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CONTRIBUTION TO THE STUDY OF THE MARINE ALGAE OF CEYLON

BY

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INTRODUCTION

THE presence of spiny lobsters in the reefs lying off the coasts of Ceylon is known to local fishermen and skin divers. However, a well established fishery for these lobsters does not exist as fishermen engaged occasionally in this activity catch only a few lobsters during the course of a day's fishing.

The gear that is used in some parts of the Island, such as in the Galle harbour, is very similar to the device employed by crab fishermen to capture the crab *Scylla serrata* (Forsk.). This device consists of a heavy iron ring about $2\frac{1}{2}$ ft. in diameter carrying a conical shaped net. A rope is stretched across the diameter of this ring and the bait is fixed at the middle of the rope. The bait generally used is animal entrails. Three strands of rope are attached to the ring at three points on its circumference. The free ends of these strands are joined to a single rope which is used to haul the gear out of the water. About four or five of these structures are carried on an outrigger canoe to the grounds where lobsters are known to exist. The fisherman sets his gear about 10 to 15 yards apart and hauls them for inspection after about 15 minutes. Hauling has to be quick and continuous since experience has taught the fisherman that any sudden jerk during the process of hauling would result in the escape of the lobsters.

Another device used by local fishermen is " bottom set nets ". These nets are those discarded by commercial drift net fishermen and are very old. The nets are set before sunset and hauled in the early hours of the morning. Very often the nets get caught to coral and rock and seldom is it possible to recover them intact.

Apart from these two methods fishermen also catch spiny lobsters with a baited hook and line. Of the three methods in use, this is the most unsatisfactory as it gives the smallest catch.

The above methods suffer from several disadvantages. First and foremost, the fisherman has to remain idle out at sea watching his gear. Secondly, the chances of his losing his gear, if he were operating with nets, are great. Finally, the returns are very poor due perhaps to the inefficiency of his gear.

In contrast to this, the methods employed in western countries to capture the lobster *Homarus vulgaris* Edw. possess several advantages over the methods used in Ceylon. Fishermen set their traps at the beginning of the season and thereafter go out each day to collect the lobsters, rebait the traps or to shift the traps to different ground. No time is wasted in watching the traps. The gear is very sturdy and seldom damaged. It is lost only in very rough weather. Moreover, the designs that are used have been exhaustively tested as lobsters which enter the traps seldom escape.

Considering the present state of development of lobster fishing in Ceylon, it is not possible to state whether lobsters are found in sufficient numbers in the seas off Ceylon. This knowledge is very important before the introduction of new methods of fishing can be made. Experiments were therefore conducted to determine the most efficient type of trap that could be used to appraise the resources present in the coral reefs and other rocky areas. Designs of traps, similar to those used in Scotland, England, Wales and Canada, were made locally. These were tested for efficiency in areas known to be inhabited by spiny lobsters.

The space on the outrigger canoe, which is the craft commonly used by local fishermen is restricted. Attention was therefore directed to convert the most effective trap into a collapsible form so as to be able to carry economically sufficient numbers of traps.

LOBSTER TRAPS USED IN EXPERIMENTS

Some of the popular traps employed to capture lobsters in western countries are the Canadian "parlour and bed-room", the Scottish creel and the Cornish "ink-well". These three types as well as another of a new design were used in the tests to capture the spiny lobster in Ceylon. These traps are described below :

(*a*) *Canadian "parlour and bed-room"*. The "parlour and bed-room" type which is used on the east coast of Canada is divided into two compartments. Two funnel shaped entrances situated immediately opposite each other lead into one compartment—"the parlour". Each of these funnels has a brass ring six inches in diameter at the inner end. A third funnel shaped entrance but without an inner ring leads from the "parlour" into the second compartment of the trap—the "bed-room". This entrance into the bed-room is situated at right angles to the two entrances leading into the "parlour" as seen in fig. 1. Canadian lobster fishermen use wood to construct the frames of their lobster pots and cover the frames with netting. In place of wood, which needs heavy ballast to sink, the frames of the traps used in the experiments were made of iron of $\frac{1}{2}$ inch in diameter. Quarter inch round iron bars were welded to the base $1\frac{1}{2}$ inches apart and similar bars were used for the top and the doors. Cotton netting was employed to make the funnel shaped entrances and to cover the sides of the trap. The dimensions of the trap were 32 inches long, 20 inches broad and 12 inches in height. Each trap weighed 40 lbs. when complete.

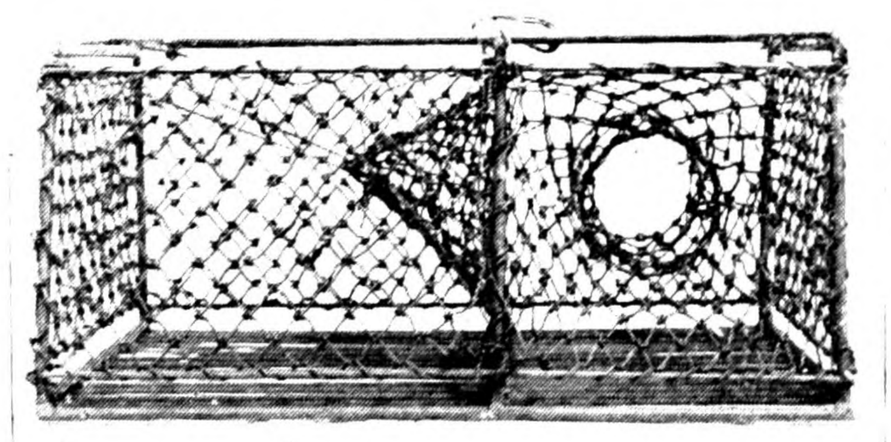


Fig. 1. Canadian "parlour and bed-room".

(*b*) *Scottish Creel.* Typically, the Scottish creel has two funnel shaped entrances situated diagonally opposite each other leading into a single chamber as seen in fig. 2. The funnel shaped entrances in the traps used in the experiments were provided with brass rings 6 inches in diameter at their inner ends.

The creels were similar in dimensions to the Canadian type and were constructed out of the same material. Each weighed 40 lbs. when complete.

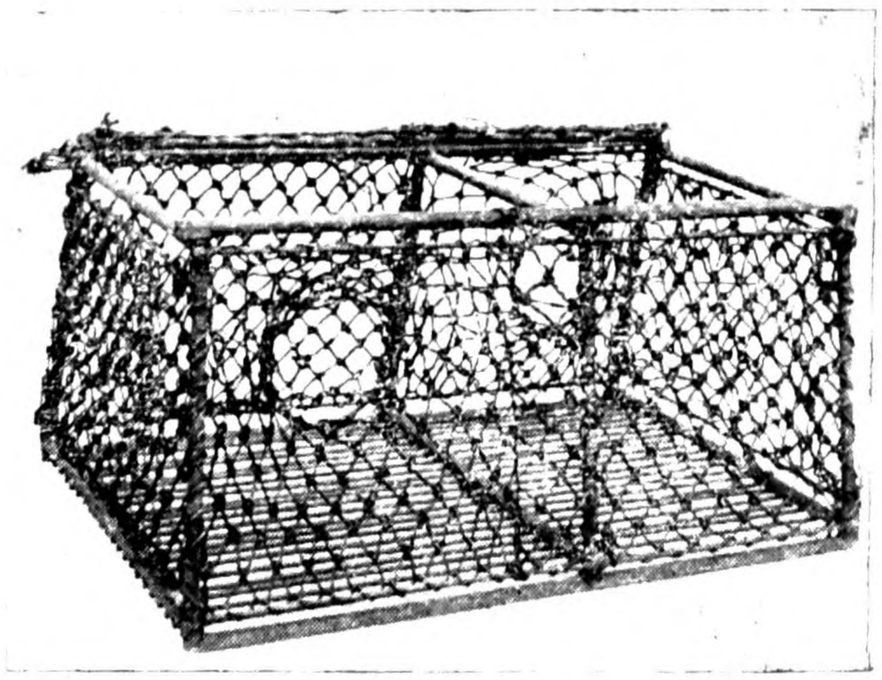


Fig. 2. Scottish Creel.

(*c*) *Cornish "ink-well"*. The traditional large Cornish pots are made of willow. The "ink-wells" used in Ceylon were however made of cane. As the name implies, the base of the ink-well type of

trap is circular and was 3 ft. in diameter in those used in the experiments. The rim of the ink-well was 1 ft. in diameter while the inner end of the funnel leading from the rim into the trap was 5 inches in diameter. Arches of stout cane $\frac{1}{2}$ inch in thickness were fixed 2 inches apart from each other to the base of the trap and the rim. These arches were joined to each other by circles of cane $\frac{1}{4}$ inch in thickness. Cane rods $\frac{1}{2}$ inch in thickness were fixed 2 inches apart across the base of the trap and were secured by $\frac{1}{4}$ inch cane rods 2 inches apart.

As can be seen in fig. 3 the entrance into the trap is at the top. A lobster can gain access to the bait within the trap only after climbing to the rim of the trap and then crawling down into its recesses.

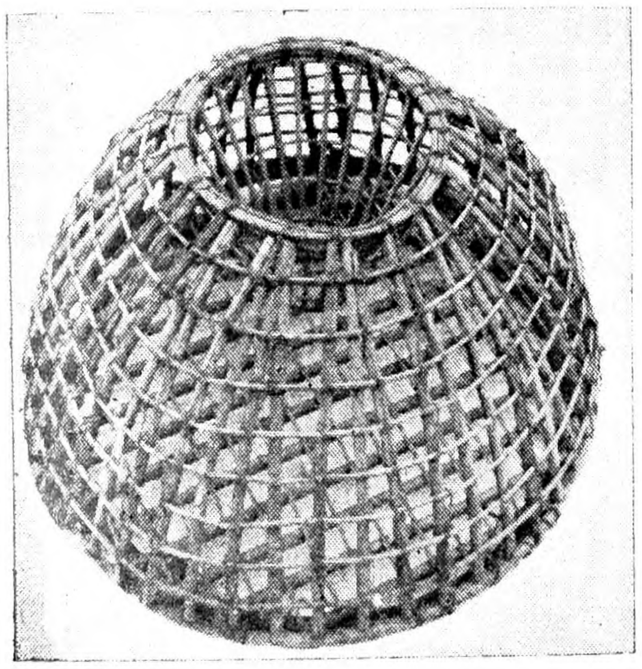


Fig. 3. Cornish "ink-well".

The cane "ink-wells" needed ballast to sink. A heavy iron ring 3 ft. in diameter weighing 50 lbs. was therefore firmly secured to the base of the trap. This proved sufficient to sink the trap and anchor it in calm weather.

(*d*) *Cane-Trap* (*new design*). This trap was constructed for the purpose of comparison with the "ink-well" type of trap and was made of cane. Unlike the "ink-well" type, the entrances are situated at the sides as seen in fig. 4. The base of the

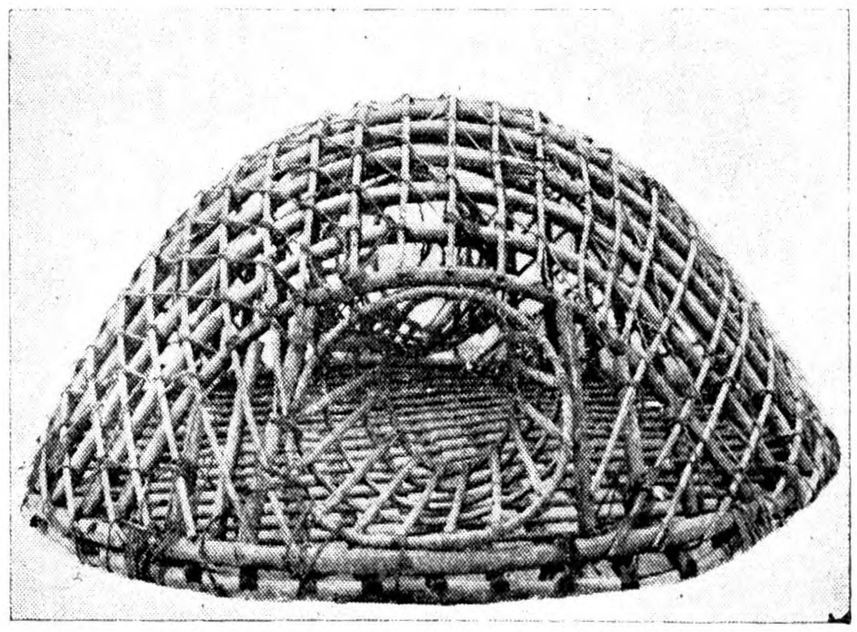


Fig. 4. Cane-Trap (new design).

trap and the cone shaped entrance are of the same dimensions as in the "ink-well" type. In place of arches, semi-circular hoops of cane $\frac{1}{2}$ inch in thickness were fixed to the base of the trap and were secured one to another by circles of cane $\frac{1}{4}$ inch in thickness situated 2 inches apart.

As in the "ink-well" type, a heavy iron ring 50 lbs. in weight was secured to the base of the trap in order to sink it.

EXPERIMENTAL OPERATIONS ON THE EAST COAST

Experimental fishing was started in August, 1958 and continued till the end of October, 1958. During this period it was possible to test the traps on the reefs, rocks, sandy and muddy areas lying off the coast between Trincomalee and Boulder Point on the one hand and between Kalkudah and Passikudah on the other. Experiments were started on the east coast because of very calm weather prevailing during this period.

Before the traps were set in the sea, diving operations were conducted to examine the nature of the bottom of the sea as well as to determine whether lobsters were present. In each experiment exactly similar bait in similar quantities was placed in each trap. The bait consisted of whole fish, fish heads, cuttlefish, animal entrails or raw beef. As a routine measure ten traps of each design were placed, one design following the other, on coralline ground which was known to have lobsters living within the crevices of the coral. The traps were distributed in this manner to avoid any errors due to a possible irregular distribution of lobsters within the area chosen.

On the first day, the traps were set before sun-set and were lifted for inspection at day-break on the following day. Thereafter, the traps were hauled every twelve hours and rebaited to compare the catches made during darkness. Moreover, the traps were inspected under water frequently to check their relative positions. The bait was varied from day to day but to no avail. Completely negative results were obtained in all experiments.

Instead of placing the traps on the reef, they were shifted to sandy and muddy ground lying close to the reefs. The tests were continued for a long period but nevertheless negative results were once more obtained. These tests lasted a full calendar month thus including the effects of moonlight, darkness, tides and other variations in the sea conditions on the behaviour of the lobsters.

When diving to check the ground on which the traps had fallen, the author was able to capture several specimens of lobsters living in the crevices of the coral quite close to the traps both during the day and at night. It was observed that both during the day and at night, lobsters chose to remain under cover, only a few being found on exposed ground at night.

During the above operations, the sea was calm, water crystal clear and the temperature comparatively low being 20–23° C.

EXPERIMENTAL OPERATIONS ON THE WEST COAST

Since the experiments were unsuccessful on the east coast, operations were diverted to the west coast in December, 1958. Exactly the same experiment was set up using the same traps on the coral reefs, rocks, sandy and muddy areas off Colombo. The results were startlingly different, every type of trap being successful in catching lobsters when placed on coral reefs or rocks especially at night. The bait used was the cheapest available, namely, heads of *Lutianus rivulatus*, *L. dodecacanthus*, *Lethrinus rostratus*, *Epinephelus tauvina* and *Drepane punctata*.

The experimental operations were then continued during the month of December, 1958, to determine the most effective type of trap.

Table I below gives the number of lobsters caught by 10 sets of the 4 different types of lobster traps.

Table I

NUMBER OF LOBSTERS CAUGHT BY 10 SETS OF EACH DESIGN OF TRAP

Trial No.	*Canadian*	*Ink-well*	*Creel*	*New design*
1	15	18	7	2
2	13	14	4	0
3	27	12	13	0
4	25	17	12	0
5	15	7	8	0
6	7	6	8	0
7	33	18	22	0
8	11	16	13	0
9	41	25	11	0
10	24	33	3	14
11	7	7	5	2
12	14	6	14	1
13	22	2	11	6
14	14	6	3	14
15	11	3	2	4

It is clear from Table I that two types of traps stand out as being the most effective in capturing spiny lobsters, namely, the Canadian "parlour and bed-room" and the Cornish "ink-well". The other two types, though successful, were relatively inefficient.

Using Student's 't' test to find out whether the difference between the mean number of lobsters caught by the Canadian and "ink-well" types is significant, it is seen that :

$$t = 3{\cdot}18 \text{ (14 degrees of freedom)}$$

At the 1 per cent. level, therefore, the difference in mean number of lobsters caught by the Canadian and "ink-well" types is significant.

Modifications were then made to the structure of the two relatively inefficient types of traps. The brass rings at the ends of the two conical entrances were removed and the base of the netting of the conical entrance was stretched taut. The overlying netting was allowed to hang as a flapper as seen in fig. 5 and 6.

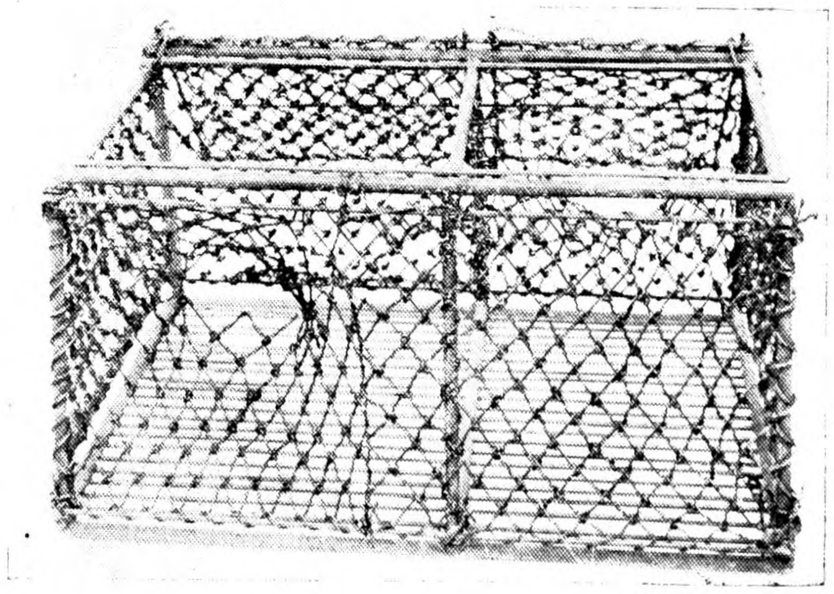


Fig. 5. Creel after modification.

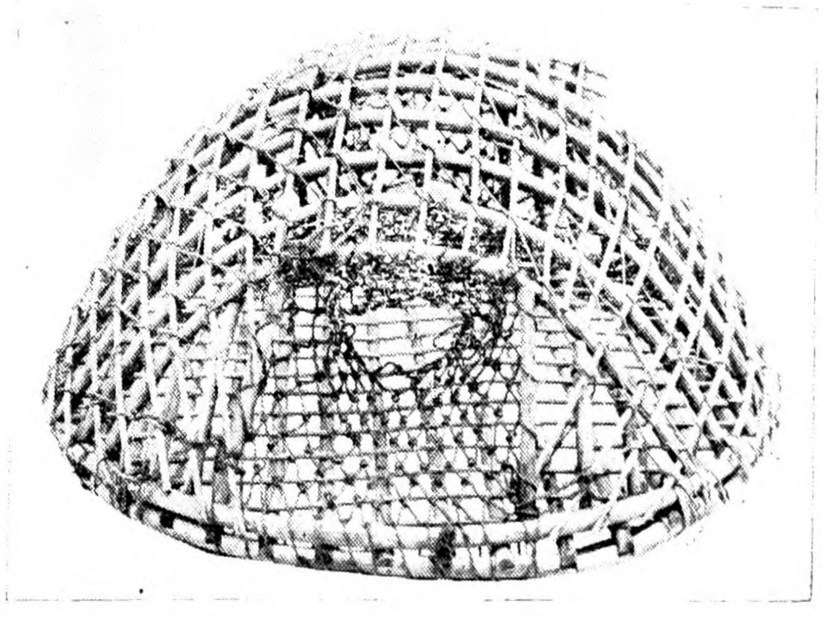


Fig. 6. Trap of new design after modification.

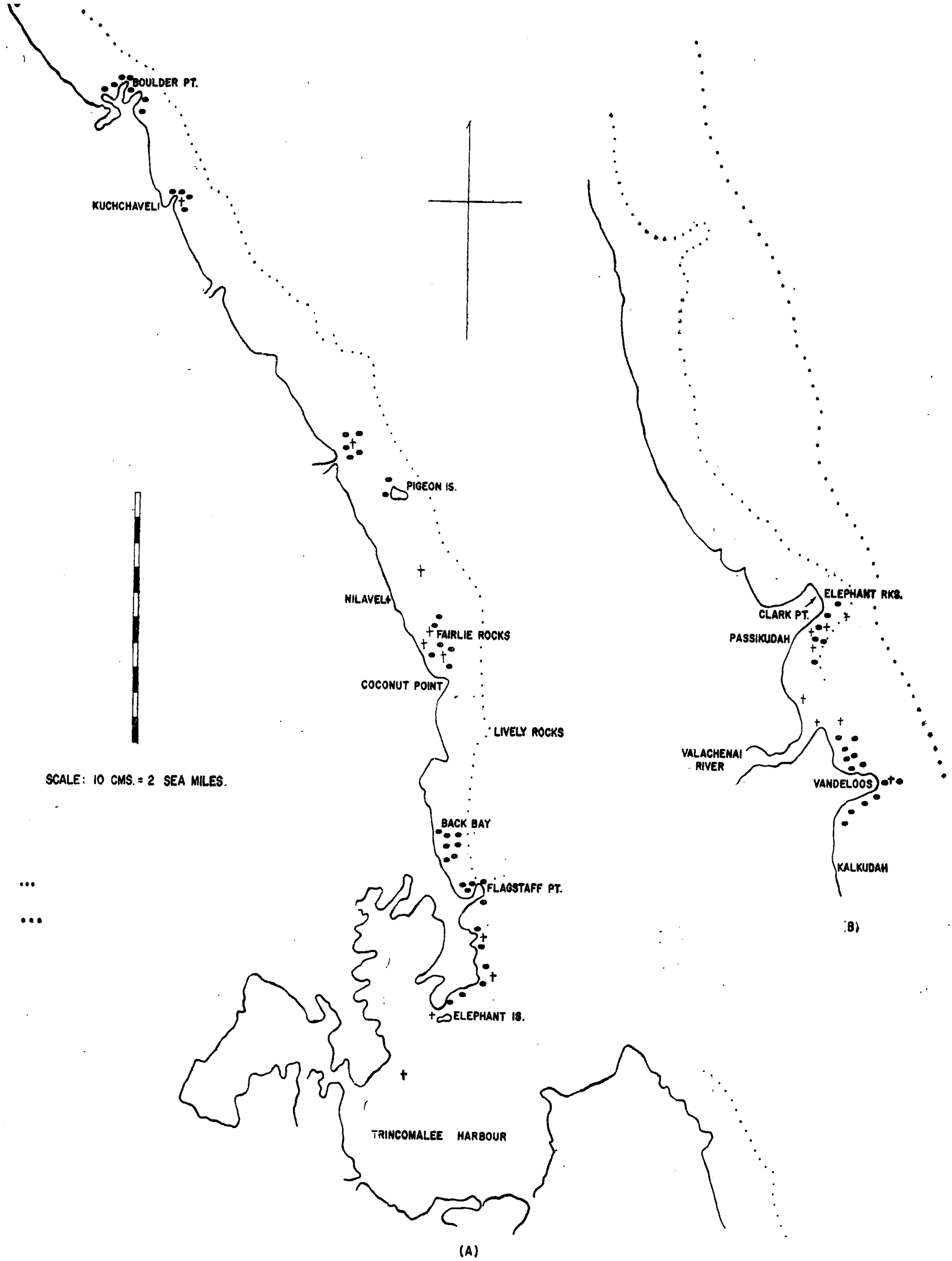
Table II below gives the results obtained after modifications were made to the structure of the creel and the trap of the new design.

Table II

NUMBER OF LOBSTERS CAUGHT BY 10 SETS OF TRAPS OF 4 DIFFERENT TYPES AFTER MODIFICATIONS TO CREEL AND TRAP OF NEW DESIGN

Trial No.	*Canadian*	*Ink-well*	*Creel*	*New design*
1	33	18	22	0
2	11	16	13	0
3	41	25	11	0
4	24	33	3	14
5	7	7	5	2
6	14	16	14	1
7	22	2	11	6
8	14	6	3	4
9	11	3	2	4

It is clear that the modification to the structure of the creel and the trap of the new design has not altered the order of efficiency of the four different types of traps. The Canadian " parlour and bed-room " and the " ink-well " types are still the most effective, with the new type lying last. However, there are indications that the modification has made some slight difference to the catches made by the creel and the trap of the new design. This might have been brought out more forcibly if more trials had been made. Since, however, the Canadian type was the obvious choice for a lobster trap, no further gear efficiency tests were performed.



Maps of the East Coast (A) Trincomalee Harbour to Boulder Point (B) Passikudah to Kalkudah showing the distribution of Spiny Lobsters.

Fig. 7

LOBSTER GROUNDS

Even though lobsters could not be trapped on the east coast of Ceylon, their presence in the coralline and rocky areas off this coast was detected by diving. Quite large numbers of lobsters of the family Palinuridae were seen living within the crevices of dead or live coral but no lobsters were found on sandy or muddy grounds. Extensive diving operations enabled several miles of ground to be inspected from the shore line to five fathoms deep during the three-month period. The distribution of lobsters on the east coast are shown in figs. 7 (A) and (B).

On the west coast lobsters of the same family Palinuridae were detected both by diving and by trapping operations. In order to ascertain the catch per unit trap and therefore appraise the relative concentrations present in different areas in the sea, fifty traps of the Canadian type were constructed. These were set 50 yards apart just before sunset and lifted for inspection the next morning.

The catch was then examined, the number of every species in each trap was recorded and the depth and nature of the sea bottom were noted.

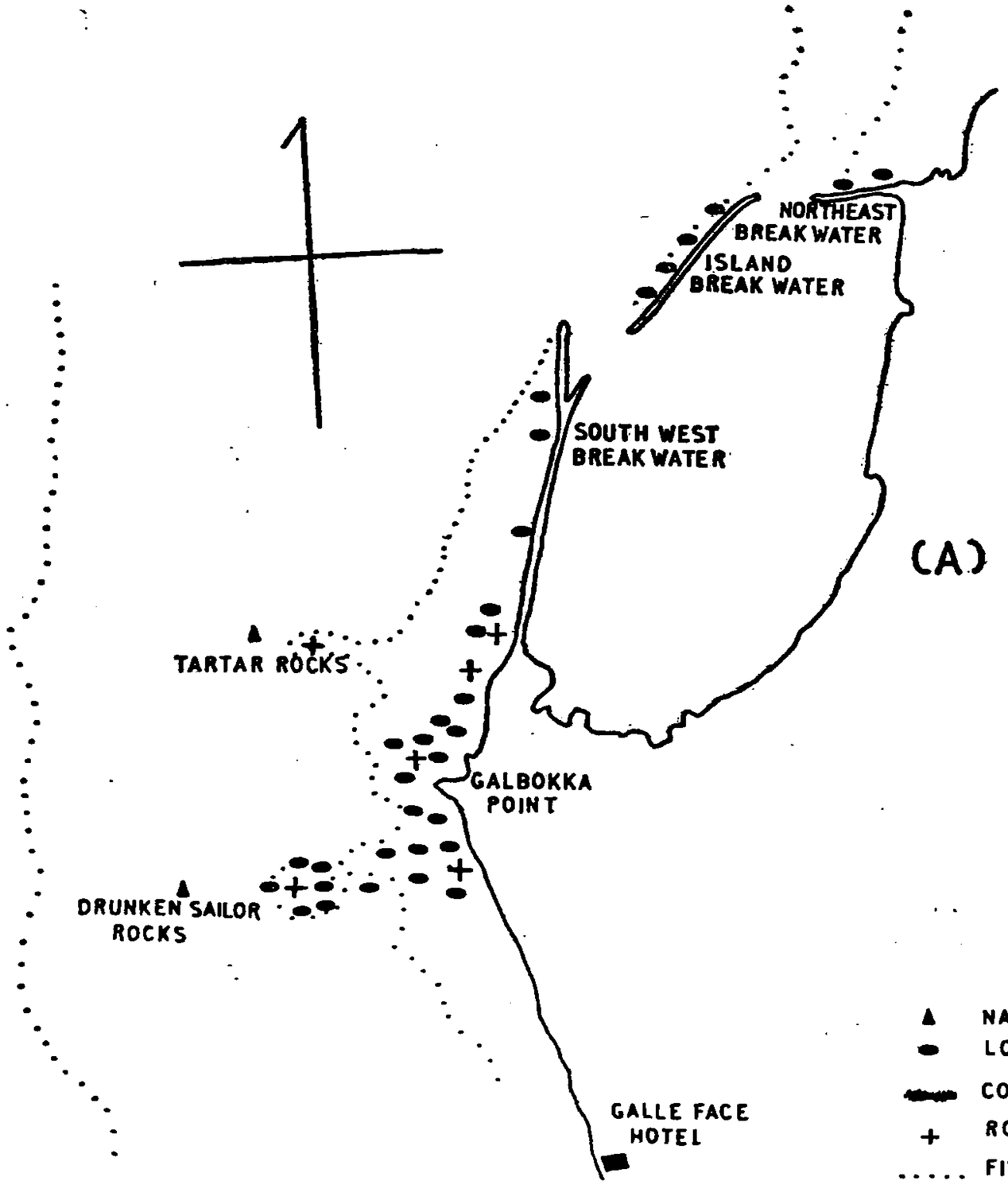
The following areas were chosen for inspection :—The rocks just off the breakwater of the Colombo harbour, the rough ground lying east of the two navigation buoys which mark the Tartar rocks and the Drunken Sailor rocks and the areas lying west of the sandstone reef between the Galle Face hotel and the Dehiwala canal.

The areas examined, the presence or absence of lobsters and the relative concentrations of lobsters in each region examined are shown in fig. 8.

It is clear that the best catches are made in areas which are rocky or coralline in character. In other words, spiny lobsters seem to concentrate in regions which give the maximum cover. Moreover, diving and trapping operations have revealed that even in rocky areas the greatest concentrations of lobsters are found under ledges which afford the maximum protection. This tendency to seek cover and the avoidance of open muddy and sandy areas would account for the irregular distribution of lobsters which was noted outside the sandstone reef between the Galle Face hotel and the Dehiwala canal. Experimental operations carried out in the Galle harbour during the months of August and September, 1959, brought out the same salient facts with regard to the distribution of spiny lobsters. They were caught only if the traps had fallen on rough ground. If they happened to fall on mud several specimens of the crab *Scylla serrata* entered the traps but no lobsters were ever caught.

Fig. 9 is a map of the Galle harbour showing the distribution of lobsters.

Experimental diving and trapping operations have therefore shown that wherever rocky or coralline formations are found in the sea, spiny lobsters are always present. These experiments were confined to a narrow strip from the coast line to the seven fathom mark. However, the trawlers "Maple Leaf" and "Braconglen" always catch some lobsters when operating the Granton trawl at depths of 20 fathoms showing that lobsters are not limited by the seven fathom line. Rocky and coralline formations are found right round the coasts of Ceylon but they are most abundant on the west, south and east coasts. In the northern part of the Island bounded by Mullaitivu on the east and by Mannar on the west extensive smooth mud banks are present, coralline formations constituting only a negligible fraction of this particular area. The vast coralline and rocky regions lying off the coasts are presumably the home of spiny lobsters. The areas examined have been found to be rich in lobsters and there is no reason why the unexplored areas should be any different.



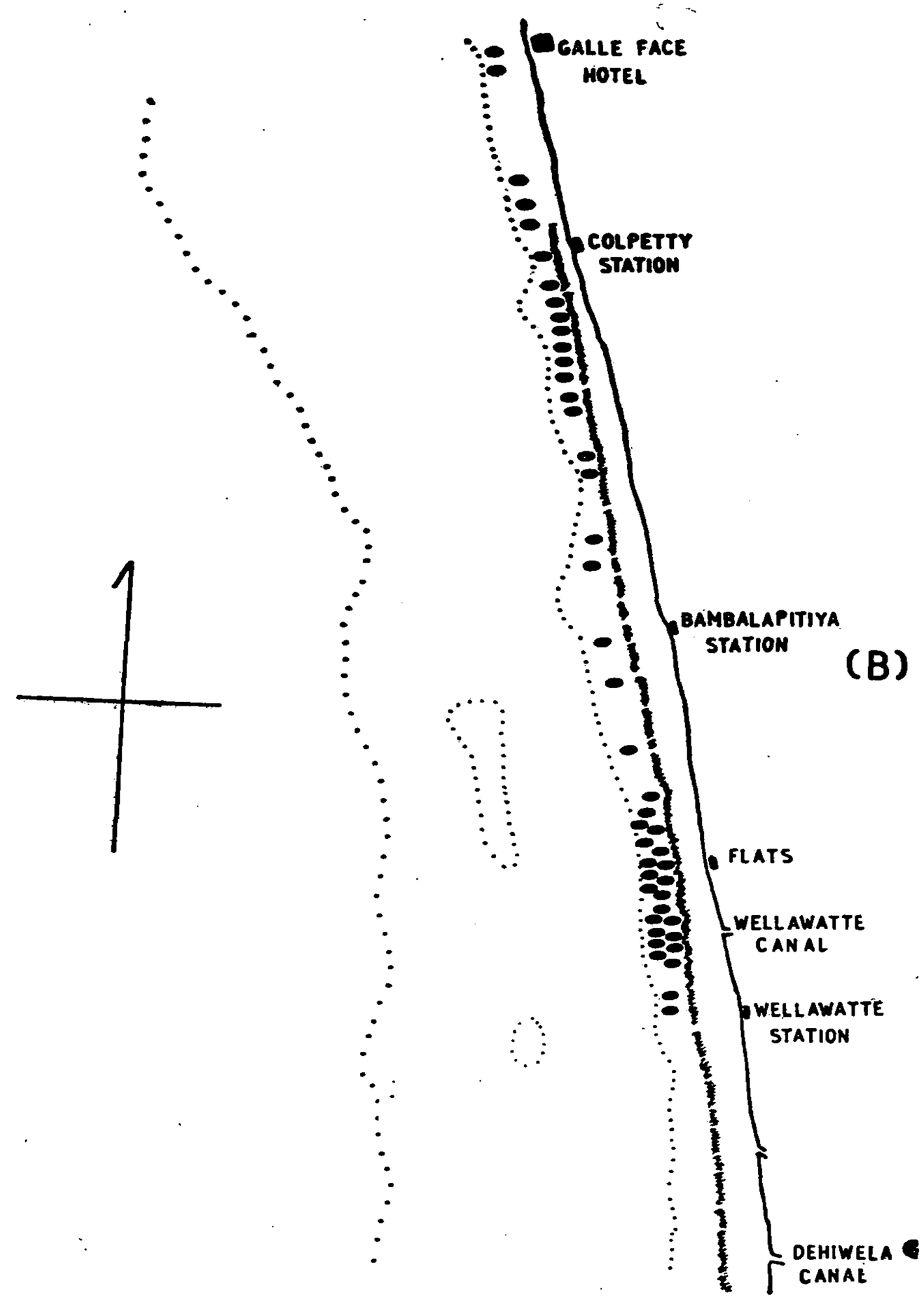
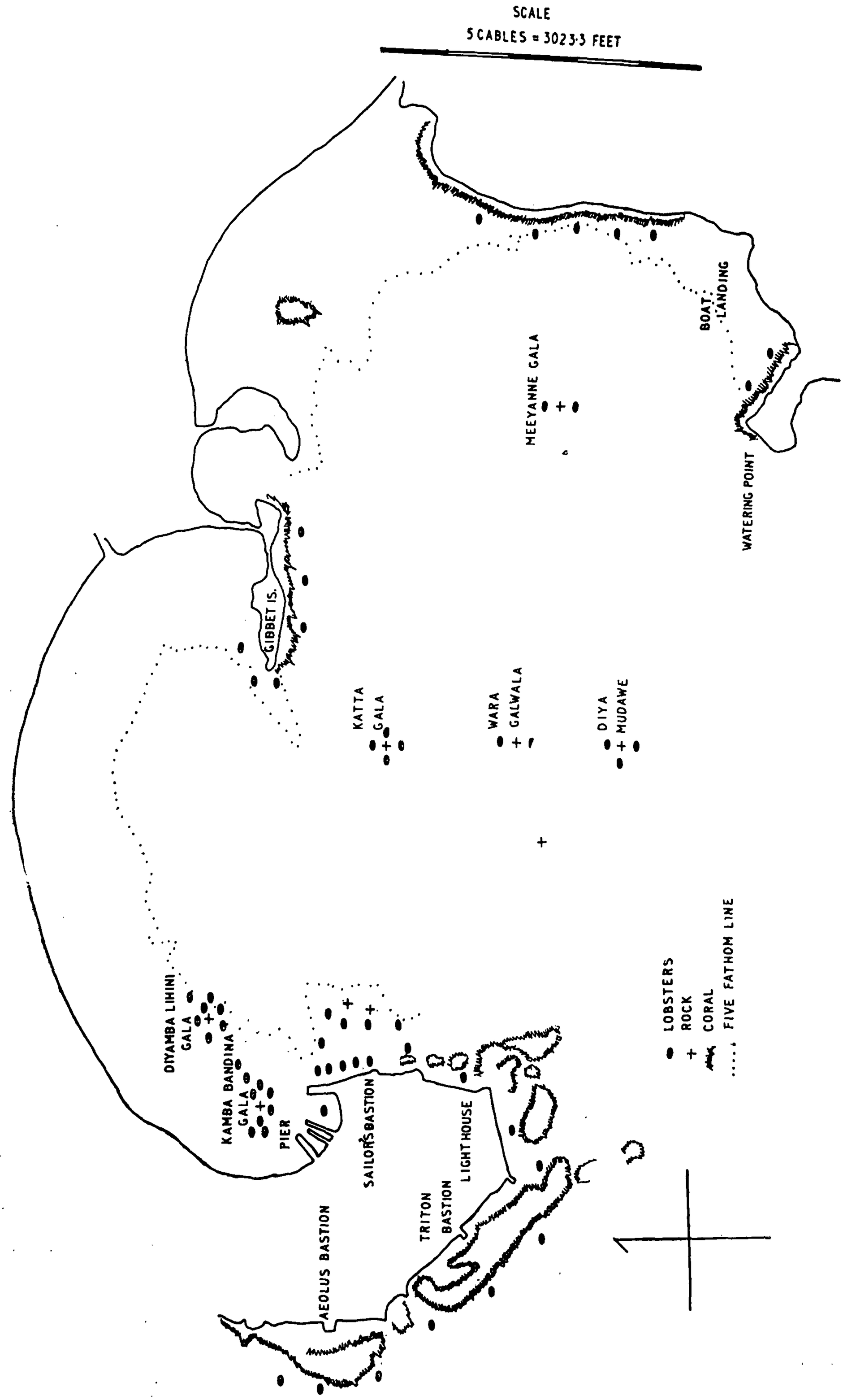


Fig. 8

MAPS OF (A)COLOMBO HARBOUR(B)COLOMBO SOUTH SHOWING DISTRIBUTION OF SPINY LOBSTERS.



MAP OF GALLE HARBOUR SHOWING
THE DISTRIBUTION OF SPINY LOBSTERS.

Fig. 9

CATCH PER UNIT TRAP

In the gear efficiency tests ten traps of the most effective type, namely the Canadian type, were used while fifty traps of the same type were used in exploring the lobster grounds off Ceylon. It would be interesting, now, to compare the catches made in these two sets of experiments.

Table III below gives the number of lobsters caught by 10 traps on the one hand and fifty traps on the other.

Table III

Trial No.	*Catch per 10 traps*	*Catch per 50 traps*
1	15	171
2	13	38
3	27	42
4	25	58
5	15	85
6	33	133
7	11	76
8	41	110
9	24	73
10	7	79
11	14	51
12	22	67
13	14	41
14	11	50

It can be seen that in both sets of experiments the catch per unit trap varies from 1 to 3. There appears to be a random variation in catches obtained during the course of the experiments. This may be attributed to the type of ground on which the traps had fallen, for lobsters are known to be concentrated in regions which give cover, only a very few being found on open ground.

The above results were obtained during the course of experiments which required the traps to be set at random regardless of the kind of substratum involved. Commercial fishermen on the other hand, in the light of experience, would concentrate on grounds which give the highest yield.

An experiment was therefore conducted to test the catches that would be obtained if the traps were to be placed on proven rich grounds day after day. The traps were placed on one of the rich areas, namely, around Lihini Gala in the Galle harbour.

Table IV below gives the results of this experiment.

Table IV

Trial No.	*No. of Lobsters*
1	19
2	23
3	35
4	25
5	30
6	31
7	22
8	31
9	30
10	14

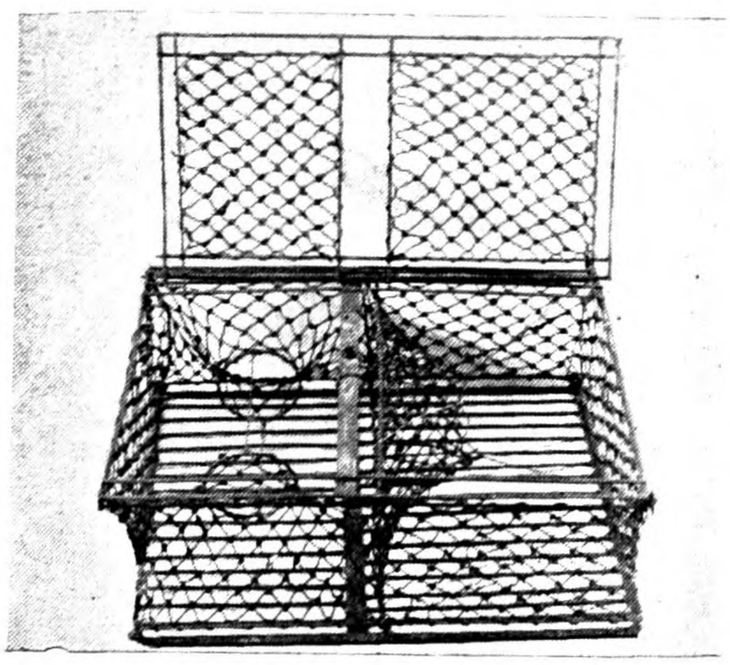
The area in which these traps were placed for the period of 10 days was approximately 400 sq. yards. A total number of 260 lobsters were captured from this small area. The results show, furthermore, that catches are remarkably consistent and higher than those made in the previous experiments. Moreover there is no evidence of a reduction in the magnitude of the catch from such a small restricted area. However, if fishing were to continue indefinitely in a small area, depletion may ensue. Commercial fishermen would no doubt observe such a trend and shift to new fishing grounds in order to maintain peak production.

DEVELOPMENT OF A COLLAPSIBLE LOBSTER TRAP

Steel traps took little time to construct, did not shift very much during rough weather, were damaged little during operations and did not require any ballast. Cane traps, on the other hand, required heavy ballast and even then tended to shift in rough weather with consequent damage to their structure. As steel corrodes in sea water and has therefore to be replaced, the expedient of using wood for the construction of the Canadian type of trap was tried. These wooden traps however required heavy ballast weighing more than double the steel traps of the same design when out of water. In the water they shifted considerably in rough weather getting damaged in the process. They gave comparatively poor catches, probably due to their movement.

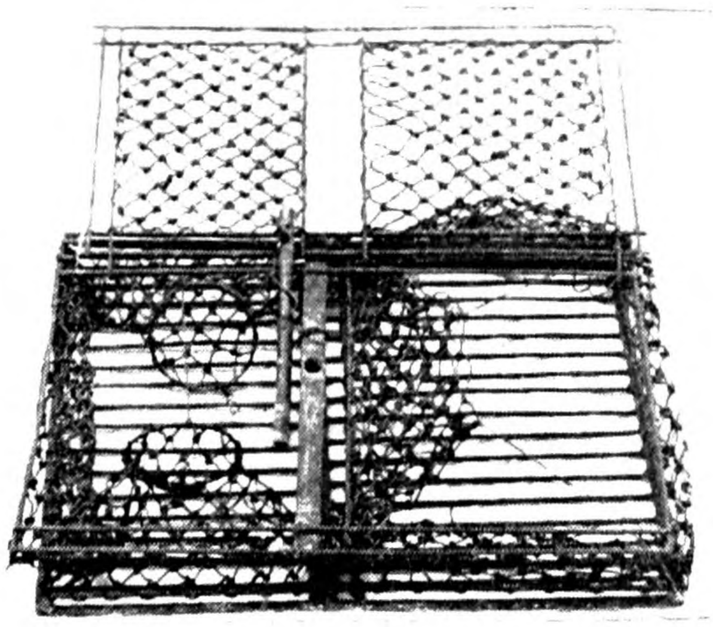
All the above types of traps were found to be too bulky and difficult to handle. Only a very few could be carried on a small boat. Modifications were therefore made to the structure of the most efficient type of trap namely the steel Canadian type in order to make the trap collapsible. In this type the top of the trap was supported by a single iron pipe at the centre, the six steel supporting uprights in the non-collapsible form of trap being dispensed with. As can be seen in fig. 10, the central pipe supporting the top of the trap rests in a socket at the base of the trap. This pipe passes through a pipe of greater diameter which is welded to the top structure of the trap. A single pin passes through these two pipes and holds the top of the trap in position. To collapse the trap the pin is removed with the result that the top section of the trap slides down. The central supporting pipe is detachable, and can therefore be stored separately. The sides of the collapsible form of trap were covered with hemp netting. When wet the hemp netting contracted giving rigidity to the entire structure. When this happens it is difficult to collapse the trap. Therefore, netting of different material such as cotton and nylon were tried in place of hemp. Cotton was found to deteriorate rapidly, while nylon was easily cut by crabs which happened to enter the trap thus affording the lobsters an easy exit. Due to these serious disadvantages of cotton and nylon, hemp was retained as the most suitable form of netting for covering the sides of the trap.

These collapsible traps were tested in Galle harbour and gave as good results as the non-collapsible type.



Collapsible trap (expanded)

Close-up of collapsing mechanism



Collapsible trap (contracted)

Fig. 10.

SUMMARY

1. Spiny lobsters of the family Palinuridae are present in Ceylon waters but an established fishery does not exist due partly to the absence of an efficient technique of capture. Gear efficiency tests were therefore conducted using lobster traps such as the Scottish creel, the Canadian "parlour and bed-room" and the Cornish "ink-well" in order to find an efficient method of capturing lobsters. The Canadian "parlour and bed-room" type constructed of steel and hemp netting proved to be the most effective trap.

2. Diving operations revealed the existence of spiny lobsters on both the east and west coasts of Ceylon but for some unknown reason traps were ineffective on the east coast. On the west coast, however, experiments with traps showed the presence of lobsters in commercial quantities in rocky areas and coral reefs. The greatest concentrations were found in regions which afforded the maximum cover. No lobsters were found on mud or sand. Illustrations of the lobster grounds are given showing the relative concentrations in different areas.

3. If a random method of setting the traps was employed, the catch per unit trap, whether operating with ten or with fifty traps of the same kind, varied from 1 to 3, with a random variation in the daily catch. If, however, the traps were set on selected rich grounds the catch was remarkably consistent and higher, the catch per unit trap being 3.

4. In the non-collapsible form, the traps employed were found to be too bulky and difficult to handle and only a few could be carried at a time on a small boat. A collapsible form of the Canadian type of trap made of steel and hemp netting was therefore developed. Sufficient numbers of this type of trap could be carried on the space of an outrigger canoe, which is the craft commonly used by local fishermen.

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