# 42. MARINE BENTHOS

## 42.1 Introduction

The littoral and subtidal habitats in lower Cook Inlet support diverse communities of marine and anadromous species of ecological and economic importance. The overall objective of the marine benthos study was to characterize benthic assemblages in marine habitats of Iniskin and Iliamna bays. Specific objectives of the study were as follows:

- Review and synthesize available information from past studies of regional and local marine conditions and resources.
- Conduct new field studies and analyses to supplement information from these past studies to gain an updated and broader understanding of the benthic ecology of the Iliamna/Iniskin Estuary.
- Establish a baseline that describes, to the extent practical, variations in plant and animal assemblages associated with elevation, season, and year.
- Identify and quantify specific sites, habitats, and benthic resources that are particularly productive or important (e.g., kelp and eelgrass beds, marshes at stream mouths, shellfish resource areas, fish spawning habitats, threatened or endangered species habitats, etc.).
- Document the food web and ecological relationships among key species in the Iliamna/Iniskin Estuary. (This study element was conducted in conjunction with the marine fish and invertebrate studies summarized in Chapter 43.)

Marine investigations under this study occurred over the 5-year period from 2004 through 2008 and included several habitat sampling events, mostly in mid to late summer. Field work consisted of various efforts largely divided between intertidal and subtidal studies as summarized below:

- Intertidal Studies:
  - Intertidal habitat surveys, including both quantitative and qualitative data collection, were conducted 2004, 2005, 2006, and 2008.
  - Intertidal samples, including samples of sediment, infauna, and biological tissue, were collected in 2004, 2005, and 2008 for analysis.
- Subtidal Studies:
  - Subtidal habitat surveys, including both quantitative and qualitative data collection and underwater photography were conducted 2004 and 2008.
  - Subtidal samples, including samples of sediment, water, infauna, and biological tissue, were collected in 2004 and 2008 for analysis.

Several sampling methods were used and included fixed quadrat transect sampling for the rocky and boulder/cobble intertidal habitats, quantitative core and quadrat sampling in soft sediment habitats for infauna (in concert with sampling for chemical analysis), and diver survey transects where fauna and habitat types were quantified by diver-biologists in situ and by video and still photographs taken during the surveys. Habitat and community composition, and the similarities and differences between sites were investigated. Specific measures examined included species abundance, species diversity, species dominance, and multivariate clustering of sites based on species similarities and composition.

## 42.2 Results and Discussion

This summary covers the biological and ecological baseline condition of marine benthos in the study area. The studies of intertidal and subtidal habitats and of oceanographic and water-quality physical characteristics are summarized in Chapter 36 and Chapter 34, respectively.

### 42.2.1 Intertidal Epibiota

Field surveys were conducted to investigate typical ecological conditions and assemblages along shorelines in the Iliamna/Iniskin Estuary. The different timing of sampling in various years, combined with consideration of seasonal data that were gathered at stations in the Iliamna/Iniskin Estuary and elsewhere in Cook Inlet in 1978 (Lees et al., 1980), aided in evaluation of seasonal patterns.

The intertidal areas sampled represent a wide range of habitat types from bedrock to mudflat. Each habitat type supports a distinct assemblage of resident organisms that have adapted to the physically rigorous environment in the Iliamna/Iniskin Estuary.

For rocky intertidal habitats the distribution of vegetation and invertebrates is determined by elevation, substrate, time of year, and exposure to physical stressors, such as waves, sun, and ice scour. These physical factors have variable seasonal and interannual influences on these habitats and associated organisms. Ice, in particular, is a major stressor on organisms found on rocky intertidal habitats. As seen at certain sampling stations in April 2006 and March 2008, ice, coupled with low wintertime light levels, largely removed sessile epibiota from all rock surfaces except crevices and tide pools during the winter months. The reach of shoreline from the mouth of Y Valley Creek to North Head (Figure 1-3c in Chapter 1) has many nearly vertical rock faces that never develop mature intertidal assemblages, suggesting a consistent annual scouring by wave-driven ice. Potentially all of the Iliamna/Iniskin Estuary shorelines may experience such icing-related effects at some point during the winter. The effects of moving ice are exacerbated by swells that repeatedly move the ice against the shore. In summary, ice damage and low light levels combine to greatly reduce intertidal epibiota each winter.

Throughout the intertidal zone, plants generally recolonize the exposed substrate each spring from ice-resistant holdfasts or encrusting life phases or through settlement of gametes from plankton. In many ice-affected areas, sessile animals appear to persist through the winter in cracks and crevices or under boulders and also recolonize from planktonic larvae. More motile animals also may take shelter in cracks, crevices, or under boulders or may migrate to subtidal areas. They also may recolonize from planktonic larvae. Early in the spring, as light levels increase, algal growth may be preceded by blooms of unicellular diatoms, as was seen in April 2006. These diatoms, some green algae, and early colonizing films of other algae encourage grazers such as limpets and periwinkles to move out of winter refuges to graze. This cycle of spring renewal is followed by an early summer peak in abundances of many algae that then decline after releasing reproductive products.

The monthly monitoring conducted at Scott Island (at the entrance to Iniskin Bay) in April through September 1978 (Lees et al., 1980) generally supports these findings. In the 1978 data from Scott Island, the algae at upper elevations were relatively constant over the spring to early fall, while those at middle and lower elevations exhibited greater seasonality. Green algae were more abundant in the early part of the season at the lower elevation, while red and brown algae developed high abundances in July to September.

The diversity of both plants and animals among the rocky stations also tended to decrease with declining wave exposure and salinity and increasing suspended-sediment load. Generally, the number of species of algae that tolerate less saline and variable light (i.e., more estuarine) conditions are fewer, and areas with high wave exposure had the highest potential for high macroalgal diversity because of the high levels of disturbance and greatest exposure to a larger recruiting stock (i.e., Cook Inlet waters). Scott Island and sampling station MPS1 (Knoll Head) were the most exposed and had the greatest diversity of algae. Station MPS1A (Knoll Head West) was only slightly less diverse. Sampling stations MPS2 (inside the western shore of Iniskin Bay) and MPS4 (North Head in Iliamna Bay) were intermediate in exposure and richness, while station MPS3 (Diamond Point at the mouth of Cottonwood Bay) had the least diverse biota, reflecting its semi-protected location and the influence of higher suspended-sediment loads from Iliamna Bay. (See Figure 1-3c in Chapter 1 for the locations of the landmarks cited here.)

An analysis of long-term temporal changes at two stations in the Iliamna/Iniskin Estuary has been possible using data from 1978 (Lees et al., 1978), 1996 (Pentec, 1996), and the Pebble Project study. As of 2004, intertidal conditions had not changed dramatically since the previous studies, and descriptions based on the previous studies remained largely valid. An exception was an apparent shift in algal dominance at middle intertidal rocky stations at Scott Island and Knoll Head West between 1978/1996 and 2004: the dominant algae shifted from rapidly recolonizing red algae (e.g., from remnant holdfasts) to a co-dominance between the red algae and rockweed, a perennial brown alga that requires a few years without disturbance to reach maturity. There also was an increase in the cover by barnacles. These shifts suggest that fewer ice-scouring events may have occurred at these sites in the winters prior to the 2004 sampling event than prior to either the 1978 or 1996 sampling events. The co-dominance of red algae and rockweed persisted at the Scott Island middle station through July 2005. In 2005, at the Knoll Head West (MPS1A) middle station and in April 2006 and July 2008 at the Scott Island middle station, there was a return to red algal dominance. The low cover of rockweed in April 2006 at Scott Island may reflect more severe ice damage over the winter of 2006.

Each intertidal habitat type provides feeding areas for different pelagic and demersal fish and invertebrates that forage over the intertidal zone during high tides. The estuarine and nearshore rearing habitats of juvenile salmonids are an important component of the intertidal zone, especially for pink and chum salmon that outmigrate from streams along the shoreline of the Iliamna/Iniskin Estuary and elsewhere in Cook Inlet. Another important component of the intertidal zone is the substrate used for spawning by Pacific herring. In Spring 2008, herring spawn was moderately abundant along lower intertidal rocky habitats from Entrance Rock nearly to Knoll Head, with less spawning intensity observed toward the Y Valley lagoon and around Scott Island. Spawn was also common on eelgrass in beach drift and in trawl samples during late May and early June. In addition, rearing of larval and juvenile herring resulting from nearby spawning is clearly important along Iliamna/Iniskin Estuary shorelines, as indicated by beach seine sampling (Chapter 43).

### 42.2.2 Subtidal Habitats

Six qualitative reconnaissance dives were performed in 2004 and revisited in 2008 for the nearshore region of the Iliamna/Iniskin Estuary to survey the habitats and benthic assemblages in areas of interest. Along diver transects, the substrate generally graded from coarsest nearshore to finest offshore, with a mixture throughout. Attached fauna at the shallowest depths tended to be relatively sparse, presumably because of occasional scouring by ice. Kelp (Laminariales) was most abundant closest to shore at station MPS4 (inside North Head) and at White Gull Island, and also at station MPS1B (inside Iniskin Bay), but at relatively low density.

For coarse substrates (e.g., cobble and small boulder) invertebrate fauna was dominated by attached and mobile organisms and not by burrowing infauna. Common attached invertebrates included sponges, hydroids, sea anemones, the rock jingle, and bryozoans. Common mobile invertebrates included several species of snails, chitons, nudibranchs, hermit crabs, and sea stars.

Dominant macroinvertebrates on soft subtidal substrates were mainly a tube-dwelling sabellid polychaete, probably *Schizobranchia insignis*. Dense mats of this suspension-feeding worm also were present in the Iliamna/Iniskin Estuary area in the 1970s (Lees et al., 1980). A few other sponges, the fleshy moose-horn bryozoan (*Alcyonidium* sp.) and seastars (*Leptasterias* spp. and *Henricia leviuscula*) also were noted.

Few pelagic fish were observed on diver transects. Instead, more bottom-oriented fish like the whitespotted greenling, starry flounder, and unidentified juvenile flatfishes were most common. All of the common plants, invertebrates, and fishes seen in 2004 and 2008 also were present in dive surveys in the Iliamna/Iniskin Estuary area in the 1970s (Lees et al., 1980), indicating a moderate degree of temporal stability in subtidal plants and animals.

### 42.2.3 Infauna

Infauna samples were collected in conjunction with sediment samples collected for chemical analyses. The infaunal assemblages of the sampled intertidal sites were composed of organisms commonly found in Alaskan waters. Polychaetes generally dominated in terms of abundance, while in terms of biomass, bivalves (because of their typically larger size) shared dominance with a few larger polychaetes. In 2008, there were a few exceptions where small polychaetes dominated in biomass in the absence of large polychaete and bivalve species. At the genus level, all of the animals identified during the Pebble Project marine benthos study are abundant in marine assemblages elsewhere in Alaska (e.g., Jewett et al., 1999; Blanchard and Feder, 2003; Blanchard et al., 2003).

A few worms—*Capitella capitata*, *Chaetozone* sp., *Prionospio* sp., and *Polydora* sp.—are known to occur in disturbed environments in Alaskan coastal environments (Jewett et al., 1999; Blanchard et al., 2002, 2003; Blanchard and Feder, 2003). Their presence in moderately high numbers in the Iliamna/Iniskin Estuary during some years may reflect frequent movement or disturbance of sediments within the intertidal region, a result of the moderate- to high-energy physical environment. From 2004 to 2008 several shifts in abundance, biomass, and diversity, such as the generally greater abundances and biomass of bivalves in 2005 and to some extent in 2008, were noted. However, these changes likely reflect small-scale spatial and temporal phenomena and demonstrate the constantly changing baseline condition in the intertidal infaunal assemblage.

For the subtidal assemblage, the dominant taxa collected were polychaetes (e.g., *Lumbrineris, Nephtys, Cossura*, and *Prionospio steenstrupi*) and the clams *Ennucula* and *Macoma moesta alaskana* (depending on the year sampled). In general, these taxa are widely observed in infaunal assemblages in Alaska (Jewett et al., 1999; Blanchard and Feder, 2003) and are generally distinct from the intertidal assemblages. Despite these generalizations, species varied widely from site to site and year to year, though relative contribution by functional group explained many of the differences between sites.

The variability of the results of subtidal faunal measures among sampling locations and elevations was substantial but falls largely within the range expected based on the results of studies of similar marine assemblages elsewhere (Jewett et al., 1999; Blanchard et al., 2002; Blanchard and Feder, 2003; Feder et al., 2005). For example, the average July abundance of subtidal infauna decreased by 50 percent or more and average July biomass decreased by an order of magnitude between 2004 and 2008. On the whole, fewer taxa were encountered in the subtidal samples in 2008, with many of the dominant taxa differing between the two years. Nonetheless, most of the species in both years fell into two functional groups (molluscs and annelids) that dominated infaunal biomass or abundance at most of the sites. High variability was noted among replicate samples from within sites, suggesting a lack of homogeneity within the sites over very small spatial scales. Only one site, station MPS1 at Knoll Head, had groupings of replicate samples in multivariate analysis that were indicative of a homogenous marine environment. Conversely, station MPS4, and to a lesser extent station MPS2, had much scattering and a low similarity among replicate samples in multivariate analysis, indicating a lack of homogeneity. The low similarity of replicates reflected in the cluster analysis and ordination may be due to sampling multiple habitats within a site, possibly as a result of a high diversity of habitats (from either horizontal zonation or habitat mosaics/patchiness) within a site; such diversity is not uncommon for these types of subtidal marine assemblages (Jewett et al., 1999; Blanchard et al., 2002; Blanchard and Feder, 2003; Feder et al., 2005).

Overall, subtidal infauna was generally more abundant and more diverse than was intertidal infauna. These differences reflect the greater stability and lower stress of subtidal environments compared to intertidal environments where wave action, large temperature and salinity shifts, and seasonal ice-gouging exert influences not seen in subtidal habitats. Despite these stresses, some areas of the intertidal environment showed substantial biomass of large infauna that far exceeded the subtidal biomass. This difference may reflect the minimal influence of large predators (e.g., sea stars) on bivalves in these intertidal areas. In addition, the infauna at subtidal stations exhibited a higher degree of within-station similarity than did the infauna at intertidal stations, a reflection of the greater diversity of intertidal substrates, again, likely a consequence of the harsher nature of the intertidal environment.

## 42.3 References

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Middle intertidal zone dominated by red algae, June 17, 2008.

Transect in the rocky mid-intertidal zone dominated by *Fucus*, July 16, 2008.

Extensive eelgrass meadow, July 5, 2008.

Collecting infauna samples on mudflats, July 14, 2008.