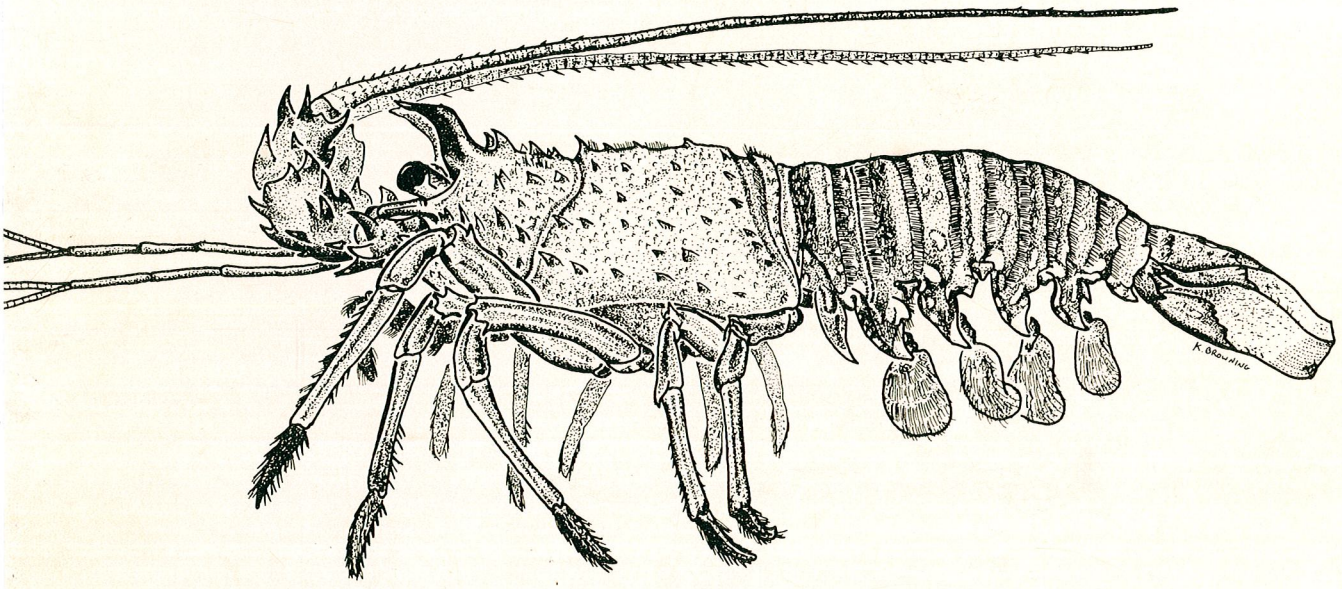
FISHERIES EDUCATION PUBLICATION

Number 1

The Western Rock Lobster Fishery



1985

EXTENSION AND PUBLICITY OFFICE
DEPARTMENT OF FISHERIES AND WILDLIFE
PERTH, WESTERN AUSTRALIA

THE WESTERN ROCK LOBSTER

Panulirus cygnus (GEORGE)

A BRIEF OUTLINE OF THE BIOLOGY OF THE WESTERN ROCK LOBSTER; MANAGEMENT AND RESEARCH; AND THE COMMERCIAL FISHERY OF WESTERN AUSTRALIA.

Department of Fisheries and Wildlife
108 Adelaide Terrace
PERTH W.A.

1984
(4th edition)

ISSN 1814-5962
ISBN 0 7309 0598 5

36876—1

PUBLISHER'S NOTE

CONTAINED IN THIS PUBLICATION IS A BRIEF OUTLINE OF THE ROCK LOBSTER FISHERY OF WESTERN AUSTRALIA.

IT IS PREPARED AND ISSUED BY THE EXTENSION AND PUBLICITY SERVICE OF THE DEPARTMENT OF FISHERIES AND WILDLIFE PRIMARILY AS A PROJECT AID FOR SCHOOLS.

THIS MUST NOT BE USED AS AN OFFICIAL REFERENCE BOOK NOR QUOTED FROM IN ANY OTHER PUBLICATION.

CONTENTS

INTRODUCTION

The management of the Western Australian Rock Lobster Fishery as an economically stable industry is vital to the livelihood of several thousand people engaged in, or associated with the fishery.

Of course, sound management must be based on a complete knowledge of what is happening to the rock lobster stock; for example, how it is affected by migration and what fishing pressures are being exerted upon it.

Continuing research furnishes most of this information - which is ever changing and varying - and provides the data upon which management decisions are made.

The Western Australian Fisheries Department's Marine Research Laboratories on the coast at Watermans - just 17 kilometres north of Perth - house some 30 State fisheries scientists and technical officers. These officers work in close liaison with Commonwealth fisheries scientists and oceanographers in the nearby laboratories of the C.S.I.R.O. Division of Fisheries and Oceanography.

Rock lobster research being carried out by the team of scientists from the State Fisheries Department relates to the commercial aspects of the Western Rock Lobster fishery.

In addition to time spent on other species research programmes, the Department's research vessel "FLINDERS" is extensively involved in rock lobster research studies.

Mark and recapture studies are carried out to estimate population densities on the commercial lobster fishing grounds and to study growth rates.

Among other things, monitoring of the commercial fishery allows scientists to determine more accurately the size at which the rock lobster reaches maturity - that is, the size and age at which the female spawns and the male is capable of fertilising the eggs.

The collection and analysis of commercial statistics provides data from which the state of the fishery can be determined; this in turn becomes the guide upon which decisions are made in respect of management measures; for example, if the catch rate is declining, should there be a reduction in the length of the fishing season.

Studies have been carried out on the effect and extent of octopus predation on the fishery. The loss of lobsters after they have entered the pot is claimed by fishermen to be quite significant and efforts are being made to reduce this loss of catch.

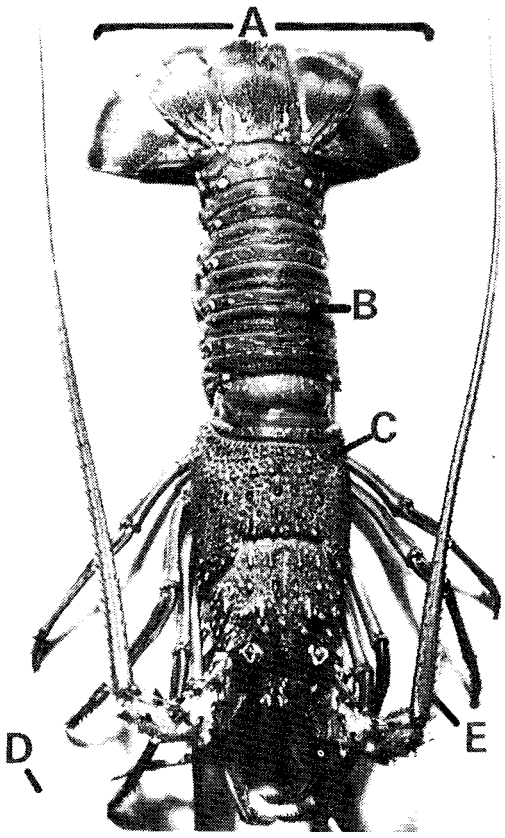
Gear research is an important aspect of the rock lobster studies. The use and efficiency of a rock lobster sorter was tested; this can reduce the time and effort taken by boat crews - and thereby cost - of sorting the undersize lobsters when they are removed from the pots.

The size, design and material specification of escape gaps in pots was the result of extensive research over a number of years.

The C.S.I.R.O. programmes are directed towards an understanding of the life history of the Western Rock Lobster. This involved the use of the chartered Commonwealth research vessel "SPRIGHTLY" for the collection of the free-drifting larvae at sea with net-samplers, and mid-water trawls for sampling final-stage larvae.

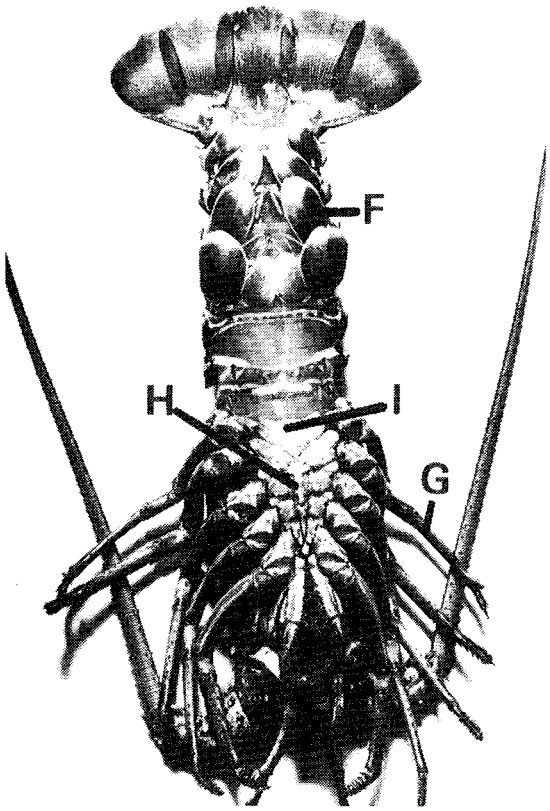
Research is a valuable and essential tool in the management of the Western Rock Lobster fishery and, perhaps, may one day even make the culturing and farming of lobsters a practical and economic proposition.

WESTERN ROCK LOBSTER
Panulirus cygnus (George)



Upper View

A. Tail fan (Telson and Uropods)
B. Tail
C. Body (Carapace)
D. Small feeler (Antennule)
E. Feeler (Antenna)



Underneath view

F. Swimmerette (Pleopod)
G. Leg (Pereiopod)
H. Oviduct opening in female
I. Sperm duct opening in male

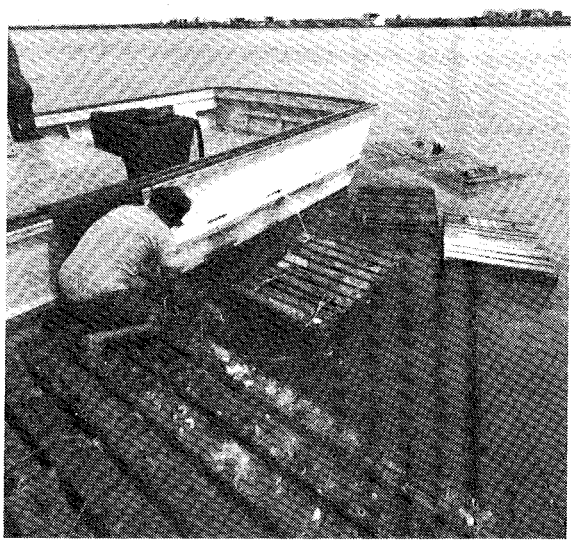
THE NAMING OF THE WESTERN ROCK LOBSTER

The Western Rock Lobster (*Panulirus cygnus* (GEORGE)) is not a crayfish - the name mistakenly given to the lobster by early migrants because of its somewhat similar appearance to the freshwater animal of other countries.

Generally, the term 'crayfish' refers to freshwater decapods (Webster's Dictionary, Oxford Shorter Dictionary and Randon House Dictionary) such as gilgies, marron, yabbies, Murray River Crayfish and koonacs.

The sea or marine animal of Western Australia is a spiny rock lobster of which there are many genera and species throughout the world.

From Western Australia, the lobster has always been marketed as 'rock lobster' and, although it was known locally as crayfish, in 1969, in order to standardize the use of the correct terminology, the Fisheries Act was amended to change all reference of crayfish to read "rock lobster" - its correct name.



Holding pots retain the day's catch of an Abrolhos lobster fisherman.

Pot tippers and winches are used to haul in and bring the heavily weighted pots aboard.

HISTORY OF THE ROCK LOBSTER FISHERY

The first commercial fishery was established in Fremantle between 1895-97 when James Cubbert Brown arrived from Victoria. Brown brought with him a semi-cylindrical piece of gear constructed of wire-netting, with a conical entrance at each end and the bait being suspended from the top. Brown started lobster fishing with the new pot. It was not until some years later, that the beehive pot was introduced.

Prior to World War 1 the taking of rock lobsters was only a part of the general fishery and was restricted to the area around Fremantle and Rottnest, with some later expansion northwards to Geraldton. By 1939 the entire general fishing fleet comprised only about 336 boats involving 675 personnel and very few of the boats took rock lobsters.

The total number of lobsters taken in the commercial catch for 1938 was 56,000 dozen - and valued at only $28,000!

It was not until 1941 that any organized rock lobster fishing took place in the Geraldton-Abrolhos region. The reason for this was the demand by the Defence Foodstuffs Administration for canned lobster for the armed forces, and by special arrangement with the Manpower Directorate, exemption from military service was afforded to approved fishermen who undertook to sell at least 75% of their total catch to a cannery which was opened in 1941 with Government financed assistance.

Up to this time most of the boats were operated under sail and were of varied design and size and only limited and sporadic amounts of lobster had ever been exported from Western Australia.

With the establishment of a large export market for lobster-tails in the U.S.A. in the post-war years (and some whole cooked lobsters to the French market) the industry began to expand.

New types of boats were introduced, equipment and gear became more sophisticated and, by 1954, the fishery had grown to become an important industry. Boats known as 'scooter' boats were in operation, pot winches were used and a bait supply industry was developing. At this time there were about 250 boats in the industry and employing some 530 men in the field of catching plus those engaged in processing etc.

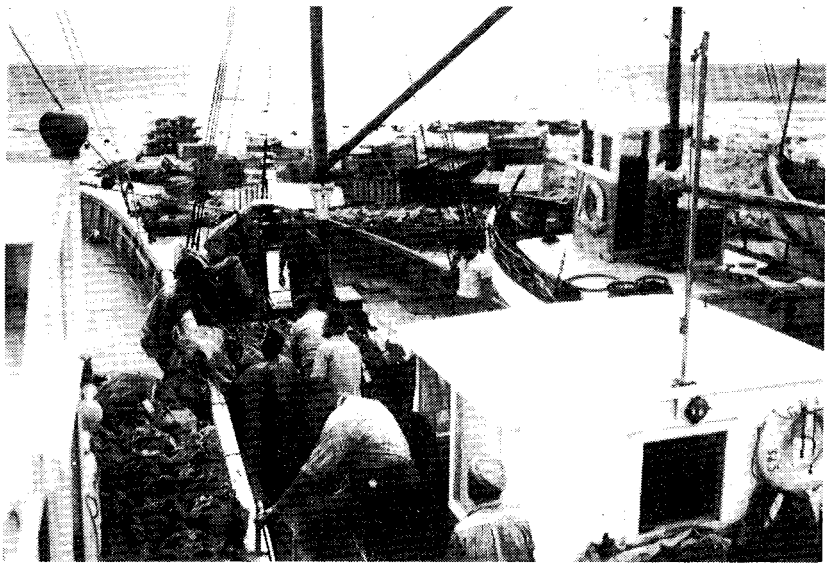
Practically no research work had been undertaken on the rock lobster population or biology on the animal itself but both Fisheries Officers and members of the industry began to realise that the pressure being exerted on the lobster stocks could perhaps lead to its depletion - in other words it would be over-fished, if the then increasing entry into the fishery was not checked.

Fishing effort continued to increase until 1963 when the W.A. fishing authorities and the Commonwealth decided to limit the number of boats and pots which could operate. This was set at 833 boats with a maximum of three pots per foot of boat length (about 76 000 pots).

From that time the fishery became strictly managed and extensive research programmes were carried out by the then Department of Fisheries and Fauna and C.S.I.R.O. This resulted in the establishment of policies and rules to limit the number of boats, their size, the number of pots, the use of escape gaps, closed seasons, defining the area of operation and a system of controls on all rock lobster processing establishments.

Today the fishery is perhaps the best managed of any fishery in the World and is often quoted as demonstrating the success of a limited entry fishery, both from a biological and economic point of view.

Emptying pots and bagging lobsters in earlier years.



Loading a carrier boat with bagged lobsters at the Abrolhos Islands.

REPRODUCTION

Mating takes place during winter/early spring with the male depositing the sperm packet ("tar spot") between the last pair of legs of the female lobster. Mated females do not moult until the eggs have completed their development and the first stage phyllosoma have been released.

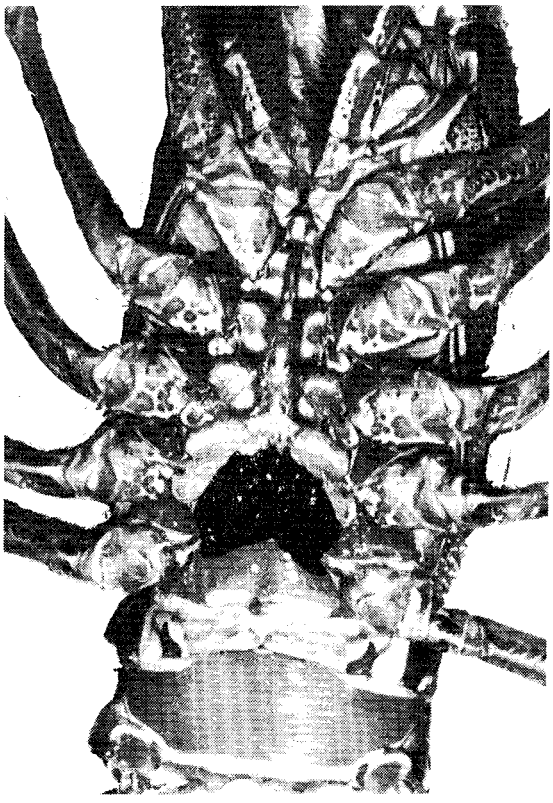
The eggs (approximately 300 000, depending on the size of the female) are laid in spring and early summer. These eggs are fertilised by the female scratching the "tar spot" which releases the sperm on to the eggs as they pass back and adhere to the fine hairs on the swimmerettes.

The eggs are now carried by the "berried" female for 3-9 weeks (depending on the water temperature) before they hatch. During this period the embryo develops within the egg.

After hatching, at about 1.3mm length, the larvae (phyllosoma) float to the surface where they are carried, as part of the plankton, by winds and currents out into the Indian Ocean. Phyllosoma have been recovered 1 900km west of the W.A. coast.

During the ten month planktonic phase of the larvae or phyllosoma, little is known of their requirements in relation to food, salinity, light and depth of water. For this reason, it has not been possible to rear them to the juvenile stage in laboratories. However once the phyllosoma stage has been attained in the natural environment, the juveniles can be held under controlled conditions in aquaria where they will grow and develop into mature lobsters.

Lobster eggs showing the embryo within - the black spots are the developing eyes.



"Tar spot" or sperm packet deposited on the female lobster.

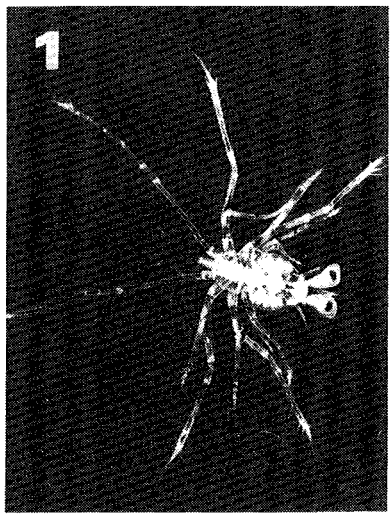
LARVAL LIFE

Development through the phyllosoma stages takes approximately ten months during which time the larvae remains completely transparent.

During this period, the phyllosoma is carried up to 1900km. seawards and passes through some 9-11 conveniently identifiable stages which may involve between 25 and 30 moults.

Little is known about the return of larvae to the inshore areas - this is part of the current research programme of C.S.I.R.O. However, surviving puerulus-stage larvae return to the coast and settle in the shallows (1-20m.) of the inshore limestone reefs.

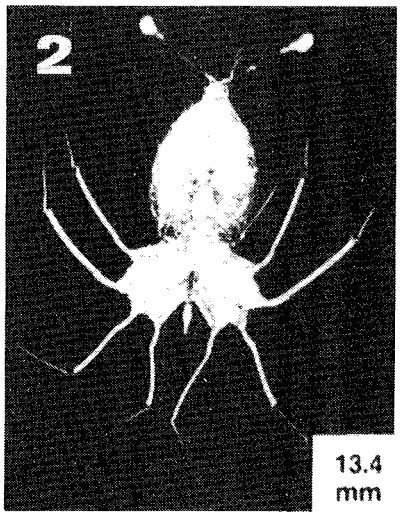
After about a week, the settled puerulus moult into the first juvenile stage. They are then approximately 3cm. long, are slightly pigmented and closely resemble the adult lobster. With successive moults and with a suitable food supply and environment, the pigment deepens into the darker red colour typical of the adult.

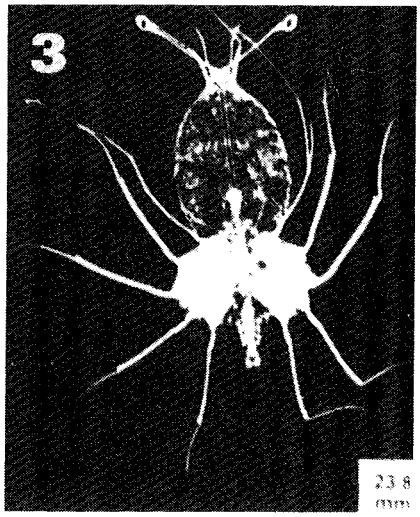


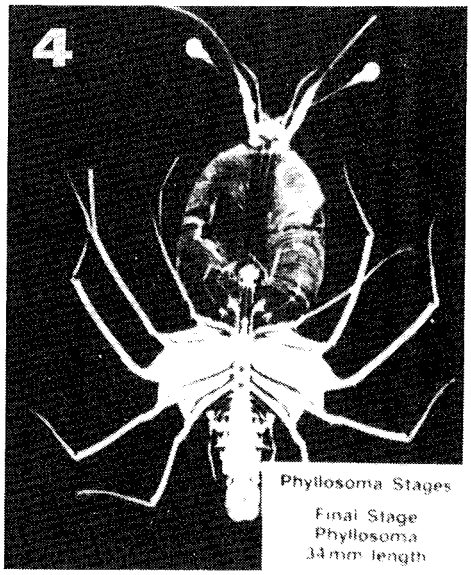
Four of the identifiable stages during the larval life of the rock lobster.

No.1: First stage of the phyllosoma after hatching - the size is about 1.3 mm.

No.4: Final stage before moulting into a very small identifiable rock lobster - about 22 mm overall length.







MOULTING

Although the actual shedding of the shell may take only minutes, the whole process of moulting takes several days. During the few days before moulting, some of the calcium of the shell dissolves while the muscles and organs of the lobster shrink slightly.

When the moulting starts, sea water is taken up by the lobster, thereby creating an internal pressure which pushes out the new soft shell underlying the old one. This causes the shell to crack along the gill chamber and split between the carapace (body) and tail.

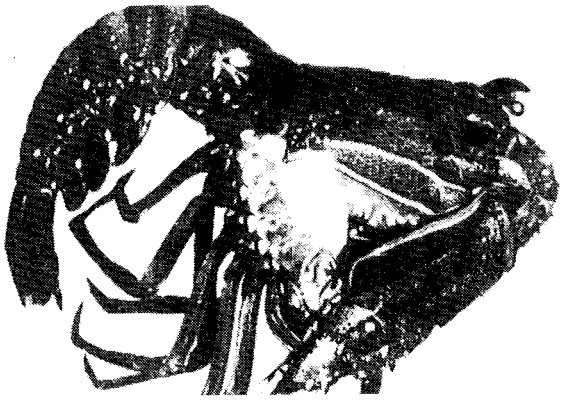
The lobster, with its new soft shell, gradually emerges through this opening, using short flips of the tail to work free from the old shell; the last part to be withdrawn is the tail.

Any leg caught in the old shell is deliberately discarded to ensure that the animal is not trapped; such losses will regrow within one or two moults.

The pressure inside the new shell causes expansion of the soft shell, which allows for subsequent tissue growth. The expanded shell is then hardened by the deposition of calcium salts.

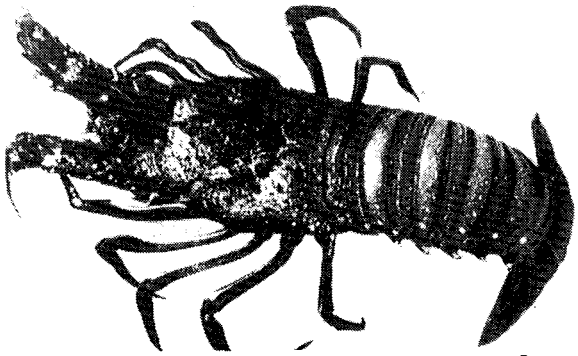
For 3-4 days following the moult, the lobster does not feed. With its shell in a soft condition the lobster is defenceless and therefore remains concealed until the shell hardens. Once the shell has hardened, the hungry lobster will resume feeding.

The top part of the carapace being cast off.



The body is almost completely withdrawn from the old carapace.

The lobster, with its new, soft shell, completely discards the old shell (right).



The lobster, now larger and soft shelled, remains in shelter until the new shell hardens.

GROWTH

Juveniles remain in the shallow coastal reefs for about five years during which time they undergo a series of moults. At each moult the length and weight of the young lobster increase. Although the number of moults may vary, it is generally in the order of:-

1st year - 6 moults

2nd year - 4 moults

3rd year - 3 moults

4th year - 2 moults

Some juveniles may moult every two to three weeks during summer but at longer intervals during winter when water temperatures are lower.

The fishing season on the west coast commences on November 15 each year and closes on June 30 - providing a non-fishing period of four and a half months, during which the lobsters are mating. The Abrolhos Islands season opens on March 15 and closes on June 30.

In November and December each year, the larger juveniles migrate from the shallow inshore-reef areas to the deeper waters. At this time they are generally pale in colour and are referred to as "whites".

The commercial stage is reached when the carapace (body) length measures 76mm (3 inches) - generally between four and five years of age.

The adult stage is reached when the lobster is sexually mature (able to reproduce) - generally about five or six years of age.

"Berried" females - those carrying eggs - are fully protected and must be returned immediately to the water in an undamaged condition.

The moulting frequency decreases each year and, in adult lobsters, may occur only once or twice a year. In females, moulting generally occurs just before mating and after after the eggs have hatched.

The number of moults and the size/weight increase is governed mainly by the age of the lobster, the water temperature and the availability of food. Animals which have been injured by predators may have their growth retarded.

Rock lobsters are believed to be able to reach an age of at least fifteen years, at which time they would probably weigh about fifteen kg. These very large lobsters are known as "jumbos".

Rock lobsters are able to re-generate lost legs or antennae over a number of successive moult cycles.

RESEARCH

One of the earliest research programmes was carried out by Frederick Aldrich (1873-1965). Aldrich recorded observations on growth, spawning and larvae of the Western Rock Lobster. These results were not published, nor were they known to research workers studying this species subsequently.

Aldrich made his observations on captive lobsters at a time when fish hatcheries were in vogue throughout the world. He appreciated the necessity for detailed studies of the life history and ecology of these species so that we can properly evaluate the prospects for artificial propagation.

During the 1950s 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 continual 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 Wildlife now incorporates a number of major research projects.

These 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 settling of the puerulus.

Current research programmes being carried out by C.S.I.R.O. are aimed at understanding the effects of water circulation and the behaviour of larvae when they return to the coast at the end of the planktonic phase, and determining the factors affecting their successful settlement. Juvenile studies are being expanded to determine the availability of food in the coastal reefs and the effects of juvenile densities, shelter and the predator levels, as well as other environmental factors which limit their recruitment to the adult stocks.

The six current research programmes carried out by the State Department of Fisheries and Wildlife include:

A. RESEARCH LOG BOOKS are maintained to record detailed daily catch and effort data in terms of area and depth of water fished and to carry out analyses to clarify the relationship between catch per unit of effort and stock density.

B. COMMERCIAL STATISTICS AND POPULATION DYNAMICS - for the purpose of obtaining adequate catch and effort statistics from the commercial fishery and to carry out analyses on these data in order to make assessments of the status of the fishable stock of the Western Rock Lobster.

C. LENGTH FREQUENCY MEASUREMENTS are obtained of both size and undersize rock lobsters taken in commercial rock lobster pots at different localities and at different depths for each month of the fishing season in order to detect any changes in the status of the fishery and to gauge the effectiveness of management regulations.

D. POT SELECTIVITY - This entails (a) examining the response of individual rock lobsters to baited pots and; (b) investigating the selectivity (if any) of rock lobster pots.

E. GROWTH RATE STUDIES examine the growth rate of legal commercial sized rock lobsters.

F. FISHERY INDUCED MORTALITY OF UNDERSIZED ROCK LOBSTERS - To study the effect of:-

(i) Removing undersized rock lobsters from the water;

(ii) Time of exposure to the air - sunlight and humidity
- damage to the animal

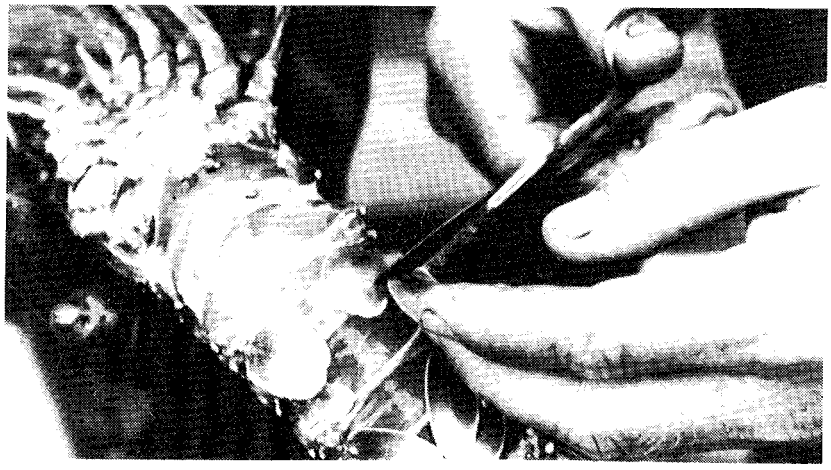
(iii) Effects of handling berried females;

(iv) Relocation of animals to different areas, or habitats.

A study was also carried out from 1974-76, to evaluate the loss of rock lobsters through octopus predation and a search for possible way of reducing predation in pots.

Another study was undertaken to examine the extent of the Amateur Rock Lobster Fishery and its relation to the rock lobster industry.

The Western Australian Marine Research Laboratories at Waterman - on the coast 17 km north of Perth.



Clipping the pleopods of a lobster to mark it for future identification - part of the study programme on lobster growth.

CATCHING AND PROCESSING

A. CATCHING

1. The Abrolhos Islands, between 50 and 100 km off the west coast, are home for many fishermen from March 15 to June 30, during the islands' open rock lobster season. The coastal season is open from November 15 to June 30.

2. Older wooden or steel vessels and modern fibreglass scooter boats make up the fleet of 785 vessels operating in the various Western Rock Lobster concession areas.

3. Charter air services from Geraldton can land on two air strips on the Abrolhos and the Geraldton Fishermen's Co-operative operates a helicopter service to the islands.

4. Boats are operated usually by a skipper and one or two crewmen. The majority of the boats are between 6m and 10.7m in length.

5. Pots which have been set in lines of 15-20 on the previous day are pulled early in the morning.

6. Winches are used to haul in the pots on to a pot-tipper.

7. After emptying the catch into holding bins, the pots of each line are re-baited and stacked for re-setting. Each lobster is measured to ensure that it is of legal size (76mm carapace length) and undersize animals are returned to the sea.

8. The baited pots are then reset in a line ready for hauling on the following morning. The next line of pots is then hauled and the process repeated.

9. Patrol vessels of the Department of Fisheries and Wildlife constantly check for any infringement of the management regulations and rules.

10. The catch is bagged (approximately 45kg per bag) ready for transport back to the anchorage.

11. At the anchorage, the bagged live lobsters are transferred into holding cages and held there until the carrier boat arrives from Geraldton.

12. At the end of the day, bait is prepared for the following morning.

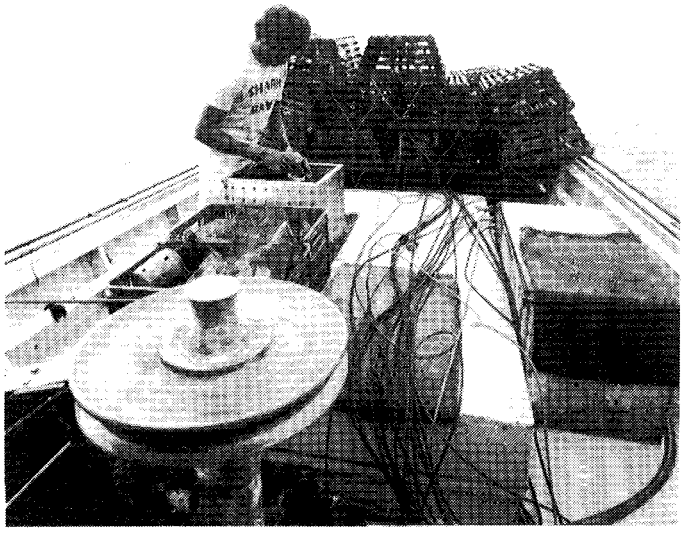
13. The carrier boats bring stores, mail and bait from Geraldton.

14. On days when the carrier boat calls, an early morning start is made to re-bag the lobsters from the holding cages.

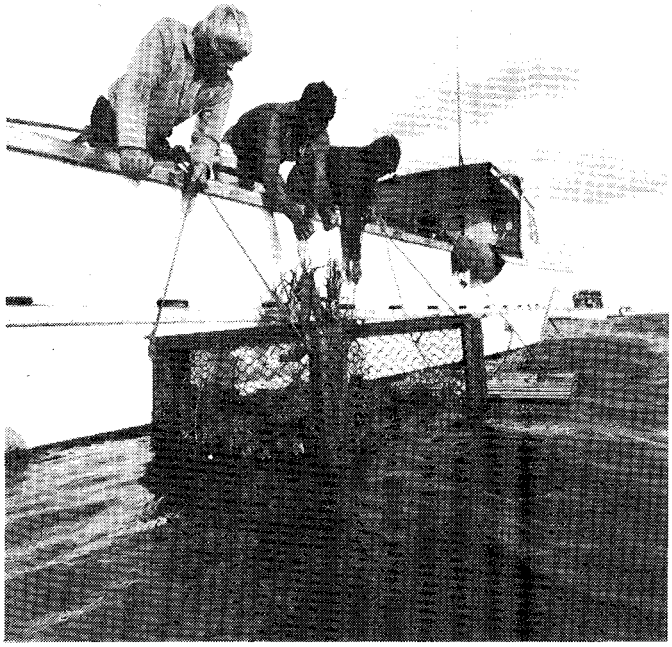
A pot is hauled aboard by the pot winch.

Lobsters being emptied from a pot ready for measuring and return of any that are undersized.

After measuring, the legal sized lobsters are bagged.

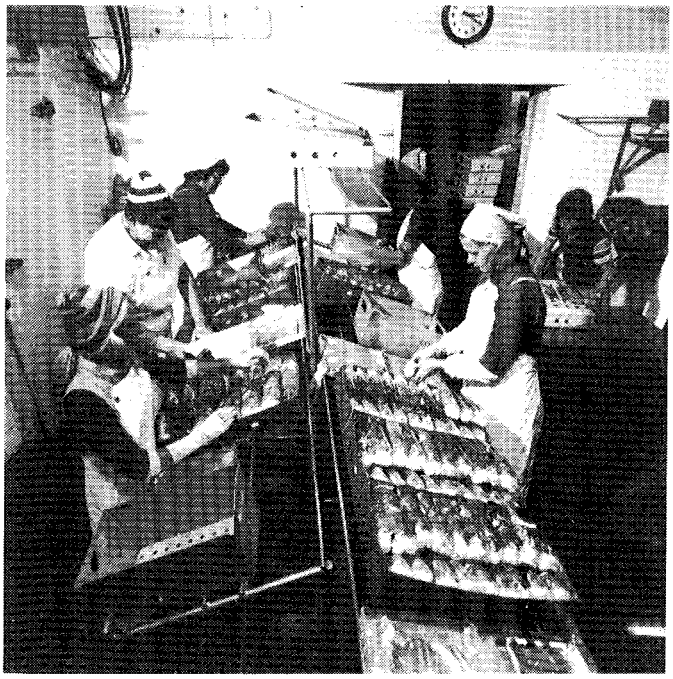


Empty pots are rebaited ready for returning to the water in a series of lines.



The day's catch is retained in holding pots before being sent to Geraldton from the Abrolhos by a carrier boat.

In the processing works the tails are removed and cleaned.



After weighing, the tails are graded, wrapped in clear plastic and packed ready for freezing.

Whole cooked lobsters are brushed and cleaned ready for wrapping and freezing.

15. The bagged live lobsters are transferred to the carrier boat for shipment to one of the processing works in Geraldton.

15A. In the case of coastal fishermen, their bagged catch is delivered direct to the processing establishment or, in the more remote areas, taken by vehicle to the factory.

B. PROCESSING

FRESH TAILS

1. At the processing works the still-live lobsters are tipped down a chute to the de-tailing benches where the tails are "screwed" out on a curved-blade device. The head and body are discarded and later processed into fertiliser. The legs from "jumbo" heads are cooked for human consumption.

2. The intestinal tract is removed from the tail with suction equipment and the tail is washed and any loose membrane is removed by hand.

3. The tails are then graded into various weight categories and placed in containers holding 11.3kg lots.

4. Each container lot is check-weighed to ensure the correct weight for each lot and the tails are then individually wrapped in clear plastic.

5. The wrapped tails are neatly and attractively arranged in boxes, each containing 11.3kg.

6. After covering and banding, the boxes are stamped with the tail weight, grade and total weight, and then snap frozen.

7. The tails are held in cold storage until ready for shipment to overseas markets (mainly U.S.A.) as refrigerated cargo.

COOKED (WHOLE)

1. Some whole lobsters are cooked - mainly for the French and Japanese markets.

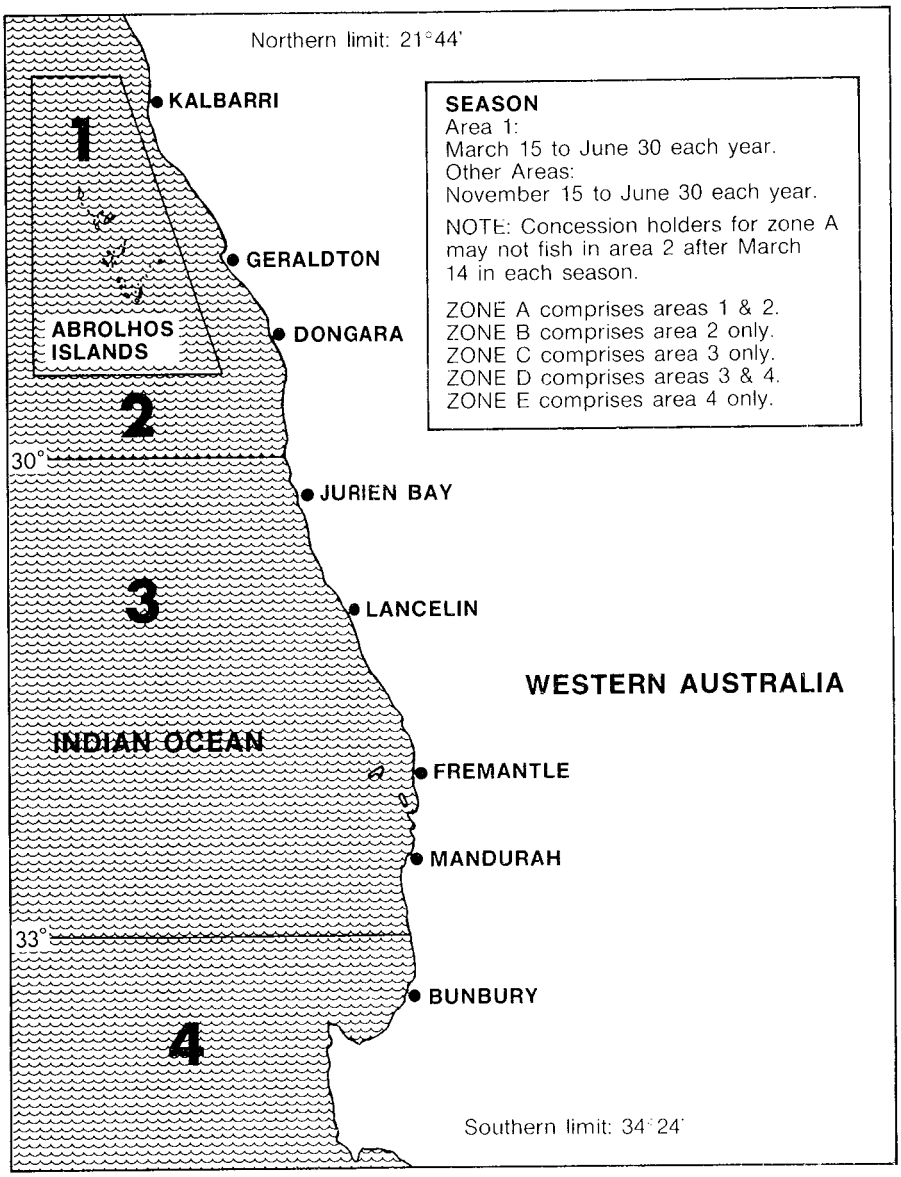
2. After being boiled in large baskets, the cooked lobsters are cooled and brushed clean to remove any cooking residues.

3. The whole cooked lobsters are graded into various weight categories, individually wrapped in clear plastic, packed into cartons and labelled; then snap frozen ready for shipment as refrigerated cargo.

VESSEL SIZE DISTRIBUTION BY CONCESSION ZONES

Each licensed rock lobster fishing vessel is permitted to fish in one 'zone' only. The boundaries of the zones are shown on page 19. The number of boats licensed to fish in each zone is shown below.

boat length	WESTERN ROCK LOBSTER ZONE					TOTAL
	A	B	C	D	E	
under 6m	0	0	2	0	0	2
6m to under 9m	50	37	29	1	0	117
9m to under 12m	99	102	186	1	6	394
12m to under 15m	38	30	114	2	3	187
15m to under 18m	10	4	41	3	0	58
18m to under 21m	3	2	9	0	0	14
over 21m	1	0	1	0	0	2
TOTAL	201	175	382	7	9	774


Northern limit: 21°44'
KALBARRI
1
GERALDTON
ABROLHOS ISLANDS
DONGARA
2
30°
JURIEN BAY
3
LANCELIN
WESTERN AUSTRALIA
INDIAN OCEAN
FREMANTLE
MANDURAH
33°
BUNBURY
4
Southern limit: 34°24'
SEASON
Area 1:
March 15 to June 30 each year.
Other Areas:
November 15 to June 30 each year.
NOTE: Concession holders for zone A may not fish in area 2 after March 14 in each season.
ZONE A comprises areas 1 & 2.
ZONE B comprises area 2 only.
ZONE C comprises area 3 only.
ZONE D comprises areas 3 & 4.
ZONE E comprises area 4 only.

AVERAGE DAYS FISHED

PER MONTH PER BOAT

NOVEMBER 15-30		15
DECEMBER		25
JANUARY		19
FEBRUARY		23
MARCH		23
APRIL		22
MAY		20
JUNE		16
JULY	CLOSED SEASON	
AUGUST		
SEPTEMBER		
OCTOBER		

WESTERN ROCK LOBSTER FISHERY - 1982/83

No. of licensed rock lobster boats	780
No. of licensed rock lobster fishermen	1,950
No. of licensed rock lobster pots	76,705
No. of processing works (landbased)	29
No. of processing vessels	10
TOTAL COMMERCIAL CATCH	12.4 million kg
TOTAL VALUE OF COMMERCIAL CATCH (to fishermen)	$93 million
EXPORT VALUE OF ROCK LOBSTER	
TAILS	$71.6 million
WHOLE	$16.5 million
ESTIMATED PERCENTAGE OF STOCK TAKEN ANNUALLY	75-80%
No. of amateur fishermen licensed to operate two pots each	27,000

ANCILLARY SERVICES PROVIDED

A considerable work force is employed in the ancillary services which support the rock lobster industry in Western Australia. The continuance of the rock lobster fishery as a stable industry is vital therefore not only to fishermen but also to the livelihood of many others:

PROCESSORS

Factory Workers
Refrigeration and Processing Equipment
Plastic and Packaging Supplies
Engineering Supplies
Marketing Staff
Transport

BAIT SUPPLIERS

Fisherman
Packaging
Refrigeration
Transport

PETROLEUM PRODUCTS

Fuels
Oils
Greases
Detergents

ADMINISTRATIVE SERVICES

Clerical
Banking
Accounting
Insurance
Legal

GEAR SUPPLIERS

Pots
Ballast
Ropes
Engineering Supplies
Navigation Equipment
Hydraulics
Floats
Cane

RADIO AND ELECTRONICS

Radios
Echo Sounders
Coastal Radio Stations
Automatic Pilots
Radar

MAINTENANCE AND REPAIRS

Slip Yards
Engineering
Shipwrights
Painters

BOAT BUILDERS

Engine Suppliers
Plastics Industry
Steel Suppliers
Timber Suppliers
Electrical Trade
Paints

36876 11 84 5M Bks O

WILLIAM C BROWN Government Printer Western Australia