

A SCOPING PAPER:

**MATTERS RELEVANT TO THE DEVELOPMENT OF
A SUSTAINABLE ALLOCATION AND GROWOUT
MODEL FOR WESTERN ROCK LOBSTER PUERULI**

FISHERIES MANAGEMENT PAPER No. 219

Published by
Department of Fisheries
168 St. Georges Terrace
Perth WA 6000

October 2006

ISSN 0819-4327



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OPPORTUNITY FOR PUBLIC COMMENT

YOUR FEEDBACK IS NEEDED

This Scoping Paper has been prepared as a first step in the development of a management framework for a commercial western rock lobster puerulus growout aquaculture industry in Western Australia. The purpose of this Scoping Paper is to identify and scope the issues associated with the development of such an industry and to identify matters which should be considered in the development of a management framework.

Comments on this Scoping Paper are sought from all stakeholders including commercial fishers, existing and potential aquaculture farmers, relevant community interest groups, government agencies and interested members of the public.

To ensure your submission is as effective as possible, please:

1. Make it clear and concise;
2. List your points according to the topic sections and page numbers in this paper;
3. Describe briefly each topic or issue you wish to discuss;
4. State whether you agree or disagree with any or all of the information within each topic or just those of specific interest to you. Clearly state your reasons, particularly if you disagree, and give sources of information where possible; and
5. Suggest alternatives to address any issues that you disagree with.

The information provided in this paper should not be considered to be conclusive and stakeholders are encouraged to consider additional information from other sources in providing the basis for comment.

Following consideration of the public comments received on this Scoping Paper, a Draft Policy Paper will be developed, which will propose the manner in which the Department of Fisheries will manage the aquaculture of western rock lobster pueruli. The Draft Policy Paper will be released for a further public comment period, followed by the development and implementation of a Final Policy. It is anticipated that the Draft Policy Paper will be released for comment in May 2007 and the Final Policy Paper published in September 2007.

Your comments on this Scoping Document would be appreciated by 31 January 2007.

Comments should be addressed to:

Chief Executive Officer
RE: Western Rock Lobster Puerulus Project
Department of Fisheries
3rd Floor, The Atrium
168 St George's Terrace
PERTH WA 6000

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ACKNOWLEDGEMENT

A number of Department of Fisheries staff contributed to the development of this Scoping Paper and the Project Officer would like to express her sincere thanks for their time, effort, valued comment and advice. Thanks to Dr Roy Melville-Smith, Dr Danielle Johnston, Dr Nick Caputi, Tim Bray, Rhys Brown, Peter Trott, Barbara Sheridan, Vicki Gouteff, Adrian Thomson and Dr Brian Jones.

The Department would also like to thank those people that provided useful information on the legislative arrangements for puerulus collection from other jurisdictions within Australia. Thanks to Dr Andrew Jeffs (National Institute of Water and Atmospheric Research, New Zealand), Dr Caleb Gardner (University of Tasmania), John Preston (Department of Primary Industries and Water, Tasmania) and Carl Waterworth (Department of Primary Industries and Water, Tasmania).

EXECUTIVE SUMMARY

INTRODUCTION

Several years of research and investigation have led to the identification of an opportunity in the development of a western rock lobster puerulus growout industry. With the development of a new industry comes the necessity to fully understand and address all issues which may arise from its development.

Ministerial Policy Guideline No. 20: Assessment of Applications for Authorisations with Regards to Rock Lobster Aquaculture (MPG 20), provides a management framework for the experimental/developmental phase of the industry's development. There is now a need to develop a management framework around a commercial scale industry.

PROCESS

A three-phase approach has been adopted for the development of a management framework for a commercial scale western rock lobster puerulus growout industry, with three associated documents: (1) Scoping Paper; (2) Draft Policy Paper; and (3) Final Policy Paper. The process will be supported by the establishment of a Working Group.

This Scoping Paper is the first in the three-phase process. The purpose of the Scoping Paper is to provide background information on western rock lobster aquaculture; put into context the opportunities; identify and scope the issues; and identify management considerations.

The Scoping Paper has been prepared to generate input on the relevant issues to the development of a commercial puerulus growout industry. Debate and comment during the public comment period will inform the development of the Draft Policy Framework, and ultimately the Final Policy.

MANAGEMENT CONSIDERATIONS

Table 1 summarises the range of issues which have been identified and associated management considerations.

Table 1: Summary of issues and associated management considerations.

ISSUE	MANAGEMENT CONSIDERATION
ALLOCATION	
<i>Mechanism for issuing allocations for the collection of pueruli</i>	The future management arrangements will need to provide a mechanism which gives longer term security to the puerulus growout industry and the commercial fishery. In the interim, a Ministerial Exemption instrument can be employed to issue commercial scale allocations in association with appropriate effort reductions.
IMPACT ON SUSTAINABILITY AND ROCK LOBSTER CATCH FROM PUERULUS COLLECTION	
<i>Mechanisms of compensation</i>	It is considered that pot compensation should be the primary mechanism of achieving biological neutrality. However, in the development of the formal management arrangements, the issues around reseeding post pueruli should be reviewed to determine if this activity should have an additional role as a compensatory mechanism.
<i>Timing</i>	In relation to timing of pot conversions, consideration needs to be given to whether the removal of effort should be in the years in which the removed pueruli would have entered into the fishery, or in the year of puerulus harvest.

ISSUE	MANAGEMENT CONSIDERATION
<i>Determining appropriate puerulus/pot conversion rates</i>	<p>If it is determined that removal of effort must occur in the year in which the pueruli entered the fishery, then the level of settlement that occurred in the year of puerulus harvest would be known at the point that the pots would be converted out of the fishery to compensate for the effect.</p> <p>If the pot conversion is to occur in the year of harvest then management arrangements will need to establish a pot conversion ratio, or method of calculating the pot conversion ratio (scenarios are given in Section 4.2.4).</p>
<i>Zones</i>	<p>The management arrangements will need to consider:</p> <ul style="list-style-type: none"> ▪ the zonal arrangements of the fishery and ideally adopt a precautionary approach when extrapolating the information known from between 29°S-30°S, to the entire area of Zone B and to the remaining fisheries zones. ▪ the opportunity which may lie in the northern Zone B area (South Passage and Quobba) for collection of higher numbers of pueruli, given that this area may be a consistently strong settlement area.
<i>Data requirements</i>	<p>The management framework should consider the ongoing research and data collection needs and determine an appropriate monitoring program to be undertaken by puerulus harvesters.</p>
MANAGEMENT OF THE COLLECTION OF PUERULI	
<i>Apparatus type</i>	<p>The management arrangements should provide assessment criteria for the apparatus type including as a minimum, aspects of environmental impact and catch rates.</p>
<i>Location of deployment</i>	<p>The management arrangements, in particular arrangements around the approvals of collection sites, should take into account important factors of location within the fisheries zones, impact on scenic values, megafauna entanglement, affects on commercial and recreational fishing activities, navigational safety issues, conflict with other existing activities or pursuits, and impact on the collection of recruitment data from Department of Fisheries collection stations.</p>
<i>Verifying numbers of pueruli collected and limits on total numbers</i>	<p>Management arrangements should address the potential for over-harvesting (both accidental and intentional), requirements for verification of collection number, supervision of collection and counting, and reporting on collection amount. The management arrangements should also give consideration to appropriate compliance activities aimed at detecting illegal or excess collection.</p> <p>In relation to total number of pueruli permitted to be harvested per individual and in total for any one season, the development of the management arrangements should consider the need for a limit, particularly if the pot compensation is to occur in the year of harvesting, not in the year in which the harvested individuals would have entered the fishery.</p>
<i>Export of pueruli for growout</i>	<p>The development of the management arrangements should consider the need to provide restriction on to whom and to where the pueruli can be sold in order to address the potential for puerulus export and overseas growout.</p>

ISSUE	MANAGEMENT CONSIDERATION
MANAGEMENT OF GROWOUT OF WESTERN ROCK LOBSTER PUERULI	
<i>Holding of female rock lobster with eggs attached to the body</i>	Management arrangements should provide that aquaculturists are able, through appropriate mechanisms, to demonstrate that tarspot and setose individuals are aquacultured product. Also management arrangements will need to consider appropriate mechanisms to ensure the ability to detect, through these arrangements, potential illegal activities of wild collected setose or tarspot individuals which are moved to an aquaculture facility as a laundering mechanism.
<i>Laundering of stock</i>	The management arrangements should provide for a mechanism through which stock can be accounted for and audited to ensure the ability to detect illegal laundering through the facility.
<i>Water quality and disease issues in land based facilities</i>	The significant issue of water quality and disease management must be adequately addressed in the management arrangements. As a minimum it would be expected that aquaculture growout facilities would be required to develop a detailed Health and Water Quality Plan.
<i>Seacage potential</i>	As seacage farming may present a significant economic advantage, the management framework should consider the range of issues associated with this farming practice and determine a regime appropriate to address the risks.
<i>Cost of management and compliance</i>	The collection and growout of western rock lobster, under the current arrangements, is considered a sector of the aquaculture industry and as such management and compliance activities would be funded from consolidated funds. In the future, if the collection of pueruli was managed under the <i>West Coast Rock Lobster Management Plan 1993</i> , then consideration may be given to the appropriateness of these arrangements.
<i>Impact on Western Rock Lobster market</i>	The management framework will need to consider the range of issues that have the potential to impact on the western rock lobster market and determine appropriate and equitable arrangements particularly with respect to the issues of permitted sale size/weight and labelling of the product. Given the significance of this issue, the impact of a puerulus growout industry on markets should be assessed based on expert marketing advice.

SECTION 1 INTRODUCTION

1.1 The Need for the Project

Several years of research and investigation have led to the identification of an opportunity in the development of a western rock lobster puerulus growout industry. With the development of a new industry comes the necessity to fully understand and address all issues which may arise from its development.

In 2003, the Minister for Fisheries released *Ministerial Policy Guideline 20: Assessment of Applications for Authorisations with Regards to Rock Lobster Aquaculture* (MPG 20), which provided a management framework for the experimental/developmental phase of the industry's development. MPG 20 provided for the allocation of a limited number of pueruli under an exemption arrangement, designed to generate interest and experimentation on the aquaculture of this species.

While interest to date has been limited, this in part may be due to the lack of security offered through the use of an exemption to deliver access to pueruli. Further, the lack of clarity around the management arrangements which will be adopted past the experimental phase and into a commercial scale phase, has created uncertainty and nervousness for both commercial western rock lobster fishers and potential aquaculturists alike. These two factors predominately combine to create the need to commence developing the arrangements to manage a commercial scale puerulus growout industry.

1.2 The Process

A three-phase approach has been adopted for the development of a management framework for a commercial scale western rock lobster puerulus growout industry. As described in Table 2, there will be three associated documents: (1) Scoping Paper; (2) Draft Policy Paper; and (3) Final Policy Paper.

The process will be supported by the establishment of a Working Group. The following groups will be represented on the Working Group: Rock Lobster Industry Advisory Committee (RLIAC), Aquaculture Development Council (ADC), Western Rock Lobster Council, Aquaculture Council of Western Australia, Western Rock Lobster Development Association, Department of Fisheries, aquaculture industry, recreational fishing and a western rock lobster fisher. The role of the Working Group will be to:

- provide comment on the issues and management considerations identified in the Scoping Paper;
- consider other comments to the Scoping Paper;
- provide advice to the Department on the appropriate direction of the Draft Policy Paper;
- consider the comments about the Draft Policy Paper; and
- provide advice to the Department on the finalisation of the Policy.

Table 2: Three-phase process for progressing the aquaculture policy initiative.

PHASE	TIMING	DETAILS
Phase 1: Scoping Paper	October 2006	Comment period until 31 Jan 2007
Phase 2: Draft Policy Paper	April/May 2007	Approximately 6 week comment period (to be confirmed)
Phase 3: Final Policy Paper	September 2007	Including Implementation Plan

This Scoping Paper is the first in the three-phase process. The purpose of the Scoping Paper is to:

- provide background information on western rock lobster aquaculture;
- put into context the opportunities;
- identify and scope the issues; and
- identify management considerations.

The Scoping Paper will identify and consider issues associated with the allocation, collection and growout of wild caught western rock lobster pueruli. It will provide information about the biology of the species, the current policy frameworks associated with the western rock lobster and past research which has been carried out in relation to the growout of wild caught western rock lobster pueruli.

The Scoping Paper has been prepared to generate input on the relevant issues to the development of a commercial puerulus growout industry. Debate and comment during the public comment period will inform the Department and its Working Group on key issues and further matters to be explored in the development of the Draft Policy Framework, and ultimately the Final Policy.

SECTION 2 BACKGROUND

2.1 What are Puerulus?

Western rock lobster pueruli (singular = puerulus) are that stage of the rock lobster life cycle when the larvae metamorphose into post-larvae (Figure 1). Pueruli are initially transparent and do not feed. They swim inshore from their pelagic larval phase, to settle in shallow (mostly <20 m) water. Shortly after settlement the pueruli start becoming pigmented and within a few days after settlement they moult to a post-puterulus (juvenile). They remain in the inshore areas for the next three or four years before moulting to a pale pink colour known as 'whites' and undertaking an offshore migration in December and January. At this stage the majority of rock lobster have reached the legal minimum size (77mm carapace length) and therefore enter the fishery. A year or two after reaching the deepwater breeding grounds, the lobsters mature and spawn, when five to six years post settlement. Significant mortality is experienced in the early life history stages of the western rock lobster with approximately 97-98% mortality estimated in the first year (Phillips et al. 2003).

Throughout this document reference has been made to 'puerulus' collection, but in reality many of the animals collected would be early post-puteruli juveniles. No distinction has been made between these two terms and for convenience the term puerulus has been used throughout.

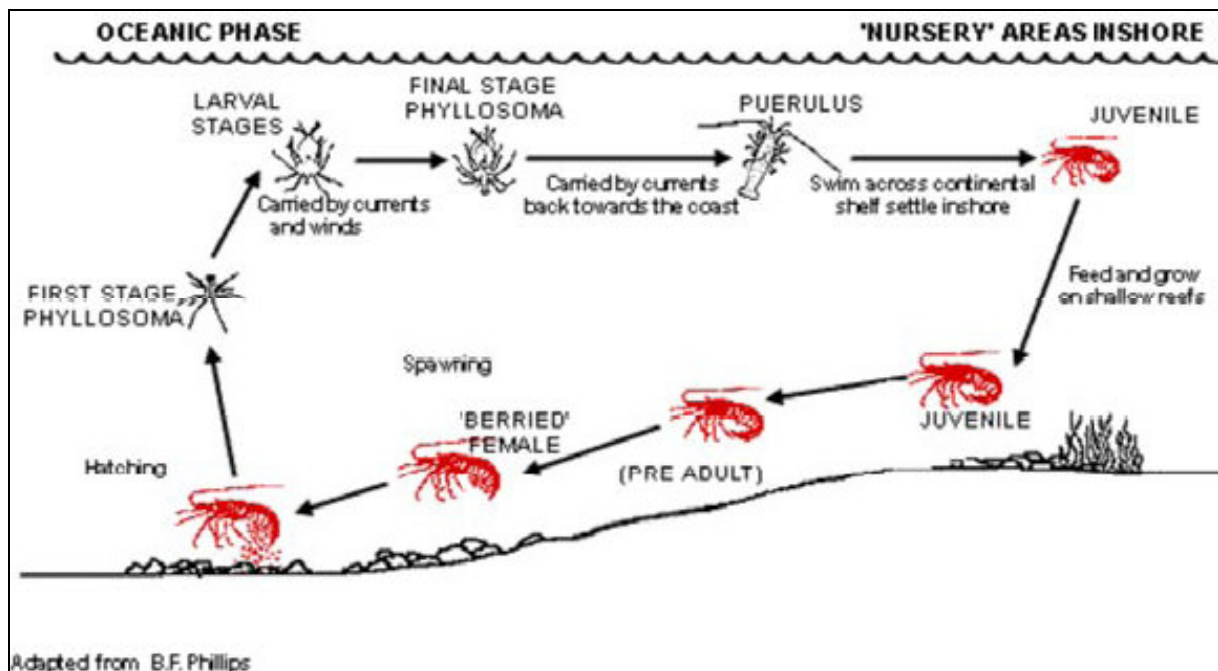


Figure 1: Life cycle of Western rock lobster, *Panulirus cygnus*.

2.2 Why Western Rock Lobster Puerulus Aquaculture?

Western rock lobsters are a high value product and the fishery is considered to be fully exploited, with little or no possibility to significantly increase production. Therefore the issue of western rock lobster aquaculture has been on the agenda for some years. Chittleborough (1974a) first proposed the potential possibilities for capturing and on-growing western rock lobster pueruli in the 1970s. His ideas were developed further in the 1980s by Phillips (1985), who gave a summary of the potential for rock lobster aquaculture including the economic,

engineering and legal considerations if it were to go ahead. In the 1990s the West Australian Fishing Industry Council employed a consultant, Dr Tim Meagher, to investigate the potential for rock lobster aquaculture. In his report “*A Review of the Practicality of Cultivating Puerulus of the Western Rock Lobster, Panulirus cygnus in Western Australia*”, he reached the following conclusions:

- Western rock lobster pueruli can be reared through to a marketable size of 250-300 grams in 18-24 months, under laboratory conditions and can be mass cultured commercially, without undue complication;
- The distribution of pueruli returning to the coast is not uniform throughout the fishery, with certain areas providing inadequate or limited habitat for pueruli and therefore resulting in ineffective recruitment to the fishery at such locations;
- Excess numbers of pueruli could be harvested and cultured without causing a reduction in the existing sustainable yield of the fishery;
- Western Australia is strategically well placed to implement western rock lobster cultivation as western rock lobster is a premium priced product with an established market and reputation, pueruli can be successfully collected and reared, there is sufficient background knowledge on the species and there are a range of suitable locations along the coast; and
- If it can be demonstrated that the pueruli harvested and cultured are excess to those for maintenance of the existing wild caught fishery, rock lobster aquaculture could result in a substantial expansion of the sustainable yield of the fishery and enable the sale of smaller sized lobster continually through the year.

It is generally understood that there are three possibilities with respect to rock lobster aquaculture:

- closed life cycle aquaculture – where broodstock are held, eggs are produced and rock lobster are grown from larvae through to a market size animal;
- growout of wild caught pueruli and post-pueruli; and
- holding and fattening of legal size commercially caught rock lobster.

The first option is considered true aquaculture, while the others are considered to be at increasing gradients away from this. Holding and fattening of commercial caught rock lobsters which involves feeding is currently permitted in association with an appropriately endorsed aquaculture licence. Holding of lobsters can be undertaken under the arrangements of the commercial fishery licence and relevant processing approvals.

Closed life cycle aquaculture of lobsters is being investigated for other lobster species that are known to be faster growing than western rock lobsters. If this research proved successful in producing large quantities of pueruli economically, then these species would be likely to be better candidates for aquaculture. However, this has not been achieved to date. Western rock lobster are one of the few species worldwide for which there is a proven ability to consistently catch pueruli in large quantities and it is for this reason that this species is being considered for growout.

Even if the technology could be developed for the western rock lobster, the long and complicated pre-*puerulus* pelagic stages (*phyllosoma*) of this species make hatchery production of larvae not feasible and therefore prevents this from being an economic venture. The relatively slow growth rates, particularly compared other species such as the tropical rock lobster, is another unfavourable factor in relation to this species.

Aside from propagation, the collection and growout of pueruli provides the only realistic opportunity to sustainably increase the production of western rock lobsters. The strength of annual puerulus settlements has long been recognised as providing a reliable index of recruitment strength in the western rock lobster fishery and researchers have used this index to predict future catches (Caputi et al. 1997) as pueruli grow and enter the fishery three and four years later. Because of the importance of these indices, there are good data for this fishery on spatial and temporal variations in puerulus settlement patterns (Caputi et al. 1995a, 1995b, 1997). The highly fecund nature of the species, together with the high mortality between the puerulus to legal size, means that the collection of pueruli may be possible without impacting on the sustainability of the species so long as the inter-relationship between collection for aquaculture and its impact on commercial wild harvest are managed appropriately.

2.3 Current Knowledge about Puerulus Collection and Growout

Significant work has been undertaken through a series of projects funded by the Fisheries Research and Development Corporation (FRDC) on the prospects of collecting and on-growing of pueruli. In 1998 the FRDC established the Rock Lobster Enhancement and Aquaculture Subprogram (RLEAS) to research the technologies for rock lobster enhancement and aquaculture. In 1998, the FRDC, through the RLEAS subprogram, first funded a project “*Towards establishing techniques for large scale harvesting of pueruli and obtaining a better understanding of mortality rates*” in Western Australia to investigate the possibilities for capturing large numbers of pueruli in a biologically neutral way.

In the outcomes of that project, Phillips et al. (2003) showed the following:

- Pueruli were easiest to catch near the shore (depths <5 m) and in locations with fringing reefs. No pueruli were caught in offshore depths, either near the surface, mid-water or bottom;
- Collectors serviced more frequently than once per month produced significantly more pueruli than those serviced only monthly;
- Larger collectors caught significantly more than small collectors and this relationship was linear for different sized collectors; and
- Collectors placed in an array catch better than individual collectors, but an optimal spacing distance between collectors has yet to be determined.

This was followed by a project initiated in 2003, “*Establishing post-pueruli data for western rock lobster*” that evaluated the growth and survival rates of pueruli to market size, so as to provide biological data to enable the economic potential for puerulus growout to be assessed. In particular, this project investigated growth and survival under different conditions of density, shelter type, temperature, feeding frequency, diet and flow rates.

The final report for the study, “*Establishing post-pueruli data for western rock lobster*” has yet to be submitted to the FRDC, but results from collective growout trials (Melville-Smith et al. 2006 and Johnston et al. 2006), together with previous western rock lobster growout research (Chittleborough 1974b; 1975, 1976 and Glencross et al. 2001) shows that western rock lobsters:

- are amenable to culture in tanks with reduced flow rates, and can tolerate the increased ammonia levels that arise from high biomass densities;
- can be held at high density with reduced survival but no adverse effects on growth;

- can be held in very high densities for culture compared with what is achieved in many other crustaceans. In their first year post-*pueruli* stocking densities of 100/m² can be achieved, but significantly better survival can be obtained at 50/m². Stocking densities of 20/ m² produce good survival rates for one and two year post settlement animals;
- reach up to 100 g by the end of the first year after settlement and 350 g (legal size in the wild) at around 2.5 years post settlement when held at 23°C;
- require warm temperatures (23°C) year round to optimize growth;
- have not suffered any culture related health problems;
- survive well on a pellet diet, though further work is necessary to improve the current feed formulation and intake/consumption; and
- achieve very good survival with mesh shelters.

A recent Aquaculture Development Council funded study explored the economics around a *puerulus* growout industry in Western Australia based on the understanding gained by the project “*Establishing post-*pueruli* data for western rock lobster*”. Although a final report on this study is not available for public release, it is noteworthy that given the slow growth rates and lack of a tailor-made food, the economic viability of such an industry is not considered to be on firm grounds at this stage.

SECTION 3 REGULATORY AND POLICY FRAMEWORK

This section provides an overview of the current regulatory policy frameworks which will influence decision making in relation to future management arrangements.

3.1 Fish Resources Management Act 1994

The *Fish Resources Management Act 1994* (FRMA) is the Act relating to the management of fish resources in Western Australia. The objects of the FRMA are to conserve, develop and share the fish resources of the State for the benefit of present and future generations.

3.2 Aquaculture Licensing

Under the FRMA, unless the contrary intention appears, “aquaculture” means the keeping, breeding, hatching or culturing of fish. Under Section 90 of the FRMA, parties engaging in aquaculture and related activities are required to have an aquaculture licence granted by the Chief Executive Officer of the Department of Fisheries. As puerulus growout involves the keeping of fish, including feeding and nurturing, this activity is considered aquaculture and would require an aquaculture licence. It is noteworthy that the requirement for an aquaculture licence does not extend to research or experimental operations.

In accordance with Section 92 of the FRMA, the Chief Executive Officer can only grant a licence (including for western rock lobster) if he is satisfied that:

- (a) The person is fit and proper to hold such a licence;
- (b) The granting of the licence will be in the better interest of the aquaculture industry;
- (c) The activities to be conducted under the licence are unlikely to adversely affect other fish or the aquatic environment; and
- (d) The activities to be conducted under the licence have been approved by other relevant authorities.

In relation to (d), “the activities to be conducted under the licence have been approved by other relevant authorities”, a range of other approvals may be required. These may include:

- Environmental assessment by the Environmental Protection Agency (EPA);
- Approval under the Commonwealth’s *Environmental Protection and Biodiversity Conservation Act 1999*;
- Planning approval by the Department of Planning and Infrastructure; and
- Local government planning approvals.

In relation to applications that are for coastal waters, the Department of Fisheries has clear processes for the assessment and granting of such licences and this is described in *Ministerial Policy Guideline No. 8: Assessment of Applications for Authorisations for Aquaculture and Pearling in coastal waters of Western Australia* (MPG 8). The MPG 8 process was developed to ensure appropriate use of public waters and provide transparent and inclusive consultation with the community.

3.3 Western Rock Lobster Fishery

This section describes the management arrangements around western rock lobster harvesting activities in Western Australia.

3.3.1 Overview and Integrated Fisheries Framework

Both commercial and recreational fishing is administered through the provisions of the FRMA and the *Fish Resource Management Regulations 1995* (FRMR). This legislation provides for the gazettal of management plans for fisheries and the issuing and management of entitlements to facilitate commercial and recreational fishing. The Department of Fisheries is moving towards a framework of Integrated Fisheries Management and has significantly progressed this within the context of the western rock lobster resource.

Integrated Fisheries Management arrangements provide a framework for the allocation and management of the western rock lobster resource in a holistic manner for the commercial, recreational, indigenous fisheries, and for a non-take allocation for the maintenance of the breeding biomass.

The Integrated Fisheries Allocation Advisory Committee (IFAAC) has released its Integrated Fisheries Management Report (Department of Fisheries, 2005) with respect to western rock lobster. The report identified the issue of the possible emergence of an aquaculture industry based on the capture and growout of pueruli, but did not recommend any allocation for the purposes of aquaculture. In its submission on this report, the Department of Fisheries agreed that at this point in time no allocation should be made for aquaculture purposes, but that it should not preclude an allocation in the future should a viable industry emerge.

3.3.2 Commercial Fishing

Commercial fishing for rock lobster is managed under the *West Coast Rock Lobster Management Plan 1993* (Management Plan) (in conjunction with the FRMA, FRMR and other subordinate legislation), with fishers having to hold a West Coast Rock Lobster Managed Fishery Licence. The number of these licences has been limited since 1963.

In March 2000, the fishery was the first in the world to be awarded Marine Stewardship Council (MSC) certification on the basis of demonstrating the ecological sustainability of its fishing and management operations. To achieve this, the fishery was assessed by an independent international group of experts against the criteria set out by the MSC guidelines. The fishery is still certified under the MSC and is currently undergoing a statutory re-certification process.

On 12 March 2003, the Commonwealth Minister for the Environment formally approved the western rock lobster fishery as having met the requirements under *Guidelines for the Ecological Sustainable Management of Fisheries* criteria.

The western rock lobster fishery is managed in three zones as described in Figure 2. The zones help distribute effort across the fishery and hence reduce the risk of effort concentration and the potential for higher harvest rates or localised depletion. They also enable the implementation of zone specific management controls. These include:

- Different maximum size restrictions in the northern and southern regions of the fishery;
- Moon closures in Zone C (February to June);

- Sunday closures in Zone B (15 March – 30 June);
- Christmas and New Years Day closures in all zones; and
- Summer closure in Zone B (15 January – 9 February).

Operators in the fishery may take any species of rock lobster but the vast majority of the catch is western rock lobsters. Fishers in this fishery are only permitted to use baited traps (pots), which they usually pull daily. Unitisation of the effort in the fishery and relatively liberal transferability provisions, allow market forces to determine what is the most efficient use of licences and available entitlement (pots). This system of management is known as an Individually Transferable Effort (ITE) system.

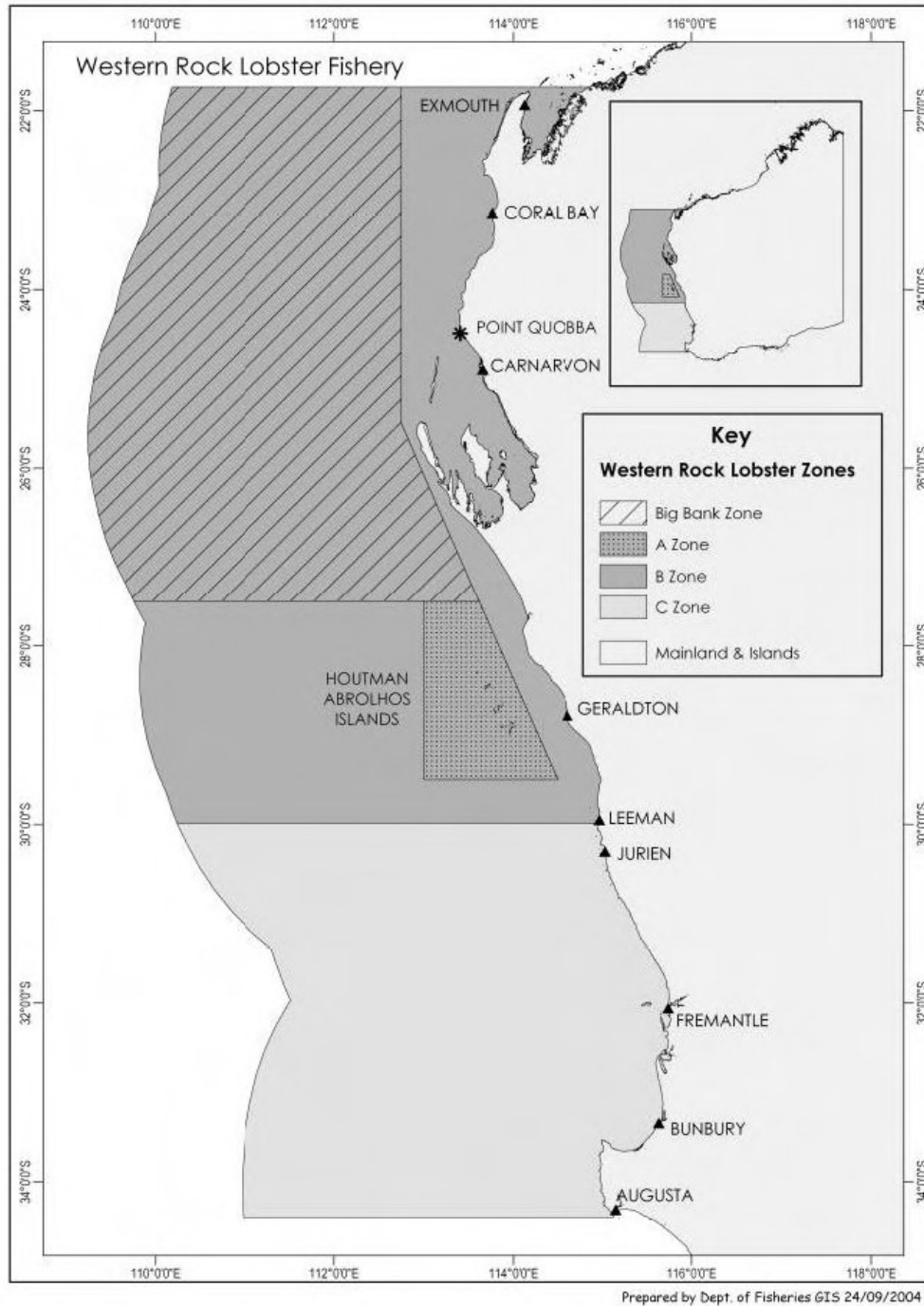


Figure 2: Management Boundaries for the Commercial West Coast Rock Lobster Managed Fishery.

The commercial fishing season varies across the three zones of the fishery:

- Zone B: 15 November to 30 June
- Zone C: 25 November to 30 June
- Zone A: 15 March to 30 June
- Big Bank: 10 February to 30 June

It is important to not the Zone A licensees fish in Zone B prior to the opening of Zone A.

The management arrangements include the protection of females in breeding condition, minimum carapace length (76mm: 1 Feb – 30 June / 77mm: 15 Nov – 31 Jan) and maximum carapace length (max size for female lobsters of 105mm in Zones A and B and 115mm in Zone C).

3.3.3 Recreational Fishing

Recreational fishing for rock lobster requires either a rock lobster recreational fishing licence or an umbrella licence permitting access to all licensed recreational fishing activities. The number of these licences issued is currently unlimited. Over 45,000 licences are issued annually to recreational fishers to take western rock lobster. These fishers take around 350 tonnes of catch annually. The rules governing recreational fishing are found in the FRMR.

The recreational rock lobster fishery encompasses all rock lobster species in all WA waters; however, western rock is the major species. The majority of recreationally caught western rock lobster are taken in waters less than 20m deep between Augusta and North West Cape.

Recreational fishers may use pots or may dive for lobster, except at the Abrolhos Islands where pots are the only permissible method. The fishing season runs from 15 November – 30 June of the following year. There is no limit on the total number of licences and the arrangements do not constrain total recreational effort or catch. The primary objectives of recreational management are to facilitate a quality fishing experience and to provide appropriate social benefits. The management arrangements for the recreational rock lobster fishery have been designed to complement those in the commercial fishery. Controls include a prohibition on the take of breeding female lobsters at all times and a minimum carapace length. These controls also govern the taking of rock lobster through the aquatic tour (charter boat) industry.

3.3.4 Indigenous Fishing

Indigenous people involved in commercial fishing for rock lobster must comply with the legislation associated with commercial fishing (see Section 3.3.2). Similarly, indigenous people recreationally fishing for rock lobster must comply with all recreational regulations, however they are not required to hold a recreational fishing licence.

It is noteworthy that both commercial and recreational sectors contribute financially towards the management of their respective fisheries. The West Coast Rock Lobster Managed Fishery (WCRLMF) is fully cost recovered; that is, the licensees cover all of the Department's operating costs associated with the management of the fishery. The government funds the management of recreational fishing for rock lobster, although recreational fishers pay a user contribution through licence fees.

3.4 Access to Pueruli

Holders of Managed Fishery Licences (MFLs) in the WCRLMF have an exclusive right to harvest lobsters for commercial purposes in accordance with all the restrictions of the Management Plan. This includes the requirements to fish with pots and not to take protected species which are those with a carapace length of under 76mm, and not to take breeding females.

The Management Plan does not provide a legal right for MFL holders to take pueruli. Holders of a recreational fishing licence for rock lobster also have a legal right, in accordance with the legislation, to collect legal size lobsters for recreational purposes.

Western rock lobster pueruli are the common property of the Western Australian community and are a totally protected fish.

3.5 Collection of Fish for Aquaculture Purposes

Under the current legislative framework, the grant of an aquaculture licence provides authority to conduct aquaculture activities for commercial purposes. An aquaculture licence does not however, confer approval to collect relevant fish from the wild for farming purposes, including broodstock collection for propagation, or juvenile collection for growout.

Generally there are three avenues through which stock for aquaculture can be obtained:

- Purchase from commercial fishers;
- Purchase from other aquaculture licence holders or retail outlets; or
- Apply for a Ministerial Exemption under Section 7 of the FRMA.

In relation to the specific case of puerulus harvesting, the opportunity to purchase from commercial fishers is not available since as outlined above, the Plan does not provide access to pueruli. The opportunity to purchase from other aquaculture licence holders is likewise not available. This is further complicated by the fact that pueruli are a protected fish and not legally able to be collected by any class of person.

Under the current regulatory arrangements therefore, authorisation to collect pueruli can be granted only by way of a Ministerial Exemption to the protected species provisions and the commercial harvesting provisions of the FRMA.

MPG 20 provides guidance on the issuing of Exemptions for the collection of pueruli for experimental projects.

MPG 20 states that the “scope of puerulus collection will be limited to three hundred thousand (300,000) per annum for the entire distribution of western rock lobsters to ensure that the impact on the wild stock and its associated ecology is insignificant”. MPG 20 provides that Exemptions should specify conditions for the exemption holder “to undertake regular reporting, possibly against performance criteria, to monitor the success of rock lobster aquaculture research and development”. MPG 20 provides guidance on the process of providing access to western rock lobster pueruli during an experimental phase of a developing industry, however, it provides no guidance in relation to future commercial scale allocations.

The 300,000 puerulus collection level was set on the basis that such allocations would be for short durations to allow targeted experimental work on puerulus collection and growout. It was anticipated that the grant of any allocations on a commercial ongoing basis would be supported by more thorough, critical and conservative analysis of the available data.

MPG 20 also provides the following policy elements:

- Closed Cycle Aquaculture: Applications for an authorisation to undertake closed cycle rock lobster aquaculture shall be considered in normal processes under the FRMA, as outlined in MPG 8;
- Holding and Fattening: When considering aquaculture licence applications to hold and fatten western rock lobster, the Chief Executive Officer must ensure that the applicant satisfies those requirements as prescribed in Part 8 of the FRMA, and where relevant, MPG 8; and
- Habitat Enhancement: The Chief Executive Officer will consider all applications to undertake habitat enhancement research subject to the applicant first gaining approval from relevant authorities as listed within MPG 8.

3.6 Review of Other Jurisdictions

This section documents a review of Tasmanian, New Zealand and Vietnam jurisdictions in relation to lobster puerulus aquaculture.

Tasmania

The Tasmanian rock lobster fishery targets southern rock lobster (*Jasus edwardsii*) in the waters adjacent to Tasmania. Sustainable management of Tasmania's marine resources is the responsibility of the Department of Primary Industry and Fisheries under the *Living Marine Resources Management Act 1995*.

Tasmania's Rock Lobster Fishery Policy (Department of Primary Industries and Water, Tasmania 1997) states that the Tasmanian Government aims to provide for the development of a rock lobster aquaculture industry through the limited and controlled harvest of pueruli. Some important strategies of the proposal included:

- Ensure that any harvest of pueruli is matched by a compensatory reduction in the commercial catch by way of purchase or leasing of quota;
- Ensure that the future development potential for the marine farming of rock lobster is achieved with no significant additional net mortality from the wild fishery;
- Develop appropriate compliance mechanisms to ensure illegally taken undersize wild rock lobster do not enter the market;
- Identify methods of collecting pueruli that result in minimal incidental mortality and minimal damage to the puerulus; and
- Undertake research to assess possible impacts on the wild rock lobster fishery through the harvesting of pueruli.

In July 2001, the Tasmanian Government authorised a five-year growout trial of wild caught pueruli and subsequently issued seven licences (permits) for the commercial harvest and ongrowing of pueruli. The permits were issued for the purpose of fisheries development and authorised the permit holder to deploy rock lobster puerulus harvesting apparatus within State fishing waters. The permit holders were each permitted to take and have possession of up to 50,000 undersize rock lobsters (*Jasus sp.*) in accordance with associated management conditions (Department of Primary Industries and Water, Tasmania 1997).

Furthermore the following condition also formed part of the licence conditions to ensure the sustainability of the southern rock lobster stock:

“Must release back into the marine environment 5% of the rock lobster harvested under the conditions of this permit after fish attain a carapace length of 35mm or after 12 months, whichever is the lesser. In addition to this amount the permit holder must release a further 20% of the number of fish surviving after the fish attain a carapace length of 35mm or after 12 months, whichever is the lesser in a manner approved by the General Manager (Primary Industries). Fish stocks released back into the marine environment should be derived from stock that are healthy and not have a history of unexplained mortalities” (Department of Primary Industries and Water, Tasmania 2005).

The permits were valid for a period of one year and the applicant was required to pay a \$5000 application licence fee.

The five-year trial came to an end on the 30th June 2006 and no further collection of rock lobster pueruli is permitted under the trial arrangements. Upon completion of the trial, only one of the original seven permit holders was still in operation. This permit holder was granted a further licence giving authority to hold fish collected under previous harvest permits so an accurate audit of rock lobster numbers per specified size class could be undertaken. During the course of the five-year period, the longest standing permit holder collected a total of 21,500 southern rock lobster pueruli (C.Waterworth pers.comm. Department Primary Industries and Water, Tasmania).

New Zealand

The New Zealand rock lobster fishery targets two species, the red rock lobster (*Jasus edwardsii*) and the packhorse rock lobster (*Sagmariasus verreauxi*). Sustainable management of New Zealand’s marine resources is the responsibility of the Ministry of Fisheries under the *Fisheries Act 1996*. Aquaculture in New Zealand is governed by the *Aquaculture Reform Act 2004*.

Lobster in New Zealand is managed by a Quota Management System - which divides the country into distinct fisheries areas - Quota Management Areas, for which fishers own a tradeable right to catch a certain amount of fish from the fishery (A.Jeffs pers.comm. National Institute of Water and Atmospheric Research, New Zealand).

On 19 August 1996 the New Zealand Minister for Fisheries approved the collection of young settled rock lobsters for on-growing. The Ministry’s aim in allowing the special permits was to trial “the viability and biologically neutrality of a system that allows adult rock lobster to be traded off against taking juveniles that have not yet been recruited into the fishery” (Jeffs 2003). Essentially anyone can apply to “trade-off” their right (or someone else’s rights that have been leased) to catch quota in return for an allowance to take early juveniles (pueruli, first and second instar juveniles) from the wild (A.Jeffs pers.comm. National Institute of Water and Atmospheric Research, New Zealand).

Some important elements of this policy included:

- Operational life of 3 years;
- Based on biological neutrality such that removal of young settled rock lobsters is balanced by the temporary setting aside of transferable quota at an agreed level of 40,000 young

settled lobsters (or 300kg green weight) per tonne of Term Transferable Quota (TTQ) for adult rock lobster;

- Applicants considered on a ‘first come first served’ basis with a minimum of 20,000 (0.5t TTQ) to a maximum of 80,000 juveniles (2.0t TTQ) per special permit;
- There is a maximum of 200,000 juveniles, or 150kg green weight or 5t TTQ per quota management area;
- There is a national limit of 400,000 juveniles or 300kg green weight or 10t TTQ for all quota management areas;
- TTQ used to obtain a special permit must be un-fished and owned, or leased, or there should be a contract to buy or lease quota, if the special permit application is successful; and
- Applicants must provide a detailed proposal, which includes the following information:
 - Proposed harvest site within a nominated quota management area;
 - Proposed harvest techniques and structures;
 - The proposed timing, frequency and quantity of young settled rock lobster to be harvested; and
 - Stock tracking and monitoring procedures.

Two special permits to catch wild seed lobsters were issued shortly after the arrangement was announced in 1996 and it has been estimated that from this time until 2003 that well in excess of 100,000 wild seed lobsters were taken. A third special permit was issued in 2001 to Konaki Aquaculture Ltd, a consortium of Maori-owned aquaculture enterprises, working with the Maori Fisheries Commission and Sanford South Island Ltd (Jeffs 2003).

Arrangements to collect pueruli ceased in 2003 and currently there are no valid permits for the collection of juvenile rock lobster. However, the arrangements to do so are still in place should anyone wish to pursue it.

Vietnam

Seven species of spiny lobsters are found in the Vietnamese East Sea: *Panulirus ornatus*, *P. homarus*, *P. longipes*, *P. stimpsoni*, *P. versicolor*, *P. penicillatus* and *P. polyphagus*.

Since 1996, lobster seafarming has developed rapidly with the methods of catching pueruli also having changed considerably. There are now three ways in which pueruli are caught in Vietnam. The main method is to use a drawing seine net. Another method is to use traps to mimic suitable settlement habitat and the third method of collection is to dive to catch the animals.

During the peak collection period as many as 50-200 individuals might be taken by one fisherman. Under the diving collection method it is estimated that about 2 million pueruli and pre-juvenile lobsters were caught in one season and in 2002, an estimated total of 126,800 *P. ornatus* pueruli were caught using the seine net collection method (Nguyen and Nguyen 2004).

SECTION 4 ISSUES AND ASSOCIATED MANAGEMENT CONSIDERATIONS

This section will explore the range of issues associated with the aquaculture of western rock lobster pueruli and proposed options for management.

4.1 Mechanism for Issuing Allocations for the Collection of Pueruli

Currently the only mechanism for issuing access to pueruli is through the grant of a Ministerial Exemption. This provides significant uncertainty as such an instrument is generally issued on a short-term basis, is non-transferable and provides no ongoing rights to future access.

Proposed amendments to the *Fish Resources Management Act 1994* (FRMA) contain a proposal to broaden the application of an aquaculture licence to provide for the collection of broodstock for propagation, and juvenile stages for growout. It would be possible to provide for puerulus collection through this process, by also providing that a defence to the collection of protected fish is that it has been done in accordance with an aquaculture licence. The aquaculture licence would be conditioned appropriately to manage issues such as collection limits etc.

The other alternative for providing more secure access to pueruli is to amend the *West Coast Rock Lobster Management Plan 1993* (Management Plan) to provide for another class of access for the collection of pueruli, together with an amendment to the FRMA providing that a defence to the collection of protected fish is that it has been done in accordance with the relevant clauses of the amended Management Plan. Under this scenario, persons other than those who are current holders of Managed Fishery Licences would be eligible to apply for the new class of licence under the amended Management Plan.

Existing commercial western rock lobster fishers, with their existing boat power, infrastructure, associated equipment and the knowledge of puerulus settlement locations, would be well placed to diversify into aquaculture of western rock lobster pueruli.

Management Consideration

The future management arrangements will need to provide a mechanism which gives longer term security to the puerulus growout industry and the commercial fishery. In the interim, a Ministerial Exemption instrument can be employed to issue commercial scale allocations in association with appropriate effort reductions.

4.2 Impact on Sustainability and Rock Lobster Catch from Puerulus Collection

One of the major issues associated with the collection and on-growing of western rock lobster pueruli is the potential impact on recruitment into the fishery, catch rates from the fishery and ultimately the sustainability of the western rock lobster resource.

In order to prevent any detrimental effects occurring, it will be important that in the process of providing access to pueruli, the existing access to the commercial, recreational and indigenous customary fisheries are acknowledged. It is recognised that it would not be appropriate to

allow the collection of pueruli at a level that would impact on the take of rock lobster, without associated compensatory mechanisms i.e. so that biological neutrality is maintained.

4.2.1 Mechanisms of Compensation

Based on the examination of other jurisdictions, two compensatory mechanisms have been identified: (1) release of post pueruli back into the environment; and (2) pot compensation. Pot compensation refers to a requirement to lease a number of pots from the commercial fishery to reduce the amount of effort to an amount which will not affect the commercial catch.

The mechanism of release of post pueruli back into the environment was explored and trialled in Tasmania (Department of Primary Industries and Water, Tasmania 2005). Gardner et al. (*in press*), also recently compared two management options for Tasmania, which can be used as compensatory mechanisms to achieve “biological neutrality”. The first of these options is a “Quota Lease System” and the second is termed “Reseeding”. Although the comparison of mechanisms promoted the reseeded option as favourable, there are two significant factors which limit its relevance. Firstly, given the understanding of the economics of a potential western rock lobster puerulus growout industry, the industry would appear unlikely to be economically viable if it were required to grow-up and then release a portion of its product. Secondly, releasing aquacultured product back into the wild poses a small but unnecessary risk of introducing disease into the wild stock.

“Pot compensation” is therefore considered the more favourable option.

Given that there is no regulation of the total number of recreational rock lobster pots, the only effective means to introduce a pot compensation mechanism would be via the commercial western rock lobster fishery. Assuming that a reliable pot compensation mechanism could be introduced for the commercial sector in association with puerulus harvesting, the collection of pueruli would not have a significant impact on recreational fishing effort or catches.

Management Consideration

It is considered that pot compensation should be the primary mechanism of achieving biological neutrality. However, in the development of the formal management arrangements, the issues around reseeded post pueruli should be reviewed to determine if this activity should have an additional role as a compensatory mechanism.

4.2.2 Relationship between settlement, puerulus harvesting and effort reduction

In 2003, the Department undertook a desktop analysis of biological neutrality aspects relevant to the harvest of pueruli (Phillips et al. 2003). The study focussed on one small zone of the fishery located between 29 and 30 degrees south.

In this analysis, “biological neutrality” was defined as “the level of catch that would need to be forgone to compensate the reproductive capacity of the breeding stock if pueruli are removed for aquaculture”. To achieve biological neutrality in a theoretical context the study determined a relationship of the fishing effort that would need to be reduced each season, if pueruli were harvested, so that the number of 6.5 year old animals (i.e. sexually mature lobsters), would be the same as if no puerulus harvesting was occurring.

Due to variable wild growth rates, juvenile lobsters enter the commercial fishery 3 and 4 years after settlement. Therefore, the effects of puerulus removal will only impact the wild capture fishery 3 to 4 years after the cohort (year class) from which they have been removed recruits to the fishery. It is also relevant that those lobsters entering the fishery in any one year, constitute 2 cohorts – those that settled 3 and 4 years previously due to differing growth rates within any one cohort. This becomes relevant when interpreting the historical data as a means of determining appropriate effort reductions to compensate for the removal of pueruli.

The 2003 study concluded that at low levels of puerulus settlement, removals of pueruli would have a greater effect than at high puerulus settlement levels. This fact is significant given that settlement in the western lobster fishery is extremely variable from year to year due to the influence of the Leeuwin current and other environmental factors (Figure 3).

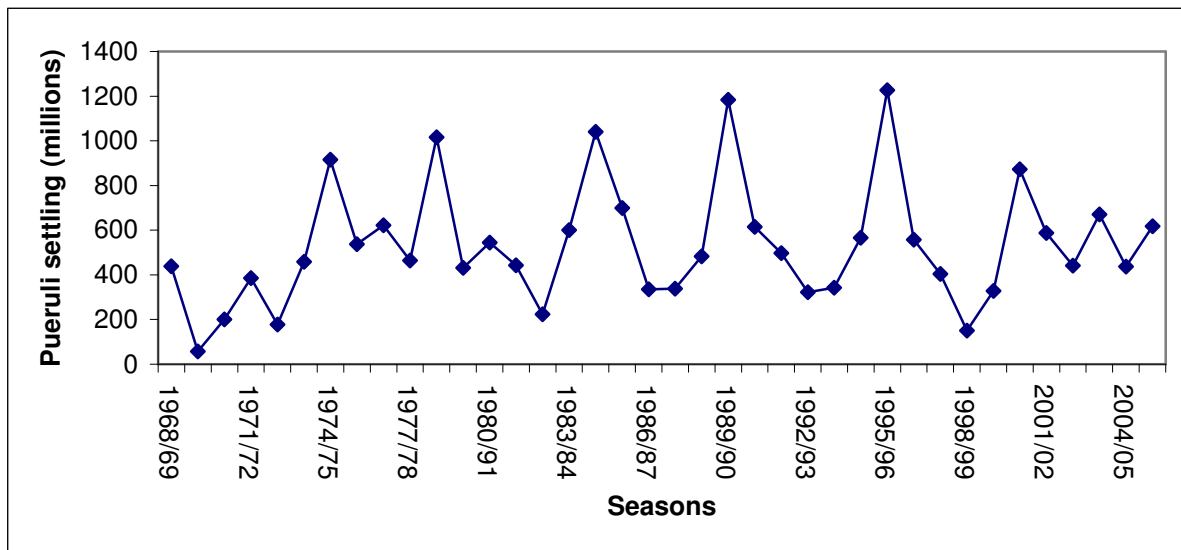


Figure 3: Predicted number of pueruli settling between 29°S-30°S between 1968-1998 (Phillips et al. 2003).

The relationship between settlement, percentage harvesting and fishing effort reductions is outlined in Table 3 and graphically in Figure 4. As shown, at a given recruitment level (expressed along the horizontal axis), and given percentage reduction of pueruli (vertical axis), the percentage reduction in fishing effort required to achieve biological neutrality, can be determined (in the 29°S-30°S region).

Table 3: The estimated percentage reduction in fishing effort (assumed to be 2.2819 million pot lifts per fishing season) required each fishing season to maintain biological neutrality in the 29°S-30°S region under different levels of puerulus harvesting.

Puerulus Reduction (%)	Puerulus Settlement																			
	60	120	180	240	300	360	420	480	540	600	660	720	780	840	900	960	1020	1080	1140	1200
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.5	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0
1	0.8	0.6	0.5	0.4	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1
1.5	1.2	0.9	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2	1.5	1.2	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2
2.5	1.9	1.4	1.2	1	0.8	0.7	0.7	0.6	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.2
3	2.3	1.7	1.4	1.2	1	0.9	0.8	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.3
3.5	2.7	2	1.6	1.3	1.2	1	0.9	0.8	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4
4	3.1	2.3	1.8	1.5	1.3	1.2	1	0.9	0.9	0.8	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.4
4.5	3.4	2.6	2.1	1.7	1.5	1.3	1.2	1	1	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.5
5	3.8	2.9	2.3	1.9	1.6	1.4	1.3	1.2	1.1	1	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.6	0.6

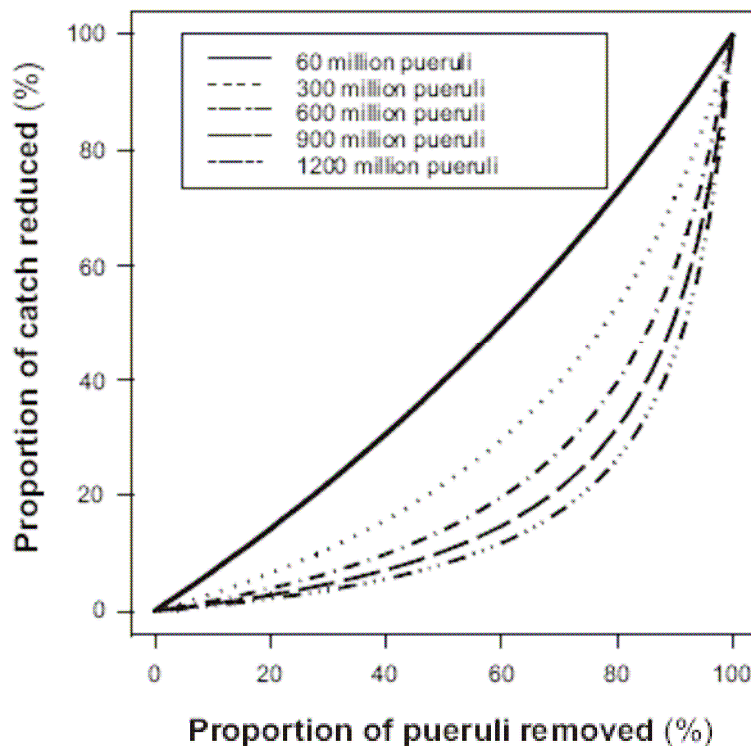


Figure 4: Effect of the proportion of western rock lobster pueruli removed, against the proportion of reduced recruitment to the fishery. The results have been produced at five different settlement levels, encompassing a range of different puerulus settlement levels recorded in the 29°S to 30°S region over the last 35 years.

To use Table 3, it is necessary to calculate the number of pueruli harvested as a percentage of the number that settled. Using the figure of the percentage harvested to establish a corresponding row in the left hand column of Table 3, move across the table to find the percentage reduction in fishing effort that is required for the particular level of puerulus settlement.

For example, consider the scenario where it is decided to permit the harvesting of six million pueruli (from the 29°S-30°S region) in a year when:

- puerulus settlement was average, (i.e. 600 million); and
- in a season when 2.2819 million potlifts were made in the area (an average of potlifts in the 1990s).

Six million pueruli is 1% of the total settlement for that area in that season. The figure in the table at the junction of the 1% reduction row and 600 million settlement column is 0.2.

This indicates that effort in the fishery would need to be reduced by 0.2% which equates to 4,564 pot lifts, in order to achieve biological neutrality. Assuming that a pot is fished 200 days a year, the removal of 4,564 pot lifts would, equate to the removal of approximately 23 pots.

From Table 3 it can be seen that the number of pueruli that can be taken from the Western Australian coast without impacting on the catch of a minimum of one pot is different each year depending on the strength of the recruitment in that year.

The natural mortality rate of the pueruli in each region is also a significant factor. The higher the natural mortality, the less impact the collection of a given number of pueruli would have. Therefore it is important to understand when considering an appropriate number of pots that would need to be removed to achieve biological neutrality that there are different density dependant effects in different areas. The lack of good data on these effects is another factor driving management responses to be precautionary.

It is not simple to progress the percentage effort reductions outlined in Table 3 into the number of pots that would be required to be leased and removed from the fishing to compensate for a given number of pueruli removed. The compensation ratio is different depending on the strength of the puerulus settlement between 29°S-30°S, the amount of effort (potlifts) in that area and since the relationship is not linear (Figure 4), even the number of pueruli being harvested would have a bearing on the compensation result, particularly at very high puerulus harvesting levels. Furthermore, the wild catch is made up of contributions from puerulus settlements in two different seasons.

This is exemplified in Table 4 which shows, under the various recruitment levels experienced in the fishery since 1968/1969, the quantity of pueruli that would be collected to require the removal of one pot in order to achieve biological neutrality. Table 4 displays a constant removal scenario of 1 million pueruli and constant fishing effort of 2.2819 million potlifts (and that pots are pulled 200 times a season). These estimates on potlifts and days fished during a season have changed in 2005/06 due to the implementation of additional management arrangements such as Sunday and moon closures. Therefore potlift estimates for this period would need to be recalculated on the same principle.

The table predicts pot reductions that would be required in order to achieve biological neutrality across the full range of recruitment strengths that have historically occurred in the fishery. The ratio relevant to any one year is that contained in the column 'conversion ratio' on the row four years after the recruitment year.

Remembering that pueruli recruit into the commercial fishery over two seasons, it is not possible to calculate the effect of the harvest on just one season. Therefore, effort reductions in a particular season in Table 4 have been calculated as the average of the predicted settlements three and four years earlier (eg. effort reductions in 1972/73, based on the average of settlements in 1968/69 and 1969/70). Depending on the strength of settlements, puerulus to pot conversion factors have varied from around 10,000 to around 450,000 pueruli per pot.

The puerulus to pot conversion ratios provided in this document are the best available information on the likely impact of puerulus removal on biological neutrality and catch. The conversion figures can be considered a conservative estimate, because they have been established for the 29°S-30°S region of Zone B. Had they been established for Zone A, where there are greater density dependant effects, it could be expected that the puerulus to pot ratios would be much larger. In Zone C, where recruitment is known to be limited, compensation for a given amount of puerulus removal would require a relatively higher pot compensation.

It does need to be emphasised that these estimates are the result of a desk study and if large numbers of pueruli are harvested there will be a need to closely monitor the result of this activity for any evidence of a change in commercial catch three to four years later.

Based on the understanding of the relationships described above, there are several issues relevant to the development of an appropriate and practical mechanism to achieve this and these are discussed below.

4.2.3 Timing

The timing of the pot conversion is a point of discussion. Given that the impact from the puerulus removal does not occur for 3 to 4 years following the removal, the leasing of the equivalent number of pots in the year of puerulus harvest will not actually alleviate the pressure in that year. This would not be a significant issue at small levels of harvest, nor where the level of recruitment in that year was high. However, for low recruitment years, particularly where a high percentage of pueruli are extracted, this could cause a significant impact on the catch and on the stock. However the strength of puerulus recruitment in any one year, cannot be determined ahead of time, giving weight to an argument for the leasing of compensatory pots to occur in the seasons 3 and 4 years after the year of harvest.

On the other hand, administratively, it would be significantly simpler and clearer for the pot leasing to occur prior to the grant of the authorisation and cope with the risks around this by setting conversion levels that assume a low to moderate recruitment year.

Management Consideration

In relation to timing of pot conversions, consideration needs to be given to whether the removal of effort should be in the years in which the removed pueruli would have entered into the fishery, or in the year of puerulus harvest.

Table 4: Estimated numbers of pueruli settling over different seasons between latitudes 29°S-30°S and puerulus to pot conversion ratios required to maintain biological neutrality when harvesting 1 million pueruli each season. It has been assumed that effort has been constant each season at 2.2819 million potlifts and that pots are pulled 200 times a season.

Season	Estimated puerulus (million)	Pot conversion ratio (based on 1 million removal)
1968 - 1969	439	
1969 - 1970	57	
1970 - 1971	201	
1971 - 1972	385	
1972 - 1973	178	12,755
1973 - 1974	458	11,508
1974 - 1975	915	65,790
1975 - 1976	537	56,180
1976 - 1977	622	59,524
1977 - 1978	464	285,714
1978 - 1979	1016	357,143
1979 - 1980	432	270,270
1980 - 1981	545	232,558
1981 - 1982	443	303,030
1982 - 1983	224	270,270
1983 - 1984	600	196,078
1984 - 1985	1040	204,082
1985 - 1986	699	80,000
1986 - 1987	336	88,496
1987 - 1988	338	434,783
1988 - 1989	483	526,316
1989 - 1990	1183	163,934
1990 - 1991	615	105,263
1991 - 1992	497	136,986
1992 - 1993	323	333,333
1993 - 1994	342	476,191
1994 - 1995	566	250,000
1995 - 1996	1227	133,333
1996 - 1997	557	102,041
1997 - 1998	404	153,846
1998 - 1999	151	434,783
1999 - 2000	328	416,667
2000 - 2001	873	185,185
2001 - 2002	588	46,083
2002 - 2003	441	43,103
2003 - 2004	671	172,414
2004 - 2005	437	384,615
2005 - 2006	617	212,766
2006 - 2007		232,558
2007 - 2008		227,273
2008 - 2009		217,391

4.2.4 Determining appropriate puerulus / pot conversion rates

The method of determination of appropriate puerulus/pot conversion ratios will depend on the timing aspects of the leasing arrangements. If it is determined that the removal of effort to compensate for puerulus harvesting must occur in the year in which those pueruli might have entered the fishery, then the level of settlement that occurs in the year of puerulus harvest will be known at the point that the pots would be leased out of the fishery to compensate for the effect. In this case, the determination of number of pots could be quite accurately calculated (as shown in Table 4 for an extraction of 1 million pueruli), in accordance with the percentage of pueruli collected relative to the settlement that occurred.

If it is determined that pot removal will occur in the year of harvesting (which would be biologically less relevant, but administratively far simpler) then a determination will need to be made about how the conversion ratio is calculated given that the strength of recruitment in any one year of collection will not be known until following the puerulus harvesting period.

Management Considerations

If it is determined that removal of effort must occur in the year in which the pueruli entered the fishery, then the level of settlement that occurred in the year of puerulus harvest would be known at the point that the pots would be converted out of the fishery to compensate for the effect.

If the pot conversion is to occur in the year of harvest then management arrangements will need to establish a pot conversion ratio, or method of calculating the pot conversion ratio. Possible mechanisms include (note that these are based on a 1 million harvesting scenario):

- Adopt an extreme low risk approach and assume that all years are consistent with one of the lowest recruitment years on record at 57 million pueruli. At a harvest level of 1 million, this would result in a conversion rate of 1 pot for every (approximately) 13,000 pueruli removed (Table 4). At this level, the take of pueruli would be unlikely to ever impact on the subsequent catch of this cohort 3 and 4 years later. Also at this level however, those collecting pueruli for on-growing would be consistently likely to over-compensate the wild capture fishery.
- Adopt a representative approach and take the average compensation over all the years of data available which is 1 pot for every 213,000 pueruli removed. At this level, over the course of several years, about half the time the harvest of pueruli may impact on wild catches, while the other half those collecting pueruli for on-growing will be overcompensating the wild capture fishery.
- Adopt a conservative approach and base the ratios on the pattern of low (but not lowest) settlement years. The most common recruitment level is between 400 and 500 million pueruli. If recruitment levels below this are considered low, then the mean pot conversion ratio 3 and 4 years following low recruitment events is 1 pot for every 83,000 pueruli collected.

Comment on an appropriate benchmark is encouraged during the public comment period of the Scoping Paper.

4.2.5 Zones

As noted in Section 3, the fishery is managed in four zones. The scope of the ‘biological neutrality’ study was a small portion of Zone B, between 29 and 30 degrees south. Given the consistency of this area within the rest of Zone B, it is considered appropriate to use the data from this small area to develop rates for the whole of Zone B.

Zone A of the fishery (Abrolhos Islands) has a higher density dependant mortality rate than at the coast and would therefore require less effort reduction for a given number of pueruli removed. As the data to quantify the extent to which it would be higher is not available, at this stage it is proposed to adopt a conservative approach and apply the same conversion factors as determined for Zone B.

Puerulus collectors in the northern region of the fishery (South Passage and Quobba) have indicated large puerulus settlements in this area. This pattern is not reflected in commercial catch rates for the area. Since 1999/2000 the catch from this region has represented less than 1% of the total commercial catch from the north coastal zone (Zone B) of the fishery (see Figure 5).

There are two possible reasons for this. It could be that this area has good puerulus settlement and that density dependent factors are involved such that the mortality rates are higher and less recruit into the fishery. Alternatively, it is possible that the strong settlements are an indication of the puerulus collectors being located in unusually optimal locations for puerulus collection and that they are not true representatives of the settlement of western rock lobster pueruli north of 26°S.

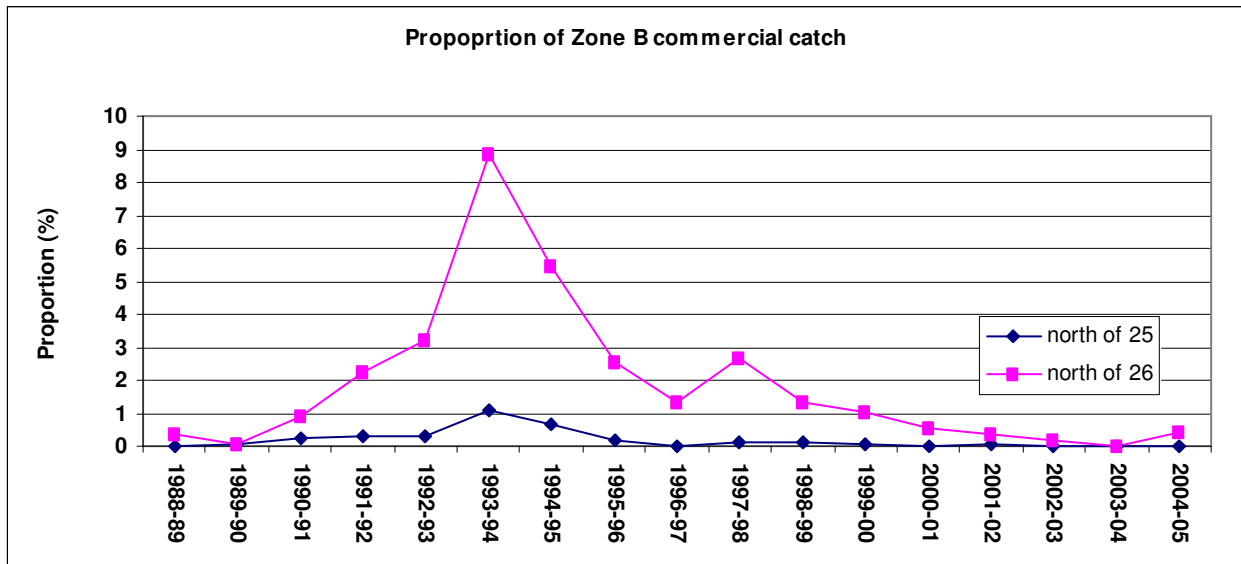


Figure 5: Proportion of Zone B commercial catch caught in the northern Shark Bay region (note that 25° is near Carnarvon; 26° is near Denham).

Zone C is situated south of the centre of the fishery and only experiences sporadic settlement in years with strong flowing Leeuwin currents. Given these facts, careful consideration would need to be given to the appropriateness of allowing pueruli to be collected from Zone C. Zone C also supports the highest recreational fishing effort in the fishery (with Zones A and B only contributing only around 0.9% of the total recreational lobster catch). Although, under commercial pot conversion arrangements, the impact of puerulus removal would be made

neutral through these arrangements, there is still some merit in separating this activity from the high density recreational fishing sector.

Management Considerations

The management arrangements will need to consider:

- the zonal arrangements of the fishery and ideally adopt a precautionary approach when extrapolating the information known from between 29°S-30°S, to the entire area of Zone B and to the remaining fisheries zones.
- the opportunity which may lie in the northern Zone B area (South Passage and Quobba) for collection of higher numbers of pueruli, given that this area may be a consistently strong settlement area.

4.2.6 Data Requirements

The study conducted by Phillips et al. in 2003 involved substantial field sampling, the results of which are being used as the basis for developing pot conversion ratios (see Section 4.2.4). To repeat research of this nature would not be cost effective, nor would it be likely to generate increased certainty. At this stage, it would be most appropriate to conduct future research in association with harvesting events.

Information should be collected on the number of pueruli collected, the relative abundance of pueruli from standard puerulus collectors used by the Department of Fisheries, and abundance of juveniles and legal-size rock lobsters from sites where pueruli were removed and control sites. This will provide further information that can be used to refine the level of pot reductions required to achieve biological neutrality.

Management Considerations

The management framework should consider the ongoing research and data collection needs and determine an appropriate monitoring program to be undertaken by puerulus harvesters.

4.3 Impact of Puerulus Collection on the Ecosystem

One other concern, which has been raised, is that the removal of pueruli will result in an imbalance of the food chain, due to the removal of a food source which is preyed upon by a number of fish species.

Phillips et al. (2003) found that at Seven Mile Beach western rock lobster pueruli are mainly eaten by small fish, including sand bass, sea trumpeter, brown spotted wrasse and gold spotted sweetlips. They reported that while they have been recorded as consuming pueruli, the low proportion of western rock lobster which they found in their gut contents suggests that their feeding on pueruli was probably largely opportunistic and as puerulus levels vary considerably, the predators are already used to fluctuations, and so presumably can adjust their diet to a reduction in puerulus numbers.

4.4 Management of the Collection of Pueruli

4.4.1 Apparatus Type

A range of different apparatus may be suitable for the collection of western rock lobster pueruli. Phillips et al. (2003) tested a number of puerulus collector methods including fixed nets (plankton nets which are set in a fixed position to face prevailing water currents), pump nets (benthic nets which produce a jet of current to expose shallow sand-burrowing fauna), mid-water trawling and the sandwich collector. They found that sandwich collectors had significantly better catch rates than other collectors and they also found that settlement rates were highly correlated with the collector size. Other collectors have been used in other fisheries. These include Mills (mesh) collector (Mills et al. 2000 *in* Phillips et al. 2003), crevice collectors (Booth and Tarring 1986 *in* Phillips et al. 2003), and the pallet collector (Lewis 1977 *in* Phillips et al. 2003). Other possible collectors also include seaweed collectors, artificial turf and bottlebrush collectors.

From the Department's perspective, it does not have an interest in prescribing a specific collector, but it does have an interest in ensuring that an apparatus used is not of a type that would create environmental harm, including that it would be designed to minimise entanglements with megafauna and minimise impacts on sensitive benthic habitats. Also it would be necessary for the Department to understand the catch rates achieved through any apparatus adopted.

Management Consideration

The management arrangements should provide assessment criteria for the apparatus type including as a minimum, aspects of environmental impact and catch rates.

4.4.2 Location of Deployment

Given that the number of pueruli permitted to be harvested will be managed on a zonal basis, it is important to understand where the proponent wishes to deploy their collectors.

Inappropriately located collection apparatus also has the potential to impact on existing scenic values, sensitive habitats, affect commercial and recreational fishing activities, create a navigational safety issue or generally conflict with other existing activities or pursuits within an area. Inappropriately located apparatus may also create a risk of entanglement with megafauna.

Other factors to consider are that the collectors should not be positioned where they might impact on the collection of scientific data from the research puerulus collectors that are used for predicting the level of recruitment and therefore future catch levels.

Management Consideration

The management arrangements, in particular arrangements around the approvals of collection sites, should take into account important factors of location within the fisheries zones, impact on scenic values, megafauna entanglement, affects on commercial and recreational fishing activities, navigational safety issues, conflict with other existing activities or pursuits, and impact on the collection of recruitment data from Department of Fisheries collection stations.

4.4.3 Verifying Numbers of Pueruli Collected and Limits on Total Numbers

It is anticipated that puerulus collectors will be deployed for an extended period of time over the settlement period. The number of times the collectors are serviced for harvesting will obviously impact on the amount of pueruli that are collected. The issue of determining on any one collection event how much is harvested is also important.

There are numerous mechanisms that can be employed to manage such a risk, including a requirement of those collecting pueruli to notify the relevant regional office prior to a harvesting event and a requirement to allow Fisheries and Marine Officers the opportunity to attend the harvesting event to verify activities.

Those collecting pueruli could be required to assess the number of pueruli collected at each event through the determination of drained weight divided by a determined average puerulus weight. The collector should also be required to undertake an estimate of puerulus numbers collected in the field, to minimise the risk of harvesting and transporting to land more pueruli than their permit allocates them.

Once the collector's full allocation has been collected, it will be a requirement for the apparatus to be removed from the water.

Where, after a harvesting event, the full allocation has not been collected, although a proportionally small amount is left to be harvested, the exemption holder will be instructed to harvest from only an appropriate proportion of apparatus at next harvest event to ensure that over collection does not occur.

In relation to the total number of pueruli that should be permitted to be harvested either by one individual or in total across all those collecting in one season, it is considered that presuming an appropriate compensatory mechanism is in place, which is both spatially and temporally relevant, there should be no need to place a limit on collection. However, if pot compensation is to occur in the year of harvesting, consideration should be given to the need for a limit on total harvesting as an additional precautionary measure.

Management Consideration

Management arrangements should address the potential for over-harvesting (both accidental and intentional), requirements for verification of collection number, supervision of collection and counting, and reporting on collection amount. The management arrangements should also give consideration to appropriate compliance activities aimed at detecting illegal or excess collection.

In relation to total number of pueruli permitted to be harvested per individual and in total for any one season, the development of the management arrangements should consider the need for a limit, particularly if the pot compensation is to occur in the year of harvesting, not in the year in which the harvested individuals would have entered the fishery.

4.4.4 Export of Pueruli for Growout

As discussed in Section 3 other countries are involved in puerulus growout. Given the relative scarcity of available pueruli in countries like Vietnam, tropical lobster pueruli are now fetching prices up to US \$10 per individual. This may create an incentive for holders of

authorisations for puerulus collection in Western Australia to want to export western rock lobster pueruli for on-growing elsewhere. Although large prices could be achieved through such activities, the benefit to the State would be questionable. This would also allow the aquacultured product to compete directly with the wild caught western rock lobster without the ability for the Western Australian government to control management arrangements. Ultimately, the matter will need to be debated giving consideration to National Competition Policy requirements and Department of Environment and Heritage export requirements.

Management Consideration

The development of the management arrangements should consider the need to provide restriction on to whom and to where the pueruli can be sold in order to address the potential for puerulus export and overseas growout.

4.5 Management of Growout of Western Rock Lobster Pueruli

This section explores the issues and management considerations surrounding growout of pueruli.

4.5.1 Holding of female rock lobster with eggs attached to the body

In accordance with the FRMA, female rock lobster with eggs or spawn attached beneath its body are totally protected fish. Section 46 of the FRMA states that a person must not take, have in the person's possession, sell or purchase, consign; or bring into the State or into WA waters any protected fish. Therefore, concern has been raised as to the ability of aquaculturists to hold such protected fish as the pueruli develop through this stage.

Section 48b of the FRMA provides that it is a defence in relation to a charge for holding protected fish, for the person charged to prove "that the fish were of a prescribed class and were being or had been, kept, bred, cultured or hatched in accordance with an aquaculture licence".

In accordance with this, aquaculturists are permitted to hold western rock lobsters that they have collected in accordance with an appropriate authorisation, and which become tarspot or setose through the growth phase. To support this defence, the aquaculture licence holder must however keep appropriate records to demonstrate that those animals are being grown out from pueruli and not collected in that condition from the wild.

Management Considerations

Management arrangements should provide that aquaculturists are able, through appropriate mechanisms, to demonstrate that tarspot and setose individuals are aquacultured product. Also management arrangements will need to consider appropriate mechanisms to ensure the ability to detect, through these arrangements, potential illegal activities of wild collected setose or tarspot individuals which are moved to an aquaculture facility as a laundering mechanism.

4.5.2 Laundering of Stock

There is concern that western rock lobster aquaculture facilities may provide potential for illegal laundering of stock by recreational or commercial fisherman; or potential for aquaculturists to catch undersize animals and claim that they are aquacultured stock.

The incentive for commercial fishers to be involved in such activity would be low given the strict penalties for selling undersize rock lobsters, however, given the increasing cost of fishing experienced in all sectors, the incentives may be increasing. There is considerably more risk that recreational fishers, or unlicensed fishers, may participate in such laundering activities.

The ability to detect laundering lies in the adequacy of stock recording and auditing requirements to ensure that all stock is accounted for. In the case of investigating suspected laundering, there are other tools available, for example chemical tests (isotope analyses), which can distinguish lobsters that have been cultured from wild collected lobsters.

It is also noteworthy that the development and implementation of appropriate stock monitoring and reporting requirements would result in the introduction of new stock being detectable within certain limits. The development of the reporting regime will need to consider the cryptic behaviour (often spending most of their lives in hides and shelters), proneness to stress and sensitivity to interference, of western rock lobsters. These factors mean that it is very difficult to conduct stock audits through the growth cycle of the lobsters (as it does for instance with abalone aquaculture where monthly audits are required) without creating extreme disturbance and increasing mortality. Regular reporting of numbers of animals surviving in their tanks is considered impractical for an aquaculturist to undertake.

Management Consideration

The management arrangements should provide for a mechanism through which stock can be accounted for and audited to ensure the ability to detect illegal laundering through the facility.

Possible mechanisms could include the requirement for recording inputs, outputs (sales etc), mortalities; the requirement for consignment notes and the ability to carry out chemical analysis as a tool for specific investigations.

4.5.3 Water Quality and Disease Issues in Land Based Facilities

A number of health and water quality issues have been raised in regards to the aquaculturing of western rock lobster. These issues have been highlighted as having a potential impact on the West Coast Rock Lobster Fishery or on the aquacultured stock.

From a water quality perspective, culturing rock lobster requires high protein diets and consequently there is a tendency to get high levels of dissolved proteins and nitrogenous and phosphorus waste in the water. As well, there can be high levels of dissolved solids. These raise issues of treatment and management of this water.

A more significant concern is the potential for poorly managed aquaculture facilities to generate and spread disease into the open ocean affecting wild stock.

FRDC Project 03/213 considered these issues and adopted numerous management protocols to manage these issues including:

- no return of stock to the wild;
- conduct weekly water quality monitoring and recording of each tank (including for dissolved oxygen, nitrate, ammonia, temperature, salinity and pH);
- regular disease monitoring and the requirement to report disease, and/or excess mortality events;
- the provision of appropriate farming arrangements to minimise stress (eg. adequate aeration), in order to minimise potential for disease;
- quarantine for two weeks of newly collected pueruli, separate from stock already in the aquaculture facility;
- all wastewater from any hatchery facility or building discharged through a rubble, sand or drum filter, which filters to at least 200 microns; and
- adoption of high standard of hygiene. This includes ensuring equipment is kept clean and where possible separate equipment is used for each tank.

These arrangements provide a benchmark for the development of appropriate requirements and standards with regard to treatment and management of disease and water quality matters relevant to a puerulus growout industry. It is imperative that appropriate requirements are placed on aquaculture facilities to ensure that appropriate wastewater and disease management measures are implemented.

Management Consideration

The significant issue of water quality and disease management must be adequately addressed in the management arrangements. As a minimum it would be expected that aquaculture growout facilities would be required to develop a detailed Health and Water Quality plan which relates specifically to how the facility will operate and which would cover the following matters:

- Requirement for appropriate disease monitoring and reporting;
- Requirements for appropriate quarantine arrangements and farming methods to ensure minimum risk of disease expression and spread;
- Requirement for appropriate water discharge arrangements;
- Requirements for appropriate hygiene management arrangements; and
- Requirements to establish and maintain a water quality monitoring program to defined specifications.

In addition the development of the management arrangements should consider requirements on aquaculturists to abide by industry standards for the processing and transport of live adult lobsters.

4.5.4 Seacage Potential

Seacage farming of rock lobster has commenced in other jurisdictions including New Zealand where success has been achieved in growout of *Jasus edwardsii* in such systems. Based on the economic analysis that has been undertaken for a land based facility, growout in seacage systems may present a significant financial advantage for growout operations.

Farming in seacage systems would introduce a range of other issues that would need to be thoroughly considered:

- Nutrient and water quality management issues resulting from feeding in an open water system;
- Disease management issues given that there is no control point from the farming system to the open ocean;
- Risk of escapes; and
- Site selection noting that sheltered coastal sites which are also socially acceptable are limited in Western Australia.

These issues will need thorough consideration with a view to determining an appropriate management regime to address the risks.

Management Consideration

As seacage farming may present a significant economic advantage, the management framework should consider the range of issues associated with this farming practice and determine a regime appropriate to address the risks.

4.5.5 Cost of Management and Compliance

There is concern within the wild capture fishery that management and compliance costs of the puerulus growout fishery would be met with cost recovered funds from licence holders in the West Coast Rock Lobster Managed Fishery (WCRLMF).

Given the infancy of the aquaculture industry in Western Australia, management and compliance activities associated with this industry is funded entirely from consolidated funds. Cost recovery of this industry would not be considered until it were deemed that it is 'developed'.

The collection and growout of western rock lobster, under the current arrangements, is considered a sector of the aquaculture industry and similarly activities would be funded from consolidated funds.

In the future, if the collection of pueruli was managed under the *West Coast Rock Lobster Management Plan 1993*, then consideration may be given to the appropriateness of these arrangements.

Management Consideration

The collection and growout of western rock lobster, under the current arrangements, is considered a sector of the aquaculture industry and as such management and compliance activities would be funded from consolidated funds. In the future, if the collection of pueruli was managed under the *West Coast Rock Lobster Management Plan 1993*, then consideration may be given to the appropriateness of these arrangements.

4.5.6 Translocation Issues

Western rock lobster are native to Western Australia and the aquaculture of which will be sourced from local Western Australian stock. Therefore there will be no translocation issues with respect to this industry.

4.5.7 Impact on Western Rock Lobster Market

Puerulus growout presents some favourable market development opportunities. Phillips et al. (2003) predicted that if techniques were developed and put in place to catch large numbers of pueruli and on-grow them, western rock lobster production could increase substantially, leading to the value of the fishery possibly doubling in the long term.

It is predicted also that aquaculture product will allow the expansion of the lobster product range and the ability to market over the whole year, thus not only diversifying product range but also increasing market stability and taking opportunity to supply at optimal price time.

Together with the potential market benefits, however, comes the potential for negative impacts. The development of a puerulus growout industry creates three means through which detrimental impacts on the western rock lobster market may occur.

Firstly, an increase in the amount of lobster product on the market could result in a reduced price per weight of lobster in the market. The case of the maxima pearling industry has been presented by the wild capture industry as demonstration of this concept, whereby the Department of Fisheries has maintained control over the number of pearls produced in order to ensure that the product maintains its rarity and therefore its price premium. It is worthwhile noting of course that the primary driver behind aquaculture development is the understanding that the amount of wild caught fish for most species is unlikely to increase, and for some may decrease, and that the global demand for seafood is increasing. Aquaculture is widely understood to be the mechanisms through which the global demand for seafood will be met. If it is agreed that the global demand for seafood, and in particular for rock lobster will increase, then it would seem unlikely that in the long term, increased production from aquaculture will cause a decrease in price.

A second issue which presents concern to the wild capture industry is the potential for aquaculture facilities to place on the market an inferior, low quality product, which may affect the value of the wild capture product. This issue might be avoided if aquacultured product was labelled as such, however there are no requirements in other aquaculture sectors for product to be labelled as aquacultured. Introducing such a requirement would create a significant precedent that could affect other sectors.

The third issue is the size at which aquacultured rock lobsters will be permitted to be sold. The slow growth rates of the rock lobster significantly impacts on the stage at which lobsters would need to be marketed. Lobsters under growout conditions grow to around 100 g (45 mm CL) after 1 year. This may be the low end of what might be considered marketable. Growout lobsters would grow to around 250 g (63 mm) after two years. This would probably be the size that aquaculturists would want to market their product, because lobsters held under aquaculture conditions (warm water, unconstrained feed) tend to mature precociously, leading to a slowing down of growth rates after this point. Lobsters held at 23°C take around 2.5 years to reach legal minimum size (76 mm) and economic analyses have determined that harvesting at this size would not be economical.

Anecdotally, the Japanese and Korean markets are consistently seeking smaller sized lobsters for the wedding market which ideally demands small 'plate-size' lobsters. The aquacultured rock lobster product could fulfil this demand which could reduce the market share of the wild capture fishery in these markets. This may be a cause for concern for the wild capture fishers.

Of course the examination of the issues above has been based on very general presumptions and arguments and given the significance and value of the wild capture western rock lobster industry, this matter needs thorough consideration based on expert advice from creditable personnel with experience and knowledge of the market.

Management Considerations

The management framework will need to consider the range of issues that have the potential to impact on the western rock lobster market and determine appropriate and equitable arrangements particularly with respect to the issues of permitted sale size/weight and labelling of the product. Given the significance of this issue, the impact of a puerulus growout industry on markets should be assessed based on expert marketing advice.

SECTION 5 CONCLUSIONS

A range of issues and management considerations have been presented in this Scoping Paper in order to generate discussion and debate and provide guidance in relation to the matters that should be addressed in the policy framework that will ultimately be developed for a commercial puerulus growout industry.

The Scoping Paper has attempted to document all issues that have been raised during the first phase of this project. Should it be considered that there are gaps in the range of issues canvassed, it is advised that the public comment period be used to present these views.

Ultimately, the aim of the paper is to provide a vehicle through which the differing sectoral views can be canvassed and brought together, so that the Draft Policy Paper which will follow can attempt to propose an equitable and sustainable management framework which allows for the development of a puerulus growout industry while maintaining a sustainable and economically viable wild capture fishery.

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APPENDIX 1 METHODS OF PUERULUS COLLECTION

The following provides a summary of the methodology of puerulus collection during the FRDC Study 2003/213 and outlines useful information in relation to appropriate transport techniques, storage and diet.

During the FRDC Study 2003/213, post-pueruli were collected from Seven Mile Beach, 15 km north of Dongara. Animals were collected using sandwich collectors set in an area north of the designated Fisheries research area in 4-6m of water. Collection occurred bi-monthly on consecutive days during the full and new moon period.

When retrieving the pueruli, sandwich collectors were pulled aboard the vessel and spun 30 times in each direction to remove all the settled post-pueruli. The contents were then poured through a sieve into a smaller bucket to remove excess water. The contents are sorted on the sieve and post-pueruli placed into a sealed insulated container containing seawater. The sandwich collector is reassembled and returned to the ocean. Seawater in the insulated container is exchanged every 30 minutes or sooner depending on water quality conditions.

During transportation from the shore to the aquaculture facility, the post-pueruli were removed from the insulated container and placed into an insulated esky with clean seawater and a small battery operated aerator. Regular water exchanges were also carried out.

Upon arrival at the aquaculture facility, post-pueruli were carefully placed into aerated 250L seawater tanks. They were sorted by size (large post-pueruli are not placed with clear pueruli) and held at densities of approximately 50 m⁻² (as determined to be optimal during the density trial). Ample mesh shelters (developed and determined to be optimal in the first year of this project) were provided in the tanks and fresh black mussel tissue removed from the shell distributed in the tank to excess once per day in the late afternoon. Post-pueruli were monitored closely every day. {If post-pueruli were kept in tanks for long periods size grading would be carried out to ensure that post-pueruli of similar size were kept together in any one tank}.

Post-pueruli were fed mussels for the first 2 months as post-pueruli were stocked at 2 weeks post-settlement and it was believed that they would not be capable of consuming the formulated pellet diet in its current size and form. After two months, pellets were introduced to excess every second day and gradually increased up to 5 days a week with mussels fed only on weekends. By this stage the post-pueruli were sufficiently large enough to ingest the pellet diet.

APPENDIX 2 GLOSSARY

- Aquaculture:** means the keeping, breeding, hatching or culturing of fish
- MPG:** Ministerial Policy Guideline
- Pelagic:** Free-swimming fish and inhabiting the surface or middle depths
- Phyllosoma:** The larva of the spiny lobsters. Its body is remarkably thin, flat, and transparent; the legs are very long.
- Propagation:** Control of the life cycle and the culture of larvae from eggs hatched in the laboratory
- Puerulus:** The stage in a lobster's life cycle between larvae and juvenile, when it swims inshore and settles on reefs (note: puerulus is singular and pueruli is plural)
- Recruitment:** New entry, either by migration or growth to legal size, of juveniles (pueruli) into the main fished stock
- Setose:** means a female rock lobster that has fine hair-like filaments for the attachment of eggs on the branched structures forming part of the swimmerets (pleopods) underneath its tail
- Tarspot:** means a female rock lobster that has a black putty-like mass (spermatophoric mass) attached to the underside of the carapace (ventral sternal plate) between its hindmost (5th) pair of walking legs.
- Whites:** A phase in the life cycle of western rock lobsters which occurs three to four years after settlement, when that cohort of juvenile lobsters moult to a pale colour and migrate to the offshore breeding grounds. The offshore migration takes place in December and early January.

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- No. 214** Integrated Fisheries Management Draft Allocation Report for Roe’s Abalone – Perth Metropolitan Area (August 2006).
- No. 215** The Granting, Renewal and Regulation of Aquaculture Leases in Western Australia. A discussion paper (May 2006).
- No. 216** Proposed Fees and Charges for Section 97 Aquaculture Leases. A discussion paper (May 2006).

- No. 217** The Minister for Fisheries' Decisions in Response to the Final Report of the RFAC Recreational Freshwater Fisheries Stakeholder Sub-Committee on the Recreational Marron Fishery (Fisheries Management Paper No. 213) (September 2006).
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