

BOTTOM INVERTEBRATE POPULATIONS BELOW 200 METERS

Until recently, the Project's surveys of the biological, chemical, and physical processes occurring in southern California waters have generally been restricted to depths shallower than 200 meters. The current interest in deeper wastewater discharge sites and our continuing interest in the extent of fish diseases, enhancement of metals, chlorinated hydrocarbons, and changes in the inhabitants of the bottom has prompted a survey of the conditions in deeper water. This article is a companion to the preceding paper and will discuss the trawl-caught (epibenthic) invertebrates collected at depths to 610 meters.

Probably the most significant discovery at depths greater than 200 meters was the great abundance of echinoderms. Ninety-nine percent of the invertebrates at several of the deepwater stations were echinoderms. In addition to the enhanced importance of echinoderms, we found that abundance and biomass of invertebrates in general increased, and the number of species decreased slightly in deeper waters. Mesopelagic invertebrates were captured at several stations, probably during the descent or ascent of the open trawl net.

The information collected during numerous benthic sampling cruises aboard vessels from the University of Southern California (Allan Hancock Foundation) have been reported in numerous scientific publications. The information most related to the work described here came out of a study of infaunal organisms on the coastal shelf (Jones 1969), several major studies of our basins and canyons (Hartman 1955, 1963, 1966; Hartman and Barnard 1958, 1960), and the recent work being done at the Allan Hancock Foundation for the Bureau of Land Management. These excellent studies are limited primarily to infaunal inhabitants of the various study areas—very little descriptive work has been done on the invertebrates captured by trawls in our deeper basin waters.

A description of our methods can be found in the companion article. In the 22 trawls made in the survey, 36,266 invertebrates, representing 115 species and weighing in excess of 408 kg, were captured. Ninety percent of the individuals (32,585) captured were echinoderms (Figure 1); echinoderms also contributed over 90 percent of the biomass (372 kg). Three species of deeper dwelling sea urchins (*Brisaster latifrons*, *Brissopsis pacificus*, and *Allocentrotus fragilis*) were by far the most abundant species, accounting for

67, 13, and 4 percent of the total catch, respectively.

In this survey, "deepwater" samples were defined as those samples from depths greater than 200 meters. This depth appears to be an excellent line of demarcation—only 10 of the 115 species taken were found in depths both shallower and deeper than 200 meters. The group of species only found at depths greater than 200 meters was somewhat smaller than the group found only at shallower stations (44 and 58, respectively). The abundance of invertebrates in the deep waters averaged 2,475 individuals/haul. This contrasts with an average of 269 individuals/haul in trawls at the stations shallower than 200 meters and an average of 369 individuals/haul found in a survey at 60 meters ("Better Control Stations: The 60 Meter Survey"). The abundance of species was somewhat greater at shallower depths (16.4 ± 4.56 SD*) than at the deeper stations (12 ± 6.45 SD), but 92 percent of the biomass came from stations deeper than 200 meters. Deepwater hauls contained an average of 11.8 times the biomass of trawls from the shallower depths.

Further information was obtained on the relative abundance of the echinoderms off Palos Verdes. Although increasing numbers of echinoderms were found at depths greater than 300 meters, their total abundance was far less than would be expected on the basis of the data collected at various depths in Santa Monica Bay and at a single station off Laguna Beach. In addition, the abundance of echinoderms at the 457-meter station off Palos Verdes was lower than at other 457-meter stations surveyed. This depression in echinoderm abundance at Palos Verdes extended to depths of at least 610 meters—a horizontal distance from the municipal wastewater outfalls of about 5 km. In the 60-meter survey, abundance of trawl-caught echinoderms was also relatively low off Palos Verdes, and the numbers of echinoderms in grab samples taken in this area in another survey was also relatively low ("Animals That are Indicators of Marine Pollution"). These findings indicate that echinoderms are being greatly affected by some condition off Palos Verdes. Further studies into this situation, which is interesting in that it involves an entire phylum invertebrates, seem to be necessary and appropriate.

Several interesting species, only rarely encountered in southern California trawls, were collected during this survey. *Histioteuthis heteropsis* (Berry, 1913), a small maroon colored squid with a greatly enlarged left eye, was collected at a depth of 610 meters off Palos Verdes. The enlarged eye is probably used by the animal in locating light while swimming at a 45-degree angle with the eye directed towards the surface and behind (Young 1975). The same sample also contained specimens of an amphipod, *Stilipes distincta* (Holmes 1908), which is interesting because it is rarely found off California and also because its morphology is similar to that of two suborders of amphipods, *Gammaridea* and *Hyperidea*.

The apparent scarcity of these organisms is certainly partially a reflection of the relatively small number of deeper-water investigations in southern California. Their appearance in our few deepwater trawls indicates they are

*SD = standard deviation.

probably more common than we once thought. We believe that additional trawl surveys of the organisms present at depths greater than those sampled during this survey must be conducted to provide accurate and complete information on southern California invertebrate fauna.

The success of the Project's surveys, especially this series of deepwater trawls, is due to the superior efforts of our colleagues, Harold Stubbs and Michael D. Moore. We also thank M. James Alien, Robert Voglin and Alan Mearns of the project and the biological staff of the Los Angeles County Sanitation Districts for their help in obtaining this data.

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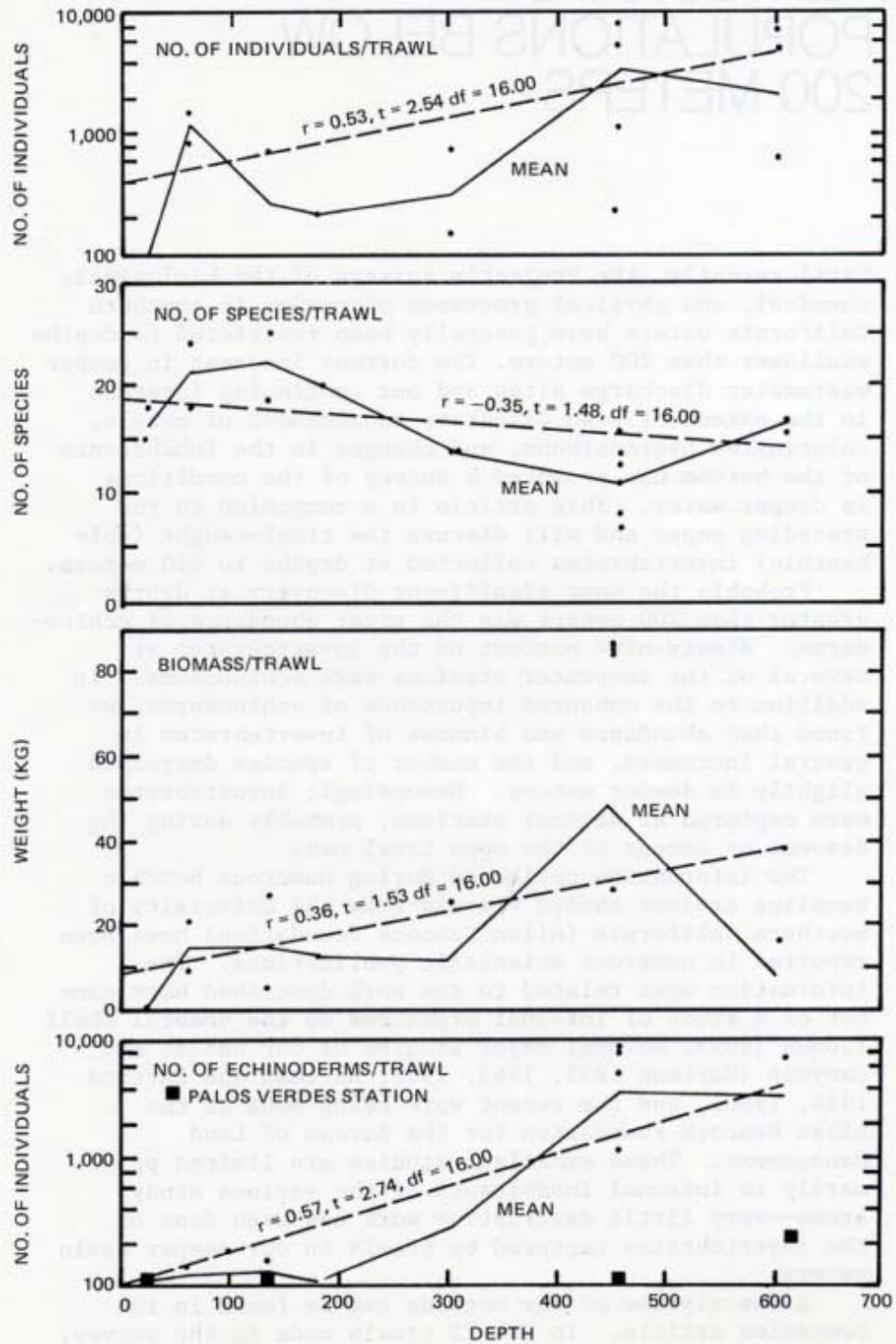


Figure. Invertebrate abundance, biomass, and number of species captured per 10-minutes of trawling in deepwater survey, 1977. Echinoderm abundance is also shown.