FOCI Recruitment Prediction -- 1994

This marks the third year that FOCI has predicted recruitment to the Shelikof Strait walleye pollock fishery. This and past years' predictions, as well as recruitment realizations for 1989 through 1992, are presented in Table 1.

Information for this year's recruitment prediction includes quantitative results from a refitting of the nonlinear transfer function time series model and several qualitative sources of information. Prior to recruitment, information sources cover time periods from the first three months of the first year of life to the first two years.

Quantitative Sources

The nonlinear transfer function time series model was refit by adding 1990 and 1991 data to the recruitment and environmental time series. In the refitting, we assumed that the model did not change (i.e., the same variables were important), and we withheld the last two data points to use the forecast as one means of evaluating the model. Predictions from the newly refit model indicate that the 1991 year class is strong and the 1992, 1993, and 1994 year classes are average. These results are somewhat suspicious as the model did not fit as well this year ($R = 0.49$) as it did in the last exercise ($R = 0.69$). Also, most other information sources suggest that 1991 is not a strong year class.

Length composition information from the spring hydroacoustic echo integration trawl survey of Shelikof Strait was considered quantitative as it reflects direct observations from trawl survey samples. Information shows the almost 1-year-olds of the previous year class as pollock in the length interval 8-15 cm. For 1992 through 1994, these percentages were approximately 4%, 3%, and 8% respectively. This suggests that 1991 is average, 1992 is weak, and 1993 is average. No data are available for the 1994 year class.

Qualitative Sources

Each piece of qualitative information was considered separately as if the particular variable was the only important one affecting recruitment.

Rainfall (a source of freshwater input to the Gulf of Alaska) is assumed to be beneficial to recruitment. This is because baroclinic instabilities arising due to the addition of freshwater to the Gulf of Alaska promote the formation of eddies. Larval survival appears to be greater in eddies. Data show that rainfall was high in 1991, average in 1992 and 1993, and strong in l994.

Low levels of wind are assumed to be good for recruitment because they promote survival of first-feeding larvae, and because they favor retention of larvae on the shelf. Wind mixing was high in 1991, average in 1992 and 1993, and low in 1994.

Vigorous advection is presumed to be bad for recruitment as it will have a tendency to wash larval pollock off the continental shelf into areas of low productivity. Information from moored current meters in Shelikof Strait shows advection was high in 1991, average for 1992 and 1993, and low in 1994.

Information on rough counts of larvae appearing in ichthyoplankton tows (a larval index of abundance) shows that in 1991 there was a high incidence of tows with no larval pollock and few tows with high abundance levels. In 1992 and 1993 larval rough counts were very similar in frequency. One difference is that in 1992 there were more occurrences of high abundance tows (>100) than in 1993. During 1994 FOCI collected the highest frequency of tows with 1-20 larvae of any year recorded and the second lowest number of tows with 0 larval pollock. Also in 1994, there were no tows with very high abundance levels (>100/tow). These patterns suggest that the 1991 year class is weak, 1992 is average to strong, 1993 is low to average, and 1994 is average.

Combined Prediction

To arrive at a combined 1994 prediction, each piece of information was classified as to whether it directly estimated a strong, average, or weak year class or whether it suggested the strength of the year class because of a presumed effect and mechanism as described above. A definitive prediction of strong was given a score of 3, average a 2, and weak a 1. In some ambiguous cases non-integer scores were used based on the following intervals:

1.00 - 1.66	Weak
1.67 - 2.33	Average
2.34 - 3.00	Strong

To arrive at the combined prediction in each year, a weighted average of all information sources for that year was calculated by multiplying the information source weight by the score of the prediction from the information source, then summing the totals over all information sources available for that year. The combined prediction depended into which interval (described above) the weighted total fell.

Weighting factors differed for each year as all information sources were not available for every year. The sum of the weights for all available information sources was 1. The combined weights for the quantitative information sources were set to 0.5. These were distributed over the time series model and hydroacoustic length composition information sources as 0.2, 0.3, respectively. Weights for the remaining qualitative information sources (rain, wind, and advection and larval index) collectively summed to the remaining 0.5, thus they each received a weight of 0.125. In years when information sources were missing, the weighting factors for the hydroacoustic and/or the time series model index were increased so as to keep the sum of the weights to 1.0.

By following the procedure described above, the combined prediction for 1994 is: the 1991 year class is weak, 1992 is weak, 1993 is average, and 1994 is average (Table 2). Table 3 presents weights and scores for the different recruitment estimators.

Table 1. Summary of FOCI Recruitment Predictions

	Year Class							
Type of Prediction	*89*	*90*	*91*	*92*	*93*	*94*	*Year Prediction Made*	*Method*
Quantitative[1]	W	W	W-A	S			92	S-R data and time sequence of data points
Quantitative[2]			A	A	A		93	Nonlinear transfer function time series model
Qualitative[3]			W	W			93	Subjective observations
Combined 1993			**W**	**W**	**A**		**93**	
Quantitative[4]			S	A	A	A	94	Nonlinear transfer function time series model
Quantitative[5]			A	W	A-S		94	Hydroacoustic length composition
Qualitative[6]			A-S	A	A	A-S	94	Rain
Qualitative[7]			W	A	A	A-S	94	Wind
Qualitative[8]			W	A	A	A-S	94	Advection
Qualitative[9]			W	A-S	W-A	A	94	Larval index of abundance
Combined 1994			**W**	**W**	**A**	**A**	**94**	
Actual Recruitment	W	W	W	W				

1 used recruitment time series 1962-1989 and spawner-recruit data 1969-1989; no environmental data
2 used recruitment time series 1962-1989 as well as environmental data
3 used NMFS survey data
4 used recruitment time series 1962-1991 as well as environmental data in refit of transfer function model
5 Hydroacoustic length composition from Shelikof Strait 1992-1994
6 Average Kodiak rainfall during January and February for 1991-1994
7 Wind energy at 55'N 156'W during April, May and June 1991-1994
8 Advection from moored current meters
9 Larval rough counts from ichthyoplankton tows in Shelikof Strait

Table 2. 1994 Recruitment Prediction Worksheet

Time Frame	*Method/Source*	*Type*	*89*	*90*	*91*	*92*	*93*	*94*
1st 2 years	Time Series Model	Quantitative			S	A	A	A
1st year	Hydro length composition	Quantitative			A	W	A-S	*NA*
1st 3 months	Rain	Qualitative			S	A	A	S
	Wind	Qualitative			W	A	A	S
	Advection	Qualitative			W	A	A	S
	Larval Index-abundance	Qualitative			W	A-S	W-A	A
		COMBINED 1994			**W**	**W**	**A**	**A**

NA - not available

Table 3. Weights and Scores for 1994 Prediction Estimators

	91			*92*		
	Weights	*Score*	*Total*	*Weights*	*Score*	*Total*
Time Series Model	0.2	2.34	0.468	0.2	1.67	0.334
Hydro length composition	0.3	1.67	0.501	0.3	1	0.3
Rain	0.125	2.34	0.2925	0.125	1.67	0.20875
Wind	0.125	1	0.125	0.125	1.67	0.20875
Advection	0.125	1	0.125	0.125	1.67	0.20875
Larval Index-abundance	0.125	1	0.125	0.125	2.5	0.3125
Total	**1**		**1.6365**	**1**		**1.57275**

	93			*94*		
	Weights	*Score*	*Total*	*Weights*	*Score*	*Total*
Time Series Model	0.2	1.67	0.334	0.5	1.67	0.835
Hydro length composition	0.3	2.33	0.699	0	0	0
Rain	0.125	1.67	0.20875	0.125	2.34	0.2925
Wind	0.125	1.67	0.20875	0.125	2.34	0.2925
Advection	0.125	1.67	0.20875	0.125	2.34	0.2925
Larval Index-abundance	0.125	1.67	0.20875	0.125	2	0.25
Total	**1**		**1.868**	**1**		**1.9625**