were incubated at various temperature (17.2 to 33.1 C) and salinity (10 to 42) ppt combinations in five experiments. The following rates were directly proportional to temperature: embryonic development, yolk absorption, eye and jaw development, and increase in length. Unfed C. MATE larvae attained a maximum size at 25 C and 20 ppt. Eyes and jaws of larvae were functional by the end of the yolk sac stage at all temperature and salinity levels tested. Hatching success and larval survival at the end of the yolk sac stage were generally greater than 50% between 22 and 32 C. Hatching success and larval survival at the end of the yolk sac stage were reduced at salinity extremes, especially in low temperature-low salinity and high temperature-high salinity combinations. The frequency of morphological abnormalities was also high at extreme temperatures and salinities. The incipient upper median thermal tolerance limit for unfed C. MATE larvae acclimated to 23.8 C increased from 31.5 C for newly hatched larvae, to 34.2 C for 72 hr. larvae, but decreased to 32.0 C for starving larvae after the exhaustion of the yolk supply. (Auth)

<619>
Sappo, G.B., Effect of Konakovo State Regional Electric Power Station Heated Water Discharge on the Bream Growth in the Ivankov Reservoir.

<619>

<619> CONT.
1975. Gidrobiol. Zh. (USSR), 11, 58-63 (State Research Institute of Pond Fisheries, Upper Volga Division, Konakovo, USSR)

Marked differences were noted in the growth of bream in the control section of the reservoir and in zones subjected to heating. In the warmest region the growth rate was slow. Growth was greatest in the weakly heated zones. The observed changes in growth rate were in agreement with the fatness coefficients and nutrition intensity. (Auth) (ST)

<620>
Sappo, G.B., The Formation of a Local Population of Bream, ABRAMIS BRAMA ORIENTALIS, in the Heated Water Zone of Konakovo Power Station.

1976. Jour. Ichthyol., 16, 35-45 (State Research Institute for Lake and River Fisheries (GosNIORKh), Upper Volga Department, Konakovo, USSR)

Ecological and morphological changes were noted in the bream, ABRAMIS BRAMA, from various regions of Ivan'kovo Reservoir, USSR. The formation of a local population in the warm water zone of the reservoir is discussed. Changes in the structure of the pharyngeal teeth in bream from the zone strongly affected by the warm water discharged from Konakovo power station are recorded. (Auth)

<621>
Sargent, J.R., A.J. Thomson, M.H. Dalgleish, and A.D. Dale, Effects of Temperature and Salinity on the Microsomal (Na+ + K+)-Dependent Adenosine Triphosphatase in the Gills of the Eel, ANGUILLA ANGUILLA (L.).

1975. Proc. 9th Europ. Mar. Biol. Symp. 463-474 (N.E.R.C. Institute of Marine Biochemistry, Aberdeen, Scotland)

Groups of eels, ANGUILLA ANGUILLA, were acclimated to temperatures of 5, 10, and 18 C in both freshwater and seawater and the specific activities of gill microsomal (Na+ + K+)-dependent ATPases determined over the temperature range 5 to 50 C. The enzyme from the seawater group acclimated to 18 C had a somewhat decreased specific activity as compared to those acclimated to 5 and 10 C. Determination of the amount of enzyme present in the preparations showed that the decreased specific activity was due to a decreased amount of enzyme. Enzymes from freshwater groups acclimated to 5 and 10 C had lower specific activities than from those acclimated to 18 C and this decrease was not due to a decreased amount of enzymes. Acclimation to 5 and 10 C gave identical plots of specific activity against temperature for both seawater and freshwater fish (Auth) (ST)

<622>
Sarker, A.L., Feeding Ecology of the Bluegill, LEPOMIS MACROCHIRUS (Rafinesque) in Two Heated Reservoirs of Texas. II. Size of the Fish and Patterns of Feeding.

1975. Bangladesh Jour. Zool., 3, 1-10 (Bangladesh Agricultural University, Department of Aguiculture and Management, Faculty of Fisheries, Mymensingh, Bangladesh)

Bluegills of all sizes taken from the discharge canals of power plants on Lakes Bastrop and Nasworthy, Texas, had a higher index of stomach fullness than did those from open water. Vascular plants, aquatic insects, non-aquatic organisms, and fish were eaten in greater quantities by the bluegill in the discharge canals, while entomostracans and amphipods were eaten more by those taken from open water. (ST)

<623>
Sastry, A.N., Metabolic Adaptation of Brachyuran Crab Larvae Cultured under Constant and Cycling Temperatures Regimes.

1975. Amer. Zool., 15, 817 (University of Rhode Island, Graduate School of Oceanography, Kingston, RI)

Pelagic larvae of CANCER IRRORATUS cultured at 10 to 20 C and 15 to 25 C cycles developed to the crab stage with a better survival than those at constant 15 and 20 C. The larvae developed only to megalops stage at 10 C and fourth zoeal stage at 25 C. Metabolic-temperature response pattern of each larval stage determined for larvae cultured at constant 15 C showed a progressive decrease in the temperature range for compensation. Metabolic rate of especially the later zoeal stages was depressed between 20 to 25 C. Larvae cultured at 10 to 20 C cycles showed an alteration in the metabolic-temperature pattern of each stage and also an extension of the temperature range for compensation. Metabolic rate of these larvae was not depressed between 20 to 25 C. Larvae cultured under variable temperatures have a greater developmental homeostasis than those at constant temperature. (Auth)

<624>
Sastry, A.N., Effects of Constant and Cyclic Temperature Regimes on the Pelagic Larval Development of a Brachyuran Crab.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (University of Rhode Island, Graduate School of Oceanography, Kingston, RI)

Larvae of a brachyuran crab, CANCER IRRORATUS, were cultured at constant and cyclic temperatures. Survival of all the larval stages cultured at 10 to 20 C and at 15 to 25 C cycles was better than that of larvae grown at comparable constant temperatures. At the 12.5 to 17.5 C cycle, the survival of larvae was less than that at the comparable 10 to 20 C cycle. Larvae cultured at the 17.5 to 22.5 C cycle developed only to the megalops stage. Duration of the zoeal stages at both 12.5 to 17.5 and 10 to 20 C cycles decreased and of the megalops stage increased when compared to that at constant 15 C. The duration of the megalops stage increased considerably at the 15 to 25 C cycle compared to that at constant 20 C. In the larval development of C. IRRORATUS, megalops is a more sensitive stage than the earlier ones. The amplitude and rate of temperature change have affected differently the duration and survival of the zoeal and megalops stages. Variable temperatures of a favorable amplitude and rate of change within the normal range for development appear to confer a greater capacity for tolerance and survival than comparable constant temperatures. (Auth)

<625>
Saunders, R.L., B.C. Muise, and E.B. Henderson, Mortality of Salmonids Cultured at Low Temperatures in Sea Water.

1975. Aquaculture, 5, 243-252 (Department of the Environment, Fisheries and Marine Service, Biological Station, St. Andrews, New Brunswick, Canada)

Brook trout, rainbow trout, and Atlantic salmon were acclimated to sea water (30 ppt S) and placed during autumn in floating cages in a concrete tide pool. The salmon (mean length 26 cm in mid-October) grew about 2 cm before they stopped feeding in December. The brook trout (19 cm) and rainbow trout (21 cm) grew little, if any, during December. Feeding by the rainbow trout and salmon continued until temperature fell below 1 C. The brook trout fed little, if any, during December while temperature fell from 4 to 1 C. Brook trout, particularly the mature individuals, had high mortality rates from the time they were put into sea water. Blood plasma osmolalities indicated that brook trout, but not the other species, were under severe osmotic stress in sea water. Most of the fish (all three species) died in a 4-day period during early January when the water cooled to -0.7 to -0.8 C. A temperature of -0.7 C is a reasonable approximation of the lower lethal temperatures for these salmonids at 30 ppt salinity. Based on our observations, it is not practicable to hold the above species in sea water which is likely to get colder than 1 C because of poor growth and the risk of mortality. (Auth)

<626>
Savage, N.B., Burrowing Activity in MERCENARIA MERCENARIA (L.) and SPISULA SOLIDISSIMA (Dillwyn) as a Function of Temperature and Dissolved Oxygen.

1976. Marine Behavior Physiol., 3, 221-234 (Normandeau Associates, Inc., Bedford, NH)

Burrowing activity was utilized as a measure of the ability of the hard shell clam (MERCENARIA MERCENARIA) and the Atlantic surf clam (SPISULA SOLIDISSIMA) to cope with extremes of temperature and dissolved oxygen. Clams were removed from clean sand substrate and the progress of reburial timed. Experiments were conducted in a once through circulating seawater system in which temperatures were maintained at selected increments above ambient levels. Results of the thermal experiments indicated a zone of optimum activity, above and below which burrowing declined with changing temperature. Thermal optima, upper limits of activity, and burrowing rates were found to be species specific. Long-term effects of dissolved oxygen concentration on burrowing were determined using an apparatus constucted to remove oxygen from seawater and reaerate in controlled increments. Ability of M. MERCENARIA to burrow, when exposed to oxygen impoverished conditions (less than one milligram of oxygen per liter of seawater) for up to three weeks, was not severely or permanently impaired. Species-specific responses to temperature and dissolved oxygen are discussed in relation to habitat and geographic distribution of the clams. (Auth)

<627>
Scelzo, M.A., and E.E. Boschi, Culture of the Shrimp HYMENOPENAEUS MULLERI (Crustacea, Decapoda, Penaeidae).

1975. Physis (Arg.), 34A, 193-197 (Instituto de Biologia Marina, Mar del Plata, Argentina)

The pink shrimp, HYMENOPENAEUS MUELLERI was reared in the laboratory. Larvae hatched in 12 to 24 hours depending upon the temperature. This species has six nauplii, three protozoeae, three mysis, and the postlarvae. The larval development was completed in 19 to 23 days at 19 to 23.5 C and in 34 days at 17 to 20 C. (ST)

<628>
Schlueter, R.A., Effects of Thermal Effluents on Reproduction of Minnows in the White River, Indiana.

1975. Ph.D. Thesis, Indiana State University, 51 p. (Indiana State University, Terre Haute, IN)

The effects of thermal effluent on reproduction of spotfin shiners, NOTROPIS SPILOPTERUS; bullhead minnows, PIMEPHALES VIGILAX; emerald shiners, NOTROPIS ATHERINOIDES; western silvery minnows, HYBOGNATHUS NUCHALIS; and river shiners, NOTROPIS BLENNIUS were studied in the spring and summer of 1971, 1972, and 1974. Average summer water temperature at heated areas of the White River exceeded those in unheated areas by 3.5 C in 1971-72 and by 2.4 C in 1974. In the summer of 1974, the number of ripe females of N. SPILOPTERUS and P. VIGILAX was greater in heated than in unheated areas. More young of N. SPILOPTERUS, P. VIGILAX, and H. NUCHALIS were collected in unheated areas. In the summer of 1971-72, more male and female N. SPILOPTERUS, P. VIGILAX, and N. ATHERINOIDES, and H. NUCHALIS were also taken in unheated areas. Collection differences between years were attributed to low river flow and high temperatures in 1971-72 and higher water levels and lower water temperatures in 1974. Ripe adults appeared to move into the heated area when water levels were higher and temperature was lower. Gonad development was similar in heated and unheated areas for the minnow species studied. Spawning times appeared to be earlier in heated areas for H. NUCHALIS and P. VIGILAX. (ST)

<629>
Schroeder, P.B., Thermal Stress in THALASSIA TESTUDINUM.

1975. Ph.D. Thesis, University of Miami, 157 p. (University of Miami, Coral Gables, FL)

A study of the effect of a thermal effluent on THALASSIA TESTUDINUM was made at Guayanilla Bay, Puerto Rico, and at the laboratory of the Puerto Rico Nuclear Center at Mayaguez, Puerto Rico. Biomass of THALASSIA was inversely correlated with temperature in established turtle grass flats near a thermal plume. Visual signs of stress were noted in transplanted THALASSIA samples after two weeks of exposure to temperatures of 34.5 to 35 C. Mortality occurred in transplanted THALASSIA after seven weeks of exposure to 35.0 to 36.4 C. Biomass and pigment values varied nonlinearly with temperature. There was strong correlation between the effect of temperature on biomass and on the absorption ratio 410nm/665nm of acetone extracts of leaf material between 28 and 36 C. This absorption ratio was proposed as an index of thermal stress in the plant. Radionuclide uptake experiments demonstrated that osmoregulation in THALASSIA was affected by temperature. Sodium and certain other cations were preferentially excluded from

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THALASSIA at temperatures normally experienced by the plant. Between 32 and 34.5 C accelerated uptake of these cations in leaves occurred. Sodium poisoning and breakdown of osmoregulatory processes were proposed as the cause of visual signs of thermal stress and mortality in THALASSIA. (Auth)

<630>
Schubel, J.R., and T.S.Y. Koo, Effects of Various Time-Excess Temperature Histories on Hatching Success of Blueback Herring, American Shad, and Striped Bass Eggs.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (State University of New York, Marine Sciences Research Center, Stony Brook, NY; Chesapeake Biological Laboratory, Center for Environmental Studies, University of Maryland, Solomons, MD)

In the laboratory blueback herring (ALOSA AESTIVALIS), American shad (ALOSA SAPIDISSIMA), and striped bass (MORONE SAXATILIS) eggs from the Chesapeake Bay region were subjected to time-excess temperature histories typical of those experienced by organisms entrained by power plants with a variety of design and operating criteria. The maximum excess temperature ranged from 7 to 20 C above ambient; the time of exposure was from 4 to 60 min; and the period of cooling to the final temperature was from 60 to 300 min. An excess temperature of 20 C resulted in nearly total mortality of eggs of all three species. An excess temperature of 15 C significantly reduced hatching success of blueback herring and American shad but not striped bass eggs. Excess temperatures of 7 and 10 C did not significantly affect hatching success of eggs of any of the three species. (Auth)

<631>
Schubel, J.R., T.S.Y. Koo, and C.F. Smith, Thermal Effects of Power Plant Entrainment on Survival of Fish Eggs and Larvae: A Laboratory Assessment.

1976. Chesapeake Bay Institute, Special Report 52, Reference 76-4; PPRP-13; 38 p. (State University of New York, Marine Sciences Research Center, Stony Brook, NY; University of Maryland, Chesapeake Biological Laboratory, Center for Environmental and Estuarine Studies, Solomons, MD)

Blueback herring (ALOSA AESTIVALIS), American shad (ALOSA SAPIDISSIMA), and striped bass (MORONE SAXATILIS) eggs and larvae from the Chesapeake Bay region were subjected in the laboratory to time-excess temperature histories typical of those experienced by organisms entrained by power plants with a variety of design and operating criteria. The maximum excess temperature ranged from 7 to 20 C above the base temperature (the average surface water temperature on the spawning grounds); the time of exposure to a maximum excess temperature from 4 to 60 minutes; and the period of cooling to the final temperature from 60 to 300 minutes. An excess temperature of 20 C resulted in nearly total mortality within two minutes for eggs of all three species. Analyses of variance indicated that exposure to an excess temperature of 15 C significantly reduced the hatching success of both blueback herring and American shad eggs, but not that of striped bass eggs. Excess temperatures of 7 and 10 C did not significantly affect hatching success of eggs of any of the three species. An excess temperature of 20 C resulted in virtually total mortality of larvae of all three species. Striped bass larvae were the most tolerant of the three species and could withstand excess temperatures of up to 10 C with no significant increase in mortality. The response patterns of the other two species were more complicated. (Auth)

<632>
Schulte, E.H., Influence of Algal Concentration and Temperature on the Filtration Rate of MYTILUS EDULIS.

1975. Marine Biol. (W. Ger.), 30, 331-341 (CNEN-Euratom, Laboratory for the Study of Contamination Radioacttiva Mare, La Spezia, Italy)

The influence of temperature on filtration activity of MYTILUS EDULIS was highest between 5 and 15 C and between 25 and 30 C. A temperature increase from 15 to 25 C resulted in only a slight increase in filtration rate. At 5 and 30 C filtration dropped to very low values. (ST)

<633>
Schuur, A.M., W.S. Fisher, J.C. Van Olst, J.M. Carlberg, J.T. Hughes, R.A. Shleser, and R.F. Ford, Hatchery Methods for the Production of Juvenile Lobsters (HOMARUS AMERICANUS).

1976. Institute of Marine Resources (IMR) Reference 76-6, University of California, La Jolla, CA: Sea Grant Publication 48 (University of California, Davis and Bodega Marine Laboratory, Bodega Bay, CA; California State University, Department of Biology, San Diego, CA; Massachusetts Division of Marine Fisheries, Vineyard Haven, MA)

Literature on the reproduction and growth of lobsters is reviewed and related to the controlled rearing process. The role of temperature on sucessful culture procedures is emphasized. A rearing kreisel and several water systems used successfully for the rearing of larval lobsters are described. Successful water systems are those that control temperature, salinity, fouling organisms, metabolites and infectious disease. (ST)

<634>
Seki, H., Y. Yamaguchi, J. Hatakenaka, and S. Ichimura, Dynamics of Organic Materials in a Natural Pool of Shimogamo Hot Spring, Japan.

1975. Arch. Hydrobiol. (Ger.), 75, 539-547 (Ocean Research Institute, University of Tokyo, Minami-dai, Nakano-ku, Tokyo, Japan; Tokyo Kyoiku University, Faculty of Science, Department of Botany, Bunkyo-ku, Tokyo, Japan)

The water of Shimogamo Hot Spring is saline (chlorinity: 10.47 ppt) and alkaline (pH 8.92) with temperature of 63.9 C. In a natural pool at a spring effluent, two different benthic mats were observed: an orange mat at 50 to 63.9 C where heterotrophic processes are predominant and blue-green mat at 41.5 to 50 C where autotrophic processes are preferential. Both orange and blue-green mats contain a cyanophyte, SYNECHOCOCCUS sp., and heterotrophic bacteria, FLAVOBACTERIUM sp. and BACILLUS sp., predominantly. The turnover time for the dissolved organic

<634> CONT.
materials in water of the pool was from a few hundred to a few thousand hours. (ND)

<635>
Selgeby, J.H., Life Histories and Abundance of Crustacean Zooplankton in the Outlet of Lake Superior, 1971-72.

1975. Jour. Fish. Res. Bd. Can., 32, 461-470 (U.S. Fish and Wildlife Service, Ashland, WI)

During the year of sampling thirty species of crustacean zooplankton were collected, of which three were new records for Lake Superior: CYCLOPS STRENUUS, ALONA COSTATA, and ALONELLA ACUTIROSTRIS. Comparisons of the data on zooplankton in Lake Superior with those for Lake Erie and Lake Michigan indicated that timing of the seasonal cycles of zooplankton in Lake Superior is markedly affected by the lower water temperatures. Most species of copepods and cladocerans bred one to three months later in Lake Superior than in Lakes Erie or Michigan and most also probably produced fewer generations than in the lower lakes. Life history details of 13 species are given. (ST)

<636>
Selivonchick, D.P., and B.I. Roots, Variation in Myelin Lipid Composition Induced by Change in Environmental Temperature of Goldfish (CARASSIUS AURATUS L.).

1976. Jour. Thermal Biol., 1, 131-135 (University of Toronto, Department of Zoology and Erindale College, Mississauga, Ontario, Canada)

Goldfish were acclimated to 5, 15, and 30 C and the lipid and protein composition of brain and spinal cord myelin was determined. Total brain lipid, with the exception of plasmalogen, was resistant to change with thermal acclimation. Differences between brain and spinal cord myelin protein and phospholipids were not observed. (ST)

<637>
Senius, K.E.O., The Thermal Resistance and Thermal Resistance Acclimation of Ciliary Activity in the MYTILUS Gills.

1975. Comp. Biochem. Physiol., 51A, 957-961 (University of Tampere, Institute of Biomedical Science, Tampere, Finland)

The thermal resistance and thermal resistance acclimation of ciliary activity in the gills of MYTILUS EDULIS was studied. Thermal resistance acclimation appeared in four days after acclimation to 5, 15, and 25 C. Thermal resistance acclimation did not occur in isolated surviving gills kept for one day at 4 or 24 C. It is suggested that gill thermal resistance of ciliary activity is controlled by neural mechanisms. (Auth) (ST)

<638>
Shameel, M., Activity of Alkaline Phosphatase in Some Seaweeds under the Influence of Hydrostatic Pressure and Temperature.

1975. Pak. Jour. Bot., 7, 169-173 (University of Karachi, Institute of Marine Biology, Karachi, Pakistan)

The combined effect of hydrostatic pressures varying from 200 to 800 atm and temperatures ranging from 5 to 25 C was studied on the activity of alkaline phosphatase in DELESSERIA SANGUINEA and FUCUS VESICULOSUS. At temperatures between 5 and 15 C the hydrostatic pressure caused a decrease in the enzymic activity; at higher temperatures however, the activity was accelerated under the same pressure. The changes in the enzyme activity brought about by increased hydrostatic pressure at temperatures other than 15 C were greater in D. SANGUINEA as compared to F. VESICULOSUS. Enzyme activity in ENTEROMORPHA LINZA, LAMINARIA SACCHARINA and PHYCODRYS SINUOSA could not be detected. (Auth)

<639>
Sheader, M., Factors Influencing Change in the Phenotype of the Planktonic Amphipod PARATHEMISTO GAUDICHAUDI (Guerin).

1975. Jour. Mar. Biol. Assn. U.K., 55, 887-891 (University of Newcastle upon Tyne, Dove Marine Laboratory, England)

PARATHEMISTO GAUDICHAUDI, a species of planktonic hyperiid amphipod, exists in a range of morphological forms, varying from the BISPINOSA to the COMPRESSA extreme, and specimens can molt towards either of these extremes. By keeping animals in the laboratory it was found that the length of the intermolt period was the key factor determining the degree of development of the BISPINOSA-COMPRESSA condition. A change in factors affecting the intermolt length such as temperature and level of nutrition were shown to bring about change in the BISPINOSA-COMPRESSA condition. At high temperatures (greater than 7 C) the animals molted towards the COMPRESSA form and at low temperature (less than 6 C) animals molted toward the BISPINOSA form. The number of molts undertaken to pass from the BISPINOSA form to the COMPRESSA form or vice versa was temperature dependent. The length of the intermolt period was also temperature dependent. At low temperature, 2.5 C, it took 240 days for the COMPRESSA form to molt to the BISPINOSA form, but at high temperature (12.5 C) it took only 20 days for the BISPINOSA form to molt to the COMPRESSA form. It is suggested that these changes in morphology allow for different size-ranges of prey species to be utilized. (Auth) (ST)

<640>
Shealy, M.H., Jr., J.V. Miglarese, and E.B. Joseph, Bottom Fishes of South Carolina Estuaries - Relative Abundance, Seasonal Distribution, and Length-Frequency Relationships.

1974. South Carolina Wildlife & Marine Resources Dep., Tech. Rep. Ser., No. 6, 201 p. (Marine Resource Research Institute, Charleston, SC)

Relative abundance, seasonal distribution, and length-frequency relationships for 88 species of fish captured by bottom trawl in South Carolina estuaries during the 12-month period from February 1973 through January 1974 are reported. Total length ranges, bottom temperature and salinity ranges, and primary locations at which each species occurred are listed. (Auth) (ST)

<641>
Sheldon, R.B., and C.W. Boylen, Factors Affecting the Contribution by Epiphytic Algae to the Primary Productivity of an Oligotrophic Freshwater Lake.

1975. Appl. Microbiol., 30, 657-667 (Rensselaer Polytechnic Institute, Troy, NY)

<641>

<641> CONT.
A diatom-dominated population of epiphytic algae collected from macrophytes in Lake George, N.Y. exhibited an optimum temperature for HCO3 uptake at 30 C, although the summer littoral lake temperature ranged from 18 to 25 C. (ST)

<642>
Shepard, L.J., and P.E. Lutz, Larval Responses of PLATHEMIS LYDIA Drury to Experimental Photoperiods and Temperatures (Odonata: Anisoptera).

1976. Amer. Midland Naturalist, 95, 120-130 (University of North Carolina, Department of Biology, Greensboro, NC)

To investigate the separate and combined roles of photoperiod and temperature in seasonal regulation in an odonate species, experiments were undertaken to measure the growth rate of PLATHEMIS LYDIA larvae when maintained to emergence under constant experimental conditions of light and temperature. Final-instar larvae were collected from Sept. 1969 to May 1970, and were maintained under eight experimental conditions: two photoperiods (11 and 14 hr) at each of four temperatures (15, 20, 25 and 30 C). Growth rates were quantitatively measured by the number of days intervening from the time of installation to emergence. Comparative statistics indicated the longer photoperiod stimulated growth rate whereas the shorter photoperiod was inhibitory. Higher temperatures were stimulatory and lower temperatures were inhibitory to growth rates. The degree of these effects varied with the season of the year; larvae collected later in the study period emerged more rapidly than larvae collected earlier and maintained under identical conditions. This photoperiodic effect may be a primary stimulus for larval metamorphosis at the outset of the reproductive period in the spring. Temperature exerted a marked influence on growth rates at 20 C when contrasted with those of 15 C, giving evidence that temperature constitutes an important factor in seasonal regulation of the life cycle. (Auth)

<643>
Shin, E.-B., and P.A. Krenkel, Mercury Uptake by Fish and Biomethylation Mechanisms.

1976. Jour. Water Poll. Control Fed., 48, 473-501 (Korea Institute of Science and Technology, Cheong Ryang, Seoul, Korea; Tennessee Valley Authority, Division of Environmental Planning, Chattanooga, TN)

Examinations of the uptake rates by fish, GAMBUSIA AFFINIS and POECILIA RETICULATUS, of methylmercury biosynthesized in sediments were conducted to find the effects of various environmental conditions such as temperature, degree of organic pollution, Cl- concentration and degree of Hg pollution. With the exception of a test at 25 C, methylmercury uptake by fish was increased with increasing temperature (17, 20, and 30 C). The accumulated uptakes for the 8-wk period were 55, 110, and 253 ng Hg, respectively. The methylmercury detected from the soil samples for the same period was 1,030, 1,480, 1,250 ng Hg. At 25 C methylmercury was contained primarily in the soil and did not go into solution. The overall production of methylmercury at 20, 25, and 30 C was in the same order of magnitude. The highest production of methylmercury by microorganisms occurred at 35 C. An attempt was made to quantify the effects on the overall methylation activities of microoganisms of varying environmental parameters such as temperature, biochemical oxygen demand, Cl-, degree of Hg pollution and pH. A rate equation and reaction order were introduced. For the conditions examined, the methylation reaction was first order with respect to the molar concentration of Hg. Rate constants of the methylation reactions of Hg and the half-lives of Hg contained in the sediments under given conditions were determined. (Auth) (ST)

<644>
Shinmura, I., Studies on the Cultivation of an Edible Brown Alga, CLADOSIPHON OKAMURANUS -V. Conjugation of Gamete and Development of Zygote.

1976. Bull. Jap. Soc. Sci. Fish., 42, 21-28 (Kagoshima Prefectural Fisheries Experimental Station, Kagoshima, Japan)

In laboratory studies gametes of CLADOSIPHON OKAMURANUS were discharged at water temperatures of 15 to 30 C and under conditions of eight to sixteen hours of light per day. Gametes settled at water temperatures of 20 to 25 C and zygotes were abundant in water at 20 C and under short day conditions. (ST)

<645>
Shinmura, I., Studies on the Cultivation of an Edible Brown Alga, CLADOSIPHON OKAMURANUS -IV. Development of Zoospore from Unilocular Sporangium.

1975. Bull. Jap. Soc. Sci. Fish., 41, 1229-1235 (Kagoshima Prefectural Fisheries Experimental Station, Kagoshima, Japan)

Gametophytes of CLADOSIPHON OKAMURANUS grew best at 25 C, 23 ppt salinity, and 5 klux illuminance. Plurilocular gametangia were formed under culture conditions of 20 to 30 C, 23 to 35 ppt salinity, and 2 to 20 klux illuminance. (ST)

<646>
Shirazi, M.A., What Can We Learn from Thermal Plume Prediction?.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (U.S.E.P.A., Environmental Research Laboratory, Corvallis, OR)

Aa analytical approach to modelling thermal jets and plumes from power plants together with some examples to demonstrate the general utility of this approach in predicting the important processes of a real plume are presented. (ST)

<647>
Shleser, R.A., and A.M. Schuur, Utilization of Power Plant Thermal Effluent for Mariculture.

1975. In Water Resources Symposium No. 8, Water Management by the Electric Power Industry, Section 5, Beneficial Uses of Low-Grade Heat, E.F. Gloyna et al. (Eds.). Center for Research in Water Resources, The University of Texas at Austin (University of California, Bodega Marine Laboratory, Bodega Bay, CA)

<647> CONT.
A physical system in which lobsters can be cultured commercially on a significant scale has been modeled at the Bodega Marine Laboratory (Calif.) and an economics production model has been constructed. The model is composed of 120 variables that relate the biological performance of the animal, the immediate culture environment, and the physical plant necessary to produce the required optimal performance. These variables are associated with the cost components of the lobster culture system. The costs of space, food, labor, water treatment, pumping and heat comprise the cost per unit output. The variables are related by use of a computerized program that provides a means of examining these costs in a total systems context. Several options for producing heat in aquatic production systems are briefly described. Problems associated with aquaculture-power plant relationships are summarized: water quality in receiving waters, toxic leaching from the plant, use of biocides in the plant, temperature fluctuations above and below aquaculture design criteria, plant shutdowns, radioactive exposure in nuclear installations, and waste treatment criteria and costs. (ST)

<648>
Shrode, J.B., Developmental Temperature Tolerance of a Death Valley Pupfish (CYPRINODON NEVADENSIS).

1975. Physiol. Zool., 48, 378-389 (Arizona State University, Department of Zoology, Tempe, AZ)

Adult CYPRINODON NEVADENSIS were collected from Saratoga Springs, Death Valley National Monument, California, and bred in the laboratory. Eggs were incubated at constant and diel fluctuating temperatures. Greater than 50% normal hatch occurred between constant temperatures of 20 and 36 C and at fluctuating temperatures of 28 to 20, 36 to 28, and 38 to 30 C. Eggs were able to withstand a daytime high temperature of 38 C when the temperature was allowed to drop at night. The tolerance limits for normal egg development paralleled the temperatures for breeding behavior observed in the field. Newly hatched larvae were longest when incubated at 28 C and shorter at both higher and lower temperatures. Most larvae hatched at temperatures of 36 C and above had yolk sacs larger than their heads. Hatching occurred at an earlier stage of development at higher temperatures and rate of development increased with increasing incubation temperature. Critical thermal maxima of young fish were consistently higher than those of older fish acclimated under the same conditions. Tolerance to high temperatures is apparently lowest during the egg stage, highest in young fish, and intermediate in large adults. (Auth) (ST)

<649>
Shyamasundari, K., Effects of Salinity and Temperature on the Development of Eggs in the Tube Building Amphipod COROPHIUM TRIAENONYX Stebbing.

1976. Biol. Bull., 150, 286-293 (Andhra University, Department of Zoology, Waltair, South India)

The effects of salinity and the combined effects of salinity and temperature on the development of eggs of the fouling organism, COROPHIUM TRIAENONYX were investigated. Egg survival and development were optimum at a combination of 30 ppt salinity and 28 C. The upper limiting salinity appeared to be 35 ppt at all temperatures and the lower limiting salinity was 10 ppt between 15 and 35 C and 15 ppt at 9 C. High temperatures at extreme salinities retarded development. (ST)

<650>
Sick, L.V., and H. Beaty, Culture Techniques and Nutrition Studies for Larval Stages of the Giant Prawn, MACROBRACHIUM ROSENBERGII.

1974. NOAA-74121106; Georgia Marine Science Center Technical Report Series No. 74-5, 30 p. (Skidaway Institute of Oceanography, Savannah, GA; University System of Georgia, Georgia Marine Science Center, Skidaway Island, GA; NOAA, Rockville, MD)

Significant decreases in development time and increases in survival of MACROBRACHIUM ROSENBERGII larvae were achieved by studying several aspects of culture conditions. Larvae reared at temperatures ranging from 20 to 35 C had maximum survival within a narrow range in temperatures (28 to 30 C). Larvae exposed to 20 to 28 C had relatively good survival; larvae were less tolerant of temperatures in excess of 30 C or less than 20 C. Each stage of larval development had specific salinity requirements. Stocking density, water hardness, disease, and nutrition studies are also discussed. (ST)

<651>
Simpson, R.D., Physical and Biotic Factors Limiting the Distribution and Abundance of Littoral Molluscs on Macquarie Island (Sub-Antarctic).

1976. Jour. Exp. Mar. Biol. Ecol. (Neth.), 21, 11-49 (Dove Marine Laboratory, Cullercoats, England)

Temperatures of loss of adherence and lethal temperatures of six species of adult molluscs (PLAXIPHORA AURATA, HEMIARTHRUM SETULOSUM, PATINIGERA MACQUARIENSIS, CANTHARIDUS CORUSCANS, LAEVILITTORINA CALIGINOSA, and KERGUELENELLA LATERALIS) from Macquarie Island, located mid-way between the southern temperate zone and the Antarctic, were determined. The effects of sustained water temperature in the ranges 12 to 15.9 C and 16 to 20 C and body temperatures and corresponding adjacent micro-climatic temperatures were also measured. At high temperatures, the tolerance of Macquarie molluscs was low in comparison to that for those from temperate regions. However, lethal temperatures for the molluscs were well above environmental temperatures. Regulation of body temperature appeared to be lacking in P. MACQUARIENSIS and K. LATERALIS. The influence of habitat, desiccation, salinity, food predation and reproduction on distribution and abundance were also determined. (ST)

<652>
Simpson, T.L., and P.E. Pell, Dormancy Among the Porifera: Gemmule Formation and Germination in Freshwater and Marine Sponges.

1974. Trans. Amer. Micros. Soc., 93(4), 544-577 (University of Hartford, Department of Biology, West Hartford, CT; Connecticut College, Department of Zoology, New London, CT)

Gemmule structure and comparative morphology is reviewed. Detailed life cycle studies and experimental field data indicate low

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temperature triggering of thin-walled gemmule formation in SPONGILLA LACUSTRIS; endogeneous factors also influence the time of formation. Gemmule hatching, while inducible by an increase in temperature in most species, can occur at low temperatures. Two types of gemmules have been described in terms of hatching. Osmotic studies indicate that hatching is coupled to a decrease in intragemmular osmotic pressure. A new concept of gemmule formation is presented which relates the colloidal state of the sponge to gemmule formation: an increased colloidal state, coupled with increased osmoregulatory demands, is viewed as the stimulus for gemmule formation. According to this view gemmules serve to compartmentalize the sponge within an acellular, osmoregulatory coat as a result of osmotic stress. (Auth) (ND)

<653>
Skoog, G., Effects of Acclimatization and Physiological State on the Tolerance to High Temperatures and Reactions to Desiccation of THEODOXUS FLUVIATILIS and LYMNEA PEREGRA.

1975. Oikos, 27, 50-56 (University of Stockholm, Department of Zoology and the Asko Laboratory, Stockholm, Sweden)

In the laboratory adult and juvenile freshwater snails, LYMNEA PERGRA, were found to be more tolerant to high temperatures (36 to 38 C) than adult and juvenile THEODOXUS FLUVIATILIS. This difference was also indicated by the field distributions of the two species. Seasonal differences were found in the tolerance of both species. During the egg laying phase, the heat tolerance of L. PEREGRA dropped drastically. Adult T. FLUVIATILIS was more tolerant to desiccation than adult L. PEREGRA. This resistance is probably due to the existence of an operculum in T. FLUVIATILIS and to the found behavioral differences at low humidities. Juvenile T. FLUVIATILIS in egg capsules, however, are less tolerant to desiccation than are juvenile L. PEREGRA. This is compensated for by T. FLUVIATILIS deposing the capsules deeper below the water surface. (Auth)

<654>
Smedile, E., and V. Parisi, Effect of Entrainment in Power Station Cooling Systems Studied Using Periphytic Communities.

1975. IAEA-SM-197/6; Part of Proceedings of a Symposium on the Combined Effects of Radioactive, Chemical and Thermal Releases to the Environment held in Stockholm, Sweden, June 2-5, 1975. International Atomic Energy Agency, Vienna (Ente Nazionale per l'Energia Elettrica, Rome, Italy; Parma University, Italy)

The impact of power stations on the aquatic environment was evaluated by studying the effect on suspended organisms entering the plant cooling system entrained in the cooling water. The ability of suspended organisms, sampled in front of the intake and in the discharge canal, to colonize immersed substrates was compared. The dynamics of colonization were examined in aquaria containing water from either the intake or the outfall of La Casella Power Plant (Italy). The numbers of systematic groups, their corresponding biomasses and the dimensional structure of animal and plant populations were determined. The data collected showed how a temperature rise (maximum 7 C above ambient) modifies the characteristics of a periphytic community and the dynamics of colonization of immersed substrate. (Auth) (ST)

<655>
Smith, D.G., Notes on the Biology of MARGARITIFERA MARGARITIFERA MARGARITIFERA (Lin.) in Central Massachusetts.

1976. Amer. Midland Naturalist, 96, 252-256 (University of Massachusetts, Department of Zoology, Amherst, MA)

Eleven populations of the mussel, MARGARITIFERA MARGARITIFERA inhabiting Massachusetts streams were examined for ecological and life history information. Gravid specimens were found from early August to mid-October. Water temperature at this time was at a maximum of 21 C; by the first week in September water temperature had dropped to 15 C. Eggs and developing glochidia were found within the mussels' gills, with individual specimens retaining embryos for 45 days. Artificial infection by glochidia and examination of randomly collected and incarcerated fish indicated that brook trout (SALVELINUS FONTINALIS) and brown trout (SALMO TRUTTA) are hosts for this mussel. (ST)

<656>
Smith, L.L., Jr., D.M. Oseid, and L.E. Olson, Acute and Chronic Toxicity of Hydrogen Sulfide to the Fathead Minnow, PIMEPHALES PROMELAS.

1976. Environ. Sci. & Technol., 10, 565-568 (University of Minnesota, Department of Entomology, Fisheries & Wildlife, St. Paul, MN)

Toxic effects of molecular hydrogen sulfide to eggs, fry, and juveniles of PIMEPHALES PROMELAS were determined in flow-through bioassays. The 96-hr LC50 of laboratory-cultured juveniles at 20 C was 0.0243 mg/l H2S. Fry were approximately twice as sensitive. Response with temperature in wild stock juveniles varied from a 96-hr LC50 of 0.7754 mg/l at 6.5 C to 0.0423 mg/l H2S at 25 C. In chronic exposure to H2S from egg through two generations of laboratory-cultured stock in flow-through bioassys, adverse effects on growth, survival, and fecundity occurred above 0.004 mg/l H2S. Chronic exposure of wild stock up to 346 days caused adverse effects on growth and survival above 0.008 mg/l H2S. At comparable temperatures apparent safe levels with long exposure were five- to sevenfold lower than the 96-hr LC50 for both stocks. (Auth)

<657>
Smith, M.H., Thermal Tolerance and Biochemical Polymorphism of Immature Largemouth Bass MICROPTERUS SALMOIDES Lacepede.

1975. Bull. Ga. Acad. Sci., 33, 180-184 (Savannah River Ecology Laboratory, Aiken, SC)

Immature largemouth bass, collected from Par Pond, Savannah River Plant, were acclimated to temperatures of 20, 28, and 36 C in the laboratory. At 36 C none of the fish survived the one-week acclimation period. The critical thermal maximum, the point temperature at which the fish lost their sense of orientation and equilibrium, was determined. Allele frequencies of fish surviving the acclimation process and those in the parental population were essentially the same. (ST)

<658>
Smith, R.A., An Expression for Phytoplankton Specific Growth Rate as a Function of Light and Temperature and Its Application in Models of Estuarine Water Quality.

1975. Ph.D. Thesis, Johns Hopkins University (Johns Hopkins University, Baltimore, MD)

A general expression for phytoplankton specific growth rate as a joint function of both light and temperature was devised. The model was used to simulate changes in algal populations over time in the upper Potomac Estuary and in the Back River Estuary, Chesapeake Bay. The phytoplankton model for the Back River Estuary was expanded to include equations for seven water quality parameters in addition to algal concentration. (ST)

<659>
Smith, R.A., A.S. Brooks, and L.D. Jensen, Effects of Condenser Entrainment on Algal Photosynthesis at Mid-Atlantic Power Plants.

1974. PB-240 758; EPRI-74-049-00-5; Electric Power Research Institute Cooling Water Studies Report No. 15; In Jensen, L.D. (Ed.), Proceedings of the Second Entrainment and Intake Screening Workshop held at Johns Hopkins University, Baltimore, Maryland, February 5-9, 1973. National Technical Information Service, Springfield, VA (Johns Hopkins University, Baltimore, MD; University of Wisconsin, Center for Great Lakes Studies, Milwaukee, WI; Ecological Analysts, Inc., Baltimore, MD)

Results of condenser entrainment studies at four mid-Atlantic power plants were used to construct models of thermal effects consistently observed at four sites. The models described deal with both mortality of entrained algae as well as transitory changes in algal photosynthesis in heated water. The response of algal photosynthetic rates to condenser temperature increases at all four sites followed a consistent seasonal pattern. Rate stimulation from temperature rise prevailed when ambient temperature was low but was gradually replaced by rate depression when ambient temperature approached a summer maximum. An exception was the Marshall Steam Station on Lake Norman, NC. Irreversible effects of condenser entrainment on photosynthetic rates were observed only when intake temperature exceeded some threshold, and during periods of chlorination. The temperature threshold varied some both seasonally and geographically, but typically appeared between 25 and 30 C. Additional experiments were carried out at three sites to determine the response of algal photosynthetic rate to small temperature elevations. The curves of rate vs temperature tended to conform to a geographic ordering of the sites, the most southerly showing the warmest optimum photosynthetic temperature. A third series of experiments were designed to elucidate the effect of varying exposure time on algal mortality. Using the annual range of intake temperatures of the Chesterfield Station, James River, VA, the calculations indicated that algal mortality in the discharge canal was low until intake temperature approached 30 C. (Auth) (ST)

<660>
Smith, W.G., J.D. Sibunka, and A. Wells, Seasonal Distributions of Larval Flatfishes (Pleuronectiformes) on the Continental Shelf Between Cape Cod, Massachusetts, and Cape Lookout, North Carolina, 1965-1966.

1975. NOAA Technical Report NMFS SSRF-691; 67 p. (National Marine Fisheries Service, Middle Atlantic Coastal Fisheries Center, Sandy Hook Laboratory, Highlands, NJ)

Larval flatfishes, representing 4 families, 17 genera, and 15 species, were identified from collections taken during a 1-yr survey designed to locate spawning grounds and trace dispersion of fish eggs and larvae on the continental shelf. Most flatfishes began spawning in the spring, a time of marked seasonal temperature change. The seasonal distribution of larvae indicated the following. Bothids had longer spawning seasons than pleuronectids. Pleuronectids spawned largely in the northern half of the survey area during the spring. Most bothids spawned in the southern half, beginning in spring and continuing through early fall. Although cynoglossids spawned incidentally off North Carolina, most of their larvae were transported into the survey area from spawning grounds south of Cape Lookout. The few representatives of the family Soleidae originated south of Cape Lookout. Spawning that began in the spring proceeded from south to north as the season progressed, but spawning that began in the fall proceeded from north to south, suggesting that the onset of spawning is triggered by spring warming and fall cooling. Most species spawned within a relatively narrow range of temperature. Salinity had no apparent influence on spawning. (Auth)

<661>
Sopina, V.A., The Multiplication Rate of Amoebae Related to the Cultivation Temperature.

1976. Jour. Thermal Biol., 1, 100-204 (Institute of Cytology, Laboratory of Cytology of Unicellular Organisms, Leningrad, USSR)

The cultivation temperature-dependent rate of multiplication in amoebae was studied using three strains of AMOEBA PROTEUS and another amoeba strain of unknown specific and generic position. The multiplication rates were characterized by optima that varied with strains. The temperature-induced changes in the multiplication rate of a given strain were non-hereditary; they are common modifications. Hereditary interstrain differences in the multiplication rate were also shown at constant temperatures. The range of modificational changes with increase or decrease of cultivation temperature appeared to be greater than interstrain differences in multiplication rate. No cell divisions were observed after the amoebae were transferred from 4 to 17 C. Multiplication rate increased with increasing temperature until a maximum was reached at 25 or 28 C, depending on the strain. It declined to zero at 31 (for the unknown genus) and 34 C and death resulted for the three strains of AMOEBA PROTEUS at 34 C. (Auth) (ST)

<662>
Sorensen, E.M.B., Thermal Effects on the Accumulation of Arsenic in Green Sunfish, LEPOMIS CYANELLUS.

1976. Arch. Environ. Contam. Toxicol., 8, 8-17 (University of Texas at Austin, Zoology Department, Austin, TX)

The pattern of arsenic concentration in several tissues of LEPOMIS CYANELLUS was measured (by neutron activation analysis) as

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<662> CONT.
a function of exposure time at 10, 20, and 30 C and 0, 30, 60 ppm of arsenic as sodium arsenate. Individual variability of arsenic uptake did not override trends of greater uptake with increasing exposure time, temperature, and arsenic concentration. The mean temperature coefficient of 4.5 for arsenic uptake in livers was higher than previously reported metabolic figures of 1.6 to 3.0 for LEPOMIS species. The biological half-life of arsenic in liver and gut of live specimens exposed to 30 and 60 ppm of arsenic at 10 C was about one week. Percentage survival decreased and mean arsenic uptake increased slightly as temperature and arsenic concentration increased. (Auth)

<663>
Southward, A.J., E.I. Butler, and L. Pennycuick, Recent Cyclic Changes in Climate and in Abundance of Marine Life.

1975. Nature, 253, 714-717 (Marine Biological Association, Citadel Hill, Plymouth, England)

Interactions between the sea, sea currents, and meteorology, all of which affect fisheries, are reviewed. Emphasis was placed on the interaction of temperature and biological trends as reflected by the number of pilchard eggs in the plankton, the catch of demersal fish, and the proportion of barnacle species in the intertidal zone. In general, the warm water fish species and the barnacle, CHTHAMALUS, were positively correlated with temperature and the cold water fish species and the barnacle, BALANUS BALANOIDES, were negatively correlated with temperature. An 11 year cyclic change in climate and in abundance of marine life was shown. (ST)

<664>
Spaargaren, D.H., On Osmotic and Ionic Regulation in Blood, Bile and Tissues of Three PLEURONECTUS Species.

1976. Neth. Jour. Sea Res., 10, 479-490 (Netherlands Institute for Sea Research, Texel, Netherlands)

The osmotic and ionic regulation responses in blood, bile, muscle, and liver tissue of PLEURONECTUS LIMANDA, P. PLATESSA, and P. FLESUS were measured at various salinities at 5 and 20 C. All three species showed strong stabiliation of their internal concentrations. PLEURONECTUS LIMANDA, however, did not survive salinities less than about 5 ppt; neither could it withstand a gradual increase in temperature to 20 C. Deviations of the normal level were found in P. PLATESSA at extreme salinities, especially at low temperature. This species also showed a slight negative influence of temperature on the osmotic concentration of the blood, caused by an increase in organic-solute concentration at lower temperature. Comparison of the three species confirmed that the highest stability of internal concentrations to variation in temperature and salinity is reached in the least marine species. (ST)

<665>
Sparks, R.E., and W.C. Starrett, An Electrofishing Survey of the Illinois River, 1959-1974.

1975. Ill. Nat. History Surv. Bull., 317-380 (Department of Registration and Education, Natural History Survey Division, Urbana, IL)

Species diversity, distribution, succession, and abundance of teleost fishes are described for the Illinois river. Factors discussed include water levels, turbidity, 02 level variation, sport and commercial fisheries, and thermal pollution. The upper river was found to be warmer because of warm industrial and municipal discharges. The following species showed a trend of increasing abundance in the downstream direction, away from Chicago, with the largest number occuring in Alton Pool: shortnose gar, bowfin, goldeye, mooneye, channel catfish, flathead catfish, and white bass. Goldfish showed a trend of increasing abundance in the upstream direction. Gamefish populations declined during the low water years 1962-1964, and recovered following the high water years 1971-1973. Recovery appears attributable to improved oxygen level in the river, and perhaps to increased dilution of toxic materials. (ND)

<666>
Spigarelli, S.A., Cesium 137 Activities in Fish Residing in Thermal Discharges to Lake Michigan.

1976. Health Phys., 30, 411-413 (Argonne National Laboratory, Radiological and Environmental Research Division, Ecology Section, Argonne, IL)

Brown trout, rainbow trout and chinook salmon were collected from the thermal discharge area of the Point Beach Nuclear Plant, tagged, released and recaptured. The objectives were to compare Cs-137 activities in plume "resident" fish with those in fish collected from reference (unheated) areas, to compare the residence effect on three important sport fish, and to evaluate the radioecological significance of thermal discharge residence on temporal trends in Cs-137 accumulation by Lake Michigan salmonid fish. Cs-137 activities in plume and reference fish collected in 1971 showed no statistical differences. In 1973, the mean Cs-137 activities in plume fish were higher than those of reference fish for each species. Covariance analysis showed no statistical difference between plume and reference samples of rainbow trout or chinook salmon; the mean Cs-137 activity of plume brown trout was significantly higher than the mean activity of reference brown trout. The majority of fish spent less than 25% (brown trout 17.0%, rainbow trout 14.9%, chinook salmon 9.2%) of the time at the maximum temperature. Cs-137 activity data from 1971 and 1973 show pronounced differences between fish species. Regardless of which groups (plume, reference, or total) are used to make comparisons brown trout and chinook salmon had significantly higher Cs-137 activities than rainbow trout; brown trout and chinook salmon were significantly different. Since plume and reference samples showed the same trend the differences in Cs-137 activities between species may be the result of differential feeding habits or metabolic requirements rather than a reflection of differential plume residence behavior. (ND)

<667>
Spigarelli, S.A., and D.W. Smith, Growth of Salmonid Fishes from Heated and Unheated Areas of Lake Michigan - Measured by RNA-DNA Ratios.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at

<667> CONT.
Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Argonne National Laboratory, Radiological and Environmental Research Division, Argonne, IL)

Relative growth-rate comparisons were made between tagged fish "resident" in a thermal plume and fish collected from two ambient temperature areas (control). Plume fish were tagged, released, and subsequently recaptured in the thermal discharge area of the Point Beach Nuclear Plant (near Two Rivers, Wis.). Total tag days indicated minimum "residence" time, and temperature-sensitive tags gave estimates of time spent at discharge temperatures. Growth-rate estimates were based on RNA-DNA ratios in epaxial muscle samples taken from brown and rainbow trout and chinook salmon. Mean RNA-DNA ratios of plume rainbow trout and chinook salmon were not significantly different from mean ratios of combined control groups for each species. The mean ratios of plume brown trout was significantly higher than that of combined control fish. Significant differences between mean ratios of control groups for each species suggest considerable natural variability in growth rates among individuals of a population. Although other workers have suggested that residence at elevated temperatures could affect fish growth, our data show no correlation between estimated residence times and RNA-DNA ratios or condition factors in plume fish. Probable reasons for a lack of difference in growth for some species and apparent differences in other species are discussed in terms of results of our fish behavioral research at thermal-discharge sites on Lake Michigan. (Auth)

<668>
Stancyk, S.E., The Life History Pattern of OPHIOTHRIX ANGULATA (Ophiuroidea).

1975. Amer. Zool., 15, 793 (University of Florida, Department of Zoology, Gainesville, FL)

Life history parameters of OPHIOTHRIX ANGULATA were studied in the polyhaline estuary at Cedar Key, Florida, to determine how this species has adapted to unpredictable variations in salinity and temperature. Analysis of monthly population samples, growth, mortality, reproduction and respiration indicate that O. ANGULATA is short-lived, with a low tolerance of environmental stress. It has numerous small (0.1 mm) eggs, short-lived planktotrophic larvae, and spawns year-round; individuals spawn for only one season. Disappearance of the population in July 1973 was correlated with poor spring recruitment due to low salinities and high adult mortality during warm periods in June. O. ANGULATA is a fugitive species selected for high dispersal and the ability to colonize or recolonize disturbed habitats after local extinction. Two other ophiuroids in the area (OPHIOPHRAGMUS FILOGRANEUS and OPHIODERMA BREVISPINUM) have adopted the opposite strategy. They have adaptions which help the young stages avoid stress conditions, and are selected for low dispersal and broad tolerance of environmental fluctuations. (Auth)

<669>
Stanley, D.W., and R.J. Daley, Environmental Control of Primary Productivity in Alaskan Tundra Ponds.

1976. Ecology, 57, 1025-1033 (North Carolina State University, Department of Zoology, Raleigh, NC)

The photosynthetic response of tundra pond algae to various combinations of temperature, light intensity, and phosphate concentration was measured at weekly intervals during the 1973 summer. In these small (50 m diam by 20 cm deep) ponds near Barrow, Alaska the epipelic algae had a higher temperature optimum (greater than 20 C) for photosynthesis than did the phytoplankton (14 C) but the epipelic Q10 (2.5 to 12.5 C) for photosynthesis was only 2.2, compared to a value of 3.0 for the planktonic algae. Thus the epipelic algae seemed to be adapted to the sediment environment where temperatures were usually higher than temperatures in the water. The plankton algae, in contrast, appeared to consist of species which photosynthesized more efficiently at the lower temperatures of the pond water. The photosynthetic half-saturation light intensity was temperature dependent, increasing as much as threefold in the epipelic experiments over a 10-degree temperature range. (Auth) (ST)

<670>
Stauffer, J.R., K.L. Dickson, J. Cairns, Jr., and D.S. Cherry, The Potential and Realized Influences of Temperature on the Distribution of Fishes in the New River, Glen Lyn, Virginia.

1976. Wildlife Monographs No. 50; Jour. Wildlife Manag. (Suppl.), 40 (Virginia Polytechnic Institute and State University, Center for Environmental Studies, Blacksburg, VA)

Laboratory and field temperature preference and avoidance data of several species of fish is reported. The importance of studying the effects of environmental parameters of each species on a site-specific basis was demonstrated. There was a good correlation between laboratory and field estimates of temperature preference of those species for which local populations were used to derive both types of data except for the spotfin shiner. Field and laboratory temperature preferences differed primarily when local population were not used for laboratory studies. The study identified five basic responses to temperature: (1) fish that avoided warm temperatures and had a relatively cool final temperature preference such as the northern hog sucker and the stoneroller; (2) fish that were attracted to warm temperatures and had a relatively warm final temperature preference such as the channel catfish; (3) fish that showed a preference temperature-acclimation temperature relationship in the laboratory, but demonstrated no preference temperature in the field, such as the spotfin shiner; (4) fish, such as the smallmouth bass, that had a distribution potentially affected by forage fish distribution and which were not present in sufficient numbers to make a field determination, but did respond to laboratory conditions; and (5) fish, such as the fantail darter, that did not demonstrate any temperature selection under laboratory conditions, but did have a field distribution markedly correlated with temperature. Results of multivariate screening techniques indicated that, with the exception of the spotfin shiner, temperature was extremely important in determining the local distribution patterns of the important species. (ST)

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Stauffer, J.R., Jr., J. Cairns, Jr., and K.L. Dickson, Distribution of Fish in Relation to Thermal Discharges.

1974. Assoc. Southeast. Biol. Bull., 21, 86 (Abstract only) (Virginia Polytechnic Institute and State University, Blacksburg, VA)

Studies to determine the distribution of fish in the New and East Rivers in relation to thermal discharges from Appalachian Power Company's fossil fuel plant at Glenn Lyn, Virginia, were conducted. Over 15,300 specimens representing 41 species were collected with seines, electrogear and rotenone at six sampling locations from February, 1973 to October 1973. Sampling frequency was designed to evaluate the effects of ambient temperature upon preferred temperature. A temperature matrix comparing numbers of specimens of each species with temperature (range 0-39 C) was constructed to illustrate temperature preferendum for selected species. Diversity indices were calculated for each location. There was a slight decrease in the diversity indices for those stations located in the thermal discharge. Coefficients of condition were calculated for NOTROPIS ALBEOLUS, NOTROPIS RUBELLUS, NOTROPIS SPILOPTERUS, ICTALURUS PUNCTATUS and ETHEOSTOMA BLENNIOIDES. Condition factors were generally lower for those fish captured in the thermal effluents. Temperature shock experiments using NOTROPIS SPILOPTERUS resulted in no mortality over a 96 hr period, when specimens acclimated to 33 C water were immediately exposed to 22 C water. Experiments using fish acclimated to 22 C water and exposed to 33 C water again resulted in no mortality. (Auth)

<672>
Stauffer, J.R., Jr., K.L. Dickson, J. Cairns, Jr., W.F. Calhoun, M.T. Masnik, and R.H. Myers, Summer Distribution of Fish Species in the Vicinity of a Thermal Discharge New River, Virginia.

1975. Arch. Hydrobiol. (Ger.), 76, 287-301 (Virginia Polytechnic Institute and State University, Blacksburg, VA)

Studies were conducted to determine the effect of several variables on the summer distribution of important species in the vicinity of a heated discharge located on the New River in southwestern Virginia. For some species (HYPENTELIUM NIGRICANS, ICTALURUS PUNCTATUS) there was a marked effect of temperature on the spatial and temporal distributional patterns. For other species multivariate techniques were used to screen for the effects of temperature, photoperiod, time since last chlorination period, river flow, and gradient on abundance. Three major responses to temperature were found: 1) an avoidance to high temperatures (HYPENTELIUM NIGRICANS; CAMPOSTOMA ANOMALUM; NOTROPIS RUBELLUS; 2) an attraction to high temperatures (ICTALURUS PUNCTATUS); 3) an indifference to temperature changes within the range observed (NOTROPIS SPILOPTERUS). Abundance of 40 species is tabulated. (Auth)

<673>
Stauffer, J.R., Jr., J.H. Wilson, and K.L. Dickson, Comparison of Stomach Contents and Condition of Two Catfish Species Living at Ambient Temperatures and in a Heated Discharge.

1976. Progressive Fish-Culturist, 38, 33-35 (Virginia Polytechnic Institute and State University, Department of Biology and Center for Environmental Studies, Blacksburg, VA)

The stomach contents and condition of young-of-the-year channel catfish (ICTALURUS PUNCTATUS) and flathead catfish (PYLODICTUS OLIVARIS) living at the highest ambient river temperature of the New River, Virginia, (26.7 C) and at their final field temperature preference (34.4 C) in a heated discharge were compared. On the basis of a comparison of stomach contents with the composition of the macrobenthic community at each station, it appeared that young-of-the-year channel catfish were nonselectively eating food organisms present at both stations. The contents of stomachs of flathead catfish from the heated site, however, were different from the fauna available in the substrate at the heated site, indicating that the fish were either moving out of the heated area to feed or were selectively feeding on organisms, particularly mayflies, which were in the substrate or drifted into the heated area. Condition factors were significantly lower for fish of both species captured in the heated area than for the reference area. (ST)

<674>
Steele, D.H., Seasonal Changes in Abundance of GAMMARUS OCEANICUS (Crustacea, Amphipoda) in Newfoundland.

1976. Can. Jour. Zool., 54, 2019-2022 (Memorial University of Newfoundland, Department of Biology, St. John's, Newfoundland, Canada)

Abundance of GAMMARUS OCEANICUS reaches a peak in late summer-early autumn and declines to a low in the spring just before the young are produced. GAMMARUS OCEANICUS disappears from the upper beach in late autumn, but is found permanently at lower levels. At low levels the numbers found under stones vary directly with stone size and inversely with the level of the stone on the beach. This, in turn, is related to environmental temperature. In the microhabitat under the stones, temperature varies inversely with stone size and directly with the level on the beach. (Auth)

<675>
Steele, D.H., and V.J. Steele, The Biology of GAMMARUS (Crustacea, Amphipoda) in the Northwestern Atlantic. XI. Comparison and Discussion.

1975. Can. Jour. Zool., 53, 1116-1126 (Memorial University of Newfoundland, Department of Biology, St. John's, Newfoundland, Canada)

Available data on some aspects of the biology of ten species of GAMMARUS are summarized and compared. It is concluded that the main adaptation allowing these species to occupy their extensive geographic range from the North Pole to the Gulf of Mexico is variation in body size. The large size of northern species (G. WILKITZKII and G. SETOSUS) results in the production of a single, large, well-timed brood, which is released within the short period of optimum conditions. The medium-sized species (G. OCEANICUS, G. DUEBENI, G. FINMARCHICUS, and G. OBTUSATUS) produce several medium-sized broods spread through the longer optimum season. The small species (G. LAWRENCIANUS, G TIGRINUS, G. STOERENSIS, and G. MUCRONATUS) can produce a large number of small broods per female and also mature second generations in the much longer and warmer optimum season characteristic of the southern environment.

<675> CONT.
The duration of embryonic development for each species at 0 and 10 C is given. (Auth) (ST)

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Steffel, S., A.E. Dizon, J.J. Magnuson, and W.H. Neill, Temperature Discrimination by Captive Free-Swimming Tuna, EUTHYNNUS AFFINIS.

1976. Trans. Amer. Fish. Soc., 105, 588-5912 (University of Wisconsin, Laboratory of Limnology, Madison, WI; Southwest Fisheries Center, Honolulu, HI)

Captive kawakawa, EUTHYNNUS AFFINIS, were instrumentally conditioned to respond to an increase in temperature to determine discrimination abilities. Two fish yielded a discrimination threshold of 0.10 to 0.15 C. Thermal sensitivity of this high-seas pelagic fish is thus no more acute than that of inshore fish and appears inadequate for direct sensing of weak horizontal temperature gradients at sea. (Auth)

<677>
Stein, L., S. Jacobson, and J. Atema, Behavior of Lobsters (HOMARUS AMERICANUS) in a Semi-Natural Environment at Ambient Temperatures and under Thermal Stress.

1975. WHOI-75-48; 49 p. (Woods Hole Oceanographic Institution, Woods Hole, MA)

In large aquaria receiving ambient seawater and containing several marine species, lobsters (HOMARUS AMERICANUS) showed little aggressive behavior. Aggression was most frequent during feeding. Although patterns of residence and dominance changed seasonally, the direction of change was different between aquaria and did not appear to be correlated with temperature. Factors such as molting and loss of dominance prior to mating in previously aggressive females were probably more important than temperature effects. The frequency of aggressive behavior in the temperature range 22 to 28 C was similar to levels at ambient temperatures. Interspecific relations between lobsters and the other species were mainly pacific. The response of eels (ANGUILLA ROSTRATA) to temperature increases was consistent between tanks. Swimming was first observed at 8 C, and feeding at 10 C. The eels in both tanks became markedly aggressive when the temperature reached 26 C. (ST)

<678>
Stepien, W.P., Jr., Feeding of Laboratory-Reared Larvae of the Sea Bream ARCHOSARGUS RHOMBOIDALIS (Sparidae).

1976. Marine Biol. (W. Ger.), 38, 1-16 (University of Miami, Rosenstiel School of Marine and Atmospheric Science, Miami, FL)

Feeding by larvae of the sea bream ARCHOSARGUS RHOMBOIDALIS (Linnaeus) was investigated from late September, 1972 to early May, 1973 using laboratory-reared larvae. Techniques were developed to estimate feeding rate, food selection, gross growth efficiency, and daily ration. Daily estimates of these were obtained through 16 days after hatching at rearing temperatures of 23, 26, and 29 C. Feeding rate increased exponentially as the larvae grew, and increased as temperature was raised. At 23 C larvae began feeding on Day 3, at 26 and 29 C larvae began feeding on Day 2. Feeding rates at initiation of feeding and on Day 16 were, respectively: 23 C, 7.16 food organisms per larva per hour (flh) and 53.78 flh; 26 C, 7.90 flh and 168.80 flh; 29 C, 17.62 flh and 142.07 flh. Sea bream larvae selected food organisms by size. Mean values for gross growth efficiency of sea bream larvae ranged from 30.6% at 23 C to 23.9% at 29 C. Mean values for daily ration, expressed as a percentage of larval weight, ranged from 84% at 23 C to 151% at 29 C and tended to decline as the larvae grew. (Auth) (ST)

<679>
Stevens, E.D., and A.M. Sutterlin, Heat Transfer Between Fish and Ambient Water.

1976. Jour. Exp. Biol., 65, 131-145 (University of Guelph, Department of Zoology, Guelph, Ontario, Canada; Department of the Environment, Biological Station, St. Andrews, New Brunswick, Canada)

The ability of fish gills to transfer heat was measured by applying a heat pulse to blood in the ventral aorta and measuring it before and after passing through the gills of a teleost, HEMITRIOPTERUS AMERICANUS. Eighty to ninety percent of heat contained in the blood was lost during passage through the gills. The fraction of heat not lost during passage through the gills was due to direct transfer of heat between the afferent and efferent artery within the gill bar. The major fraction of metabolic heat (70 to 90%) was lost through the body wall and fins of the sea raven in seawater at 5 C; the remainder was lost through the gills. (Auth)

<680>
Stewart, B.Y., The Influence of Temperature on the Fatty Acid Composition of TETRAHYMENA PYRIFORMIS W.

1975. Ph.D. Thesis, Bryn Mawr College; 104 p. (Bryn Mawr College, Bryn Mawr, PA)

A change in the environmental temperature of TETRAHYMENA PYRIFORMIS altered the fatty acid composition of the glycerophospholipids and sphingolipids. Lowering the growth temperature from 25 to 15 C resulted in an increase in the proportion of odd iso saturated fatty acids and a replacement of the unsaturated fatty acids belonging to the omega-9 series by unsaturated acids belonging to the omega-7 series. An elevation in culture temperature from 25 C to the supraoptimal condition at 31 C resulted in a diminution in unsaturated fatty acids, an increase in long chain saturated fatty acids and a replacement of the members of the omega-7 series of unsaturated fatty acids by components of the omega-9 series. The data indicated that changes in the fatty acid composition of the phospholipids at low temperature are due to an increase in the utilization of leucine as a precursor for odd iso fatty acids and a decrease in the activity of the enzyme system elongating palmitate to stearate. Alterations in the fatty acid composition at the supraoptimal temperature of 31 C suggested an inhibition of the activity of the delta-6 desaturase and an elevation in the activity of the enzyme system elongating palmitate to stearate. These changes in the fatty acid pattern of the phospholipids may affect membrane fluidity and, thus, enable the ciliate to adapt to a wide range of temperatures. (Auth) (ST)

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Stiles, C.D., and N.J. Blake, Seasonal Distribution of a Podocopid Ostracod in a Thermally Altered Area of Tampa Bay, Florida.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA. (University of South Florida, Department of Marine Science, St. Petersburg, FL)

As part of a general ecological survey to determine the effects of a thermal effluent, quantitative samples of living benthic ostracods were collected from November 1973 through June 1974 and during August 1974 in the vicinity of a power plant located on Tampa Bay, Florida. Sampling stations were in the areas of maximum thermal influence and at a control site. For each sampling period, samples taken for organic carbon, salinity, sediment and water temperature, and dissolved oxygen showed that the areas were quite similar, except for temperature, which was found to have the greatest difference among stations of the effluent and ambient areas on a monthly basis. This study concentrates on the distribution of HAPLOCYTHERIDEA SETIPUNCTATA, the dominant ostracod in the study area. Significant differences between population means were detected for all months except May and June. Maximum numbers of living H. SETIPUNCTATA occurred at all stations in June, with densities of 55,000 individuals/m 2 in the area of thermal influence. A positive correlation of temperature with population density was found to occur from March through June at all stations. Temperature was found to play a significant role in limiting populations during the warmer months of the year. Carapaces of this ostracod were found to be depleted of calcium carbonate in individuals occurring in the thermal effluent. (Auth)

<682>
Stipanov, J.A., Investigations into Minimizing Fish Loss at Stream Electric Generating Stations.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Southern California Edison Co., Rosemead, CA)

Efforts by Southern California Edison Co. to mitigate fish loss by entrainment and entrapment at stream electric generating stations are summarized. The development of fish pump systems, diversion nets, and inlet pipe configurations at intake structures are described. A new system which guides entrained fish at the screenwell to a holding area where they can be raised from the screenwell water level and returned to their source was developed. This system is applicable to new generating stations located on ocean sites. A copy of the patent is included. (ST)

<683>
Streit, B., Experimental Investigations on Metabolism of ANCYLUS FLUVIATILIS (Gastropoda - Basommatophora). 1. Ingestion, Assimilation, Growth and Egg-Laying.

1975. Arch. Hydrobiol./Suppl. (Ger.), 47, 458-514 (Universitat Freiburg, Limnologisches Institute, Konstanz-Egg, Germany)

Ingestion, assimilation and production rates of the freshwater pulmonate ANCYLUS FLUVIATILIS were determined by offering them algae on millipore filters. Experiments on the influence of algal quality, algal quantity, temperature, season and animal size were run. The animal showed highly irregular activity patterns during the day as well as during the year. Maximum ingestion and assimilation rates were found at 25 C, maximum growth and egg-laying at 19 C, maximum value of K sub 1 (production/ingestion) at 13 C, lower limit of egg-laying between 7 C and 10 C. Growth stopped below 7 C. (Auth)

<684>
Streit, B., Energy Flow in Four Field Populations of ANCYLUS FLUVIATILIS (Gastropoda - Basommatophora).

1976. Oecologia (Ger.), 22, 261-273 (University of Freiburg, Institute of Limnology, Konstanz, Germany)

In the laboratory hatching of limpet (ANCYLUS FLUVIATILIS) eggs occurred in 16 days at 25 C and in 58 days at 10 C. At 7 C or below no development was observed. (ST)

<685>
Strong, R.D., Distribution, Morphometry, and Thermal Stress Studies on Two Forms of LINCKIA (Asteroidea) on Guam.

1975. Micronesica, 11, 167-183 (University of Guam, Marine Laboratory, Agana, Guam)

The rate of oxygen uptake of the starfish, LINCKIA sp., increased between 25 and 34 C. For LINCKIA LAEVIGATA it increased between 25 and 31 C, but leveled off between 31 and 34 C. At 36 C the rate of oxygen consuption in both forms decreased, indicating a disturbance in metabolic activity. LINCKIA LAEVIGATA was more tolerant to short exposures at 36 C and survived for longer periods of time when maintained at 34 and 36 C than did LINCKIA sp. (ST)

<686>
Stroud, R.H. (Ed.), and H. (Ed.) Clepper, Black Bass Biology and Management.

1975. Proceedings of a Symposium on Black Bass Biology and Management of the Centrarchid Basses held in Tulsa, Oklahoma, February 3-6, 1975. Sport Fishing Institute, Washington, D.C. (Not given)

The symposium highlighted the biology and management of black bass, MICROPTERUS sp. Two papers on the response of bass to natural and artificial temperature regimes and to thermal stress were selected and abstracted separately for the data base. (ST)

<687>
Studt, J.P., and N.J. Blake, Chronic in Situ Exposure of the Bay Scallop to Power-Plant Effluents.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (University of South Florida, Department of Marine Science, St. Petersburg, FL)

<687> CONT.
The bay scallop, ARGOPECTEN IRRADIANS CONCENTRICUS (Say), was transplanted to the vicinities of two power-plant installations, the P.L. Bartow site (Tampa Bay, Fla.) and the Anclote estuary site (near Tarpon Springs, Fla.). The mean increase in temperature over ambient at the P.L. Bartow site was 6 C near the outfall, and the mean thermal increase at the Anclote site was 2 C near the outfall. Scallops were exposed to a thermal gradient at three stations (temperature increase of 1 to 2 C) at the P.L. Bartow site for one month, and a temperature increase of 1 to 2 C station at Anclote for over five months. Incidence of mortality was higher at the thermally altered stations than at the ambient stations. Sublethal effects (disruption of the normal reproductive cycle) were found at all thermally altered stations. (Auth)

<688>
Stuntz, W.E., Habitat Selection and Growth of Bluegill.

1975. Ph.D. Thesis, University of Wisconsin (University of Wisconsin, Madison, WI)

Laboratory growth, temperature preference, light intensity preference, substrate size preference, and cover density preferences were considered as variables in the process of habitat selection by bluegills (LEPOMIS MACROCHIRUS). Field observations were made on bluegill distribution and behavior. Growth of individual bluegills was measured at daily rations of 1 and 4% of the wet body weight/day and when the ration was in excess over the temperature range of 4 to 34 C at 3 C intervals. Growth rate was highest at 19 C for fish receiving an ad libitum ration, 16 C on a 4% daily ration and 13 C on a 1% daily ration. Although growth was low, conversion efficiency was high at 4 and 7 C. Conversion efficiency was least at 10 C and peaked at 19 C. When receiving food ad libitum, bluegills were able to grow at all temperatures tested. In temperature preference experiments the median selected temperature for growing fish was 31.2 C. Fish losing weight selected 29.8 C. Fish receiving the maintenance daily ration (2%) selected lower temperatures as the experiment progressed, selecting less than 24 C on the last day. In two-chambered shuttle-box aquaria, individual fish, allowed to select between different levels of light, temperature, substrate size and cover density, selected a temperature near the present acclimation state. When two pairs of variables were presented, there was a hierarchy of variables: light followed by temperature and cover or substrate. Temperature did not appear to influence habitat selection in the field. (Auth) (ST)

<689>
Stuntz, W.E., and J.J. Magnuson, Daily Ration, Temperature Selection, and Activity of Bluegill.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (University of Wisconsin, Laboratory of Limnology, Madison, WI)

Growth consequences of variations in daily ration were studied in relation to temperature preference of bluegill (LEPOMIS MACROCHIRUS). Yearling bluegills held at 25 C were fed earthworms at daily rations of 0, 2, 4, and 6% of body weight. After two weeks they (about seven fish per ration) were monitored in a temperature-preference device for five days. Preferred temperature, but not spontaneous activity, decreased at lower rations; these were adaptations expected for energy conservation. Thus bluegill would be expected to occur at their preferred temperature over long periods of time only if sufficient rations were available. At preferred temperatures they grew on rations of 4 and 6% of body weight but not of 0 and 2%. (Auth)

<690>
Styron, C.E., T.M. Hagan, D.R. Campbell, J. Harvin, N.K. Wittenburg, G.A. Baughman, M.E. Bransford, W.H. Saunders, D.C. Williams, C. Woodle, N.K. Dixon, and C.R. McNeill, Effects of Temperature and Salinity on Growth and Uptake of Zinc-65 and Cesium-137 for Six Marine Algae.

1976. Jonr. Mar. Biol. Assn. U.K., 56, 13-20 (St. Andrews Presbyterian College, Division of Mathematical, Natural and Health Sciences, Laurinburg, NC)

Population growth and concentration factors for Zn-65 and Cs-137 were measured for ACHNANTHES BREVIPES, CARTERIA sp., CHLAMYDOMONAS sp., DUNALIELLA SALINA, NANNOCHLORIS ATOMUS, and PHAEODACTYLUM TRICORNUTUM subjected to factorial combinations of eight temperatures (6 to 40 C) and ten salinities (3.5 to 44.0 ppt). Regression coefficients were calculated for polynomial models describing response surfaces for growth and radionuclide concentration. Salinity was more important than temperature in describing population growth for CARTERIA, DUNALIELLA, NANNOCHLORIS and PHAEODACTYLUM. No independent variable was consistently of primary importance in describing Cs-137 concentration factors, while temperature accounted for more variation in Zn-65 concentration factors than salinity or population growth in all algae except DUNALIELLA. Concentration factors for Zn-65 were uniformly higher than Cs-137 concentration factors. (Auth)

<691>
Sulkin, S.D., E.S. Branscomb, and R.E. Miller, Induced Winter Spawning and Culture of Larvae of the Blue Crab, CALLINECTES SAPIDUS Rathbun.

1976. Aquaculture, 8, 103-113 (University of Maryland, Chesapeake Biological Laboratory, Center for Environmental and Estuarine Studies, Solomons, MD)

Female crabs were induced to produced eggs out of their normal spawning season by holding them at constant temperatures. Of ten crabs held at 19 C, two produce egg masses and one died when spawning was about to commence. Among those crabs not producing egg masses during the experiment, ovarian development at 19 C proceeded further than among those held at 15 C. None of the crabs held at 15 C produced eggs. (ST)

<692>
Sullivan, M.J., Diatom Communities from a Delaware Salt Marsh.

1975. Jour. Physiol. (Fr.), 11, 384-390 (University of Delaware, Department of Biological Sciences, Newark, DE)

Edaphic diatoms were collected from 5 representative habitats of Canary Creek salt

<692>

<692> CONT.
marsh, Lewes, Delaware, from 24 July 1969 to 21 July 1970. Of the 104 taxa encountered, 32 had a general distribution on the marsh and 41 were endemic to one of the 5 habitats sampled. Three of the habitats supported stands of grasses: tall SPARTINA ALTERNIFLORA, dwarf S. ALTERNIFLORA, and DISTICHLIS SPICATA; and these habitats possessed the highest species diversity and the greatest number of diatom species. The remaining two habitats, a barebank and a panne, were devoid of macroscopic vegetation. The diatoms of these last two habitats were exposed to hypersaline conditions during warmer periods of the year and this was considered a contributing factor to the lower values observed for the aforementioned parameters of community structure. A comprehensive examination of the community structure characterizing the five habitats, employing statistical analyses and the distribution of species, showed each habitat to support its own unique and easily recognizable edaphic diatom community. A multiple regression analysis indicated that the differences between the five communities were closely related to differences in temperature and elevation between the habitats, and also a result of significant interactions between edaphic diatoms and filamentous algae. The panne had the highest average temperature which indicates that the algal mat has a higher heat capacity than the mud surface of the tall SPARTINA ALTERNIFLORA habitat. The temperature of the marsh surface and the standing water were virtually identical throughout the year. (ND)

<693>
Sundararaj, B.I., and S. Vasel, Photoperiod and Temperature Control in the Regulation of Reproduction in the Female Catfish HETEROPNEUSTES FOSSILIS.

1976. Jour. Fish. Res. Bd. Can., 33, 959-973 (University of Delhi, Department of Zoology, Delhi, India)

Ovarian development and maturation of the catfish, HETEROPNEUSTES FOSSILIS, was advanced by manipulation of temperature and photoperiod in the laboratory. Warm temperature (30 C) advanced the spawning period form the usual time of July-August to April. During the postspawning and preparatory periods, ovarian recrudescence occurred faster at 30 C than at ambient, 25, or 34 C regardless of photoperiod. In addition, the temperature of 30 C postponed the ovarian regression until October. At 30 C and with the administration of luternizing hormone, catfish were induced to spawn four times between April and July of the same year. The implications for aquaculture potential are discussed. (ST)

<694>
Swain, W.R., R.M. Wilson, and R.P. Neri, Studies on the Effects of Thermal Additions on Selected Zooplankton Populations.

1975. Water Resources Research Center Bulletin 84, 85 p. (University of Minnesota, School of Medicine, Duluth, MN)

The effects of calefaction upon members of the animal portion of the Lake Superior ecosystem were examined. Additionally, certain species which are widely available were also utilized in order to establish a point of reference which could be used by workers in other parts of the country. The conventional approach to a problem of this sort has been to measure the effects of an effluent source on a specific community and attempt to understand the ecological interrelationships of the altered environment. The method described here utilized the establishment of an artificial segment of Lake Superior in a carefully controlled laboratory setting which could be modified at will in order to observe the impacts of each change upon the test organism or community. A method of non-invasive, non-inhibitive remote monitoring using a modified impedence conversion system was utilized. This method enabled measurement of critical physiological and behavioral responses which provided a baseline for work with thermal additions. Studies reported include the respiration response to diminished oxygen by dragonflies (ANAX and SOMATOCHLORA), effect of environmental parameters (heat and light) on MYSIS RELICTA, vertical movement of MYSIDS, determination of activity ranges of selected zooplankton (DAPHNIA), effects of thermal additions on reproductive potential at DAPHNIA MAGNA, horizontal temperature gradient experiments, and lake confirmation of light studies within selected thermal regimes. Thermal additions tended to reduce longevity, increase reproductive rates, and increase factors related to fecundity of DAPHNIA MAGNA. (ND)

<695>
Sylvester, J.R., C.E. Nash, and C.R. Emberson, Salinity and Oxygen Tolerances of Eggs and Larvae of Hawaiian Striped Mullet, MUGIL CEPHALUS L..

1975. Jour. Fish Biol., 7, 621-629 (Oceanic Institute, Waimanalo, HI)

Salinity and dissolved oxygen tolerances of eggs and larvae of MUGIL CEPHALUS were studied. Optimal salinities for eggs incubated at 19.5 to 20.5 C were 30 to 32 ppt. Maximum larval survival occurred within the salinity range of 26 to 28 ppt. Significant decreases in egg survival occurred with eggs incubated in mean 02 concentratiosn below 5.0 ppm. The results are discussed in terms of spawning sites and the effects of 02 saturation values on fish eggs and larvae. (Auth)

<696>
Symons, P.E.K., J.L. Metcalf, and G.D. Harding, Upper Lethal and Preferred Temperatures of the Slimy Sculpin, COTTUS COGNATUS.

1976. Jour. Fish. Res. Bd. Can., 33, 180-183 (Department of the Environment, Fisheries and Marine Service, Biological Station, St. Andrews, New Brunswick, Canada)

The upper lethal and preferred (96-hr LT50) temperatures of slimy sculpin (COTTUS COGNATUS) acclimated at 20 C were 25.0 and 13 C, respectively. (Auth)

<697>
Tanaka, S., Migration of Yellowtails along the Pacific Coast of Japan Observed by Tagging Experiments. 4. Movement in and around the Sagami Bay.

1975. Bull. Jap. Soc. Sci. Fish., 41, 423-427 (University of Tokyo, Tokyo, Japan)

A relationship was observed between water temperature and movement of yellowtails (SERIOLA QUINQUERADIATA) in Sagami Bay, Japan. In the 1963 season water temperature

<697> CONT.
was extremely low and the catch was poor. The temperature rose unusually high toward the end of the season in 1964 and the fish tended to move northward. The temperature was slightly high in January 1965, delaying opening of the fishing season. During the rest of the season the temperature remained within suitable limits and the catch was good. (ST)

<698>
Tanii, K., Effect of Hot Drainage on Fishery.

1974. Genshiryoku Kogyo (Jap.), 20, 23-27 (Japanese Fishery Resources Conservation Association, Tokyo)

The effect of thermal effluent from nuclear power plants on the coastal fishery of Japan is discussed. No deleterious effects from the Sendai steam power plant and the Tsuruga nuclear power plant on the fishery have been observed. The topography of the area and effluent drainage control may be responsible for the lack of effects. (ST)

<699>
Tash, J.C., and C.D. Ziebell, Some Limnological Characteristics of Arivaca Lake in Southern Arizona.

1975. Arizona Acad. Science Jour., 10, 8-14 (University of Arizona, Tucson, AZ)

Physicochemical characteristics (temperature and dissolved oxygen) are presented from Arivaca Lake. Zooplankton and benthos sampling results (occurrence, relative biomass, abundance, and vertical distribution) are also described. High temperature in combination with low dissolved oxgyen severely inhibited the abundance and distribution of benthic insects and zooplankton. (ND)

<700>
Tay, K.L., and E.T. Garside, Some Embryonic Responses of Mummichog, FUNDULUS HETEROCLITUS (L.) (Cyprinodontidae), to Continuous Incubation in Various Combinations of Temperature and Salinity.

1975. Can. Jour. Zool., 53, 920-933 (Dalhousie University, Department of Biology, Halifax, Nova Scotia, Canada)

Embryos of mummichog, FUNDULUS HETEROCLITUS were incubated in various combinations of constant salinity (0, 10, 20, 30, 60 ppt S) and temperature (15, 20, 25, 30 C) from fertilization to completion of hatching. In all instances, the velocity of embryonal development was accelerated at higher temperatures. In salinities of 0, 10, 20, 30 ppt, higher temperature had a similar accelerating effect on developmental rate throughout the embryonal term. However, the highest salinity (60 ppt) retarded embryonal development particularly after neurulation. This retarding effect increased with the increasing temperature. The onset of hatching and 50% hatching time were also retarded in 60 ppt S. Embryos hatched with difficulty in the lowest incubation combination, 0 ppt S, 15 C. This observation is discussed in the light of pertinent literature. Highest percentage total hatch and viable (normal) hatch were obtained at 20 C in all test salinities. Response surface analysis showed that optimum conditions for survival for mummichog embryos appeared to be associated with salinities and temperature of 19 to 20 ppt and 18 C. Larval length was greatest in groups incubated at 15 and 20 C and 0 to 30 ppt S. (Auth)

<701>
Teleki, G.C., The Incidence and Effect of Once-Through Cooling on Young-of-the-Year Fishes at Long Point Bay, Lake Erie: A Preliminary Assessment.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (Ministry of Natural Resources, Port Dover, Ontario, Canada)

Every 2 weeks, from June 7 to Aug. 21, 1974, larval and young juvenile fish were sampled in the forebay, outfall gates, and effluent channel of the Nanticoke Generating Station located on Long Point Bay, Lake Erie, Ontario, Canada. With the plant operating at 25% maximum capacity, from 7708 to 134,820 larvae of six species were entrained every 24 hr. At peak plant output, estimates were from 30,800 to 539,000 fish entrained per 24 hr. This equals an hourly removal of 2.9% of the study-area water (22.4 by 106 m3) and most of the organisms contained therein. Smelt (OSMERUS MORDAX), constituting 95% of the total number of larvae entrained, were taken during all sampling hours. Mottled sculpin (COTTUS BAIRDI), carp (CYPRINUS CARPIO), alewife (ALOSA PSEUDOHARENGUS), and gizzard shad (DOROSOMA CEPEDIANUM) made up 4% of the catch and were captured only at night. Yellow perch (PERCA FLAVESCENS) comprised the remaining 1% and were taken in dawn and dusk samples. Of all the fish passing through the condenser, only 1 to 3.7% survived. However, on the basis of the density of living smelt larvae in the forebay and effluent channel, 84% were killed by the time they had reached the effluent channel via the condenser and the tempering water. Separating the lethality on the basis of volume of water used by the two systems, 49.5% of the total plant mortality was due to mechanical injuries and only 34.5% due to condenser-passage shock. The impact of this entrainment loss to the harvestable stock, not including loss of spawners, would be 43 tonnes annually, assuming the survival from larvae to recruit in nature is 1%. This loss is equal to 12% of the average (1972 to 1974) annual catch of one trawl fisherman operating in the eastern basin of Lake Erie. (Auth)

<702>
Teppen, T.C., and J.R. Gammon, Distribution and Abundance of Fish Populations in the Middle Wabash River.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (DePauw University, Department of Zoology, Greencastle, IN)

A field investigation was made of the distribution and abundance of fish within a 161-km portion of the Wabash River to determine effects of heated effluents as well as changes in water quality on ichthyofaunal communities within the river. Twenty-six sampling stations were electrofished, sequentially four times in 1974 with extended sampling efforts made in the vicinity of two

<702> CONT.
power-generating stations studied since 1967 and 1968. During August an overall rise in river temperature of 4 C was observed from upstream to downstream, with several chemical factors also showing slight increases. Although the majority of species populations were influenced either negatively or positively by the gradient of river conditions available to them, the only statistically significant parameters found in the analysis of community structure involved a lower diversity by weight below Terre Haute and a greater abundance of fish avove the Cayuga generating station. Decreases occurred downstream in populations of redhorse (MOXOSTOMA sp.), sauger (STIZOSTEDION CANADENSE), longear sunfish (LEPOMIS MEGALOTIS), and gizzard shad (DOROSOMA CEPEDIANUM), with increases downstream observed in flathead catfish (PYLODICTIC OLIVARIS), shortnose gar (LEPISOSTEUS PLATOSTOMUS), longnose gar (L. OSSEUS), and bowfin (AMIA CALVA) populations. Carp (CYPRINUS CARPIO) were present in large numbers throughout the study area with a tremendous population increase evident in recent years. Although species associations were variable among the segments, overall community parameters remained relatively unaffected. (Auth)

<703>
Terpin, K.M., J.R. Spotila, and R.R. Koons, Effect of Photoperiod on the Temperature Tolerance of the Blacknose Dace, RHINICHTHYS ATRATULUS.

1976. Comp. Biochem. Physiol., 53A, 241-244 (State University College at Buffalo, Department of Biology, Buffalo, NY)

Blacknose dace, RHINICHTHYS ATRATULUS, were acclimated to long daylength, 16 hr of light and 8 hr of darkness (L:D 16:8), and short daylength, 8 hr of light and 16 hr of darkness (L:D 8:16), at 20 C. Long daylength fish had a higher incipient upper lethal temperature (29.9 C) than short daylength fish (28.8 C). Long daylength fish had a significantly higher mean resistance time at all but one lethal test temperature. Lethal temperature of R. ATRATULUS is compared to that of ecologically related species. (Auth)

<704>
Thatcher, T.O., M.J. Schneider, and E.G. Wolf, Bioassays on the Combined Effects of Chlorine, Heavy Metals and Temperature on Fishes and Fish Food Organisms. Part I. Effects of Chlorine and Temperature on Juvenile Brook Trout (SALVELINUS FONTINALIS).

1976. Bull. Environ. Contam. Toxicol., 15, 40-48 (Battelle Pacific Northwest Laboratories, Ecosystems Department, Richland, WA)

The combined effects of chlorine and temperature on brook trout were determined in continuous-flow bioassays. Acclimation temperatures were 7, 10, 15, and 20 C; experimental temperatures were 10, 15, or 20 C. There was no significant difference between the 96-hr LC50 values from experiments run at 10 or 15 C regardless of the previous acclimation temperature. However, in fish exposed to the 20 C test temperature, all 96-hr LC50 values were significantly less than at the lower test temperatures. Since there were no deaths in the control chambers, the combined effects of thermal alteration and chlorine exposure indicated synergism under these conditions. There was an absence of delayed mortality over an additional three to five day period. The observations indicated that the greater the temperature shock, either an increase or decrease, the higher the mortality. (ST)

<705>
Thomas, A.E., Migration of Chinook Salmon Fry from Simulated Incubation Channels in Relation to Water Temperature, Flow, and Turbidity.

1975. Progressive Fish-Culturist, 37, 219-223 (U.S. Fish and Wildlife Service, Fish Farming Experimental Station, Stuttgart, AR)

Artificially-induced variables of increased water temperature and turbidity both produced major increases in migration of chinook and chum salmon fry (ONCORHYNCHUS TSHAWYTSCHA and ONCORHYNCHUS KETA) from incubation channels receiving natural stream water while doubling the water flow did not. Natural stream water temperature was raised 2.2 C during the study. (ST)

<706>
Thompson, G.D., and R.W. Davies, Observations on the Age, Growth, Reproduction, and Feeding of Mountain Whitefish (PROSOPIUM WILLIAMSONI) in the Sheep River, Alberta.

1976. Trans. Amer. Fish. Soc., 105, 208-219 (University of Calgary, Department of Biology, Calgary, Alberta, Canada)

The ecology of mountain whitefish in the upper Sheep River was studied during 1972 and 1973. Mountain whitefish spawn from late September to mid-October in shallow, fast, midstream areas. The daily variation of water temperature during the spawning period ranged from 0 to 8 C. Two to twenty fish occupied each spawning site. (ST)

<707>
Thomson, D.A., and C.E. Lehner, Resilience of a Rocky Intertidal Fish Community in a Physically Unstable Environment.

1976. Jour. Exp. Mar. Biol. Ecol. (Neth.), 22, 1-29 (University of Arizona, Department of Ecology and Evolutionary Biology, Tucson, AZ)

A seven-year census of intertidal fishes was made by repeated defaunation of tide pools in the northern Gulf of California. The intertidal fish community showed long-term resilience, and hence stability, under a rigorous, unstable physical environment. Although the majority of fishes have tropical affinities (76%), warm temperate species (24%) constitute 33% of total numbers and 69% of total biomass of the entire intertidal fish community. Short-term seasonal fluctuations in species diversity and population numbers of temperate fishes were in better synchrony with the annual light regime and sea temperature cycles than those of tropical species. A winterkill due to abnormally low sea temperatures in January, 1971, exerted faunal selection by killing several tropical fishes. Warm temperate species tolerated these low temperatures both experimentally and during the 1971 winterkill. The only tidepool fish directly observed to be affected by the low water temperature was the sergent major, ABUDEFDUF TROSCHELII. During this period sea temperatures abruptly dropped from 15 to 8.9 C during 14 days. In the laboratory marked interspecific differences in the feeding behavior, activity, and tolerance of seven

<707> CONT.
tidepool fish subjected to gradually decreasing temperatures from 18 to 7 C were observed. Responses to introduced food ranged from frenzied feeding at 18 to 13 C to lethargy and refusal to accept food at temperatures lower than 12 C. There was no mortality due to heat in a 41 day experiment (18 to 12 C), but only a few fish survived the 31-day experiment (about 20 days at temperatures below 12 C). Low sea temperatures were judged to be more limiting to diversity than high sea temperatures. The seasonal tidal pattern in the northern Gulf of California moderates summer heating but accentuates winter cooling thus favoring winterkills. (Auth) (ST)

<708>
Thorhauge, F., Reproduction of POTAMOTHRIX HAMMONIENSIS (Tubificidae, Oligochaeta) in Lake Esrom, Denmark. A Field and Laboratory Study.

1976. Arch. Hydrobiol. (Ger.), 76, 449-474 (University of Copenhagen, Freshwater Biological Laboratory, Copenhagen, Denmark)

Production of cocoons, the number of eggs, and the duration of breeding of POTAMOTHRIS HAMMONIENSIS in relation to temperature and weight of the adult individuals was studied in the laboratory. A relation between the developmental rate of embryos and the temperature was found with development time lasting 76 days at 10 C and 19 days at 23 C. At 11 to 20 m depth in Lake Esrom deposition of cocoons occurred in spring and summer, beginning at lower depths at about 5 C due to a larger weight of the specimens there. Usually breeding first ceased at lower depths because of higher temperature. In the deepest parts of the lake the breeding period may be shortened by anaerobic conditions. The production of eggs per individual increased with decreasing depth. Deposition of cocoons was accompanied by decrease in weight of the individuals. (Auth)

<709>
Thorhauge, F., Growth and Life Cycle of POTAMOTHRIX HAMMONIENSIS (Tubificidae, Oligochaeta) in the Profundal of Eutrophic Lake Esrom. A Field and Laboratory Study.

1976. Arch. Hydrobiol. (Ger.), 78, 71-85 (Not given)

Growth of POTAMOTHRIX HAMMONIENSIS in the profundal of Lake Esrom, Denmark, was most rapid in spring and fall, and negative at low oxygen concentrations during late summer. Growth decreased at low temperatures, but occurred at temperatures as low as 2 C. (ST)

<710>
Tilly, L.J., Periphyton Crops and Productivity in a Reactor Thermal Effluent.

1975. DP-MS-74-77; Proposed for presentation at the 38th Annual Meeting of the American Society of Limnology and Oceanography held in Halifax, Nova Scotia, June 23-26, 1975, 21 p. (Savannah River Laboratory, Aiken, SC)

Samples of periphyton grown for two weeks on microscope slides in surface waters of the reactor cooling reservoir Par Pond on the Savannah River Plant were examined for differences in species composition, diversity, standing crop, and C-14 uptake relatable to 7 positions in the thermal effluent. For stations which differed in average temperature by less than 5 C, weight specific productivity differed by a factor of 7. Periphyton biomass differed more than fivefold between stations 5.5 C apart. For most incubation intervals, both weight specific productivity and accumulated crop correlated highly with the average growing temperature, but slopes of regressions from consecutive periods often differed greatly while species composition and temperature regime changed only slightly. Recent experiments indicate that observed differences may be due to interactions between nutrients and temperatures. (Auth)

<711>
Tilly, L.J., Changes in Water Chemistry and Primary Productivity of a Reactor Cooling Reservoir (Par Pond).

1975. CONF-740513; In Howell, F.G., et al. (Eds.), Mineral Cycling in Southeastern Ecosystems held at the University of Georgia, Athens. Savannah River Ecology Laboratory (Savannah River Ecology Laboratory, Aiken, SC)

Water chemistry and primary productivity of a reactor cooling reservoir have been studied for eight years. Initially the primary productivity increased sixfold, and the dissolved solids doubled. The dissolved-solids increase appears to have been caused by additions of makeup water from the Savannah River and by evaporative concentration during the cooling process. As the dissolved-solids concentrations and the conductivity of makeup water leveled off, the primary productivity stabilized. Major cation and anion concentrations generally followed total dissolved solids through the increase and plateau; however, silica concentrations declined steadily during the initial period of increased plankton productivity. Standing crops of net seston and centrifuge seston did not increase during this initial period. The collective data show the effects of thermal input to a cooling reservoir, illustrate the need for limnological studies before reactor siting, and suggest the possibility of using makeup-water additions to power reactor cooling basins as a reservoir management tool. (Auth)

<712>
Tilton, J.E., Aquatic Life in Texas Reservoirs.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Texas Electric Service Company, Fort Worth, TX)

Several reports and studies of Texas reservoirs that receive thermal discharges are reviewed. The papers indicate that thermal effects from electric generating facilities do not affect the phytoplankton, zooplankton, benthos, or fish populations in a detrimental manner. Total fish and game fish productivity in 20 reservoirs is tabulated. Nine of the reservoirs receive thermal discharges. A bibliography is not included. (ST)

<713>
Tilton, J.E., The Potential for Aquaculture Utilizing the Water Flow and Waste Heat from Power Plant Operations.

<713>

<713> CONT.
1975. In Water Resources Symposium No. 8, Water Management by the Electric Power Industry, Section 5, Beneficial Uses of Low-Grade Heat, E.F. Gloyna et al. (Eds.). Center for Research in Water Resources, the University of Texas at Austin (Texas Electric Service Company, Fort Worth, TX)

Several sources of information on aquaculture projects are listed. The author contends that aquaculture is a viable, but underdeveloped, food production method. Thermal effluents from power plants provide both temperature control and water flow and volume for aquatic production. Two culture problems in non-flowing systems, the build-up of wastes from cultured organisms and the continuous proliferation of fish pathogens, are discussed. The utilization of Texas reservoirs for experimental food production which would help meet the world's future food needs is proposed. However, the need for research funds and the proposed effluent guidlines presently hamper such a project. (ST)

<714>
Tinsman, J.C., S.G. Tinsman, and D. Maurer, Effects of a Thermal Effluent on the Reproduction of the American Oyster.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (University of Delaware, College of Marine Sciences, Lewes, DE)

Oysters (CRASSOSTREA VIRGINICA) were sampled from September 1970 to September 1972 from two stations in Indian River Bay, Delaware, for histological examination. Station 1 (control) was located near the intake of the Delmarva Power and Light Company's fossil-fuel plant in Millsboro, Del. Station 2 (effluent) was 2.5 km east of the plant at the mouth of Island Creek. A combination of classical and quantitative methods was used to document changes in the developmental cycle of oysters resulting from the influence of a thermal effluent. Oysters in the effluent showed precocious gonadal development during the spring, but the time of maximum ripeness and spawning activity was the same at both stations. An extension of the spawning season for several weeks into September was noted for oysters in the effluent. During 1972, oysters in the thermal effluent showed a significantly lower level of gonadal development than did controls. Since this season of decreased reproductive amplitude corresponds with a period of high mortalities among effluent oysters, it seems likely that these oysters were thermally stressed, requiring more energy for maintenance and leaving less available for reproduction. (Auth)

<715>
Titarev, Ye.P., Acceleration of Maturation in the Rainbow Trout (SALMO GAIRDNERI) under the Influence of Increased Water Temperature.

1975. Jour. Ichthyol., 15, 507-509 (All-Union Pond Fisheries Research Institute (VNIIPRKh), Rybnoye Settlement, Moscow Province, USSR)

The experimental rearing of rainbow trout in the cooling pond of an electric power plant (USSR) showed that the increased water temperature in winter, compared with natural waters, promoted accelerated growth and maturation of the fish. The first mature males were recorded at an age of 19 mo and the first mature females at an age of 22 mo. This is one to two years earlier than found in natural waters of the central zone of the USSR. (ST)

<716>
Tones, P.I., and U.T. Hammer, Osmoregulation in TRICHOCORIXA VERTICALIS INTERIORES Sailer (Hemiptera, Corixidae) - an Inhabitant of Saskatchewan Saline Lakes, Canada.

1975. Can. Jour. Zool., 53, 1207-1212 (University of Saskatchewan, Department of Biology, Saskatoon, Saskatchewan, Canada)

Results of freezing point depression determinations of haemolymph showed that first instars, third instars, and adults of TRICHOCORIXA VERTICALIS INTERIORES have well-developed powers of osmoregulation and can hyporegulate in saline water. This species osmoregulated equally well at 13, 20, and 25 C, but the mean tolerance limit decreased as the temperature increased. It was also tolerant to changes in ionic composition. (Auth) (ST)

<717>
Truchan, J.G., Power Plant Chlorination: Regulatory Considerations.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Michigan Water Resources Commission, Lansing, MI)

The chlorine limitations imposed in National Pollutant Discharge Elimination Systems (NPDES) permits in Region V of the U.S.E.P.A. are discussed. Programs which utilities in the Region have underway to comply with these limitations or to demonstrate that the limitations are not necessary to protect aquatic life are presented. Areas for future research are also discussed. (ST)

<718>
Tsekos, I., and S. Karataglis, Der Einflub der Temperatur aur das Wachstum von Karposporen-Keimlingen der Rhodophycee GRACILIARIA CONFERVOIDES (L.) Grev..

1974. Botanica Marina, 17, 223-226 (Botanisches Institut der Universitat Thessaloniki, Thessaloniki, Griechenland)

The growth of germlings from carpospores of the red alga GRACILARIA CONFERVOIDES showed a clear dependence on the temperature which is represented by the equation y equals negative 14.8 plus 7.2x minus 0.17x(E*2). The optimum temperature for growth was 21.1 C. (Auth)

<719>
Tsuruta, A., and S. Tawara, The Influence of the Warm Cooling Water from a Fossil Fueled Power Plant on Oceanographic Conditions and Composition of Plankton in Owase Bay. I. Water Temperature in Relation to Distribution of Microplankton.

1975. Jour. Shimonoseki Univ. Fish. (Jap.), 23, 121-136 (Not given)

Preliminary investigations of the influence of the warm cooling water from a fossil

<719> CONT.
fueled power plant on oceanographic conditions and the composition of plankton in Owase Bay are reported. Temperature distribution in the surface layer depended on interactions among the cooling water, the Naka River and oceanic water. The distribution of abundant planktonic groups such as Chromonadae (CERATIUM FURCA) showed seasonal variation with dense populations associated with nutrient salts and high temperature in August and January. The Bacillariophyceae and nauplii of copepods were less abundant in the area affected by the thermal discharge than in other areas. (ST)

<720>
Ueno, M., H. Nakamura, T. Maeda, and H. Hirakawa, Ecological Studies on the Alaska Pollack in the Adjacent Waters of the Funka Bay, Hokkaido-I. Feeding Season.

1975. Bull. Jap. Soc. Sci. Fish., 41, 1237-1245 (Hokkaido University, Faculty of Fisheries, Hakodate, Japan; Fukushima Pref. Fish. Exp. Stat., Onahama, Japan)

During the feeding season, July to November, Alaska pollack, THERAGRA CHALCOGRAMMA, were distributed at the 300 m depth at water temperatures of 3 to 4 C and salinities of 33.6 to 33.7 ppt. (ST)

<721>
Ulitzur, S., VIBRIO PARAHAEMOLYTICUS and VIBRIO ALGINOLYTICUS: Short Generation-Time Marine Bacteria.

1975. Microb. Ecol., 1, 127-135 (Hebrew University-Hadassah Medical School, Department of Microbiol. Chemistry, Jerusalen, Israel)

The growth rates of 30 different strains of VIBRIO PARAHAEMOLYTICUS and V. ALGINOLYTICUS at 37 C was determined. Each species consisted of two major groups, one having a short generation time (12 to 14 min) and one with a longer generation time (20 to 25 min). The diversity in generation times of different strains belonging to the same species is discussed. The effect of temperature, salt, and nutrient concentrations on the growth rate of one V. ALGINOLYTICUS strain was studied. Most striking was the effect of the temperature; at 39 C the generation time is 10 to 11 min, while at 21 C it is 60 min. The heat of activation for growth calculated from such data is 22,580 kcal/mol-hr. The ecological significance of these results is discussed. (Auth)

<722>
Umminger, B.L., and H. Kenkel, Ionoregulatory Role of Prolactin in Salt Water Adapted Killifish at Subzero Temperatures.

1975. Amer. Zool., 15, 796 (University of Cincinnati, Cincinnati, OH)

FUNDULUS HETEROCLITUS, acclimated to subzero temperatures in salt water, responded with a hypernatremia and hyperchloremia. Histological studies of gills of killifish acclimated to 15, 8, 2 and -1C indicated that, at subzero temperatures, chloride cells become inactive and mucous cells are stimulated secreting a thick mucous coating over the gills. Histological studies of pituitary prolactin cells indicated an increase in activity at subzero temperatures (large round nuclei with prominent nucleoli) and hypophysectomy abolished the cold-induced hypernatremia seen in intact fish. Prolactin release at subzero temperatures presumably inactivates chloride cells, leading to the rise in serum electrolyte levels, and stimulates mucous production, which may protect the supercooled blood from being seeded by ice crystals through the gills. (Auth)

<723>
Vaccaro, A.M., R. Raschetti, G. Ricciardi, and G. Morpurgo, Temperature Adaptation at the Hemoglobin Level in CARASSIUS AURATUS.

1975. Comp. Biochem. Physiol., 52A, 627-634 (Instituto Superiore de Sanita, Rome, Italy; Istituto dell'Orto Botanico, Rome, Italy)

Electrophoretic examination of hemolysates of goldfish acclimated at 4, 21, and 37 C showed a single hemoglobin band, identical in the three groups. Oxygen dissociation curves of the blood of animals acclimated to different temperatures differed. The changes were caused by a cofactor present in the blood which acts allosterically on the hemoglobin molecule and not by a substitution mechanism. (ST)

<724>
Vadas, R.L., M. Keser, and P.C. Rusanowski, Influence of Thermal Loading on the Ecology of Intertidal Algae.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (University of Maine, Department of Botany and Plant Pathology, Orono, ME; Environmental Analysts, Inc., Woodbury, NY)

Thermal effluents from the Maine Yankee Atomic Power Company (operating intermittently from October 1972 to December 1974) increased water temperatures in the discharge area by 7 to 15 C. Plant operation and the removal of a causeway increased mixing and salinities in Montsweag Bay. Four small red algae immigrated into the area, but no species were lost from the system. Distribution and abundance patterns of the dominant algae, ASCOPHYLLUM NODOSUM and FUCUS VESICULOSUS, were altered by the thermal discharge. The cover of F. VESICULOSUS decreased, whereas that of A. NODOSUM increased in 1973 but declined significantly in 1974. Reductions in biomass and percent cover were accompanied by changes in the growth dynamics of A. NODOSUM. Growth and survival in the discharge area were enhanced in 1973 but reduced in 1974. Growth was initiated earlier at all sites affected by the warm water. Plants at experimental sites not directly in the discharge channel grew at accelerated rates during the two years, but stressed plants in the discharge produced few or no viable apexes in 1974. The net effect has been a compression and reduction of intertidal algae into a narrower and less dense band. (Auth)

<725>
Vadas, R.L., M. Keser, P.C. Rusanowski, and B.R. Larson, The Effects of Thermal Loading on the Growth and Ecology of a Northern Population of SPARTINA ALTERNIFLORA.

1976. CONF-750425; ERDA Symposium Series 40; In

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<725> CONT.
Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (University of Maine, Departments of Oceanography and Zoology, Orono, ME; University of Maine, Department of Botany and Plant Pathology, Orono, ME; Environmental Analysts, Inc., Woodbury, NY)

Thermal effluents from the Maine Yankee Atomic Power Co. increased the plant densities of SPARTINA ALTERNIFLORA during the first year of operation (1973) but reduced the densities substantially the second year (1974). Growth and flowering were initiated earlier near the heated effluent. Subsequent growth was reduced in early summer but was more normal during late summer and fall of the first year. During the second year of operation, growth was greatly reduced, and large plants never developed. Biomass and net-production estimates at the control site compare favorably with other marshes along the east coast of North America. In the marsh affected by the thermal discharge, biomass decreased by 48% in 1973 and 40% in 1974. The rhizome system of affected plants collapsed in 1974-1975. These plants, in contrast to southern forms, appear to have lost their tolerance of high temperatures. (Auth)

<726>
Vaillancourt, G., and R. Couture, Effects of Variations of Water Temperature on Some Species of Physidae, Lymnaeidae, Planoribidae, and Hydrobiidae (Gastropoda).

1975. Sterkiana, No. 57, 18-32 (University of Quebec, Three Rivers, Quebec, Canada)

Literature on the effects of temperature on the growth, reproduction, mortality, parasitism, and migration of several species of freshwater snails is reviewed. (ST)

<727>
Vaillancourt, G., R. Couture, E. Laoursiere, and J. Dube, Effets Thermiques de la Centrale Gentilly I.

1976. Les Presses de l'Universite de Quebec, Montreal, Canada (Biologie, Groupe de Recherche Thermopol, Trois-Rivieres, Canada)

The effects of thermal discharge from the Gentilly I Nuclear Power Plant on the physical, chemical and bacteriological characteristics of the St. Lawrence River and on some species of malacological fauna were studied. During average operation of the reactor neither the temperature of the water nor the malacological fauna was affected. During full operation discharge temperatures reached 10 C above ambient and an increased mortality and disappearence of molluscs were observed. During summer of 1972 mortality of BITHYNIA TENTACULATA, AMNICLOA LIMOSA, VALVATA TRICARINATA, PHYSA GYRINA and HELISOMA TRIVOLVIA reached 100%. Recolonization by BITHYNIA TENTACULATA after reactor shutdown was extremely slow. No secondary effect on the physico-chemical characteristics of the water was observed except for an increase in pH, due to an increase in photosynthetic activity. The affected area covered approximately 381,000 m2 of shallow water. (ST)

<728>
Valtonen, J.O.T., Seasonal Phenomena of Temperature Selection, Gonadal Cycle and Liver Carbohydrate Metabolism in the Whitefish, COREGONUS NASUS (Pallas), sensu Svardsen.

1974. Ph.D. Thesis, Oulu University (Oulu University, Finland)

Adult whitefish in the Bay of Bothnia selected their environment during the summer so that a temperature of 12 C in the thermocline was the upper limit of vertical movement. Adults left the coastal waters for deeper, cooler open sea when the comparatively warm epilimnion water reached the bottom. Underyearlings were still encountered in the warm epilimnion in June and July. Changes in liver glycogen content, glucose-6-phosphatase, and glycogen phosphorylase activity were studied in relation to temperature, nutrition and gonadal cycle. (ST)

<729>
van Maren, M.J., The Biology of CHAETOGAMMARUS MARINUS (Leach) and EULIMNOGAMMARUS OBTUSATUS (Dahl) with Some Notes on Other Intertidal Gammarid Species (Crustacea, Amphipoda).

1975. Bijdragen Tot de Dierkunde (Neth.), 45, 205-223 (University of Amsterdam, Institute of Taxonomic Zoology, Amsterdam, Netherlands)

The reproductive cycles of CHAETOGAMMARUS MARINUS and EULIMNOGAMMARUS OBTUSATUS in northern Brittany are compared, as well as the environmental conditions under which these gammarids live. Both species show reproductive activity throughout the year. The maximum rate of ovigerous females was established for E. OBTUSATUS in the months of February-March (the coldest period of the year), for C. MARINUS in December. The former species showed the lowest rate in August (the warmest month of the year) and the latter species in March. EULIMNOGAMMARUS OBTUSATUS lives in the lower half of more exposed beaches and was rarely found on a substrate containing mud, contrary to CHAETOGAMMARUS MARINUS. It was established that the southern distribution limit of E. OBTUSATUS lies in Brittany. Ecological data are given on a number of other gammarid species from the tidal zone of the Atlantic coast of France. (Auth)

<730>
Van Olst, J.C., R.F. Ford, J.M. Carlberg, and W.R. Dorband, Use of Thermal Effluent in Culturing the American Lobster.

1975; 1976. PB-256 426; In Power Plant Waste Heat Utilization in Aquaculture- Workshop I, held in Trenton, New Jersey, November 6-7, 1975. PSE&G Co., Newark, New Jersey (San Diego State University, Department of Biology, San Diego, CA)

Studies indicated that the thermal effluent from typical fossil fuel generating stations in southern California provides a suitable heated water source for the culture of HOMARUS AMERICANUS. Growth and survival of larval and juvenile lobsters maintained in a series of short and long-term laboratory bioassay experiments at constant temperatures of 18.5 and 22 C were not significantly different using effluent water from the Encina power plant and the Encina intake and Scripps Institution of Oceanography water sources. No significant differences in mean concentrations of Cu, Zn, Co, Cr, and Pb in whole-body tissues of juveniles and adults maintained in the three water types were observed. (ST)

<731>
van Weers, A.W., The Effect of Temperature on the Uptake and Retention of Cobalt-60 and Zinc-65 by the Common Shrimp.

1975. IAEA-SM-197/10; Part of Proceedings of a Symposium on the Combined Effects of Radioactive, Chemical and Thermal Releases to the Environment held in Stockholm, Sweden, June 2-5, 1975. International Atomic Energy Agency, Vienna (Reactor Centrum Nederland, Netherlands)

The effect of temperature on the uptake of Co-60 and Zn-65 directly from seawater and on the retention after uptake from labelled feed by the common shrimp CRANGON CRANGON was studied. The mean concentration factor after 16 to 21 days uptake from seawater ranged from 6 to 10 and from 30 to 60 for Co-60 and Zn-65, respectively. The effect of temperature on the uptake from seawater was small for both radionuclides. From the loss of Co-60 and Zn-65 observed when shrimps moulted, it appeared that a large fraction of the radionuclides was bound by the exoskeleton. Moulting frequency and the rate of food uptake increased with temperature. Both radionuclides were assimilated from labelled food and were retained according to a two-compartmental model. A temperature increase of 10 C reduced the biological half-lives of the long-lived component of both radionuclides by a factor of about two. It was concluded that shrimp will accumulate Co-60 and Zn-65 primarily through the food chain. An increase in temperature will result in a higher rate of uptake of the radionuclides with food and in a shorter biological half-life. Consequently the equilibrium concentration factor will be reached sooner. (Auth)

<732>
Van Winkle, W., S.Y. Feng, and H.H. Haskin, The Effect of Temperature and Salinity on Extension of Siphons by MERCENARIA MERCENARIA.

1976. Jour. Fish. Res. Bd. Can., 33, 1540-1546 (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN; University of Connecticut, Marine Research Laboratory, Noank, CT; Rutgers State University, Department of Zoology, New Brunswick, NJ)

Extension of siphons was used as a criterion of activity to examine the response of the quahog clam, MERCENARIA MERCENARIA, to various combinations of test and acclimation temperatures and salinities. A quadratic regression model for the percentage of clams active as a function of the test temperature and salinity was assumed, and response surface contours for various percentages of activity were calculated and plotted. The regression model accounted for 72 to 88% of the observed variability in the 13 experiments considered. The contours are hyperbolic instead of elliptical for five of the experiments: no biologically meaningful estimates of the lower and upper temperature and salinity limits can be obtained in such cases. Low levels of activity, even at optimal temperature-salinity combinations, occurred during the summer. Some of the observed shifts in the position and shape of the temperature-salinity response surfaces were expected in light of shifts in acclimation temperature or salinity. Other shifts in response surface could not be accounted for. The implications of these results for the purification of quahog clams harvested from polluted waters are discussed. (Auth)

<733>
Vanderborgh, G.H., Jr., Oyster Development in Power Plant Discharge.

1975. In Water Resources Symposium No. 8, Water Management by the Electric Power Industry, Section 5, Beneficial Uses of Low-Grade Heat, E.F. Gloyna et al. (Eds.). Center for Research in Water Resources, The University of Texas at Austin (Long Island Oyster Farms, Inc., Northport, NY)

For the past six years Long Island Oyster Farms has been successfully growing seedling oysters on a commercial scale using Long Island Lighting Company's power station effluent. The life history of CRASSOSTREA VIRGINICA, its cultivation in the warm water lagoon, predators, and problems involved in using power plant effluent for aquacultrure are briefly discussed. (ST)

<734>
Verstraete, W., and J.P. Voets, Comparative Study of E. COLI Survival in Two Aquatic Ecosystems.

1975. Water Res. (G.B.), 10, 129-136 (University of Gent, Laboratory of General and Industrial Microbiology, Gent, Belgium)

The survival of ESCHERICHIA COLI in samples of aquatic environments was measured by means of a simple test procedure which allowed the deduction of the effect of various factors upon the E. COLI die-off or aftergrowth. The results of the survival tests were transformed to a log No/Nt form and expressed as die-off indexes. In the Watersportbaan, a beta-mesosaprobic lake, fluctuations of the die-off indexes were governed in major part by the seasonal variations in insolation and the concomitant changes in pH and in temperature. In the Coupure, a heavily polluted beta-polysaprobic biotope, the indexes correlated primarily with the insolation and the temperature and to a minor extent with the dissolved oxygen content of the water. (Auth) (ST)

<735>
Verstraete, W., J.P. Voets, and H. Vanstaen, Shifts in Microbial Groups of River Water upon Passage through Cooling Systems.

1975. Environ. Poll., 8, 275-281 (University of Gent, Interfaculty Center for Environmental Sanitation, Gent, Belgium)

Three industrial cooling plants, using river water in a once-through flow pattern at rates ranging from 1.8 to 20 m3/sec, were studied for their possible impact on the microbiota of the cooling water. In spite of the temperature increases ranging from 5 to 10 C, no drops in cell counts were observed. On the contrary, various microbial groups and particularly ESCHERICHIA COLI and faecal streptococci populations were magnified by a factor ranging from one to seven. In addition, a shift in dominance towards mesophilic and thermophilic micro-organisms was noted and a net decrease in sporulated versus total bacteria observed. Further investigations indicated that these shifts result from the fact that the industrial coolers act as tubular microbial reactors, producing at rapid rates not only aquatic micro-organisms, but also faecal bacteria. (Auth)

<736>

<736>
Vladykov, V.D., and H. March, Distribution of Leptocephali of the Two Species of ANGUILLA in the Western North Atlantic, Based on Collections Made between 1933 and 1968.

1975. National Museums of Canada, National Museum of Natural Sciences Syllogeus No. 6; 38 p. (University of Ottawa, Department of Biology, Ottawa, Ontario, Canada)

Based on collections made over a period of years it was concluded that the American eel, ANGUILLA ROSTRATA, spawned from February to July and the European eel, ANGIULLA ANGUILLA, spawned principally in May and June. (ST)

<737>
Vlasblom, A.G., Ecological-Physiological Investigations in IDOTEA CHELIPES (Isopoda).

1975. Neth. Jour. Zool., 25, 374 (Dleta Institute of Hydrobiological Research, Yerseke, Netherlands)

The investigations showed that the tolerance of IDOTEA for lower salinities at 5 C was higher than at 15 C. The 02 consumption at 5 C decreased in salinities higher and increased in salinities lower than that of the natural environment. At 10 C and at 15 C no differences in 02 consumption in different salinities existed. The osmotic concentration of the hemolymph was higher in winter than in summer. The hemolymph was hypertonic in salinities less than 16 ppt Cl at 5 C as well as at 15 C. In 16 ppt Cl it was about isotonic. Effective osmoregulation took place in salinities between 8 and 16 ppt Cl. (Auth)

<738>
von Vaupel-Klein, J.C., and R.E. Weber, Distribution of EURYTEMORA AFFINIS (Copepoda: Calanoida) in Relation to Salinity: Field and Laboratory Observations.

1975. Neth. Jour. Sea Res., 9, 297-310 (Netherlands Institute for Sea Research, Texel, Netherlands)

In the Wadden Sea EURYTEMORA AFFINIS was found at higher salinities at low water temperatures (less than 5 C) than at higher temperatures (above 13 C). This was particularly true at high salinities. In the laboratory LT50 values at 5 C were increased compared to 15 C. (ST)

<739>
Vcronov, P.M., Activation of the ARTEMIA SALINA Eggs.

1976. Zool. Zh. (USSR), 55, 521-525 (AzNIRKh, Roston-na-Donu, USSR)

Results of experiments on egg activation of ARTEMIA SALINA are presented. Maximum hatching was recorded at temperatures from 0 to -5 C. At positive temperatures eggs did not develop and eggs which were not exposed to NaCl developed in the 0 to -23 C temperature range, with highest intensity between 0 and -5 C. The maximum developmental activity was observed when water content in the eggs was 40 to 45% while at 10 to 16% they could not be activated. (Auth)

<740>
Ward, J.V., Comparative Limnology of Differentially Regulated Sections of a Colorado Mountain River.

1976. Arch. Hydrobiol. (Ger.), 78, 319-342 (Colorado State University, Department of Zoology and Entomology, Fort Collins, CO)

Studies of one-year duration were conducted from 1972 to 1975 on four sections of the South Platte River in the Colorado mountains to elucidate the effects and extent of influence of deep release dams on stream macroinvertebrates. Study sites represented a gradient from highly regulated to unregulated by dams. Macroinvertebrates exhibited lower standing crops but much higher diversity at unregulated sites. GAMMARUS and gastropods were restricted to regulated sites, whereas filipalpian stoneflies, heptageniid mayflies, and certain dipterans were not found below the dam. Restriction of taxa to regulated or unregulated sites is explained by differences in (1) chemical limiting factors, (2) distribution and abundance of submerged angiosperms and epilithic algae, (3) diversity of organic matter inputs, (4) predation pressure and competitive interactions, (5) environmental stability and predictability, and (6) thermal signals. (Auth)

<741>
Ward, J.V., Effects of Thermal Constancy and Seasonal Temperature Displacement on Community Structure of Stream Macroinvertebrates.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (Colorado State University, Department of Zoology and Entomology, Fort Collins, CO)

Diurnal and seasonal thermal constancy, a greatly delayed seasonal temperature maximum, and summer cool and winter warm conditions characterize the stream environment below a deep-release dam in Colorado. Low diversity index and equitability values and changes in macroinvertebrate species composition may result from failure of the temperature regime to provide the thermal stimuli essential for various life-cycle phenomena. It is hypothesized that the following sublethal effects, directly or indirectly resulting from the modified temperature regime, may further alter macroinvertebrate community structure: (1) reduction of niche overlap and a shift toward an equilibrium community as a consequence of reduced environmental fluctuation; (2) more intense competition associated with greater productivity; (3) elimination of major invertebrate predators; and (4) failure of the limited temperature range to provide optimal temperatures for various physiological processes. Effects of the temperature regime on diversity pattern should be considered in dam construction and operation. (Auth)

<742>
Waugh, D.L., Delayed Mortality Following Thermal Stress in Three Species of Intertidal Pelecypod Molluscs (MODIOLUS DEMISSUS, MYA ARENARIA, and MYTILUS EDULIS).

1975. Can. Jour. Zool., 53, 1658-1662 (Department of the Environment, Halifax, Nova Scotia, Canada)

Determination of delayed mortality following thermal stress in three species of intertidal

<742> CONT.
pelecypod molluscs (MODIOLUS DEMISSUE, MYA ARENARIA, and MYTILUS EDULIS) showed that substantial mortality may occur for some considerable interval following removal of a potentially lethal thermal stress. In general, delayed mortality was greater in short-term bioassay (less than 96 hr) than in long-term bioassays (greater than 96 hr). Moreover, the extent of delayed mortality was evident much earlier in bioassays lasting less than 12 hr than in longer bioassays. These observations are discussed in relation to the determination of levels of safety for environmental pollutants. (Auth)

<743>
Weber, R.E., S.C. Wood, and J.P. Lomholt, Temperature Acclimation and Oxygen-Binding Properties of Blood and Multiple Haemoglobins of Rainbow Trout.

1976. Jour. Exp. Biol., 65, 333-345 (University of Aarhus, Institute of Zoology and Zoophysiology, Aarhus, Denmark)

Acclimation of rainbow trout to 5, 15, and 22 C for periods exceeding four months had no significant effect on the oxygen affinity of whole blood or on the concentration of ATP, which is the main organic phosphate in red cells. Slight differences were, however, found in the oxygenation properties of the hemolysates, which correlate with changes in the relative concentration of the multiple hemoglobins. The oxygen binding properties of the main hemoglobin components account for the observed differences in the hemolystates. The possible thermoacclimatory significance of changes in hemoglobin multiplicity and co-factor concentrations is discussed. (Auth)

<744>
Weiner, R.M., L. Schimel, and S. Rosen, The Isolation of HYPHOMICROBIUM from the Mouth of the Patuxent River and the Isolation and Characterization of HYPHOMICROBIUM from a Rock Creek Tributary.

1975. Chesapeake Sci., 16, 153-161 (University of Maryland, Department of Microbiology, College Park, MD)

Bacteria belonging to the order Hyphomicrobiales comprised less than 0.01% of the planktonic bacterial community of water samples collected from the Chesapeake Bay and surrounding tributaries, but were present in all samples assayed. Optimum growth conditions for HYPHOMICROBIUM RC, isolated from a Rock Creek tributary, were pH 7.0, temperature 30 C, and salinity 0.5%. (ST)

<745>
Welch, H.E., Ecology of Chironomidae (Diptera) in a Polar Lake.

1976. Jour. Fish. Res. Bd. Can., 33, 227-247 (Department of the Environment, Fisheries and Marine Service, Biological Station, St. Andrews, New Brunswick, Canada)

Chironomids collected from Char Lake, Canada were active down to 0 C with no indication of metabolic compensation. They survived in the laboratory at temperatures over 15 C. (ST)

<746>
West, A.B., and C.C. Lambert, Control of Spawning in the Tunicate STYELA PLICATA by Variations in a Natural Light Regime.

1976. Jour. Exp. Zool., 195, 263-270 (California State University, Department of Biological Sciences, Fullerton, CA)

Temperature limits for spawning of STYELA PLICATA in the laboratory were 11 to 28 C, with most success between 15 and 24 C. Gravid animals left in constant light did not spawn until they were subjected to a minimum dark period followed by a sufficient amount of light. The minimum dark adaption time was 8 hr 30 min. In the laboratory the highest spawning success was observed between September and March, with the highest values in October and February. (ST)

<747>
West, P.J., Combined Effects on the Environment of Radioactive, Chemical and Thermal Releases from the Nuclear Industry: Report on the International Symposium held in Stockholm June 2-5, 1975.

1975. Atomic Energy Review, 13, 629-634 (International Atomic Energy Agency, Division of Nuclear Safety and Environmental Protection, Vienna, Austria)

Papers presented at the symposium are reviewed. Subjects include the effects of temperature on radionuclide uptake, synergism and combination effects in aquatic systems, effects of chemical releases on radionuclide uptake, synergism and combination effects from releases to the atmosphere, and other factors in assessment of synergistic and combination effects. The majority of the papers are concerned with aquatic ecosystems. (ND)

<748>
White, C.J., Effects of 1973 River Flood Waters on Brown Shrimp in Louisiana Estuaries.

1975. Louisiana Wildlife and Fisheries Commission, Technical Bulletin No. 16, 24 p. (Louisiana Wildlife and Fisheries Commission, Oyster, Water Bottoms and Seafoods Division, New Orleans, LA)

Brown shrimp data depicting larval occurrence, juvenile density and growth are presented for four years during the period of January through June. These data are presented for the seven coastal study areas offering a coast-wide comparison of the life history indices of the brown shrimp. Comparisons are made of brown shrimp populations occurring during periods of normal hydrological conditions and during flood conditions. The effects of a major flood upon survival, growth, and production are discussed. Production trends for recent years are presented. Hydrological conditions prior to the flood of 1973 are examined to show the relationship of hydrology on subsequent production under more normal conditions. Temperatures and salinities were monitored throughout the study. The temperature level remained below the 20 C mark considerably longer in 1973 than in the three previous years. Subsequently, the growth of the brown shrimp for the April 11 - May 27 period was slight. (Auth) (ND)

<749>
White, J.C., Jr., R.A. Hammond, N.H. Wooding, Jr., and M.L. Brehmer, Temperature as a Growth Accelerator in the Spot (Teleost: Sciaenidae).

1976. CONF-750425; ERDA Symposium Series 40; In

<749>

<749> CONT.
Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Virginia Electric and Power Company, Environmental Services Department, Richmond, VA)

Young spot, LEIOSTOMUS XANTHURUS, and ten other species of fish, were trapped by the installation of a weir across the effluent canal at the Yorktown Power Station of the Virginia Electric and Power Company in December 1973 during a discharge modification. In the subsequent 12 months, the fish were subjected to a wide spectrum of temperature changes and to chlorination associated with the normal operation of two existing units and the start-up of a third unit. Certain individuals of the spot apparently grew at a faster rate and to a larger size than has been heretofore reported in the literature. (Auth)

<750>
Whitfield, A.K., and S.J.M. Blaber, The Effects of Temperature and Salinity on TILAPIA RENDALLI Boulenger 1898.

1976. Jour. Fish Biol., 9, 99-104 (University of Natal, Zoology Department, Pietermaritzburg, South Africa)

Temperature and salinity tolerances of TILAPIA RENDALLI were determined experimentally. Results indicate that they are tolerant over a wide range of temperatures (11 to 37 C), but are incapable of surviving in salinities above 19 ppt. The maximum salinity tolerance is at temperatures between 20 to 28 C. The osmotic concentration of the blood rises from 255 mosmol/l in freshwater to 340 mosmol/l in a salinity of 19 ppt. T. RENDALLI is restricted to the warmer waters of the Zambezi river system in central Africa and southwards to the Pongolo river, as well as certain tropical and subtropical brackish water lagoons and lakes. Evidence from these experiments suggest that the distribution of T. RENDALLI is governed by both temperature and salinity. (Auth)

<751>
Widdows, J., Physiological Adaptation of MYTILUS EDULIS to Cyclic Temperatures.

1976. Jour. Comp. Physiol., 105, 115-128 (Institute for Marine Enviornmental Research, Plymouth, England)

MYTILUS EDULIS adapted to cyclic temperatures by reducing the amplitude of response of oxygen consumption and filtration rate over a period of approximately two weeks, and thereby increasing their independence of temperature within the range of the fluctuating regime. When acclimated to cyclic temperature regimes within the range from 6 to 20 C, the metabolic and feeding rates, measured at different temperatures in the cycle, were not significantly different from the adapted response to equivalent constant temperatures. In a fluctuating thermal environment which extended above the normal environmental maxima, respiratory adaptation occurred at higher temperatures than was possible in a constant thermal environment. The feeding rate was also maintained at higher temperatures in a cyclic regime than was possible under constant thermal conditions. This represented a short-term extension of the zone of activity in a fluctuating thermal environment. The net result of these physiological responses to high cyclic and constant temperatures has been assessed in terms of scope for growth. Animals acclimated to cyclic temperatures between 21 and 29 C had a higher scope for growth at 29 C and were less severely stressed than those maintained at the constant temperature of 29 C. (Auth) (ST)

<752>
Wigley, R.L., R.B. Theroux, and H.E. Murray, Deep-Sea Red Crab, GERYON QUINQUEDENS, Survey off Northeastern United States.

1975. Marine Fisheries Rev., 37, 1-21 (National Marine Fisheries Service, Northeast Fisheries Center, Woods Hole, ME)

A quantitative survey of the deep-sea red crab, GERYON QUINQUEDENS, was conducted in continental slope waters off the northeastern United States in June-July 1974. Red crabs were present in all geographic areas sampled, between offshore Maryland and eastern Georges Bank. They were found at water depths ranging from 274 to 1,463m, but there were striking differences in size and number of red crabs related to depth. The estimated number of red crabs of commercial size, 114 mm or larger in carapace width, in the survey area was 43 million and the standing crop biomass 27 million kg (59 million pounds). Both number and biomass of crabs were greater at intermediate depths, 320-914 m, than in either shallower or deeper waters. Size of crabs ranged from 8 to 142 mm. Males were substantially larger (average weight 413 g; 0.9 lb) than females (average weight 244 g; 0.5 lb). Largest crabs occurred in shallow, warmer, waters and smallest crabs occurred in deepest, colder, waters. An up-slope migration is deduced from this pronounced size-depth relationship. Data revealed a definite trend of highest densities and largest quantities of crabs at intermediate temperatures (from 5 to 8 C) and substantially lower densities and smaller quantities at both warmer and colder temperatures, but is probably a secondary result of the correlation between bottom water temperature and water depth. Other topics included in this report are: notes on red crab biology, estimates of density of the American lobster, and descriptions of bottom sediments and topography. (Auth) (ND)

<753>
Willaert, E., and A.R. Stevens, Isolation of Pathogenic Amoeba from Thermal-Discharge Water.

1976. Lancet, No. 7988, 741 (Oak Ridge National Laboratory, Biology Division and Environmental Sciences Division, Oak Ridge, TN; University of Florida, Veterans Administration Hospital and Department of Biochemistry, Gainesville, FL)

Pathogenic, free-living amoebas of the genus NAEGLERIA were detected in the thermal-discharge water of two out of five electric power stations located on lakes and rivers in Florida. The water temperatures were 35 to 38 C. Samples from lakes without power plants served as controls; their temperatures were 32 to 34 C. These samples showed no outgrowth of amoebas. (ST)

<754>
Williams, G.C., Viable Embryogenesis of the Winter Flounder PSEUDOPLEURONECTES AMERICANUS from -1.8 to 15 C.

<754> CONT.
1975. Marine Biol. (W. Ger.), 33, 74-74 (State University of New York, Department of Ecology and Evolution, Stony Brook, NY)

PESUDOPLEURONECTES AMERICANUS spawns in late winter near New York, and its eggs may be found in shallow water under ice at temperatures below the usual freezing point of vertebrate tissues. Survival and duration of development at a variety of constant temperatures were recorded for artificially fertilized eggs in the laboratory. Many eggs hatched into normal larvae after two months at the lowest temperature tried, -1.8 C. The upper lethal temperature was about 15 C. There was a linear relation between log time and temperature in the minimum mortality range (0 to 10 C), with a Q10 of about 4.8. (Auth)

<755>
Windell, J.T., J.F. Kitchell, D.O. Norris, J.S. Norris, and J.W. Foltz, Temperature and Rate of Gastric Evacuation by Rainbow Trout, SALMO GAIRDNERI.

1976. Trans. Amer. Fish. Soc., 105, 712-717 (University of Colorado, Department of Environmental, Population and Organismic Biology, Boulder, CO)

Young-of-the-year hatchery reared rainbow trout, SALMO GAIRDNERI, were used to estimate the rate of gastric evacuation of meals of oligochaetes and commercial pellets at water temperates of 5, 10, 15, and 20 C. Regression models were used to predict the time for stomach evacuation. Depending on food type, it took three to four times as long to empty the stomach by 50% or 100% at 5 C as it did at 20 C. Time to empty the stomach increased from a minimum of 16.4 hr at 20 C for both foods to 58.5 hr and 72.4 hr at 5 C for oligochaetes and pellets, respectively. (Auth) (ST)

<756>
Winkler, P., Thermal Tolerance of GAMBUSIA AFFINIS (Teleostei: Poeciliidae) from a Warm Spring. I. Field Tolerance under Natural Stream Conditions.

1975. Physiol. Zool., 48, 367-377 (University of Arizona, Department of Biological Sciences, Tucson, AZ)

GAMBUSIA AFFINIS living at stations closer to the source pond of a warm spring in Arizona and therefore in areas of the stream with higher mean, high, and low temperatures had a higher thermal tolerance than fish living at cooler stations farther from the source pond. Photoperiod itself did not seem to affect the field thermal tolerance of G. AFFINIS. The thermal tolerance of fish freely swimming about the stream may rise during the day as stream temperatures rise; however, fish at warmer stations may behaviorally modify this tendency by seeking cooler water, if it is available to them. GAMBUSIA AFFINIS tended to respond to the total thermal cycle to which it is exposed. At any one habitat temperature and station, fish exposed to ultimately warmer temperatures during the day showed a higher thermal tolerance than fish exposed to ultimately lower temperatures. At any one habitat temperature and maximum temperature, fish from cooler stations had a significantly lower thermal tolerance than those from warmer stations. GAMBUSIA AFFINIS did not acclimate to the maximum temperatures present in their habitat but, rather, to a behaviorally modal temperature. Smaller females had a higher thermal tolerance to the same temperatures in the field than did larger females. In the same way, females had a higher thermal tolerance than males. The distributional ecology and behavior of G. AFFINIS appeared to be regulated by the dominant abiotic factor, temperature, in Mammoth Warm Spring. (Auth)

<757>
Wodtke, R., Discontinuities in the Arrhenius Plots of Mitochondrial Membrane-Bound Enzyme Systems from a Poikilotherm: Acclimation Temperature of Carp Affects Transition Temperatures.

1976. Jour. Comp. Physiol., 110, 145-157 (Universitat Kiel, Zoologisches Institut, Kiel, Germany)

Evidence is presented for breaks in the Arrhenius plots of succinate and cytochrome oxidase systems of mitochondria from carp liver and red epaxial muscle. Breaks in Arrhenius plots of membrane bound enzymes may reflect changes in the lipid constituents of membranes. Carp acclimated to 26 and 10 C did not differ significantly with respect to specific activity of liver succinate oxidase, liver-somatic index, and liver mitochondrial protein. Changes were observed in these parameters if the carp are in a transitory state of temperature acclimation (soon after transfer from 26 to 10 C). (Auth) (ST)

<758>
Wolfe, J.K., and I. Gray, Structural Changes in Glyceraldehyde-3-Phosphate Dehydrogenase Isolated from Temperature-Acclimated Rainbow Trout (SALMO GAIRDNERI) (39549).

1976. Proc. Soc. Exp. Biol. Med., 153, 374-377 (Georgetown University, Department of Biology, Washington, DC)

Glyceraldehyde-3-phosphate dehydrogenase from rainbow trout acclimated to 15 C (warm) and 5 C (cold) was purified and compared with respect to electrophoretic properties, NAD-binding behavior, and ultraviolet absorption. Both the warm and cold species of G3PDH showed the some electrophoretic properties. They differed, however, in NAD-binding behavior and in ultraviolet-absorption properties. It was concluded that temperature acclimation brings about a conformational change in the higher-order structure of G3PDH which is stable through purification procedure. (Auth) (ST)

<759>
Wolters, W.R., and C.C. Coutant, The Effect of Cold Shock on the Vulnerability of Young Bluegill to Predation.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

A laboratory study with young bluegill (LEPOMIS MACROCHIRUS) showed that cold shock of 9 C was sufficient to cause increased vulnerability to predation by unstressed adult largemouth bass. Equal numbers of control and test fish acclimated at higher temperatures than those of the test tanks

<759>

<759> CONT.
were offered simultaneously to unstressed predators, and predation was halted when approximately 50% of the prey were eaten. Survival proportions and predation ratios were calculated from the remaining fish. At temperature differentials of 9 C or more, predation ratio was found to accelerate with increasing thermal shock. (Auth)

<760>
Wong, T.M., and R.F.H. Freeman, Seasonal and Thermal Effects on the Concentration of the Haemolymph in the New Zealand Freshwater Crayfish PARANEPHROPS ZEALANDICUS White.

1976. Comp. Biochem. Physiol., 55A, 17-22 (University of Otago, Department of Zoology, Dunedin, New Zealand)

In any one season, PARANEPHROPS ZEALANDICUS collected from freshwaters varying 10-fold in ionic concentration maintained a constant hemolymph concentration. Hemolymph concentration showed a cyclic seasonal variation with a peak in winter. There were no differences in hemolymph concentration between males and females in any season. Crayfish maintained at 5 C for 15 weeks showed hemolymph concentrations 12 to 17% higher than those of crayfish maintained for 15 weeks at 16 C. Crayfish transferred to 16 C after 58 days at 5 C showed an immediate and sustained decrease in blood concentration, and thereafter showed a gradual increase. Seasonal fluctuations in blood concentrations were attributed to changes in environmental temperatures. (Auth)

<761>
Wood, R.J., The Effect of DDT and Rearing Temperature on Pecten Spine Number in Larvae of the Mosquito AEDES AEGYPTI L..

1976. Genetica, 46, 45-48 (Manchester University, Department of Zoology, Manchester, England)

Following hatching at 28 C, first instar larvae of AEDES AEGYPTI were reared at 15, 25, or 28 C. Lowering the rearing temperature increased larval mortality. Mean pecten spine number was significantly higher in larvae reared at 15 C compared with 28 C. The variance of spine number was also higher at the lower temperature but not significantly so. The range was 10 to 20 spines at 28 C and 12.5 to 22 spines at 15 C. The change may have been a function of increased development time to the fourth instar (approximately 4, 5, and 16 days at 28, 25, and 15 C, respectively). (ST)

<762>
Woodhead, P., and B. Moss, The Effects of Light and Temperature on Settlement and Germination of ENTEROMORPHA.

1975. Brit. Phycol. Jour., 10, 269-272 (The University, Department of Plant Biology, Newcastle upon Tyne, England)

The rate of germination of zoospores of the green alga, ENTEROMORPHA sp., was more than doubled by a rise in temperature from 10 to 20 C. (ST)

<763>
Woodward, D.F., Toxicity of the Herbicides Dinoseb and Picloram to Cutthroat (SALMO CLARKI) and Lake Trout (SALVELINUS NAMAYCUSH).

1976. Jour. Fish. Res. Bd. Can., 33, 1671-1676 (U.S. Fish and Wildlife Service, Fish-Pesticide Research Laboratory, Jackson, WY)

In static tests of the toxicity of two herbicides, dinoseb (2,4-dinitro-6-sec-butylphenol) and picloram (4-amino-3,5,6-trichloropicolinic acid) to cutthroat (SALMO CLARKI) and lake trout (SALVELINUS NAMAYCUSH), the 96-hr LC50's ranged from 32 to 1400 ug/l for dinoseb and from 2050 to 8600 ug/l for picloram. Generally, toxicity increased with increasing water temperature (5,10, and 15 C). Toxicity also varied with pH and with water hardness for dinoseb. (ST)

<764>
Woodward, R.L., and T.E. Wissing, Age, Growth, and Fecundity of the Quillback (CARPIODES CYPRINUS) and Highfin (C. VELIFER) Carpsuckers in an Ohio Stream.

1976. Trans. Amer. Fish. Soc., 105, 411-415 (Miami University, Department of Zoology, Miami, OH)

An analysis of age, growth, and fecundity was carried out on 208 quillback and 32 highfin carpsuckers collected from Four Mile Creek, Ohio, May-October, 1972. Water temperatures in Four Mile Creek during the spawning period, late June through September, ranged from 19.0 to 28.0 C. (ST)

<765>
Wrenn, W.B., Temperature Preference and Movement of Fish in Relation to a Long Heated Discharge Channel.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (Tennessee Valley Authority, Browns Ferry Nuclear Plant, Decatur, AL)

Four species of fish (six smallmouth bass, one largemouth bass, two flathead catfish, and one walleye) were tagged with temperature-sensing ultrasonic transmitters during 1972 and 1973 to monitor temperature preference and movement in relation to a 4.5-km heated discharge channel from Colbert Steam Plant on the Tennessee River. Summer effluent temperatures (33 to 35 C) did not create a thermal barrier to the movement of smallmouth bass, largemouth bass, and flathead catfish. One flathead catfish frequently selected temperatures above 30 C. The single walleye tagged remained in the heated discharge 30 days, during which time the effluent temperature increased from 19. to 27.4 C. (Auth)

<766>
Wrenn, W.B., Preliminary Assessment of Larval Fish Entrainment, Colbert Steam Plant, Tennessee River.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, VA (Tennessee Valley Authority, Muscle Shoals, AL)

Condenser cooling water for Colbert Steam Plant (1396 Mw, fossil fueled) is pumped from the Tennessee River, heated about 8 C, and

<766> CONT.
discharged into a creek channel that flows back into the river about 1.6 km below the plant. In 1972 and 1973 the larvae of at least 13 species of fish were entrained by this plant; shad (gizzard and threadfin) and freshwater drum comprised 90 and 6%, respectively, of the total number entrained. Peak density of entrainment (1.5/m3) occurred in June. Assessment of entrainment was complicated since four to six species apparently spawned in the discharge channel in phase with their spawning in the Tennessee River. The overall ecological impact was considered minor since this plant uses only about 3% of the river flow for condenser cooling. (Auth)

<767>
Wright, D.J., B.H. Woodworth, and J.J. O'Brien, A System for Monitoring the Location of Harvestable Coho Salmon Stocks.

1976. Marine Fish. Review, 38, 1-7 (Oregon State University, Schools of Oceangraphy and Business, Corvallis, OR; Florida State University, Departments of Meteorology and Oceanography, Tallahassee, FL)

During the summer of 1973, a pilot program was undertaken to test a system for monitoring the location of environmental factors favorable to coho salmon (ONCORHYNCHUS KISUTCH) fishing off the central Oregon coast. The pilot program was successful in locating 11.1 to 13.3 C water 92.7% of the time. Statistical analysis of the catch rate data showed that the forecast system was capable of locating harvestable stocks of coho salmon. The catch rate on certain days in the recommended areas was double that in other areas. This analysis lends support to the hypothesis that coho salmon are a temperature dependent species. The system could provide a valuable input in the management of fisheries resources. (ST)

<768>
Wyllie, M.C., E.R. Holmstrom, and R.K. Wallace, Temperature Preference, Avoidance, Shock, and Swim Speed Studies with Marine and Estuarine Organisms from New Jersey.

1976. Ichthyological Associates, Inc., Bulletin No. 15; 76 p. (Ichthyological Associates, Inc., Brigantine Experimental Laboratory, Brigantine, NJ)

Studies of temperature preference and avoidance, cold shock, and swimming performance were conducted on 31 species of marine fish and three species of macroinvertebrates. In horizontal temperature preference studies, the mean preferred temperatures were generally higher than, or equal to, the acclimation temperatures. Red hake, which were abundant in the colder months, preferred temperatures lower than those species which were abundant during the warmer months. Red hake, spotted hake, and white hake, acclimated to 18.0 to 25.0 C preferred the lower temperatures of 14.5 to 21.5 C. Alewife, Atlantic menhaden, and bay anchovy chose a range of preferred temperatures: alewife acclimated from 20.0 to 26.0 C preferred 22.0 to 26.5 C; bay anchovy acclimated to 10.0 to 20.0 C preferred 21.0 to 28.0 C; and Atlantic menhaden continually swam from one end of the test tank to the other in 13 of 25 tests and chose 22.0 to 27.5 C at acclimations from 20.0 to 25.0 in the others. Winter flounder, red hake, spotted hake, and Atlantic silverside, acclimated to 3.3 to 6.5 C showed low thermal responsiveness with winter flounder remaining in temperatures that were eventually lethal in several tests. In vertical preference studies most species selected mean preferred temperatures above their acclimation temperatures. Results are given for 14 species of fish. Fifty-five tests of temperature avoidance were performed on 11 species of fish. Avoidance temperatures were generally higher than the highest acclimation temperature (25 C). Acclimation temperatures ranged from 5 to 25 C, being different for different species of fish. Sixteen cold shock studies were conducted with 11 species of fish. Two hundred thirty-one critical swim speed tests were conducted on 26 species of fish. The highest observed critical swim speed was greater than 140 cm/sec exhibited by striped mullet at acclimation temperatures of 15 and 20.0 C. The lowest critical swim speed was 14.0 cm/sec for a three spine stickleback at an acclimation temperature of 4.0 C. The relationship between critical swimming speed, acclimation temperature, total fish length and salinity was studied for Atlantic menhaden, red hake, spotted hake, and Atlantic silversides by multiple regression analyses. Results of all studies are given in tabular form. (ST)

<769>
Wyzga, R.E., The Relevance of Cost-Benefit Analyses in Choosing among Alternative Cooling Technologies.

1976. CONF-750980; EPRI SR-38; In Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments (Volume II) held in Asilomar, Pacific Grove, Calif., September 28-October 2, 1975. Electric Power Research Institute, Palo Alto, Calif. (Electric Power Research Institute, Environmental Assessment Department, Palo Alto, CA)

It is suggested that monetary estimates of the environmental damage associated with alternative cooling technologies can be used to help compare the alternative technologies. The state of the art of monetary damage estimation is illustrated. Although imprecise, such analysis may be useful in the development and implementation of environmental policy. The reduction in the striped bass population and the damage of increased fogging at the Indian Point site are cited as examples. (ST)

<770>
Yamauchi, K., Influence of Temperature on the Growth of Sporelings of Laver. II. Temperature Changes and the Development of Sporelings.

1976. Bull. Jap. Soc. Sci. Fish. 42, 387-394 (Fisheries Experimental Station of Hyogo-Ken, Akashi, Japan)

The effect of temperature changes on the early development of sporelings of PORPHYRA TENERA was studied. Sporelings were grown at temperatures of 5, 10, 15, 20, 25, and 30 C with a 5 C increase or decrease in temperature every five and two days. At a temperature change from 30 to 25 C and from 25 to 20 C cells took on abnormal shapes and growth was inhibited. At rapid temperature decreases between 20 and 15 C and 15 and 10 C, only a slight abnormality of cell shape occurred. At a declining temperature regime of 25, 20, 15, 10 C, growth was rapid. Many sporelings showed abnormal shapes at 25 and 20 C, but the number of abnormal sporelings

<770> CONT.
decreased and the degree of abnormality lessened as the temperature fell. At temperature changes below 10 C, the degree of abnormality was slight. From these results temperature changes are regarded as one of the factors causing abnormal sporelings, but are not regarded as a major factor for growth inhibition. (Auth) (ST)

<771>
Yang, H.C., On the Extermination of Polyclads: Calcium Hypochlorite (CaOC12) Treatment in the Period of High Water Temperature.

1974. Bull. Korean Fish. Soc. 7, 121-125 (Yeosu Fisheries Technical College, Korea)

Polyclads (STYLOCHUS IJIMAI and PSEUDOSTYLOCHUS OBSCURUS) which damage oysters were treated with calcium hypochlorite to determine the TLm (median tolerance limit) concentration. The TLm and the extermination density as well as the growth of the oyster after the treatment were checked. TLm's decreased with increasing temperature (18 to 26 C) and with longer periods of treatment. Increasing salinity weakened the action of the calcium hypochlorite and thus increased the TLm. In seawater extermination coefficients were 2.4 to 7.1 times higher than the TLm in fresh water. Oyster growth rate was not affected after treatment. (Auth) (ST)

<772>
Yarish, C., Polymorphism of Selected Marine Chaetophoraceae (Chlorophyta).

1976. Brit. Phycol. Jour., 11, 29-38 (University of Texas, Department of Botany, Austin, TX)

Variations in light intensity and temperature influenced the morphology of several genera of marine green algae. Light intensities and temperatures optimum for growth of PSEUDENDOCLONIUM SUBMARIUM, OCHLOCHAETE HYSTRIX, ECTOCHAETE TAYLORI, E. RAMULOSA, and BOLBOCOLEON PILIFERUM are given. The concentration of both nitrates and phosphates was important for setae production in some algae. (ST)

<773>
Yasunaga, Y., Effect of Water Temperature and Salinity on the Embryonic Development of Eggs and the Survival of Larvae of PARALICHTHYS OLIVACEUS.

1975. Bull. Tokai Reg. Fish. Res. Lab. (Jap.), No. 81, 151-169

Eggs and larvae of PARALICHTHYS OLIVACEUS were cultured in combinations of temperatures (0 to 30 C) and salinities (0 to 68 ppt). Eggs hatched over a temperature range of 10 to 20 C with a peak at 15 C and a salinity range of 26 to 50 ppt. Larval survival was best at 15 C and 17 ppt salinity. (ST)

<774>
Yoder, C.O., and J.R. Gammon, Seasonal Distribution and Abundance of Ohio River Fishes at the J.M. Stuart Electric Generating Station.

1976. CONF-750425; ERDA Symposium Series 40; In Thermal Ecology II, G.W. Esch and R.W. McFarlane (Eds.), Proceedings of a Symposium held at Augusta, Georgia, April 2-5, 1975. National Technical Information Service, Springfield, Va. (DePauw University, Department of Zoology, Greencastle, IN)

Distributions of Ohio River fishes were studied in the vicinity of a 2400 Mw coal-fired electric generating plant. Three thermally elevated zones, two ambient river zones, and a backwater zone were sampled intensively from June 1974 through February 1975 following the completion of all four units of the power plant. Less intensive collections were made preceding and during construction from 1970 to 1973. Overall variations in water temperature in 1974 to 1975 ranged from 6 to 40 C in the heated zones, 4 to 30 C in the ambient river zones, and 5 to 27 C in the backwater zone. Seasonal and spatial differences in abundance, diversity, and faunal associations were largely influenced by temperature. Notable changes in species populations from 1970 to 1975 were observed which were attributed to power-plant operation. Although seasonal definitions in terms of summer, fall, and winter were generally used, they were of very limited value, as demonstrated by annual fluctuations in community parameters. Apparently near-freezing temperatures in the ambient river zones, as well as high summer temperatures in the effluent canal, limit the time fish can spend in these areas and force them to seek more hospitable temperatures. This suggests that there are critical winter as well as summer months, with spring/fall transitional periods in between in the vicinity of thermal effluents. (Auth)

<775>
Young, J.O., The Population Dynamics of PHAENOCORA TYPHLOPS (Vejdovsky) (Tubellaria: Neorhabdocoela) Living in a Pond.

1975. Jour. Animal Ecol., 44, 251-262 (University of Liverpool, Department of Zoology, Liverpool, England)

PHAENOCORA TYPHLOPS was present in the substratum of a small pond from May to September with peak numbers recorded in the second half of June; the remainder of the year was spend in the egg stage which had an obligatory diapause. Recruited animals grew rapidly at first but the growth rate slackened as numbers and average size increased. In the laboratory animals held at 3.5 C did not grow and death occurred within eight days. Within the range of 7 to 18 C growth rate increased and longevity decreased with rising temperature. Cocoon production was low at 7 C and similar at the higher temperatures. Food availability influenced growth rate and survival. Temperature also influenced diapause and development and the subsequent hatching of cocoons. (ST)

<776>
Young, J.S., and A.B. Frame, Some Effects of a Power Plant Effluent on Estuarine Epibenthic Organisms.

1976. Intl. Rev. Gesamten Hydrobiol. (Ger.), 61, 37-61 (Batelle Pacific Northwest Laboratories, Marine Research Laboratory, Sequim, WA)

A study using the submerged test panel method was conducted at the Oyster Creek Nuclear Generating Station near Barnegat Bay, NJ to investigate effects of the heated effluent on epibenthic communities. Test panels were placed in the intake and discharge canals and collected using SCUBA at 28, 84, 168 and 335 day intervals between Oct. 1970-Oct. 1971. Exposed panels were replaced by clean panels upon collection. Faunal resemblance, both

<776> CONT.
between stations during a sampling date and within stations from one sampling date to the next, was low. Numbers of species were higher at the discharge station than at the intake station from late fall to early summer and lower from midsummer to early fall. Overall differences in diversity at the two stations could not be detected. The optimum temperature for growth of BALANUS sp. was approached more closely during winter in the discharge canal than in the intake canal where growth was retarded by cold water. BALANUS EBURNEUS appeared to have an extended breeding season. Because of dilution of the discharge in the summer, the effluent was not seriously harmful to amphipod reproduction. Seasonal abundances of numerous invertebrates at both stations are reported and possible power plant effects are discussed. (Auth)

<777>
Young, W.C., D.H. Kent, and B.G. Whiteside, The Influence of a Deep Storage Reservior on the Species Diversity of Benthic Macroinvertebrate Communities of the Guadalupe River, Texas.

1976. Texas Jour. Sci., 27, 213-224 (Southwest Texas State University, Biology Department, Aquatic Station, San Marcos, TX)

Low summertime temperatures and the stable annual temperature range of the Guadalupe River below Canyon Reservoir, Texas were believed to be partly responsible for a stressed community structure of benthic invertebrates compared to the river upstream of the reservoir. Hydrogen sulfide in the hypolimnetic waters also was a factor. (CCC)

<778>
Yusa, T., Early Life History of LIMANDA YOKOHAMAE (Gunther).

1974. Part of Proceedings of an International Symposium held at the Dunstaffnage Marine Research Laboratory of the Scottish Marine Biological Association, Oban, Scotland, May 17-23, 1973. Springer -Verlag, Berlin-Heidelberg (Tohoku Regional Fisheries Research Laboratory, Shiogama City, Japan)

Hatching of mud dab eggs occurred at temperatures of 5, 10, and 15 C, but not at 2.5, 20, and 25 C. Egg survival to hatching was 50% at 5 C, 70% at 10 C, and 10% at 15 C. The duration of embryonic development varied inversely with temperature. (ST)

<779>
Zaugg, W.S., and L.R. McLain, Influence of Water Temperature on Gill Sodium, Potassium-Stimulated ATPase Activity in Juvenile Coho Salmon (ONCORHYNCHUS KISUTCH).

1976. Comp. Biochem. Physiol., 54A, 419-421 (Western Fish Nutrition Laboratory, Cook, WA)

Gill sodium, potassium-stimulated ATPase activity was determined from December to July in gills of yearling coho salmon (ONCORHYNCHUS KISUTCH) maintained at four temperatures, 6, 10, 15 and 20 C. Compared to fish held at 6 C, elevation in ATPase activity and the associated parr-smolt transformation were accelerated in fish at 10 and 15 C whereas animals at 20 C experienced at best only a transitory elevation in activity. Fish transferred from one temperature to another developed ATPase activities characteristic of fish residing at temperatures to which they were transferred. Cold water (6 C) tended to preserve the elevated ATPase activity while higher temperatures (10 and 15 C) ca used decreases after an initial accelerated increase. (Auth)

<780>
Zavodnik, N., Effects of Temperature and Salinity Variations on Photosynthesis of Some Littoral Seaweeds of the North Adriatic Sea.

1975. Botanica Marina, 18, 245-250 (Rudjer Boskovic Institute, Center for Marine Research, Rovinj, Yugoslavia)

The photosynthetic activity of the littoral algae, FUCUS VIRSOIDES, ULVA LACTUCA, and PORPHYRA LEUCOSTICTA, in seawater diluted with distilled water increased with increasing salinities (0 to 42 ppt) and temperatures (5 to 25 C). Exposure of the sublittoral alga, WRANGELLA PENICILLATA, to salinities lower than normal resulted in negative net production, especially at temperatures below 20 C. The same general trend was observed when seawater was diluted with nutrient rich, fresh spring water, except in ULVA LACTUCA and PORPHYRA LEUCOSTICTA at 37 and 42 ppt. In WRANGELIA PENICILLATA photosynthetic activity was highest at 42 ppt and 20 to 25 C, but decreased steadily in dilutions of 10 ppt, when negative production occurred. Photosynthetic values for the three littoral algae were higher in seawater diluted with fresh spring water compared to dilution with distilled water. (ST)

<781>
Zawacki, C.S., and P.T. Briggs, Fish Investigations in Long Island Sound at a Nuclear Power Station Site at Shoreham, New York.

1976. N.Y. Fish & Game Jour., 23, 34-50 (New York State Department of Environmental Conservation)

Long Island Sound at Shoreham, N.Y., supports a wide variety of shore-zone and near-shore fish. The shore zone appears to be a nursery ground for several species seasonally. A study was undertaken during 1971 and 1972 to gather information on fish species and relative and seasonal abundance at the proposed nuclear power station site. Juvenile Atlantic herring and American sand lance were abundant in May. Juvenile Atlantic menhaden were abundant in June and July. Juvenile Atlantic silversides first appeared in July and remained abundant through October. The near shore area appeared to be an important summer area for scup and juvenile bluefish. Other abundant migrants included sea robins and striped bass. The most common resident fish was the windowpane. Water temperatures rose from less than 5 C in March to summer levels in the low 20's by mid-July, while seasonal declines began in mid-September. The lowest temperature recorded during the study was 2.2 C on March 13, 1972. On that date five windowpanes and one longhorn sculpin were netted. The highest temperature recorded was 24.6 C on July 25, 1972. On that date the first and largest catch of juvenile bluefish was made. (ST)

<782>
Zeikus, J.G., and M.R. Winfrey, Temperature Limitation of Methanogenesis in Aquatic Sediments.

1976. Appl. Environ. Microbiol, 31, 99-107

<782>

<782> CONT.
(University of Wisconsin, Department of Bacteriology, Madison, WI)

Microbial methanogenesis was examined in sediments collected from Lake Mendota, Wisconsin, at water depths of 5, 10, and 18 m. The optimum temperature, 35 to 42 C, for sediment methanogenesis was considerably higher than the maximum observed in situ temperature of 23 C. (ST)

<783>
Zieman, J.C., Seasonal Variation of Turtle Grass, THALASSIA TESTUDINUM Konig, with Reference to Temperature and Salinity Effects.

1975. Aquatic Botany, 1, 107-123 (University of Virginia, Department of Environmental Sciences, Charlottesville, VA)

Although turtle grass, THALASSIA TESTUDINUM, is a tropical marine plant, studies show it undergoes seasonal fluctuation. Maximum values of productivity, standing crop, leaf length, blade density, and other biotic variables are reached in the warmer summer months. THALASSIA has a temperature optimum near 30 C and a salinity optimum near 30 ppt. Significant deviations of these environmental parameters from their optima depress the biotic viability of the plant. Minimum values for the measured variables were encountered during periods of seasonally low temperatures or high temperatures coupled with lowered salinity. THALASSIA is seen to have a slow response to environmental stress due to the stored starch reserves in the extensive robust rhizome system. (Auth)

<784>
Zweifel, J.R., and R. Lasker, Prehatch and Posthatch Growth of Fishes - A General Model.

1976. Fish. Bull., 74, 609-621 (National Marine Fisheries Service, Southwest Fisheries Center, La Jolla Laboratory, La Jolla, CA)

The developmental stages of fish eggs and the growth of larval fishes of several species can be represented by a Gompertz-type curve based on the observation that in widely different living systems, exponential growth tends to undergo exponential decay with time. Further, experimental studies and field observations have shown that the effect of temperature on the growth process follows the same pattern, i.e., the rate of growth declines exponentially with increasing temperature. Evidence suggests that prehatch growth rates determine ideal or optimum trajectories which are maintained after hatch in the middle temperature range but not at either extreme. Also, posthatch growth exhibits a temperature optimum which is not apparent in the incubation period. These studies have also shown that for the same spawn both the prehatch and yolk-sac growth curves reach asymptotic limits independent of temperature. Other biological events (e.g., jaw development) occur at the same size for all temperatures. The growth of the post-yolk-sac larvae follows a curve of the same type and hence the posthatch growth trajectory may be represented by a two-stage curve. For starving larvae, the second stage shows a decline in size but maintains the same form, i.e., the rate of exponential decline decreases exponentially with time. (Auth)

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