Abundance and Distribution of Northern Anchovy Eggs and Larvae (*Engraulis mordax*) off the Oregon Coast, Mid-1970s vs. 1994 and 1995

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Extended Abstract

Northern anchovy (*Engraulis mordax*) is one of the most abundant fish species in the California Current and is a major prey for many species of fish, seabirds, and marine mammals off the Oregon and Washington coast. Egg and larval fish surveys in the 1970s (Richardson 1981) revealed that the northern subpopulation of northern anchovy residing off Oregon and southern Washington spawned primarily in July in an offshore area centered just south of the Columbia River mouth and offshore 80-160 km. Using an egg production method, Richardson (1981) estimated minimum northern anchovy spawning biomasses for this population in 1975 and 1976 were 262,506 and 144,654 metric tons, respectively. Coincidentally, marine survival of coho salmon smolts which out-migrated in 1975 were high and those of 1976 relatively low, in the Oregon Production Area (Nickelson 1986).

The objective of our research is to identify the status of the northern anchovy population off Oregon and southern Washington and investigate the relationship between anchovy abundance and juvenile coho salmon ocean survival. To accomplish this task, eggs and larvae of northern anchovy were collected using a vertically towed 25-cm-diameter bongo (CalVET) net constructed of 0.15-mm mesh and deployed from the National Marine Fisheries Service (NMFS) 17.4-m research vessel *Sea Otter*. At each station, the net was deployed to a depth of 70 m (or just above the bottom) and retrieved at a rate of 70 m per minute. Samples were preserved in a 4% buffered formaldehyde solution. Other
parameters measured included profiles of temperature, conductivity, and depth. Seawater samples were taken at each station at a depth of 3 m, filtered, and frozen for later chlorophyll a analysis. Ichthyoplankton samples were collected during July 1994 and 1995 off southern Washington and northern Oregon; July is the peak month of spawning for northern anchovy in the Pacific Northwest (Richardson 1981).

A total of 234 stations along 12 east-west transects were sampled in 1994 and 121 stations were sampled in 1995. Transects extended from 9 to 190 km offshore and were located about 32 km apart. Each transect consisted of up to 20 evenly spaced sampling stations.

The July 1994 and 1995 ichthyoplankton collections revealed that the abundance and distribution of northern anchovy eggs and larvae were extremely limited when compared to those observed in the mid-1970s (Figure 1). In 1994, we found northern anchovy eggs at only one station (0.4% of all stations sampled) located 18 km west from the Columbia River mouth (Figure 1B). Calculated egg densities were 400 eggs per 10 m² at this station. In 1995, we found egg concentrations as high as 5,600 per 10 m² at one station (Figure 2). However, during both years, eggs, and thus spawning, occurred nearshore on the continental slope. Richardson (1981) found concentrations of anchovy eggs as high as 17,931 per 10 m² and 5,777 per 10 m² during 1975 and 1976, respectively, over a broad area off the continental slope and associated with the Columbia River plume.

Although the 1994 and 1995 distribution of larval northern anchovy was somewhat similar to the 1970s (i.e., offshore in the Columbia River plume), they were markedly less abundant than in historical surveys. In 1994, we found only two larvae that were positively identified as northern anchovy at two stations. An additional 18 clupeiform larvae were in poor condition and could not be identified. Even including these unidentified larvae as possible northern anchovy larvae, larval densities were much lower in July 1994 and 1995 than off Oregon in 1975 or 1976 (Richardson 1981) or during 1983 (Brodeur et al. 1985), an El Niño year.

Assuming that all the identified clupeiform larvae were northern anchovy, the highest larval anchovy density we observed was 1,000 per 10 m² at one station in 1994. Richardson (1981) found higher larval anchovy densities during both 1975 and 1976. She also found northern anchovy larvae at 47% and 57% of her sampling stations, respectively. In contrast, we noted larval anchovy at only 5% of our stations in 1994 and 9% in 1995. Further, anchovy larvae were relatively rare in July 1994 and 1995, numerically less than 10% of all larvae collected. This differs markedly from Brodeur et al. (1985), who observed that northern anchovy was the dominant larval fish collected in 1983, accounting for half of all larval fish collected.

We have not yet estimated spawning biomass, but these data indicate that northern anchovy spawning biomass in 1994 and 1995 was
low, indicating that the northern subpopulation of northern anchovy has probably declined in abundance.

Regardless of the specific factors that caused this apparent decline, the consequences for other living marine resources dependent on this species as prey are probably significant. Although there is some indication that Pacific sardines (*Sardinops sagax*) may be increasing in abundance and occupying the same niche presently occupied by northern anchovy off Oregon (Bentley et al. 1996), there is no evidence that sardines are an important prey of predators which typically consume northern anchovy. Most migrating juvenile salmonids enter the ocean at approximately the same length as adult anchovies. A severe reduction in the anchovy populations off the Pacific Northwest coast could result in increased predation rates on salmonids if no alternative baitfish or invertebrate prey is available. We are currently investigating this possibili-

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**Figure 1.** Location and density of northern anchovy eggs and larvae found in July 1976 (A) (from Richardson 1981) and July 1994 (B) from ichthyoplankton surveys off Oregon and southern Washington. Actual numbers of eggs and larvae captured in 1994 are shown in B. In 1994, larvae included some unidentified clupeid larvae that could have been northern anchovy or Pacific sardine.
ty in a pilot-scale study of the distribution and stomach contents of piscivorous fish near the mouth of the Columbia River.

References


