Exploration for Deep Benthic Fish and Crustacean Resources in Hawaii

Thomas A. Clarke

UNIHI - SEAGRANT - CR - 72 - 02
HIMB Technical Report No. 29
October 1976

EXPLORATION FOR DEEP BENTHIC FISH AND CRUSTACEAN RESOURCES IN HAWAII

by

Thomas A. Clarke

Final report on the Sea Grant project, Exploration for Mesobenthic Fish and Crustacean Resources; Vernon E. Brock, Principal Investigator, Sea Grant Years 01-02; Thomas A. Clarke, Principal Investigator, Sea Grant Year 03.

Sea Grant Cooperative Report
UNIHI-SEAGRANT-CR-72-02

Originally issued July 1972, Hawaii Institute of Marine Biology Technical Report No. 29.

October 1976

SEA GRANT
UNIVERSITY OF HAWAII

This work is a result of research sponsored by NOAA office of Sea Grant, Department of Commerce, under National Science Foundation Grant Nos. GH-28, GH-62, and GH-93, and the Hawaii Institute of Marine Biology, University of Hawaii. The U. S. Government is authorized to produce and distribute reprints for governmental purposes notwithstanding any copyright notations that may appear hereon.

TABLE OF CONTENTS

LIST OF FIGURES

Figure

LIST OF TABLES

Table

INTRODUCTION

This paper presents results of an exploratory survey of deep benthic fish and crustacean resources in Hawaii. The purposes were to determine if any unexploited species are present in commercial quantities, to test methods and gear for these and some presently exploited species, and to provide general information on the depth distribution and biology of deep benthic fishes and crustacea.

The survey was conducted using traps and gill nets set on the bottom. The equipment required, a fathometer with the proper depth range and a heavy-duty line-hauler for retrieving gear, could be mounted on most local fishing vessels. Also, it was felt that sampling with set devices would be a useful complement to recent trawling surveys conducted by the Honolulu Laboratory of the National Marine Fisheries Service.

Three types of fishing were considered: trap fishing for unexploited shrimps below 80 fathoms (ca. 150 m), trap fishing for presently exploited crabs and lobster between 30 and 100 fathoms (ca. 50 and 185m), and gill netting for fishes presently exploited by hook-and-line between 60 and 200 fathoms (ca. 110 and 365 m). After a general description of gear and procedures, each of these areas will be considered separately.

GEAR AND METHODS

Gear was tethered to stainless steel floats (surplus aircraft oxygen cylinders) on the surface. Float lines were of twisted polypropylene. For sets below 100 fathoms, the length of float line used was equal to the depth plus 50 fathoms; shallower than 100 fathoms, about 1.5x the depth was used. We lost no gear during hauling unless it was obviously snagged on the bottom, however, it appeared that hauling more than 10 traps of 100 fathoms of gill net approached the breaking strength of 3/8" polypropylene line.

Anchors were attached to the gear with lighter line. Several traps anchored with "sampan" anchors were lost and apparently drifted off, but no gear was lost with Danforth-type anchors. In addition, the latter appeared to snag less often and were not lost as frequently when the gear was pulled off the bottom. With gill nets, there was no problem of drifting, and almost any type of weight sufficed for an anchor.

Traps were constructed of galvanized wire mesh wrapped around frames of ¼" diameter reinforcing rod. Most were about 30cm high X 60 X 90 cm. Various types of funnels were tested, but appeared to have little effect on catch rates. Fish, usually frozen smelt, was used for bait. The bait was placed in a basket of ½" mesh wire mesh and suspended from the center of the trap.

With few exceptions the gill nets were of multifilament nylon of several twine and mesh sizes. They were hung on a 50% basis (200 stretch feet of netting/100 feet of finished net) using 3/16" polypropylene lead and float line. Hard plastic floats were used successfully down to 200 fathoms.

When set in strings, the traps were attached at about 10 fathom intervals to a ground line of nylon or polypropylene. An anchor and float line were attached at each end. One float line was paid out as the ship slowly approached the desired depth. With the ship still underway, the first anchor was dropped at the depth and the traps dropped as the ground line paid out. The ship was then speeded up and the second anchor and float line paid out. Strings of gill nets, usually about 100 fathoms per string, with an anchor and float line at each end were set similarly.

RESULTS

Deep-water shrimps

An initial cruise off Barbers Point, Oahu, in December, 1968, indicated that small pandalid shrimps, particularly *Heterocarpus ensifer*, were present in large quantities below 100 fathoms. In October, 1969, traps were set at 100, 150, and 200 fathoms off Barbers Point and Makua. Results (Table 1) indicated that *Heterocarpus* was more abundant at 150 and 200 fathoms and that catch/trap in these depths was high enough for consideration as a potential fishery.

Table 1. Catches of *Heterocarpus ensifer* in twelve traps set off Barbers Point (28-29-Oct-69) and Makua (29-30-Oct-69), Oahu.

Depth (fathoms)	Catch (kg)	Head count for all over 23mm CL #/kg	#/lb
Barbers Point			
100*	0	-	-
100*	0	-	-
150*	1.9	79	36
150*	0	-	-
200	1.1	94	43
200	0.2	125	57
Makua			
150	0	-	-
150	3.1	86	39
150	2.3	99	45
200	2.8	77	35
200	1.4	86	39
200	1.4	77	35

*Large numbers of eels, *Gymnothorax spp*. were caught in these traps and almost certainly affected the catch of shrimps.

Two strings of 20 traps each set at 160 fathoms off Kaneohe in December, 1969 further confirmed this. Due to an equipment failure on the ship, the traps had to be left out for two nights. Undoubtedly some shrimp escaped after the baits were consumed. Still the catch was about 1.5 kg (3.25 lb)/trap.

For these preliminary sets, traps of both $\frac{1}{4}$" and $\frac{1}{2}$" mesh were used. The smaller mesh caught many more small shrimps - 10-20mm carapace length. Since these sizes contributed little to total weight of the catch and are of little commercial value, all subsequent traps were of $\frac{1}{2}$" only. For the discussions below, it should be kept in mind that the smaller shrimps were underrepresented in the catches.

A detailed survey of the depth distribution of _H. ensifer_ was conducted off Kaneohe in November, 1970. Strings of eight traps each were set between 40 and 300 fathoms and shorter strings were set at 350, 400, and 500 fathoms. Catch data are given in Table 2. _Heterocarpus ensifer_ was caught between 80 and 400 fathoms (only seven individuals were caught in four traps at 400 fathoms). The catch per trap indicated that _H. ensifer_ was most abundant between 150 and 250 fathoms.

Carapace lengths of the shrimp from the total catch or, for large catches, a 1 kg. subsample thereof, were measured to the nearest mm. The shrimps ranged in size from 11 to 34 mm CL; the smallest egg-bearing females were 23 mm. The relationship between carapace length and weight, based on linear regression of logarithms of measurements from 50 individuals, was $W(gm) = 6.47 \times 10^{-4} \, CL(mm)^{2.85}$. For all the sets between 150 and 250 fathoms, the count for shrimp over 23 mm CL was 100/kg or 45/lb. The range for eleven sets was 65-122/kg or 29-55/lb.

Table 2. Catch data and composition for <u>Heterocarpus</u> <u>ensifer</u> caught in traps off Kaneohe, Oahu, in November, 1970. For depths of 300 fathoms or less, each set consisted of a string of eight traps. Individuals over 23mm CL are considered adults; those smaller, juveniles. Other crustacea and fishes caught are listed in Appendix I. Numbers of each sex from samples of the catch are given in the right hand columns.

Depth (fathoms)	Catch (kg)	Catch/ trap	# of Females juv.	# of Females adult	# of Males juv.	# of Males adult
9-10-Nov						
160[1]	0.95	0.12	7	70	6	18
175	16.28	2.04	17	56	16	36
200	9.66	1.81	20	41	15	45
10-11-Nov						
175	32.12	4.02	12	57	9	37
11-12-Nov						
40	0	-	-	-	-	-
150[2]	0.53	0.53	2	39	2	7
12-13-Nov						
60[3]	0	-	-	-	-	-
100[4]	5.90	0.74	50	92	21	29
20-21-Nov						
80	0.35	0.04	15	26	14	6
125	6.45	0.81	41	103	15	18
250[5]	15.10	1.90	17	54	10	48
21-22-Nov						
150	4.60	0.58	11	82	8	59
175	6.11	0.76	15	98	6	50
200	43.50	5.44	11	56	15	43
22-23-Nov						
175	2.10	0.26	10	59	18	65
300[6]	6.02	0.75	34	42	40	41
23-24-Nov						
350[7]	1.47	0.37	36	75	57	92
400[8]	0.02	0.00	4	0	3	0
500[9]	0	-	-	-	-	-
175[10]	7.03	1.02	8	45	25	48

[1]Trap mouths were too widely opened and most shrimp probably escaped.
[2]Ground line broken; only one trap recovered
[3]Caught 0.4 kg of <u>Plesioneka</u> <u>martia</u>
[4]Also caught 1.9 kg of <u>Plesioneka</u> <u>martia</u>
[5]Also caught 9.1 kg of <u>Heterocarpus</u> <u>laevigatus</u>
[6]Also caught 1.47 kg of <u>H.</u> <u>laevigatus</u>
[7]Four traps; also caught 2.70 kg of <u>H.</u> <u>laevigatus</u>
[8]Four traps; also caught 1.25 kg of <u>H.</u> <u>laevigatus</u>
[9]Three traps
[10]Traps left out from morning of 23rd to late 24th

Size-frequency plots from different depths (Fig. 1) show that between 150 and 250 fathoms, the zone of maximum abundance, the catch was made up of significantly larger shrimps. The percentage of individuals less than 23 mm CL was lower in this zone. The smaller individuals contributed less than 1% of the total weight here, but constituted 6-13% shallower and 18-22% deeper.

From January 1971 to October, 1971 (at approx one month intervals) a single trap was set overnight at 150 fathoms off Kaneohe. The catches for these sets (Table 3) do not give a clear picture of seasonal abundance; this was expected since variability between single traps was high even when several were set together. However, all the low catches and no really large ones were made between March and September, suggesting that abundance was less during the summer months. Other, preliminary sets also suggested this.

Table 3. Catch (kg) of *Heterocarpus ensifer* in single traps set overnight off Kaneohe at 150 fathoms during 1971.

Date	Catch (kg)
3-4 January	1.19
3-4 February	9.63
10-11 March	1.48
12-13 April	0.438
6-7 May	1.20
14-15 June	1.12
15-16 July	0.77
5-6 August	0.67
7-8 September	1.25
17-18 October	2.68

The size frequency curves for the monthly sets (Fig. 2) show that the January, February, and October samples consisted of mostly larger

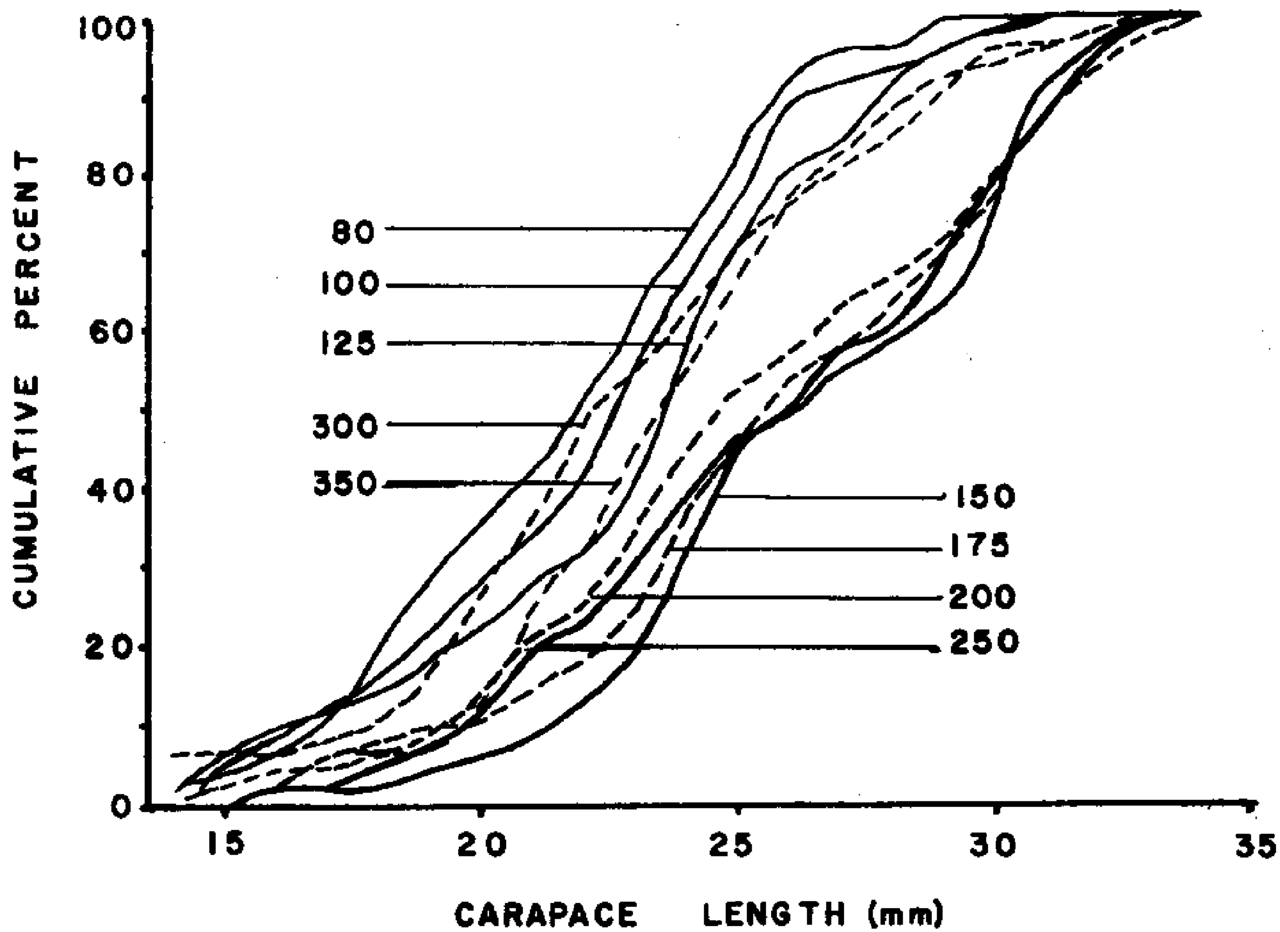

Figure 1. Cumulative size frequency curves for <u>Heterocarpus ensifer</u> taken from depths between 80 and 350 fathoms. For most pairs of curves, those between 150 and 250 fathoms differed significantly ($P < .05$, Kolmogorov-Smirnov test) from those shallower or deeper.

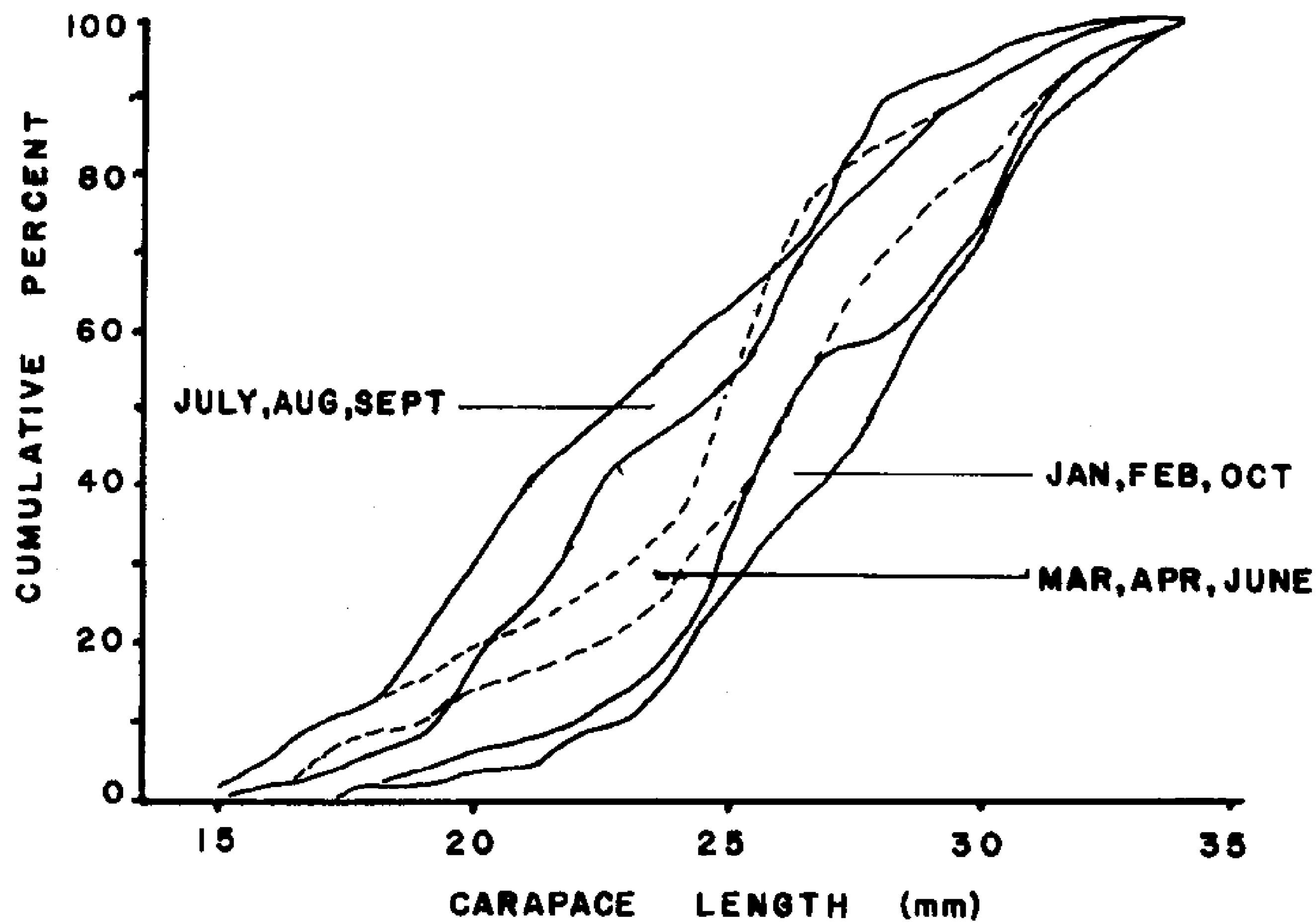

Figure 2. Envelopes of cumulative size frequency curves for <u>Heterocarpus ensifer</u> taken at 150 fathoms during March - June (dashed lines), July - September (solid lines on the left), and January, February, and October (solid lines on the right), 1971. All single curves in the July - September group differed significantly from those in the January, February, and October group ($p < .05$, Kolmogorov-Smirnov test).

shrimps and were similar to those taken at 150-250 fathoms during November, 1970. The June to September samples were significantly different and were made up of more smaller shrimps. The curves for March to May are intermediate.

The data also indicated several trends with depth and season. The proportion of gravid females out of all females greater than 23 mm CL varied between 64 and 87% above 200 fathoms and dropped gradually to 35% at 350 fathoms. The proportion of gravid females among all larger individuals dropped steadily with depth. The monthly sets at 150 fathoms indicated that the percentage of gravid females was less in the summer.

The percentage of males in the total population tended to increase gradually with depth. Both males and females followed the overall trend of larger sizes between 150 and 250 fathoms and during the winter, but the changes for males were more extreme. Since the catch samples probably underestimated the proportion of smaller individuals, the changes in size-frequency of the population with depth and time may actually be greater.

These shrimps are almost certainly protanderous hermaphrodites, but the situation appears more complex than for other pandalids in that a large proportion of the males reach near-maximum size without transforming. Also many small individuals - well below egg-bearing size - are females. Part of the problem may be resolved if internal sex characters are examined. Sex was determined only by the shape of the first pair of pleopods, and it is possible that the external features do not correlate well with internal characters or functional sex.

Although much more data are needed to confirm the general life cycle of these shrimps, it seems likely that they aggregate, mostly between 150 and 250 fathoms, during the winter months to spawn and perhaps breed. Probably the egg-bearing females die after spawning. Perhaps newly-transformed females are inseminated at this time. During the remainder of the life cycle, they are apparently dispersed either deeper or pelagically. (A current program of mid-water trawling between 0 and about 600 fathoms has taken only a few very small *H. ensifer* pelagically.)

The few day-time traps sets made, mostly ca. 100 fathoms deep, indicated that the shrimps are either not present or are inactive during the day. Also none were observed in a series of daytime submarine dives between 100 and 200 fathoms. Possibly they move in at night from deeper areas. If this were true, changes in the frequency and range of their movements with season could explain the observed seasonal changes in abundance.

The data presented here suggest that overnight catch rates of 1.0 kg/trap or better obtain between 150 and 250 fathoms from at least October through February and that the catch is composed of larger shrimp at these depths and times. The shrimps are definitely present in comparable abundance all around Oahu and probably the other islands also.

Another, larger, species of *Heterocarpus*, *H. laevigatus* was collected between 200 and 400 fathoms. Few were caught at 200 fathoms and catches at 250 fathoms (8 traps), 300 (8 traps), 350 (4 traps), and 400 (4 traps) were 1.14, 0.18, 0.67, and 0.31 kg/trap respectively. There were no obvious trends with depth, and since all deep sets were made in November 1970, no seasonal picture is available.

H. laevigatus ranged in size from 14-57mm CL. The smaller individuals weighed about the same as comparable-sized H. ensifer. H. laevigatus of 40 mm CL weighed about 25 g each, 50 mm CL about 50 g each, and the largest, a 57mm gravid female, weighed 82 g.

Individuals over 40mm CL made up 85% of the catch by weight at 250 fathoms, 38% at 300, 36% at 350, and 43% at 400 fathoms. The counts for these larger shrimps were 26, 25, 30, and 46/kg or 12, 11, 14, and 21/lb respectively. From the catch per trap rates, this predicts 0.97, 0.07, 0.24, and 0.13 kg/trap of larger shrimps.

Several other species of pandalids were collected. Plesioneka martia occurred between 60 and 150 fathoms and was most abundant between 80 and 120. The size range was about the same as for H. ensifer, but Plesioneka are "better quality" shrimp in that they have larger tails. Unfortunately, they were never caught consistently enough nor in large enough numbers to consider for a fishery. P. ensis, and P. ocellus were caught only rarely. Parapandalus sp. was quite common between 60 and 120 fathoms but is much too small to be considered for commercial use.

The penaeid shrimp, Penaeus marginatus, was caught between 60 and 120 fathoms. The best catch was off Haleiwa, Oahu - 26 adults in eight traps at 60 fathoms. Catches of this sort would not sustain a fishery in spite of the high value of this species.

Shallow water crabs and lobster

This aspect of the survey concentrated on smooth, gradually-sloping bottom off Haleiwa. Single trap sets were made in March 1970 and a series of multiple sets were made in November, 1970. The only species of commercial importance were the white or haole crab, *Portunus sanguinolentus* and the lobster *Panulirus marginatus*. Catch data on *P. sanguinolentus* for November, 1970 is summarized in Table 4.

Table 4. Catch data for *Portunus sanguinolentus* during November, 1970. Each set consisted of eight traps in a string.

Depth (fathoms)	Date	# of crabs Males	Females	Carapace width (mm) average(range)
30	18-19	51	6	127(112-149)
43	16-17	63	22	133(113-168)
53	16-17	55	7	141(94-162)
60	17-18	1	2	137(125-145)
60	18-19	12	6	141(122-160)
80	17-18	8	6	138(109-158)
100	17-18	0	16	131(110-147)
120	16-17	0	0	----------

The catches clearly show that the crabs are more abundant between about 30 and 50 fathoms. Catches were not weighed. Carapace widths of all crabs were measured, but the relationship between carapace width and weight, determined by linear regression of the logarithms of measurements from 34 individuals, was $W(gm) = 1.63 \times 10^{-5}\ CW(mm)^{3.25}$.

Based on this relationship, most of the crabs weighed between 120 and 180 gms each or about 3-4 individuals to the pound. The catch/trap in the 30-50 fathom zone was thus 1.0-1.5 kg or 2.0-3.5 lb/trap.

The proportion of females was greater in the deeper sets; at 100 fathoms, no males were caught. However, all gravid females, a total of six, were caught between 30 and 53 fathoms.

Only six lobsters were taken in these sets - all at 60 fathoms. The carapace lengths ranged from 58-94mm. The trap mouths were such that larger individuals probably could not get in, and thus some could have been missed. A few lobsters were taken in gill nets at 60 fathoms off Kaneohe. None were taken deeper during any of the operations described here. In no case is there an indication of substantial populations in deeper water.

The 30 and 43 fathom sets off Haleiwa were made over known fishing grounds for the kona crab, *Ranina serrata*, but none were taken.

Fishes

A total of 14 gill net sets were made, most off Barbers Point and most between 90 and 125 fathoms. Although a number of rare and unrecorded species were taken in these sets, the catch of commercially valuable species was small. Relevant data and lists of fish caught are given in Appendix II.

The ehu, *Etelis marshi*, was caught between 64 and 150 fathoms and almost entirely in 3" mesh nets. Catches per 100 feet of such net ranged from 0.15 to 2.0 kg with an average of about 1.2 kg (2.6 lb)/100 feet.

The opakapaka, Pristopomoides microlepis, was caught only over a known fishing ground at 60 fathoms and mostly in 5" mesh nets. For the one successful set, the catch/100 feet of such netting was 7.3 kg or about 15 lb.

Other commercially valuable species taken were mempachi, Myripristis and Ostichthys spp.; aweoweo, Priacanthus spp.; haupuupuu, Epinephelus quernus; onaga, Etelis carbunculus; kalikali, Bristopomoides sieboldii; weke-ula, Mulloidichthys pflugeri; and hogo, Pontinus macrocephalus. None were taken in substantial quantities.

Although the gill nets appear to be a useful collecting device for scientists, they have little potential for commercial fishing in deep water. The catches were almost certainly too low to merit the great deal of effort in retrieving and untangling the nets. Also for some sets the nets suffered heavy damage from being dragged along the bottom during retrieval or from large sharks attacking the entangled fishes.

DISCUSSION AND CONCLUSIONS

The results of this survey suggest that only two, or possibly three, species offer potential for new or increased exploitation in deep water.

One of these, Portunus sanguinolentus, is being exploited. Concurrent with and independently of this project, two or three vessels have started to fish this species around Oahu with apparent success. However, there appear to be relatively few areas where high catches can be taken, and these areas tend to become temporarily "fished out" after several weeks of heavy fishing. Further efforts with this species should encourage fishermen to explore and fish suitable grounds on other islands and also should attempt to estimate sustainable yields for this species.

The shrimp, Heterocarpus ensifer, has not yet been successfully exploited although at least two fishermen have tried for the fresh market. A myriad of marketing problems were encountered including hesitance and lack of acceptance by the buyers (probably because of lack of familiarity with these type of shrimp) and overpricing by both fishermen and dealers. Thus, until a more coordinated marketing effort is made, it is not known whether the local fresh market could absorb the catch from even a single vessel. The possibility of large scale processing of the shrimp should also be considered. Although more detailed studies of the seasonal abundance are needed, it seems possible that a total season's catch could support a processing plant.

The larger Heterocarpus laevigatus has not been marketed but almost certainly would be accepted at a high price on the local fresh market. The estimates of catch rate given above are based on too few data. A more thorough survey might indicate that this species could be fished profitably - perhaps in conjunction with a fishery for *H. ensifer*.

The unpromising catches of lobster and deep-water fishes may have been due to improper gear but are more likely a result of low abundance of these forms. Lobster are almost certainly more abundant in shallower water. The fishes appear to be concentrated only around "holes" where they are best caught by handline. Attempts to artificially, e.g. with lights, aggregate these fishes may prove successful, but at this point there seems to be no obvious, economically feasible method of increasing yields of these species.

Appendix I. Fishes and other crustacea caught in shrimp traps set off Kaneohe, Oahu, November, 1970 (see Table 2).

9-10-Nov

160 fathoms - 6 Squalus blainvillei, 10 Lyreidus tridentatus, 1 Cyrtomaia smithi, 1 Homala japonica, 7 Plesioneka martia

10-11-Nov

175 fathoms - 1 Squalus blainvillei

11-12-Nov

40 fathoms - 2 Portunus sanguinolentus

12-13-Nov

60 fathoms - 11 Portunus sanguinolentus, 4 Parapandalus sp.

100 fathoms - 2 Physiculus grinnelli

20-21-Nov

80 fathoms - 5 Apogon maculiferus, 1 Pontinus macrocephalus, 2 Portunus sp., 1 Penaeus marginatus, 2 Plesioneka martia, 8 Parapandalus sp.

125 fathoms - 2 Neopercis roseoviridis, 1 Lyreidus tridentatus, 1 Penaeus marginatus

21-22-Nov

150 fathoms - 1 Plesioneka martia

200 fathoms - 1 Plesioneka ensis, 5 Heterocarpus laevigatus

23-24-Nov

350 fathoms - 1 Acanthephyra eximea, 1 Congrellus aequoreus

400 fathoms - 1 Synaphobranchus brachysomas, 1 unidentified macrourid, 6 Acanthephyra eximea

500 fathoms - 1 Centroscyllium granulosum, 5 Acanthephyra eximea

Appendix II. Raw data for gill net sets. Given are date, location, depth and types of nets used for each set. (Each link of net was 100' x 7' or 10'.) Mesh sizes of nets are given in inches stretch mesh. The 1½" nets were of #69 nylon, the 3" and 4" of #139, the 5" of #277 and #415, and the 6" of #277. An "M" after the mesh size denotes monfilament equivalent to #139.

14-15-Dec-68 - Barbers Point
100-120 fath. - 3,1½,3M,3,1½,3M

Squalus blainvillei	2
Odontaspis ferox	1
Ostichthys sp.	1
Physiculus grinnelli	2
Etelis marshi	10
Epinula magistralis	1
Brotula multibarbata	1
Pontinus macrocephalus	1

15-16-Dec-68 - Barbers Point
100-135 fath. - 3M,1½,3M,1½,3

Polymixia japonicus	3
Etelis marshi	8
Pontinus macrocephalus	1

9-10-Apr-69 - Barbers Point
90-110 fath. - 3,3M,3,1½,5

Gymnothorax berndti	1
Polymixia japonicus	26
Etelis marshi	6

9-10-Apr-69 - Barbers Point
140-170 fath. - 5,1½,3,1 3/4M,3M

Odontaspis ferox	1
Centrophorus tesselatus	4
Polymixia japonicus	3
Etelis marshi	7
Promethichthys prometheus	1

10-11-Apr-69 - Barbers Point
150-170 fath. - 3M,3,1½,5

Polymixia japonica	14
Etelis marshi	5

10-11-Apr-69 - Barbers Point
125-150 fath. - 3M,1 3/4M,3,1½,5

Etelis marshi	2
Pontinus macrocephalus	1

28-29-Oct-69 - Barbers Point
200 fath. - 5,3,3M,3,5

Centrophorus tesselatus	6
Urotrygon daviesi	1
Lophiomus miacanthus	1

28-29-Oct-69 - Barbers Point
150 fath. - 5,3,3,3,1½,5

Squalus blainvillei	1
Sphyrna lewini	1
Polymixia japonica	13
Promethichthys prometheus	3

28-29-Oct-69 - Barbers Point
100 fath. - 5,3,1½,3,1 3/4,5

Carcharhinus milberti	1
Squalus blainvillei	1
Gymnothorax sp.	1
Physiculus grinnelli	1
Ostichthys sp.	1
Hoplostethus mediterraneus	2
Priacanthus alalaua	3
Symphysanodon typus	1
Pristopomoides sieboldii	3
Etelis marshi	4
Etelis carbunculus	2
Promethichthys prometheus	1
Brotula multibarbata	1
Pontinus macrocephalus	9

Appendix II (Cont.)

14-16-Jan-71 - Lanikai *
150 fath. - 1½,4,4,5,3,3

Squalus blainvillei	17
Pontinus macrocephalus	2
Peristidion engyceros	1

14-16-Jan-71 - Mokumanu *
60 fath. - 3,3,4,4,5,5

Carcharhinus milberti	2
Myripristis chryseres	2
Velifer multispinosus	1
Epinephelus quernus	1
Priacanthus cruentatus	2
Pristopomoides microlepis	14
Naso hexacanthus	5
Sarda orientalis	1

19-20-Apr-71 - Barbers Point
21-23 fath. - 6,5,3,3,5,6

Myripristis berndti	14
Chaetodon miliaris	1
Scarus sp.	1
Acanthurus dussumieri	2
Naso hexacanthus	6

19-20-Apr-71 - Barbers Point
46-52 fath. - 6,5,4,4,5,6

Carcharhinus milberti	2
Myripristis chryseres	1
Ostichthys pilwaxii	1
Priacanthus cruentatus	1
Mulloidichthys pflugeri	2
Histiopterus typus	1

19-20-Apr-71 - Barbers Point
64-70 fath. - 3,4,3,3,4,3

Myripristis chryseres	3
Ostichthys sp.	1
Priacanthus alalaua	1
Erythroclus schlegelii	1
Etelis marshi	14
Etelis carbunculus	2
Chaetodon modestus	2
Pontinus macrocephalus	2

* Due to a storm, these nets were left out for two nights. All other sets were over a single night.