

expected to result in the development of gear modifications to decrease salmon bycatch in the pollock fisheries. These types of fish behavior and gear technology research have generally been successful in identifying and implementing gear modifications that increase the escapement of select species of sizes of fish.

Additionally, in gear research conducted by the Washington Sea Grant Program (WSGP) and partially funded by a NOAA Saltonstall-Kennedy grant, seabird avoidance gear devices for use in the groundfish and halibut longline fisheries off Alaska were tested and found to significantly reduce the incidental catch of seabirds. NMFS is in the process of revising regulatory requirements for longline vessel operators off Alaska, based on this WSGP research.

As new methods are developed for increasing the escapement of select species or sizes of fish, there is an increased need to estimate escapement mortality. If the escapement mortality rates are very high, increased escapement simply replaces one type of bycatch mortality (e.g., discard mortality) with another type of bycatch mortality (i.e., escapement mortality), and the latter is unobserved, and, therefore, often more difficult to estimate. Examples of escapement and discard mortality research being conducted by the AFSC include: (1) research to determine the escapement mortality rate for juvenile pollock and to develop methods and equipment for use in future survival studies; (2) research on the factors that affect the escapement and discard mortality rates for halibut; and (3) research on the injury rates of red king crab that encounter and escape bottom trawl footropes on the sea floor.

At the Southwest Fisheries Science Center (SWFSC), satellite tracking of sea turtles is revealing significant new information on sea turtle habitat, movement patterns, and post-hooking survival. Approximately 50 turtles have been tracked with conventional ARGOS transmitters, and about 20 turtles have been tracked with 'pop-up' satellite tags. ARGOS transmitters indicate that sea turtles survive for many months after release from longline gear. The pop-up tags will provide more long-term information on post-hooking survival rates indicating whether turtles survive for 6 months or longer after release from longline gear. Post-hooking survival is also being correlated with the condition of released turtles.

SWFSC scientists have initiated research to develop gear and technique modifications to reduce the incidental take of sea turtles in the Hawaii-based

pelagic longline fishery. The development of turtle-safe longline gear and turtle-safe fishing techniques are also needed to foster collaborative efforts with foreign fishing fleets in addressing the sea turtle bycatch problem on a world-wide basis. Although the research has been stalled due to litigation, NMFS remains committed to finding cost-effective approaches for protecting and conserving sea turtles while sustaining our domestic longline fisheries.

In 2001, the Southeast Fisheries Science Center, in cooperation with the U.S. pelagic longline fishing industry, the SWFSC, the Northeast Fisheries Science Center, and the University of Florida, began a research effort to investigate the feasibility of gear modifications and fishing practices to reduce the incidental capture of endangered and threatened sea turtles by pelagic longline fishing gear. NMFS gear specialists are working with fishermen and state and university researchers to gain insight into fishing gear and fishing practices to develop mitigation measures to reduce turtle interactions with longline gear. Prototype mitigation techniques are being developed using captive reared turtles in controlled experiments and these techniques are being evaluated on commercial fishing vessels in the Atlantic pelagic fishing grounds. These studies are ongoing and include evaluation of de-hooker and line cutter prototypes to allow removal of fishing gear from turtles; bait types and hook designs developed to reduce hooking rates and the severity of hooking of sea turtles; satellite tags to determine survival, distribution, and behavior of sea turtles released from fishing gear; and operational changes in fishing practices to reduce turtle interactions.

There have been several successful efforts by commercial fishermen and scientists in the Northeast to develop fishing gear with greater selectivity for a particular species, thus allowing the commercial fishing industry access to areas that have been closed to fishing due to declining groundfish stocks or entanglement mortality of marine mammals. Most notable among bycatch reduction efforts has been the use of sound producing devices called "pingers" in the sink gillnet fishery. Pingers that emit intervals of high frequency sound work well in deterring harbor porpoise from being entangled in fixed sink gillnets. In addition, various configurations of fish excluder devices have been tested and proven successful for the Northern shrimp fishery, which utilizes small-mesh net materials that

are capable of catching groundfish species as bycatch.

The Nordmore grate was introduced to the Northwest Atlantic shrimp fishery after successful deployment by northern European shrimp fishermen. This grate allows large fish to slide up and out of the net, while at the same time allowing the smaller shrimp to pass through the grate into the codend for harvest. Shrimp fishing has been demonstrated to be more efficient using the grate. The Pandalid shrimp fishery has been successful in reducing finfish bycatch, particularly bycatch of Atlantic cod, to less than 5 percent of total catch in most areas. Current research projects are looking at similar grates with horizontal configurations to allow harvest of flatfish such as flounders while protecting round fish such as cod, haddock, and pollock.

Similar small mesh fisheries in waters off the coast of Massachusetts and Georges Bank targeting silver hake or whiting have benefitted from the development of otter trawl gears with "raised footropes." Cape Cod and Massachusetts Bay fishermen developed and tested the raised footrope trawl to protect flounder species while allowing fishing for whiting during summer months. This innovative gear has reduced flounder bycatch in the whiting fishery by as much as 40 percent to 50 percent. The raised footrope trawl has been incorporated into the Georges Bank groundfish management plan and is being further tested in the Gulf of Maine. Additionally, various configurations are being researched using numerous short vertical dropper chains attached to the mouth of the net instead of the long horizontal "tickler" chain that is attached below the mouth of the net.

B. NMFS Observer Programs

Observers provide the most reliable source of high quality, objective, fishery-dependent data. Observers provide information on all aspects of fishing operations, including total removal levels of catch and bycatch, biological samples and weights and measurements for life history research, temporal and spatial fishing strategies, and socio-economic data on fish loss and operating costs. They assist in special research activities, such as tagging and tracking of released animals. They also collect oceanographic and climate data for an ecosystem approach to fisheries and protected species management.

NMFS has seen an expansion in observer programs since the passing of the SFA. This has partly been in response to national standard 9, which