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The Western Australian Amateur Fishery for Australian Herring (*Arripis georgianus*)

RESULTS OF THE 1973 CREEL CENSUS

BY

R. C. J. LENANTON

AND

N. G. HALL

1976

PERTH
WESTERN AUSTRALIA

Department of Fisheries and Wildlife

108 Adelaide Terrace

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62668-1

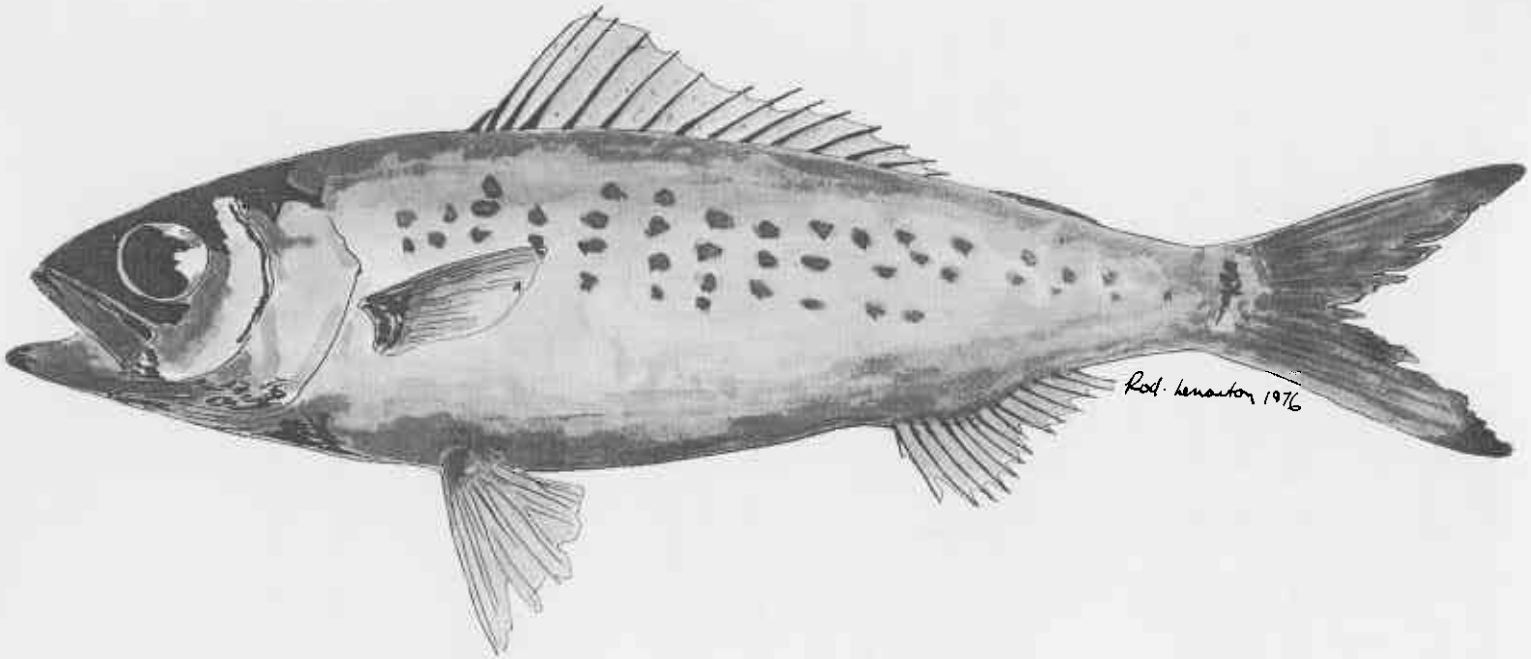
CONTENTS

APPENDICES

TABLES

FIGURES

FRONTISPIECE



Australian herring *(Arripis georgianus)*

2 cm

FRONTISPIECE

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THE WESTERN AUSTRALIAN AMATEUR FISHERY FOR AUSTRALIAN HERRING (ARRIPIS GEORGIANUS): RESULTS OF THE 1973 CREEL CENSUS

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I INTRODUCTION

Historically, the Western Australian production of Australian herring (*Arripis georgianus*) has fluctuated from year to year in response to changing market demand. Prior to 1968, the annual catch taken by professional fishermen was relatively stable, ranging from 200 000 kg (approx. 500 000 pounds) to 450 000 kg (approx. 1 000 000 pounds). From 1968, commercial production has risen to a peak of 1 187 440 kg (2 617 857 pounds) recorded in 1972/73 (Table I). An increase in demand for herring as bait for the rock lobster fishery is considered to be the major factor involved in this observed rise in Australian herring production.

In addition to the expanding professional fishery, the amateur fishery has expanded as a result of population growth in Western Australia and the increase in privately owned pleasure boats. Conflict between professional net fishermen and amateur line fishermen has grown with the expanding fisheries. This has been found to be particularly severe in May, which is the month in which Australian herring appear to be most abundant and is also the school holiday period, when amateur and professional fishing pressure is expected to be at a maximum.

The possible effect on the Australian herring fishery of the expanding professional and amateur sectors has caused concern both to management and to the fishing fraternity.

An initial step towards assessing the effects of the increasing fishing pressure on the Australian herring stocks of Western Australia, and in attempting to resolve the conflict

between professional and amateur fishermen, is the estimation of the total catch. The professional catch can be relatively easily obtained from fishermen's monthly statistical returns or from research logbooks. No catch data is available for the amateur fishery, however, and if this should happen to comprise a relatively large portion of the total catch, then considerable bias would be introduced by interpreting only the professional catch and effort data.

The problem of assessing the amateur catch has arisen in many sport fisheries throughout the world. Three methods commonly used to provide harvest data are tagging, postal questionnaires and creel census. The tagging method basically consists of using the ratio of amateur returns to professional returns in conjunction with the professional catch to obtain an estimate of the amateur catch. The major problems associated with this technique are the release of sufficient tagged fish, the possible non-random distribution of the tagged fish, and non-reporting of recaptured fish. Carline (1972) reported the results of an experiment which compared the postal questionnaire and creel census techniques, in which he concluded that estimates of fishing success were seriously overestimated by the postcard method. Although other studies discussed by Carline have found the postal questionnaire technique to be relatively free from bias, it would appear that the creel census method is more likely to produce an accurate estimate of the total harvest than the postcard method.

On consideration of the three techniques, tagging and postal questionnaire methods appeared to be most likely to be biassed. Accordingly, a creel census of amateur Australian herring fishermen was carried out in April, May and June of 1973, the results of which are reported in this paper.

II METHODS

A. LOCATIONS TO BE SURVEYED

The amateur Australian herring fishery extends over the south, lower west and metropolitan coasts, the major proportion of the amateur effort and a significant proportion of the professional effort being applied along the metropolitan beaches and the waters surrounding Rottnest and Garden Islands. As the conflict between the professional and amateur fishermen arose in the metropolitan area, the census was limited to this section of the fishery.

The area being studied can logically be divided into two sections,

i.e. (i) the metropolitan coastal fishery, extending from Mandurah to the Yanchep-Two Rocks area (see Figure 1); and,

(ii) the Rottnest Island fishery (see Figure 2).

The Garden Island fishery is accessible only to boats operating from the mainland or Rottnest; the island is serviced by a ferry from Palm Beach, but access over the recently completed causeway from Point Peron to the Naval Base is limited. It was considered that the census of fishermen operating at Garden Island would be adequately covered by the metropolitan boat ramp section of the survey.

In planning the creel census it was necessary to consider separately the activities of shore based fishermen and boat fishermen. Obviously the greater accessibility of Australian herring to the boat fishermen results in a greater catch rate (when the effort is directed towards Australian herring) than is possible for shore based anglers.

1. THE METROPOLITAN COASTAL FISHERY

(a) Shore locations (see Figure 1)

This section of the fishery includes thirty three shore locations, which listed from north to south are as follows: Two Rocks, Yanchep, Quinns Rocks, Burns Beach, Mullaloo, Whitfords, Sorrento, North Beach, Trigg, Scarborough, City Beach, Swanbourne, Cottesloe, Leighton, North Mole, South Mole, Fishing Boat Harbour Groyne, South Beach Groyne, Bradford-Kendal, Robbs Jetty, Shilkin Tannery, Woodman's Point, Haval Base Groyne, Kwinana, Rockingham, Palm Beach, Point Peron, Shoalwater Bay, Safety Bay, Warnbro Sound, Long Point, beaches north of Mandurah, and Mandurah.

(b) Boat ramps (see Figure 1)

The boat ramps, twenty one in all, listed from north to south, are as follows: Two Rocks, Yanchep, Quinns Rocks, Burns Beach, Whitfords, Marmion, Trigg, Cottesloe (annex), East Street, Aquarama, Melville, Freshwater Bay, (the previous four boat ramps are situated on the banks of the Swan River), Fishermen's Harbour, Anchorage, Cockburn Sound (two ramps), Palm Beach (two ramps) and Mandurah (two ramps).

2. THE ROTTNEST ISLAND FISHERY (SEE FIGURE 2)

There are approximately twenty popular shore based fishing localities scattered around the perimeter of the island. The most popular ones are those which are closest to the settlement and protected from adverse prevailing weather conditions. There are also about ten bays around the island which are most commonly fished by both boat and dinghy fishermen. Again proximity to a good anchorage in the case of large boats, the settlement in the case of dinghies, and shelter from adverse prevailing weather conditions are the factors most likely to dictate fishing areas.

As it was obviously impossible to cover all of the above locations with the limited resources available, the survey was restricted to the Rottnest Island fishery and two "typical" shore locations and two "typical" boat ramps on the metropolitan coast. Counts were to be made at other boat ramps and shore locations during the period of the survey to enable a rough estimate of the total catch to be made.

North Mole and Swanbourne-Cottlesloe were considered to be "typical" shore based fishing locations because they catered for the complete range of angling techniques i.e. jetty, groyne, reef and beach fishing, within close proximity to major population centres. As such, they were likely to be used fairly consistently by a proportion of the public who might be expected to display an average angling ability.

The Naval Base and East Street boat ramps were chosen as "typical" boat ramps, because being well protected from adverse weather conditions, and close to major population centres, they were also likely to be used by a proportion of the angling public who might be expected to display an average angling ability.

B. TIMING OF THE CENSUS

Again because of limited resources, it was impossible to consider conducting the survey throughout the entire year. It was therefore decided to carry out the census during April, May and June, the months of the year in which the catches of Australian herring in metropolitan waters are usually found to be at their peak.

C. RESOURCES AVAILABLE TO CONDUCT THE SURVEY

The available staff consisted of two interviewers who were employed temporarily for the period of the survey and four technical officers from the Department of Fisheries and Wildlife. The latter were available only when free from other duties. In addition to these six people who worked principally on weekdays, a pool of eight University students was available to interview on weekends and public holidays.

D. INFORMATION TO BE COLLECTED BY THE INTERVIEWERS

In theory (Neuhold and Lu, 1957, Johnson and Wroblewski, 1962, and Erman, 1972), in order to estimate the total number of fish caught by amateur fishermen over a given time period at any given location, the basic information required is

(i) the total number of fishermen fishing at the location during the period,

(ii) the average duration of fishing for the fishermen at the location during the period, and,

(iii) the average catch-rate for the fishermen at the location during the period.

Accordingly, interviewers at shore locations were required to count the number of people fishing at the location on the hour every hour. Between these counts the interviewer was requested to determine, from a sample of those anglers present, the following information:

(i) the length of time that the angler had already been fishing;

(ii) the number of fish of each different species he had caught during this period;

(iii) how long he intended to continue fishing.

Interview sheets and count sheets used at the shore locations are shown in Appendices 1 and 3 respectively. Interviewers at boat ramps were required to count the empty boat trailers on the hour every hour and to interview the people returning to the ramp between counts. The following information was to be obtained from each interview:

(i) the number of people on board who had been fishing;

(ii) the area fished;

(iii) the time spent fishing;

(iv) the number of fish of each different species caught during the period.

Interview sheets and count sheets used at the boat ramps are shown in Appendices 1 and 2 respectively.

Rottnest Island was treated as a single location because of the tendency for fishermen to move to different areas in response to the direction of the wind, with its resulting adverse conditions. Interviewers were required to conduct two different types of interview and count. Firstly, in order to interview shore based anglers, it was necessary to use a four wheel drive vehicle to travel around the island, all fishermen located being interviewed and counts being made of both shore based anglers and boats. Secondly, a boat was to be used to move around the island in order to interview those people fishing from boats; again all shore based anglers and boats fishing were to be counted. Interviews at sea were necessitated by the large number of boat anglers who were day visitors from the mainland or alternatively who were on extended visits, anchoring offshore overnight in one of the many anchorages around the island. The information required from the interviews was similar to that described for the shore locations and boat ramps. Interviews for uncompleted boat trips were required to provide the additional information regarding the length of time that it was proposed to continue fishing. Interview sheets and count sheets used at Rottnest Island are shown in Appendices 1 and 3 respectively.

In addition to the above, total instantaneous counts were to be made of the number of anglers and boats fishing at all locations within the area of coast being considered. The count sheets used to record these total counts are shown in Appendix 3.

Interviewers at the various locations were also requested to provide such additional information as weather conditions, bait type, type of fishing gear, subjective estimates of the fisherman's ability and anecdotal information (i.e. information regarding previous fishing trips). Whenever possible, both boats and occupants fishing offshore from the location where the interviewer was based and unoccupied boats moored at different anchorages were to be counted.

E. INTERVIEW TECHNIQUES

At the beginning of each interview, the interviewer was requested to introduce himself as representing the Fisheries Research Section of the Department of Fisheries and Wildlife, which was attempting to determine both the number of people fishing on metropolitan beaches and at Rottnest Island, and the catch of Australian herring and salmon during the period from April to June.

For shore based anglers, the fisherman was to be identified by either asking his name (or asking him to provide a fictitious name; e.g. Mickey Mouse) or by some distinguishing feature (e.g. Green cap), in order that, if he happened to be contacted a second time on the same day, the interviewer would not have to repeat questions regarding the time at which he started fishing, etc. Also, the re-identification was required to enquire the exact catch-rate between the last encounter and the current interview. Boats were to be identified by either the registration number or name of the boat.

In the event that a fisherman refused to cooperate or gave obviously fictitious answers, a "nil interview" was to be recorded for that person.

Each fisherman's catch was to be examined (if possible) by the interviewer to determine the number of fish of each species. If it was found to be impossible to examine the catch, the fisherman's estimate of the catch composition was to be recorded.

In order to obtain a representative sample of fishermen to be interviewed, the starting point for each series of interviews (i.e. each interview period between counts) at shore locations was to be chosen randomly. If, based on the number of people at the location and the rate of interviewing, it was decided by the interviewer that he could interview, say, one out of every ten anglers present during the counting interval, then he was to interview every tenth person. Because of the queueing nature of boat ramps, interviews were to be carried out as often as possible between the counts.

F. COUNTING TECHNIQUES

For shore locations counts were to be made from a suitable vantage point if at all possible. If, however, it was found to be impossible to count all fishermen from a single location, the interviewer was required to conduct a progressive count, which entailed the counting of anglers as the interviewer moved from one end of the location to the other. It was

expected that the instantaneous form of count would be suitable for the Swanbourne-Cottesloe section of the survey, but that a progressive count would be required at North Mole.

For boat ramps, it was considered that the most suitable index of the number of boats fishing was the number of boat trailers present at the ramp. In nearly all cases the trailer is left at the ramp to await the boat's return. The number of empty trailers at the ramp was to be counted on each counting occasion. In addition to the trailer count, the interviewer was also instructed to record the number or name of each boat which arrived or departed from the ramp, the time of arrival or departure and the number of people on board.

The counts at Rottnest Island both for fishing boats and shore based fishermen were, by necessity, to be of the progressive type as the interviewer moved around the island. Because of the time involved in visiting each location on the island, it was necessary for the interviewer to conduct his interviews whenever fishermen were located, rather than attempting to interview between counts.

In all cases of progressive counting, the interviewer was to reduce the frequency of counting if this was found to be required in order that sufficient interviews could be conducted. It should be noted that, as this was the first attempt to conduct a creel census by the Department of Fisheries and Wildlife and, in particular, for these locations, instructions to the interviewers on both interviewing and counting techniques were at first rather general in nature; it was left to the interviewer's own judgement to modify the suggested techniques if they were found to be impracticable in the light of actual experience.

G. SAMPLING DESIGN

1. SHORE LOCATION

Because it was considered that both the number of anglers and the expertise of these anglers would vary from day to day, the week was considered to be divided into the following periods

(a) Weekday mornings (i.e. Monday, Tuesday, Wednesday, Thursday, and Friday),

(b) Weekday evenings (i.e. Monday, Tuesday, Wednesday and Thursday),

(c) Friday evening ,

(d) Saturday morning,

(e) Saturday evening,

(f) Sunday morning, and,

(g) Sunday evening.

Because dawn and dusk were thought to be the most favoured periods for fishing, morning (from 0500 hrs to 1400 hrs) and evening (from 1400 hrs to midnight), sampling periods were designed to specifically include these fishing times. Interview periods were to be chosen as a stratified sample to obtain adequate coverage of the above periods. Accordingly a random sample of three weekday mornings and two weekday evenings was to be made for each week that the location was to be studied, and the census was to be carried out on these chosen mornings and evenings in addition to (c) to (g) above.

2. BOAT RAMPS

Fishing periods for any one week at a boat ramp were considered to be

(a) weekdays (Monday through Friday),

(b) Saturdays, and,

(c) Sundays.

The census was to be carried out on a (random) sample of two weekdays and Saturday and Sunday. Again the reason for stratifying the week was the belief that fishing pressure and expertise would vary through the week; retired men were considered to form the majority of the midweek fishermen, with an influx of working men over the weekends.

3. ROTTNEST ISLAND

Rottnest was considered to be similar to shore locations in so

far as stratification of the week was concerned. Because the interviewers were to be stationed on the island for each week that the census was to be carried out however, interviewing was to be carried out either during a morning or an evening on each day of the week, the choice between mornings and evenings being made randomly.

It should be noted here that additional time was taken during the regular visits to Rottnest Island by interview staff to facilitate the collection of length frequency, scale and gonad samples from angler caught fish, principally to enable the determination of the age composition and spawning condition of these fish.

H. FREQUENCY OF SAMPLING

Because of the limitations on the number of interviewers available and the rather short season (April to June), it was decided to carry out the census at each location every second week. Rottnest Island and the boat ramps were to be sampled during one week and North Mole and Swanbourne-Cottesloe during the next.

In addition, during the whole survey, interviews and counts were to be made whenever possible at locations other than those specified, to determine whether the "typical" interview localities selected were in fact typical of all localities within the survey area.

Special emphasis was to be given to the holiday periods (Easter long weekend, May school holidays and June long weekend) during the sampling period.

I. ALLOCATION OF RESOURCES

One of the two temporary employees was to interview on weekdays at Swanbourne-Cottesloe and at the two boat ramps and the other was to interview at North Mole and Rottnest Island. University students were to interview at the shore localities and boat ramps on weekends and public holidays. Technical staff from the Fisheries Research Section were to conduct counts and interviews irregularly at other localities in the area of the survey and to assist at Rottnest Island, where a two man interview team

was required because of the necessity of using a boat to conduct interviews.

J. METHODS OF DATA ANALYSIS

1. INTERVIEWS - SHORE BASED ANGLERS

The information gathered for each interview was to be analysed to determine the following:

(a) The total time (to be) spent fishing, t_t. This was taken to be the difference between the estimated time of departure from the fishing location and the estimated time of arrival at the fishing location.

(b) The fishing time, t_f. This was the time spent by the fisherman to catch the observed catch and was taken to be the difference between the time at which the interview was conducted (or the time at which the fisherman stopped fishing) and the estimated time of arrival at the fishing location. If the fisherman had been interviewed previously on the same day, t_f was calculated by taking the difference between the time at which the current interview was conducted and the time at which the previous interview ended.

(c) The number in the fishing party, n_p.

(d) The number of Australian herring caught, C. This was taken to be the total number of Australian herring caught between the time of arrival at the location and the time at which the interview was conducted. If the fisherman had been interviewed previously on the same day, C was calculated by taking the difference between the number of Australian herring at the current interview and the number at the previous interview.

(e) The number of Australian herring per man per hour, C_{mh}. This was calculated from the above by the formula

$$C_{mh} = \frac{C}{t_f . n_p}$$

Information from all interviews for the same location and period was combined by calculating the following:

(f) The mean time spent fishing, $\bar{t}_t$, where

$$\bar{t}_t = (\Sigma t_t)/(\text{number of parties interviewed})$$

where the summation is over the individual parties interviewed (i.e. does not include subsequent interviews of the same party).

(g) The mean number of Australian herring per man per hour, $\bar{C}_{mh}$, where

$$\bar{C}_{mh} = (\Sigma C_{mh})/(\text{number of actual interviews})$$

where the summation is over all interviews.

2. INTERVIEWS - BOAT FISHERMAN

In addition to the above (1.(a) - 1.(g)), the average number of men per boat, $\bar{n}_p$, was calculated for the boat fisherman, where

$$\bar{n}_p = (\Sigma n_p)/(\text{number of boats interviewed.})$$

3. COUNTS

Because of problems in obtaining adequate information on the number of people fishing at each locality and because of the difference between counting techniques at different locations, a number of techniques were used to estimate the actual number of fishermen (m) or boats (b) present at any location during any period.

Let m_i = the number of fishermen counted at the i^{th} count

b_i = the number of boat trailers counted at the i^{th} count

$\bar{t}_c$ = the average time between counts

and $\bar{t}_d$ = the average duration of each count

then

(a) if the counts were made on the hour every hour (i.e.

instantaneous counts),

$$m = \Sigma_i m_i / \bar{t}_t$$

and $$b = \Sigma_i b_i / \bar{t}_t$$

(b) If the counts were made in a progressive fashion and the average duration of count exceeded one hour

$$m = (\Sigma_i m_i)(\bar{t}_d)/\bar{t}_t$$

and $$b = (\Sigma_i b_i)\ (\bar{t}_d)/\bar{t}_t$$

(c) If instantaneous counts were made but the average interval between counts exceeded one hour,

$$m = (\Sigma_i m_i)\ (\bar{t}_t)/\bar{t}_t$$

and $$b = (\Sigma_i b_i)\ (\bar{t}_c)/\bar{t}_t$$

(d) If insufficient counts were made to accurately determine m and b from any of the above techniques, then, based on the interviews and counts actually made, subjective estimates of m and b were made.

4. NUMBER OF BOAT FISHERMEN

This was calculated from the average number of men per boat and the estimate of the number of boats

i.e. Number of boat fishermen = $\hat{m} = b \cdot \bar{n}_p$

5. TOTAL CATCH OF AUSTRALIAN HERRING FOR THE PERIOD AND LOCATION

This was then calculated from the formula

Total number of Australian herring caught = $\bar{C}_{mh} . m . \bar{t}_t$

6. TOTALS FOR THE MONTH FOR EACH LOCATION

The estimate of number of men fishing and catch were then

separately totalled for mornings and afternoons for all weekdays, weekends and public holidays on which interviews were conducted (see Tables 2 - 5). By simple proportion, the total number of men fishing and the total catch were then estimated for all weekdays, weekends and public holidays for all days of the month, and finally these estimates were accumulated to provide an estimate of the total number of man-days of fishing and total catch for the month.

7. TOTALS FOR THE METROPOLITAN COASTAL AREA

Based on the relative numbers of anglers at the various locations compared with those actually surveyed, it was possible to estimate (again by simple proportion) the catch at other locations for each month.

III RESULTS

A. DEFICIENCIES OF THE CENSUS

The major problem encountered during the survey was the lack of adequate count information, particularly in those locations where progressive counts had to be made. Although the average count at North Mole was found to take only about fifteen minutes (and could be regarded as being instantaneous), the length of shoreline and the inaccessibility of the Swanbourne drain fishing location (access through the Swanbourne Rifle Range by kind permission of the Commonwealth Department of Defence (Army)) caused the count at Swanbourne-Cottesloe to have an average duration of sixty minutes, with additional time required for interviews. Also, it was found easier to interview fishermen in the Swanbourne-Cottesloe area as they were encountered, rather than attempting to interview between counts.

At the boat ramps, it soon became apparent that the most convenient count was that of the empty trailers at the ramp, and that recording of the time of departure and arrival of individual boats interfered with the interviewing of boats returning to the ramp. The latter technique was therefore abandoned. It was found that interviewing at the boat ramps became difficult when only a few boats were using the ramps as people were

anxious to remove their boats from the water and return home; when boats were plentiful and were queuing to use the ramps, the fishermen were most cooperative.

Counts at Rottnest Island were found to require about three hours. When combined with biological sampling, it was usually found impossible to obtain more than one count per day for the island.

Lack of staff made it difficult to obtain sufficient counts of anglers fishing the entire area covered by the survey.

Limited time available by a Research Officer to supervise and coordinate the operation, and to analyse the data on a continuing basis, resulted in the failure of interviewers in several instances to provide all the required information. Supervision was complicated by lack of contact with interviewers ranging up to two weeks from the time the work was carried out; the lack of contact being caused by the interviewer's schedule of operations. Certain faults only became obvious when the data was being analysed at the conclusion of the census. The most common fault appeared to be the failure of the interviewer to take sufficient counts.

It was found that the proposed sampling design was not entirely practical. The Rottnest Island fishery would not be sampled at the times originally specified due to limited availability of the four wheel drive vehicle (which was required for another programme) and the additional time required to take length frequency scale and gonad samples. Also, because the same interview staff were used at Rottnest Island and North Mole on alternate weeks, travel to and from Rottnest Island (with additional time being required to clean the laboratory at the conclusion of each sampling week at the island) used time which should have been spent at North Mole, thereby reducing the number of days of interviewing at North Mole from that originally proposed.

The time available from budgetted funds for temporary interview staff was reduced by the need to pay overtime for the additional time spent at Rottnest Island. The available time was further reduced by the necessity for bringing all university students together on the first sampling period to demonstrate the interviewing and counting techniques which were to be used and to show them the locations to be covered.

Because of these reductions in the available fund, other reductions had to be made in the programme. As few fishermen were observed to be fishing at North Mole and Swanbourne-Cottesloe between 0500 hours and 0800 hours, and between 2000 hours and 2400 hours, the interview times were changed to

morning : 0800 hours to 1300 hours

evening : 1500 hours to 2000 hours

Little activity was noticed at the East Street boat ramp during the preliminary surveys. It was therefore decided to concentrate attention on the Cockburn Sound boat ramp.

Because of the inadequate number of available sampling staff, the proposed stratification of each week was not carried out. Instead, each week at shore locations was considered to consist of

Weekday mornings and evenings

Weekend mornings and evenings

and Public holiday mornings and evenings.

The allocation of personnel to these was made randomly for those days of each week that staff were available. Sampling at Rottnest Island proved to be more opportunistic than random, as, to a large extent, available time was determined by the biological sampling programme.

The interview and count forms used in the survey were found to be not entirely satisfactory. Additional space was needed on the form for comments by both the interviewer and the fishermen and, insufficient provision was made on the form for the number of different species that were observed to be caught. Counts and interviews could well have been recorded on the same form, with provision being made for more interviews on the one sheet. Possibly if detailed instructions to the interviewer had been provided on the form, in addition to changing the layout (see Appendix 5 for proposed sheet), the failure of interviewers to provide complete information might have been avoided.

On occasions when anglers' catches exceeded three dozen fish it became too time consuming to individually count each fish in the catch. Under these circumstances only the fishermen's estimates of the catch were recorded. This of course introduces bias as the fisherman tends to round to the nearest dozen or round figure.

It was observed that anglers at some locations (e.g. Naval Base Groyne) were using more than one rod at the same time. Although the number of men fishing was recorded, interviews did not request information on either the number of rods or the number of hooks being used.

Although few salmon were actually recorded as having been caught, from speaking to anglers it appeared that quite a number were hooked at Cottesloe Groyne, North Mole and Mandurah, mostly at times when interviewers were not working. Also, it would appear that the number of salmon landed is considerably less than the number hooked.

B. BIAS IN THE ANALYSIS

Because of inadequate count information at Rottnest Island, it was necessary to make the assumption that a single count detected all fishermen fishing at the Island during the whole day. It is extremely doubtful that this assumption is correct, but it would be difficult to assess the error actually involved without additional information on the distribution of fishing throughout the day.

Failure to obtain sufficient counts over the whole area being surveyed made it impossible to provide more than extremely rough estimates of the total catch for the whole metropolitan coast.

The influence of weather and of time of day on both fishing pressure and catch-rate have not been analysed, nor have the subjective estimates of the fisherman's ability been used in the present analysis.

C. AUSTRALIAN HERRING CATCH BY AMATEUR FISHERMEN

Daily summaries of the data collected from each "typical" location throughout the survey are recorded in Appendix 4.

62668-5

Tables 2 - 5 show the estimates of fishing pressure and Australian herring catch for each month at each location surveyed.

As mentioned previously, the number of counts which covered the whole area being surveyed were too few to provide more than very gross estimates of the total Australian herring catch. These estimates are however provided below.

Based on the count of 6.4.73 (see Table 6), it was estimated that twenty six of the shore locations yielded a catch of 173 000 Australian herring during April. Adjusting this for the thirty three locations (by simple proportion), the catch was estimated to be of the order of 219 000 Australian herring. Similarly, the count on 22.4.73 produced an estimate of 100 129 Australian herring for April. A similar technique was then used for the counts of 1.5.73 and 19.5.73. No counts were made during June, and the figures for May were therefore used again to estimate the June catch. The resulting estimates for the shore locations are as follows:

April	100 129	and	219 257.	Australian	herring	mean:	159 000
May	216 425	"	216 949	"	"	"	216 000
June	173 898	"	173 478	"	"	"	173 000

Insufficient count data for the boat ramps (see Table 7) made it impossible to provide more than the following estimate. If it is assumed that each boat ramp has only ten per cent of the volume of boats observed at Cockburn Sound, then, for the twenty one boat ramps, the estimates are:

April	82 000	Australian	herring
May	17 000	"	"
June	17 000	"	"

The estimates for Rottnest Island (see Table 5) were:

April	13 000	Australian	herring
May	32 000	"	"
June	2 000	"	"

Then, by combining, the total amateur catch for the metropolitan coast and Rottnest Island is of the order of

April	254 000	Australian herring
May	265 000	" "
June	192 000	" "

It should be mentioned again that these figures are based on extremely broad assumptions and must therefore be viewed with a high degree of scepticism. They do provide however a rough index of the magnitude of the amateur Australian herring fishery.

D. OTHER INFORMATION

It is perhaps useful to note that strong north winds were the only weather conditions which made the public Cockburn Sound ramp unusable.

A number of complaints were received from anglers regarding alleged illegal netting of herring in Cockburn Sound.

Publicity given to the survey (mainly through the press) prior to its commencement was most successful. Most anglers interviewed were aware that the survey was being conducted and hence gave excellent cooperation throughout the survey. Those few complaints which were received were in relation to some anglers (mainly regulars at certain locations) being repeatedly interviewed during a single interview session, or over a number of different sessions, and others who objected to being asked to supply their name.

IV DISCUSSION

The lack of adequate counting information severely hampered the analysis of the data gathered during this census. If future censuses are to be conducted this fault should be borne in mind; extra counts must be obtained either at the expense of interviewing time or by the provision of additional staff

or by aerial surveys. In addition, a Research Officer should be assigned full time to the task of supervising and coordinating the survey, with a Technical Officer to arrange the basic logistics of the census. A preliminary survey of the area to be studied combined with a trial run of the census for at least a week should be regarded as a prerequisite to the proper planning of any future census. Future studies should also consider the possible bias produced by weather, etc. and also provide estimates of the variance of the estimates of catch.

However, with these shortcomings in mind, it is still possible to use the above data to estimate the order of magnitude of the contribution of amateur caught Australian herring to the total Australian herring catch from the waters off the Perth metropolitan area.

Assuming that one Australian herring has an average weight of 200 grammes, then the weight of the total amateur catch from waters off the metropolitan area during April, May, and June, 1973 was approximately 142 000 kilogrammes. Then compared to the recorded (Australian Bureau of Statistics) and estimated (research log books) professional catch for 1972 and 1973 (Tables 8 and 9) and allowing for considerable bias in the estimate of the amateur catch, it is clear that in 1973, the latter was considerably greater than the professional catch.

However, as 1973 was the first year that the waters around Rottnest Island, within 805 metres of the shore, were completely closed to the netting of all fish, (Ministerial Notice, Govt. Gazette 25, 23rd March, 1973) it would be reasonable to expect a relatively small professional catch during that year.

To obtain a more realistic impression of the expected relative magnitudes of the amateur and professional catches, the catches for the year prior to the Rottnest closure (i.e. 1972) were compared. Assuming the 1972 amateur catch was the same order of magnitude as the 1973 catch, then it would appear that the 1972 amateur catch would have still been approximately twice as great as the professional catch during that year (Table 9).

V CONCLUSIONS

Before undertaking a detailed creel census operation of the type described above, it must clearly be recognised that it will be an expensive operation involving a large number of field staff to obtain catch estimates within any reasonably acceptable limits of error.

However despite the considerable number of recorded deficiencies in the design and execution of the creel census programme, a rough index was obtained of the magnitude of the amateur Australian herring catch in the waters off the Perth metropolitan area during the months of April, May and June, 1973.

Compared to the recorded and estimated professional catch during 1972 and 1973, and allowing for considerable bias in the estimate of the amateur catch, it is clear that the latter is capable of being at least equal to, and probably considerably greater than the professional catch from these waters.

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TABLE 1 Western Australian commercial production of Australian herring (source - summaries produced by Australian Bureau of Statistics).

Period (July 1 to June 30)	Production (kg live weight)
1951-52	268 498
52-53	457 941
53-54	343 789
54-55	403 942
55-56	325 056
56-57	461 420
57-58	395 457
58-59	625 372
59-60	490 420
60-61	416 815
61-62	353 556
62-63	381 369
63-64	240 457
64-65	400 419
65-66	423 755
66-67	322 920
67-68	338 461
68-69	619 462
69-70	614 994
70-71	734 091
71-72	865 638
72-73	1 187 440
73-74	951 556
74-75	793 712
75-76	406 691

TABLE 2 - The number of fisherman days expended and the total number of Australian herring caught each survey month during 1973 for Swanbourne-Cottesloe.

		OBSERVED			ESTIMATED		
		Inter-view days	No. of man/ days	No. of Australian herring caught	Poss-ible days	No. of man/ days	No. of Australian herring caught
April	MORNING						
	Weekdays	5	62	629	19	236	2 390
	Weekends	2	118	1 218	7	413	4 263
	Easter	4	167	404	4	167	904
	AFTERNOON						
	Weekdays	6	47	181	19	149	573
	Weekends	2	64	175	7	352	962
	Easter				4		
	TOTAL					1 317	9 092
May	MORNING						
	Weekdays	12	160	1 645	23	307	3 153
	Weekends	3	83	1 442	8	221	3 845
	AFTERNOON						
	Weekdays	6	99	1 565	23	379	5 999
	Weekends	4	83	171	8	166	342
	TOTAL					1 073	13 339
June	MORNING						
	Weekdays	3	41	625	20	273	4 167
	Weekends	2	48	1 059	7	168	3 706
	Long Weekend	3	123	1 052	3	123	1 052
	AFTERNOON						
	Weekdays	1	12	42	20	240	840
	Weekends	2	40	206	7	140	721
	Long Weekend	2	46	137	3	69	206
	TOTAL					1 013	10 692

TABLE 3 - The number of fisherman days expended and the total number of Australian herring caught each survey month during 1973 for North Mole.

		OBSERVED			ESTIMATED		
		Inter-view days	No. of man/ days	No. of Australian herring caught	Poss-ible days	No. of man/ days	No. of Australian herring caught
April	MORNING						
	Weekdays	4	133	315	19	632	1 496
	Weekends	2	118	488	7	413	1 708
	Easter	4	422	459	4	422	459
	AFTERNOON						
	Weekdays	2	40	429	19	855	4 076
	Weekends	2	166	233	7	581	816
	Easter	1	268	58	4	1 072	232
	TOTAL					3 475	8 787
May	MORNING						
	Weekdays	6	319	3 018	23	1 223	11 569
	Weekends	4	381	872	8	762	1 744
	AFTERNOON						
	Weekdays	3	131	76	23	1 004	583
	Weekends	2	115	359	8	460	1 436
	TOTAL					3 449	15 332
June	MORNING						
	Weekdays	2	118	1 207	20	1 180	12 070
	Weekends	2	96	578	7	336	2 023
	Long Weekend	2	118	150	3	177	225
	AFTERNOON						
	Weekdays	2	111	793	20	1 110	7 930
	Weekends	2	121	710	7	424	2 483
	Long Weekend	2	184	734	3	276	1 101
	TOTAL					3 503	25 834

TABLE 4 - The number of fisherman days expended and the total number of Australian herring caught each survey month during 1973 for Cockburn Sound boat ramp.

		OBSERVED			ESTIMATED		
		Inter-view days	No. of men fishing	No. of Australian herring caught	Poss-ible days	No. of men fishing	No. of Australian herring caught
April	Weekdays	3	186	1 240	19	1 178	7 853
	Weekends	4	672	2 871	7	1 176	5 024
	Easter	2	1 190	7 255	4	2 380	14 510
	TOTAL					4 734	27 387
May	Weekdays	5	78	354	23	359	1 628
		3	381	1 557	8	1 016	4 152
	TOTAL					1 375	5 780
June	Weekdays	8	4	27	20	10	68
	Weekends	3	302	2 004	7	705	4 676
	Long Weekend	2	264	629	3	396	944
	TOTAL					1 111	5 688

TABLE 5 - The number of fisherman days expended and the total number of Australian herring caught each survey month during 1973 for Rottnest Island

		OBSERVED			ESTIMATED		
		Inter-view days	No. of men fishing	No. of Australian herring caught	Poss-ible days	No. of men fishing	No. of Australian herring caught
April	ANGLERS						
	Weekdays	8	127	733	19	302	1 741
	Weekends	4	170	1 315	7	298	2 301
	Easter	3	93	558	4	124	744
	TOTAL					724	4 786
	BOAT FISHERMEN						
	Weekdays	2	24	347	19	228	3 296
	Weekends	2	88	942	7	308	3 297
	Easter	2	115	1 032	4	230	2 064
	TOTAL					766	8 657
May	ANGLERS						
	Weekdays	4	380	3 385	23	971	8 650
	Weekends	3	86	785	8	229	2 093
	TOTAL					1 200	10 743
	BOAT FISHERMEN						
	Weekdays	2	88	937	34	1 012	10 776
	Weekends	2	120	2 226	8	480	10 656
	TOTAL					1 492	21 432
June	ANGLERS						
	Weekdays	7	41	621	20	260	1 774
	Weekends	4	39	238	7	68	416
	Long Weekend	1	10	12	3	30	36
	TOTAL					358	2 226

TABLE 6 - Total counts of shore based anglers over the survey period.

LOCATIONS	FRI 6/4	MON 9/4	FRI 13/4	SUN 22/4	MON 23/4	WED 25/4	TUES 1/5	THURS 10/5	FRI 11/5	SAT 19/5	TUE 19/6
Two Rocks				11			0			0	0
Yanchep				12			0			3	0
Quinns Rock				11			3			1	0
Burns Beach				5			2			1	0
Mullaloo				4			0			2	0
Whitfords				15			0			7	0
Sorrento				32			5			5	0
North Beach	2			14			13	15	7		0
Trigg	0									11	0
Scarborough	0			32	13	2	8			6	0
City Beach	11			47			13			13	0
Swanbourne	0	0		47			6			6	0
Cottesloe	4	5		14			4			4	0
Leighton	0			7			1				0
North Mole	7			34			14				11
South Mole	10										
FBH Groyne	2										
Sth Beach Groyne	5										
Bradford Kdl.	1		3								
Robbs Jetty	3		4								
Shilkin T.	0		0								
Woodman Pt	9		3								
Naval Base Groyne	0										
Kwinana	0										
Rockingham	4										
Palm Beach	13										
Pt Peron	0										
Shoalwater Bay	0										
Safety Bay	3										
Warnbro Sound	0										
Long Pt	0										
Beaches Nth Mandurah	2										
Mandurah	0										

TABLE 7 - Total counts of trailers at boat ramps and dinghies sighted fishing offshore. (B = Boats M = Men)

LOCATION	BOATS FISHING								BOAT TRAILERS							
	FRI 6/4		SUN 22/4		TUES 1/5		SAT 19/5		WED 4/4	FRI 6/4	SAT 14/4	SUN 15/4	THURS 26/4	SAT 28/4	SUN 29/4	SAT 19/5
	B	M	B	M	B	M	B	M								
Two Rocks			0	0	0	0	0	0								0
Yanchep			0	0	0	0	0	0								0
Quinns Rocks			16	0	0	0	1	2								3
Burns Beach			0	0	0	0	0	0								0
Mullaloo			0	0	0	0	0	0								0
Whitfords			0	0	0	0	0	0								0
Sorrento			0	0	0	0	2	4								1
North Beach			0	0	0	0	0	0								0
Trigg			0	0	1	4	0	0								3
Scarborough			0	0	0	0	0	0								0
City Beach			0	0	0	0										
Swanbourne			0	0	1	1										
Cottesloe			0	0	0	0										
Leighton			0	0	0	0										
East Street									4		36	74	3			
North Mole	0	0	0	0	0	0				0						
South Mole	4	4								0						
FBH Groyne	0	0								0						
Sth Bch Groyne	0	0								0						
Bradford Kdl	0	0								0						
Robbs Jetty	2	4								0						
Shilkin T.	0	0								1						
Woodmans	12	27								4						
Cockburn Sound	2	4								21						
Rockingham	0	0								0						
CYC Jetty	0	0								0						
Palm Beach	0	0								6				22	18	
Hymus St Bch	0	0								0						
Pt Peron	0	0								0						
Shoalwater Bay	0	0								0						
Safety Bay	2	3								0						
Warnbro Sound	0	0								0						
Long Pt	0	0								0						
Bch Nth Mandurah	0	0								0						
Mandurah	1	2								0						

TABLE 8 - Recorded Commercial Carches (kg) from waters off the Perth Metropolitan area - 1973.

	SPECIES					
	AUSTRALIAN SALMON			AUSTRALIAN HERRING (RUFF)		
BLOCK	APRIL	MAY	JUNE	APRIL	MAY	JUNE
3215	4 463	15 472	0	148	0	0
3115	634	0	0	100	273	0
9501	0	0	0	0	0	0
9502	0	0	65	0	0	54
Monthly Total	5 097	15 472	65	248	273	54
TOTAL	20 634			575		

TABLE 9 - Recorded and estimated professional catch (kg) and amateur catch of Australian herring from waters off the Perth Metropolitan area, 1972 and 1973.

CATCH	YEAR 1972	1973
Recorded	31 877	575
Estimated	62 024	4 759
Amateur	not available	142 000

APPENDIX 1 - Interview sheets used at shore locations and boat ramps.

Recorded by: INTERVIEW SHEET Date:

Interview Commenced						
Location						
Name of Fisherman/Boat						
No. in Party						
Interview before/anecdote						
Time commenced fishing						
Time intend leaving						
Time finished						
Gear rigged						
Bait						
No. of Blowfish*						
Rod/Line						
Type of Fishermen						
No. of Australian herring						
No. of Australian salmon						
Catch examined						
Interview end						

* Blowfish *(Sphoeroides pleurogramma)*

APPENDIX 2 - Count sheet used for boats and trailers at boat ramps.

BOAT RAMP COUNT

Count of boats at location: .....

Date: .....

Commenced at: ..... hours

Wind	Sea	Weather
Calm	Calm	Blue sky
Light breeze	Slight	Less than 50% overcast
Moderate breeze	Moderate	Greater than 50% overcast
Strong breeze	Rough	Drizzle
Moderate gale	Very rough	Moderate rain
Strong gale		Heavy rain

Boat No.	Time of Departure from Ramp	Time of Arrival Back at Ramp	No. of People

Recorded by: ..... Completed at: .... hours

APPENDIX 3 - Count sheet used at shore locations and Rottnest Island.

BOAT AND ANGLER COUNT

Recorded by:

Date:

Wind

Calm	C
Light breeze	LB
Mod. breeze	MB
Strong breeze	SB
Mod. gale	MG
Strong gale	SG

Sea

Calm	C
Slight	S
Mod.	M
Rough	R
Very rough	VR

Weather

Blue Sky	BS
<50% overcast	<50
>50% overcast	>50
Drizzle	D
Mod. rain	MR
Heavy rain	HR

LOCATION	Hours		Boats			No. of Shore Based Fishermen	Conditions			
	Comm.	Comp.	Moor.	Fish.	No. of Anglers		Wind	Dir.	Sea	Weath.

APPENDIX 4 - Daily Summaries of data collected throughout the survey.

LOCATION: SWANBOURNE-COTTESLOE MONTH: APRIL 1973 SAMPLING PERIOD: MORNING

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of Anglers	No. of Australian herring caught by anglers	No. of Australian herring/ man/hour for anglers
1	Sun							
2	Mon							
3	Tues							
4	Wed							
5	Thurs	C	E	C	BS	29	105	1.3302
6	Fri							
7	Sat	LB	SW	S	<50%	25	430	5.447
8	Sun	LB	SSE	S	<50%	93	788	2.8881
9	Mon							
10	Tues							
11	Wed							
12	Thurs							
13	Fri							
14	Sat							
15	Sun							
16	Mon	SB	SW	R	50%	0	0	0
17	Tue							
18	Wed	C	-	C	50%	19	265	3.6589
19	Thurs							
20	Fri	C	E	S	<50%	98	641	2.0065
21	Sat	C	S-NE	C	<50%	34	164	1.5755
22	Sun	C	E	C	BS	23	63	1.5699
23	Mon	M	-	-	50%	12	36	0.7405
24	Tues							
25	Wed							
26	Thurs							
27	Fri	S	NW	R	50%	6	44	2.3543
28	Sat							
29	Sun							
30	Mon	MB	NE	M	BS	8	215	8.2189

LOCATION: SWANBOURNE-COTTESLOE MONTH: APRIL 1973 SAMPLING PERIOD: AFTERNOON

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of Anglers	No. of Australian herring caught by anglers	No. of Australian herring/ man/hour for anglers
1	Sun							
2	Mon							
3	Tues	SB	SW	M	>50%	12	12	0.25
4	Wed	MB-LB	SW-SE	M-S	BS	18	8	0.185
5	Thurs							
6	Fri	MB-C	SW	M-C	>50%-BS	8	90	5.6111
7	Sat	SB-MB	SW	M-R	>50%	24	96	2.3
8	Sun	LB-MB	S	S	50%	40	79	0.8909
9	Mon							
10	Tues							
11	Wed							
12	Thurs	SB-MG	NW	R-VR	50%	1	0	0
13	Fri							
14	Sat							
15	Sun							
16	Mon							
17	Tues	MB-LB	SW	M-S	50%	3	41	2.1923
18	Wed							
19	Thurs	LB	SW	S	BS	5	30	1.5971
20	Fri							
21	Sat							
22	Sun							
23	Mon							
24	Tues							
25	Wed							
26	Thurs							
27	Fri							
28	Sat							
29	Sun							
20	Mon							

LOCATION: SWANBOURNE-COTTESLOE MONTH: MAY 1973 SAMPLING PERIOD: MORNING

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of Anglers	No. of Australian herring caught by anglers	No. of Australian herring/ man/hour for anglers
1	Tues	M-LB	N	S-M	<50%	24	59	1.3345
2	Wed	SB	SW	R	BS	0	0	0
3	Thurs	MG	NW	VR	MR	0	0	0
4	Fri							
5	Sat	MG	W	R	MR	6	255	17.0276
6	Sun	SB	W	R	>50%	33	539	7.0969
7	Mon							
8	Tues	SG	NW	VR	HR	0	0	0
9	Wed							
10	Thurs							
11	Fri							
12	Sat							
13	Sun							
14	Mon	LB	E	S	BS	26	286	3.6701
15	Tues	SB	E	C	BS	24	563	6.2011
16	Wed							
17	Thurs							
18	Fri	C	SW	C	BS	29	167	1.5956
19	Sat							
20	Sun	LB	E	C	<50%	44	648	4.7497
21	Mon							
22	Tues							
23	Wed							
24	Thurs							
25	Fri	C	E	C	BS	37	177	1.5499
26	Sat							
27	Sun							
28	Mon	M	SW	M	50%	12	26	0.9544
29	Tues	MG	W	VR	MR	0	0	0
30	Wed	MG	W	VR	MR	0	0	0
31	Thurs	C	E	C	50%	8	367	10.7319

LOCATION: SWANBOURNE-COTTESLOE MONTH: MAY 1973 SAMPLING PERIOD: AFTERNOON

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of Anglers	No. of Australian herring caught by anglers	No. of Australian herring/man/hour for anglers
1	Tues							
2	Wed							
3	Thurs							
4	Fri	SB	NW	R	50%	4	91	6.2579
5	Sat	MG	W	R	MR	12	0	0
6	Sun	MB	S	S-M	>50%	25	106	2.3484
7	Mon							
8	Tues							
9	Wed							
10	Thurs							
11	Fri							
12	Sat							
13	Sun							
14	Mon	LB	E	S	BS	24	473	6.5644
15	Tues	SB	E	C	BS	18	279	5.8218
16	Wed	LB	E	S	BS	29	523	5.6556
17	Thurs	LB	E	S	BS	24	199	3.2797
18	Fri							
19	Sat	C	W	C	>50%	36	36	0.3438
20	Sun	LB	W	C-S	D-MR	10	29	1.3243
21	Mon							
22	Tues							
23	Wed							
24	Thurs							
25	Fri							
26	Sat							
27	Sun							
28	Mon							
29	Tues							
30	Wed							
31	Thurs	SB	W	R	>50%	0	0	0

LOCATION: SWANBOURNE-COTTESLOE MONTH: JUNE 1973 SAMPLING PERIOD: MORNING

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of Anglers	No. of Australian herring caught by anglers	No. of Australian herring/man/hour for anglers
1	Fri							
2	Sat	S	NE	S	>50%	36	463	5.3321
3	Sun	CB	SE	S	50%	61	426	2.2309
4	Mon	C	E	C	D	26	163	1.7684
5	Tues							
6	Wed							
7	Thurs							
8	Fri							
9	Sat							
10	Sun							
11	Mon	LB	NE	S	50%	15	209	4.653
12	Tues							
13	Wed	MB	S	M	50%	14	383	8.0417
14	Thurs							
15	Fri	L-MB	N	S-M	50%	12	33	0.8293
16	Sat	LB	W	R	MR	7	52	4.6861
17	Sun	MB	L	S	<50%	41	1 007	8.9947
18	Mon							
19	Tues							
20	Wed							
21	Thurs							
22	Fri							
23	Sat							
24	Sun							
25	Mon							
26	Tues							
27	Wed							
28	Thurs							
29	Fri							
30	Sat							

LOCATION: SWANBOURNE-COTTESLOE MONTH: JUNE 1973 SAMPLING PERIOD: AFTERNOON

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather Cloud Cover)	No. of Anglers	No. of Australian herring caught by anglers	No. of Australian herring/ man/hour for anglers
1	Fri							
2	Sat	C	S	C-S	D	18	61	2.0366
3	Sun	LB	S	M	>50%	28	76	1.2256
4	Mon							
5	Tues							
6	Wed							
7	Thurs							
8	Fri							
9	Sat							
10	Sun							
11	Mon							
12	Tues							
13	Wed							
14	Thurs	M	E	M	BS	12	42	1.6068
15	Fri							
16	Sat	LB	W	M	>50%	26	156	4.0111
17	Sun	LB	W	M	<50%	14	50	1.4273
18	Mon							
19	Tues							
20	Wed							
21	Thurs							
22	Fri							
23	Sat							
24	Sun							
25	Mon							
26	Tues							
27	Wed							
28	Thurs							
29	Fri							
30	Sat							

LOCATION: NORTH MOLE MONTH: APRIL 1973 SAMPLING PERIOD: MORNING

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of Anglers	No. of Australian herring caught by anglers	No. of Australian herring/man/hour for anglers
1	Sun							
2	Mon							
3	Tues	LB	SE-NE	C	>50%-D	18	60	1.1489
4	Wed	LB-SB	S-SW	C	<50%	50	58	0.5599
5	Thurs							
6	Fri							
7	Sat	LB-C	SE-SW	C	<50%	40	154	1.1695
8	Sun	LB	E	S-C	50%	78	334	1.1033
9	Mon							
10	Tues							
11	Wed							
12	Thurs							
13	Fri							
14	Sat							
15	Sun							
16	Mon							
17	Tues							
18	Wed	LB	NW-SW	C	>50%	39	126	1.0225
19	Thurs	C-SB	SW	C	50%	26	71	0.8298
20	Fri	C	SW-SE	C	BS	68	199	0.8519
21	Sat	C	ESE	C	BS	73	216	1.0727
22	Sun	MB	NE	M	>50%	99	0	0
23	Mon	MB	NW	M	>50%	182	44	0.0923
24	Tues							
25	Wed							
26	Thurs							
27	Fri							
28	Sat							
29	Sun							
30	Mon							

LOCATION: NORTH MOLE MONTH: APRIL 1973 SAMPLING PERIOD: AFTERNOON

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of anglers	No. of Australian herring caught by anglers	No. of Australian herring/man/hour for anglers
1	Sun							
2	Mon							
3	Tues							
4	Wed							
5	Thurs	SB	SW	C	BS	39	137	1.536
6	Fri	SB-LB	SW	C	>50%	51	292	1.9053
7	Sat	LB-C	SE-SW	C	<50%	70	71	0.3118
8	Sun	SB-C	SW	S-C	>50%	96	162	0.6119
9	Mon							
10	Tues							
11	Wed							
12	Thurs							
13	Fri							
14	Sat							
15	Sun							
16	Mon							
17	Tues							
18	Wed							
19	Thurs							
20	Fri	LB	SW	C	BS	268	58	0.069
21	Sat							
22	Sun							
23	Mon							
24	Tues							
25	Wed							
26	Thurs							
27	Fri							
28	Sat							
29	Sun							
30	Mon							

LOCATION: NORTH MOLE MONTH: MAY 1973 SAMPLING PERIOD: MORNING

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of Anglers	No. of Australian herring caught by anglers	No. of Australian herring/man/hour for anglers
1	Tues							
2	Wed							
3	Thurs	SW	NW	M	>50%	41	39	0.5531
4	Fri							
5	Sat	SB-MG	W	M-VR	>50%	55	264	1.6508
6	Sun	SB	SW	M	>50%	189	396	0.6874
7	Mon	LB	NW	C	>50%	71	272	1.3717
8	Tues	SG	SW	VR	>50%	14	0	0
9	Wed	MB	NW	M	>50%	65	975	4.3331
10	Thurs							
11	Fri	MB	NW	M	>50%	74	329	1.6682
12	Sat							
13	Sun							
14	Mon							
15	Tues							
16	Wed							
17	Thurs							
18	Fri							
19	Sat	MB	E	S	BS	29	27	0.3376
20	Sun	C	N	C	>50%	108	185	0.4654
21	Mon							
22	Tues							
23	Wed							
24	Thurs							
25	Fri							
26	Sat							
27	Sun							
28	Mon							
29	Tues							
30	Wed							
31	Thurs	MB	SW	M	>50%	54	1 403	10.3138

LOCATION: NORTH MOLE MONTH: MAY 1973 SAMPLING PERIOD: AFTERNOON

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of anglers	No. of Australian herring caught by anglers	No. of Australian herring/ man/hour for anglers
1	Tues							
2	Wed							
3	Thurs							
4	Fri	MB	W	S	>50%	46	31	0.2589
5	Sat	SB	NW	R	HR	57	27	0.1642
6	Sun	LB-MB	SW	C-M	<50%	58	332	1.4656
7	Mon							
8	Tues							
9	Wed							
10	Thurs	MB	NW	VR	HR	16	2	0.075
11	Fri							
12	Sat							
13	Sun							
14	Mon							
15	Tues							
16	Wed							
17	Thurs							
18	Fri							
19	Sat							
20	Sun	LB	W	C	MR	69	43	0.2769
21	Mon							
22	Tues							
23	Wed							
24	Thurs							
25	Fri							
26	Sat							
27	Sun							
28	Mon							
29	Tues							
30	Wed							
31	Thurs							

LOCATION: NORTH MOLE MONTH: JUNE 1973 SAMPLING PERIOD: MORNING

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of Anglers	No. of Australian herring caught by anglers	No. of Australian herring/man/hour for anglers
1	Fri							
2	Sat	C	E	C	>50%	47	133	0.7925
3	Sun	C	E	C	<50%	71	17	0.074
4	Mon							
5	Tues							
6	Wed							
7	Thurs							
8	Fri							
9	Sat							
10	Sun							
11	Mon							
12	Tues							
13	Wed	MB	SW	S	>50%	77	868	3.366
14	Thurs	MB	NE-N	C	>50%	41	339	2.2759
15	Fri							
16	Sat	MB	NW	M	D	27	59	0.7193
17	Sun	M	NE	M	>50%	69	519	2.0292
18	Mon							
19	Tues							
20	Wed							
21	Thurs							
22	Fri							
23	Sat							
24	Sun							
25	Mon							
26	Tues							
27	Wed							
28	Thurs							
29	Fri							
30	Sat							

LOCATION: NORTH MOLE MONTH: JUNE 1973 SAMPLING PERIOD: AFTERNOON

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of Anglers	No. of Australian herring caught by anglers	No. of Australian herring / man/hour for anglers
1	Fri	C	SE	C	>50%	64	403	2.3332
2	Sat	MB	SW	S	<50%	111	565	1.884
3	Sun	LB	SE	C	>50%	73	169	0.7165
4	Mon							
5	Tues							
6	Wed							
7	Thurs							
8	Fri							
9	Sat							
10	Sun							
11	Mon							
12	Tues							
13	Wed							
14	Thurs							
15	Fri	MB	NNW	S	>50%	47	390	3.0279
16	Sat	LB	NW	S	>50%	57	43	0.2477
17	Sun	SB	NW	R	D	64	667	3.1325
18	Mon							
19	Tues							
20	Wed							
21	Thurs							
22	Fri							
23	Sat							
24	Sun							
25	Mon							
26	Tues							
27	Wed							
28	Thurs							
29	Fri							
30	Sat							

LOCATION: ROTTNEST ISLAND MONTH: APRIL 1973 SAMPLING PERIOD: MORNING

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of anglers	No. of Australian herring caught by anglers	No. of Australian herring / man/hour for anglers
1	Sun							
2	Mon							
3	Tues							
4	Wed							
5	Thurs							
6	Fri							
7	Sat							
8	Sun							
9	Mon							
10	Tues							
11	Wed	MB	NE	S	>50%	9	32	1.4623
12	Thurs							
13	Fri	LB	SW	S	>50%	4	68	9.0033
14	Sat	LB	SW	C	<50%	54	448	3.0758
15	Sun	M-SB	E-W	C	>50%	27	167	2.6857
16	Mon							
17	Tues							
18	Wed							
19	Thurs							
20	Fri							
21	Sat							
22	Sun	MB	NE	M	<50%	29	371	5.1455
23	Mon							
24	Tues							
25	Wed							
26	Thurs	SB	E	S	<50%	1	0	0
27	Fri							
28	Sat							
29	Sun	L-MB	S	S	50%	60	352	3.335
30	Mon	SB	E	C	BS	5	0	0

LOCATION: ROTTNEST ISLAND MONTH: APRIL 1973 SAMPLING PERIOD: AFTERNOON

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of Anglers	No. of Australian herring caught by anglers	No. of Australian herring / man/hour for anglers	No. of boats	Man/ boat	No. of boats fishermen	No. of Australian herring caught by boat fishermen	No. of Australian herring/man/ hour for boat fishermen
1	Sun												
2	Mon												
3	Tues												
4	Wed												
5	Thurs												
6	Fru												
7	Sat												
8	Sun												
9	Mon												
10	Tues	LB	SW	C	<50%	15	75	2.2975			10	207	10.8
11	Wed												
12	Thurs	SG-MG	WNW	R	>50%	40	249	3.0678					
13	Fri												
14	Sat	LB	SW	C	<50%						44	284	3.6938
15	Sun												
16	Mon												
17	Tues												
18	Wed												
19	Thurs												
20	Fri	LB	SW	S	BS	7	5	0.857			50	279	0.929
21	Sat												
22	Sun												
23	Mon	MB	W	C	>50%	57	182	1.6771			65	753	7.7252
24	Tues	SG	W	VR	>50%	26	66	2.1233					
25	Wed	SB	S	R	>50%	27	243	4.8063			14	140	6.667
26	Thurs												
27	Fri												
28	Sat	L-MB	WNW	S	>50%	52	348	4.0664			44	658	10.3209
29	Sun												
30	Mon												

LOCATION: ROTTNEST ISLAND MONTH: JUNE 1973 SAMPLING PERIOD: MORNING

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of anglers	No. of Australian herring caught by anglers	No. of Australian herring/man/hour for anglers	No. of boats	Men/boat	No. of boat fishermen	No. of Australian herring caught by boat fishermen	No. of Australian herring/man/hour for boat fishermen
1	Fri												
2	Sat		No	Interviews									
3	Sun	SB	E	S	<50%	10	12	12.4222			86	1 528	12.4222
4	Mon		No	Interviews									
5	Tues	SB	NE	*	D	4	142	11.6443					
6	Wed	SB	SW	*	MR	11	158	8.8262					
7	Thurs	MB	SW	*	>50%	8	62	2.9328					
8	Fri												
9	Sat	MB	NE	*	D	6	65	3.8287					
10	Sun	LB	E	C	BS	19	79	1.572					
11	Mon												
12	Tues												
13	Wed												
14	Thurs												
15	Fri												
16	Sat												
17	Sun												
18	Mon												
19	Tues												
20	Wed												
21	Thurs	MG	NW	*	>50%	15	103	10.3582					
22	Fri		No	Interviews									
23	Sat	SB	SW	M	>50%	10	67	4.4775					
24	Sun												
25	Mon												
26	Tues												
27	Wed												
28	Thurs												
29	Fri												
30	Sat												

* Not recorded.

LOCATION: ROTTNEST ISLAND MONTH: MAY 1973 SAMPLING PERIOD: MORNING

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of Anglers	No. of Australian herring caught by anglers	No. of Australian herring/man/hour for anglers	No. of boats	Men/boat	No. of boat fishermen	No. of Australian herring caught by boat fishermen	No. of Australian herring/man/hour for boat fishermen
1	Tues												
2	Wed												
3	Thurs												
4	Fri												
5	Sat												
6	Sun												
7	Mon												
8	Tues												
9	Wed												
10	Thurs												
11	Fri												
12	Sat												
13	Sun												
14	Mon												
15	Tues	MB	SE	S	BS	33	57	1.714					
16	Wed	MB	NE	S-C	BS	29	248	3.1267					
17	Thurs												
18	Fri	SB	NE	S	>50%	36	584	4.6164					
19	Sat												
20	Sun												
21	Mon	SB	SW	M-R	>50%	61	713	6.2491			10	143	9.556
22	Tues	MB	SW	S	>50%	97	945	4.0971					
23	Wed	MB	NE	S	BS	43	438	4.1881					
24	Thurs	MB	SW	*	>50%	7	6	0.4178					
25	Fri	C	NE	C	BS						78	794	4.767
26	Sat	C-LB	NE	C-S	<50%	7	21	1.6025					
27	Sun	MB	NW	S	<50%	42	594	7.0129					
28	Mon												
29	Tues												
30	Wed												
31	Thurs												

* Not recorded

LOCATION: ROTTNEST ISLAND MONTH: MAY 1973 SAMPLING PERIOD: AFTERNOON

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of anglers	No. of Australian herring caught by anglers	No. of Australian herring/man/hour for anglers	No. of boats	Men/boats	No. of boat fishermen	No. of Australian herring caught by boat fishermen	No. of Australian herring/man/hour for boat fishermen
1	Tues												
2	Wed												
3	Thurs												
4	Fri												
5	Sat												
6	Sun												
7	Mon												
8	Tues												
9	Wed												
10	Thurs												
11	Fri												
12	Sat												
13	Sun												
14	Mon												
15	Tues												
16	Wed												
17	Thurs	SB	NE	S-C	BS	14	210	2.5					
18	Fri												
19	Sat												
20	Sun	LB	W	M	HR	15	33	1.765					
21	Mon												
22	Tues												
23	Wed												
24	Thurs												
25	Fri	C	NE	C	BS	60	184	1.4059					
26	Sat	C	N	C	>50%	17	105	1.8764			84	1 788	11.4218
27	Sun	LB	NW	S-M	>50%	5	32	3.1565			36	876	19.4658
28	Mon												
29	Tues												
30	Wed												
31	Thurs												

LOCATION: ROTTNEST ISLAND MONTH: JUNE 1973 SAMPLING PERIOD: AFTERNOON

Date	Day	Wind Intensity	Wind Direction	Sea Condition	Weather (Cloud Cover)	No. of anglers	No. of Australian herring caught by anglers	No. of Australian herring / man/hour for anglers
1	Fir							
2	Sat							
3	Sun							
4	Mon							
5	Tues							
6	Wed							
7	Thurs							
8	Fri							
9	Sat							
10	Sun							
11	Mon							
12	Tues							
13	Wed							
14	Thurs							
15	Fri							
16	Sat							
17	Sun							
18	Mon	LB	WSW	M	>50%	16	32	1.1603
19	Tues	MG	SW	*	>50%	10	12	0.6666
20	Wed	MB	N	M	>50%	27	112	1.57
21	Thurs							
22	Fri							
23	Sat							
24	Sun	LB	S	*	>50%	4	27	2.3335
25	Mon							
26	Tues							
27	Wed							
28	Thurs							
29	Fri							
30	Sat							

* Not recorded

WESTERN AUSTRALIAN MARINE RESEARCH LABORATORIES

CREEL CENSUS REPORT FOR INSTANTANEOUS COUNTS AND INTERVIEWS

INSTRUCTIONS TO INTERVIEWER: This counting period is to be started at _____ hours. The next counting period is to commence at _____ hours. Attempt to interview ___ fishermen at this location during the current counting period.

INTERVIEWER		LOCATION		DATE	___/___/___

WEATHER CONDITIONS: Please tick the appropriate boxes.

WIND						SEA					WEATHER					
Calm	Light Breeze	Moderate Breeze	Strong Breeze	Moderate Gale	Strong Gale	Calm	Slight	Moderate	Rough	Very Rough	Blue Sky	Less than 50% overcast	More than 50% overcast	Drizzle	Moderate Rain	Heavy Rain

COUNT: Please move from sublocation to sublocation completing the table below.

Sublocation	Time	Boats			Boat Trailers	Shore Based Anglers	Sublocation	Time	Boats			Boat Trailers	Shore Based Anglers

INTERVIEWS:

Interview Time	SUBLOCATION (Leave blank if the area cannot be subdivided)	Description of fisherman or name of fisherman or boat number	Interviewed previously (Yes/No)	If not interviewed previously, then complete this section — Number in Party	Time began fishing	Time ended fishing	How is gear rigged?	Rod or line	Number of rods or lines	Number of hooks	BAIT	CATCH Herring	Salmon							

Interviewer: Additional space is provided on the reverse of this sheet for additional interviews, for comments and for anecdotal information.

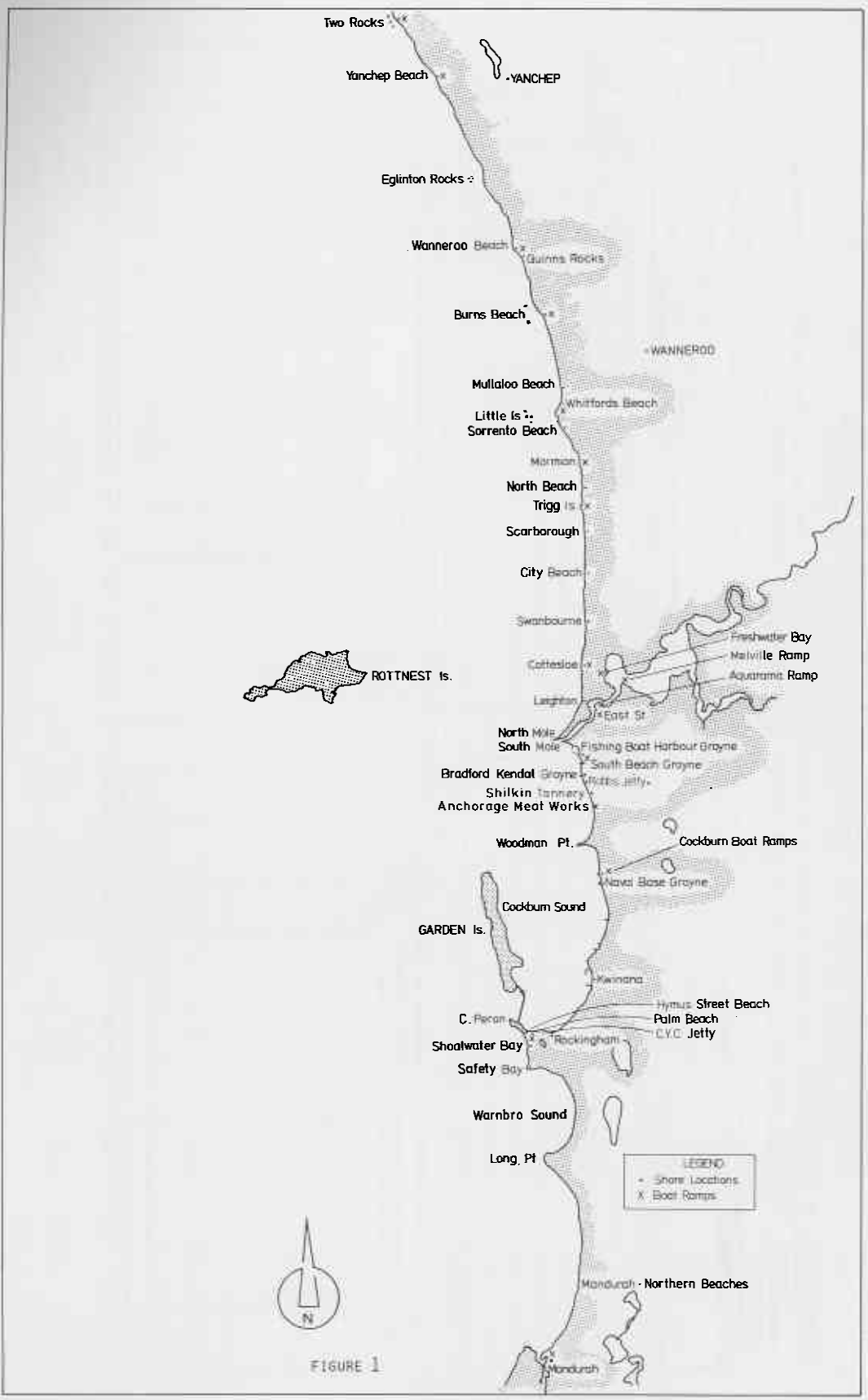
Two Rocks
Yanchep Beach
YANCHEP
Eglinton Rocks
Wanneroo Beach
Quinns Rocks
Burns Beach
WANNEROO
Mullaloo Beach
Whitfords Beach
Little Is.
Sorrento Beach
Marmion
North Beach
Trigg Is
Scarborough
City Beach
Swanbourne
Cottesloe
Leighton
East St
North Mole
South Mole
Fishing Boat Harbour Groyne
South Beach Groyne
Bradford Kendal Groyne
Shilkin Tannery
Anchorage Meat Works
Woodman Pt.
Naval Base Groyne
Cockburn Sound
GARDEN Is.
Kwinana
C. Peron
Rockingham
Shoalwater Bay
Safety Bay
Warnbro Sound
Long Pt
ROTTNEST Is.
Freshwater Bay
Melville Ramp
Aquatarnia Ramp
Cockburn Boat Ramps
Hymus Street Beach
Palm Beach
C.Y.C. Jetty
LEGEND
Shore Locations
Boat Ramps
Mandurah
Northern Beaches
N

FIGURE 1

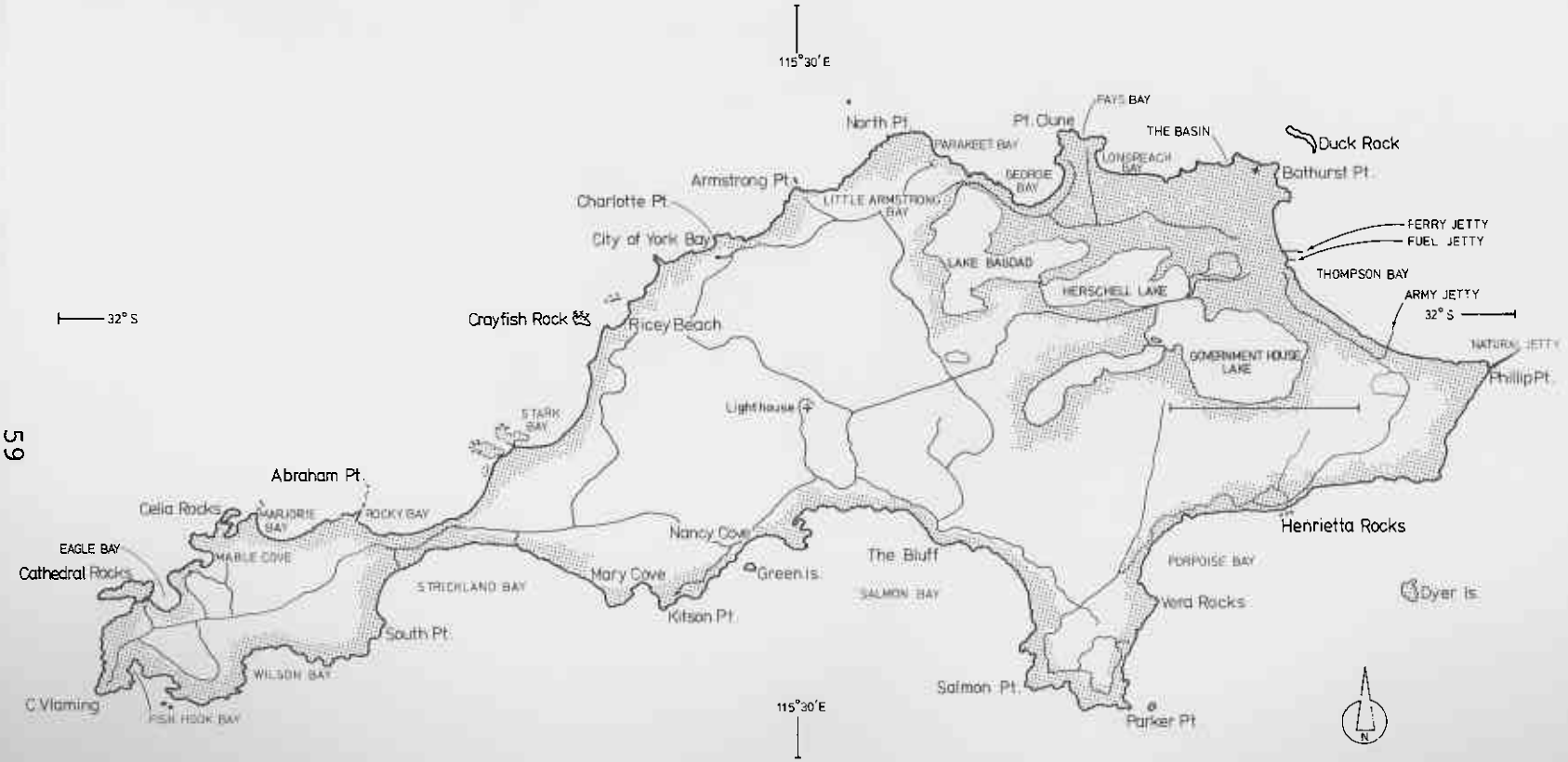
115°30'E
North Pt
Pt Clune
FAYS BAY
THE BASIN
Duck Rock
PARAKEET BAY
LONGREACH BAY
GEORGE BAY
Bathurst Pt
Armstrong Pt
LITTLE ARMSTRONG BAY
Charlotte Pt
City of York Bay
FERRY JETTY
FUEL JETTY
LAKE BAIDAD
HERSCHELL LAKE
THOMPSON BAY
ARMY JETTY
32° S
32° S
Crayfish Rock
Ricey Beach
GOVERNMENT HOUSE LAKE
NATURAL JETTY
Phillip Pt
STARK BAY
Lighthouse
Abraham Pt
Celia Rocks
MARJORIE BAY
ROCKY BAY
Nancy Cove
Henrietta Rocks
EAGLE BAY
MABLE COVE
Cathedral Rocks
The Bluff
PORPOISE BAY
STRICKLAND BAY
Mary Cove
Green Is
SALMON BAY
Dyer Is
Kitson Pt
Vera Rocks
South Pt
WILSON BAY
C Vlaming
FISH HOOK BAY
Salmon Pt
Parker Pt
115°30'E
N
ROTTNEST ISLAND
0
1/2
SCALE OF MILES

FIGURE 2