FOCI Prediction

10/23/01

2001 Pollock Year-Class Prediction: Average to Strong Recruitment

BASIS: This forecast is based on five data sources: three physical properties and two biological data sets. The sources are: 1) observed 2001 Kodiak monthly precipitation, 2) wind mixing energy at [57N, 156W] estimated from 2001 sea-level pressure analyses, 3) advection of ocean water in the vicinity of Shelikof Strait inferred from drogued drifters deployed during the spring of 2001, 4) rough counts of pollock larvae from a survey conducted in May 2001, and 5) estimates of age 2 pollock abundance from this years assessment.

ANALYSIS: The winter was wet this year (Table 1) with only February's rainfall near the 30-year mean. Spring rain (except for April at 119% of the 30-yr mean) was low. Thus winter and spring conditions favored larval survival and the recruitment score for rainfall is high.

TABLE 1. Kodiak precipitation for 2001

Month	% 30-yr average
Jan	175
Feb	96
Mar	193
Apr	119
May	81
June	45

FOCI believes that Kodiak precipitation is a valid proxy for fresh-water runoff that contributes to the density contrast between coastal and Alaska Coastal Current water in Shelikof Strait. The greater the contrast, the more likely that eddies and other instabilities will form. Such secondary circulations have attributes that make them beneficial to survival of larval pollock. The low precipitation of January and May offset the benefits of high February through April precipitation toward production of fresh water runoff with its connection to enhanced potential for ocean eddies, thought conducive to pollock larvae survival. Based on this information, the forecast element for Kodiak rainfall has a score of 2.45. This is "strong" on the continuum from 1 (weak) to 3 (strong).

Wind mixing at the exit area of Shelikof Strait followed a similar pattern established in 1997 when the PDO changed sign. Mixing is significantly below the 30-yr mean.

TABLE 2. Wind mixing at the exit of Shelikof Strait for 2001

Month	% 30-yr average
Jan	36
Feb	31

Mar	49
Apr	49
May	54
June	27

Strong winds in winter help mix nutrients into the upper ocean layer to provide a basis for the spring phytoplankton bloom. Weak winter winds this year did not aid concentration of nutrients in the photic zone. Weak spring winds, as experienced especially during April and May, are thought to better enable first feeding pollock larvae to locate and capture food. Weak mixing in winter is not conducive to high survival rates, while weak mixing in spring favors recruitment. This mix produces an average forecast.. The wind mixing score for this year is 2.25, which equates to "average".

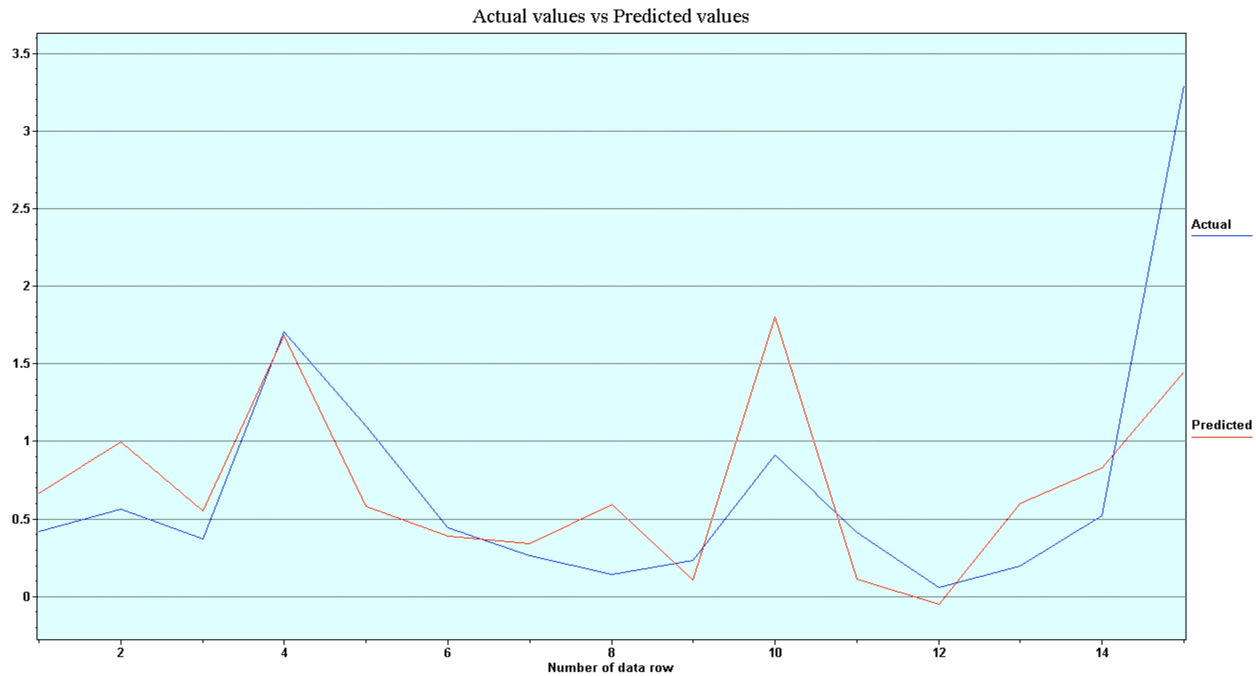
Data based on analysis of regional wind stress (correlated with transport in Shelikof Strait) for spring 2001 in the Gulf of Alaska and inferred from satellite tracked drifters indicate that advection was average and circulation was average, a sign of average recruitment. Advection was given a score of 2.0.

A nonlinear neural network model with one input neuron (larval abundance), 3 hidden neurons, and one output neuron (recruitment) was used to relate larval abundance (catch/m^2) to age recruitment abundance (billions). The model estimated 6 weighting parameters.

The data used was

Year Class	Average Larval Abundance (catch/m^2)	Age 2 Recruitment (billions)
1982	66.44347	0.419118
1985	80.4266	0.564285
1987	324.9025	0.37081
1988	255.586	1.70397
1989	537.2943	1.09657
1990	335.0086	0.441219
1991	54.2223	0.264139
1992	563.6741	0.144109
1993	45.80764	0.235283
1994	124.9386	0.914687
1995	600.9925	0.412825
1996	472.0225	0.057794
1997	561.1063	0.196107
1998	73.07128	0.5215
1999	102.3862	3.29389
2000	535.4901	
2001	136.2054	

The neural network model, which used the first 15 observation pairs to fit the model, has an R^2 of 0.45. A plot of the observed recruitment (actual) and that predicted from larval abundance (predicted) are given below where row number corresponds to the rows of the data matrix given above.



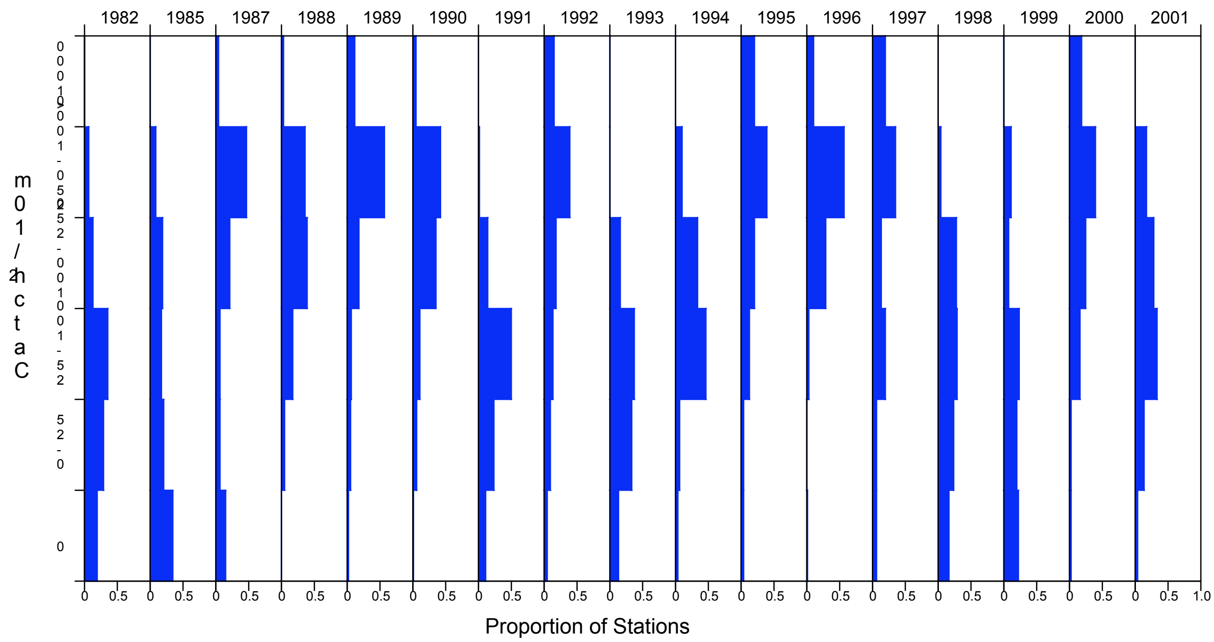
The trained network was then used to predict the recruitment for 2000 and 2001.

The predictions are

Year	Actual Recruitment	Predicted Recruitment
2000	n/a	0.572589
2001	n/a	1.935386

These values, using the 33% and 66% cutoff points given below correspond to a average 2000 year class and a strong 2001 year class.

Plotting the data by year and binning the data into catch/m^2 categories (given below) provides another view of the data. The pattern for 2001 (based on rough counts) seems similar to 1994, a year of strong recruitment.



Both of these analyses suggest that the 2001 year class may be strong. The score for larval rough counts is set to the low end of the strong range, 2.4.

The time series of recruitment from this year's assessment was analyzed in the context of a probabilistic transition. The data set consisted of estimates of age 2 abundance from 1961-2001, representing the 1959-99 year classes (see Table XX). There were a total of 41 recruitment data points. The 33% and 66% percentile cutoff points were calculated from the full time series (33%=0.391388 billion, 66%=0.717574 billion) and used to define the three recruitment states of weak, average and strong. The lower third of the data points were called weak, the middle third average and the upper third strong. Using these definitions, nine transition probabilities were then calculated:

1. Probability of a weak year class following a weak
2. Probability of a weak year class following an average
3. Probability of a weak year class following a strong
4. Probability of an average year class following a weak
5. Probability of an average year class following an average
6. Probability of an average year class following a strong
7. Probability of a strong year class following a weak
8. Probability of a strong year class following an average
9. Probability of a strong year class following a strong

The probabilities were calculated with a time lag of two years so that the 2001 year class could be predicted from the size of the 1999 year class. The 1999 year class was estimated to be 3.29 billion and was classified as strong. The probabilities of other recruitment states following a strong year class for a lag of 2 years (n=41) are given below:

2001 Year Class		1999 Year Class	Probability	n
Weak	follows	Strong	0.077	3
Average	follows	Strong	0.128	5
Strong	follows	Strong	0.128	5

The probability of an average or strong weak year class following a strong year class had the highest probability. The prediction element from this data source was classified as average to strong and given a score at the low end of the strong range, 2.4.

Each of the data elements was weighted equally. The larval index was used but was weighted equally with the other elements because average-to-high larval numbers are promising of good recruitment but not necessarily so.

CONCLUSION: Based on these five elements and the weights assigned in the table below, the FOCI forecast of the 2001 year class is average to strong.

Element	Weights	Score	Total
Time Sequence of R	0.23	2.40	0.552
Rain	0.2	2.45	0.49
Wind Mixing	0.2	2.25	0.45
Advection	0.16	2.00	0.32
Larval Index-abundance	0.21	2.40	0.504
Total	1.0		2.316 = Average to Strong