

STUDY TITLE: Distribution, Abundance, Diversity, and Productivity of Benthic Organisms in the Gulf of Alaska.

REPORT TITLE: Distribution, Abundance, Community Structure, and Trophic Relationships of the Nearshore Benthos of the Kodiak Shelf, Cook Inlet, Northeast Gulf of Alaska, and the Bering Sea.

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AFFILIATION: National Oceanic and Atmospheric Administration.

ADDRESS: Alaska OCS Region, 949 East 36th Avenue, Anchorage, AK 99508-4302.

PRINCIPAL INVESTIGATOR(S)*: H.M. Feder, S. Jewett (University of Alaska).

KEY WORDS: Benthos; benthic community; benthic assemblage; benthic infauna; benthic epifauna; benthic macrofauna; benthic assessment; annelida; arthropoda; mollusca; echinodermata; crustaceans; snow crabs; king crabs; trawls; grabs; Kodiak shelf; lower Cook Inlet, northeast Gulf of Alaska; Bering Sea.

BACKGROUND: Benthic organisms, especially infaunal species, are extensively used as indicator species to identify environmental disturbance because they tend to remain in place for relatively long periods of time. Their use for this purpose, however, is dependant on an adequate data base against which possible changes could be compared. In response to oil and gas interest in the Kodiak, Gulf of Alaska, lower Cook Inlet, and the Bering Sea, this study was initiated to provide both quantitative and qualitative information on benthic communities in these proposed lease-sale areas.

OBJECTIVES: (1) To provide a qualitative and quantitative inventory of benthic species within and adjacent to oil-lease sites in the northeast Gulf of Alaska, the Kodiak shelf, lower Cook Inlet, and the Bering Sea; (2) To describe the spatial distribution patterns of selected species in the designated study areas; and (3) To observe the biological interrelationships, specifically trophic interactions, between components of the benthic biota in designated study areas.

DESCRIPTION: Field sampling occurred on the Kodiak shelf, lower Cook Inlet, northeast Gulf of Alaska (NEGOA), and the Bering Sea in 1976 and 1977. Sampling for benthic infauna was accomplished with a van

Veen grab and epifaunal species were sampled with an eastern otter trawl, try net, Agassiz trawl, and pipe dredge. All dredge and grab samples were washed and sieved on 1.0 mm screens.

SIGNIFICANT CONCLUSIONS: The initial analyses and assessment of collected data suggested that sufficient knowledge had been acquired so that development of a satisfactory long-term monitoring program could be accomplished. The benthic communities at established stations represented the diversity of the regional benthic fauna including the unique species which occur in potential lease-sale areas. The authors also concluded that the acquired data would be useful in selecting species which could be used for monitoring purposes once lease sites are identified.

STUDY RESULTS: Fifty-three stations were sampled in Alitak and Ugak Bays of Kodiak Island. Twelve phyla were represented in the collections. The dominant groups in terms of number of species, in descending order were arthropoda, mollusca, echinodermata, and annelida. The latter three groups accounted for less than 1.0% of the biomass collected in each bay, while arthropoda accounted for 95.8 and 99.1% of the biomass in Ugak and Alitak Bay respectively. There were differences in the sex composition and stage of maturity of king and snow crabs between and within the two bays. At Alitak Bay, king crabs occurred mainly at the outer stations and consisted primarily of egg-bearing females and juveniles of both sexes. King crabs were well dispersed throughout Ugak Bay but the population consisted mainly of juveniles. Snow crabs in Alitak Bay were primarily juveniles while mainly adult males inhabited Ugak Bay. Deposit-feeding clams constituted the primary food item for king and snow crabs in the two bays.

Forty-two widely dispersed stations were sampled for benthic infauna in the northeastern Gulf of Alaska (NEGOA). Four hundred and fifty-seven species from 14 phyla were represented in the collections. The dominant groups in terms of number of species in descending order were the polychaetous annelids, mollusca, arthropoda, and echinodermata. Through use of clustering techniques, three different groups were identified. Group I consisted of stations south of Prince William Sound; Group II consisted of stations close to shore; and Group III consisted of stations that are near the shelf edge. The trawls conducted on the NEGOA shelf for epifaunal invertebrates and demersal fish in soft-bottom locations were effective. A major limitations, however, was the selectivity of the sampling equipment used. Rocky-bottom areas could not be sampled with the sampling equipment. Captured organisms were grouped into eight categories in descending order of importance: heart urchin (*Echinoides*), snow crabs (*Chionoecetes bairdi*), scallops (*Pecten caurinus*), shrimps (*Pandalus borealis*, *P. platyceros*, and *Pandalopsis dispar*), king crabs (*Paralithodes camtschatica*), and miscellaneous invertebrates (shells, sponges, etc.). Preliminary analysis of this data indicated that molluscs, crustaceans, and echinoderms are the most common invertebrate groups on the shelf with the commercially important snow crab, *Chionoecetes bairdi*, clearing dominating all other species. Further, stomach content analysis of the Pacific cod, *Gadus macrocephalus*, on the shelf, revealed that *C. bairdi* is a dominant food item.

Seventy-seven widely dispersed stations were sampled in the Bering Sea. Six hundred and forty-three species representing 13 phyla were represented in the benthic infaunal and epifaunal collections. In terms of number of species, the important groups in descending order were the annelida, arthropoda, mollusca, and echinodermata. The benthic epifauna species most commonly found at the trawling stations were *Asterias amurensis*, *Chionoecetes opilio*, *Neptunea* spp., *Buccinum* spp., *Gorgonocephalus caryi*, *Pagurus ochotensis*, *P. trigonocheirus*, *Halocynthia aurantium* and *H. igaboja*.

Seventy-four stations were sampled in the lower Cook Inlet. The dominant infaunal species at these stations were polychaetous annelids and molluscs. A total of 76 species of bivalve molluscs were collected. Deposit-feeding clams dominated in the fine sediments of the western side of the Inlet while suspension-feeding clams dominated in sandier areas of outer Kachemak Bay. Arthropod crustaceans dominated the epifauna in number, weight, and

biomass. The commercially important snow crab, Chionoecetes bairdi, dominated the catch at trawl stations. Snow crabs in lower Cook Inlet were found to feed on barnacles, hermit crabs, crangonid shrimps, and clams. With the exception of barnacles, the prey of snow crabs are deposit feeders which take up variable amounts of sediment in the feeding process. Deposit-feeding clams were found to be important in the diet of king crabs and some demersal fishes. In addition, many demersal fishes were found to utilize snow crab and crangonid and pandalid shrimps in their diets. These prey species which are indirectly or directly dependent on sediments in their food habits indicate that in the lower Cook Inlet, much of the shallow benthos is driven energetically by the sediment-detrital system. It was also felt that the shallow sediment-detrital systems are very susceptible to oil contamination, especially in bodies of water like lower Cook Inlet with high suspended loads, if adsorbed oil fractions on settling particles become incorporated into the bottom sediments. Suspension-feeding barnacles were also found to be an important prey item for king crab in the lower Cook Inlet.

STUDY PRODUCT(S): Feder, H.M. and S. Jewett. 1978. Distribution, Abundance, Community Structure, and Trophic Relationships of the Nearshore Benthos of the Kodiak Shelf, Cook Inlet, Northeast Gulf of Alaska and the Bering Sea. A final report to the U.S. Department of the Interior, Bureau of Land Management, Alaska OCS Office, Anchorage, AK and the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, OCS Environmental Assessment Program, Anchorage, AK. Contract No. IA5-35; Research Unit No. 281. 296 pp.

*P.I.'s affiliation may be different than that listed for Project Manager(s).