Herring in the study area school above the krill at day, schools disperse at night and herring then forage on vertically migrating krill. Nocturnal predation is probably visual, and seems to be restricted to the upper 20-30 m. The non-schooling whiting lives deeper than herring, occupying the same depth range, and performing a similar diel migration pattern to that of krill. They forage on krill throughout the diel cycle. Prey search may be visual both day and night, and whiting appears to be able to forage at lower light intensities (i.e. deeper water) than herring. Norway pout is semi-demersal, largely remaining associated with the bottom at day, migrating into the water column at night. They forage on krill by day where the bottom intercepts the krill daytime habitat, otherwise predation is nocturnal by vertically migrating individuals ascending into the water column. Norway pout has large eyes, and may forage visually in relatively deep water at day. Their swimming behaviour, hanging motionless in the water column, does, however, suggest that they may be ambush feeders by night.

Krill antipredator behaviour includes a flexible DVM pattern, apparently responding to the presence of fish. They partly remain below visually foraging pelagic fish at day, but may avoid the near-bottom zone in presence of demersal fish. In waters devoid of nocturnally foraging planktivores, vertically migrating krill ascend all the way to the surface. while they modify their DVM pattern and largely avoids the upper 20-30 m at night in waters with abundance of nocturnally foraging fish. Antipredator behaviour also constitutes instantaneous escape responses upon encounters with fish. The talk also addresses how more subtle mechanisms like modification of feeding and swimming behaviour in response to mortality risks may be studied in the field. I argue that acoustic studies, comprising acoustic target tracking of individual plankters and fish, hold yet unexploited opportunities for studies of fish-krill interactions and for understanding of both krill and fish behaviour.

Euphausiids and western Bering Sea herring feeding

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The paper is based on long-term information (1939-1998) from weight method examination of 2997 stomach content from 117 coastal stations in Karaginsky Bay, Olyutorsky Bay, Olyutorsky-Navarin area, and 1486 stomach examinations at 9 daily stations. Rations were calculated in three ways: (1) using daily station data; (2) a physiological method using the well-known Vinberg equation; and (3) our identification of a strong dependence between daily ration, body weight, stomach fullness index, and water temperature.

Food composition and trophic activity by Korfo-Karaginsky herring are very labile among years, seasons, areas, age cohorts. The herring diet (excluding the larval stages) contains 70 species of marine animals from 13 classes. The dominant prey is copepods which make up more than a half (51.7%) of the annual ration. The portion of euphausiids in the diet fluctuates annually from 9.8% to 70.7% with average value 42.1%. In May – September the herring feed mainly on copepods – from 49.9% in September to 88.4% in July. During other months, euphausiids contribute 68-88% of the stomach contents.

The variability of the herring diet is related to age composition. Through summer and autumn, age

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