Echinoderm biology and general benthic collecting along the Antarctic Peninsula

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From February to April 1982, we continued field and laboratory studies of the diets, feeding behavior, morphology of feeding structures, and general benthic ecology of asterozoan echinoderms (sea stars and brittle stars) along the Antarctic Peninsula (Dearborn, Edwards, and Fratt 1981). The field team included a crustacean specialist (L. Watling). Gordon Hendler, supervisor for benthic invertebrates at the Smithsonian Oceanographic Sorting Center (SOSC), participated in R/V *Hero* cruise 82-4 and was responsible for some laboratory studies of echinoderm behavior and for collecting, sorting, and preserving benthic invertebrates other than asterozoan echinoderms for systematic biologists assisted by SOSC.

The general purpose of our continuing research is to provide detailed information on the foods and feeding ecology of dominant asteroid and ophiuroid echinoderms found on the antarctic shelf. Qualitative and quantitative determinations of the extent of direct or indirect feeding of these echinoderms on krill and other zooplanktonic or benthic prey and derived detritus

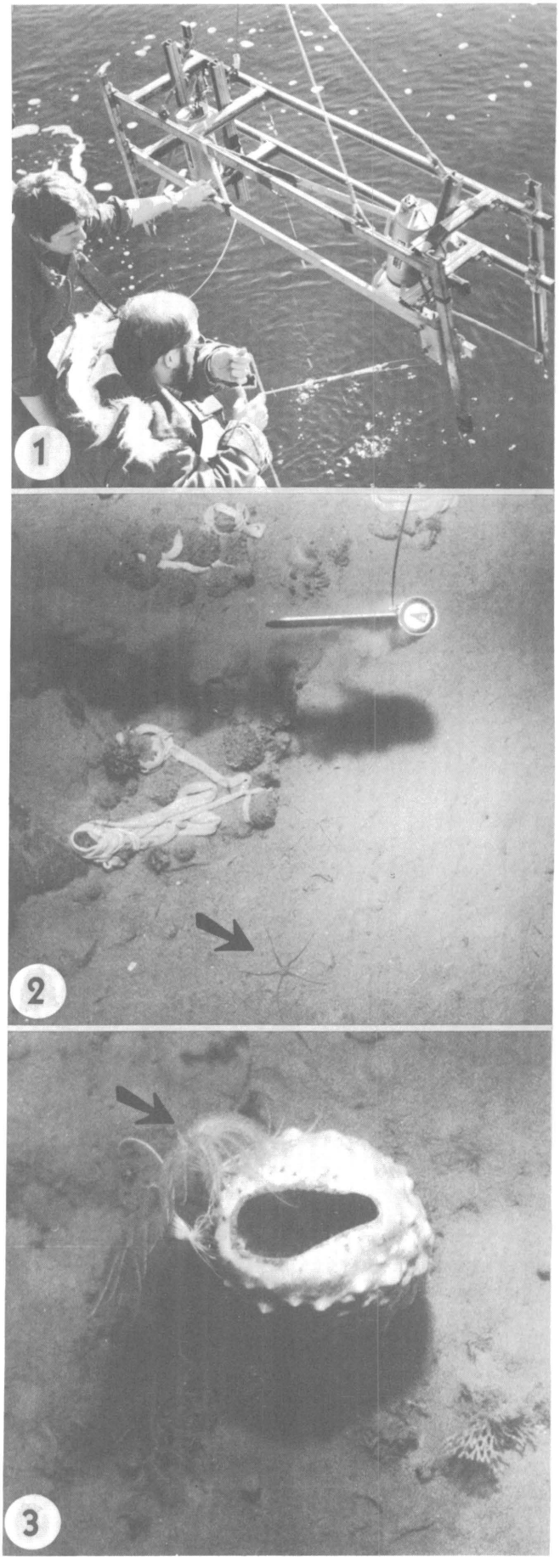
provide a basis for evaluating the role of these abundant predators and scavengers in overall energy flow between benthic and planktonic communities. The ecological data obtained will be critical in formulating a realistic model of the trophic interactions of benthic invertebrates, plankton, and fishes developed for the antarctic marine ecosystem.

R/V Hero cruise 82-3. D. Fratt participated in R/V *Hero* cruise 82-3, which left Ushuaia, Argentina, on 29 January 1982. On the way to Palmer Station, on 2 February, several otter trawls were made at Low Island in the South Shetlands to obtain demersal fishes for Audrey E. V. Haschemeyer (Hunter College). These collections included sufficient numbers of the brittle star *Ophiurolepis gelida* for analyses of stomach contents and morphological studies using scanning electron microscopy. Trawls made on 5 and 6 February in cooperation with Robert Y. George (University of North Carolina at Wilmington) also provided echinoderm material for us, including specimens of the large sea star *Labidiaster annulatus* and the brittle star *Ophionotus victoriae*, both key species in our ecological studies. Later cooperative efforts of D. Fratt and scuba divers Langdon Quetin (University of California at Santa Barbara) and Flip Nicklin (National Geographic Society) provided specimens of the unusual asteriid sea star *Granaster nutrix* from near Palmer Station. D. Fratt and Richard B. Williams (National Science Foundation) used zodiacs to obtain additional *Granaster* near Litchfield Island.

In the Palmer Station laboratory, a flow-through aquarium was used for observation of the feeding strategies of *Ophionotus victoriae*. Changes in feeding postures with variations in current velocity were noted. Methods of capture and handling of food from the water column and substrate were studied by offering krill, bivalves, polychaetes, and carmine particles to starved specimens.

Qualitative observations on the feeding of *Labidiaster annulatus* also were made. With the help of Flip Nicklin, close-up photographs were taken of this sea star feeding on live krill. These sequences show the capture of krill by pedicellariae and subsequent manipulation of the prey by podia and arm surfaces prior to ingestion.

R/V Hero cruise 82-4. J. Dearborn, L. Watling, K. Edwards, and G. Hendler participated in R/V *Hero* cruise 82-4, which left Punta Arenas, Chile, on 8 March 1982. D. Fratt joined the group at Palmer Station on 14 March, and all personnel returned to Punta Arenas on 9 April.



Underwater camera operations and results. (1) Authors Fratt (left) and Edwards lowering the Benthos, Inc., model 371 underwater camera and model 381 utility flash, 23 March 1982, west of Vladivia Point, east side of Gerlache Strait (photo by J. H. Dearborn). (2) Sea floor at 52 meters depth in Arthur Harbor, between Palmer Station and Torgersen Island. A deep-sea compass with attached vane indicates direction of bottom current. Several specimens of the large nemertean *Parborlasia corrugatus* (left center and top) and an unidentified ophiuroid (arrow) are visible (photo taken 28 March 1982). (3) A large, hexactinellid sponge on the bottom off Prospect Point, 66°05.0′S 65°20.9′W, at 85 meters depth. Several specimens of the comatulid crinoid *Promachocrinus kerguelensis* (arrow) cling to the sponge. The sponge osculum has a maximum diameter of about 25 centimeters (photo taken 17 March 1981).

Locations for sampling benthic invertebrates extended from the northern end of Adelaide Island in the south to King George Island (South Shetlands) in the north, in depths of 33 to 730 meters. A total of 38 trawl or grab stations and 13 underwater camera stations were made. Sixteen rolls of black-and-white film and eight rolls of color film were taken at depth ranging from 33 to 172 meters. These photgraphs will provide data on the nature of sediments, types and distribution of macroinvertebrates, and orientation of echinoderms in relation to bottom currents (see figure, page 163).

A total of 193 echinoderm tissue samples were fixed in a glutaraldehyde/formalin solution for scanning electron microscopy. These samples will be used for detailed morphological studies of six species of sea stars, nine species of brittle stars, and at least five species of crinoids. More than 130 specimens of seven species of sea stars were examined for gut content and stomach fullness. Approximately 1,000 specimens of *Ophionotus victoriae* were obtained from three sites for analyses of stomach contents by size of animal, location, and season.

Forty samples of environmental sediments also were obtained for comparison with sediment from the stomachs of *O. victoriae* taken in the same grabs. Such a comparison should provide information on particle size selectivity, sediment handling and breakdown by invertebrate deposit-feeders, and the nature and extent of sediment organic content utilized by these deposit-feeders.

The collection of benthic invertebrates other than echinoderms centered on obtaining amphipods for taxonomic studies and examining the associated fauna of selected sponges. Many species of amphipods were obtained; those of particular interest represent the families Acanthonotozomatidae and Paramphithoidae. Within the latter, several species of the genus *Epimeria* were found. About 15 species of amphipods larger than 1 centimeter in body length were photographed to record color patterns; in *Epimeria*, these patterns readily separate the closely related species.

Five sponge species were examined for associated fauna. Each sponge was isolated immediately from the general trawl contents. The small animals were extracted from the sponges, washed over a 150-micrometer screen, and sorted from the debris under a dissecting microscope. Many species, chiefly ostracods, isopods, and amphipods, as well as many small polychaetes, gastropods, brittle stars, and sea stars, were obtained. A number of groups usually found in low numbers in sediments, such as sebid and pagetinid amphipods and munnid isopods, were especially abundant in the sponges.

Remaining invertebrate material from trawls and grabs was sorted, and representative specimens narcotized, preserved, and prepared for shipment to the SOSC largely through the efforts of G. Hendler. Approximately four 55-gallon drums of preserved specimens were obtained for the national collections. This material will be distributed to various taxonomic specialists by the SOSC.

Several laboratory experiments were conducted at Palmer Station by G. Hendler and D. Fratt. The rate of digestion of the ophiuroid *Ophionotus victoriae* was estimated using specimens dredged from 50–150 meters and acclimated to the running seawater aquaria at Palmer. The ophiuroids were starved prior to experiments. Series of animals were offered blotted, weighed pieces of *Euphausia* sp. abdomens as food. Ophiuroids that ingested food within 5 minutes were held in running seawater for periods of 1 to 30 hours and then dissected, and the food remaining in their stomachs was removed, dried, and weighed. The weight of material digested during the experimental interval was determined by subtracting the dry weight of undigested food from the calculated dry weight of the ingested piece of *Euphausia* tissue.

The experimental protocol was identical to that previously used (Hendler in press) to determine the digestion rate of the temperate zone ophiuroid *Ophioderma brevispinum* at Woods Hole, Massachusetts. Preliminary calculations for one experiment show that *Ophionotus victoriae* that ingested 15.80-milligrams (mean dry weight) portions of *Euphausia* digested tissue at a rate of 0.63 milligrams per hour. In a second experiment, smaller *Ophionotus* that ingested larger (31.80 milligram) pieces of *Euphausia* digested tissue at 0.76 milligrams per hour. These experiments were carried out at temperatures of from $-.05°$ to 1.0°C. At a temperature of 20.6°C, the temperature zone species *Ophioderma brevispinum* of roughly the same size as *Ophionotus victoriae* digested 16.3-milligram pieces of the shrimp Palaemonetes vulgaris at a rate of 1.01 milligrams per hour.

Additional calculations and comparisons are necessary to interpret the results, but important implications for the ecology and physiology of *Ophionotus victoriae* are already apparent. Interestingly, this antarctic ophiuroid is capable of digesting food at a rate similar to that of a temperate zone ophiuroid despite a 20°C difference in the ambient water temperature of the two species.

Rate processes of ophiuroids were examined by timing the "righting reflex" of various specimens of several antarctic species at ambient temperatures. In addition, more than 30 species of antarctic echinoderms were tested for their ability to luminesce. At least three holothuroid species and four species of ophiuroids examined were capable of luminescence.

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