NMFS Safety Board Reviews Scuba Diving Operations: NMFS Regional Diving Officers and Diving Coordinator William L. High (wearing sunglasses) met in Boston, Mass., to pinpoint unsafe procedures and to document successful uses of diving as a research tool.

Left to right: Clifford Newell, Boothbay Harbor, Maine; Ray Shuey, La Jolla, Calif.; Ian Ellis, Seattle, Wash.; Mike Russell, Pascagoula, Miss.; John Naughton, Honolulu, Hawaii; High, Seattle; Richard Cooper, Boothbay Harbor; Louis Barr, Auke Bay, Alaska.

(Photo: Gareth W. Coffin)

UNDERWATER FISHERY STUDIES ARE VALUABLE

William L. High

Scuba-diving scientists and technicians are making valuable contributions to man's understanding of the ocean and its creatures. Divers frequently conduct underwater research in minutes or hours which would take surface-restricted scientists with elaborate support vessels and equipment many days or months to accomplish. Although scuba is only one of many available professional tools, nearly 100 National Marine Fisheries Service (NMFS) scientists don underwater breathing apparatus from time to time to directly observe and study the ecosystem and the behavior of marine organisms to it.

Diving teams are very mobile, thereby increasing their capabilities and effectiveness. Occasionally, tasks assigned to some large research vessels can be carried out more quickly and less expensively by divers operating from a skiff. In Alaska, diving scientists employ many methods for reaching their dive sites. Large commercial jets carry the biologists on the 3,600-mile trip from home base at Auke Bay to Amchitka Island, where they are monitoring the marine environment (Figure 1) for effects of nuclear testing. On more modest trips, they may travel to the dive site by research vessel, skiff, snow-track vehicle, helicopter, or floatplane. Occasionally a floatplane may be used for both transportation and as a diving platform. Two divers and a pilot fly to a remote location, carry out their underwater work, and return home in a fraction of the time needed to operate from a boat.

DIRECT OBSERVATIONS

In many studies, diving gear has eliminated a portion of the surface-bound scientist's blind spot. With scuba he can go "where the action is." NMFS divers in Seattle were invaluable during development of a hydraulic clam dredge. In spite of several dredge modifications, the water supply hose broke repeatedly without apparent cause. Yet, in less than two minutes, a diving team of gear experts observed that the nylon dredge tow rope stretched until the strain was picked up by the supply hose. After shortening the rope several feet, hose breakage ceased. Simple solution? Yes, once you have the needed information.

Later, the dredge failed to take clams when all engineering factors indicated it

Fig. 1 - Diver-biologists Lou Barr, Bill Heard, and Dave Hoopes, NMFS Laboratory, Auke Bay, Alaska, count and collect urchins at Amchitka Island as part of a bioenvironmental study to evaluate effects of nuclear testing. (NMFS Alaska: J. Helle)

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should. Diving scientists were again asked to observe the dredge and see if the digging blade penetrated into the seabed deeply enough to encounter clams. A single 20-minute dive confirmed the dredge worked as designed--but there were no clams. Weeks of vessel time were saved.

Lobster life-history studies are an important aspect of research at the NMFS Boothbay Harbor Laboratory in Maine. Here the diver-scientist is defining the population ecology and dynamics of the "inshore" lobster, migratory behavior, population density, etc. (Figure 2). Habitat requirements and estimates of population structure are more precisely measured through direct observation and sampling--as opposed to indirect sampling from the surface using devices known to be selective.

The geoduck, a very large clam found along some Pacific Northwest shores at low tied, were thought to be few and far between until divers discovered large numbers in deep water. Surveys conducted by biologists diving for the Washington State Department of Fisheries and NMFS showed that great numbers of these delicious clams were available down to 100 ft. Because of diver-aided studies we now know most geoducks are inaccessible to shoreside clam diggers. A diver-operated commercial fishery now exists for geoducks.

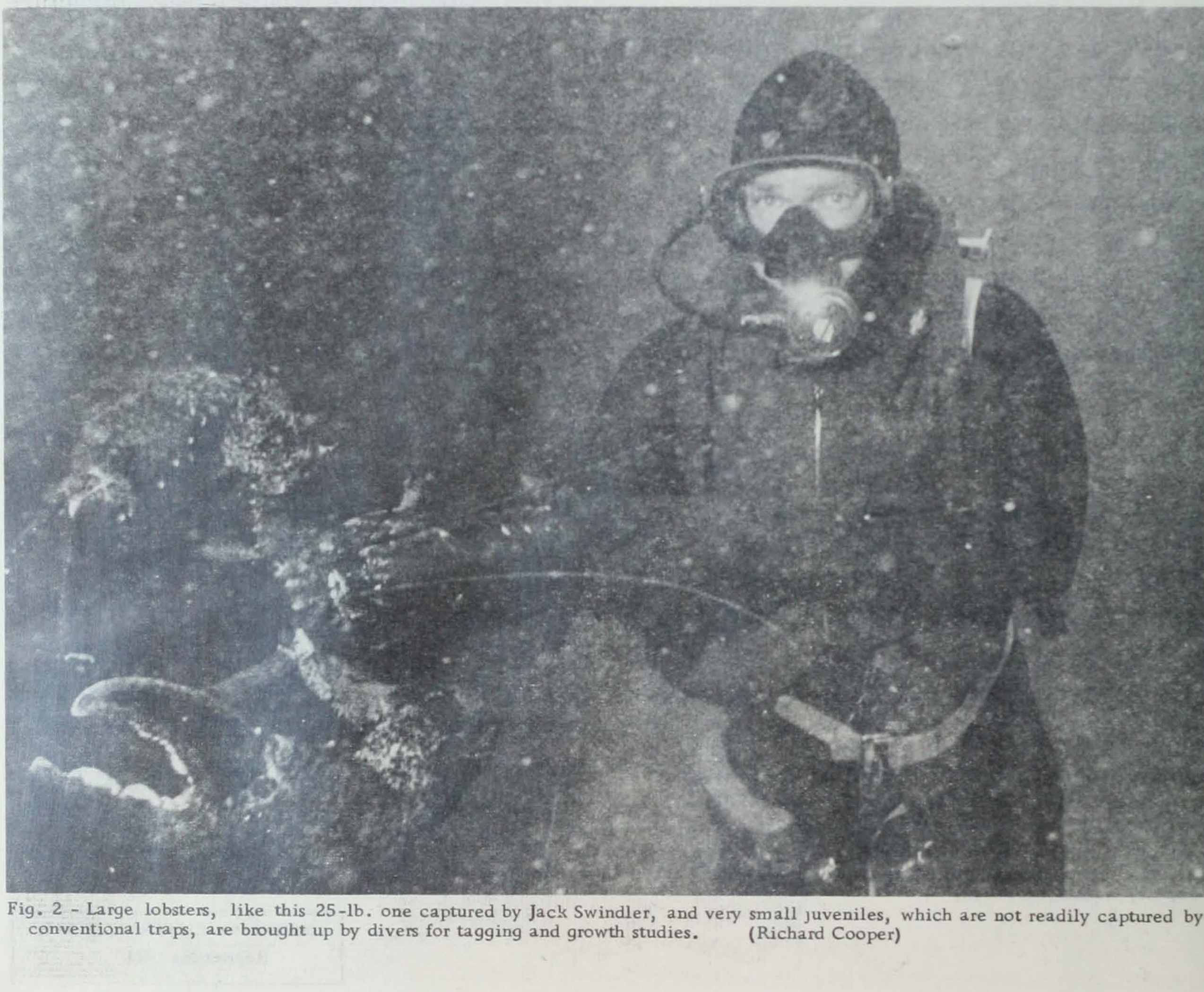

Fig. 2 - Large lobsters, like this 25-lb. one captured by Jack Swindler, and very small juveniles, which are not readily captured by conventional traps, are brought up by divers for tagging and growth studies. (Richard Cooper)

GEAR DEVELOPMENT

Major strides were made in trawl development because diving-gear specialists observed experimental trawls in operation (Figure 3). The giant Cobb pelagic trawls and, more recently, the NMFS shrimp-sorting trawl developed by the Exploratory Fishing and Gear Research Base in Seattle, owe much of their success to diver evaluations (Figure 4). When nets are fished in relatively shallow water, divers can follow the towing warp to the otterboard, then swim along the groundlines to the trawl. Areas of slack web or excessive strain are immediately recognized. Biologists easily observe fish escape efforts (Figure 5). Vertical and horizontal openings of the trawl net are readily measured.

Several times, divers have discovered trawl defects made during manufacture which severely reduced the trawl's fishing capability (Figure 6). Occasionally, divers find nets used by both research and commercial vessels that have been hooked up incorrectly--causing trawl wings to cross or roll up. One fisherman asked the Seattle NMFS gear-diving team to observe his commercial trawl. The divers discovered the footrope passed about 10 inches above the ocean floor. Up to 50% of the potential catch was seen escaping beneath the net. Unfortunately, the fisherman had used the net for several months before the deficiency was discovered.

Divers assigned to the Pascagoula, Mississippi, Laboratory installed floating and submerged artificial structures in offshore locations to attract fish as part of a preliminary study to develop an NMFS-proposed automated fishing platform. Divers' estimates of fish school populations at structure sites were compared immediately after each dive with catches made by a purse seiner (Figure 7). Divers' estimates were found to be accurate enough to be used when the use of a commercial purse seiner was not feasible.

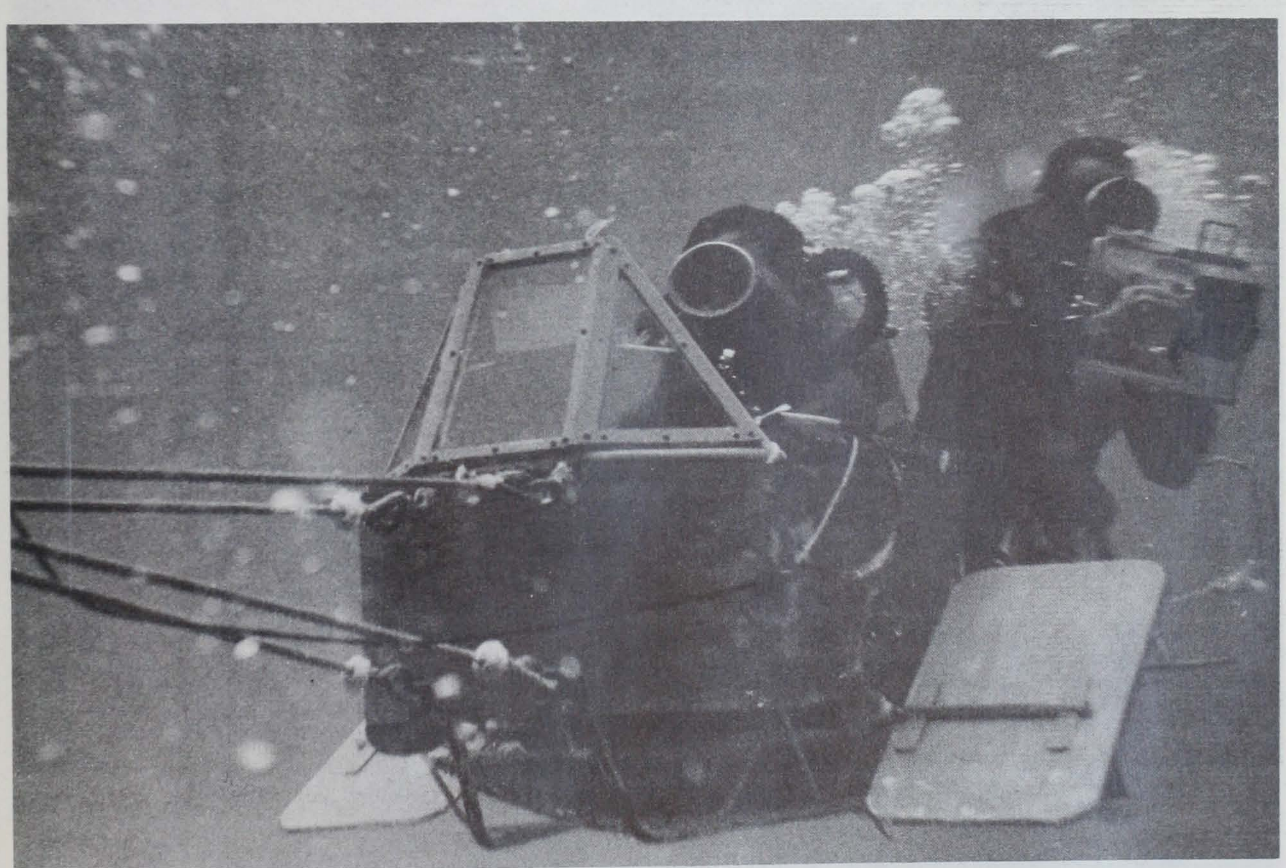

Fig. 3 - A sea sled piloted by Randolph Chang is towed alongside a midwater trawl to serve as a photographic platform for cameraman Reginald Gooding. Movies afford surface-restricted fishermen and biologists a fish-eye view of capturing gear. (NMFS Hawaii)

Fig. 4 - A nearly invisible, giant midwater trawl appears to engulf Hawaii area scientist John Naughton, who has discovered a small hole. Special training and safety requirements are imposed to protect scientist-divers working directly on a moving trawl. (NMFS Hawaii)

Fig. 5 - Scientists Larry D. Lusz and Ian E. Ellis hang onto headrope of a commercial bottom trawl to visually assess trawl's performance and to observe behavior of fish near the net. (William L. High)

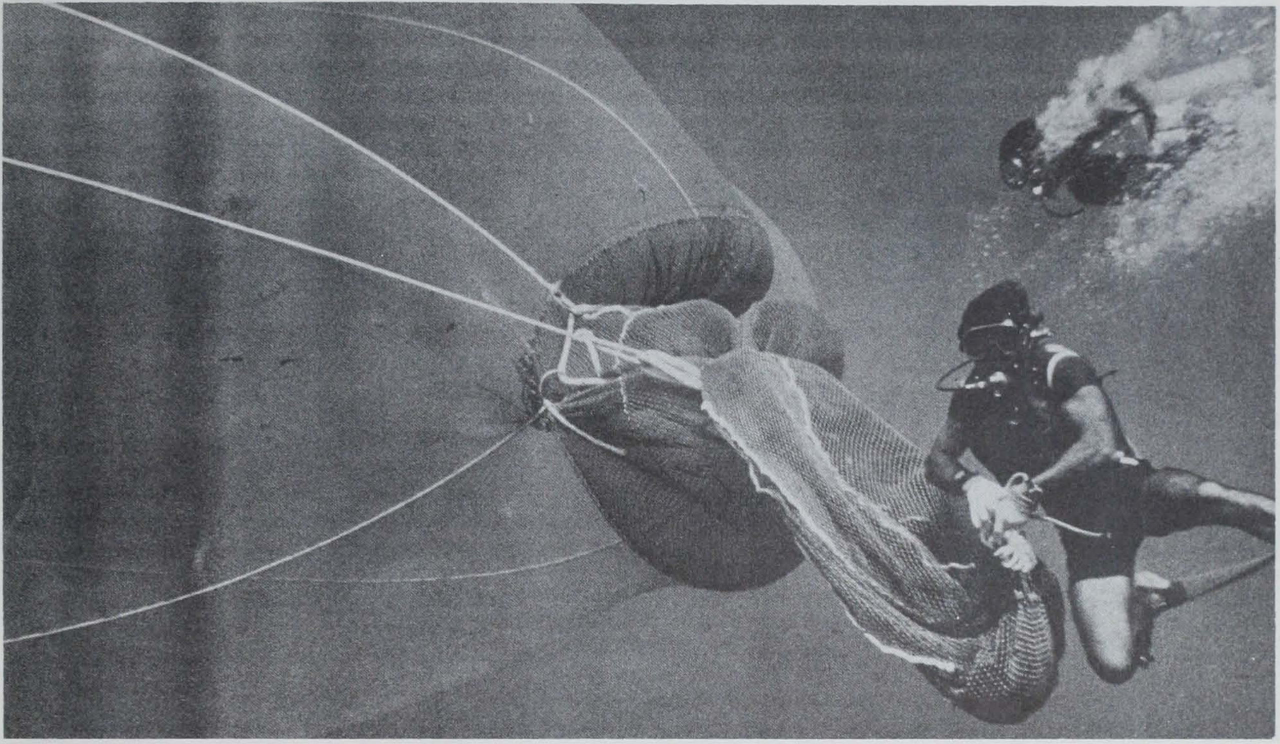

Fig. 6 - As seen from cod end, John Naughton and Robert Moncrief discover that a Cobb pelagic trawl used to sample juvenile tuna is distorted by a faulty lazyline. Sampling and commercial-gear deficiencies such as this, which are difficult to detect from the vessel, can be observed and often corrected by divers in a few minutes.

Fig. 7 - A dense school of Spanish sardines and cigar fish is shown gathering adjacent to a diver-installed artificial habitat. The aggregating characteristics of several structures were evaluated by biologist-divers near Panama City, Florida. (NMFS)

Fig. 8 - Aquanaut fishery biologists William L. High and Alan J. Beardsley position a fish trap for behavior experiments during Tektite II. They lived for two weeks on the ocean floor.

Observations of a midwater trawl by Pascagoula NMFS divers during actual fishing operations revealed that coastal pelagic school fish were swimming along with the net, entering and leaving the mouth of the net at will. These observations provided background information on fish-gear interaction required for the development of a proposed electrical trawl.

SATURATION DIVING

NMFS biologists participating in the Tektite II undersea program were able to conduct studies 25 to 80 ft below the ocean surface for up to 8 hours per day. Spiny lobsters habits, including feeding, nocturnal movements, and social relationships were investigated intensively because divers could readily observe the animals both day and night. Fish were observed in and around experimental and local fish traps (Figure 8). Methods were found to alter catch rates and species captured.

OTHER DIVING PROGRAMS

Research programs which have used diving as a research tool include recapturing tagged fish; assessing demersal and bait fish resources, and assessing pearl shell resources throughout the Trust Territories; determining effects of polluting, channel blasting, dredging, and log dumping; and observing shrimp densities, natural animal behavior, and behavior influenced by capturing gear.

More sophisticated diving systems currently under development by industry will soon extend the depth and work capability of all diving scientists and technicians. By direct observation they will better understand how to assist in environmental protection and to manage commercial and sport fisheries.