Feeding biology of sea stars and brittle stars along the Antarctic Peninsula

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During R/V *Hero* cruise 81-2, 9 February to 5 March 1981, we conducted field studies of the foods and feeding behavior of selected species of two groups of echinoderms, sea stars (Asteroidea) and brittle stars (Ophiuroidea). Our objectives for this first field season were (1) to collect a large number of individual specimens of the most abundant species from a few widely separated stations for analysis of stomach contents, (2) to obtain material from selected species for preservation for later morphological studies, particularly for examination of ciliated surfaces by scanning electron microscopy, and (3) to obtain at each principal station a representative series of bottom photographs for both analysis of the community and determination of feeding postures and orientation of individual asterozoans.

Food habits. A total of 16 trawl stations were made between 15 and 26 February. Invertebrates were obtained in depths ranging from 66 to 690 meters. Additional collections were made with fish traps, grabs, and plankton traps from R/V *Hero* and with fish traps and dip nets from zodiacs used near Palmer Station. Our ship operations took place from Grandidier Channel (65°29'S 64°31'W) in the south to Admiralty Bay, King George Island (62°09'S 58°28'W) in the north; fieldwork in the Palmer Station area was emphasized. Large collections of echinoderms (figure 1) were obtained together with numerous other invertebrates, some of which were preserved for eventual shipment to the Smithsonian Oceanographic Sorting Center. Ten species of sea stars and seven species of brittle stars were collected in sufficient numbers to provide adequate samples for analysis of stomach contents. A total of 360 individual specimens from these collections were measured in the laboratory at Palmer Station and their stomach contents noted. Several thousand additional specimens were preserved and returned to Maine for later analysis.

Our studies of echinoderm food habits involve recording the size, sex, and reproductive condition of each individual, then determining the composition of the diet by a numerical-points method modified from Brun's (1972) work on the asteroid *Luidia ciliaris*. The points method assesses percent frequency of occurrence of each item, stomach fullness, and the relative proportion of each diet component in relation to a full stomach. The resulting information is then organized for later computer analysis.

We were especially interested in obtaining data on two abundant large species which were the ones most likely to feed on krill or krill remains. These were the multi-armed sea star *Labidiaster annulatus* and the brittle star *Ophionotus victoriae*.

Examination of 50 specimens of *Labidiaster annulatus* taken off Janus Island near Palmer Station showed that 93 percent of

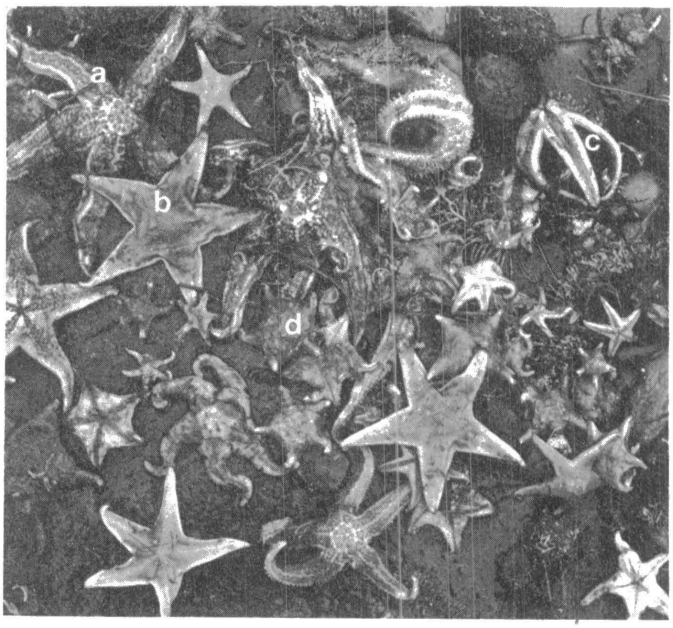

Figure 1. Assortment of sea stars on deck, collected by otter trawl, 100–110 meters, off Janus Island at University of Maine station 19, 23 February 1981. (a) *Diplasterias brucei;* (b) *Acodontaster* sp., about 18 centimeters across; (c) *Psilaster charcoti*, with oral surface uppermost; (d) *Porania antarctica glabra*.

the 43 individual specimens containing food had been feeding on living krill. One specimen contained a small unidentified fish. These sea stars capture krill and small fish by means of long flexible arms (figure 2) and rings of numerous small, pincer-like structures called pedicellariae. At other locations this species was more catholic in its diet. Additional prey included polychaetes, gastropods, bivalves, amphipods, mysids, and ophiuroids. These data confirmed earlier studies (Dearborn 1977) demonstrating the opportunistic nature of this predator.

Other asteroids obtained in large numbers included *Bathybiaster loripes obseus, Psilaster charcoti, Odontaster validus, Porania antarctica glabra,* and *Diplasterias brucei* (figure 1).

The brittle star *Ophionotus victoriae* was particularly important for our studies of food habits and trophic relationships because of its large size, abundance, and known biological interactions. It literally carpeted the seafloor at several stations in the South Shetlands and south of Anvers Island. During the 1981 fieldwork, specimens were collected primarily at three locations: Whalers Bay at Deception Island, off Janus Island, and at the Argentine Islands. About 1,500 individual specimens were preserved for stomach analysis. At Whalers Bay the population was dominated by young individuals having disc diameters generally less than 15 millimeters. This may have reflected recolonization following recent volcanic disturbance. At the Argentine Islands the population consisted mostly of individuals having disc diameters larger than 22 millimeters.

This species obtains food from both the bottom and the water column. The various food items taken with the long flexible arms include diatoms, foraminifera, mollusks, polychaetes, copepods, mysids, krill, fragments of sea urchins, and brittle stars. Sufficient data are now available to compare pop-

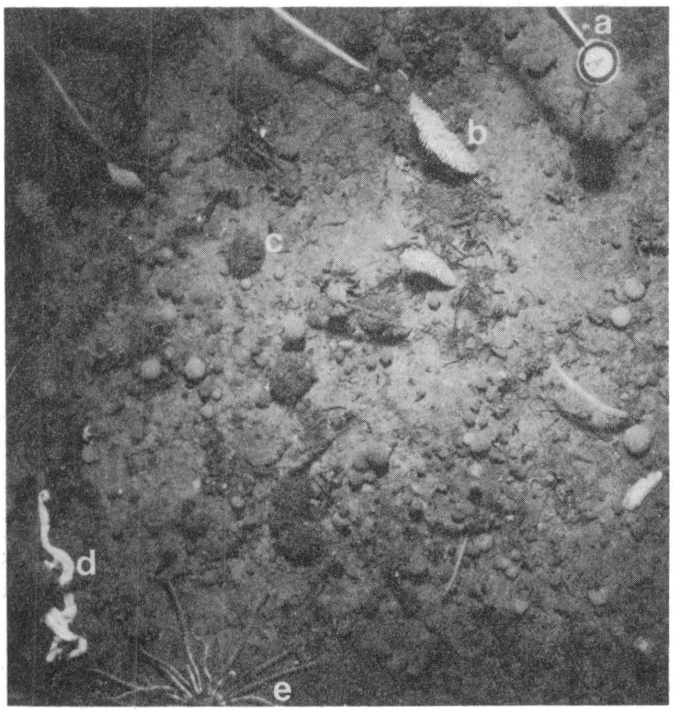

Figure 2. Photograph of the seafloor at a depth of 77–78 meters, taken off Janus Island at University of Maine camera station 7, 23 February 1981. (a) compass, suspended from camera frame, with vane indicating direction of bottom current; (b) gorgonian; (c) solitary ascidian; (d) large nemertean worm, probably *Parborlasia corrugatus;* (e) medium-sized specimen (about 38 centimeters across) of the multi-armed sea star *Labidiaster annulatus.* This asteroid can capture krill and small fishes with its flexible arms.

ulations at various locations and different size groups within the same population.

These and other data on *Labidiaster, Ophionotus,* and other asterozoan genera support and expand earlier observations (Dearborn 1977) on the presence of krill and krill remains in the diet of certain benthic macroinvertebrates.

Morphological studies. Various external parts and internal tissues were dissected from a number of echinoderms and other invertebrates. These were fixed in a buffered glutaraldehyde-formalin solution and returned to Maine for later examination, especially with scanning electron microscopy. We obtained sufficient material to begin descriptive studies of the surface morphology of asterozoans as it relates to capture, handling, and eventual ingestion of food particles. It was important to determine the presence or absence of cilia on particular surfaces and their functional arrangement because of the role of cilia in transporting small particles and maintaining respiratory surfaces, particularly in ciliary-mucoid and deposit feeders (Shick, Edwards, and Dearborn 1981). Other structures designated for study were asteroid spines, dermal papulae, podia and pedicellariae, and ophiuroid spines, arm plates, and podia.

Underwater photography. Underwater photographs provided important ecological data on the kinds, numbers, and orientation of invertebrates on the seafloor (figure 2) and the condition of the bottom as it was affected by anchor ice or scouring by icebergs. Photographs were taken at eight stations ranging in depth from 24 to 78 meters. Equipment used included a Benthos (Benthos, Inc., North Falmouth, Massachusetts 02556) model 371 utility camera and a model 381 flash activated by a bottom contact switch. A model 395 deep-sea compass was suspended below the camera frame and appeared to some degree in each photograph (figure 2). The compass had an attached vane so that the instrument oriented into the bottom current and thus indicated direction of current flow in the photograph. This was important because knowledge of bottom current direction was required for interpreting the orientation of feeding postures of individual echinoderms and other macroinvertebrates. Negatives were returned to Maine for printing and detailed examination. Preliminary results show that the substrate at all sites photographed was greatly affected by ice action. There was little development of the community of sessile, slow-growing hexactinellid sponges, colonial cnidarians, and ectoprocts so characteristic of the seafloor in the deeper waters of the antarctic shelf free of ice disturbance (Dell 1972).

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