

D. J. JELLYMAN



NEW ZEALAND MARINE DEPARTMENT

FISHERIES TECHNICAL REPORT
No. 62

**PELORUS SOUND - MUSSEL SURVEY
DECEMBER 1969**

D. H. STEAD

WELLINGTON, NEW ZEALAND

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D. H. STEAD,
Fisheries Division,
Marine Department,
WELLINGTON.

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SUMMARY

The survey was carried out in December 1969 to assess the effects of exploitation on the green mussel Perna canaliculus in Pelorus Sound.

Diving was carried out at 10 stations during the first week and dredging at 24 stations in the second week.

Most observations were made in Kenepuru Sound. Diving revealed a characteristic distribution of Perna, suggesting a relation between population density, depth, and substrate type. Most Perna were observed on a firm rock base.

Most exploitation had occurred on exposed shore areas and at depths of 15'-25' close inshore.

The evidence available suggests that many areas have been exploited to a marginal economic level in 1969, though many inaccessible Perna remain.

INTRODUCTION

Results of the preliminary survey in Pelorus Sound in December 1968-January 1969 showed that commercial quantities of the green mussel Perna canaliculus occurred at many inshore sites, mainly in Kenepuru Sound. Most of these areas had never been exploited commercially although some of the well known, heavily dredged grounds were showing signs of depletion. (Stead 1971).

In order to regulate the fishery during the subsequent season (March 1 to November 30, 1969), conditions of the fishing permit specified the use of only one dredge, (not exceeding 4' in width) for each boat, and a minimum takeable size limit for Perna of 5½" shell length (height). All empty shell was to be returned to suitable settlement areas. In addition, hand-gathering of mussels from the shore, and diving without underwater breathing gear were permitted.

During the 1969 season, 9,580 cwt (whole weight) of Perna were taken by dredging and hand-gathering mainly from Kenepuru Sound.

The main object of the post-season survey in December 1969 was to assess the effect of this exploitation on mussel stocks, and the efficacy of present regulations.

The survey took place from 8 December to 19 December 1969. Map 1 shows the area investigated.

METHODS

The survey was carried out in two main stages, by diving and dredging.

1. Diving Survey

A chartered local vessel, the "Volantis" was anchored at each diving station. Most stations were close inshore in less than 50' of water. Map 1 shows the 10 diving stations.

At some stations, random samples of mussels were taken at different depths by using a one square metre frame. Mussels were examined and measured. At other stations observations were made by swimming or towed divers searching the area.

Underwater visibility was less than 6 feet at most stations in the inner Sounds but clarity was better further out to sea.

A wrist depth gauge was used to record depths.

2. Dredging Survey

The "Rangi II", equipped with a single 4'6" wide commercial mussel-scallop dredge (Plate 1) was chartered.

It was not possible to charter a suitable vessel with an 8' wide dredge to allow direct comparison with the results of the previous survey (Stead 1971).

Map 1 shows the 23 dredge stations.

The dredge was towed for 10 minutes at most stations but the towing time exceeded this at stations 13, 17, 20, 21, 23 and 24.

The shell length of all Perna, live and dead, taken at each station, was recorded together with other relevant data. An echo-sounder was used to record depths.

3. Shore Survey

Exposed shore areas were also examined to assess the effects of hand-gathering of Perna.

A shore survey of Kenepuru Sound took place on 5 September 1969, using a chartered launch.

4. Long Lining

Long lines, each with about 200 hooks, were laid at two sites in Pelorus Sound during the surveys. Fish species caught were recorded and stomach contents of snapper were examined to find out if they were eating mussels.

RESULTS

1. DIVING

0' represents the water surface at the time of diving; generally this was close to low water mark.

STATION 1

About 70 yards along the south shore of Weka Point; down to 50' in places.

0-15 Feet Deep

Shelving rock overlain with loose rubble in places. Perna occurred singly and in clusters attached by byssus to rock surfaces, the density often exceeding 20 per square metre. Perna under about 2" in length were rare but some were attached to larger specimens.

Stripping had occurred within 5-6 feet of the surface but below this there was no evidence of exploitation. Few whole dead Perna were seen, but old broken shell was abundant in places.

15-25 Feet Deep

Rock rubble merging into a shelving mud bottom overlain with broken shell.

Perna occurred singly and in clusters among broken shell. Density was below that of the upper rocky zone and evidence of dredging was the amount of broken shell, the distribution of mussels and the obviously scoured bottom.

Below 25 Feet Deep

Soft silty mud with occasional rocks and shell fragments.

Perna were seen only occasionally at intervals of 5-6 yards, either singly or in small clumps.

STATION 2

About 50 yards of the sub-littoral, along the rocky shore of Raft Bay (between Weka Point and St Omer Bay) down to depths of 40 feet.

0-10 Feet

Shelving rock with loose boulders and rubble. Large Perna abundant on rocks just below the handpicking zone at about 4 feet. Several Perna smaller than 3" long also seen in this zone.

10-27 Feet

Shell-covered mud slope with occasional areas of silt-covered rock rubble. A random distribution of single and clumped Perna with depressions and scour marks indicating dredge action.

Below 27 Feet

A soft mud slope with occasional broken shell, rocks and live Perna. Figure 2 shows random square metre samples from various depths.

STATION 3

About 100 yards of the rock headland between Portage and Puketea Bays; down to 40 feet in places.

0-15 Feet

Large boulders and rubble. Perna occurred in dense clumps in crevices and on rock faces among the boulders at the 5-10 feet level. There was evidence of stripping near the surface.

15-25 Feet

A mud slope covered with old broken shell and rock debris most of it beneath a thin layer of silt.

A random distribution of Perna, mainly clumped, with evidence of dredging.

Below 25-30 Feet

A soft mud slope with occasional shells, rocks and Perna.

Figure 3 shows random square metre samples from various depths.

STATION 4

About 120 yards of the sub-littoral (down to 45 feet in places), off the headland east of Skiddow homestead.

0-10 Feet

A steep boulder strewn zone with rock outcrops. Smaller rubble from 10-15 feet. Perna were seen in this zone attached mainly to vertical rock faces, dense in places but there were signs of stripping near the surface.

15-25 Feet

Broken shell and debris on a mud slope. Patches of Perna up to 7 per square metre at the 15-20 foot level. Dredging was indicated by excavations and recently damaged Perna.

Below 25 Feet

Thin-shelled Perna were occasionally seen on the fine soft mud.

STATION 5

Just off Schnapper Point; down to 40 feet in places.

Many Perna and Mytilus in the intertidal zone.

0-20 Feet

Reefs and large boulders.

Perna occurred in high densities down to about the 15 foot level.

20-30 Feet

Rock debris and shell-covered mud with only occasional Perna, single and clumped. Scoured bottom indicated dredging.

Over 30 Feet

Occasional, single, Perna seen on the soft mud slope.

STATION 6

Offshore between Weka Point and Portage Peninsula. Visibility about 6 inches on the bottom. Soft thick mud on the bottom at 50 feet. No Perna over a distance of about 70 yards.

STATION 7

Along the west shore of Clark Island, Kenepuru Sound; down to 35 feet in places.

0-15 Feet

Reefs and angular shale slabs, a large shelving shallow reef joining the north of the island to the mainland. Perna attached singly and in clusters to slabs and reefs, densities up to 15 per square metre were recorded in places, though most Perna were separate individuals at intervals of 1-2 yards.

15-25 Feet

A gradual mud slope covered by broken shell and rock debris in places. Small clusters and several single Perna scattered over the slope. The scoured, pitted substrate indicated intensive dredging.

25-35 Feet

A mud slope almost devoid of covering. Dead Perna shells only.

STATION 8

An area just off Kaiako Point; down to 50 feet in places.

0-10 Feet

Reefs and boulder . Perna abundant in this zone although the upper regions had been stripped of large stock.

10-25 Feet

A steep mud slope with a shell covering and patches of rock debris. Clusters of Perna, up to 23 per square metre in places, most of them over 5" in length. Occasional clusters of small Perna (1"-3") were also seen in this zone. Several Mytilus, attached to Perna clusters, were seen at 20 feet. Many dead, broken Perna covered the slope and the scoured, pitted bottom indicated dredge action.

Below 25 Feet

A steep soft mud slope bearing widely scattered Perna, the position and attitude of which suggested dispersal from the upper zone by dredge action.

STATION 9

About 50 yards along the west shore of Putanui Point; down to 50 feet in places.

0-15 Feet

A rocky shelf covered with boulders and debris.

Perna were attached singly and in small clusters over the rock area just below the surface, averaging about 2 per square metre in the sample area. Most were over 5" in length and had thickened shells. This zone was inaccessible to hand-picking (5-15 feet) and dredging (bottom too rough).

15-25 Feet

A steep mud slope with occasional boulders, debris and broken shell in places.

Perna occurred in large numbers attached to some rocks at the 15-20 foot level.

25-50 Feet

A steep mud slope with occasional rocks, broken shell, and occasional live Perna.

Little evidence of dredging was seen at this station.

STATION 10

Shore to the middle of Paradise Bay, opposite the entrance to Kenepuru Sound.

0-10 Feet

A rock strewn area bearing only a sparse population of live Perna, about one per 3 square metres.

10-25 Feet

Soft mud - no Perna seen.

Many Perna were seen on large boulders further out in this bay. No dredging had occurred in the bay.

STATION 11

A sub-littoral area at the head of Godsiff Bay in Tawhitunui Reach; down to about 50 feet.

Visibility up to 20 feet in places.

Sand, shell and rock outcrops down to about 6 feet below low water mark - area quite extensive with thin-shelled Perna and Mytilus attached to most rocks. Mytilus abundant on vertical intertidal rock surfaces.

A shell-covered mud slope from about 10-15 feet bearing scattered Perna at densities of about one per 5 square yards.

The soft mud bottom shelved steeply from 15 to 50 feet bearing a few shells and only occasional live Perna.

This area has not been commercially exploited.

SUMMARY OF DIVING RESULTS

Figure 4 shows a typical shore transect in Kenepuru Sound, based on diving observations.

This is divided into zones related to the predominant type of substrate, the distribution of Perna, and the method of commercial exploitation.

Zone 1 is the area of shore exposed at mean low water spring tides and the Perna in this zone are subject to exploitation by hand-gathering. The substrate is rock or beaches strewn with boulders.

Zone 2 (M.L.W.S. to about 15 feet): The substrate is an uneven rock slope strewn with boulders, debris, and shell, with mud areas mainly off beaches. At most diving stations in this zone unexploited populations of Perna were seen, usually aggregated on rock surfaces, often in densities exceeding 20 m². Square metre samples in Figures 1-3 were taken from flat areas in Zone 2. An average of 12 Perna m² were taken from 4 square metre samples at depths down to 11 feet at Stations 1, 2 and 3.

Zone 3 (15-25 feet): At depths of about 15 feet at most stations the rock substrate merged into a mud slope, usually strewn with broken shell and rock debris.

Several large aggregations of Perna were observed in this zone during the survey.

Nine random square metre samples taken at stations 1, 2 and 3 in depths ranging from 15 to 22 feet, yielded an average of 8 Perna m² (Figures 1-3).

Zone 4 (below 25 feet): At all stations, the bottom at this depth was soft mud with a sparse epifauna and occasional Perna, singly or in small clumps. Three random square metre samples in this zone at stations 1, 2 and 3 yielded an average of one Perna m² (Figures 1-3).

The only quantitative data obtained were at Stations 1, 2 and 3. Observations at other diving stations revealed a similar density gradient from the littoral zone to depths of around 30 feet.

DIVING - CONCLUSIONS

Perna were most abundant in depths of M.L.W.S. - 15 feet in Kenepuru Sound. Dredging has reduced populations in deeper water though commercial quantities remain at several sites.

2. DREDGING

Table 1 shows the number of Perna taken by the 4'6" dredge during a 10 minute tow at stations shown on Map 2.

TABLE 1

STATION	NO. OF PERNA	STATION	NO. OF PERNA
1	0	13	11
2	46	14	39
3	36	15	0
4	16	16	0
5	19	17	0
6	11	18	0
7	7	19	0
8	8	20	0
9	4	21	0
10	11	22	0
11	6	23	0
12	37	24	0

Figures 5 and 6 show length frequency histograms of individual Perna samples dredged at stations shown on Map 2.

Most Perna were taken by the dredge at stations in Kenepuru Sound and at one station (2) in Mahau Sound. No Perna were taken by the dredge at stations north of Nihau Bay in Pelorus Sound.

Comparison of Survey Data

Diving and dredging during the 1969 survey took place at some stations where the 8 foot dredge had been used one year earlier in December 1968.

Table 2 compares catches and observed densities of Perna.

TABLE 2

8' Dredge - 1968		4'6" Dredge - 1968		Diving - 1969	
Station	No. of Perna	Station	No. of Perna	Station	Average density at 15'-25' depth
1	75	8	8		
3	115	9	4		
10	48	12	37	7	2 m ²
13	38	7	7	1	8 m ²
15	38	11	6	3	2 m ²
17	46	6	11	2	12 m ²
27	59	3	36	4	7 m ²
30	55	2	46		

These results show considerable variation due to:-

- (a) The difference in dredge size and variable efficiency under different conditions.
- (b) The fact that the two dredges did not necessarily trace the same path on the bottom, although the same area was dredged.

DREDGING - CONCLUSIONS

The main conclusions of the 1969 dredging survey are that most of the available commercial areas of Perna (see Map 2) have been dredged and most areas show signs of depletion, compared with the situation one year earlier.

Figure 7 compares length frequency of dredged samples in 1968 and 1969. The percentage of Perna over 5½" long is lower in 1969 than in 1968 but overall there is little change.

3. SHORE SURVEY - Survey September 1969.Kenepuru Sound

Most of the accessible, market size, Perna had been harvested along the south shore from Putanui to Schnapper Point. Larger mussels were, however, seen in deeper water.

Schnapper Point

Nearly all market size Perna had been taken from this headland, though many undersized mussels remained. Hand-picking in this area is no longer profitable.

Te-Mahia Bay and offshore Island

This area had been picked during L.W. spring tides and most large Perna removed. The shore from Te-Mahia to Portage had also been well picked and nearly all Perna seen were under $5\frac{1}{2}$ " in length.

East Portage Bay

Over 600 cases of Perna had been picked from about 300 yards of this shore in 1969 but many small intertidal Perna remained.

Clark Island

Only small Perna remained on the shore exposed at low water.

Weka Point

Although many clumps of Perna were seen on the shore, they were nearly all below market size. This shore had been extensively worked in 1969.

Pelorus SoundHikapu Reach

Only a few patches of market size Perna were seen along these shores in 1968 and most of these had been taken in 1969.

Nikau Point

Large aggregations of Perna were seen on the exposed rocks at this point in January 1969 but most of these were under $5\frac{1}{2}$ " in length, possibly due to overcrowding. In September most of these remained, although some stripped areas of rock were seen below L.W. mark.

Shore areas north of Nikau Bay and in Craill and Beatrix Bays were examined but no commercial quantities of Perna were found in the intertidal zone.

December 1969

Examination of shore areas in December revealed little change from the situation in September and apparently only a small amount of hand-picking had occurred since then.

During 1969 most hand-picking occurred in Kenepuru Sound in March-April-May when 12 boats operated. Subsequently 6 boats worked the area for a few weeks; in September only two boats were working intermittently.

Conclusions

Only small stocks of Perna remain which are accessible by hand-harvesting methods and at present this is regarded as unprofitable by most operators.

4. LONG LINING

One 220 hook line was set in Double Bay on 16 December 1969.

25 snapper, 4 eagle rays, 1 sting ray and 1 kahawai were caught. The snapper stomachs contained many small crabs, several broken pipi shells, small sponges, a small gastropod and a prawn.

Two 200 hook long lines were set in Godsiff Bay - Tennyson Inlet on 19 December 1969. The catch was 19 snapper, 2 eagle rays, 5 sting rays, 1 dogfish, 1 elephant fish and 1 gurnard. Snapper stomachs contained mainly small ophiuroids, many small crabs, 4 small fish (half digested and unidentified), broken scallop shell, broken nesting mussel-shell and clumps of byssus, and turret shells.

The fragments of thick, broken, pipi shell found in snapper stomachs shows these fish to be capable of eating Perna but the absence of these mussels in the samples suggests that snapper are not a major mussel predator.

DISCUSSION

Commercial Exploitation - 1969

The preliminary survey in December 1968 showed that substantial unexploited stocks of Perna occurred in the sub-littoral zone of Kenepuru Sound. The highest catches were taken close inshore. Large populations of Perna were also seen at many sites in the intertidal zone. During 1969, a total of 9,580 cwt of Perna were taken, largely from Kenepuru Sound. This represents about a million mussels, although it is not known what proportions were taken by hand-picking and dredging.

The large catch did, however, support the conclusions of the preliminary survey.

The most intensive dredging took place in March to June when about 12 boats worked, nearly all in Kenepuru Sound. The fishing intensity declined rapidly after this with the discovery of new scallop grounds in Golden Bay and subsequent migration of boats to this fishery.

Diving revealed an almost untouched population of Perna on rough, undredgable bottom in depths between M.L.W.S. and 15 ft, although there was evidence of dredging at many sites in depths of 15 to 25 ft on a smoother bottom.

There was no evidence that rakes or tongs had been used, or that diving for mussels had occurred.

The shallow sub-littoral zone provides a favourable habitat for Perna and is virtually inaccessible to profitable fishing methods and thus should remain unexploited even when other areas are depleted.

Sufficient stocks of Perna should therefore remain to produce larvae for re-settlement of exploited areas and raft culture.

The first commercial raft was towed into position between Weka Point and St Omer Bay in Kenepuru Sound on 16 December 1969. (See Plate 2).

Management of the Fishery

The use of smaller dredges and the $5\frac{1}{2}$ " takeable size limit have reduced fishing intensity on the known offshore grounds to a large extent and there has been a wider distribution of dredging in Kenepuru Sound. Only small quantities of empty shell have been returned to suitable settlement areas as recommended early in 1969. Most of this shell has been dumped ashore.

The large quantities of Perna taken during 1969, and signs of depletion towards the end of the season and during the survey suggests, however, that the stock has been overfished despite the controls introduced prior to the 1969 season.

Survey results indicate that the present level of Perna resources would only support a small continuing fishery of two or three small units.

Temporary closure of Kenepuru Sound for one season would protect remaining accessible stocks and possibly encourage commercial prospecting elsewhere in Pelorus Sound.

The effects of closure could be assessed by another survey later in the year.

The $5\frac{1}{2}$ " size limit has not led to thinning in many intertidal aggregations of Perna because most of these do not grow to the limit size, probably due to overcrowding. A temporary reduction in the size limit for shore-picking may be beneficial.

The present closed season of November 30 to 1 March protects Perna during the spawning season but it may be more beneficial if extended to the end of March to allow undisturbed larval settlement and early growth.

CONCLUSIONS

Most commercial exploitation of Perna has occurred in Kenepuru Sound in 1969 and only small catches were taken north of Nikau Bay.

Stocks of accessible market size Perna in the intertidal zone have been reduced to a marginal level by hand-gathering. Dredging has depleted Perna populations at many inshore sites though commercial quantities remain in some areas. Perna populations in the upper sub-littoral zone on rough substrates remain almost unexploited and are expected to remain so. The optimum yield of fishable Perna has almost certainly been exceeded in 1969 and a revision of some regulations may be necessary to ensure a continuing fishery.

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in Pelorus Sound.

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MAPS

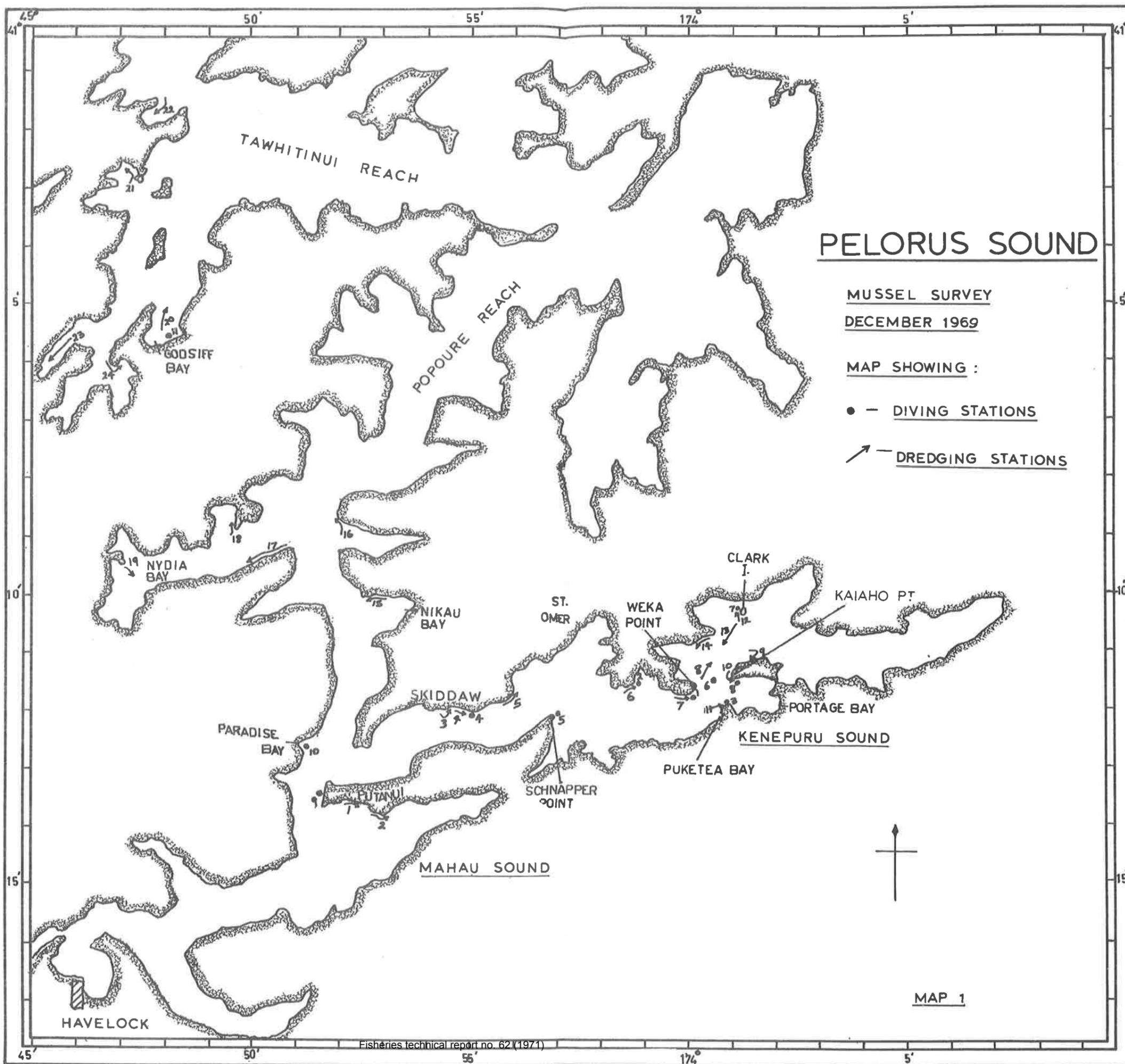
- MAP 1 - Pelorus Sound:
Map showing diving and dredging stations.
- MAP 2 - Pelorus Sound:
Map showing main commercial dredging areas
for Perna.

PLATES

- PLATE 1 - 4½' wide mussel dredge used as a sampler.
- PLATE 2 - First commercial mussel raft, Kenepuru Sound.

FIGURES

- FIGURE 1 - Perna Length Frequency at Diving Station 1.
- FIGURE 2 - Perna Length Frequency at Diving Station 2.
- FIGURE 3 - Perna Length Frequency at Diving Station 3.
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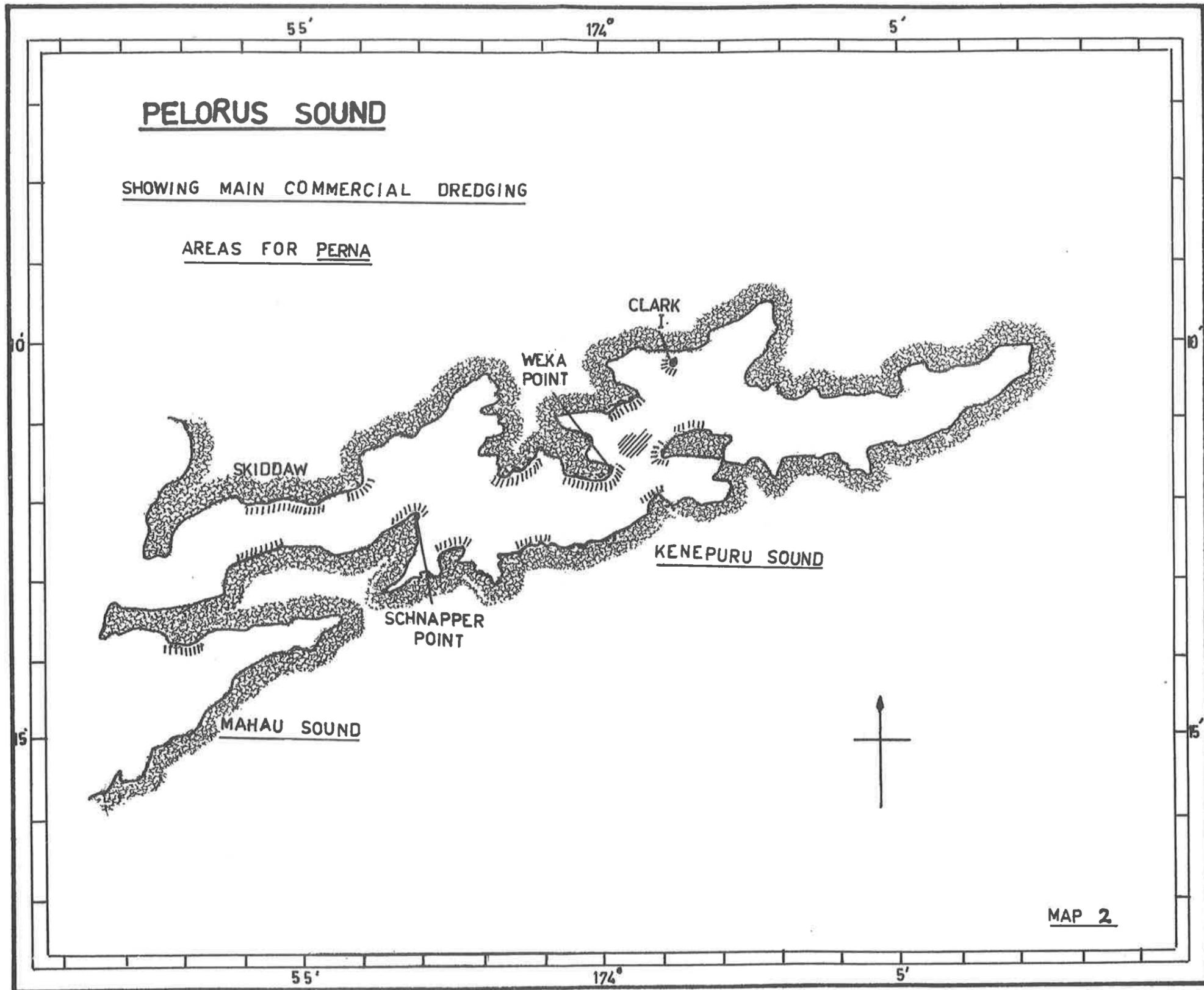




Plate 1. $4\frac{1}{2}$ ft mussel dredge used in sampling



Plate 2. First commercial mussel raft Kenepuru Sound

FIG. 1

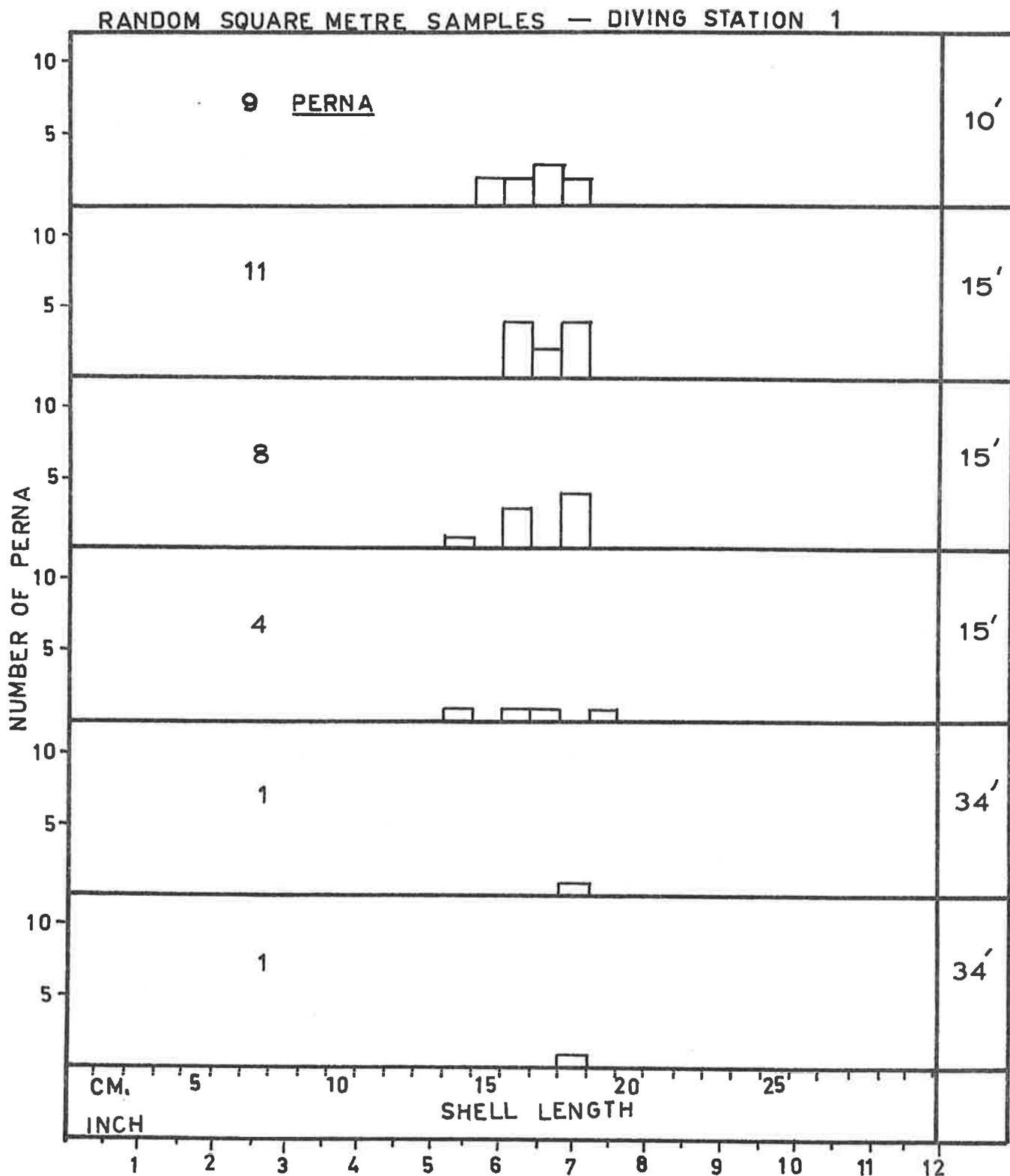


FIG. 2

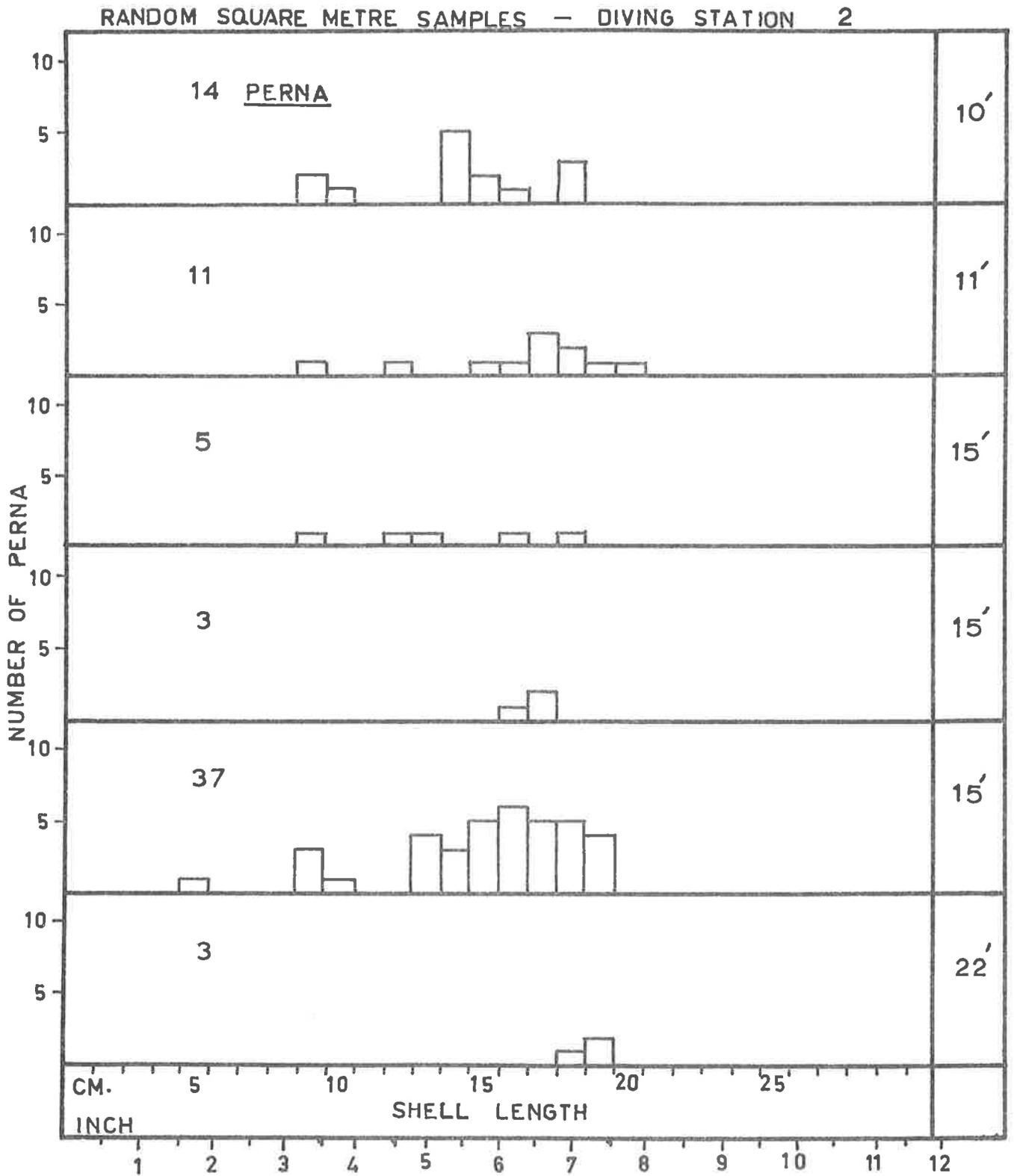


FIG. 3

RANDOM SQUARE METRE SAMPLES - DIVING STATION 3

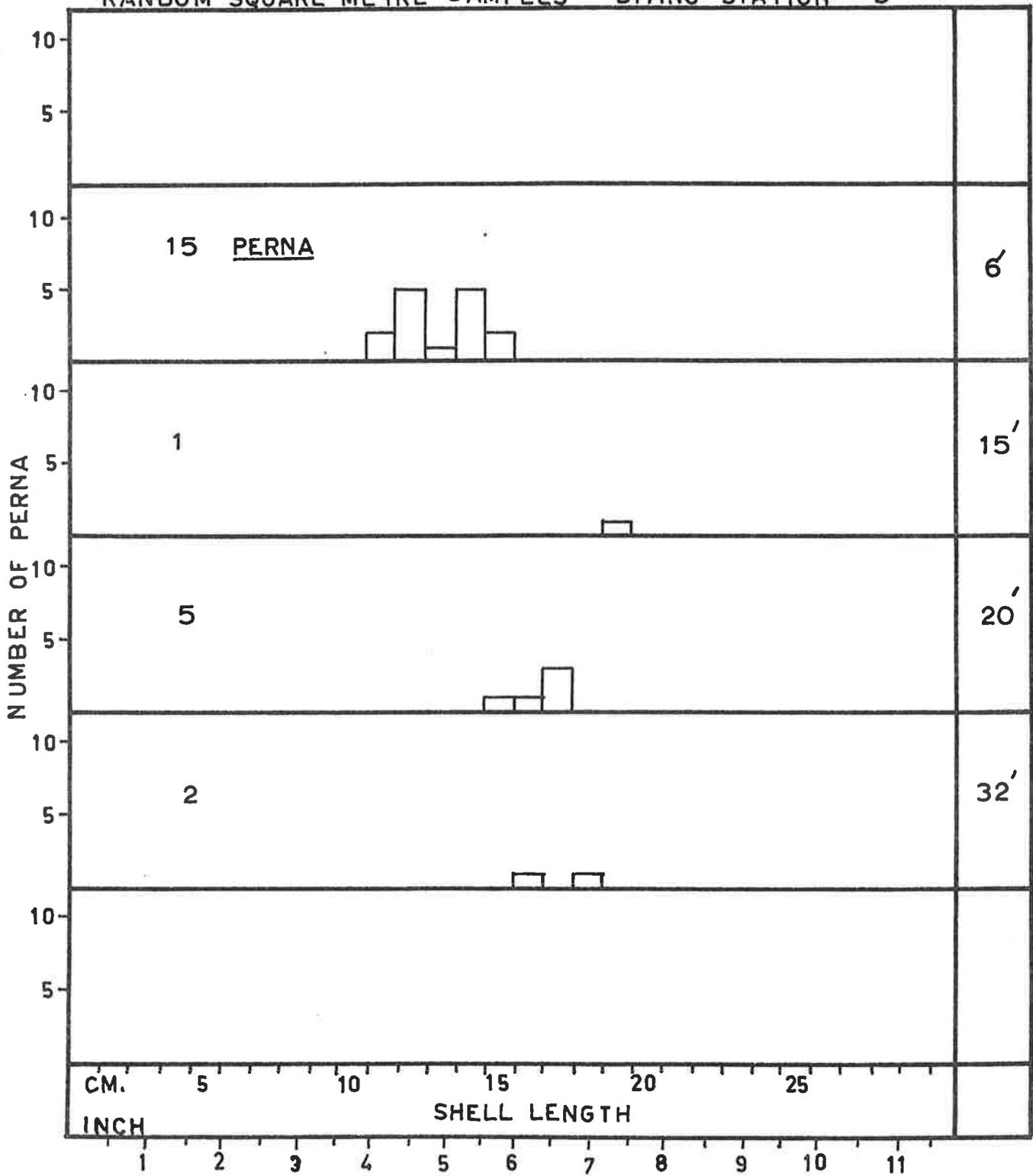


FIGURE 4

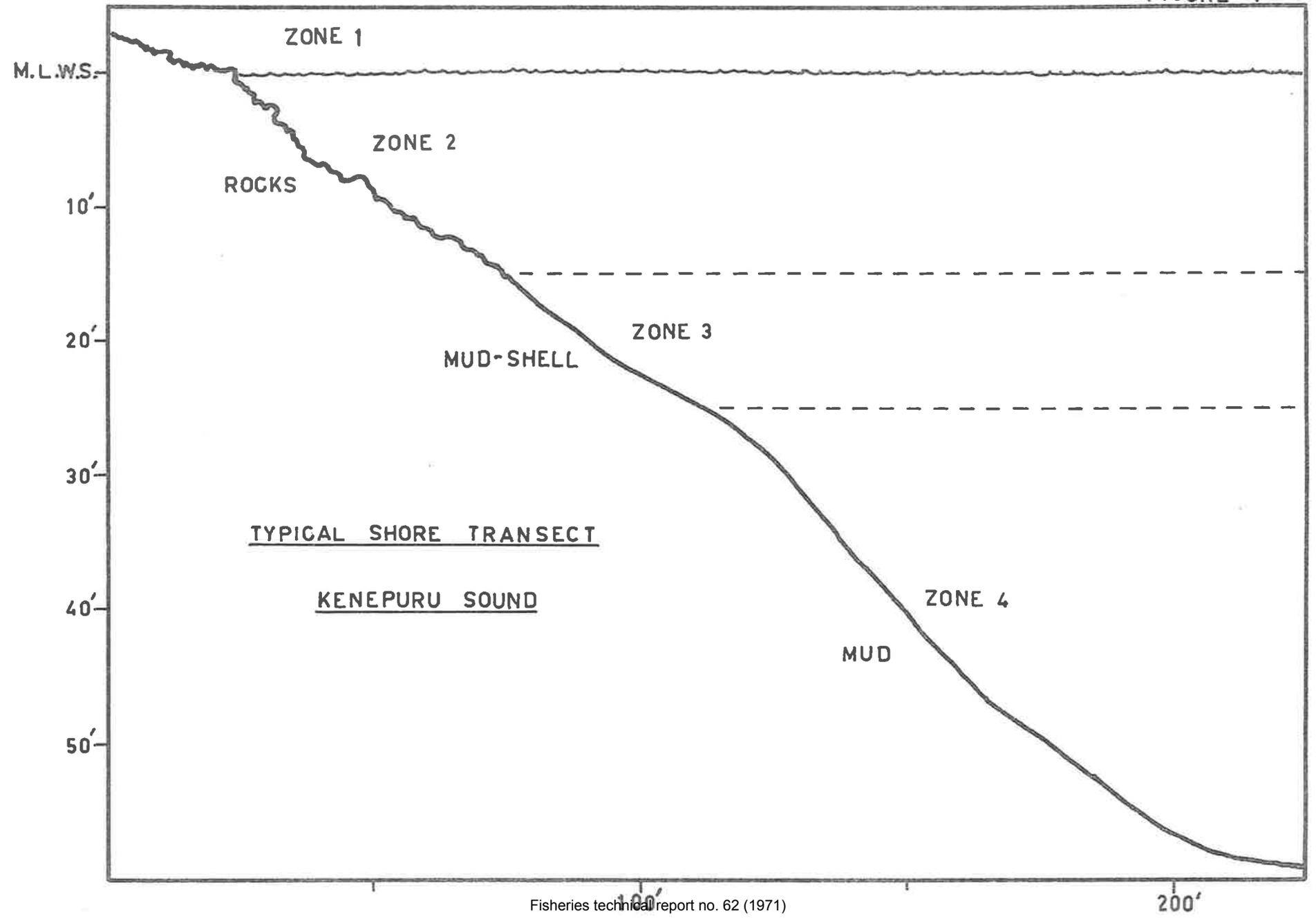
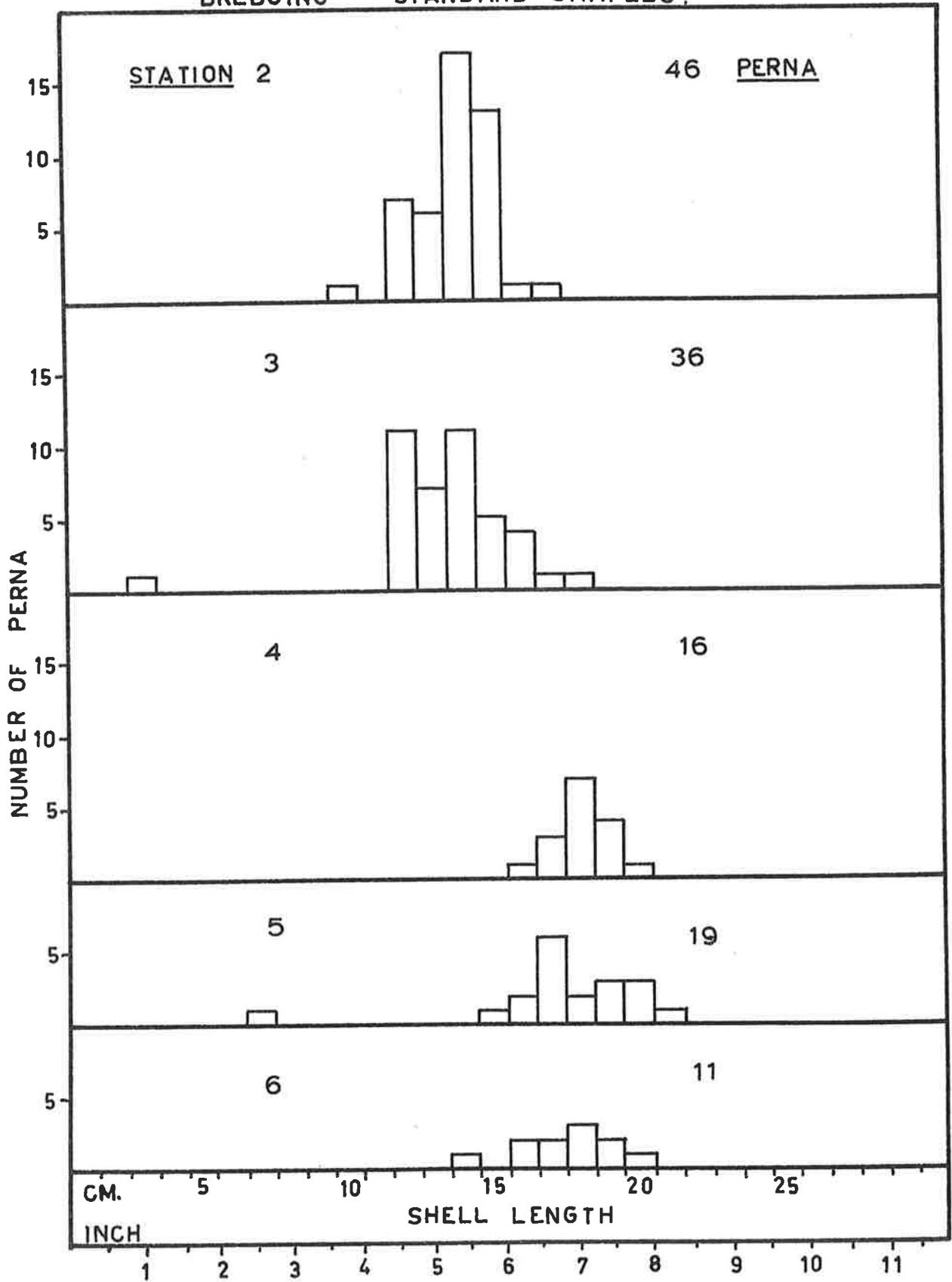


FIG. 5

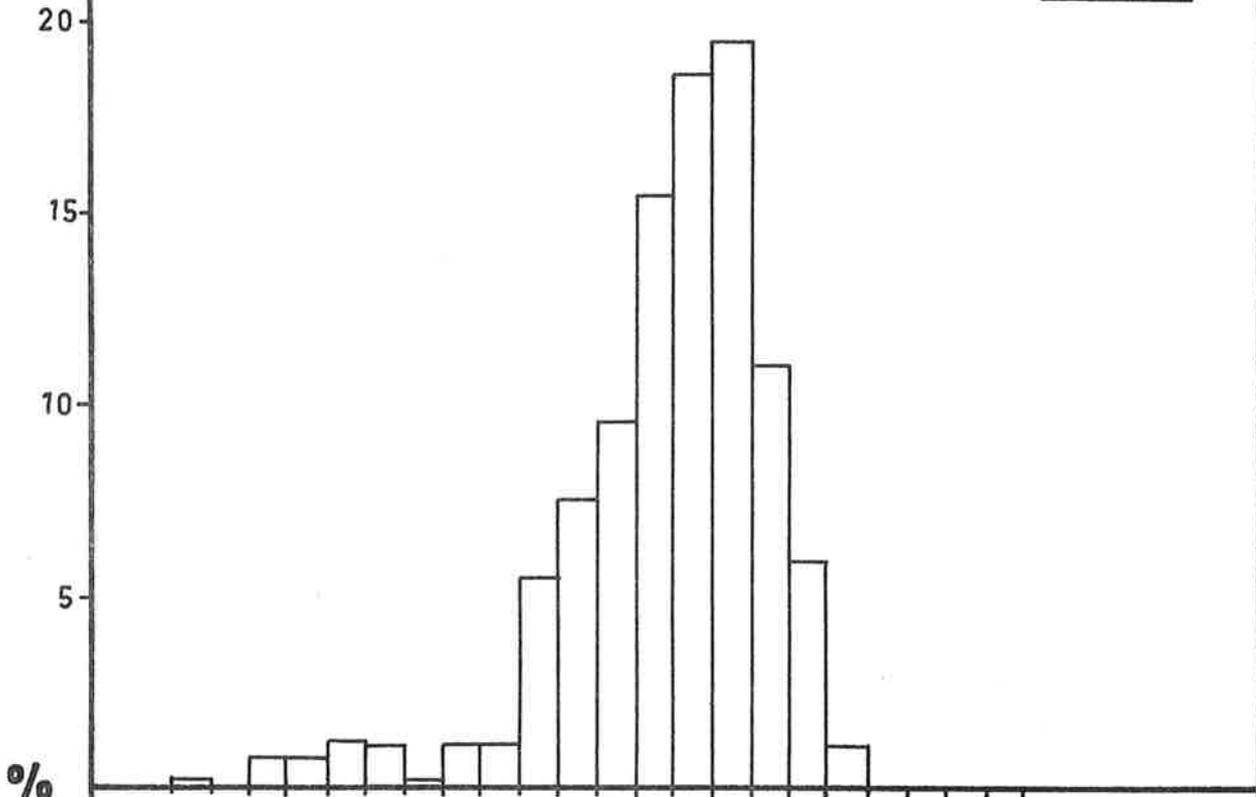
DREDGING — STANDARD SAMPLES.



LENGTH PERCENTAGE FREQUENCY - PERNA - PELORUS SOUND, FIG. 7

372 PERNA dredged at 9 unexploited inshore station areas

DEC. 1968



267 PERNA dredged at 13 exploited inshore station areas

DEC. 1969

