SPAWNING POLLOCK SURVEYS IN THE GULF OF ALASKA

Prior to 1981, the fishery for walleye pollock (*Theragra chalcogramma*) in the Gulf of Alaska was essentially foreign with the total catch averaging about 0.1 million metric tons (t) per year between 1977 and 1981. During this period, only small amounts of pollock were taken by either joint venture or domestic fisheries. From 1981 to 1985, a joint venture fishery developed in the Shelikof area during the January-March period with the annual catch peaking at 0.24 million t in 1985 (Fig. 1). In 1985, the domestic fishery began to develop and by 1988 the domestic fleet was catching the total harvest. This domestic fleet was primarily land-based (in Kodiak) with catches primarily from the Shelikof and Kodiak areas. In 1989, however, over half of the walleye pollock taken in the gulf were taken by catcher-processors fishing prespawning pollock for roe in the Sanak (western gulf) and Chirikof areas. Almost all of that catch was taken in March from waters over 100-500 fathoms deep.

The Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC) has been conducting echo integration-midwater trawl surveys in the Gulf of Alaska annually since 1980 (with the exception of 1982). These surveys have focused on spawning walleye pollock in Shelikof Strait. Initially, RACE Division scientists believed that the majority of pollock in the Gulf of Alaska (particularly the central Gulf) spawned in Shelikof Strait in March. Biomass estimated from the surveys decreased from nearly 4 million t in the early 1980s to less than 0.4 million t in 1988 and 1989 (Fig. 2). Surveys were also carried out in 1983, 1984, and 1986 in the Gulf of Alaska, outside of Shelikof Strait, to search for significant quantities of mature pollock that were not being included in the Shelikof population estimates. During each of these surveys, no substantial concentrations of adult (greater than age 2) pollock were observed outside Shelikof Strait.

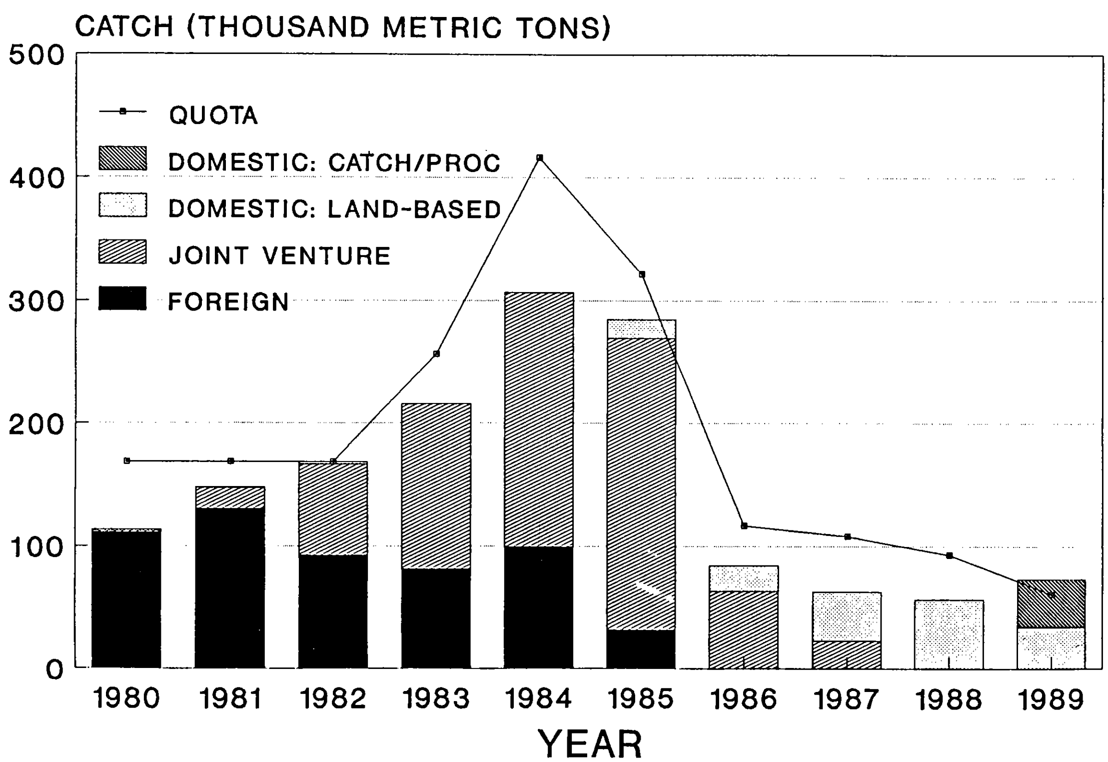


Figure 1. Catch of walleye pollock in the Gulf of Alaska from 1980 to 1989 segregated by fishery type.

Coincident with the extraordinary decrease in population abundance within Shelikof Strait during the latter half of the 1980s were notable changes in the biological characteristics of walleye pollock in the area. The proportion of mature pollock (expected to spawn within about 1 month) that were observed in March in the 4-7 age group decreased significantly from the early to late 1980s. Nearly 90% of walleye pollock aged 4 and 5 were mature in 1983; less than 20% of these same age groups were mature in 1988. The analysis of data from a bottom trawl survey of the Gulf of Alaska in 1987 resulted in an abundance estimate of 0.86 million t; analysis of a bottom trawl survey conducted in a portion of the central Gulf of Alaska in 1989 produced a biomass estimate of 0.82 million t. These data, when compared to the echo integration-midwater trawl survey results, suggest that, at least in recent years, the echo integration-midwater trawl survey in Shelikof Strait is not assessing such a major portion of the adult pollock (greater than age 2) population in the Gulf of Alaska as previously believed. Echo integration-midwater trawl surveys carried out in the Gulf of Alaska outside of Shelikof Strait in March 1983 and again in March 1986 did not indicate the occurrence of significant quantities of adult pollock in that area. The magnitude of the abundance of pollock outside of Shelikof Strait is still under study and remains uncertain.

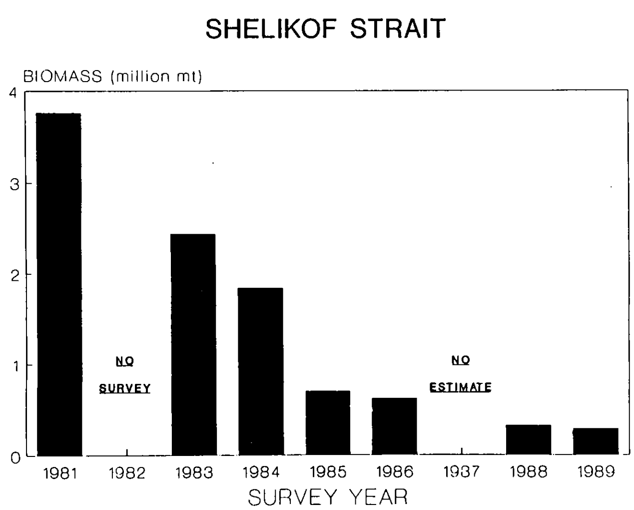


Figure 2. Biomass estimates from echo integrator-midwater trawl surveys in Shelikof Strait from 1981 to 1989. There was no survey in 1983. Because of equipment malfunction, no biomass estimate was possible for 1987.

In March 1989, based on reports from catcher-processor vessels of spawning schools of pollock in two small areas near Chirikof Island, a portion of the RACE Division's survey effort scheduled for Shelikof Strait was diverted there. Pollock biomass estimated for those two areas together was small (about .03 million t) compared with that estimated for Shelikof Strait (0.29 million t). However, nearly all of the pollock observed in the Chirikof area were in spawning condition, while only about one-third of the pollock in Shelikof Strait were near spawning. Adding the spawning biomass observed during the survey to the .03 million ton catch reported from an intensive fishery near Chirikof in March yields an estimated spawning biomass of at least .06 million t--over half the spawning biomass estimated for inside Shelikof Strait. The age composition was significantly different between the two areas. In Shelikof Strait, over 94% of the fish were less than age 6, while in the Chirikof area, about 21% of the pollock were less than age 6. In the Chirikof area, the 1978 year class (age 11) was an important component of the population. That year class is the largest in both the eastern Bering Sea and Gulf of Alaska pollock populations since the mid-1970s.

During February and March of 1990, the RACE Division expanded its Shelikof Strait pollock survey to other potential spawning areas in the Gulf of Alaska. The continental slope areas (100-500 fm) were surveyed from Middleton Island to Unimak Pass (Fig. 3) with more effort in areas where spawning pollock had been intensively fished in 1989. In addition, Prince William Sound, where a small population of spawning pollock is known to occur, and several gullies near Kodiak, where most of the land-based fishery has taken place in recent years, were surveyed.

Again, no large concentrations of pollock were observed outside of Shelikof Strait. A population of mature pollock was encountered in Prince William Sound and only a few small schools of pollock were located in Marmot and Chiniak Gullies. Over much of the continental slope between 100 and 500 fathoms a diffuse scattering layer composed primarily of plankton with very few mature

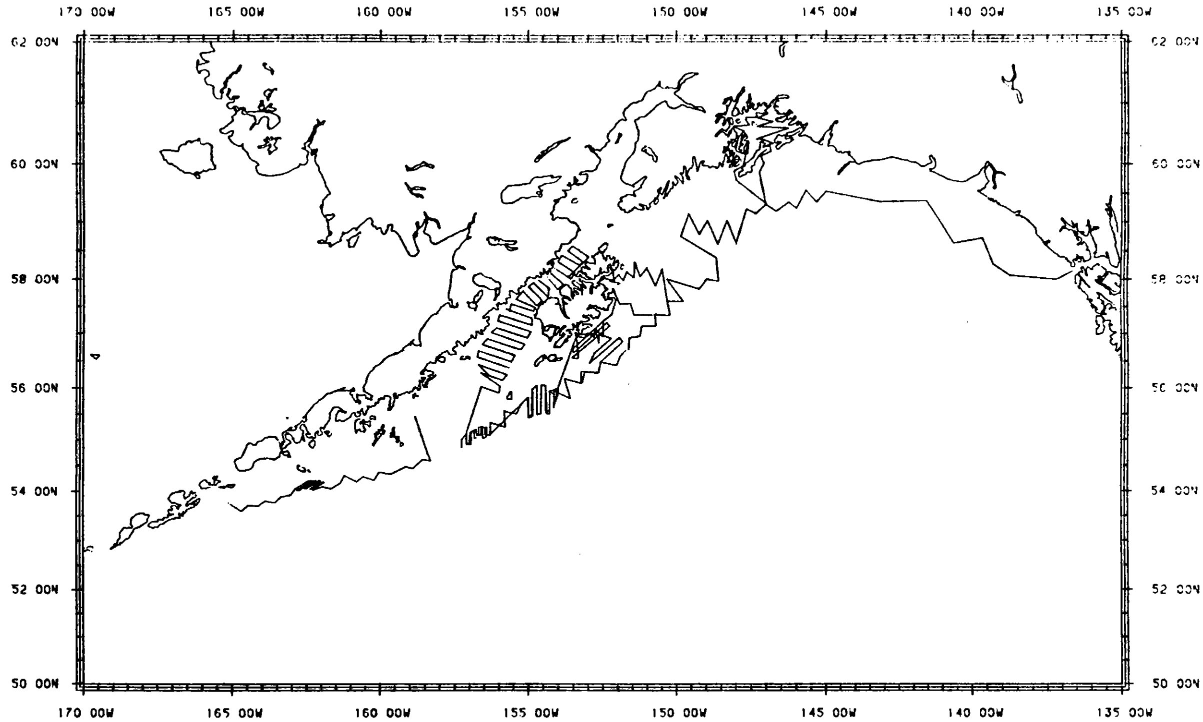
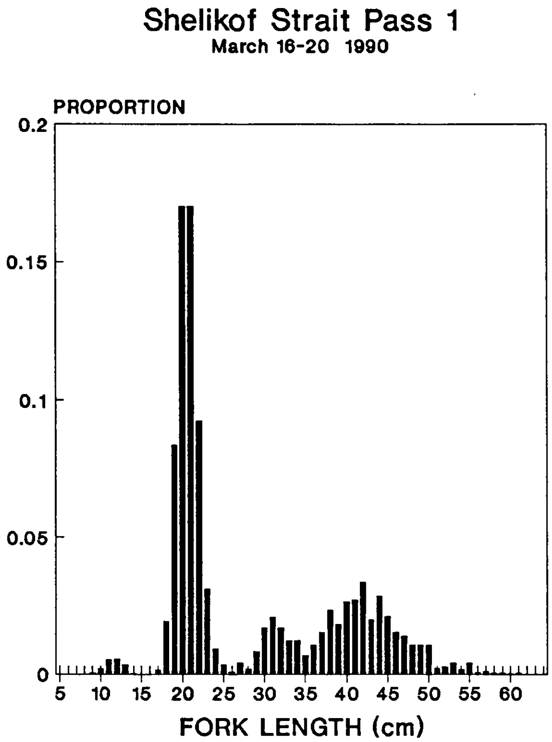


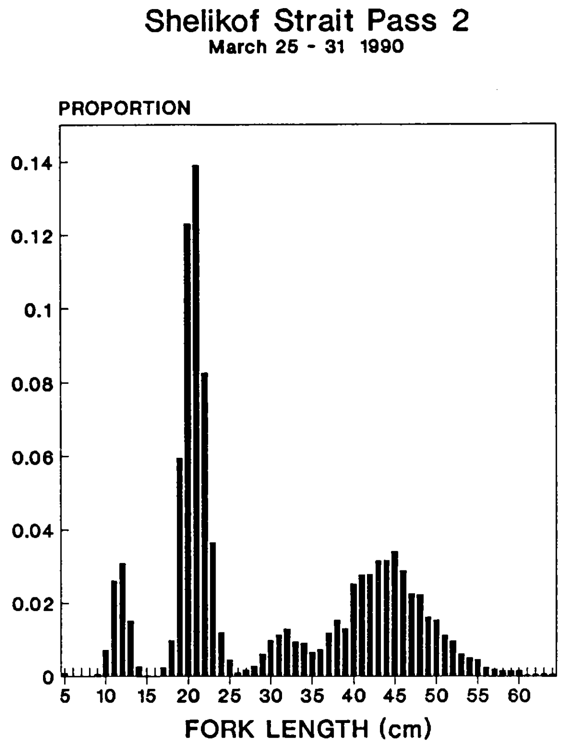
Figure 3. Map of Gulf of Alaska study area in 1990 showing location of transects for echo integrator-midwater trawl survey.

pollock was observed. Trawling in this layer yielded very small catches except in a small area near Sanak Island and another area near Chirikof Island. Even in the Sanak and Chirikof Islands areas, only moderate catch rates occurred. As in 1989, the pollock captured in these areas were all greater than about 40 cm (Fig. 4). Because of the large scattering layer at depths where low densities of pollock were observed, it will be impossible to obtain echo integration abundance estimates for some of the region.

Within Shelikof Strait, the distribution of pollock was similar to that observed in previous years. Adult fish (greater than about 30 cm) were concentrated in the deep basin on the western side of the central portion of the strait. Smaller fish were more abundant at shallower depths, and the average size generally increased with depth. A significant number of age-2 pollock (16-25 cm, Fig.4) were encountered within the strait.

Since 1980, the RACE Division has conducted its echo integration surveys using a conventional echo sounder with a transducer housed in a deadweight fin towed at a depth of about 20 m. Echo integration data are processed using a Hewlett Packard 1000 computer. In late 1989, the Division acquired a second acoustic assessment system which since has been used with the original system to collect dual sets of acoustic survey data. The new system consists of a Simrad EK500 echosounder-digital processor interfaced to a SUN Work Station with a graphics display. The transducer for this system is installed in the centerboard of the NOAA research vessel *Miller Freeman*. The installation of the transducer in the centerboard of the *Miller Freeman* placed it in a very favorable operating environment. Typical hull-mounted transducers are usually not very effective even in moderate weather conditions because air is forced in front of the transducer and prevents effective transmission of acoustic energy. Use of a transducer in a towed fin often reduces the air blocking problem but can introduce a large amount of acoustic and mechanical noise produced by the propeller. Installation of the transducer in the *Miller Freeman's* center-





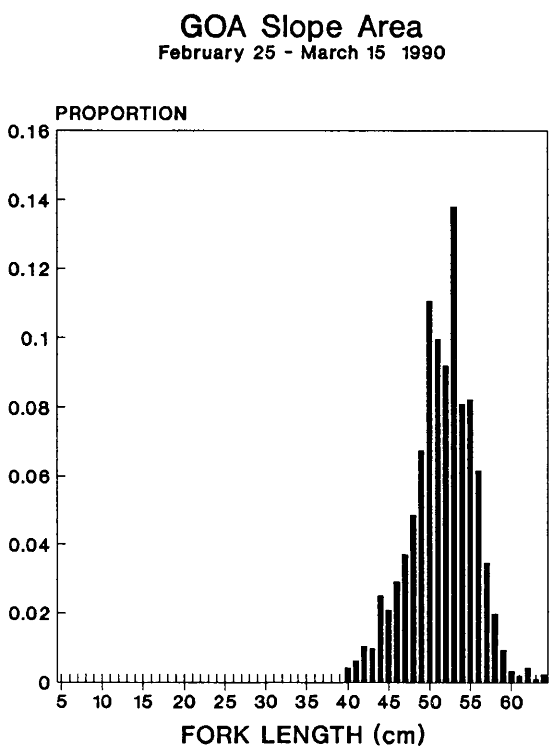


Figure 4. Length frequencies of samples collected during 1990 echo integrator-midwater trawl surveys in Shelikof Strait and the Gulf of Alaska slope areas.

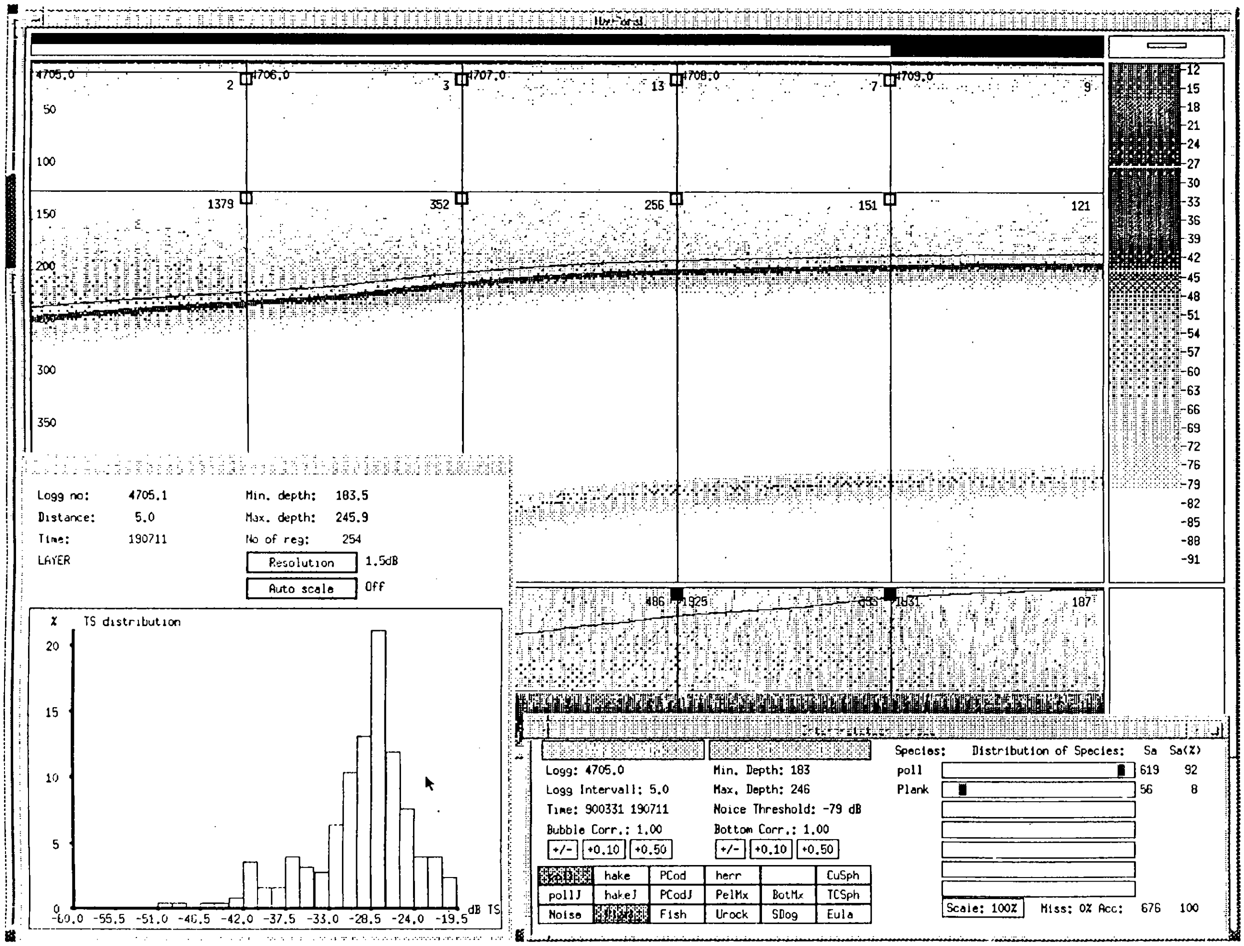


Figure 5. Black and white representation of color display of data interpretation windows of Simrad echo integration-data analysis system. Midwater sign in the upper window is segregated by species using the species allocation window (lower right). The bottom 10 meters of the water column are magnified for more accurate delineation of echo sign near bottom. In the lower left portion of the figure is the target strength display.

board placed the transducer approximately 4 m below the hull and greatly reduced these problems.

Although the two acoustic systems are functionally equivalent and provide estimates of fish density per unit area as their primary output, the new system allows much more flexibility in evaluation and analysis of acoustic data. The new system is more technically advanced and easier to use than the first and has the capability to collect, display, and analyze echo integration data and split-beam target strength data, as well as log various environmental and other ancillary data. The operator-computer interface is designed to take full advantage of the graphic capabilities of the workstation. Density data are presented in the form of a color display with a dynamic range of 90 dB (density differences by a factor of one billion). The application of new technology which greatly expands the dynamic range has eliminated saturation of the echo sounding system by dense fish schools or even the bottom signal. The system simultaneously presents fish density (echo integration) and target strength (acoustic size) information (Fig. 5). For data storage and presentation, the water column is divided into 500 equal intervals. At a typical range setting of 500 m, the range resolution of collected fish density data would be 1 m. In the interval from 10 m above to 5 m below the detected bottom, the density data interval is adjusted to 0.1 m. The ability to segregate echo sign on the basis of echogram appearance is greatly enhanced by the increased system dynamic range. The simultaneous presentation of target strength information further assists the operator in determining the appropriate categorization of the echo sign. The operator has a great deal of flexibility to assign density data to particular fish species or other sources (Fig. 5). Different portions of the water column can be assigned different species composition. In addition, discrete water volumes can be specified by the operator and separately assigned to particular species or used to examine finer detail echo integration or fish target strength data. One major improvement of the new systems is the way in which echo sign near bottom is treated. With all echo integration systems, when assessing fish near the bottom particular care must be taken to avoid including echo returns from the bottom with those from fish targets. The detailed, color display near the bottom and a user-adjustable bottom indicator in the echo integration system allows fish density to be estimated very near the bottom much more easily, while still ensuring that echo returns from the bottom are not included in the echo integration values. In areas with favorable bottom conditions, it is possible to assess midwater fish to within less than 1 m above bottom.

The results from analysis using the two echo integration systems during the 1990 Gulf of Alaska Survey are currently being compared to ensure that the two systems provide similar results. Once this comparison is completed, it is expected that the new echo integration system will become the primary data collection device.

The next echo integration-midwater trawl survey is scheduled for February-March 1991. A survey of the spawning pollock stock in the Bogoslof Island as well as shelf areas of the Bering Sea will be completed by mid-March. A short survey (approximately 10 days) of Shelikof Strait spawning pollock will follow.

This article was written by DR. JIM TRAYNOR of the RACE Division.