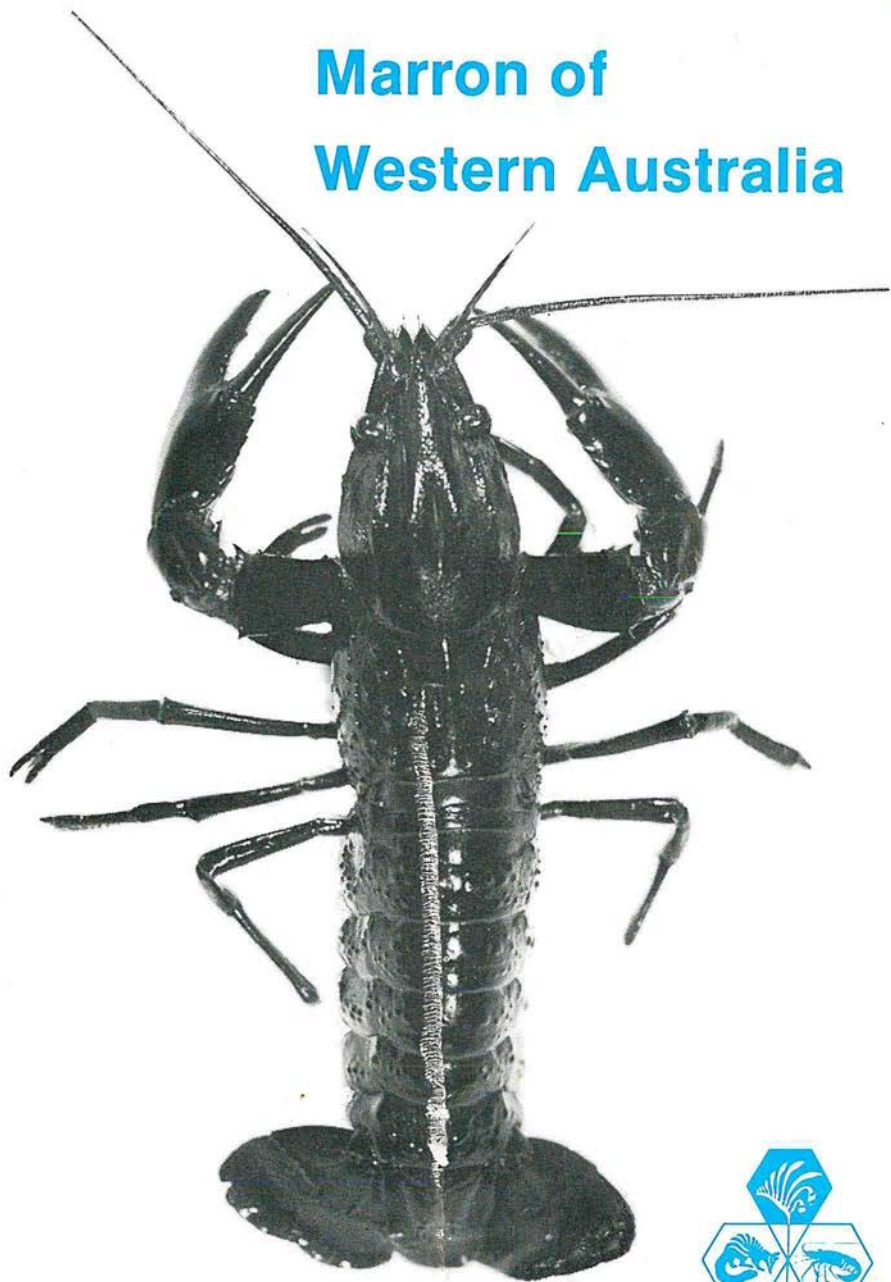


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Marron of Western Australia



MARRON OF WESTERN AUSTRALIA

This booklet was prepared by the Extension and Publicity Service of the Department of Fisheries and Wildlife, in conjunction with Dr. N. Morrissy of the Department's Fisheries Research Branch.

It is issued as a means of fulfilling the many requests received for information on marron. While it is accurate in all detail, it is only intended for use as a guide and should not be quoted as a reference.

DEPARTMENT OF FISHERIES AND WILDLIFE
PERTH WESTERN AUSTRALIA

1981

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PLEASE NOTE

The regulations and restrictions contained in this publication were current at the time of printing. Any amendments subsequently made will be publicised in the daily press, but marron fishermen are advised to contact the Department of Fisheries and Wildlife to check the regulations and restrictions in force at the time of their fishing trip.

Any requests for further information about marron, particularly in relation to marron farming, should be addressed to:

Department of Fisheries and Wildlife,
108 Adelaide Terrace,
PERTH W.A. 6000
Phone: (09) 325 5988

THE MARRON

The marron (*Cherax tenuimanus*) is a freshwater crayfish found only in Western Australia. It belongs to the family of Southern Hemisphere freshwater crayfish known to scientists as the Parastacidae and it is the largest of several species found in the State. In fact, the marron may grow to about 2 kg and is the world's third largest freshwater crayfish, surpassed only by Tasmania's *Astacopsis franklinii*, and the Murray River crayfish, *Euastacus serratus*, from the Eastern States.

The marron's original range was the south-western portion of Western Australia in freshwater streams from the Harvey River to the Kent River near Denmark. They have since been established as far afield as the Chapman River at Geraldton and small streams to the east of Albany and around Esperance. The range has been further extended by introduction into farm dams beyond Esperance to the east and inland throughout the wheatbelt to north of Geraldton (Fig. 1).

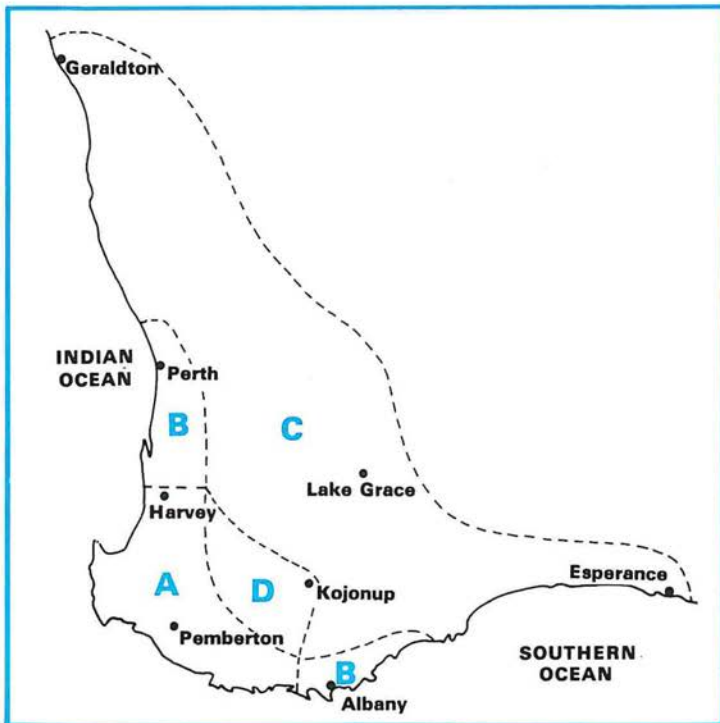


Fig. 1: DISTRIBUTION OF MARRON. A—natural range of marron in large permanent streams; B—extension of natural range; C—marron found in small dams; D—former natural distribution.

In their natural habitat, marron prefer the larger deep-water pools found on the lower reaches of permanent streams. There is evidence that the occurrence of marron in the upper reaches of longer rivers has diminished as a result of higher salinities caused by land clearing and agricultural pollution.

Unlike many freshwater crayfish, marron do not burrow to a great extent, but shelter among logs and rocks at the bottom of pools during daylight hours, emerging at sunset to forage for food.

Most female marron begin spawning in their third year. Mating starts with the upturn in water temperature in early spring. Unlike marine lobsters, which tend to produce vast numbers of small eggs, marron produce relatively few large eggs (approximately 300 in the case of a female of just legal size). These eggs are carried beneath the mother's tail during October and November and after hatching the young remain attached to the mother and are well-developed when released in December or January.

There is considerable variation in growth rates: a marron may take from eleven and a half months to five years to reach the legal minimum size of 76 mm carapace length.

The flesh of the marron has been rated as having the finest flavour of any crustacean. This reputation has resulted in the marron's status as the favoured catch of the State's amateur freshwater fishermen. In order to protect this valuable amateur fishery, the commercial exploitation of wild marron stocks was prohibited in 1955.

More recently there has been interest in the potential of marron for commercial aquaculture. In addition to the demand for marron flesh there are many factors which enhance the marron's value as a candidate for cultivation: for example, a rapid growth rate to large size, high tail recovery weight and simple life cycle.

The establishment of fish farms was permitted under legislation introduced in 1975. Since the declaration of marron as a "farm fish" species in 1976, several marron farming ventures have been set up. While continued development of culture techniques is required before commercial production levels are achieved, it is anticipated that marron will provide a valuable industry.

DESCRIPTION OF SPECIES

Australia has an extensive freshwater crayfish fauna. In Western Australia there are four main types of crayfish each being characteristic of a certain type of habitat. However, except for marron, many intergrading forms can be found and the exact number of different native species has only recently been established as five, plus three land crayfish.

MARRON (*Cherax tenuimanus*)

Marron of up to 2.72 kg weight have been recorded but these weights are the exception. A legal size marron with a carapace length of 76 mm weighs about 120 grams.


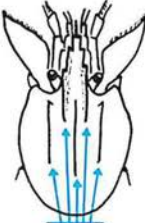
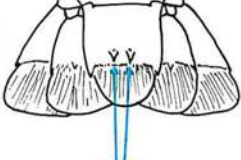













ROSTRUM (SPIKE)	HEAD	TAIL	CLAW
<p>MARRON</p>  <p>Side view of rostrum showing 3 pairs of spines behind tip</p>	 <p>5 Keels</p>	 <p>2 central spines on top of tail</p>	 <p>Narrow to medium-width claw</p>
<p>GILGIE</p>  <p>2 pairs of spines behind tip</p>	 <p>5 Keels</p>	<p>Spines as above absent or indistinct</p>	 <p>Medium-width claw</p>
<p>KOONAC</p>  <p>No distinct spines</p>	 <p>4 Keels</p>	<p>No spines as above</p>	 <p>Broad, spade-like claw with pronounced serrations</p>
<p>YABBIE</p>  <p>No distinct spines</p>	 <p>4 Keels</p>	<p>No spines as above</p>	 <p>Claw narrower than Koonac with distinctive pattern and thick mat of hairs covering serrations</p>
<p>LAND CRAYFISH</p>  <p>No distinct spines</p>	 <p>No distinct keels, body length only about 25 mm</p>	<p>No spines as above</p>	 <p>Broad claw</p>

Fig. 2: Distinguishing features for identification of freshwater crayfish.

Marron are identified by the presence of five ridges or keels on the back of the head (see Fig. 2); these include those forming the side of the spiny rostrum or spike, on the front of the head. The rostrum is long and pronounced with three or more spines on each side. In addition there are 2 spines located centrally on the upper surface of the telson or tail end. There is no mat of fine hairs on the upper surface of the hand as is the case with the other species.

Mature marron are generally black in colour, although bright blue specimens are frequently reported and red ones are occasionally found. Juveniles in their first year have dark markings over a general body colour ranging from greenish-yellow to brown, while older juveniles are brownish.

GILGIE (*Cherax quinquecarinatus* and *Cherax crassimanus*)

Although the gilgie has five keels on the back of the head (similar to marron) there are less than three pairs of spines on the rostrum. These spines and the rostrum itself are less prominent than for marron (see Fig. 2). The telson or tail end has no central spines. Gilgies are usually coloured brownish-black with bluish mottlings or spottings on claws and body.

Gilgies are usually found in the smaller, less permanent streams, and also swamps near the coast. They are able to survive in a drought year by retreating to a capped burrow if the water dries up.

KOONAC (*Cherax plebejus* and *Cherax glaber*)

Koonacs are generally smaller than marron and are identified by four ill-defined keels on the back of the head (see Fig. 2) plus a very short smooth rostrum and a mat of fine hairs on the upper surface of the hand. There are no central spines on the surface of the telson. The colour of koonacs is blue-black to mottled brownish-black, with small, evenly-distributed spots on the well-rounded, spade-like claws.

Koonacs are found in the inland headwaters of rivers and swamps which habitually dry up. They appear to be capable of surviving for several years under drought conditions by burrowing.

YABBIE (*Cherax destructor* — *albidus*)

Yabbies are **not** indigenous to Western Australia and were introduced from the Eastern States. They have been found in farm dams of the Wheatbelt.

They have only four ill-defined keels on the back of the head with a short, smooth rostrum and a mat of fine hairs on the upper surface of the inner portion of the hand.

Yabbies are very similar to koonacs but they may be distinguished by their claws which are generally narrower and less spade-like than those of the koonac. Yabbies also have a mottled, mosaic-like pattern on the outer edge of the claw which is not found on koonacs' claws.

Both yabbies and koonacs do well in turbid farm dams where the yabbie's colour becomes very pale.

LAND CRAYFISH (three species of the genus *Engaewa*)

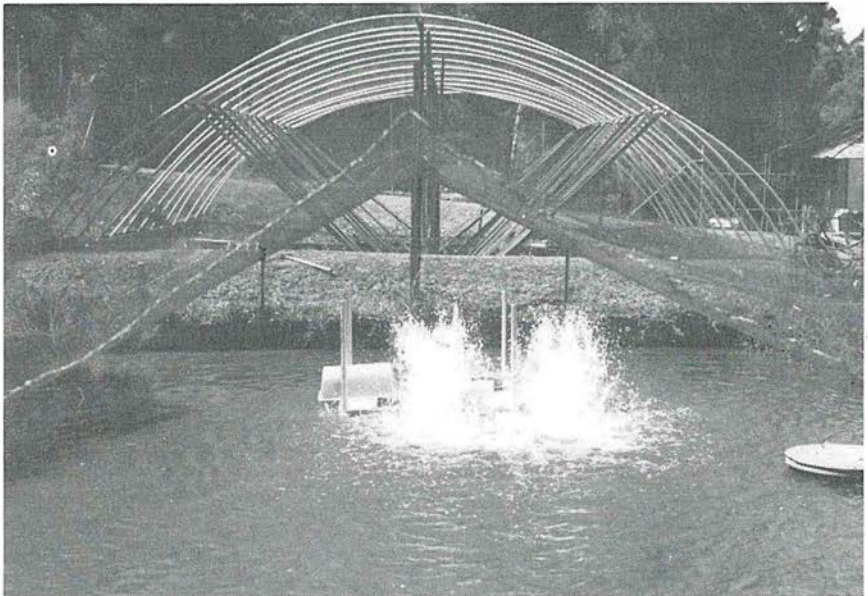
These are very small crayfish which live permanently in extensive burrow systems in permanently wet swamp ground in the Cape Leeuwin-Cape Naturaliste part of the extreme south-west. They are rarely seen because of their nocturnal feeding habits, but are sometimes uncovered when habitat is being destroyed by land clearing.

RESEARCH

Research on marron by the Department of Fisheries and Wildlife has been directed towards two areas: the amateur fishery and marron culture.

The influence of fishing on the stocks of marron in rivers and irrigation storage dams is constantly monitored by means of logbooks issued to marron fishermen and sampling by research staff. This research is important in assessing the effectiveness of current and proposed regulations for the conservation of marron stocks.

Studies at the Department's fish hatchery at Pemberton have provided essential information on the breeding and rearing of marron in high density conditions. Facilities at Pemberton enable experiments to be made on the growth of marron under conditions of differing stocking densities, feeding regimes etc. Extensive research has also been done on the growth of marron in Wheatbelt farm dams.



An electrically powered water mill aerates the water in an experimental marron pond at the Pemberton Fish Hatchery.

MARRON FISHING

The excellent flavour of the marron is justifiably renowned, but few marron fishermen would deny that a “marroning” trip has other pleasures that attract locals and visitors alike.

A gourmet meal is the culmination of a convivial evening spent in the bush with pleasant company, a glowing campfire and your favourite liquid refreshment. The whole evening's activities form a ritual observed by thousands of devotees each year.

In order that fishermen may continue to enjoy the pleasures of marroning in years to come, regulations have been introduced to conserve the marron stocks. Without protection, young, undersize marron would be fished out before reaching the age at which they can breed. Additionally, the regulations ensure that marron reach a worthwhile size for a meal—they can grow to king-size, why catch them before they are able to do so?

The regulations in force at the time of printing are summarised below. Fishermen should carefully observe these regulations, not only because of the heavy penalties which may be imposed for offences, but also to play their part in conserving a valuable natural resource.

FISHING REGULATIONS

INLAND FISHERMAN'S LICENSE: Any person over the age of thirteen years who catches or attempts to catch marron by any means must hold an Inland Fisherman's License. This license may be obtained from offices of the Department of Fisheries and Wildlife for a fee of six dollars (licenses for pensioners and students under 16 are free). The license is also required before fishing for trout and certain other freshwater species. Information on laws relating to these other species is available from departmental offices.

CLOSED SEASON: By Ministerial notice the marron fishing season is closed from May 1 to December 15 inclusive each year. Any variation of this period is publicised in advance in the daily press. The closure period is based on biological grounds in that it protects the female during the spawning period and at the same time acts as a means of reducing the number of marron caught. By May the larger, legal-sized marron have been well fished and it affords a respite during which the immature marron may develop to legal size for the following season.

LEGAL SIZE: A minimum legal-sized marron measures 76 mm from the tip of the rostrum or spike to the rear of the carapace (Fig. 3).

BAG LIMIT: Not more than twenty marron may be taken in any one day.

METHOD OF CAPTURE: The only means by which marron may be taken are by drop net, pole snares or hand scoop net. The use of traps, nets (other than drop nets and hand scoop nets), spearguns, harpoons, hawaiian slings and all other pointed instruments is illegal. Boats or similar craft may not be used in the taking of marron, and no artificial aid, apparatus or equipment may be used which permits the user to move or remain under water.

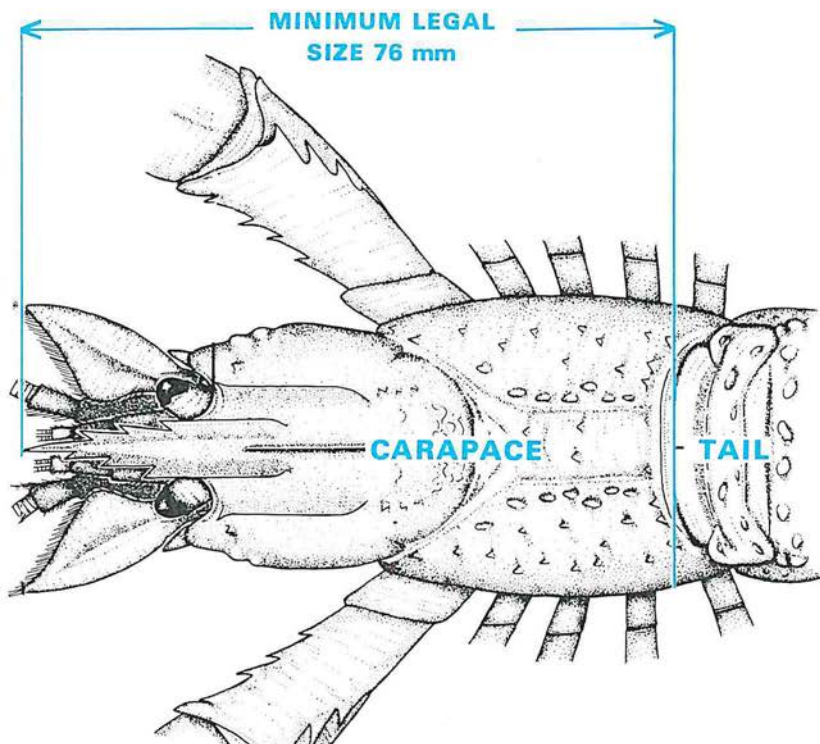


Fig. 3: The 76 mm minimum size for marron is measured from the tip of the rostrum (spike) to the rear of the carapace (body).

PERMITTED GEAR: Not more than six drop nets, or one pole snare or one hand scoop net per person shall be used for taking marron.

BERRIED OR SPAWNING FEMALES: Female marron with eggs, spawn or larvae attached to their body may not be taken. They should be returned to the water immediately.

SALE: Marron may not be sold, consigned or offered or exposed for sale, except under special license (penalty \$1 500).

PROCESSING: Marron may not be de-tailed or otherwise processed except in a licensed processing establishment or at the place where they are to be eaten. In circumstances other than these, the possession of marron tails is prohibited.

PENALTIES: The penalty upon conviction of an offence under these regulations is a maximum of \$750.

FISHING LOCATIONS

As mentioned earlier, marron are widely distributed but the best fishing is obtained from those more inaccessible and remote places not often frequented by other "marroners".

The least fished streams are in the dense forest areas of the south coast and they will naturally offer the best fishing for big marron. On the other hand, the irrigation dams and more popular streams such as the Warren, Murray and Blackwood Rivers contain smaller marron, many of which are likely to be below the legal minimum size. Intensification of fishing in any area containing large marron will inevitably result in a reduced stock of the larger animals. For this reason, many marroners are reluctant to disclose the location of their best fishing spots!

CATCHING TECHNIQUES

IN RIVERS: Generally these have steep banks and fishing is done in the deeper pools, which necessitates the use of drop nets (a limit of 6). These nets are similar to the conventional crab drop nets and may be baited with either some form of fresh meat or chicken pellets. The latter, tied up in a piece of cheese cloth or silk stocking, makes an ideal bait—particularly for the holiday maker or traveller who can keep a stock on hand for all occasions. Pellets eliminate messy meat problems—and pollution problems too!



A popular marron fishing spot on the Murray River.

IN IRRIGATION DAMS (Not Domestic Water Supplies): These dams usually have large areas of shallow water around gently sloping banks. The fishing method adopted here is to put down baits of chicken pellets (or meat) in the shallow water area along the bank just before sundown. With the approach of darkness the marron move into the shallow areas where they are attracted by the baits. Using a longhandled scoop net and a light (preferably the head-type used by miners) the marron are scooped up from the bait. Drop nets are inefficient in these shallow waters — the sidelong pull to the shore inevitably lets the marron escape.



Wellington Dam—one of the irrigation dams in the South West where marron may be caught.

PLEASE NOTE: The catching of marron, and in fact any fishing, is prohibited by By-laws, in water catchment areas, water reserves and reservoirs under the control of the Metropolitan Water Supply Sewerage and Drainage Board.

IN FARM DAMS: Baited drop nets are the most efficient method of capture in these dams. Quite often good hauls may be made during daylight hours if the dam is turbid. Normally marron feed only at night in clear gully dams, but with turbid water conditions in Wheatbelt dams they do not require hiding places and forage for food during the day.

SNARES: These are considered to be the most sporting method of catching marron. They were once used quite extensively and they deserve more popularity today.

A running loop of flexible wire (usually the gilt picture-frame type) is attached to the end of a long pole. With the aid of a light the loop is lowered over the tail of a marron feeding near the banks of a stream. Once over the tail it is manoeuvred up towards the carapace or body and the free end of the wire quickly tautened to close the loop. The marron is then hauled to the surface. The addition of baits to the streams helps to lure the marron to a suitable spot for catching.

TIME: The best time to catch marron in clear water is just after sunset for a period of three to four hours. During the day the marron hide from predatory birds under logs and other debris in deep water, but with the coming of darkness they move out to the more open areas to feed. Larger marron are, however, immune to attack from birds and may move about during the day. In some areas where the water is turbid or muddy (such as some farm dams) it is possible to fish during the daylight hours.

COOKING THE CATCH

Marron may be used as an ingredient in a variety of exciting dishes. However, the majority of marron caught are prepared for eating at the water's edge using the basic technique below. Variations are limited only by the cook's imagination.

A large pot, water and salt are the first essentials. Having caught your marron (kept alive in a wet bag) get the salted water boiling over a good fire — then add the **live** marron. Bring the water to the boil again and allow the marron to cook for 5-10 minutes for just legal size and a little longer for larger size. After cooking, remove the marron from the water and allow to cool.

If you intend to take the marron home for cooking, **they must be kept alive**. This is done by keeping them cool and in a damp bag where they should last overnight until the next day. Once dead, marron deteriorate very quickly and become highly odourous and it is therefore essential to cook them only if alive.

After cooking, the flesh may be removed and frozen for later use but the eating quality will not be as good as that of freshly cooked marron.

At the end of your marron fishing trip, please remember to extinguish your fire and remove all litter from your fishing spot.

MARRON CULTURE

In recent years there has been growing interest in marron culture. The following information is intended only as a guide to the three areas of interest: backyard pools, farm dams and intensive commercial pond production. Those interested in large-scale marron production will find more detailed information in the publication *Marron and Marron Farming* which is available on request from the Extension and Publicity Office of the Department of Fisheries and Wildlife, Perth.

BACKYARD POOLS

Marron and other Western Australian freshwater crayfish (such as koonacs and gilgies, which are smaller but hardier than marron) can be "farmed" in backyard pools.

PONDS: Small plastic wading pools (2 metre diameter or larger) can be useful but concrete ponds are more durable and easily managed in the long term. Water depth should be from 15 to 50 cm in the deepest part (sump) with shallower shelving areas where crayfish can move if oxygen depletion occurs in deeper water. A screened outlet system allowing complete drainage of water and periodic flushing of bottom ooze is a very desirable feature. New concrete ponds should be cured with builder's lime before use and the bottom then covered with a coarse sand-clay-limestone mixture. Bird predation should be prevented by caging. Shelters can be provided in the form of PVC or earthenware pipes.

WATER SUPPLY: Tap water can be dechlorinated rapidly by efficient aeration. Bore water fresh from the ground is always deoxygenated, and will require aeration, which is also necessary to allow iron to settle out before addition to the pond. Normally the abundant, low-cost, well-aerated water supply required to exchange the pond water every day or two will be unavailable. Water supply can only be reduced to a "topping up" rate if efficient aeration is provided.

TEMPERATURE AND AERATION: Water temperature should be prevented from approaching 30°C in summer by covering with shadecloth. Daily extremes of temperature can be monitored with a plastic cased maximum-minimum thermometer (read and reset at midday) available from plant nurseries.

Aeration by bubbling air from airstones is ineffective in shallow, open ponds. The best device is a floating electric paddle wheel or "water mill" which throws up a spray of water, aerating and mixing the pond water very quickly. A time switch can be used to operate the water mill for ten minutes at the two or three times a day necessary in summer. Aeration may be necessary when water temperatures are high in late afternoon or in the early hours of the morning if algae are present. Algae may be in the form of long green strands or, more likely with crayfish present, as minute green cells giving the water a green, soupy appearance. Algae only produce oxygen during the daylight hours; overnight their continuing respiration can drastically reduce oxygen levels until sunrise.

FEEDING: Excessive feeding or the wrong type of food will pollute the pond causing deoxygenation and mass deaths; animal flesh is particularly bad in this respect. Poultry pellets or (preferably) lucerne pellets can be fed but red manure-worms obtainable from compost heaps are the safest food. Worms can also be "farmed" using wooden boxes kept in a cool place. Initially fill a box with a mixture

of fine limestone, pre-soaked cow manure and garden peat moss, cover with a damp bag. Soaked poultry pellets or any non-acidic vegetable scraps are placed under the bag regularly to feed the worms. Larger worms with a "collar" are breeders which lay eggs in batches contained in yellow capsules about 1-2 mm diameter.

PRODUCTION: Over a two year period, with intensive feeding, aeration and other care, up to 300 grams of marron can be produced per square metre of pond, feeding lucerne pellets at up to 30 grams per square metre per week. However, this level of production is very difficult to achieve and a much lower yield must be expected under average conditions.

Young, newly released marron are stocked alone at ten per square metre, with about two or three per square metre surviving to harvesting. Using the high yield figure of 300 grams per square metre, a pond of 100 square metres would be needed to farm a weight of marron equal to the approximate season's catch taken by a proficient amateur fisherman from rivers and dams (20 to 30 kg). At lower stocking densities, particularly below one per square metre, growth and survival are higher but the crop weight is less. At higher densities growth and survival are much poorer.

SAFETY: Small children may drown as easily in a shallow pond as in a swimming pool. It is vital that every precaution is taken to prevent accidents. Backyard marron farmers should consult their local authority concerning by-laws relating to fencing of pools etc.

FARM DAMS

Many farms dams are unsuitable for marron. The following points should be borne in mind to prevent disappointment as a result of stocking an unfavourable dam.

GULLY DAMS: These dams are generally built in the steep gullies of the cooler, well-watered hills of the south-west and are usually suitable for marron.

Water supply varies from a minimum of a winter creek and springs, to a maximum of a perennial stream. The dam will usually be well flushed by overflow in winter and the water is generally clear, which will permit predation by birds unless weed beds or other refuge such as logs and rock piles are available.

The dam bed and bank should be cleared of scrub and grassed to prevent initial organic enrichment which leads to oxygen deficiencies.

EXCAVATED TANK DAMS: These dams are characteristic of the drier, flatter inland wheatbelt areas from Geraldton around to Esperance. The most suitable dams are those excavated on higher ground in light-coloured clays so that the dam is not influenced by the salty conditions common in lower-lying soils and the water is clouded by the clays thus preventing predation by birds.

The dam should be no less than 1 500 cubic metres in capacity or about 1 000 square metres in area (a "2 000 cubic yard" dam). Low summer water depth should not be less than 1.5 metres in drier years.

The dam is filled and flushed by winter runoff from crop, pasture, scrub or roaded catchment (in ascending order of suitability). The greatest danger to marron in farm dams is the overloading of the dam with pasture or crop debris and stock wastes—particularly due to heavy cyclonic summer rains. Marron will sometimes walk out of a dam where severe pollution has caused a lack of dissolved oxygen. A bank across the front of the dam, with a gate opened for the normal winter rains and closed during summer to divert heavy runoff, has been found to be successful in keeping dams clean.



This typical Wheatbelt farm dam was stocked with marron. Research workers monitored the growth of marron in many dams of this kind.

SPREAD BANK DAMS: These dams are found in the flat station areas of ill-defined river drainage in the Esperance region. Water supply is derived from runoff from a large man-made catchment with some dams also receiving water from paddock and roaded catchments.

Lack of provision for overflow flushing leads to clay siltation from the catchment and an accumulation of salt and nutrients. These factors limit the useful life of the dam for keeping marron. If drainage is possible, provision of an overflow pipe just below high water mark will be beneficial. A silt trap and the exclusion of stock from the dam and catchment area will also improve the dam's value for marron culture.

Marron are generally only successful for a brief period in new dams. Older dams are usually only suitable for yabbies and koonacs, which are better able to tolerate low dissolved oxygen levels.

PRODUCTION: Research conducted over a number of years on excavated tank dams in the Kojonup area indicated an average yield of 35 kg of marron from a successful '2 000 cubic yard' dam over a two year period. This yield is much lower than that sought in intensive commercial marron farming, where high costs are involved for the provision of special ponds, equipment and continuous management.

While a farm dam may supply sufficient marron for domestic use, yield is not high enough to sustain a worthwhile economic enterprise for an individual farmer. However, it is possible that one person could achieve an economic return by operating a large number of existing dams on many separate properties, provided that favourable dams are chosen and poaching of stock is prevented.

COMMERCIAL PRODUCTION

To achieve the high yields required for a feasible commercial enterprise, marron farmers must employ specialised facilities and more sophisticated techniques than those used for domestic marron culture in farm dams.

For example, care must be taken in the siting and construction of ponds. The following points from *Marron and Marron Farming* indicate some of the criteria involved initially in site selection:

- * The farm should be situated in an area where the climate provides the least variation in water temperature, ideally between 15 and 25 degrees Celsius. Low temperatures will inhibit growth rates; high temperatures may cause water stratification and deoxygenation.
- * Ponds should be excavated in an impervious clay.
- * Water supply must be adequate to maintain a constant depth of water in ponds and to flush them regularly. Water must not be too salty (less than 1 500 milligrams per litre).

Considerable effort and expense may be involved in satisfying even these basic requirements. Subsequent farm management will include the development of techniques for maximising growth and avoiding mortality. As in all business ventures, the cost of developing and implementing these measures must be carefully weighed against the expected return.

Before commencing any fish farming enterprise, licenses must be obtained for various facets of the operations. Full details of the licensing requirements may be obtained from the Head Office of the Department of Fisheries and Wildlife, 108 Adelaide Terrace, Perth 6000—telephone (09) 325 5988.

OBTAINING MARRON STOCKS

In order to obtain the small number of marron necessary to stock a backyard pool, legal sized marron may be captured from the wild provided that all the regulations specified earlier are observed.

Larger numbers of marron may be obtained from commercial farmers. Details of licensed farmers and the availability of stocks may be obtained from the Secretary of the Marron Growers' Association of Western Australia, 12 Williams Road, Kalamunda 6076 or the Department of Fisheries & Wildlife.

Permits are not required to purchase marron for domestic purposes, but suppliers will issue a receipt accompanying each consignment. This should be retained by the purchaser to indicate that the marron have been legally obtained. Commercial growers must obtain appropriate licenses from the Department before they purchase stocks.

Marron are usually supplied in a sealed plastic bag containing oxygenated water. The unopened bag should be placed in the pond or dam for about twenty minutes so that the temperature of the water in the bag gradually equals that of the surrounding water, the marron may then be released at the water's edge.

If obtained from the wild, marron should be transported in a damp bag. They should be released on the bank of the pond or dam and allowed to walk a short way into the water.

MANAGEMENT OF STOCKS

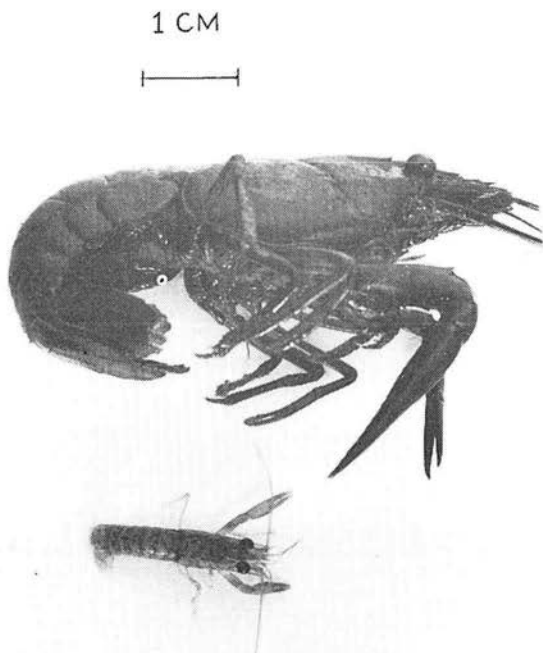
FEEDING: The provision of food for backyard "farming" is dealt with in an earlier section.

In the case of farm dams, marron will generally derive sufficient food from the detritus formed by the breakdown of organic material which has been washed into the dam. If a new dam is to be used, it may take some years before sufficient detritus is available to permit stocking. This situation may be remedied by breaking up two or three bales of pasture hay and placing the pieces around the water's edge.

Foods currently used in commercial culture ventures include lucerne pellets and chaff, which are presoaked for several days, however it is hoped that specially formulated feeds will ultimately be developed.

In all instances, care must be taken to avoid overfeeding and the resulting deterioration in water quality and oxygen level.

SEXING: Female marron have an opening at the bases of the middle pair of the five pairs of legs; males have two blue penes at the base of the rearmost pair.



The smaller marron illustrates the size of the young when released from the mother. The larger marron is one year older.

BREEDING: In the case of backyard ponds or intensive culture situations, a stocking rate of about ten newly-released young per square metre is suggested, whereas for farm dams one per square metre is more appropriate. In either event, only a few mature females will be needed to produce the number of young required. Following mating in early spring it is wise to separate the berried females from the main population in either a separate pond or a wire mesh enclosure in the shallow water.

In anticipation of the release of young marron (in December-January), bundles of fine rope fibres or synthetic material such as onion bags should be placed in the shallows. When released, the young will shelter in the fibres and, rather than disturb the females, the bundles may be periodically examined to find out when the young are released.

When the marron have been found to have spawned twice, there are thus three groups; very small ones (as in the fibre bundles), ones of intermediate size from the previous year's spawning and the large original marron. The large original marron can then be removed because the ones of intermediate size will breed the following year.

Always ensure in future years that marron of intermediate size (less than 76mm carapace length or 152 mm overall) are present in good numbers and are returned to the water, but remove all larger marron each year.

The best method for catching marron in farm dams is by the use of baited drop nets with a mesh of about 25mm. Experiments have shown that to be adequately stocked, a normal farm dam requires a total of 500-2 500 young marron, released from parent females in December; faster growth rate is obtained with lower numbers. Only one or two large females are necessary to provide this number of young.

SHELTER: The provision of shelter in ponds and dams is important in preventing two causes of mortality: competition between the marron and predation by birds.

During their earliest days, newly-released marron are liable to be attacked and eaten by their mothers. If, as advised in the section "Breeding" the young are hatched in a mesh enclosure, they may escape through the mesh and avoid this fate. If a separate breeding pond is used, the females should be removed from the pond as soon as the young are released.

There will be fierce competition for the available shelter between the young marron and between marron of various age groups. Mortality may be reduced by abundant shelter. The fibre bundles previously mentioned should be used for smaller animals and lengths of PVC pipe and corrugated asbestos or plastic sheeting for the larger. After initial mortality a well-established "pecking order" should emerge within the population.

In commercial production, competition may result in unacceptably low growth rates when stocking density is too high. Ideally, separate ponds should be used for different age or year classes, otherwise it may be necessary to continually crop the larger individuals to reduce population pressures.

The white clays typically found in wheatbelt dams and recommended for marron farms will generally produce turbid conditions which should be maintained to limit bird predation. In clearer water the provision of artificial shelter assumes great importance if this problem is to be avoided.

INJURY AND DISEASE: The marron is relatively hardy, in that it does not involuntarily shed its limbs and may survive out of water for short periods in a cool, damp atmosphere. To date, there is no record of mass deaths due to disease.

In farm dams a watch should be kept for the appearance of small, buff-coloured eggs on marron during summer. The eggs are those of the aquatic insect *Corixidae*. The adult is about 6 mm long, white underneath, with grey-brown wings and a pair of oar-shaped legs. Neither the eggs nor the insect is a parasite; the marron is just a convenient object on which the insect may lay its eggs in an otherwise bare-bottomed dam. Since the insect comes to the surface to breath air, the appearance of the insect and its eggs is one symptom that the water is running out of oxygen due to a build-up of debris on the bottom. This should be cleared and the dam restocked.

COMPETING SPECIES: Koonacs, yabbies, fish (particularly redfin perch) and tadpoles which have become established in a dam or pond should be removed, as they appear to cause breeding failure and poor growth in marron.

