

MANAGEMENT OF THE WESTERN ROCK LOBSTER
(Panulirus longpipes cygnus George)

by

B.K. Bowen
Director,
Department of Fisheries and Fauna,
108 Adelaide Terrace
Perth, Western Australia

ABSTRACT

The history of the exploitation, scientific study and management of the rock lobster in Western Australia waters is reviewed. The fishery is based on a single species, using a single standard gear - the pot. The resource has become heavily exploited. Regulations of one kind or another have been in force since 1897. Some control the size taken - minimum sizes of lobster or of lobster tails, and escape gaps in the pots. Others control the amount of fishery - through limiting both the number of boats and the number of pots used per boat, and also the duration of the open season.

INTRODUCTION

The western rock lobster occurs on the west coast of Australia from North West Cape ($21^{\circ}45'S$) to Cape Leeuwin ($34^{\circ}22'S$), and is caught mainly in depths ranging from one to 80 fathoms. This animal has a planktonic larval phase (phyllosoma) of approximately eleven months after which it settles in the sea bed and is associated with the coastal reefs.

In general, the smaller animals, up to 3 to 4 years of age, inhabit the shallow water reef areas in depths of one to 15 fathoms. The larger animals move into deeper waters resulting in the location of mature rock lobsters principally in the 18 to 50 fathom reef systems. The average age of first maturity of the female rock lobsters is about 5 years.

The fishery on the western rock lobster developed rapidly after the acceptance of frozen green rock lobster tails on the American market in the late 1940's. By 1962 the catch had risen to 20 million pounds and the number of boats to about 800. Both industry and Government viewed the growth in the industry with concern because of the apparent fall in population abundance resulting from the fishing intensity.

This paper discusses the possibilities of a high exploitation rate in the rock lobster fishery and gives details of the management measures introduced. The responsible management authority is a combination of the Department of Fisheries and Fauna, Government of Western Australia, and the Fisheries Division, Department of Primary Industry, Commonwealth of Australia.

BOATS AND GEAR

(a) Gear: The standard method of catching rock lobsters in Western Australia is by means of pots (traps) baited with fish heads, whole small fish, sheep heads or cattle hooves (or a combination of these). There are three types of pots in general use - batten, stick or cane beehive, and iron beehive (Fig. 1). Research on the relative fishing power of each type has not been undertaken. However, it is generally recognised that the batten pot is ideal for shallow (one to 15 fathoms) protected waters, and the beehive pot more suitable for deep water, although there are a large number of beehive pots also used in shallow waters. Pots are lifted and checked each morning.

(b) Boats: In the early years of the fishery, the boats were small (up to 30 feet) and the pots were lifted by hand. The areas of operation were determined by the suitability of the boat to cope with the prevailing weather conditions, and the capability of the skipper to locate reef areas (and thus rock lobster populations).

During the 1950's and early 1960's significant technological progress was made: new boats were built specifically for the rock lobster industry, including the provision of pot winches, large deck space for carrying gear, and a hull design which permitted rapid movements of pots each day. In addition, there was progressive use of echo sounder equipment to aid in the location of reef.

Table I gives the numbers of boats in the rock lobster industry in 5 ft. size classes for the year 1965/66.

CATCH AND EFFORT

Since the commencement of the fishery, boat skippers have been required by law to submit to the Western Australian Department of Fisheries and Fauna monthly returns setting out the catch for the month, the area of operations in grid squares measuring 1° latitude by 1° longitude, the number of rock lobster pots used, the number of days fishing during the month, and the number of men on board their boats. The catch and the number of men operating for the years 1945/46 to 1968/69 is given in Fig. 2.

One of the purposes of the collection of catch and effort data is to provide information on relative levels of population abundance. The abundance is proportional to the catch per unit effort provided the catchability remains constant. There are three main requirements for a successful catch in this fishery. Firstly, the skipper must be able to locate the habitat of the rock lobster; secondly, the pot must be baited with a substance which will attract the rock lobster; and, thirdly, the rock lobster must be in a physiological state such that it is searching for food. Rock lobsters do not feed for a few days before and after moulting, and therefore are not vulnerable to the fishing gear during these periods. As a result, the catchability co-efficient must vary considerably over a short period of time. In addition, fishermen hold the view that rock lobsters are more active after stormy weather than during periods of relative calm. However, it is reasonable to assume that gross changes in the catch per unit effort figures over a period of years to reflect changes in the population levels.

EXPLOITATION RATE

The exploitation rate generated by the total fishing effort on a unit stock of fish is the resultant of a number of interacting factors. The western rock lobster industry is an example of the interaction of four principal factors to produce in that population a high exploitation rate potential.

(a) Market Outlet: Approximately 95 percent of the western rock lobster catch is sold on the North American market, and this market has readily accepted increasing quantities of lobster tails from Australia.

The price too has increased during the years of expansion, rising from 20 cents Australian per pound of frozen tails in 1952 to one dollar per pound in 1969. This increase in the price per pound has allowed fishermen to maintain their profit margins in the face of a falling catch per unit effort.

(b) Capital Costs: Western rock lobsters may be taken in shallow waters close to the coast. When the fishery first commenced, rock lobsters were very abundant in these waters, and capital costs for boats and gear were relatively small. As a result, the fishery attracted a large number of men from all walks of life, and the fleet of rock lobster boats increased at a rapid rate. Most of these vessels carried a crew of skipper and deck-hand.

(c) Distribution of rock lobster population: Not only was the inner boundary of the western rock lobster population close to the coastal line, but it was close by the ports of Fremantle and Geraldton. Fishermen were able to centre their activities on these two ports and expand northwards, southwards and seawards. Investment of capital in fishing villages along the coast came after an area had been explored and exploited, and the villages were able to expand as money became available. A decision to spend risk capital was not required.

(d) Vulnerability: The western rock lobster is highly vulnerable to the fishing gear (rock lobster pot). Mark and recapture studies undertaken on one of the reef areas showed that the fishing gear is capable of taking approximately 40 percent of the animals with a carapace length of 3 inches or greater (legal minimum length 3 inches) in the first six weeks of the season. The area under study was one fished heavily by the industry and would have had a higher concentration of pots than the average for the whole rock lobster area. However, the study did show that the fishing gear in operation is an efficient method of taking rock lobsters.

Studies undertaken by Bowen and Chittleborough (1966) showed that the exploitation rate in recent years has risen to 60 to 70 percent.

MANAGEMENT MEASURES

When a fishery is being first developed there is little need to implement restrictive measures. However, as the exploitation rate rises there is an increasing need to consider the introduction of management procedures in an attempt to maintain an average annual catch on a sustained basis. The two most widely accepted management concepts are those which relate to the size (or age) at first capture, and to the total

effective fishing effort. Most other regulations are either extensions of these concepts or aimed at protecting the breeding fractions of the population. The development of the rock lobster fishery is an interesting example of an attempt to regulate the effective fishing effort by means of a combination of license limitation and a legal minimum length (size at first capture). The general restrictive measures introduced into the western rock lobster fishery are set out below, together with a general discussion of the sequence of events which lead to the introduction of license limitations, and the success of these limitations.

(a) Size at first capture:

(i) Legal minimum length: The legal minimum length had its basis in the concept of the approximate size at first maturity, together with the size acceptable to the local market. Initially, this was in terms of a minimum whole weight. In March 1897, a minimum weight of 8 oz. was prescribed, but in September of the same year this was increased to 12 oz. This remained in force until 1940, when the Act was amended to allow a minimum carapace length to be applied. A length of $2\frac{1}{2}$ inches measured from the rear end of the base of the rostral horns to the end of the carapace was substituted as being approximately equivalent to a 12 oz. whole weight animal. Later the method of measuring was changed to that distance along the mid-dorsal line from the anterior edge to the posterior edge of the carapace, and the new legal minimum length to 3 inches being equivalent to $2\frac{1}{2}$ inches measured under the previous system.

(ii) Escape hatches in the fishing gear. Although it is generally true that the smaller rock lobsters are in shallow water and the larger ones in deeper water, the separation is not sufficient to ensure the capture in a rock lobster pot of large animals only. In some shallow water areas it is possible to catch 60 to 70 rock lobsters in a trap per night, but only one to five of these will be legal size. For this reason a series of experiments were commenced in 1963 (Bowen, 1963) to determine the likelihood of small rock lobsters passing through an escape hatch in the pot after having been attracted to the bait. The experiments showed quite clearly that pots with escape hatches did catch less "undersize" rock lobsters than those without this device. Ideally an escape hatch size of $2\frac{1}{8}$ inches in width should be used because the number of "legal size" rock lobsters retained in these pots is not less than that retained in the control pots. However, tests (conducted out of water) with grills of varying sizes showed that a rock lobster which has just reached the legal size can be passed through a $2\frac{1}{8}$ inches hatch, but not through a 2 inches hatch.

Many fishermen held the view that if it was physically possible for a "legal size" rock lobster to fit through a 2 1/8 inches hatch, then they may be losing "size" animals on the sea bed. Although the results of the experiments showed that, in practice, this did not happen, a decision was made to introduce the 2 inch hatch as a legal requirement to ensure complete acceptance by all members of the rock lobster industry. Acceptance by the industry of each management measure has been an essential factor in the development of the rock lobster management measures.

(b) Total fishing effort:

(i) A decision to limit effort. In the rock lobster fishery, the fishing effort is generated by the number of boats operating and the number of pots used per boat. A combination of these two factors gives the total number of pots in the water fishing during any one season. Although data on exploitation rates were not available when a decision was made to limit fishing effort, an inspection of gross catch and effort data showed that some type of limitation was desirable. Fig. 3 gives the catch for the year 1952/53 to 1962/63 plotted against total effort in terms of the maximum numbers of rock lobster pots in the water during the season. The number of rock lobster pots increased by 66 percent from 1958/59 to 1961/62 but the production increase was only 8 percent. The data indicated that very little benefit would be obtained by allowing this continual increase in fishing effort, and a decision was made to limit both the number of boats operating and the number of pots per boat.

Approximately four months' notice was given concerning the impending restrictions on rock lobster boat licenses which became effective on March 1, 1963. The notification of the impending restrictions was given to provide those people who had commenced building rock lobster boats time to bring them into operation. As at March 1, 1963, the number of rock lobster boats in the industry was fixed, and to the present date no further licenses have been granted.

The number of pots allowed per boat was fixed at 3 per foot of boat length with a maximum of 200 pots per boat. This decision had the effect of reducing the number of pots in the water from approximately 97,000 during the 1962/63 season to an estimated 76,000 during the 1963/64 season.

(ii) Increases in effective fishing effort within the regulations. The first reaction to the license limitation regulations was to replace small inefficient vessels with larger, faster vessels. The limitation regulation did not specify a replacement policy, and therefore larger replacement vessels were allocated a pot quota of three pots per foot of the new boat length. This led to an increase in the number of pots in the water, and a potential for a rapid increase in future years.

Consequently, on May 8, 1965, a policy decision was handed down by the Western Australian Government that fishermen replacing their boat would not be allowed more pots, even though their new vessels may be longer. This policy had the effect of allowing fishermen to build larger vessels but without sufficient catching power (in terms of number of pots) to provide an adequate return on capital. As a result some fishermen were inclined to use a greater number of pots than their entitlement.

On December 14, 1965, a new boat replacement policy was determined in an effort to slow down the increase in effective fishing effort within the framework of the regulations. Essentially, the policy stated that new vessels must not be longer than those being replaced. However, for reasons of boat safety at sea, exceptions were made where a boat was less than 25 ft. (stem post to stern post) in length. With minor amendments the policy introduced in December 1965, is still in operation today; it provides for:

(1) Boats up to and including 25 ft. in length may be replaced at any time by a boat not exceeding 25 ft. in length. The allocation of pots will be three pots per foot of the original boat length plus one and one-half pots per foot for the length increase of the new boat, e.g. a 25 ft. boat replacing a 19 ft. boat has an allocation of 66 pots.

(2) Boats greater than 25 ft. in length may be replaced only by a boat of the same length. The pot entitlement remains the same.

Even with the boat and pot limitations and the boat replacement policy, the effective fishing effort has increased over the years, and will continue to increase. The major causes are (a) increases in the efficiency of new boats; (b) increases in the technology of locating reef areas; (c) increase in the frequency of pots being lifted and shifted; and (d) increase in the number of days of operating by the fleet during the season.

(c) Summary of management measures:

(i) Closed Seasons: All rock lobsters in water between 30°S and 33°S within one mile of high water mark from January 1 to November 14.

All rock lobsters within the Abrolhos Islands area from August 15 to March 14.

All rock lobsters in the waters between 24°S and 34°S from August 15 to November 14.

(ii) Minimum length: All rock lobsters 3 in. carapace.

(iii) Minimum tail weight: All rock lobsters 5 oz.

(iv) License limitation and pot limits: Licenses for rock lobster fishing "frozen" as at March 1, 1963. The Minister may approve replacement of boats in special circumstances. Rock lobster pots restricted to three per foot of vessel. Maximum number of pots irrespective of length 200. Every surface float attached to a rock lobster pot shall be branded with the letter of the port at which the license was issued and distinguishing number of the boat used in working the pot.

(v) Berried females: Prohibited.

(vi) Cutting up or dismembering at sea: Processing in any fishing boat not registered as an export establishment under the Commonwealth Export Regulations and not licensed as a processing establishment under the W.A. Fisheries Act is prohibited. Portions of rock lobster not processed in a registered export establishment and licensed processing establishment shall not be brought into Western Australian waters or on to land.

Processing in the Abrolhos Islands area is prohibited. No person shall bring into Western Australian waters, or on to land, any portion of any rock lobster taken in that area.

(vii) Receptacles containing fish consigned or delivered by fishermen: Every receptacle shall have attached thereto a label bearing the name and address of the person consigning or delivering the fish and the registration number of the boat used in the capture of fish. Bags used for carrying rock lobsters shall not exceed 39 in. by 23½ in. when empty and shall not contain more than 100 lb.

(viii) Limitations as to fishing area:

- (1) Boats and men fishing between 30°S and 33°S in any year may not fish between 28°S and 30°S during the same year.
- (2) Boats and men fishing between 28°S and 30°S in any year may not fish between 30°S and 33°S during the same year.
- (3) Boats fishing between 28°S and 33°S in any year may fish north of 28°S and south of 33°S during the same year.

- (4) Boats fishing in the defined Abrolhos area may not fish outside that area from March 15 to August 14.
- (5) Boats which have not fished in the defined Abrolhos area during the three years prior to January 1, 1966, are not permitted to fish in that area.

(ix) Escape gaps in rock lobster pots: Every rock lobster pot shall have an unobstructed escape gap, rectangular in shape measuring not less than 12 inches in length and not less than 2 inches in width, on the side or on the end or on the upper surface of the pot.

(x) Restrictions on the operations of freezer boats (sea-going vessels which both catch and process their catch):

- (1) No additional freezer boats will be licensed as processing establishments for processing rock lobsters.
- (2) Freezer boats may not operate within territorial waters between Mandurah and Geraldton from January 1 to August 14.
- (3) Freezer boats may not start processing rock lobsters before all under size rock lobsters on board are returned to the sea.
- (4) Undersize rock lobsters taken by a freezer boat shall be returned to the sea prior to the boat arriving at anchorage.
- (5) No freezer boat licensed as a processing establishment shall process rock lobster caught by any other boat.

(xi) Catching by diving prohibited in the Abrolhos Islands.

(d) Success of limitation policy: The limitation policy has produced attendant administrative difficulties. Each boat replacement, and each boat sale, requires the approval of the Department of Fisheries and Fauna. In addition, it has been found necessary to introduce numerous regulations to ensure orderly fishing, and these require constant policing. However, the policy, which has in effect produced a concession fishery, has brought substantial benefits to those in the industry:

(a) The annual production is likely to be stable over a long period of years. Bowen and Chittleborough (1966) estimate this production level to be about 16 million pound \pm two million pounds.

(b) The economic return per boat has resulted in a high standard of living for those in the industry.

(c) Most of those in the rock lobster industry have adopted a very responsible attitude towards the management measures in force, and are keen to ensure the persistence of the industry. Accordingly, there is a high degree of industry participation in the management discussions and decision making.

RESEARCH

During the 1950's, the main research work was in relation to the collection and analyses of catch and effort data, together with the collection of general biological information. A study was also undertaken of the effects of continuous fishing on a small area of reef at Houtman Abrolhos.

Since 1963 there has been a gradual expansion in the research activity. A combined programme of the Division of Fisheries and Oceanography, C.S.I.R.O. and the Western Australian State Department of Fisheries and Fauna now has five research projects:

- (1) A study of the distribution of the phyllosoma stages.
- (2) Study of the pattern of settlement and growth of the puerulus and early post-larval stages.
- (3) Study of the rate of recruitment of two and three year old animals on to selected reef areas, and the patterns of growth and mortality during the two year period before reaching legal minimum size.
- (4) Basic research upon the physiology of moulting and growth.
- (5) Study of the exploited phase of the population, including analyses of catch and effort data and measurement of variations in catchability.

The research programmes will provide a wealth of information on the status of the fishery, the pattern of recruitment into the fishable stock, and the factors controlling this recruitment after the setting of the puerulus. These research programmes, and management decisions, are based on the assumption that the level of recruitment is independent.

of the size of the brood stock. However, because of the high exploitation rate being generated by the fishing effort, those involved in the management of this fishery can no longer afford to leave this assumption untested. What is now needed is an extension to the present research programme in a quantitative survey of larvae hatching each season, leading to an estimate of the size of the female breeding stock for a number of years. A study of this would provide those charged with the management of the fishery with information about the effect upon recruitment of the high exploitation rate.

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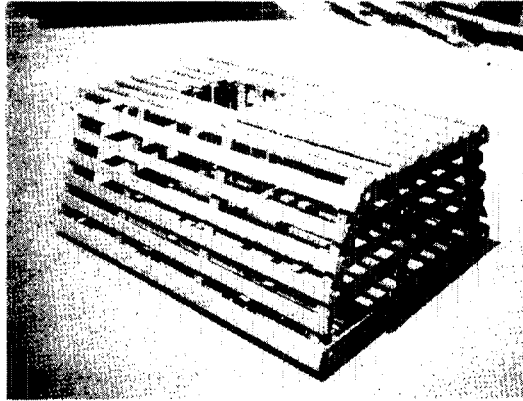
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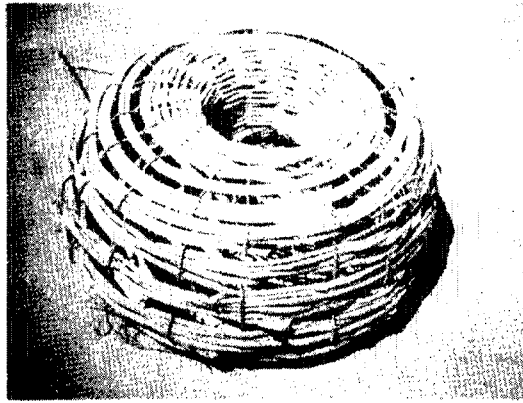
TABLE I

Numbers of rock lobster boats by 5 ft. size classes operating in the rock lobster fishery during the 1965/66 season

Boat Length 5 ft. class intervals	Number
15	82
20	169
25	116
30	168
35	72
40	49
45 and greater	102
Total	758



(A)



(B)

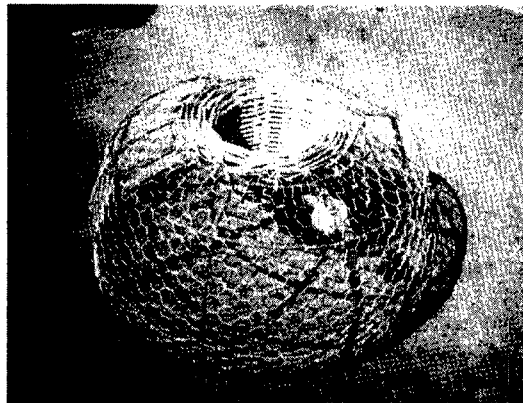
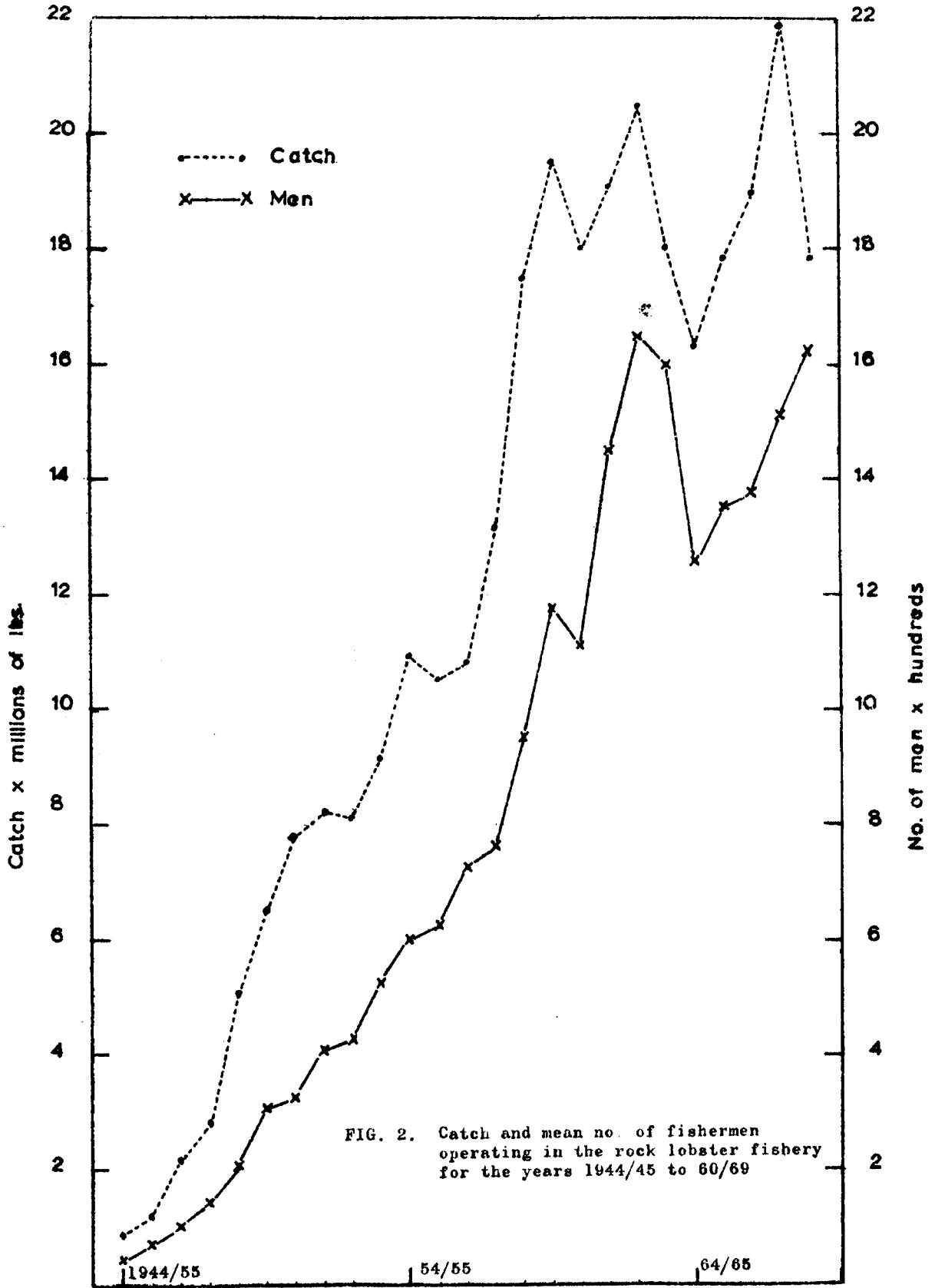


Fig. 1. Batten
(A) Stick beehive
(B) and iron beehive
(C) pots used in the Western Rock Lobster fishery.



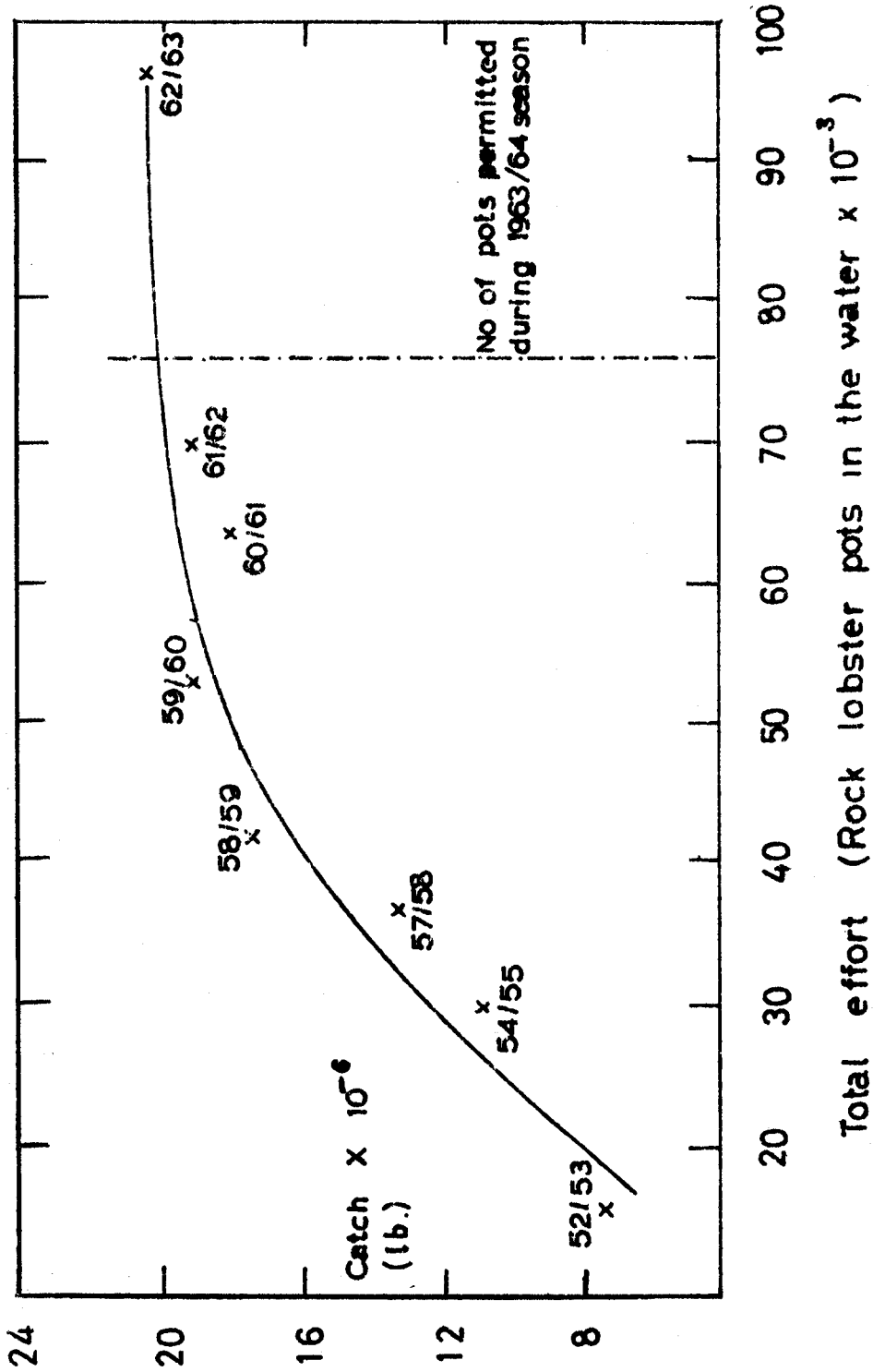


FIG3 GRAPH OF TOTAL EFFORT PLOTTED AGAINST CATCHES FOR YEARS 1952/53 TO 1962/63