

**THE TRANSLOCATION OF BARRAMUNDI  
(*LATES CALCARIFER*) FOR AQUACULTURE AND  
RECREATIONAL FISHERY ENHANCEMENT IN  
WESTERN AUSTRALIA**

By Tina Thorne

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FISHERIES MANAGEMENT PAPER NO. 159

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## 1 INTRODUCTION

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Barramundi (*Lates calcarifer*) is found throughout the south-east Asian region, including northern Australia. The species is highly regarded as a table fish and supports a relatively small but important wild-capture commercial fishery in Western Australia.

Barramundi is successfully cultured in a number of states in Australia, although production is characterised by a large number of relatively small producers, with approximately 8 - 900 tonnes of fish produced in 1998/99. Although production of barramundi in WA is in its infancy with less than 10 tonnes of fish produced in 1997/98, it has grown rapidly in the last three to four years.

The Department of Fisheries has identified that there may be considerable prospects for large-scale barramundi aquaculture in WA, particularly in the abundant tropical waters of Lake Argyle in the Kimberley region. There is also considerable interest in the production of barramundi for both commercial and non-commercial aquaculture, using outdoor ponds and closed recirculating systems.

Barramundi is also regarded as a premier sport fish in the inland waters of northern Australia. The Department of Fisheries recognises that an opportunity exists to improve the quality and diversity of recreational fishing by restocking and enhancement programs using hatchery-reared juvenile stock.

Recreational fishing for barramundi is an important attraction for tourists in the north of WA, with an estimated 50,000 tourists fishing in the Kimberley region each year. The participation rate of residents in the Ord River fishery is well above national and State averages, and a recreational fishing management strategy has been developed to ensure that this unique fishing experience is maintained at sustainable levels.

The establishment of a successful barramundi aquaculture industry and the enhancement of the recreational fishery in the north of Western Australia have the potential to bring a wide range of social and economic benefits to the Kimberley region. In preparing this policy, the Department of Fisheries has taken into account the submissions made on Fisheries Management Paper No. 127 'The Translocation of Barramundi - A Discussion Paper' and has sought advice on this issue from a wide range of stakeholders.

It should also be noted that the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* came into effect on 16 July 2000. Under this legislation, certain actions may require approval from the Commonwealth Environment Minister. The requirement for approval is triggered by an action that has, or will have, or is likely to have, a significant impact on a matter of national environmental significance. The matters of national environmental significance identified in the Act as triggers for the Commonwealth assessment and approval regime are:

- World Heritage properties;
- RAMSAR wetlands;
- nationally threatened species and ecological communities;
- migratory species;
- commonwealth marine areas; and
- nuclear actions.

Further information with respect to this issue can be found on the following website:  
<http://www.environment.gov.au/epbc>.

## **2 OBJECTIVES OF PAPER**

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This Management Paper is intended to assist the Executive Director when considering the issuing of authorisations for commercial aquaculture under Section 92 of the *Fish Resources Management Act 1994*; written approvals or written authorities for the translocation of barramundi under Regulation 176 of the *Fish Resources Management Regulations 1995*; and in the development of programs for recreational fishery enhancement of barramundi. It is also designed to provide guidance to the aquaculture industry and recreational fishing groups when considering the farming or stocking of barramundi in this State.

The Paper has been developed in accordance with the principles of risk assessment and taking into account the principles outlined in Ministerial Policy Guideline No 5. “*The aquaculture and recreational fishing stock enhancement of non-endemic species in Western Australia*”. Barramundi are considered endemic to WA, but there is debate over the fact that there may be genetic differences between stocks that need to be taken into account when developing a translocation policy.

It is considered that the implementation of this policy will assist in the protection of the natural environment and native aquatic species and stocks. It will also allow for the development of what may be a significant aquaculture industry, and assist with the development of recreational fishery enhancement programs that could provide a unique opportunity for regional development in the Kimberley.

It should be noted that genetically modified barramundi (excluding triploids) are not permitted for aquaculture or fisheries enhancement in WA.

## **3 KEY ISSUES**

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The translocation of barramundi for commercial aquaculture, non-commercial aquaculture and recreational fishing stock enhancement raises a number of important issues. These include the potential for any translocated barramundi to:

- (i) introduce disease;
- (ii) impact on the natural environment and the biodiversity of native species; and
- (iii) impact on the genetic diversity of existing stocks.

### **3.1 The Introduction of Disease**

The accidental introduction of disease organisms into WA via the translocation of fish can be of major concern, given the State’s relative freedom from significant aquatic diseases. Adequate health testing to ensure freedom from disease is a vital component of any translocation policy.

An outline of the major disease problems of barramundi is given in Fisheries Management Paper No. 127 'The Translocation of Barramundi - A Discussion Paper'. Copies of the paper are available from the Department of Fisheries and on the Departmental website at [www.wa.gov.au/westfish](http://www.wa.gov.au/westfish).

A full disease testing protocol for juvenile barramundi, eyed barramundi ova and the requirements for a barramundi quarantine facility are outlined at Attachment 3.

### **3.2 Impact on Biodiversity and the Environment**

Barramundi are top-order predators in the water bodies in which they naturally occur. The effect of introducing the species into water bodies in which it does not naturally occur is not known.

As this is the case, careful consideration needs to be given to ensure that management regimes minimise the risk of escape of barramundi and that a requirement to monitor possible impacts on the environment pre- and post-translocation are part of any approval.

### **3.3 The Impact on Genetic Diversity**

There have been a number of studies of the genetic structure of barramundi populations from eastern and northern Australia. In their summary paper of data collected in the 1980s, Shaklee *et al.* (1993) argue that Australian barramundi comprised a number of genetically distinct populations and speculated that long-term reproductive isolation has resulted in those populations becoming adapted to local conditions.

This interpretation was challenged by Keenan (1994), who argued that genetic differences were the result of non-adaptive genetic drift. Mitochondrial DNA (mtDNA) studies by Chenoweth *et al.* (1998) suggested an ancient origin of two major genetic clades on either side of Cape York Peninsula that had arisen during alternating periods of inundation of the Torres Strait.

The only published study of the genetic structure of barramundi from Western Australia (Doupé *et al.* 1999) also found two major mtDNA clades, but they were not distributed in a way that was consistent with the Cape York boundary proposed by Chenoweth *et al.* (1998).

The lack of a precise definition of barramundi stock boundaries is largely due to a number of studies (i.e. Shaklee *et al.* 1993; Keenan 1994; Chenoweth *et al.* 1998; Doupé *et al.* 1999) that have lacked uniformity in sampling locations (particularly), sample sizes and data analyses. Apart from one study (Doupé *et al.* 1999), they have been characterised by a sampling regime that has been heavily biased toward eastern Australian populations; the work of Doupé *et al.* has similar problems for its heavy Western Australian bias.

The subsequent ambiguities in what the results of these studies might mean for appropriate barramundi translocation policy in WA has resulted in differences of opinion and protracted debate.

Maintaining and protecting the genetic diversity of wild barramundi stocks is important in the context of stocking natural waterways for the purposes of recreational fishery enhancement. Stock enhancement programs have different aims (i.e. conservation or to supplement existing barramundi stocks) but to ensure the stocking is successful, always involves the release of large numbers of fish.

It must be assumed that large numbers of released fish will interact, and possibly breed, with existing stocks. Barramundi that are translocated for the purposes of aquaculture will usually be genetically different to natural populations because of artificial selection, but they are ordinarily secured in ponds, tanks, dams and fish cages where the chances of escape are minimised as much as possible.

Given this scenario, it could be argued that translocating barramundi for the purposes of stock enhancement poses a greater risk to the genetic integrity of wild populations than does translocating fish for the purposes of aquaculture. Consequently, more stringent management arrangements are required for stock enhancement programs.

However, it is important that escapes from aquaculture facilities are minimised as much as possible. It is for this reason that the commercial and non-commercial aquaculture of barramundi in Western Australia is subject to strict conditions aimed at minimising escapes, so as to avoid any consequent interactions between aquacultured fish and existing wild stocks.

Based on the information provided in Doupé and Lymbery (2000) the following criteria have been developed to assist policy development for aquaculture:

- (1) Facilities at which the aquaculture of barramundi is to occur must be fitted with mechanisms to ensure that the risk of escape of stock is minimised.
- (2) The need for aquaculture licence holders to comply with the requirements of (1) above should be imposed as a condition on the aquaculture licence.
- (3) Industries should be encouraged to develop Codes of Practice and audited quality assurance processes to ensure farming practices are environmentally sustainable.

These criteria have been used to develop the aquaculture policy as set out in Section 6 and Attachment 2 of this Fisheries Management Paper.

When considering translocation of barramundi, the issues relating to the introduction of disease and the impact the translocation activity may pose on biodiversity and the environment are less problematic given that strict management measures can be implemented that will minimise risk.

The issue of the impact the translocation may pose on the genetic diversity of existing stocks is more complex. It is vital that policies dealing with this issue are developed in a balanced manner, taking into account all views using the scientific information that is currently available.



Whilst acknowledging that there may be a minimal degree of risk in allowing the translocation of what may be a different genetic stock, the Department of Fisheries believes that the biological and environmental risks of this must be balanced against the significant social and economic benefits that may ensue from the subsequent establishment of an aquaculture industry and enhancement of the barramundi recreational fishery in the north of the State.

#### **4 ASSESSMENT CRITERIA**

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When assessing any proposal for farming or stocking barramundi, a number of criteria need to be considered. These include:

- the location of the proposed farm or water body to be stocked;
- the culture system to be used;
- the source of the barramundi to be utilised;
- the conditions that may be applied, including disease testing requirements; and
- the long-term security of the aquaculture system.

Each of these criteria has been considered and incorporated in the policy guidelines outlined below.

#### **5 LOCATION OF FARMS OR WATER BODIES FOR AQUACULTURE OR STOCK ENHANCEMENT**

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Commercial and non-commercial barramundi farms and the stocking of barramundi for recreational fishing will only be permitted in areas where the proposed activity will have minimal impact on the conservation values of the drainage basin in which the farm is located.

The conservation values of the drainage basins shall be determined taking into account the following factors:

1. the condition of the river systems in the basin (i.e. pristine, degraded, etc.) and their conservation value in relation to the conservation of native species;
2. the amount of land area covered by National Parks or Nature Reserves;
3. World Heritage properties;
4. habitats of special importance (i.e. mangroves and wetlands);
5. the presence of RAMSAR\* wetlands; and
6. river systems that support populations of rare or endangered aquatic or terrestrial native species that have been identified at a State or National level.

\* Those wetlands declared at the RAMSAR world conference in the 1970s as being environmentally significant and especially worthy of protection.

Information for each drainage division within Western Australia relevant to the factors outlined above is given in Attachment 1. All proposals to farm barramundi or to stock barramundi into natural water bodies will be assessed in relation to these factors and the impact the activities may pose on the environment.

Proposed barramundi farms, particularly those located in areas within the natural range of barramundi and utilising stock from a different drainage basin, will be subject to a property inspection to ensure that the location of the farm poses minimal impact on the environment.

The farming and stocking of barramundi will not be permitted in any National Park, Conservation Park, Nature Reserve or State Forest, or any contiguous catchment areas around these parks and reserves.

## 6 POLICY FOR AQUACULTURE

Commercial and non-commercial aquaculture of barramundi will be permitted in Western Australia, provided the farm is located in an area deemed suitable as outlined in Section 5 above and in accordance with the following principles:

Culture system	Location	Stock permitted for use	Criteria
1. Closed recirculating tank, pond or dam systems with no discharge. (This may include farming in disused mine pits, with no discharge or hatcheries)	<ul style="list-style-type: none"> <li>In areas <i>within</i> the natural range of barramundi.</li> </ul>	<ul style="list-style-type: none"> <li>From any farm in Australia.</li> </ul>	<ul style="list-style-type: none"> <li>Stock must be certified disease-free. See Attachment 3.</li> <li>Commercial aquaculture permitted subject to an aquaculture licence and conditions and a property inspection. See Attachment 2.</li> <li>Non-commercial aquaculture permitted subject to a property inspection to confirm location and security. See Attachment 2.</li> </ul>
	<ul style="list-style-type: none"> <li>In areas <i>outside</i> of the natural range of barramundi.</li> </ul>	<ul style="list-style-type: none"> <li>From any farm in Australia</li> </ul>	<ul style="list-style-type: none"> <li>Stock must be certified disease-free. See Attachment 3.</li> <li>Commercial aquaculture permitted subject to a licence and appropriate conditions relevant to translocation issues. See Attachment 2.</li> <li>Non-commercial aquaculture permitted subject to translocation approval and conditions and a property inspection to confirm location and security. See Attachment 2.</li> </ul>
4. Ponds, dams or tank systems with a discharge, or where the systems may overflow in the event of a flood.  (This may include hatcheries)	<ul style="list-style-type: none"> <li>In areas <i>within</i> the natural range of barramundi.</li> </ul>	<ul style="list-style-type: none"> <li>From any farm in Australia.</li> </ul>	<ul style="list-style-type: none"> <li>Stock must be certified disease-free. See Attachment 3.</li> <li>Screens must be fitted on overflow pipes or spillway.</li> <li>Commercial aquaculture permitted subject to an aquaculture licence and conditions. See Attachment 2.</li> <li>Non-commercial aquaculture permitted subject to a property inspection to confirm screening and site location.</li> </ul>
	<ul style="list-style-type: none"> <li>In areas <i>outside</i> of the natural range of barramundi.</li> </ul>	<ul style="list-style-type: none"> <li>From any farm in Australia.</li> </ul>	<ul style="list-style-type: none"> <li>Stock must be certified disease-free. See Attachment 3.</li> <li>Screens must be fitted on overflow pipes or spillway.</li> <li>A property inspection will be required to confirm screening and site location.</li> <li>Commercial aquaculture permitted subject to a licence and appropriate conditions relevant to translocation issues. See Attachment 2.</li> <li>Non-commercial aquaculture permitted subject to translocation approval and conditions. See Attachment 2 and points below.</li> </ul>
6. Cage farming in open water bodies (freshwater or marine).  (e.g. Lake Argyle, marine sites and lakes on private property)	<ul style="list-style-type: none"> <li>In areas <i>within</i> the natural range of barramundi.</li> </ul>	<ul style="list-style-type: none"> <li>From any farm in Australia.</li> </ul>	<ul style="list-style-type: none"> <li>Stock must be certified disease-free. See Attachment 3.</li> <li>Commercial aquaculture permitted subject to an aquaculture licence and conditions. See Attachment 2.</li> <li>Licence conditions will be imposed that dictate code of practice and gear requirements to minimise risk of escape.</li> <li>An inspection will be required to confirm gear requirements and site location.</li> <li>Non-commercial aquaculture is <i>not</i> permitted (i.e. no domestic stocking).</li> </ul>
	<ul style="list-style-type: none"> <li>In areas <i>outside</i> the natural range of barramundi.</li> </ul>	<ul style="list-style-type: none"> <li>From any farm in Australia.</li> </ul>	<ul style="list-style-type: none"> <li>Stock must be certified disease-free. See Attachment 3.</li> <li>Commercial aquaculture permitted subject to a licence and appropriate conditions relevant to translocation issues. See Attachment 2 and points below.</li> <li>Licence conditions will be imposed that dictate code of practice and gear requirements to minimise risk of escape.</li> <li>A property inspection will be required to confirm gear requirements and site location.</li> <li>Non-commercial aquaculture permitted on private property subject to translocation approval and conditions. See Attachment 2.</li> </ul>

NB: The natural distribution of barramundi (*Lates calcarifer*) is defined in Section 2.1.2 of Fisheries Management Paper No 127 "The Translocation of Barramundi - A Discussion Paper" May 1999

## **7 RECREATIONAL FISHERY ENHANCEMENT PROGRAMS**

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The Department of Fisheries recognises that economic and social benefits can ensue from the creation - or enhancement - of recreational fisheries based on stock enhancement in water bodies depleted of barramundi or where barramundi do not currently exist. The determination of which water bodies may be suitable for stocking or restocking purposes should be based on a number of factors including:

- an assessment of why barramundi stocks may be depleted or non-existent in the water body;
- the water quality of the system;
- whether the system will support barramundi;
- the 'fitness' of the hatchery-reared stock;
- the accessibility of the water body for recreational fishing;
- assessment of the ecological effects of stocking;
- the cost/benefit of the stocking;
- compatibility of recreational fishing with the other users of the water system; and
- the potential quality of the recreational fishery resulting from the stocking program.

Restocking proposals will only be adopted and approved if proponents provide sufficient information relating to:

- the rationale for the restocking;
- an evaluation of its benefits and costs;
- a program for monitoring population size and genetic diversity in the restocked population; and
- the management actions that may be triggered from the possible outcomes of the management program.

The guidelines outlined below are designed to provide guidance on the impact the translocation of barramundi may have with respect to genetic stock differentiation when developing fishery enhancement programs. It should be noted that these guidelines are not intended to present any given view on whether or not stock enhancement programs should proceed in Western Australia.

The Department of Fisheries has recently commenced an investigation into the legislative, scientific and policy issues surrounding stock enhancement and reseeded proposals with a view to drafting an issues paper for public comment. Consideration is also being given to the development of a consultation process in relation to proposals of this nature to ensure that the views of all stakeholder groups are taken into account.

### **Guidelines to be taken into account when proposing to stock barramundi into public water bodies where the species naturally occurs**

1. All stock to be placed into public water bodies should originate from broodstock obtained from that water body or an interconnecting system.

2. Large numbers of broodstock should be used to produce the fingerlings or yearlings necessary for the restocking. The use of large numbers of broodstock will assist in preventing loss of genetic diversity through inbreeding and genetic drift. Any breeding program should be developed in liaison with a geneticist with expertise in fish population genetics, preferably of barramundi.
3. No selection process to improve the stock must occur. Unintentional domestication of stock may be unavoidable, but it is possible that it can be minimised by the introduction of new broodstock from the wild every generation. *NB: Different stocking strategies can be used to improve returns to recreational fishers (i.e. stocking yearling fish as opposed to fry).*
4. All fish must be disease tested prior to release into the environment (See Attachment 4).
5. A sound scientific monitoring program to evaluate the success and determine the cost benefits of the stocking program must be implemented.

**Guidelines to be taken into account when proposing to stock barramundi into public water bodies where barramundi did occur, but are now depleted**

1. A stock assessment must be conducted to determine the extent of the depletion prior to any stocking program being undertaken. This should include an evaluation to identify the cause of stock depletion.
2. Remedial action should be taken to improve habitat or regulate recreational or commercial take if that is the cause of the initial depletion, and the effectiveness of the stocking program should be evaluated against other management methods.
3. All stock to be placed into the natural environment should preferably originate from broodstock obtained from that water body or an interconnecting system. If broodstock from that system are not readily available as natural stock populations are depleted, then broodstock with a similar adaptive potential should be sourced (i.e. with a common evolutionary history).
4. Large numbers of broodstock should be used to produce the fingerlings or yearlings necessary for the restocking. The use of large numbers of broodstock will assist in preventing loss of genetic diversity through inbreeding and genetic drift. Any breeding program should be developed in liaison with a geneticist with expertise in fish population genetics, preferably of barramundi.
5. Some selection to improve the stock may be permitted to ensure optimum fitness and therefore increase its chances of survival in the system.
6. All fish must be disease-tested prior to release into the environment (See Attachment 4).
7. A sound scientific monitoring program to evaluate the success and determine the cost benefits of the stocking program must be implemented.

## **Guidelines to be taken into account when proposing to stock barramundi into public water bodies where barramundi have never occurred**

1. Proposals to stock barramundi into public water bodies where they have never occurred will be assessed on a case-by-case basis, but will require a full translocation assessment as outlined in accordance with the process outlined in Ministerial Policy Guideline No. 5. This may include referral to the Environmental Protection Authority and should take into account the issues outlined in Section 5 above. In certain areas, approval from Environment Australia may also be required under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*.
2. Approval to stock barramundi into areas where they do not naturally occur is unlikely to be granted unless it can be demonstrated that the activity is unlikely to impact on important biological resources, as shown on the maps in Attachment 1.

## **8 REFERENCES**

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Chenoweth S. F., J. M. Hughes, C. P. Keenan & S. Lavery (1998) When oceans meet: a teleost shows secondary intergradation at an Indian-Pacific interface. *Proceedings of the Royal Society of London B* **265**, 415-420.

Doupé R. G., P. Horwitz & A. J. Lymbery (1999) Mitochondrial genealogy of Western Australian barramundi: applications of inbreeding coefficients and coalescent analysis for separating temporal population processes. *Journal of Fish Biology* **54**, 1197-1209.

Doupé R. G., & A. J. Lymbery (2000) Managing translocations of aquatic species. *Aquaculture Research* **31**, 151-156.

Keenan C. P. (1994) Recent evolution of population structure in Australian barramundi, *Lates calcarifer* (Bloch): an example of isolation by distance in one dimension. *Australian Journal of Marine and Freshwater Research* **45**, 1123-1148.

Shaklee J. B., J. Salini & R. N. Garrett (1993) Electrophoretic characterisation of multiple genetic stocks of barramundi (*Lates calcarifer*) in Queensland, Australia. *Transactions of the American Fisheries Society* **122**, 685-701.

**ATTACHMENT 1      MAPS OF THE IMPORTANT BIOLOGICAL  
REFERENCES IN DRAINAGE BASIN  
DIVISIONS**

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*Figure 1      Map of the Important Biological Resources in the Timor Sea Drainage Basin  
Division*

*Figure 2 Map of the Important Biological Resources in the Indian Ocean Drainage Basin Division*



*Figure 3 Map of the Important Biological Resources in the Western Plateau Drainage Basin Division*

*Figure 4 Map of the Important Biological Resources in the South West Drainage Basin Division*

## **ATTACHMENT 2      CRITERIA FOR THE FARMING OF BARRAMUNDI**

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If an aquaculture proponent is to stock a farm with adult or juvenile barramundi that originate from outside of the drainage basin in which the farm is located, the following criteria may be applied:

**Closed recirculating tank, pond or dam systems with no discharge** (Commercial or non-commercial aquaculture)

1. The barramundi must only be kept in a closed recirculating system with no discharge water leaving the property.
2. Any waste water from transport or the aquaculture operation shall be:
  - a) disposed of on dry ground at least 100 metres from any waterway; or
  - b) disposed of by discharge to a soakwell system that does not have the facility for surface water flow; or
  - c) sterilised by treatment with chlorine to 50 parts per million for 10 minutes prior to discharge.
3. The barramundi shall be sourced from a batch that has been certified disease-free to the satisfaction of the Senior Fish Pathologist of the Department of Fisheries.
4. At least 48 hours prior to the transportation of the barramundi, a copy of the certificate citing freedom from disease shall be forwarded to the Translocation Officer of the Department of Fisheries.
5. The barramundi shall be transported directly from the airport to the holding facility with no prior unpacking or processing.
6. The fish are not to be removed from the facility except for the purposes of consumption without the prior written approval or authority of the Executive Director of the Department of Fisheries.
7. Any unusually high mortalities (i.e. greater than five per cent) must be reported to the Senior Fish Pathologist and the Translocation Officer of the Department of Fisheries within 24 hours of their occurrence.

**Ponds, private dams or tank systems with a discharge, or where the systems may overflow in the event of a flood**

1. The barramundi to be farmed must only be sourced in accordance with the policy outlined in this Fisheries Management Paper.
2. If the farm system is located in an area within the natural range of barramundi, an aquaculture licence endorsed for barramundi or approval to translocate fish for non-commercial purposes is required.

3. Properties must be inspected to assess the level of risk of escape and the proximity of the property to areas of high conservation value or important biological resources, as shown on the maps in Attachment 1.
4. Screens designed to prevent the escape of stock into natural waterways must be fitted to all outlet pipes on the property.
5. The barramundi shall be sourced from a batch that has been certified disease-free to the satisfaction of the Senior Fish Pathologist of the Department of Fisheries.
6. The fish are not to be removed from the facility except for the purposes of consumption without the prior written approval or authority of the Executive Director of the Department of Fisheries.
7. Any unusually high mortalities (i.e. greater than five per cent) must be reported to the Senior Fish Pathologist and the Translocation Officer of the Department of Fisheries within 24 hours.
8. At least 48 hours prior to the transportation of the barramundi, a copy of the certificate citing freedom from disease shall be forwarded to the Translocation Officer of the Department of Fisheries.
9. The barramundi shall be transported directly from the airport to the holding facility with no prior unpacking or processing.
10. At any time when the proponent has knowledge or information that indicates that large numbers of fish (greater than 100) have escaped from the cages, the losses must be reported to the Executive Director of the Department of Fisheries within 24 hours.

#### **Cage farming in open water bodies (freshwater or marine)**

1. The barramundi to be farmed must only be sourced in accordance with the policy outlined in this Fisheries Management Paper.
2. If the farm system is located in an area within the natural range of barramundi, you must be the holder of an aquaculture licence endorsed for barramundi.
3. All cages for holding fish must be physically marked with an individual number.
4. All fish considered unsuitable for 'on-growing' are to be culled and not released.
5. At any time when the proponent has knowledge or information that indicates that large numbers of fish (greater than 100) have escaped from the cages, the losses must be reported to the Executive Director of the Department of Fisheries within 24 hours.

6. All staff involved in net changing activities must be appropriately trained and supervised.
7. The proponent must ensure that the main cage is:
  - a) constructed of net of a mesh size, type and quality that will reliably provide a complete barrier that will retain 100 per cent of the fish stocked in the cage;
  - b) of a mesh size between 2.5 - 22.5 cm stretched mesh size, depending on the size of the fish to be contained;
  - c) does not contain holes or openings greater than 1.5 times the size of the net mesh;
  - d) constructed so that the cage netting extends no less than 50 cm above the water line, or is secured by overhead netting to prevent fish escape by jumping; and is
  - e) fitted with predator exclusion or reduction devices.
8. The proponent must ensure that netting installed to deter predators is:
  - a) constructed of a mesh that uses cord greater than 2mm in diameter;
  - b) of a mesh size between 2.5 - 22.5 cm stretched mesh size, depending on the size of the fish to be contained;
  - c) constructed so that the cage netting extends no less than 50 cm above the water line, or is secured by overhead netting to prevent fish escape by jumping;
  - d) does not contain holes or openings greater than 1.5 times the size of the net mesh; and
  - e) hung from the main cage a minimum distance of 30 cm.
9. In addition to the obligations for licence holders under Regulation 64 of the *Fish Resources Management Regulations 1995*, the proponent must make and maintain the following records:
  - a) the numbers of fish stocked into each holding cage;
  - b) the movements of fish from one cage to another;
  - c) the numbers of fish culled and removed from the cages; and
  - d) the numbers of fish removed from the cages at the time of harvesting.
10. At all times the proponent must maintain the written records referred to in (9) in a secure place within the aquaculture facility, for a period of seven years.

*NB: Additional conditions may be placed on any approval as a result of a site inspection or depending on the location of the facility.*

## **ATTACHMENT 3      DISEASE TESTING PROTOCOL FOR AQUACULTURE**

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### **Introduction**

It is vital to the overall success of the aquaculture industry and the protection of other aquatic organisms that all barramundi moved into and within Western Australia are tested for freedom from disease.

Barramundi are prone to a number of viral and bacterial diseases and parasitic infections. An overview of these diseases and infections is outlined in Fisheries Management Paper No. 127 'The Translocation of Barramundi - A Discussion Paper'.

A number of these pathogens, parasites and diseases have been described elsewhere in Australia, but have not been recorded in Western Australia. The main disease of concern is a nodavirus that causes the syndrome known as viral nervous necrosis (VNN) or viral encephalopathy.

This disease, which is notifiable in Australia, has been implicated in high mortality rates in hatchery-reared juvenile barramundi and as the presence of the disease is yet to be recorded in Western Australia, certification of fish free from VNN is seen as essential prior to fish being imported into the State.

Parasitic disease is uncommon in barramundi in Australia, but the presence of protozoan and metazoan parasites is common and strain differences may occur. These parasites can often proliferate in culture situations and lead to mortality and disease. It is important therefore that all batches of fish tested prior to movement are declared free of protozoan and metazoan parasites to the satisfaction of a competent authority acceptable to the Senior Fish Pathologist of the Department of Fisheries, Government of Western Australia.

### **General Issues**

There are a number of fundamental criteria that must be considered prior to the movement of any barramundi stock. These are as follows:

1. It is highly preferable that barramundi stocks for the purposes of commercial and non-commercial aquaculture be sourced from stocks within the drainage basin in which the farm is located.
2. Barramundi brought into Western Australia from interstate shall be sourced from licensed hatcheries only (i.e not from the wild) and shall be health-tested to the satisfaction of the Senior Fish Pathologist of the Department of Fisheries.
3. Health testing and certification shall be performed by government veterinary officers or other authorised officers in laboratories using methods approved by the Senior Fish Pathologist of the Department of Fisheries.

4. Testing standards shall meet with a 95 per cent degree of confidence that the imported population is free of the 'nominated' diseases.
5. 'Nominated' disease must include relevant 'notifiable' diseases, as listed under the *Enzootic Disease Regulations 1970*, and any other diseases nominated by the Senior Fish Pathologist of the Department of Fisheries for the particular populations to be imported.
6. All cost of importation, quarantine and disease testing will be borne by the proponent.

### **Testing protocol for juvenile barramundi**

1. A sample of 150\* fish shall be taken from a given batch of barramundi for disease testing prior to importation or movement between drainage basins.
2. Each batch of fish must be numbered and kept in isolation until the testing is completed.
3. The sample of 150 fish are subject to examination for signs of disease or pathogenic organisms using current diagnostic techniques as designated by the Senior Fish Pathologist of the Department of Fisheries.
4. Batches of fish that cannot be declared free from viral nervous necrosis (VNN), notifiable diseases or significant protozoan or metazoan infections will not be permitted to be imported into the State, or moved from drainage basin to drainage basin.
5. If testing proves negative, a health certificate can be issued. The certification is specific for the particular batch of fish tested from the specified hatchery or farm and remains current for two weeks. Should the certification expire prior to the fish being imported, the fish will be required to be retested.

**\*NOTE:**

A sample size of 150 fish is an internationally accepted standard size. It is based on sampling a population of at least 10,000 fish and gives a probability of 95 per cent of finding a pathogen in the sample if two per cent or more of the sampled population are infected. This assumes that the testing is performed by qualified personnel and that the testing procedure is 100 per cent reliable.

### **Testing protocol for barramundi eyed ova**

Barramundi eyed ova may be imported into Western Australia subject to the following conditions:

1. The proponent must be the holder of a current Aquaculture Licence and have obtained the written approval of the Executive Director of the Department of Fisheries prior to importation.

2. The consignment of eyed ova to be imported shall be accompanied by any required certification (such as disease certificates or translocation approvals) to enable inspection at the point of entry to proceed.
3. The eyed ova shall be transferred directly to an 'approved' quarantine facility and will remain in quarantine until the health testing on the resultant larvae has been completed to the satisfaction of the Senior Fish Pathologist of the Department of Fisheries.

*NB: See below for details on the requirements of an 'approved' quarantine facility.*

4. Any imported packing materials and water are to be disinfected, destroyed by incineration or disposed of as directed by the Senior Fish Pathologist of the Department of Fisheries
5. Any unusually high mortalities (i.e. greater than five per cent) must be reported to the Senior Fish Pathologist and the Translocation Officer of the Department of Fisheries within 24 hours of occurrence.
6. All costs of testing and inspection are to be borne by proponent.
7. A sample of 150\* fish, a minimum of 20 days old, shall be taken from the batch of barramundi for disease testing prior to release from quarantine.
8. The sample of 150 fish are subject to examination for signs of disease or pathogenic organisms using current diagnostic techniques as designated by the Senior Fish Pathologist of the Department of Fisheries.
9. Batches of fish that cannot be declared free from viral nervous necrosis (VNN), notifiable diseases or significant protozoan or metazoan infections will not be released from quarantine and may need to be destroyed.
10. If testing proves negative, a health certificate may be issued. The certification is specific for the particular batch of fish tested from the specified hatchery or farm and remains current for two weeks. Should the certification expire prior to the fish being imported, the fish will be required to be retested.

### **Testing protocol for adult barramundi**

Sampling protocols that may be required for the disease testing of adult barramundi will be developed by the Senior Fish Pathologist on a 'case-by-case' basis, but will involve many of the elements outlined above.



## **Quarantine Facility Requirements**

1. The quarantine facility shall be constructed in a location approved by local government authorities where required, and not be located in an area classified as flood-prone by the relevant State authority.
2. The facility is to be used only as a quarantine facility and must not contain any other fish unless these are never to be removed from the facility.
3. All tanks and other holding devices shall be permanently numbered and fitted with a recording chart which is kept up-to-date and indicates the total number of fish, losses through death, and any signs of disease.
4. The facility shall be lockable so as to prevent unauthorised entry, and have secure walls and sealed floors so as to hold the total volume of water.
5. The quarantine facility shall be constructed so that the fish can be readily accessed and inspected, and sufficient light must be supplied.
6. Any waste water from transport or the aquaculture operation shall be:
  - a) disposed of on dry ground at least 100 metres from any waterway; or
  - b) disposed of by discharge to a soakwell system that does not have the facility for surface water flow; or
  - c) sterilised by treatment with chlorine to 50 parts per million for 10 minutes prior to discharge.
7. The facility shall contain a sink discharging to a sewer as in (6) above, or tubs or other devices to enable the washing and rinsing of hands or any other part of the body in contact with the fish or water with a quaternary ammonium compound or other approved general skin disinfectant. All persons entering the facility shall carry out such disinfection prior to leaving the facility.
8. Entry to the facility shall be restricted to the owner and designated employees thereof, and to officers of the Department of Fisheries.

**ATTACHMENT 4      DISEASE TESTING PROTOCOL FOR  
BARRAMUNDI STOCKED INTO NATURAL  
WATER BODIES**

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1. Barramundi may be sourced from wild stocks within Western Australia (subject to relevant approvals), but if the fish are to be moved from one drainage basin to another, the stock shall be health tested to the satisfaction of the Senior Fish Pathologist of the Department of Fisheries.
2. Health testing and certification shall be performed by government veterinary officers or other authorised officers in laboratories using methods as approved by the Senior Fish Pathologist of the Department of Fisheries.
3. Testing standards shall meet the 95 per cent degree of confidence that the imported population is free of the 'nominated' diseases. 'Nominated' disease must include relevant 'notifiable' diseases as listed under the *Enzootic Disease Regulations 1970* and any other diseases nominated by the Senior Fish Pathologist of the Department of Fisheries for the particular populations to be stocked.
4. All cost of stocking and disease testing will be borne by the proponent.

## FISHERIES MANAGEMENT PAPERS

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- No. 1** The Report of the Southern Western Australian Shark Working Group. Chairman P. Millington (1986)
- No. 2** The report of the Fish Farming Legislative Review Committee. Chairman P. Rogers (1986)
- No. 3** Management Measures for the Shark Bay Snapper 1987 Season. P. Millington (1986)
- No. 4** The Esperance Rock Lobster Working Group. Chairman A. Pallot (1986)
- No. 5** The Windy Harbour - Augusta Rock Lobster Working Group. Interim Report by the Chairman A. Pallot (1986)
- No. 6** The King George Sound Purse Seine Fishery Working Group. Chairman R. Brown (1986)
- No. 7** Management Measures for the Cockburn Sound Mussel Fishery. H. Brayford (1986)
- No. 8** Report of the Rock Lobster Industry Advisory meeting of 27 January 1987. Chairman B. Bowen (1987)
- No. 9** Western Rock Lobster Industry Compensation Study. Arthur Young Services (1987)
- No. 10** Further Options for Management of the Shark Bay Snapper Fishery. P. Millington (1987)
- No. 11** The Shark Bay Scallop Fishery. L. Joll (1987)
- No. 12** Report of the Rock Lobster Industry Advisory Committee to the Hon Minister for Fisheries 24 September 1987. (1987)
- No. 13** A Development Plan for the South Coast Inshore Trawl Fishery. (1987)
- No. 14** Draft Management Plan for the Perth Metropolitan Purse Seine Fishery. P. Millington (1987)
- No. 15** Draft management plan, Control of barramundi gillnet fishing in the Kimberley. R. S. Brown (1988)
- No. 16** The South West Trawl Fishery Draft Management Plan. P. Millington (1988)
- No. 17** The final report of the pearling industry review committee. F.J. Malone, D.A. Hancock, B. Jeffriess (1988)
- No. 18** Policy for Freshwater Aquaculture in Western Australia. (1988)
- No. 19** Sport Fishing for Marron in Western Australia - Management for the Future. (1988)
- No. 20** The Offshore Constitutional Settlement, Western Australia 1988
- No. 21** Commercial fishing licensing in Western Australia. (1989)
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- No. 24** Management of the Perth metropolitan purse-seine fishery. N. Moore (1989)
- No. 25** Rock Lobster Industry Advisory Committee report to the Minister for Fisheries November 1988. (1989)
- No. 26** A report on marron fishing in Western Australia. Chairman Doug Wenn MLC (1989)
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- No. 30** Foreign investment in the rock lobster industry. (1989)
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- No. 33** Guidelines for by-laws for those Abrolhos Islands set aside for fisheries purposes. N. Moore (1989)
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- No. 36** Long term management measures for the Cockburn Sound restricted entry fishery. P. Millington (1990)
- No. 37** Western rock lobster industry marketing report 1989/90 season. MAREC Pty Ltd (1990)
- No. 38** The economic impact of recreational fishing in Western Australia. R.K. Lindner, P.B. McLeod (1991)

- No. 39** Establishment of a registry to record charges against fishing licences when used as security for loans. P. Rogers. (1991)
- No. 40** The future for Recreational Fishing - Forum Proceedings. Recreational Fishing Advisory Committee (1991)
- No. 41** The future for Recreational Fishing - The Final Report of the Recreational Fishing Advisory Committee. Recreational Fishing Advisory Committee (1991)
- No. 42** Appendix to the final report of the Recreational Fishing Advisory Committee. (1991)
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- No. 47** Long term management measures for the Cockburn Sound restricted entry fishery. Summary of submissions and final recommendations for management. P. Millington (1992)
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- No. 54** Rock Lobster Industry Advisory Committee, Management proposals for 1993/94 and 1994/95 western rock lobster season (July 1993)
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- No. 64** The Warnbro Sound crab fishery draft management plan. F. Crowe (June 1994)
- No. 65** Not issued
- No. 66** Future management of recreational gill, haul and cast netting in Western Australia and summary of submissions to the netting review. F.B. Prokop, L.M. Adams (September 1994)
- No. 67** Long term management strategies for the Western Rock Lobster Fishery. (4 volumes) Evaluation of management options Volume 1. B. K. Bowen (September 1994)
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- No. 69** Long term management strategies for the Western Rock Lobster Fishery. (4 volumes) A market-based economic assessment for the western rock lobster industry, Volume 3. Marec Pty Ltd (September 1994)
- No. 70** Long term management strategies for the Western Rock Lobster Fishery. (4 volumes) Law enforcement considerations, Volume 4. N. McLaughlan (September 1994)
- No. 71** The Rock Lobster Industry Advisory Committee Chairman's Report, October 1994, The Western Rock Lobster Fishery - Management proposals for the 1994/95 and 1995/96 seasons (November 1994)
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- No. 77** The Offshore Constitutional Settlement, Western Australia. H. Brayford & G. Lyon (May 1995)
- No. 78** The Best Available Information - Its Implications for Recreational Fisheries Management. Workshop at Second National Fisheries Managers Conference, Bribie Island Queensland. F. Prokop (May 1995)
- No. 79** Management of the Northern Demersal Scalefish Fishery. J. Fowler (June 1995)
- No. 80** Management arrangements for specimen shell collection in Western Australia, 1995. J. Barrington & C. Campbell (March 1996)
- No. 81** Management Options (Discussion Paper) for the Shark Bay Snapper Limited Entry Fishery. Shark Bay Snapper Limited Entry Fishery Working Group, Chaired by Doug Bathgate (June 1995)
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- No. 83** Translocation Issues in Western Australia. Proceedings of a Seminar and Workshop held on 26 and 27 September 1994. F. Prokop (July 1995)
- No. 84** Bag and Size Limit Regulations From Around Australia. Current Information as at 1 July 1995. Third Australasian Fisheries Managers Conference, Rottneest Island. F. Prokop (July 1995)
- No. 85** West Coast Rock Lobster Fishery Management Plan 1995 - Draft for Public Comment. Edited by M. Moran (August 1995)
- No. 86** A Review of Ministerial Policy Guidelines for Rock Lobster Processing in Western Australia from the Working Group appointed by the Minister for Fisheries and chaired by Peter Rich (December 1995)
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- No. 96** Summary Report of the Freshwater Aquaculture Taskforce (FAT) by Chris Wells (*in press*)

- No. 97** (in press)
- No. 98** A Pricing Policy for Fisheries Agencies - Standing Committee on Fisheries and Aquaculture Management Committee. P Millington (March 1997)
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- No. 119** Access to Wildstock for Aquaculture Purposes (not published)
- No. 120** Draft Management Plan for Sustainable Tourism at the Houtman Abrolhos Islands. Prepared by LeProvost, Dames and Moore for the Abrolhos Islands Management Advisory Committee in conjunction with Fisheries WA. (December 1998)
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- No. 124** A Quality Future for Recreational Fishing in the Gascoyne. Proposals for Community Discussion. A five-year management strategy prepared by the Gascoyne Recreational Fishing Working Group (May 1999)

- No. 125** Changes to Offshore Constitutional Settlement Arrangements; North West Slope Trawl Fishery and Western Deepwater Trawl Fishery. A discussion paper by Fiona Crowe and Jane Borg (May 1999)[not published]
- No. 126** The South Coast Estuarine Fishery. A discussion paper by Rod Pearn and Tony Cappelluti. (May 1999)
- No. 127** The Translocation of Barramundi. A discussion paper by Makaira Pty Ltd.[July 1999]
- No. 128** Shark Bay Pink Snapper Managed Fisheries in WA
- No. 129** Review of the Western Australian Pilchard Fishery 12 - 16 April 1999. Prepared by K.L. Cochrane, Fisheries Resource Division, Food and Agriculture Division of the United Nations (November 1999)
- No. 130** Developing New Fisheries in Western Australia. A guide to applicants for developing fisheries Compiled by Lucy Halmarick (November 1999)
- No. 131** Management Directions for Western Australia's Estuarine and Marine Embayment Fisheries. A strategic approach to management (November 1999)
- No. 132** Summary of Submissions to Fisheries Management Paper No. 126 - The South Coast Estuarine Fishery - A Discussion Paper. Compiled by Rod Pearn (November 1999)
- No. 133** Abalone Aquaculture in Western Australia, A Policy Guideline (December 1999)
- No. 134** Management Directions for WA's Coastal Commercial Finfish Fisheries. Issues and proposals for community discussion (March 2000)
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- No. 138** Information on Quota Management of Rock Lobster Fisheries in South Australia, Tasmania and New Zealand. By Kevin Donohue and Eric Barker (May 2000)
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- No. 140** Aquaculture Plan for the Recherche Archipelago, Western Australia. (June 2000)
- No. 141** Fish Protection Measures in Western Australia (July 2000) *in press*
- No. 142** Fisheries Environmental Management Plan for the Gascoyne Region (*in press*)
- No. 143** Western Rock Lobster. Discussion paper for seasons 2001/2002 and 2002/2003 (July 2000)
- No. 144** The Translocation of Brown Trout (*Salmo trutta*) and Rainbow Trout (*Oncorhynchus mykiss*) into and within Western Australia. Prepared by Jaqueline Chappell, contributions from Simon Hambleton, Dr Howard Gill, Dr David Morgan and Dr Noel Morrissy. (*in press*)
- No. 145** The Aquaculture of non-endemic species in Western Australia - Silver Perch (*Bidyanus bidyanus*). As amended October 2000. Tina Thorne. This replaces Fisheries Management Paper No. 107
- No. 146** Sustainable Tourism Plan for the Houtman Abrolhos Islands (February 2001)
- No. 147** Draft Bycatch Action Plan for the Shark Bay Prawn Managed Fishery - Full Report (February 2001)
- No. 148** Draft Bycatch Action Plan for the Shark Bay Prawn Managed Fishery - Summary Report (February 2001)
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- No. 155** Plan of Management for the Cottesloe Reef Fish Habitat Protection Area (September 2001)
- No. 156** The Translocation Brown Trout (*Salmo Trutta*) and Rainbow Trout (*Oncorhynchus mykiss*) into and within Western Australia (*in press*)

- No. 157** Policy for the Implementation of Ecologically Sustainable Development for Fisheries and Aquaculture within Western Australia. By W.J. Fletcher (*in press*)
- No. 158** Draft Plan of Management for the Miaboolya Beach Fish Habitat Protection Area (*in press*)
- No. 159** The Translocation of Brammudi (*Lates calcarifer*) for Aquaculture and Recreational Fishery Enhancement in Western Australia. By Tina Thorne (March 2002)