FOCI RESEARCH BENEFITS FISHERIES MANAGEMENT

1993 Recruitment Forecast - Average

NOAA's National Marine Fisheries Service (NMFS) advises the North Pacific Fisheries Management Council using a "stock projection analysis" initialized with results from a "stock assessment analysis." The stock assessment analysis employs commercial catch statistics and research survey information to assess retrospectively the past and current stock abundance. Once the current condition is estimated, the stock projection analysis uses it to project the future abundance as a function of different harvest and recruitment scenarios.

The stock assessment model requires information independent of the fishery to calibrate estimates of absolute population. Prior to FOCI guidance, these independent resources were limited to the hydroacoustic and bottom-trawl surveys. For the last two years, spawning mass estimates and variances derived from the Annual Egg Production Method (Picquelle and Megrey 1993) have provided a third source of information.

To examine the effects of management on population, alternative harvest strategies and recruitment scenarios are submitted to the stock projection model. This model is very sensitive to the assumed recruitment. Beginning in 1992, FOCI has analyzed biological and physical time series to estimate recruitment qualitatively. This prediction significantly simplifies the stock projection analysis by limiting the number of viable recruitment scenarios.

PRESENT METHOD OF ESTIMATING RECRUITMENT

FOCI's year-class (including recruits) forecast is based on the annual hydroacoustic survey of spawning aggregations, on the FOCI ichthyoplankton survey of eggs and larvae, on estimates of spawning biomass and recruitment time series (1969-1989) from the annual stock assessment (Hollowed et al. 1993), and on the remaining suite of biological and physical data assembled by FOCI. In 1992 only the spawner and recruit data were used. No apparent relationship appeared between spawning abundance and subsequent recruitment (Fig. 1, missing), but when recruits were arranged by year class, autocorrelated regularities emerged (Fig. 2, missing). We calculated probabilities of a strong recruitment year following a poor year or a strong year, a strong year class resulting from a small spawning biomass, and so on. A ranking of weak, average, or strong as determined by the 33% and 66% percentiles was assigned to the recruitment and spawner values (Fig. 3, missing).

Previous correlative modeling of pollock recruitment (Megrey et al. 1994) showed a significant relationship between recruitment, rainfall, and large-scale atmospheric pressure gradient. However, this simple model did not address the autocorrelated nature of the recruitment data. In

1993 FOCI extended its recruitment modeling ability with the development of a transfer function model. This model (Fig. 4, missing) uses the same rainfall and pressure data but addresses the autocorrelation of recruitment. In addition, it directly predicts recruitment, and in 1993 it was used to generate recruitment scenario candidates for the stock projection model.

Table 1 shows the prediction for 1993. FOCI's prediction in 1992 was for weak 1989 and 1990 year classes, a weak to average 1991 year class, and a strong 1992 year class. In 1993 the transfer function model predicted that the 1991, 1992, and 1993 year classes were of average abundance, while NMFS hydroacoustic and ichthyoplankton survey data suggested the 1991 and 1992 year classes would be of less-than-average abundance. The combined 1993 prediction was for weak recruitment to the 1991 and 1992 year classes and average recruitment to the 1993 year class. Recent observations of recruitment to the 1989 and 1990 year classes verify the initial FOCI prediction.

Table 1. 1993 Forecast

	1993			
Element	**Weight**	**Rank**	**Score**	**Total**
Time series model	0.800	a	2.00	1.60
Time sequence	0.000		0.00	0.00
Hydro length	0.000		0.00	0.00
Rain	0.000		0.00	0.00
Mixing	0.000		0.00	0.00
Advection	0.000		0.00	0.00
Larval abundance	0.200	a	2.00	0.40
Puffin diet	0.000		0.00	0.00
Total	1.000			**2.00**
Intial forecast			2.00	a

Observed recruitment is based on 33 and 66 percentiles of assessment in latest SAFE

Score continuum: 1.0≤weak<1.666≤average<2.334≤strong≤3.0

SHORTCOMINGS

The correlative models described above are purely empirical. They derive their power from historical trends, but because history never repeats itself in exactly the same way, they ultimately must fail. Although the models suggest important biological and physical variables that may affect pollock recruitment, they tell us nothing about the underlying responsible processes.

FUTURE RESEARCH

FOCI's prediction goal is to replace correlative models with models that incorporate our understanding of pollocks' interaction with the environment. The short-term focus is on four tasks. We are improving methods of combining the quantitative and qualitative information into an integrated forecast. We are extending the probabilistic technique to incorporate additional environmental information, and we are developing a life-stage recruitment model using Baysian estimation procedures. Finally, through communication with industry representatives and individuals at the North Pacific Fisheries Management Council, we will invite discussion of these findings with commercial fishermen and solicit their observations.

REFERENCES

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