0+ to age 2+ individuals are found mainly in Karaginsky Bay; age 3+ in Olyutorksy Bay, and age 4+ to age 7+ are adjacent to the Koryak Coast/Elder. Herring reach Far Eastern areas and during periods of high abundance, they inhabit offshore waters. Diet composition is in high conformity with habitat: 4-year-old and older individuals feed more on euphausiids while the younger fish feed on copepods.

The annual consumption of euphausiids by the population is from 1.3 (depressed condition) to 8.7 (high stock abundance) million tonnes. On average, each individual feeds from 0.39 kg (32,000 individuals) to 0.54 kg (45,000 individuals) of these class organisms.

Interactions Between Fish and Euphausiids and Potential Relations to Climate and Recruitment

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The interaction of euphausiids and fish is complex. Each at times may be the predator, prey, or competitor of the other. However, certain interactions may be dominant. Here, I present preliminary data consistent with one such interaction, predation by euphausiids on sardine and anchovy eggs in the California Current Region.

High resolution maps of near-surface distributions of euphausiids and the eggs of the Pacific sardine (*Sardinops sagax*) and northern anchovy (*Engraulis mordax*) were made during CalCOFI cruise 9603JD using the Continuous, Underway Fish Egg Sampler, CUFES (Checkley *et al.* 1997, in press). This device collects eggs of fish from 3-m depth continuously during a survey by a ship at full speed. Eggs of the target species are identified live at sea, for near-real-time mapping and adaptive sampling, and all eggs are identified and counted ashore in preserved samples. At sea, simultaneous measurement is made of date, time, location, temperature, salinity, and chlorophyll *a* fluorescence. Euphausiids and other plankters are collected as "by-catch" of the egg sampling.

Sardine and anchovy eggs sampled during CalCOFI cruise 9603JD were distributed in a complementary fashion. Sardine eggs were most abundant along the inner edge of the California Current, north of Point Conception, in waters characteristic of isopycnal shoaling. Anchovy eggs were in water upwelled either recently (cool) or in the past (warmed), mostly south of Pt. Conception. An analogous cruise in March 1997 yielded very similar results.

Despite sampling caveats, including possible avoidance of the near-surface intake of the CUFES pump by euphausiids and diel variation in their surface residence, the patterns of sardine and anchovy eggs and euphausiids were complementary during CalCOFI cruise 9603JD. The figure below shows that sardine eggs were abundant only in the absence of euphausiids and vice versa.

Similar results have been obtained off northern Peru for eggs of the anchoveta (*Engraulis ringens*) and euphausiids. This is work in progress in collaboration with Dra. Guadalupe Sanchez (Instituto del Mar del Peru). In essence, anchoveta eggs and euphausiids, occurred but not together.

The most parsimonious explanation of these patterns is euphausiid predation on sardine eggs. These results and those of others indicated that variation in the abundance and distribution of

euphausiids may significantly affect survival of planktonic eggs and larvae and hence recruitment of sardine and other species of fish.

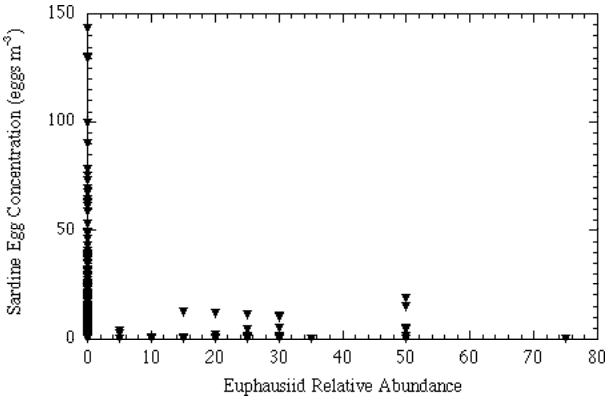

Fig. 1 Concentration of eggs of Pacific sardine (*Sardinops sagax*) in relation to the relative abundance of euphausiids [0(absent), 100(maximal abundance)] in CUFES samples from CalCOFI cruise 9603JD (Checkley *et al*. in press).

Predation and competition require overlap in distributions of species populations, which, in turn, depend on available habitat. Climate variation will affect interactions between fish and euphausiids in part through expansion, contraction, and overlap of such habitats and hence the distributions of the species involved. A high priority should be given to characterizing such habitats and their variation. The use of standardized and coordinated techniques of data collection and analysis is recommended. This is one area in which PICES might take a leadership role. Additional work is also needed on the biology of euphausiids and, in particular, their feeding on fish eggs and larvae. Seminal work was done by Theilacker (1993), but further work is needed in order to quantify the predatory impact of euphausiids on fish eggs and larvae.

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Shall we expect the Korf-Karaginsky herring migrations into the offshore western Bering Sea?

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In the 1990s, Pacific herring became one of the dominant species in the western Bering Sea pelagic fish community, especially in the sea shelf zone. The Korf-Karaginsky herring population has a leading role in total fishery biomass and herring fishery harvest in the western Bering Sea as in 1960s, when the harvest totalled up to 268,000 mt (Kachina, 1981). Whereas, during the 1980s, the harvest did not exceed 32,000 mt. Since the early 1990s, walleye pollock biomass has noticeably declined due to global climate change and reorganizations of the fish community structure. Herring have occupied a leading place in the southwestern Bering Sea