with the National Environmental Policy Act and other environmental laws. The problem of heating river waters is primarily nonradiological in nature and, thus, also germane to coal-fired plants, pumped-storage reservoirs, and other operations that have the potential to cause large-scale changes in river conditions.

By reviewing and analyzing worldwide experience and by conducting laboratory experiments, researchers were able to compile a data base on aquatic ecology impacts and establish criteria for altering water quality. From these data was developed a set of models of fish population dynamics, entrainment and impingment at plant intakes and discharges, and transport of water and entrained fish and larvae. The focus of this research was on the striped bass population of the Hudson River, site of the Indian Point Unit 2 nuclear plant. Later, the scope of the program was expanded, both in depth (to include more detailed studies of factors governing entrainment and impingement) and breadth (to include studies of other fish populations).

Benefits This basic research on riverine ecology led to the development of a body of knowledge that could be applied to a variety of problems arising in the design and construction of large electric power plants. The information was used specifically to evaluate the need for cooling towers planned for several power plants on the Hudson River.

Riverine ecology research was instrumental in the negotiated resolution of the longstanding dispute over the impacts of power plants at Indian Point (nuclear) and Bowline and Roseton (oil-fired) on the ecology of the Hudson River. At the time of the settlement (December 1980), EPA had entered its fifth year of administrative deliberations over whether the plants would be required to be retrofitted with cooling towers. Previous studies had alleged that the plant's emission of warm water and its huge withdrawals of river water for once-through cooling would kill mature fish (through collision or impingement) and would draw in and injure or destroy (entrain) juveniles, larvae, and eggs and, thus, contribute to a serious depletion of the Hudson River population of striped bass.

The use of the models developed in the OHER research indicated that the impacts on striped bass were smaller than alleged but determinable. With the boundaries of the dispute settled, the parties were able to reach a compromise solution that served both their plan and the public interest. This is, perhaps, the major significance of the Hudson River case. Following its settlement, Russell Train, former EPA Administrator and mediator for the Hudson River case, stated, "the settlement demonstrates that acceptable accommodations can be reached which effectively balance the environmental and energy needs of the Nation . . . [through] mediation and negotiation, rather than by sole reliance on the more traditional adversarial legal procedures."

Ecology of the Continental Shelf The continental shelf, which accounts for less than 10 percent of the total ocean surface area, produces most of our seafood. This shallow perimeter of water off our coast receives nearly all of the contaminants that wash off the land and flow downstream. Because it is the more productive, the coastal area is more susceptible to damage from pollution than are deeper parts of the ocean. Research on the continental shelf was initiated to determine the environmental impact of effluents from nuclear and fossil power plants on coastal areas and also to predict the effect of energy discharges over the coastal zone.

The sea, like the lowest region of the earth's atmosphere near the surface, is self-cleansing. Thus, it has a carrying capacity for contaminants. We need to know this carrying capacity to be sure that the sea is not used beyond its capabilities.

History The continental shelf program evolved from work that grew out of concern about nuclear fallout from weapons testing in the Pacific. Work began in the deep ocean, following the movement of the radionuclides from Eniwetok and Bikini in the Kuroshio Current toward Alaska. It soon became apparent, however, that the primary route of radioactivity to humans from the ocean was through seafood. Fallout on land was washed into the coastal zone, raising interest in the natural processes that move contaminants in this area.

The first integrated program dedicated to coastal transport was begun by DOE in 1975, using oceanographers from Skidaway Institute, the University of Georgia, the University of Miami, and North Carolina State University. The study began with an investigation of coastal currents that move dissolved contaminants, specifically the Gulf Stream that sends tongues of water twisting into the coastal zone, causing quantities of contaminant-laden water to move offshore. The scientists then moved inshore to study the mechanism driving freshwater runoff from rivers through the "dam" of saltwater offshore, carrying contaminated coastal water out to the deep ocean. Their research has shown that the coastal zone is regularly flushed and the buildup of contaminants is reduced periodically.

In the Northeast, oceanographers from the Woods Hole Oceanographic Institution, Yale University, the University of California at Los Angeles, North Carolina State University, Columbia University, and Brookhaven National Laboratory studied, and continue to study, the movement of natural particles and the manner in which they attract contaminants. The importance of this research was highlighted by the earlier discovery, in which DOE played an important role, that many, indeed most, pollutants tend to attach themselves to particles that gradually fall to the bottom of the sea. Also, since many of the particles involved are photoplankton cells