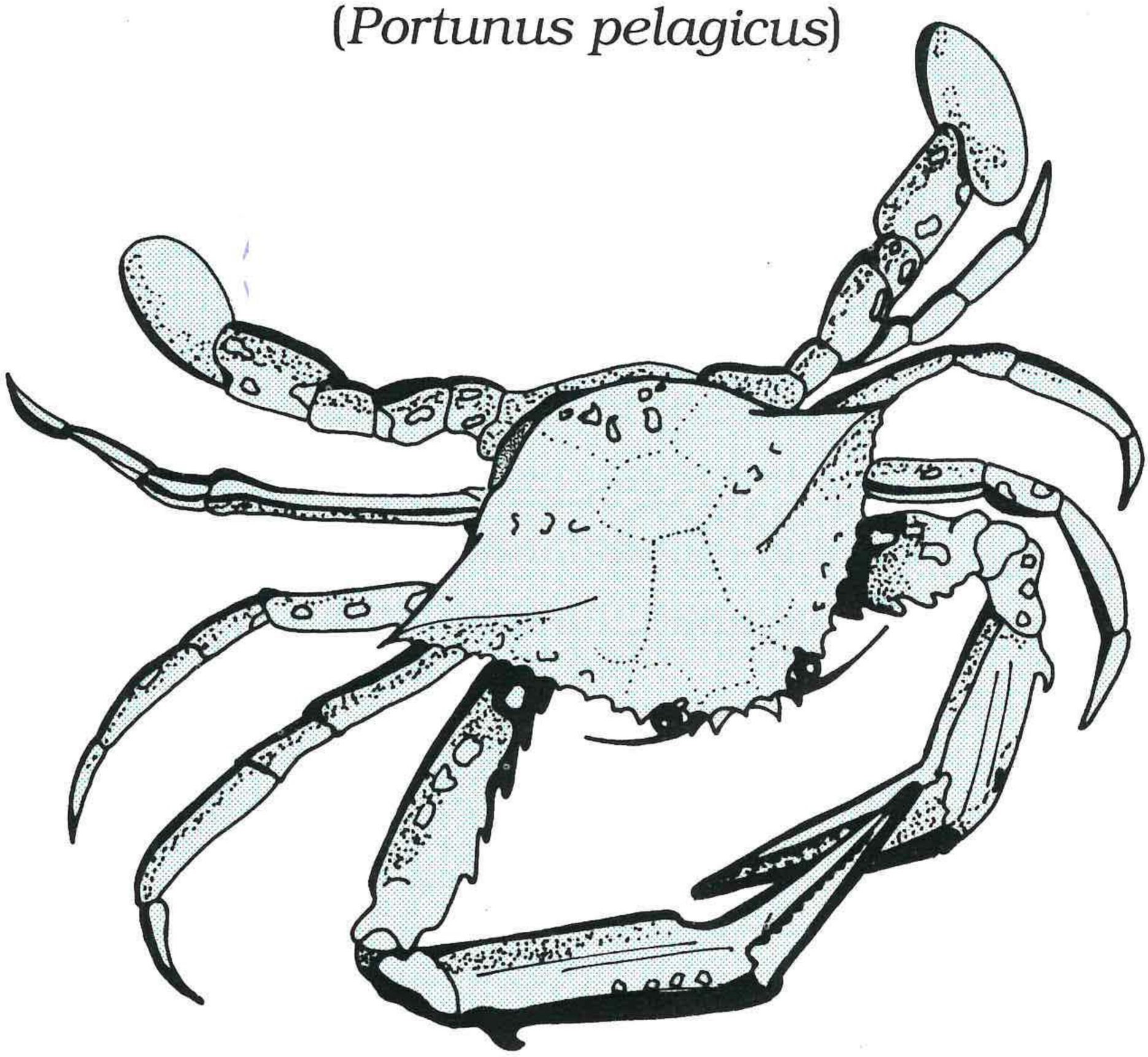
The Biology of the Blue Manna Crab...

(*Portunus pelagicus*)

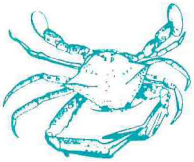


...in Estuaries of South-west Western Australia

Waterways Information No. 1

By Greg Davis
Peel Inlet Management Authority

Waterways Commission, October 1988



The Biology of the Blue Manna Crab (*Portunus pelagicus*) in Estuaries of South-west Western Australia.

INTRODUCTION

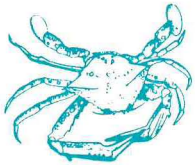
The blue manna crab, *Portunus pelagicus*, has been a popular catch for generations of locals and visitors to the south-west, especially Mandurah and Bunbury, and also forms part of the annual catch of the commercial fishery in the Peel-Harvey Estuary, Leschenault Inlet and the Swan River.

Crabs can be caught in scoop nets on shallow banks or by using baited drop-nets in deeper water throughout the estuaries. Some are also taken by skin-divers and as an incidental catch in nets set for fish. It is illegal for recreational fishermen to use set nets for crabbing.

The abundance of crabs in the Peel-Harvey and other south-west estuaries fluctuates greatly from year to year and the exploitation rate is often very high. These observations often cause concern to the fishing public, and debate about the causes of variable catches and the need for management is common during the crabbing season.

This leaflet gives an account of the biology of the blue manna crab to provide background information for people interested in this popular fishery. The life cycle of the crab and ways in which the crabs use estuaries are described in some detail because they are important to understanding why numbers in the estuaries fluctuate from year to year.

The information presented has been obtained from published scientific papers, discussions with fisheries researchers, and personal observations by the author.



THE BIOLOGY OF THE BLUE MANNA CRAB

Distribution

The blue manna crab is found around the entire Australian coastline, and from East Africa through the Indo-Pacific region to Japan, Tahiti and occasionally New Zealand. In south-western Australia, it is found in sheltered embayments and estuaries around the coastline, particularly in Peel Inlet, Leschenault Inlet, Geographe Bay and Cockburn Sound (Figure 1).

Habitat

Although found in ocean waters to about 40 metres, adult crabs prefer the shallow waters of estuaries and marine embayments, especially where seagrass meadows provide refuge and foraging areas.

Where there is no seagrass, crabs will use weedy, muddy or sandy habitats.

Juvenile crabs are normally found only in shallow areas.

How the crabs use estuaries

Many blue manna crabs spend their entire lives in the ocean. Some juvenile and adult crabs move into estuaries and saline regions of tributary rivers when the estuary is at around the salinity of seawater (Potter et.al., 1983). Peak abundance in estuaries is over the summer months, and the vast majority of crabs are taken between January and May. The adult crabs usually move towards the inlet channel where the salinity is closer to seawater when the estuarine salinity decreases during the winter periods of fresh-water river flow. They are found mainly near the mouth during winter and spring, and many migrate out to inshore marine waters.

Crabs mate in the estuaries, but it is thought that females return to the sea to spawn. Some may spawn in the inlet channel if conditions are suitable.

The larval stages are oceanic. Juvenile crabs enter the estuaries where they feed and grow rapidly to maturity in the shallows, taking advantage of the abundant food supplies and the shelter provided by algae and seagrass.

Marine dependence

Portunus pelagicus is "marine dependent" i.e. some stages of the life cycle depend on oceanic conditions and the crabs cannot live and breed entirely within an estuary.

It has been suggested that the crabs could not hatch and grow successfully within estuaries for two main reasons:

(i) Hatching is dependent on high oxygen levels in the water.

Laboratory tests have shown that egg hatching is very successful at 100% oxygen saturation. At 40%, it

fails completely (Meagher, 1970). At dawn, when the eggs are believed to hatch, oxygen levels in the ocean are high but can be as low as 25% saturation in estuarine waters. The difference in oxygen levels is primarily due to the larger amount of algae in the estuaries. Algal respiration consumes oxygen at night and by morning the oxygen level is very low.

(ii) The young larval stages rely on suitable food being available when they hatch.

The larvae feed on zooplankton (minute animals floating at the surface of the water). The types they feed on occur in both estuaries and the ocean, but they are only found in the surface layers of the estuary at night and sink lower in the water during the day. If the eggs are released at dawn, when this food source is not available, any estuarine spawning would fail.

Predators

In South Australia, the main predators of the blue manna crab are the smooth stingray (*Dasyatis brevicaudata*), the southern fiddler (*Trygonorhina fasciata*) and the gummy shark (*Mustelis antarcticus*). (Smith, 1982). All of these animals are found in south-western Australian waters and probably predate marine populations of the crab. Octopus and cuttlefish also eat crabs in marine waters (L. Joll, pers. comm.).

Larval stages are likely to be eaten by fish, birds and other animals which feed on plankton, but no studies are known to have been done.

Recreational and commercial fishermen are by far the greatest predators of crabs in estuaries such as the Peel-Harvey Estuary and Leschenault Inlet.

Diet

Portunus pelagicus is a carnivore, feeding on benthic (bottom-living) invertebrates. The diet consists of other crustacea, small molluscs (gastropods and bivalves) and brittle stars (ophiuroids). There appears to be no dietary variation with crab size, except for the size of prey. There is no variation with season or between males and females (Williams, 1982).

Crabs cease feeding just before and during moulting. They resume feeding as the shell hardens.

Life cycle

The life cycle of the blue manna crab is shown in Figure 2. This description concentrates on the life cycle of the crabs which enter the estuaries. It should be remembered, however, that blue manna crabs breed in sheltered embayments right around the coastline, providing a source of recruitment of juvenile and adult crabs to the estuaries.

Courtship

The male crab courts the female for 4 to 10 days by carrying her beneath him while aggressively fending off other males. Courtship ends when the female is ready to moult.

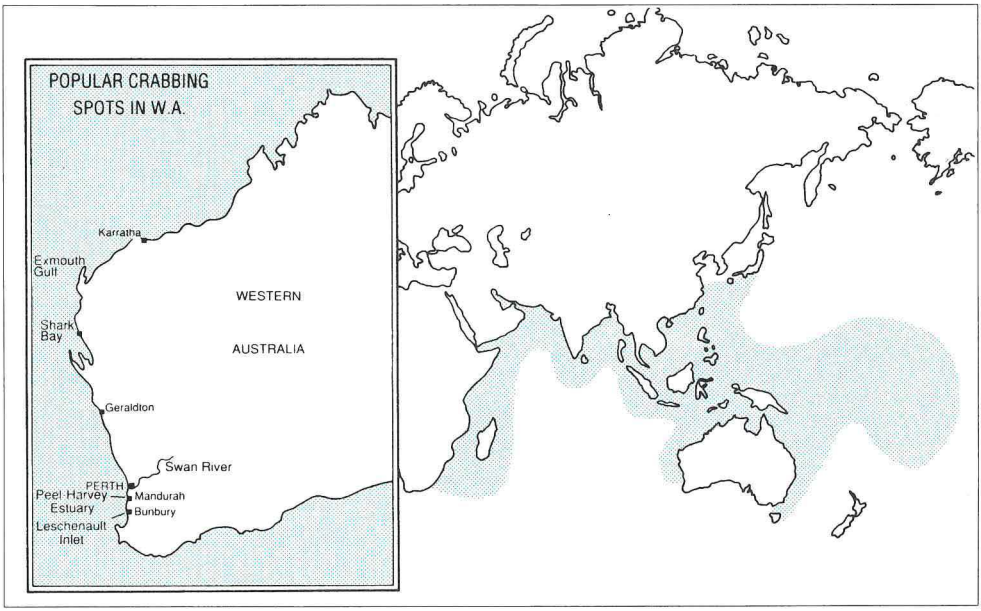


Figure 1. Distribution of the blue manna crab (from Fishing WA, Leaflet 7: The Blue Manna Crab).

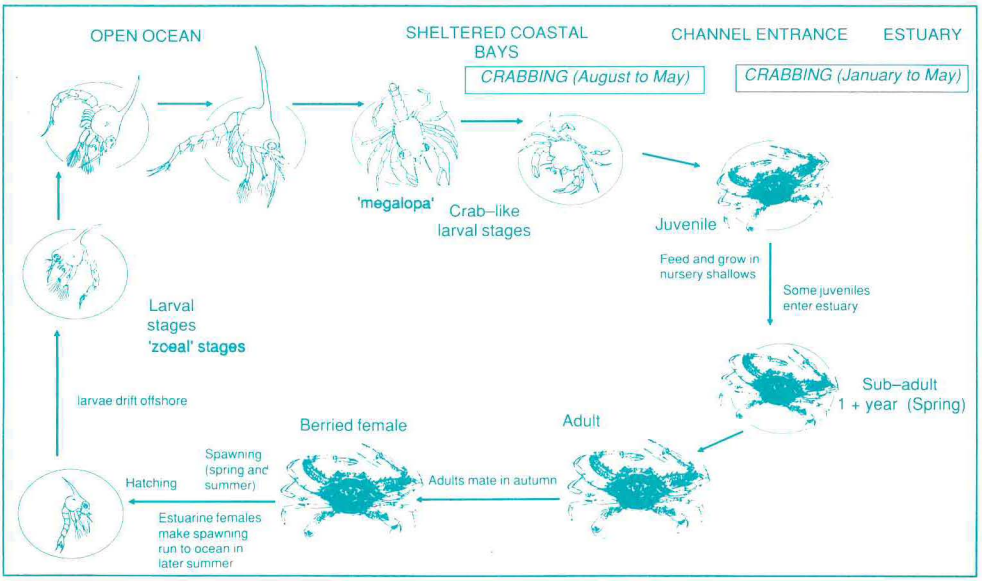


Figure 2. Life cycle of the blue manna crab (from Fishing WA Leaflet 7: The Blue Manna Crab).

Mating

The male assists the female in shedding her old shell so that mating can occur. He turns her over to copulate while she is still soft-shelled. The male extends his abdomen and inserts it beneath the female's to transfer packets of sperm. This process can take up to 8 hours. The male continues to carry the female for a further 3 to 4 days until her new shell hardens. In the estuaries, most mating occurs in mid-summer when the adult crabs congregate in deeper water (Penn, 1977).

A male may mate with more than one female over the season. In aquarium studies, males have been observed to mate with up to 4 females over a period of 5 weeks (Meagher, 1970).

Most of the large mature female crabs mate only once a year, but receive enough sperm to fertilise millions of eggs. They retain the sperm over winter until the ovaries develop in the following summer (Meagher, 1968). Juvenile females often reach maturity in the middle of summer at about a year of age. Some of these will mate and spawn during that summer.

The female becomes more active after moulting and mating, and begins feeding and building up food reserves.

Egg laying

The female crab's ovaries begin to develop as water temperature increases. Eggs are not deposited until a critical water temperature is reached (Meagher, 1970).

When the female is ready to deposit her eggs she settles into the sand with her abdomen extended. The eggs are extruded and attach to hairs on the female's abdomen. Some sperm are released and fertilisation takes place externally.

The number of eggs carried by females varies between 180,000 and 2 million depending on the size of the crab (Potter et.al., 1983; Museum of Western Australia Information Bulletin).

Incubation

The eggs are incubated by the female. They are bright orange when first spawned and change progressively to dark grey as they develop and use up the yolk. The speed of development depends on water temperature. At 25°C it takes 8 days for the eggs to become fully developed, and at 20°C it takes 18 days.

The appearance of the egg clusters has led to the term "berried female" for a female carrying eggs.

Spawning

Female crabs head to sea only a few hours before the eggs are due to be released. This "spawning run" can be observed in the Peel Inlet entrance channel, usually during late summer nights.

The female raises her whole body to release the eggs and jerks her legs vigorously with her abdomen fully extended. This reduces the compactness of the egg mass, and the eggs are then combed out.

After hatching, the female cleans the remnants of the eggs from her abdomen. All traces of old egg cases are removed, usually within 4 hours of hatching. Females can have up to 3 successful spawnings in one season. Each batch is fertilised by sperm stored from the one mating.

Females may move back into the estuary or stay in the ocean between spawnings.

Larval stages

The larvae grow through a series of larval stages in the ocean. They moult approximately 15 times, sometimes changing considerably in appearance. The stages have been described by Shinkarenko (1979) and Kurata and Midarikawa (1975).

The eggs hatch into the first of a series of "zoeal" larval stages (see Figure 2). They feed furiously at the surface on tiny plankton. This initial feeding is critical. Many larvae die if not enough food is available (Anon, 1978).

These small larvae are carried many kilometres offshore. It is thought that they feed in the morning and are transported by morning offshore winds. They sink lower in the water at about noon when the sea breeze comes in. Zoeal larvae have been found up to 80 kilometres out to sea after 8 days. By this time they have reached the second zoeal stage.

The third and fourth zoeal stages are believed to change to feeding near the surface during the afternoon. As a result, they are transported back to the coast by prevailing sea breezes. The zoeal stages last around 16 days.

The larvae next enter a "megalopa" stage, which lasts 7 to 8 days. Megalopa larvae live on the seafloor and have been found up to 20 kilometres offshore.

Eight "crab" larval stages follow, each lasting about 8 to 14 days. These larvae look like miniature adult crabs, growing from about matchhead size to the size of a 10 cent coin.

Some of these juvenile crabs enter estuaries, usually from mid-summer onwards.

Growth

The young crabs feed and grow very rapidly in the sheltered estuarine shallows. Growth is temperature-dependent. The crabs moult, possibly as often as every 2 weeks, when the temperature is above a critical level. At each moult their weight can increase by 75-80% and their carapace (shell) width by 20% (Meagher, 1968).

The adult size of about 76 millimetres (mm) is usually reached just before the crabs' first winter. The growth rate slows during winter due to a decrease in temperature. These crabs may overwinter in the estuary by remaining buried in the mud.

The next moult is known as the seasonal moult. Males moult in October-November and females in December-January. This difference in timing probably allows for successful mating, as already described. By the end of summer, at just over one year old, these crabs have a carapace width of between 100-115 mm. Some may have reached the minimum legal size of 127 mm. It is thought that this "year class" leaves the estuary in winter (Potter et.al., 1983). Evidence for this can be seen in the increased commercial catch in Warnbro and Cockburn Sounds during the winter (Penn, 1977). However, some of these one year-old crabs may overwinter in the estuary.

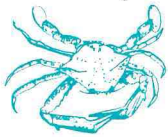
Moulting

Just prior to moulting, the skin secretes substances which sever the connections between the skin and the old shell. A thin layer of new shell is excreted just below the old shell, which begins to split.

Once the old shell is discarded, the crab takes up water to stretch the new, wrinkled shell. While the shell is soft, the crab ingests calcareous material, such as shell fragments, and processes it to incorporate the calcium in its new shell. Substances are secreted by the skin which oxidize and harden the shell.

The crab is very vulnerable to predators during moulting and usually stays buried.

Just after moulting, the crab still has poor muscle tone (meat) while it is growing into its new shell. For this reason, recently-moulted crabs are poor eating and are often referred to as "mushy" or "empty".



RECRUITMENT TO THE ESTUARIES

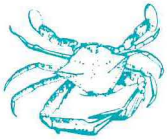
Because of the long larval life and the distance larvae are transported offshore by winds and currents, juvenile crabs entering the Peel-Harvey and other south-west estuaries almost certainly come from spawning up and down the coast.

Juvenile crabs enter the estuaries when they are about the size of a ten cent coin (see Larval stages).

They enter as a result of a combination of factors. These include winds, currents, salinity and crab behaviour. Impacts on any one of these could have an adverse effect on the number of crabs moving into an estuary. For example, no juvenile crabs entered the Leschenault Inlet during the normal recruiting period in 1969 (Meagher, 1970).

Some adult crabs are also recruited from the marine population.

Equal numbers of males and females are recruited.



HARVESTING

The recreational and commercial catch

The Peel-Harvey estuary and Leschenault Inlet are the most popular recreational crabbing areas in the south-west. The crabs are most abundant in the estuary during the summer holiday season from January to May. Combined with the commercial fishery, this results in a high harvesting rate. Commercial fishing varies seasonally according to the number of crabs in the estuary.

Regulations

The Fisheries Department has laid down some rules to protect the blue manna crab populations and the future of the fishery.

The regulations for recreational crabbing are described in Recreational Fishing - a Guide to the Rules, and Fishing WA Leaflet 7: The Blue Manna Crab. These publications are available from the Fisheries Department of Western Australia.

Commercial fishermen are also subject to regulations to protect the fishery. The numbers of commercial fishermen are strictly controlled and the amount of net permitted is limited. They are also required to observe the minimum legal size and are not permitted to take berried females.

The Fisheries Department frequently reviews regulations and alters or introduces new rules when necessary.

One current cause for concern is the number of undersize crabs caught in recreational set nets, especially in spring, and the number of females carrying eggs (berried females) caught in the same way in summer. The crabs are difficult to remove from nets and are usually dead or badly damaged by the time they are returned to the water.

The sex ratio of the catch

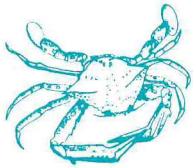
Fishermen often comment on the sex ratio of their catch. Males usually dominate the catch at the start of the season. The proportion of females taken steadily increases as the season progresses.

Male crabs moult earlier than females. They are very hungry after moulting and are easily caught in baited traps. Female crabs are less active before they moult and mate in mid-summer. As the season progresses, more males will have been caught than females, to the extent that by autumn, females begin to dominate the catch.

The impact of fishing on crab populations

Blue manna crabs have a very high reproductive rate and fast growth rate and can withstand heavy fishing pressures.

While fishing pressure on the crab populations in areas such as Peel Inlet may be intense, the recruitment rate is generally sufficient to maintain as much stock as the environment can sustain by way of food and shelter. It must also be remembered that crabs are recruited into the estuary, in part, from the marine population. The estuaries cannot be "fished out" as long as the marine populations are breeding along the coastline.



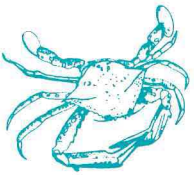
CONCLUSIONS

The most important factor affecting the continued use of the Peel-Harvey and other estuaries by crabs is the condition of the estuarine environment. For example, in the Peel-Harvey Estuary, crabs leave the system in spring during bad blooms of the blue-green alga *Nodularia* and catches are poor over the following summer.

Other factors such as winter rainfall are also very important in controlling the availability of crabs in these estuaries. Heavy winter rainfall can have a similar effect of pushing crabs out of the estuaries (J.Penn, pers. comm.).

The harvesting rate within the popular estuaries during the summer is always high, but the stocks are maintained by crabs entering the estuaries from marine populations when environmental conditions are favourable. The estuarine habitat must be maintained in a condition that allows recruitment of young crabs and encourages growth and survival of the crab stocks.

Management to maintain a healthy productive estuarine ecology is therefore vital to the future of this popular fishery.



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