Ecological and taxonomic studies of echinoderms, mollusks, and fishes from the Antarctic Peninsula

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Ecological and taxonomic studies of echinoderms, mollusks, and fishes were carried out during February and March 1972 aboard R/V *Hero* in the vicinity of Anvers Island and south to Marguerite Bay. Experimental work was conducted in the laboratory at Palmer Station. The program was a cooperative venture between the University of Maine at Orono and two French scientists: an ichthyologist (Hureau), and a malacologist (Arnaud). We were assisted by F. Julian Fell and D. Keith Serafy, both graduate students in the Department of Zoology at Maine.

Organisms were obtained with a variety of nets, dredges, trawls, traps, and long lines from 106 stations ranging in depth from the intertidal to 670 meters. Studies emphasized the feeding and reproductive biology of selected species of echinoderms, mollusks, and fishes, respiratory rates in echinoderms, and the physiology of fish blood.

Initially, we also had hoped to investigate the relationships between the ophiuroid genus *Ophiurolepis* and an epizoic sponge *Iophon* as well as the ecology of the two known species of the crinoid genus *Notocrinus*. However, few specimens of these organisms were obtained, and these studies were abandoned.

Taxonomic aspects were also important. Material obtained at or near Booth and Petermann Islands and the Lemaire Channel include some species of echinoderms and mollusks not taken in these localities since the two French expeditions under Charcot early in this century.

Among the echinoderm genera most studied were the crinoids *Florometra, Isometra,* and *Promachocrinus,* the asteroids *Odontaster, Porania, Labidiaster, Diplasterias,* and *Lysasterias,* the ophiuroids *Ophiura, Ophionotus,* and *Ophiacantha,* and the echinoid *Sterechinus.*

Observations were made on the feeding mechanisms of various crinoids, asteroids, and ophiuroids in the field and laboratory. The large multi-armed sea star *Labidiaster annulatus* is a particularly interesting common predator in Arthur Harbor. It eats a wide variety of mollusks and other invertebrates, including other asteroids and ophiuroids, and seems in its habits to be an ecological equivalent of *Pycnopodia helianthoides,* a very large multi-armed species found along the western coast of North America. The ophiuroid *Ophionotus victoriae* (fig. 1), a large common species in Arthur Harbor, lives on mud and mixed bottoms. Adults feed with disks raised above the substrate. Tentacles of the proximal arm segments pass food to the mouth. This species eats a variety of prey including diatoms, sponges, hydroids, polychaetes, flatworms, small crustaceans, and other ophiuroids.

As expected, many of the echinoids obtained had other organisms living on them. This was particularly true of the cidaroids, which frequently were host to numerous commensals. The genus *Ctenocidaris* was very prone to such infestations (fig. 2).

Individual studies by Serafy on the regular echinoid *Sterechinus neumayeri* were concerned with the growth rates of 160 recently metamorphosed specimens measured at weekly intervals for 5 weeks. Size-frequency relations for 445 specimens were examined to determine year classes and approximate growth rates in nature. Spawning was induced with potassium chloride, and early development followed. Food of adult *S. neumayeri* consisted primarily of diatoms.

Allen determined rates of respiration on individual species of echinoderms representing 12 genera (one crinoid, eight asteroids, one ophiuroid, one echinoid, and one holothurian), and the gastropod *Neobuccinum eatoni.* Rates were measured at 0°C. (±0.5°). Respiration rates on *Odontaster validus* and *S. neumayeri* also were measured at 5° and 10°C. Measurements were obtained with an oxygen meter (Yellow Springs Instrument Co., model 54) and electrode (series 5400). Animals were brought to Palmer Station and allowed to acclimate in the running sea water system for at least 24 hours before use. Ecological data pertinent to these organisms will be employed in the analysis of the respiration rates. Preliminary analyses showed that, for the echinoderms, the lowest respiratory rates were found in relatively sluggish ciliary-mucoid feeders (*Porania*: mean equals 30.2 cubic centimeters per kilogram dry weight per hour) or sponge eaters (*Perknaster*: mean equals 30.5 cubic centimeters per kilogram dry weight per hour) while the highest rate was found in the active carnivore scavenger *Odontaster validus* (mean equals 60.5 cubic centimeters per kilogram dry weight per hour).

Fell studied osmotic response in *O. validus* and *S. neumayeri* using a freezing point depression technique. These two echinoderms were occasionally found in the intertidal zone and could encounter considerable osmotic stress from both fresh water runoff and freezing effects on sea water. These species are strictly

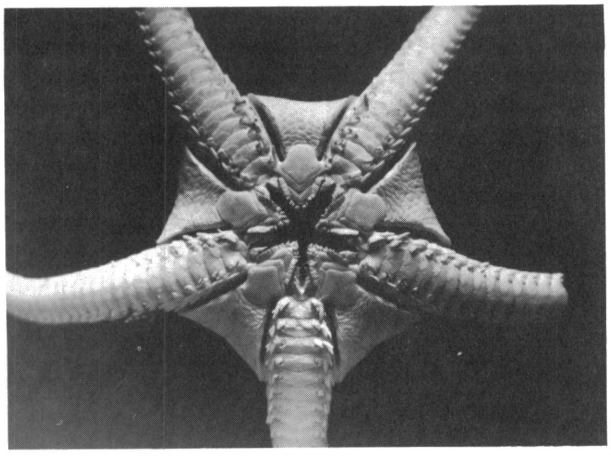
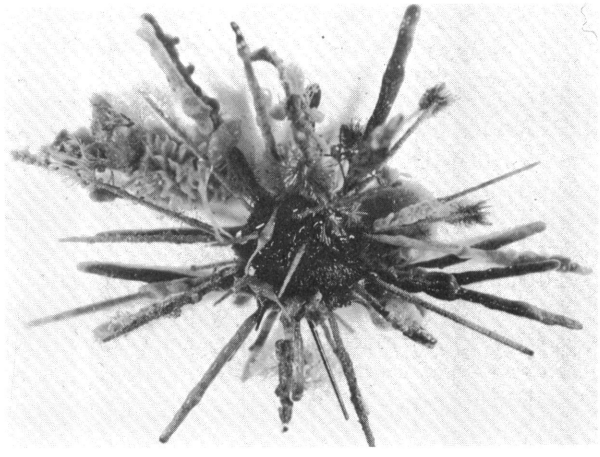


Figure 1. Oral view of *Ophionotus victoriae*, a large common brittle star in the Antarctic Peninsula region. Disc diameter in this specimen is 26 millimeters.



Photos: J. H. Dearborn

Figure 2. The spines of this *Ctenocidaris* collected near Arthur Harbor are heavily encrusted with other organisms, including sponges, coelenterates, ectoprocts, and ascidians. Such infestations are common on antarctic echinoids, especially cidaroids.

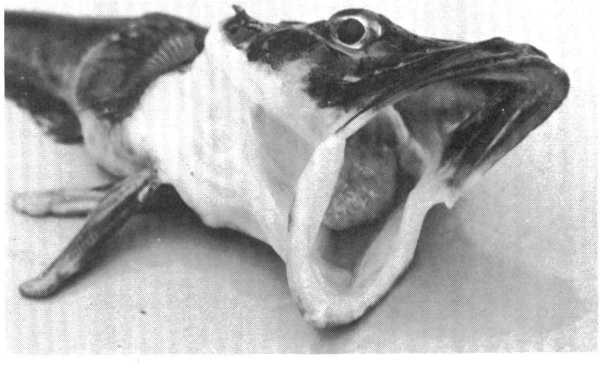


Figure 3. The head of *Chaenocephalus aceratus*, the most common icefish (Family Channichthyidae) in the Palmer Station area.

osmoconformers. Specimens normally found in a salinity of 32 parts per thousand were still alive after 18-hour exposures to salinities ranging from 38 to 25 parts per thousand.

Mollusks were studied by Arnaud. Preliminary results from the present cruise compared to those previously obtained in Adélie Land and Kerguelen Island suggest that the mollusk fauna from off the west coast of the Antarctic Peninsula is closely allied to the fauna of East Antarctica. However, there are two important differences. The Antarctic Peninsula has a higher diversity, related to the occurrence of some additional species having subantarctic origins or affinities. Differences in relative abundance of some species also occur (for example, the large gastropod *Neobuccinum eatoni* is far more common in Arthur Harbor than in the shallow waters off Adélie Land).

The primary interest in mollusks was ecological, particularly as it related to reproductive and feeding biology. Some prosobranch egg capsules were collected including the previously unknown capsules of the volutid *Harpovoluta charcoti*. Brood protection was observed in several species of small pelecypods and the chiton *Haemiarthrum setulosum*. New observations on the diet of several species of gastropods and pelecypods were made, and new data on the frequency of necrophagy among gastropods were obtained.

The interesting occurrence of a commensal relationship between *Harpovoluta charcoti* and an actiniarian (Arnaud, in press) was further documented by some excellent new material and *in vivo* observations.

About 300 specimens of fishes were obtained. They represent 20 species in seven families as follows: Nototheniidae (eight species), Channichthyidae (four), Bathydraconidae (three), Harpagiferidae (two), Rajidae (one), Trichiuridae (one), Zoarcidae (one). Stomach contents of 200 individuals were removed to study the food habits of common fish in relation to the composition of the invertebrate benthos. *Notothenia coriiceps neglecta* is best represented in this work. For each fish studied, the sex and standard length were noted. Later the weight of the stomach contents will be taken and detailed analyses of the food organisms will be made.

The principal part of the fish work consisted of a physiological study of blood by Hureau. Eighty individuals representing 18 species were studied. A total of 95 tubes of serum were obtained from these specimens. Analyses of the serum proteins were made in the Palmer laboratory utilizing cellulose polyacetate electrophoresis (Gelman chamber). Multiple serum traces were obtained for each sample. This work will be repeated in Paris to separate and identify more accurately the diverse serum proteins. For each blood sample, a smear was made to study cell types present. A total of 38 counts of erythrocytes and white cells were made. The essential result was that in the four species

of Channichthyidae studied, cells with the characters of erythrocytes were present as previously demonstrated in *Channichthys rhinoceratus* from Kerguelen (Hureau, 1966; Spillman and Hureau, 1967). Furthermore, in *Chaenocephalus aceratus* (fig. 3), we observed in fresh blood various stages of nuclear degeneration in erythrocytes. The presence of erythrocytes in small numbers, 15 to 30 times less than in normal fish blood, is therefore established in the Channichthyidae, the so-called white-blooded fishes.

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References

Arnaud, P. In press. Sur une petite collection de Gastéropodes Prosobranches et Pélécypodes de l'île Petermann (Antarctique). Téthys, 4.

Hureau, J. C. 1966. Biologie de *Chaenichthys rhinoceratus* Richardson, et problème du sang incolore des Chaenichthyidae, poissons des mers australes. *Bulletin de la Société Zoologique de France,* 91: 735–751.

Spillman, J., and J. C. Hureau. 1967. Observations sur les éléments figurés du sang incolore de *Chaenichthys rhinoceratus* Richardson, poisson téléostéen antarctique (Chaenichthyidae). *Bulletin du Muséum National d'Histoire Naturelle,* 38: 779–783.

Respiration in New Zealand echinoderms

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I spent 6 weeks in October-November 1971 in New Zealand at the Portobello Marine Biological Station (University of Otago) investigating the respiratory physiology of echinoderms. Sea urchins (*Goniocidaris umbraculum* and *Eyechinus chloroticus*) and starfish (*Pentagonaster pulchellus* and *Coscinasterias calamaria*) were dredged from the research vessel *Munida* and collected using scuba. Measurements of oxygen uptake were obtained using polarographic oxygen electrodes. Specimens were fixed for histochemical study by Sister Aquinas Nimitz at the College of San Rafael. This study is adjunct to ongoing research in echinoderm physiology under Dr. Arthur C. Giese at Stanford University and was supported by National Science Foundation grant GA-4458.

A summary of the oxygen consumption of various sea urchins and starfish will be published in the *New Zealand Journal of Marine and Freshwater Research.* No studies on oxygen consumption of New Zealand invertebrates have hitherto been published. The present investigation raises a number of interesting problems of respiratory physiology for further study. The respiratory rates of New Zealand species of echinoderms are in the range of those for species of echinoderms from Monterey Bay studied at the Stanford laboratories. These rates will be compared to those of *Sterechinus* and *Odontaster,* which will be measured at McMurdo Station in October 1972 along with other antarctic echinoderms.

I acknowledge the assistance of Dr. E. J. Batham and the staff at Portobello Marine Biological Station in providing me with laboratory space and use of R/V *Munida.*

Shallow-water foraminifera studies, Antarctic Peninsula, 1971-1972

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Previous work on the biology of temperate and tropical foraminifera and theoretical considerations suggest that these organisms use different adaptive strategies in different environmental situations. To test this assumption on foraminifera, we initiated a comparative study on the Antarctic Peninsula supported by National Science Foundation grant GV-31162. No previous work had been done on the biology or ecology of polar species, hence our objectives included understanding the zoogeography, depth distribution, habitat preferences, tolerances for environmental variables, reproductive biology, and population dynamics of shallow-water species. Our 1971-1972 season began when DeLaca, Krebs, and Stockton arrived at Palmer Station in early December. Lipps joined this group at Deception Island in early January. DeLaca and Lipps terminated their field work February 24, while Krebs and Stockton remained at Palmer Station for work throughout the antarctic winter.

R/V *Hero* was used to sample in seven areas from King George Island in the north to Prospect Point in the south, a distance of approximately 575 kilometers. Detailed sampling was done in Arthur Harbor adjacent to Palmer Station, in Port Lockroy, around Wiencke Island, and in Port Foster, Deception Island. These areas of concentrated sampling will provide data on local variations in distribution of foraminifera and on the effects on foraminifera of the recent volcanic eruptions at Deception Island that decimated portions of the macrobenthos (Gallardo and Castillo, 1968). Over 500 samples now being processed for study were collected using various sized grab samplers and Blake trawls.