APPENDIX Part 2


by

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INTRODUCTION

Acoustic/midwater trawl surveys of the abundance of walleye pollock (Theragra chalcogramma) in Prince William Sound (PWS) were initiated in winter 1995 after the observations of the Sound Ecosystem Assessment (SEA) program during 1994 indicated substantial biomass of this species. Subsequently, surveys were conducted in 1997, 1998 and 2000. This report describes the results of surveys conducted during March 2001 by the PWSSC in cooperation with ADF&G and with support from the Oil Spill Recovery Institute (OSRI) and the Pollock Conservation Cooperative (PCC).

METHODS

Acoustic techniques, specifically echo integration (Thorne 1970, 1971, 1983a,b), have been used for decades to assess abundance of pelagic fishes (MacLennan and Simmonds 1992; Thorne 1977a). Walleye pollock are managed as groundfish. However, younger age pollock are almost exclusively pelagic (Brodeur and Wilson 1996). Adult pollock tend to be demersal on the continental shelf (less than 200 m) and pelagic off the continental slope (Thorne 1979). In the Gulf of Alaska, walleye pollock populations are assessed both by echo integration/midwater trawl surveys and groundfish surveys (Hollowed and Megrey 1990; Hollowed et al. 1991, 1993, 1994, 1995, 1996; Wilson 1994; Wilson et al. 1995, 1996).

Evidence from acoustic records suggests that adult pollock begin to accumulate in PWS in early winter, and remain in aggregations until after spawning in April. During this time, the distribution is almost exclusively pelagic. Acoustic surveys are designed to take advantage of this accessible and relatively restricted distribution.

The PWS survey design consists of a three stage sampling procedure (Cochran 1977; Scheaffer, Mendenhall and Ott 1986). First, historical patterns, information from commercial fishermen and broad area sonar/echosounder surveys are used to identify the general distribution of the pollock within Prince William Sound. Second, a quantitative (echo integration) acoustic survey is conducted, with sampling intensity proportional to abundance indicated in stage One. Third, midwater trawl net sampling is directed toward the surveyed concentrations to obtain biological information (McClathy and Thorne 2000). Published target strength relationships for pollock (Traynor 1996) are used to convert echo integration values to absolute density estimates.

Historically, acoustic systems at both 38 kHz and 120 kHz have been used for the pollock surveys in Prince William Sound. The original survey in 1995 used 38 kHz. The survey in 1997 used both a high power 120 kHz system with a preamp transducer and a 70 kHz
system. The 120 kHz had better detection because of superior transducer characteristics. A 38 kHz digital transducer system was applied in both the 1998 and the 2000 surveys along with the high power 120 kHz system. However, the signal to noise characteristics of the 120 kHz system were substantially better than the 38 kHz system due to a variety of electronic problems both years. Although some of the noise problems were corrected for the 2001 surveys, the 120 kHz system still outperformed the 38 kHz system and was used as the primary system. All systems were calibrated with a tungsten carbide spheres following procedures of Foote et al. (1987). System time-varied gains were measured and corrections were made for deviation from theoretical. Attenuation values are corrected based on salinity/temperature characteristics measured with a SeaBird Electronics Model 19.03 CTD.

Echo integration measurements were made in real time using a BioSonics model 221 Echo Integrator. Data were collected in 5-m depth intervals to 400 m. Resulting echo integration values were analyzed with Microsoft Excel spreadsheets. Occasional bottom intrusions were edited from the data. Conversion factors for target strength, system calibration and deviations from theoretical propagation losses were made within the spreadsheet calculations. Water column densities for the pollock depth layers were integrated to determine biomass per unit area values for each transect, and weighted averages were calculated for each run. Population estimates were made by extrapolating the average surface area biomass values to the surface area represented by the survey. Variances were estimated from variations among the replicates using standard formulas (Seber 1973; Cochran 1977; Scheaffer, Mendenhall and Ott 1986). Grouping of the zigs and the zags in the survey pattern allows two independent measurements of the mean density from each survey, both composed of several parallel transects. This approach combines the best elements of systematic survey coverage without the problems of autocorrelation.

The ADF&G Research Vessel Pandalus was used for the first survey. The start of the survey was delayed by weather conditions that precluded transit to Cordova from Homer, where the vessel is based. The Pandalus arrived in Cordova the evening of March 1, was loaded, departed out of Cordova just before midnight, and searched Hinchinbrook entrance, Montague Trench, the southeast corner of Knight Island and Lower Knight Island Passage before conducting a quantitative survey in Port Bainbridge the evening of March 2 (Figure 1). A quantitative survey was conducted along the southeast portion of Knight Island during the morning of March 3, and in Montague Trench that night. The next day the fourth survey was began in Hinchinbrook Entrance and continued northward to Johnstone Point before 50 mph SE winds terminated the effort and the vessel returned to Cordova. Two trawls were made during the cruise, one along the southeast corner of Knight Island and the second in Hinchinbrook Entrance.

The second cruise was conducted aboard the FV KyleDavid in conjunction with a survey of herring. The vessel departed Cordova March 25 and surveyed herring concentrations for the first three days. On March 28, replicate surveys were conducted on pollock in Port Bainbridge (Figure 2), followed by a survey of Lower Knight Island Passage and the southeast corner of Knight Island on March 29. Additional herring surveys were
conducted March 30, followed by a pollock survey in Montague Trench March 31. The
cruise terminated April 1 due to deteriorating weather conditions and limited time. The
RV Pandalus made five additional midwater trawls between March 31 and April 2, one
in Bainbridge Passage and two each along the southeast corner of Knight Island and in
Montague Trench. Additional biological information was obtained from ADF&G
sampling of the commercial catch.

RESULTS AND DISCUSSION

The midwater trawl catches showed that walleye pollock was the dominant biomass in
the water column, as has been the case in all surveys. Samples sizes were too small to
establish definitive differences among the various areas, although the mean length of
pollock was largest in Port Bainbridge and smallest in Montague Trench/Hinchinbrook, a
pattern that had been observed during 2000 (Table 1). The length data from the
commercial fishery also showed a mean length of 518 mm in Port Bainbridge and 508
mm for the other areas. The differences in length among the various locations have only
a minor impact on the acoustic target strength. A backscattering cross section of 0.00055
was selected as the most representative value to convert the acoustic data to biomass for
all surveys. The value corresponds to an acoustic target strength of ~32.6 dB/Kg.

The total biomass estimate from the area directly covered by the first cruise was 20,660
mt (Table 2). However, the fourth survey, Hinchinbrook Entrance and north to Glacier
Island, covered only 70 square nautical miles, compared to the 170 square nautical mile
area of pollock concentration observed in March 2000. In order to estimate the missing
abundance because of the curtailed survey, the mean density measured in the covered
area was extended to the full 170 square nautical miles. This area extension increased the
estimate from the curtailed fourth survey from 5,439 mt to 13,239 mt, and the grand total
to 28,460 mt (Table 2).

The total biomass from the area covered by the second survey was only 11,653 mt.
Extending the estimate to non-surveyed areas based on previous observations would
increase the estimate to 24,892 (Table 2).

Based on these assumptions, the mean estimate would be 26,676 with a 95% confidence
interval of +/- 2,521 mt. This value compares to the estimate from March 2000 of 28,277
mt. The results suggest an insignificant change between the two years. The estimate
contains an additional uncertainty because of the lack of complete survey coverage.
However, the conclusion of only minor change between the two years is reasonable
considering the direct estimate of 20,660 mt from the primary cruise and the substantial
area that was not covered.

While the results suggest minor change between 2000 and 2001, the general trend in the
estimates since 1998 is negative, and the decrease in the abundance within Port
Bainbridge, site of the primary commercial fishery, has been substantial (Figure 3).
About 75% of the total population biomass was located in Port Bainbridge in 1975, about

22
27,000 mt. Only 3,612 mt was located in Port Bainbridge during the first survey of 2001, about 13% of the total. By the second cruise, the biomass had decreased to less than 1000 mt.

In addition to the major change in abundance at Port Bainbridge between the two cruises in 2001, there were other smaller changes. The concentration of pollock off the southeast portion of Knight Island had dispersed. A commercial fishery had operated on this area. Whether the changes between surveys and among years are responses to commercial fishing or other factors cannot be ascertained without specific research efforts to evaluate these changes. Some of the changes appear to result from different distributions associated with dominant year classes. Changes within a winter period may also be natural behavior associated with prespawning activity.

Most fish were observed between 175 and 250 m depth (Figure. 4). A slightly deeper distribution was observed in the Montague Trench area, with appreciable density extending to 300 m and an indication of a minor secondary concentration at about 340 m. Day and night differences in vertical distributions were minor.

**Survey Timing**

A critical feature of acoustic surveys, particularly on migrating stocks, is timing (Thorne 1973, 1977b, Trumble et al. 1983). Commercial fishing for pollock in PWS begins in January and the pollock spawn in April. Prior to the 2001 survey, the timing for the pollock surveys had varied slightly (February 23 to March 13) among years. Replicate surveys in 1995 and 1998 suggested changes in abundance and distribution within survey periods, indicating the possibility that fish may continue to recruit to the spawning biomass during the survey periods. The second survey during 2001 was the first survey to take place during the latter half of the month of March. Although the survey was incomplete, the data suggest temporal changes in distribution, and perhaps overall biomass.

**Impacts of Acoustic Frequency**

Because of continuing electronic problems with the 38 kHz system, the 2001 acoustic survey, like the 1997, 1998 and 2000 surveys, used the 120 kHz system. The detectability of the 120 kHz system was closely examined (Figure 5). The target strengths of adult pollock are virtually all above −45 dB. The 120 kHz system was able to detect this target strength down to about 275 m. In all locations except Montague Trench, this detectability would be sufficient for virtually 100% detection for the depth distributions of pollock in Prince William Sound. The frequent occurrence of multiple fish targets would further enhance detectability. Consequently, the magnitude of underestimation from the 120 kHz system should be minor. Since the same system has been used since 1997, the relative trends among years should be unbiased. Additional
work is planned to correct problems with the 38 kHz system to verify these conclusions in future surveys.

CONCLUSIONS AND RECOMMENDATIONS

The results from the 2001 survey indicate a minor decrease in the overall population biomass of pollock in Prince William Sound. However, the continuing negative trend in the population since 1998, and in particular the substantial decrease in abundance in Port Bainbridge, is a cause for some concern.

The estimates from the 2001 surveys contain an additional uncertainty because of lack of full coverage. The problem resulted from limited funds for shiptime and adverse weather conditions. A second survey was conducted in conjunction with the annual herring survey in an attempt to provide additional coverage, but that survey was also incomplete. However, the use of two vessels during the second survey, one for acoustics only and the second for midwater trawling, did provide increased survey efficiency. A two-vessel operation is recommended for 2002, as well as a slightly earlier start time and wider survey window. Currently, little is known about changes in abundance and distribution between initiation of the commercial fishery in January and spawning in April. The peak of the run timing curve needs to be established. Estimates near the peak of abundance provide the best tracking of the stock magnitude and its annual variability. Multiple surveys are recommended to improve understanding of these temporal changes in distribution.

The 120 kHz system appears to have sufficient detectability for the vertical distributions observed in Prince William Sound. However, future application of both 38 kHz and 120 kHz is needed to resolve uncertainties associated with frequency effects.

LITERATURE CITED


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<th>Ave. Wt.</th>
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Table 2. Results of March 2001 Surveys

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<th>Mean</th>
<th>Var</th>
<th>Pop  (mt)</th>
<th>PopVar (mt)</th>
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Figure 1. Approximate location of transects and unsampled area during cruise 1.

Figure 2. Approximate location of transects and unsampled area during cruise 2.
Figure 3. Estimated biomass of pollock in Port Bainbridge, 1995-2001.

Figure 4. Vertical distribution of pollock at various locations, March 2-4, 2001.
Figure 5. Comparison of detectability between 120 and 38 kHz systems used during March 2001 surveys.