

Recent Research Topics on Biological Oceanography

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Summary

We conducted biological and ecological studies on a variety of marine organisms ranging from bacteria to mesozooplankton as plankton and polychaetes as benthos. Basic studies on microbial loop components and lower trophic levels of grazing food chain are continued in Onagawa Bay. Taxonomic and ecological studies on novel diatom-feeding flagellates and hydromedusae are under way. We show the outlines of research results of euphausiid crustaceans and polychaetes here.

Euphausiid Study

Species succession of euphausiids (32 species) in warm-core ring 82B was investigated (Endo and Wiebe 2005). Major physical changes of 82B occurred in March-April by convective mixing and thermostad cooling, in April/May by stratification of the surface waters, and in August by the interaction with Gulf Stream. Substantial changes in species composition were observed that corresponded to these physical changes. Four different patterns were found in temporal change in abundance of warm-water species. There were species that decreased in number from March to August, species that decreased from March to June, but increased in August, species that increased from March to August, and species that showed no systematic trend. These differences may be attributable to a species tolerance to the thermostad temperature decrease and their vertical distribution. The monthly percentage decrease in the abundance of warm-water species in 82B was high compared with that of cold-water species in cold-core rings as a result of the more rapid changes in the physical structure and the shorter lifetimes of warm-core rings in the Western North Atlantic.

The species composition of euphausiids was investigated in relationship to the hydrographic conditions in the North Atlantic cold-core rings (CCR) and adjacent waters to elucidate species succession in evolving water masses (Endo and Wiebe

2007). A general pattern of euphausiid succession and change in vertical distribution in rings with time was obtained. This pattern was related to the general distribution of euphausiids in the northwestern North Atlantic Ocean, aiming at providing basic information on probable response of North Atlantic marine ecosystem to global warming. Among cold-water species, *Euphausia krohni* and *Nematoscelis megalops* were dominant in CCRs. *E. krohni* became rare in rings older than 6 months, whereas *N. megalops* survived longer, being abundant in some rings of 9 months or older, by staying within its preferred temperature range as the CCR elevated isotherms sank to depths where they are normally found in the Sargasso Sea and because it is an omnivore-carnivore. Among warm-water species, epipelagic species appeared first in rings, corresponding to the physical change occurring most rapidly in the surface layers. Mesopelagic species appeared later. In CCRs, only a limited number of species were dominant even if there were more species present in rings as old as 9–12 months than in the northern Sargasso Sea. In rings older than 9 months, euphausiids showed two peaks in their vertical distribution: a shallow daytime peak at about 400 m and a nighttime peak in the upper 100 m consisting of warm-water species (mainly *E. brevis*) and a deeper persistent peak at 800 m or deeper consisting of the species *N. megalops* and *T. parva*. This shallow peak in CCRs is shallower than that in the surrounding northern Sargasso Sea, and the deep peak is rarely observed in these waters.

The diel vertical migration of the dominant euphausiid in the North Pacific, *Euphausia pacifica*, was investigated in relation to molt and reproductive processes and feeding activity in April and September 2001 at fixed stations off northeastern Japan (Endo and Yamano 2006). The vertical distribution of this species was shallower in April than in September during both day and night, which was partly explained by a high surface temperature (19°C) and the existence of a subsurface chlorophyll maximum in September. It has been demonstrated for the first time that diel vertical migration of this species is influenced by molt processes because upward migration of molting individuals was restricted compared with non-molting ones.

Molting of *Euphausia pacifica* was investigated in relation to reproductive and feeding activities off northeastern Japan (Endo and Yamano 2008). The percentage of molting individuals was lower (7%) in the gravid females than in other maturity stages (12–22%), which suggests that gravid females molt less frequently, about 2-fold less, than other stages of females and males. Feeding activity of molting individuals, assessed by the stomach fullness, was reduced compared with non-molting individuals. Molting of this species proved to be related to reproductive and feeding activities.

Benthos Study

We reported the first study of sperm whale-fall ecosystems, based on mass sinking of whale carcasses at shelf depths in the northwest Pacific (Fujiwara *et al.*, 2007). We conducted three observations over a 2-year period on replicate sperm-whale carcasses implanted at depths of 210–254 m off the southern part of Japan from July 2003 to August 2005. Dense aggregations of unique chemosynthesis-based fauna had formed around the whale carcasses after 18 months. The mytilid mussel *Adipicola pacifica* was the most abundant macrofaunal species and covered most of the exposed bone surfaces. The general composition of the fauna was similar to that of deep-water reducing habitats, but none of the species appearing in this study has been found at hydrothermal vents, cold seeps, or deep-water whale falls. The succession of epifaunal communities was relatively rapid and the sulphophilic stage was considerably shorter than that of other known whale falls.

Growth performance of the Antarctic bivalve *Laternula elliptica* was examined both by shell microstructural observation and by applying a fluorescent substance, tetracycline, as a shell growth marker (Sato-Okoshi and Okoshi 2008). The shell was composed of two calcareous layers: the thick outer layer was homogeneous or granular in structure and the thin inner layer was nacreous. The growth rate of the nacreous layer was analyzed to be very low. High correlations were found between the major axis of chondrophore and both shell length and shell dry weight, respectively. It is suggested that the chondrophore is an appropriate growth indicator, and combining the information of growth increments with the fluorescent method may be useful in estimating the bivalve growth performance in the Antarctic sea.

Eight species of Polydorid polychaetes were found to inhabit mollusk shells from south-western Australian waters (Sato-Okoshi *et al.*, 2008). Numerous individuals of *Polydora uncinata* were extracted for the first time from the shells of both land-based cultured abalone *Haliotis laevigata* and *H. roei*, as well as from natural subtidal *H. roei* and *Chlamys australis*. Shells of the oyster *Saccostrea commercialis* cultured in sea-based systems were infested by *Boccardia knoxi* which was first recorded in these waters. This study suggests that further monitoring of polydorid species is needed not only from the viewpoint of marine biology but also to survey the risk invasive species pose to commercially important mollusks in this region and worldwide.

Today, ecosystem management of ecosystem services and invasive species is becoming more and more important toward sustainable utilization of fishery resources. We summarized the present situation of the invasive marine species in Japan and discussed the subject (Hori *et al.*, 2007).

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