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Literature Cited

BROOK, I. M.
1978. Comparative macrofaunal abundance in turtle grass (*Thalassia testudinum*) communities in south Florida characterized by high blade density. Bull. Mar. Sci. 28:212-217.

CADDY, J. F.
1973. Underwater observations on tracks of dredges and trawls and some effects of dredging on a scallop ground. J. Fish. Res. Board Can. 30:173-180.

FOLK, R. L.
1974. Petrology of sedimentary rocks. Hemphill Publ. Co., Austin, Tex., 182 p.

GLUDE, J. B., AND W. S. LANDERS.
1953. Biological effects on hard clams of hand raking and power dredging. U. S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 110, 43. p.

INGRAM, R. L.
1971. Sieve analysis. *In* R. E. Carver (editor), Procedures in sedimentary petrology, p. 49-67. Wiley-Interscience, N.Y.

MEDCOF, J. C., AND J. S. MACPHAIL.
1964. Fishing efficiency of clam hacks and mortalities incidental to fishing. Proc. Natl. Shellfish. Assoc. 55:53-72.

NELSON, W. G.
1979. An analysis of structural pattern in an eelgrass (*Zostera marina* L.) amphipod community. J. Exp. Mar. Biol. Ecol. 39:231-264.

O'GOWER, A. K., AND J. W. WACASEY.
1967. Animal communities associated with *Thalassia, Diplanthera*, and sand beds in Biscayne Bay. I. Analysis of communities in relation to water movements. Bull. Mar. Sci. 17:175-210.

ORTH, R. J.
1977. The importance of sediment stability in seagrass communities. *In* B. C. Coull (editor), Ecology of marine benthos, p. 281-300. Belle W. Baruch Lib. Mar. Sci. 6, Univ. S. C. Press, Columbia.

PETERSON, C. H.
1982. Clam predation by whelks (*Busycon* spp.): Experimental tests of the importance of prey size, prey density, and seagrass cover. Mar. Biol. (Berl.) 66:159-170.

SANTOS, S. L., AND J. L. SIMON.
1974. Distribution and abundance of the polychaetous annelids in a south Florida estuary. Bull. Mar. Sci. 24:669-689.

STONER, A. W.
1980. The role of seagrass biomass in the organization of benthic macrofaunal assemblages. Bull. Mar. Sci. 30: 537-551.

SUTHERLAND, J. P., AND R. H. KARLSON.
1977. Development and stability of the fouling community at Beaufort, North Carolina. Ecol. Monogr. 47:425-446.

THAYER, G. W., D. A. WOLFE, AND R. B. WILLIAMS.
1975. The impact of man on seagrass systems. Am. Sci. 63:288-296.

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HETEROCARPUS LONGIROSTRIS MACGILCHRIST FROM THE NORTHERN MARIANA ISLANDS

In March and April 1981 the National Marine Fisheries Service Honolulu Laboratory chartered the FV *Typhoon* to conduct a fisheries resource survey in the waters of the Commonwealth of the Northern Mariana Islands. One of the major objectives of this survey was the investigation of deepwater pandalid shrimp stocks. Although not previously recognized as a species of commercial interest (Holthuis 1980), *Heterocarpus longirostris* MacGilchrist 1905 was caught in sufficient numbers on this cruise to suggest a commercial potential.

Heterocarpus longirostris has been recorded in the literature from a few specimens caught in the Indian Ocean. MacGilchrist (1905) reported taking two male specimens at 1,754 m in the Bay of Bengal; Balss (1925), one female specimen taken at 1,143 m off Nias Island, Sumatra; and Calman (1939), one female specimen taken at 914-1,463 m in the Maldive area. Catches from this cruise constitute a first record of this species from the Pacific Ocean. *Heterocarpus longirostris* is very similar to *H. laevigatus* in general morphology. *Heterocarpus longirostris* differs from *H. laevigatus* in that the preorbital dorsal surface of the rostrum is multidentate and there is a blunt point posteriorly on the carina of the third abdominal somite. In *H. laevigatus* the dorsal surface of the rostrum is edentate in advance of the orbit and the posterior portion of the third abdominal somite is rounded. Further differences are discussed in MacGilchrist (1905).

The FV *Typhoon* fished for shrimp in the Saipan-Tinian area using traps baited with chopped fish, usually skipjack tuna, *Katsuwonus pelamis*. The traps consisted of half-round frames of iron rebar (91 × 72 × 42 cm) wrapped with 13 × 25 mm or 13 × 13

mm wire mesh and covered by either burlap or canvas over the arched upper surface. On each sampling day one string of three traps was set at each of three sampling depths, 366, 732, and 1,097 m (200, 400, and 600 fathoms). Strings were set in the afternoon and recovered the next morning with a normal soaking time of between 16 and 20 h. Three species of *Heterocarpus*—*H. ensifer, H. laevigatus,* and *H. longirostris*—accounted for the majority of the catch. Shrimp referable to both *H. laevigatus* and *H. longirostris* were present in the catches throughout the cruise, but during the major part of the cruise they were considered to be the same species and recorded as "*H. laevigatus.*" These two species were recorded separately only on the last two series of sets (two strings at each of the three experimental depths). Information on the catch for these six strings is presented in Table 1.

The species with the highest catch rate (kilograms per trap) was *H. laevigatus; H. ensifer* and *H. longirostris* followed with catch rates about half that of *H. laevigatus. Heterocarpus laevigatus* was also the largest species caught, averaging 25 individuals/kg. *Heterocarpus longirostris* was next, averaging 47/kg, and *H. ensifer* was the smallest, averaging 146/kg. Differences in the reproductive biology of these species are suggested by the differing proportion of egg-bearing females present in the catch for each species. The percentage of berried females was highest for *H. ensifer* at 33% whereas that for *H. longirostris* was only 19%, and no berried *H. laevigatus* were caught. It is quite likely that these values change on a seasonal basis. Vertical separation of the three species was complete for the last six strings set. *Heterocarpus ensifer* was caught only at 366 m, *H. laevigatus* only at 737 m, and *H. longirostris* only at 1,097 m.

Though not documented due to confusion in the species identification of *H. laevigatus* and *H. longirostris* during most of the cruise, there is reason to believe that species separation by depth was essentially complete for the entire cruise. Table 2 lists the catch of the three species of *Heterocarpus* for the entire cruise excluding the last six strings. *Heterocarpus ensifer* was found almost exclusively at 366 m with a few being caught at 732 m. Mean size and percentage of berried female values for the entire cruise (Table 2) are very similar to those obtained from the last six strings (Table 1) for *H. ensifer* (112/kg compared with 146/kg and 31% compared with 33%, respectively). Similarly, values of mean size and percent berried for *H. laevigatus* in Table 1 match closely those for the *H. laevigatus/H. longirostris* group at 732 m (and the few at 366 m) in Table 2 as do the values for *H. longirostris* (Table 1) with those at 1,097 m (Table 2). This supports the assumption of vertical separation of these three species.

Both *H. laevigatus* and *H. ensifer* are considered to be commercially important species and have supported small local fisheries in some Pacific areas (Hawaii State 1979). Based on the results of this cruise, *H. longirostris* compares favorably with these two species as one with commercial potential. It is very close to *H. ensifer* in relative abundance (mean catch in weight per trap) and second, to *H. laevigatus*, in mean size. *Heterocarpus laevigatus* is first in both

TABLE 1.—Catch of *Heterocarpus ensifer, H. laevigatus,* and *H. longirostris* for the last six strings of the cruise.

Depth (m)	No. of traps fished	Catch			Mean catch/ trap (kg)	Mean size of shrimp (No./kg)	Percent berried
		Species	Number	Weight (kg)			
366	6	*H. ensifer*	542	3.7	0.6	146	33
732	6	*H. laevigatus*	172	7.0	1.2	25	0
1,097	6	*H. longirostris*	170	3.6	0.6	47	19

TABLE 2.—Catch of *Heterocarpus ensifer, H. laevigatus,* and *H. longirostris* for the entire cruise excluding the last six strings.

Depth (m)	No. of traps fished	Catch			Mean catch/ trap (kg)	Mean size of shrimp (No./kg)	Percent berried
		Species	Number	Weight (kg)			
366	34	*H. ensifer*	1,580	14.05	0.4	112	31
366	34	*H. laevigatus/H. longirostris*	67	3.5	0.1	19	1.5
732	56	*H. ensifer*	35	0.3	0.01	117	17
732	56	*H. laevigatus/H. longirostris*	2,654	90.75	1.6	29	1.6
1,097	57	*H. laevigatus/H. longirostris*	1,920	35.9	0.6	53	21

categories. Although further survey work is needed to determine the depth of maximum abundance for *H. longirostris,* the apparent greater depth of habitat for this species (1,097 m as compared with 766 m for *H. laevigatus* and 366 m for *H. ensifer)* is the major undesirable characteristic for development of any proposed fishery. Fishing at these greater depths would require greater capital investment not only in a more powerful depth recorder but also in expensive line which would need to be replaced after any gear loss.

Literature Cited

BALSS, H.
1925. Macrura der Deutschen Tiefsee-Expedition 2. Natantia, Teil A. Wiss Ergeb. Deutsch Tiefsee-Exp. "Valdivia" 20:221-315.

CALMAN, W. T.
1939. Crustacea: Caridea. Sci. Rep. John Murray Exped. 1933-34, 6(4):183-224.

HAWAII STATE.
1979. Hawaii fisheries development plan. State of Hawaii, Department of Land and Natural Resources, 297 p.

HOLTHUIS, L. B.
1980. FAO species catalogue, vol. 1—Shrimps and prawns of the world, an annotated catalogue of species of interest to fisheries. FAO Fish. Synop. 125, 271 p.

MACGILCHRIST, A. C.
1905. Natural history notes from the R.I.M.S. "Investigator," Capt. T. H. Heming, R.N. (retired), commanding.—Series III, No. 6. An account of the new and some of the rarer Decapod Crustacea obtained during the surveying seasons 1901-1904. Ann. Mag. Nat. Hist., Ser. 7, 15:233-268.

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