REPORT

ON

THE GENERAL HEALTH AND MORALE OF THE OFFICERS AND CREW DURING A 30 DAY SIMULATED WAR PATROL ABOARD A SNORKEL SUBMARINE

Report No. 3
on
BuMed Research Project
NM 002 009
"Effect of Snorkelling on Submarine Personnel"

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ABSTRACT

U. S. S. IREX (SS-482), an experimental snorkel submarine with conventional superstructure and battery, conducted a submerged patrol during the period 1--30 March 1948, during which time she was submerged 615 hours, 390 by snorkel and 225 on battery propulsion.

During this patrol, morale and health were good. The increased monotony and emotional stress incident to a largely or totally submerged patrol is considered to make mandatory an even more stringent personnel selection program and efforts directed toward augmented physical and emotional comfort, proper illumination, pleasing interior color and design, and all practical diversifications.

The effect on personnel of atmospheric pressure fluctuation due to opening and closing of snorkel headvalve presented no problem during this patrol. However, conditions of operations did not afford an evaluation of the problem, in that negligible pressure fluctuations were experienced. A concise appraisal is required of the effect on personnel of prolonged snorkelling during periods of sleep; this most easily accomplished by a proposed dockside study.

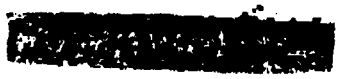
U.S.S. IREX (SS-482) is an experimental snorkel submarine with conventional superstructure and battery. Incident to obtaining information regarding operational material and habitability characteristics, she was directed to conduct a simulated war patrol, 1-30 March 1948, assuming route to be patrolled by enemy air, surface and submarine units. Period of submerged operation was designated as 2--29 March 1948. The patrol materialized essentially as planned with the one exception of surfacing 34 hours on 8 March for required repairs on the snorkel apparatus.

Weather conditions ranged during the submerged periods from relatively calm to Force-7 sea; rough seas being more prevalent.

Total submerged time was 615 hours, 390 by snorkelling, and 225 on battery propulsion.

MORALE

U. S. submarines are undoubtedly the most livable of all, but the stresses of confined living conditions inherent in submarine warfare are anticipated to increase with each step toward the true submersible. Poor habitability is inherent to the submarine. Increased space is unfeasible. It is mandatory that every effort be directed toward augmented comfort, proper illumination, pleasant interior color and design and all practicable diversifications.

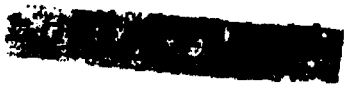


Normally, a person may devote free time and excess energies to a great variety of activities; his day is diversified by the never-ending changes of environment. During a submerged cruise, these activities and diversions are greatly limited. Movement is restricted to the crowded compartments of the submarine. The ship may remain submerged for days on end. Such an environment, if prolonged, particularly in inadequate individuals, may produce emotional stress of a magnitude to result in abnormal behavior patterns, and a general low state of morale.

During this patrol, approximately 8 to 12 hours per day were devoted to ship's work and underway duty stations. Leisure time was spent largely by sleeping, with interspersions of reading, card games, and group conversation. Recorded music was available and popular. Movies were occasionally shown and enthusiastically received during off-duty hours.

With this schedule, there was no evidence of extreme malcontentment but minor intermittent irritability, restlessness, and boredom were observed. There was no indication of lowered mental alertness. No overt pathological emotional reactions were observed.

During the recent world war, submarine patrols continued for periods of 60 to 70 days, being terminated usually by exhaustion



of fuel, food supplies, or torpedoes. Several patrols, however, were limited earlier by personnel fatigue, a product of emotional as well as physical stress. In the event of future war, submarines will be called upon again for extended and successive periods at sea; the entire duration of the patrol may be submerged. The additional emotional strain of continued submergence appears to make mandatory an even more stringent personnel selection program and all possible provisions for diversion, emotional and physical comfort.

HEALTH

The general health of the officers and men throughout this patrol was excellent, except for a number of mild upper-respiratory infections. The diet was well balanced and the food excellently prepared; multi-vitamin capsules were available at each meal.

The ship's personnel were weighed prior to getting underway and immediately upon return from the patrol with the following results:

	Total No. men	Average change	Extreme change
Lost weight	16*	2 lbs.	3 lbs.
No change in weight	15	-	-
Gained weight	38	3.5 lbs.	8 lbs.

* 5 men showing weight loss were not included because they placed themselves on reducing diets during the patrol. The greatest weight loss among this group was 9 lbs.

[redacted]

In an attempt to evaluate the effect of these operating conditions upon physical fitness, 28 men were subjected to the Navy "step-up test" at the beginning, and again toward the end of the cruise. The subjects included the majority of the men in one of the three duty sections. The test was conducted at approximately the same time during the late afternoon on three successive days, (3, 4, and 5 March), and again under the same conditions on two successive days toward the end of the cruise (27, 28 March).

The results were scored according to the system suggested by Behnke et al [1], which provides a range of values between 54 (good), and 90 (poor). No significant changes were noted in successive scores. The average group score for the first series was 72.2 as compared to 71.7 of the second series. Thirteen of the individual scores of Series II were slightly higher and 14 were slightly lower than their counterpart in Series I. The remaining scores were the same in both series.

SNORKELLING

The effect on personnel of atmospheric pressure fluctuation due to the opening and closing of the snorkel headvalve presented no problem during this patrol. There were two cases of mild transitory ear trauma noted, the complaint in each case being only of moderate discomfort in the ear and in men who were suffering

from head colds at the time.

However, it must be noted that conditions of operations during this cruise did not afford an evaluation of the problem, in that negligible pressure fluctuations were experienced. Due to conditions prevailing a depth was maintained to prevent frequent head valve closure. Physiologically, the personnel "flew" at a relatively unvarying altitude of about 1500 feet during the major portion of the snorkel periods. Consequently, in spite of the lack of evidence in this report of pressure fluctuations presenting a medical problem, a complacent attitude is not indicated.

Optimum snorkel depth* varies considerably with the prevailing weather conditions, the employment of one or both snorkel engines, and the R.F.M. of the engines. Running at optimum snorkel depth through various types of seas will result in continuous and irregular atmospheric pressure fluctuations over a range of one to seven.

It is realized that it will not be necessary at all times, even during a war patrol, to run at optimum snorkel depth. However, in the face of active enemy opposition and air cover, it would appear

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*assuming the definition of this term to be the maximum underway depth on main engine propulsion not resulting in accumulative vacuum and engine stoppage.

unquestionable that the snorkel head, if exposed at all, would be maintained at the lowest possible level. The discomfort of resultant pressure fluctuation undoubtedly would be acceptable to submarine personnel as the lesser of the evils. With a continuance of pressure fluctuation over a period of 24 hours or longer, a real problem of obtaining restful sleep may ensue. As was stated in a previous report [2], the large majority of submarine personnel are able to cope successfully with rapid fluctuations during waking hours, but since pressure equalization in the middle ear is not an automatic process, difficulty is anticipated during sleep.

A study is considered indicated to enable appraisal of the seriousness of the problem of obtaining adequate rest in an atmosphere continuously fluctuating in pressure to a magnitude operationally experienced at optimum snorkel depth in various sea conditions. It appears that this investigation may be made in a simple and expeditious manner by rigging a submarine for snorkelling alongside the dock with full crew aboard. With snorkel engine(s) running, the headvalve would be cycled manually to produce continuous atmospheric pressure fluctuations of a rate, rhythm, and degree operationally predetermined, and for a duration of 48 hours or less as may be consistent with findings.

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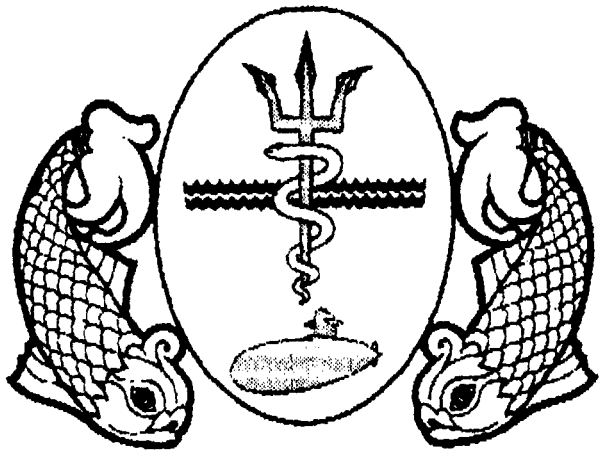

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