

**AQUACULTURE PLAN
FOR THE
HOUTMAN ABROLHOS ISLANDS**

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for the Houtman Abrolhos Islands

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*Aerial photo of Basile, Burnett, Coronation
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Inset picture:

Panel of blacklip pearl oyster (Pinctada margaritifera)

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Executive Summary

Fisheries Western Australia has prepared the aquaculture plan for the Abrolhos Islands to provide for the future management of aquaculture in the archipelago.

The plan will assist prospective aquaculturists in preparing proposals and guide Fisheries WA in the decision-making process for aquaculture licence applications.

The plan identifies constraints to aquaculture development and areas where aquaculture could occur. It also identifies species that may be used for aquaculture development. Implementation of this plan will ensure that aquaculture can occur in the Abrolhos systems while retaining their unique features and maintaining recognised conservation and tourism values.

The Abrolhos Islands are regarded as one of the most important marine environments in Western Australia. Visitors to these islands and the local community recognise their high conservation and tourism values and seek to have them protected from environmental changes caused by human activity.

The objective of this aquaculture plan is to:

Provide a sound basis for developing a new aquaculture industry in the Abrolhos Islands, while at the same time conserving the unique environment of the islands for present and future generations, and minimising conflict between aquaculture and existing and future users of the islands.

Community concerns regarding the conflicts between aquaculture and other uses of the area and the potential environmental risks associated with some forms of aquaculture are recognised by Fisheries WA. Consequently, the plan advocates the use for aquaculture of only endemic species, and outlines site constraints where aquaculture will not be, or is unlikely to be, approved.

A rigorous environmental assessment process is recommended for finfish, in particular, to ensure that any future finfish farms do not have any adverse effects on the marine environment of the Abrolhos Islands.

Aquaculture proponents need to be aware of the constraints on the development of aquaculture in the Abrolhos Islands, which include the:

- fragile nature of both the terrestrial and marine environments;
- lack of fresh water;
- frequently adverse weather conditions;
- strict requirements for waste disposal;
- lack of infrastructure; and
- need to consider other users.

In addition, all aquaculture activities must take place within the context of the recently developed management plan for the islands, titled *Management of the Houtman Abrolhos System* (Fisheries Management Paper No. 117 – Fisheries WA, 1998). The management plan states that:

- Before further aquaculture is undertaken in the Abrolhos Islands, appropriate examination of potential impacts – both beneficial and adverse – must be undertaken.
- All aquaculture proposals will also be subject to the established Statewide consultative arrangements outlined in Ministerial Policy Guideline No. 8.
- Land-based infrastructure for use in aquaculture projects in the Abrolhos will only be considered on islands that are already inhabited.

The plan also includes the following strategies in relation to aquaculture:

- Ensure any non-endemic species considered for aquaculture at the Abrolhos Islands undergoes adequate risk assessment in accordance with established translocation protocols.
- Ensure all aquaculture proposals for the Abrolhos Islands undergo adequate environmental impact assessment in accordance with Department of Environmental Protection (DEP)/ Environmental Protection Authority (EPA) processes.
- Identify suitable areas within each Abrolhos Island group where aquaculture projects may be established.
- Develop an aquaculture plan for the Abrolhos Islands that is consistent with the intrinsic values and uses of the area.

A list of species that could potentially be suitable for aquaculture in the Abrolhos Islands is presented in Table 1. This list includes only species endemic to the Abrolhos Islands. The rationale for including these species is discussed extensively in the plan. They could be grown either through traditional aquaculture and/or aquaculture-related activities.

It will be the responsibility of proponents wishing to undertake aquaculture to examine in their application the competing usage of the areas by other interests. Extracts of applications are sent to other interested parties as a matter of course during the public comment phase of the application. Maps showing existing values and human uses are included in the plan (Figures 2 -7). More detailed maps are held by Fisheries WA.

In developing their proposals for aquaculture in the Abrolhos Islands, proponents should consider the site selection criteria shown in Table 2:

- sites which cannot be used for aquaculture;
- sites where approval of aquaculture is unlikely; and
- sites which may be considered favourably for aquaculture.

The Abrolhos Islands have a complex variety of habitats that may change considerably over very small distances, meaning that detailed habitat information will be required with the application. It may be that much of a given area will be suitable for aquaculture but there may be isolated corals or other significant features in the desired location that will not be available for use. The applicant will also be required to provide information on uses by other people, such as recreational fishers, tourism operators, and private users.

Table 1 Species with potential for aquaculture in the Abrolhos Islands

Species with potential for aquaculture in the Abrolhos Islands	
Molluscs	Blacklip pearl oyster (<i>Pinctada margaritifera</i>)
	Shark Bay pearl oyster (<i>Pinctada albina</i>)
	Giant clam (<i>Tridacna maxima</i>)
	Rock oyster (<i>Saccostrea</i> sp.)
	Saucer scallop (<i>Amusium balloti</i>)
Crustaceans	Western rock lobster (<i>Panulirus cygnus</i>)
Fish*	Snapper (<i>Pagrus auratus</i>)
	Black bream (<i>Acanthopagrus butcheri</i>)
	Yellowtail kingfish (<i>Seriola lalandi</i>)
	Yellowfin tuna (<i>Thunnus albacares</i>)
	Mahi mahi (<i>Coryphaena hippurus</i>)
	Bar-cheeked coral trout (<i>Plectropomus maculatus</i>)
	Coral trout (<i>Plectropomus</i> spp.)
	Estuary cod (<i>Epinephelus coioides</i>)
	Breaksea cod (<i>Epinephelides armatus</i>)
	Baldchin groper (<i>Choerodon rubescens</i>)
	Westralian dhufish (<i>Glaucosoma hebraicum</i>)
	Tropical snappers (<i>Lutjanus</i> spp.)
	Parrot fishes (Family Labridae, multiple local species)

* Note – Proposals for aquaculture of non-filter feeding species will be subject to a rigorous assessment of the potential environmental impacts. Fisheries WA will forward all applications for such aquaculture to the Department of Environmental Protection, with a recommendation that the application be formally assessed by the Environmental Protection Authority, in accordance with section 40 of the *Environmental Protection Act 1986*.

Table 2 Site selection criteria for aquaculture in the Abrolhos Islands

Sites which cannot be used for aquaculture
<p>Reef Observation Areas and protected shipwreck sites cannot be used for aquaculture (Figures 5 – 7).</p>
Sites where approval of aquaculture is unlikely
<p>Sites where aquaculture is unlikely to be approved include: areas of high conservation value and locations already extensively utilised by other interests, such as navigation areas; and locations extensively used by commercial fishermen, tourist operators or private visitors to the islands (Figures 5 – 7). High conservation areas include:</p> <ul style="list-style-type: none"> • mangroves, significant seagrass meadows and coral reefs; • major habitats of significant fauna, such as seabirds and marine mammals; and • any other areas which might later be set aside for the protection of flora and fauna or habitats. <p>Sites located in areas adjacent to, or otherwise able to affect, areas of high conservation value are also unlikely to be approved, i.e. waters adjacent to important seabird nesting areas. Also, sites with significant social importance or high visual amenity values are unlikely to be approved for aquaculture operations.</p>
Sites which may be considered favourably for aquaculture
<p>All other areas may be considered favourably for aquaculture, but a detailed habitat description is required as part of an aquaculture proposal. The application will also be required to provide information on the existing uses of the proposed area, by people such as recreational fishers, tourism operators and private users.</p>

Summary of Recommendations

Community members made numerous useful suggestions during the consultation process to develop the draft Aquaculture Plan. Many of these suggestions have been used to modify the recommendations in the final plan. The agency responsible for implementation of these recommendations is shown in brackets under each recommendation (see below).

Recommendation 1

Ensure that all future aquaculture applications in the Abrolhos Islands contain adequate data on water circulation and flushing times in the vicinity of the proposed aquaculture site to enable the Environmental Protection Authority (EPA) to determine the appropriate level of assessment of the application.

(proponent/FWA/EPA)

Recommendation 2

Ensure that the management strategies contained in the plan *Management of the Houtman Abrolhos System* (Fisheries Management Paper No. 117 – Fisheries WA, 1998), and future management strategies to protect specific areas, are taken into account when assessing future aquaculture proposals.

(FWA)

Recommendation 3

Modify existing management arrangements to allow holders of aquaculture licences in the Abrolhos Islands to purchase, or make use of, existing facilities in the islands if they become vacant, subject to the development of guidelines as to tenure.

(FWA)

Recommendation 4

Ensure that the extended use of existing land-based facilities and any new land-based facilities are subject to appropriate licence conditions to protect the environment, including an agreed waste disposal management program consistent with the objectives of the plan *Management of the Houtman Abrolhos System* (Fisheries Management Paper No. 117 – Fisheries WA, 1998).

(FWA)

Recommendation 5

Ensure that:

1. all land-based structures associated with aquaculture activities are consistent with established building standards; and
2. any aquaculture infrastructure placed in the marine environment is approved by the Executive Director, Fisheries WA, until such time as suitable standards for marine infrastructure are developed.

(FWA)

Recommendation 6

Expand the membership of the Abrolhos Island Land Management Sub-committee to include representation from the aquaculture industry.

(AIMAC/FWA)

Recommendation 7

Accept species listed in Table 1 as potential species for aquaculture in the Abrolhos Islands, noting that any applications for non-filter feeding species will be referred by Fisheries WA to the Department of Environmental Protection (DEP) with a recommendation that the application be formally assessed by the Environmental Protection Authority (EPA), in accordance with section 40 of the *Environmental Protection Act 1986*. (FWA/proponents/EPA)

Recommendation 8

Consider applications for endemic species not listed in Table 1 on an individual case basis when a proponent lodges an application for a licence for their aquaculture in the Abrolhos Islands. (FWA)

Recommendation 9

Prohibit aquaculture of non-endemic species in the Abrolhos Islands, unless specific approval has been granted by the EPA.

Recommendation 10

Ensure that broodstock for aquaculture species listed in Table 1 either originates from the Abrolhos Islands or have similar genotypes. If broodstock for shellfish and finfish, with the exception of blacklip pearl oyster, does not originate from the Abrolhos and has genotypes distinct from Abrolhos populations, ensure that the translocation of the species is subject to Fisheries WA's translocation protocol. (FWA)

Recommendation 11

Allow broodstock for the aquaculture of blacklip pearl oysters in the Abrolhos Islands to be sourced from the Shark Bay area. (FWA)

Recommendation 12

Consider applications for wild-stock enhancement in the Abrolhos Islands on an individual case basis. (FWA/proponents)

Recommendation 13

Take into account Fisheries WA's two to five nautical mile separation guideline in the assessment of new applications for pearl oyster aquaculture licences in the Abrolhos Islands. (FWA)

Recommendation 14

Use the criteria listed in Table 2 in determining where potential licence sites may be located. (proponents/FWA)

Recommendation 15

Ensure that aquaculture licence conditions address the issues of removal of infrastructure; reinstatement of the area disturbed by any environmental impact; and performance criteria to measure whether licences are being used by licensees in the manner they were intended. (FWA)

Recommendation 16

Ensure that all aquaculture proposals continue to be subject to the established Statewide consultative arrangements outlined in Fisheries WA's Ministerial Policy Guideline No. 8 (FWA)

Recommendation 17

Advertise for public comment all applications received for aquaculture leases and licences, in accordance with Fisheries WA's Ministerial Policy Guideline No. 8 (FWA)

Recommendation 18

Ensure that all proposals for non filter-feeding species are forwarded to the Department of Environmental Protection, with a recommendation that the application be formally assessed by the Environmental Protection Authority, in accordance with section 40 of the *Environmental Protection Act 1986*.

(FWA/EPA)

Recommendation 19

Develop performance criteria upon which to judge the success of this aquaculture plan. (FWA)

Recommendation 20

Review the success and appropriateness of the management strategies contained in this aquaculture plan in five years. (FWA)



Section 1

Introduction

1.1 Significant Features of the Abrolhos Islands

The Houtman Abrolhos Islands is a small archipelago of 122 low-lying islands located 60 km and more to the west of Geraldton, Western Australia at latitudes of 28°15' to 29°00'S. Three major groups of islands comprise the Abrolhos Islands: North Island-Wallabi Group; Easter Group; and Pelsaert (or Southern) Group, separated by the Middle and Zeewijk Channels respectively, which are each approximately 40 m deep.

Virtually all the islands of the Abrolhos archipelago support bird nesting and breeding areas, and populations of some species of seabirds are of international significance (Storr *et al.* 1986; Fuller *et al.* 1994). Other important fauna include the tammar wallaby (*Macropus eugenii*), Abrolhos painted-button quail (*Tumix varia scintillans*), brush bronzewing (*Phaps elegans*), Abrolhos dwarf bearded dragon (*Pogona minor minima*), and Abrolhos spiny-tailed skink (*Egernia stokes stokes*) (Fisheries WA, 1998).

The marine areas of the islands are perhaps even more important. The coastline of Western Australia can be divided into three marine biogeographical zones: a tropical north coast (which extends north-eastwards from North West Cape and is continuous with the remainder of the Indo-West Pacific Ocean); a temperate south coast (which extends east of Cape Leeuwin, across the southern coastline of Australia, and up the east coast to southern Queensland); and a west coast overlap zone (where the two faunas are mixed and where the Abrolhos Islands are situated).

A small component of the marine biota of the State is endemic to WA, the proportions varying between phyla. Despite their low diversity, endemic species can be ecologically and economically important (Marsh, 1976; Wells, 1980; 1997a; 1997b; Wilson and Allen, 1987).

The western rock lobster, *Panulirus cygnus*, is the best example of an economically important endemic species. It forms the basis of the largest single-species fishery in Australia, which is the dominant industry for many small communities on the State's west coast.

The value of the fishery fluctuates annually. There was a record high catch of 13,000 tonnes in 1998/99, which returned a landed value of around \$260 million, despite weaker demand from overseas buyers. Catch values have reached as high as \$300 million in a single year. The catch of 1,970 tonnes from the Abrolhos Islands in season 1998/99 was a record and approximately 10 per cent higher than the previous season's catch of 1,790 tonnes. About 15 per cent of the catch of *Panulirus cygnus* is caught during the Abrolhos season of 15 March to 30 June each year. The islands are even more important as a source of larvae than as a fishing area, and may provide between 50 and 80 per cent of the total larvae for the State (Fisheries WA, 1998).

The Abrolhos Islands are located towards the northern limit of the west coast overlap zone, and have considerable scientific importance. The Abrolhos has the southernmost development of coral reefs in the

Indian Ocean and one of the highest latitude coral reef systems in the world. While the biota is overwhelmingly tropical (Wells, 1997a), there is a complex mixture of tropical species with temperate forms, most notably macroalgae (Hatcher et al., 1989) and seagrasses (Brearley, 1997), and endemic Western Australian species.

In addition to their biological importance, the Abrolhos Islands contain sites of two of the most famous shipwrecks in Australia, those of the Dutch East Indiamen *Batavia* and *Zeewijk*. The wrecks and associated land sites are protected under the Western Australian State *Marine Archaeology Act 1973* and Commonwealth *Historic Shipwrecks Act 1976*.

1.2 Purpose of the Plan

Fisheries Western Australia has prepared the aquaculture plan for the Abrolhos Islands to provide for the future management of aquaculture. The plan will assist prospective aquaculturists in preparing proposals and guide Fisheries WA in the decision-making process for aquaculture licence applications.

Implementation of this plan will ensure that aquaculture is undertaken sensibly in the Abrolhos Islands, while retaining the unique features of the island systems and maintaining the recognised conservation and tourism values.

1.3 Area Covered by the Plan

The plan area is the State Territorial Waters of the Houtman Abrolhos Islands, Western Australia (Figure 1).

1.4 Approach and Method

Fisheries WA provided Terms of Reference for the aquaculture plan when it called for tenders to select a consultant to undertake the project. As part of the Terms of Reference, Fisheries WA specified that particular stakeholder groups be consulted about the project.

When the contract was let, Fisheries WA wrote to the targeted stakeholder groups informing them that Enzer Marine Environmental Consulting (Enzer) would be undertaking the project. Enzer then sent a copy of the Terms of Reference to the stakeholders and asked for written or verbal comments. Enzer offered to meet personally with organisations in Perth at their convenience. A meeting was held in Geraldton on 12 August 1998 with interested stakeholders (Appendix A).

Fisheries WA prepared a usage map showing the current usage of the islands as understood by officers in the Geraldton Regional Office. This was discussed with Fisheries Officers in Geraldton on 24 July 1998 and with stakeholders on 12 August 1998.

Preparation of the *Aquaculture Plan for the Abrolhos Islands* has not been undertaken in isolation. Numerous management plans and studies of the Abrolhos Islands have been undertaken in recent years.

Most useful to the present report have been the plan *Management of the Houtman Abrolhos System* (Fisheries Management Paper No. 117 – Fisheries WA, 1998) and *Management Plan for Sustainable Tourism in the Houtman Abrolhos Islands, Western Australia* (Fisheries Management Paper No. 120 – LeProvost Dames & Moore, 1997). Earlier Abrolhos Islands studies and plans were also used as appropriate.

The meeting with stakeholders was treated as an information-gathering opportunity. Enzer wished to obtain the views of the stakeholders on the future management of aquaculture in the Abrolhos Islands.

This information was used to further develop ideas about aquaculture in the Abrolhos Islands and a preliminary draft plan was written. The draft plan was then examined by officers from Fisheries WA, and refined, following discussion of their comments. The draft plan was then submitted to the Abrolhos Islands Management Advisory Committee (AIMAC) and the Aquaculture Development Council (ADC) for comment before being finalised.

A draft aquaculture plan was released for public comment in July 1999 (Fisheries WA/Enzer, 1999) and 16 submissions were received. The submissions were summarised by an independent consultant (Enzer).

The plan has now been revised, taking into account the comments from the public, the AIMAC and the EPA. Appendix B contains a summary of the submissions, along with a statement on how those comments have been addressed within the plan.



Section 2 Physical, Biological and Social Features of the Abrolhos Islands

2.1 Physical Features

2.1.1 Geology and Geomorphology

The Abrolhos Islands archipelago is made up of 122 low lying islands located near the edge of the continental shelf 60 km and more west of Geraldton. The maximum altitude of 15 m above sea level occurs in the Wallabi Group. Three islands (North Island, and East and West Wallabi Islands) are of continental origin – that is, they were part of the continental mainland during a period of lower sea level. These islands have extensive sand dunes.

The other islands of the Abrolhos are composed of Pleistocene and Holocene limestone. They were formed by a combination of erosion and deposition of sediments as sea levels rose and fell over time, and by short term events such as cyclones and other storms, the actions of waves and swells, and wind.

A small limestone outcrop on East Wallabi Island is a fossil site of international significance.

2.1.2 Climate

2.1.2.1 Air temperatures

Monthly mean air temperatures in the Abrolhos Islands vary from a low of 17.7°C in August to a high of 23.5°C in February. The minimum temperature recorded from 1990 to 1995 was 10.7°C and the maximum was 37.7°C.

Both the monthly means and minimum and maximum temperatures in the Abrolhos are ameliorated by the ocean, compared to the inshore area at Geraldton. The monthly mean air temperature varies by 10°C at Geraldton, as compared to only 6°C at the Abrolhos. Air temperatures in the Abrolhos Islands are appreciably warmer than in Geraldton during winter months (Pearce, 1997).

2.1.2.2 Rainfall

The Abrolhos Islands archipelago has a low rainfall, with an average of 89 raindays per year producing 469 mm of precipitation. Rainfall is strongly seasonal, with the largest amount, 100 mm, falling in June.

The seasonality is clearly shown by the fact that 86 per cent of all rain occurs in the six months from April to September. The remaining six months of October to March have a total fall of only 70 mm (Pearce, 1997).

2.1.2.3 Winds

Winds at the Abrolhos Islands are dominated by southerlies over much of the year, which are strongest in summer. During the summer there is a strong diurnal change in the southerlies. They exceed 10 m/sec

(about 20 knots) for only 13 per cent of the time in the morning (9 am) but 47 per cent of the afternoon (3 pm).

Winds are variable in the autumn, with relatively low wind speeds and sporadic calms. Wind speeds increase in winter, when they can exceed 15 m/sec (29 knots), but wind direction is highly variable. In winter, wind speeds exceed 10 m/sec for 10 per cent of the time. There is a general pattern of alternation of northerlies and southerlies, but little diurnal change.

In spring, there is a weakening of wind speeds and southerlies again become dominant. The average wind speeds are 6.5 m/sec in winter and 8.6 m/sec in summer.

Three types of storms occur in the Abrolhos Islands:

- Potentially destructive tropical cyclones with wind speeds that can reach 30 m/sec (about 58 knots) occur in January to April. Tropical cyclones are infrequent in this area, averaging only one every three years.
- Squalls in the summer (December to April) can generate wind speeds between 25 and 30 m/sec and can occur from any direction.
- The eastward passage of southern storms to the south of the Geraldton-Abrolhos region can bring winter gales with wind speeds of up to 35 m/sec (Pearce, 1997, Sukumaran, 1997).

2.1.3 Oceanography

2.1.3.1 Sea Temperatures and Salinities

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) maintained a research station at Rat Island for a number of years, gathering data which was discussed by Pearce (1997). Thermal stratification near Rat Island is low, with temperatures and salinities at the sea bottom being essentially the same as at the surface.

Sea-surface temperatures at the islands are very stable, with the monthly mean minimum of 20.0°C occurring in September and the maximum of 23.7°C in March.

Water temperatures can drop below 20°C in tidally-exposed areas and shallow pools in winter when air temperatures drop. This is critical because a mean monthly minimum water temperature of no less than 20°C is regarded as being required for tropical species to survive.

The Leeuwin Current maintains Abrolhos water temperatures at warmer levels than inshore. During winter, the water around the islands can be up to 4°C warmer than at Geraldton.

Salinity levels in the Abrolhos Islands are essentially those of the open ocean, with the monthly mean at Rat Island varying only from 35.4 ‰ to 35.7 ‰ (parts per thousand).

2.1.3.2 Tides and Waves

Tides are mixed in the Abrolhos Islands; they alternate between diurnal (one maximum and one minimum per day) and semi-diurnal (two cycles per day), though the tides are predominantly diurnal. The daily tidal range is low, about 0.7 m.

Wave heights in the open ocean near the Abrolhos Islands average about 2 m, but 10 per cent of wave heights exceed 4 m and they can be greater in storms. Wave heights are substantially lower in the island groups of the Abrolhos as they are significantly dampened by the shallow reefs and islands.

2.1.3.3 Currents

The Leeuwin Current originates in the open ocean north of North West Cape, and flows southwards along the west coast of WA, along the outer continental shelf. It is strongest in winter, raising sea surface temperatures significantly higher than they otherwise would be.

At the Abrolhos Islands, there are strong southward currents in autumn, winter, and early spring. Mesoscale eddies and meanders of the Leeuwin Current often occur.

At the continental shelf break, to the west of the Abrolhos Islands, the flow is southwards during all seasons, due to the Leeuwin Current. The peak flow of 50 cm/sec (about 1 knot) occurs in April/May. Occasional weak reversals occur in September/October and December/January, when there is a weak flow to the north.

Currents are weak and variable on the middle of the continental shelf, inshore of the Abrolhos Islands. Between September and February, there is a northwards tendency of flow, with a speed of less than 10 cm/sec. From March to July the flow is southwards at up to 20 cm/sec, forced by coastal winds (Pearce, 1997).

2.1.3.4 Flushing Times

The 'flushing time' in the lagoons of the Abrolhos Islands is a key characteristic for aquaculture. It is a measure of the time required for the volume of water in a given area to be completely replaced. A lower flushing time means that the waters are replaced more often, reducing the chance of nutrient or other build-up from aquaculture to occur.

Unfortunately, only one detailed study of flushing times in the Abrolhos Islands has been made, that of Sukumaran (1997) for the Easter Group. No information is available for the other island groups, but because of its open structure and depths similar to those of the Easter Group, the Wallabi Group may have similar flushing times. The Southern Group has large expanses of shallow water, and flushing times might be different.

The average depth in the Easter Group lagoon is 20-25 m, with the deepest point of 28.3 m being near Wooded Island. The lagoon has an area of 9.5 km² and a volume of 125 million cubic metres. The lagoon is very open, with three entrances.

Wooded Island Passage has two entrances: the northern (2,150 m wide, 25-30 m deep) and southern entrance (1,500 m wide, 5-10 m deep). In addition, Rolland Passage is 750 m wide and 30 m deep.

The flushing time of the Easter Group lagoon is a result of a combination of a variety of forces, including wave action, currents (including the Leeuwin Current), wind stress, tides, etc. Wind speed and direction are the major determinants of the circulation and flushing characteristics of the lagoon. The circulation is the result of a balance between the wind stress, the Coriolis force and the pressure gradient.

Currents in the Easter Group lagoon range between 2-5 cm/sec under the influence of most winds. Gyres are induced under the influence of southerly winds and westerlies are the only winds to induce strong currents through Rolland Passage. Wooded Island Passage generally experiences medium to strong currents.

Estimates of flushing times obtained by Sukumaran (1997) ranged from 0.5 to 1.5 days during the year. The good flushing time is due to the open nature of the lagoon and the lack of sills that would inhibit circulation. Sukumaran (1997) recorded a storm event on 5 September 1995, causing currents within the lagoon to reach 50 cm/sec, and flushing the lagoon within hours.

Acquisition of appropriate water circulation and flushing time information is critical and should be given high priority.

Strategies

Short Term

Recommendation 1

Ensure that all future aquaculture applications in the Abrolhos Islands contain adequate data on water circulation and flushing times in the vicinity of the proposed aquaculture site to enable the EPA to determine the appropriate level of assessment of the application. *(proponent/FWA/EPA)*

2.1.3.5 Nutrient Levels

The waters off the west coast of Western Australia are nutrient poor, and major upwelling does not occur. In other parts of the world, such upwellings bring relatively nutrient-rich deeper waters to or near the surface where they can be used by plants in primary production, providing the basis of marine foodwebs. Many of the most productive areas for marine fisheries are associated with upwellings.

The Leeuwin Current which flows past the Abrolhos Islands is also nutrient-poor, raising the question of how such a biologically productive region as the Abrolhos Islands exists in the midst of a sea where the necessary nutrients for plant production are in such low supply.

Hatcher (1991) postulated that small scale, isolated upwellings of nutrient-rich water at the Abrolhos

Islands would have profound effects on the structure and function of marine communities. Pearce (1997) provided evidence that such events do sporadically occur on time scales of two to four days, but more information is needed to confirm this.

2.2 Biological Environment

2.2.1 Terrestrial Environment

The Abrolhos Islands have been separated from the continental mainland for thousands of years. During this time, the flora and fauna of the islands have developed independently of the mainland, and contain a number of important features.

2.2.1.1 Flora

Mangroves are plants which have adapted to survive in the upper portions of the intertidal zone where their roots, trunks and at least a portion of their leaves are periodically immersed in seawater during high tide. The immersed portions of the plants are then exposed to the air on the following low tide. Mangroves live in protected areas such as bays and estuaries, where there is protection from the erosion caused by waves and tidal currents in more exposed areas.

Mangroves are diverse and extensive along the northern coastline of Western Australia, but the diversity and extent of mangroves decrease with increasing latitude. Small populations of one mangrove species, *Avicennia marina*, occur in the Abrolhos Islands. These populations are important as they are the only mangroves between the extensive forests found along the eastern shore of Shark Bay and a small stand which survives in the Leschenault Inlet at Bunbury.

Mangroves provide an important source of primary production for marine food chains and are a source of habitat for birds, such as the lesser noddy, marine invertebrates and fish.

Atriplex cinerea dwarf shrublands occur on both sandy soils and shellgrit in the Abrolhos, also growing on deeper soils, where burrowing birds such as shearwaters and petrels build nests.

Saltbush flats are common on islands such as North Island and West Wallabi Island, but have limited populations elsewhere in the Abrolhos Islands.

All native terrestrial flora in the Abrolhos Islands is protected under the *Wildlife Conservation Act 1950*.

2.2.1.2 Terrestrial Fauna

Birds are the most important terrestrial animal group in the Abrolhos Islands, with the islands being recognised as one of the most important breeding areas for seabirds in Australia. The major features of bird populations in the islands are:

- The Abrolhos has the largest breeding colonies in Western Australia of a number of species, including the wedge-tailed shearwater, little shearwater, white-faced storm petrel, common noddy, lesser noddy,

Caspian tern, crested tern, roseate tern, and fairy tern. The islands are also important breeding areas for several other species: eastern reef heron, Pacific gull, bridled tern, white-breasted sea eagle and osprey. The mainland populations of many of these species are declining.

- The red-tailed tropic bird and lesser noddy have been identified as rare, likely to become extinct, or in need of special protection under the *Wildlife Conservation Act 1950*. The red-tailed tropic bird previously nested in the islands but no longer does so.
- The only Western Australian breeding colony of the lesser noddy occurs in the Abrolhos Islands. The Abrolhos population is recognised as an endemic subspecies.
- The painted button-quail is also recognised as an endemic subspecies.

Two indigenous mammals are found in the Abrolhos Islands: the tammar wallaby (*Macropus eugenii*) and the bush rat (*Rattus fuscipes*). The two species have been restricted to East and West Wallabi Islands. The tammar wallaby has recently been re-established at North Island.

Twenty-six species of reptiles have been recorded from the Abrolhos Islands, 22 of which occur in the Wallabi Group. The spiny-tailed skink (*Ergenia stokes stokes*) and the carpet python (*Morelia spilota imbricata*) have been identified as rare or otherwise in need of protection.

All native terrestrial fauna in the Abrolhos Islands are protected under the *Wildlife Conservation Act 1950*.

2.2.2 Marine Environment

As indicated in Section 1.1, the Abrolhos Islands are located near the northern end of the west coast overlap zone, where tropical marine species dominate but significant numbers of temperate species occur. Western Australian endemic species in the Abrolhos Islands can be significant commercially (western rock lobster, *Panulirus cygnus* and the Westralian dhufish *Glaucosoma hebraicum*) or ecologically important (western rock lobster and the turban snail *Turbo intercostalis*).

The marine system contains a considerable development of high latitude coral reefs, the southernmost in the Indian Ocean, but also has extensive growths of temperate macroalgae such as kelp. The combination of tropical, temperate and WA marine species makes the Abrolhos Islands a unique area, with considerable scientific value.

2.2.2.1 Macroalgae

Marine macroalgae – the seaweeds – occur extensively in the Abrolhos Islands. These plants require a hard substrate for attachment. The Abrolhos Islands are unusual due to a large temperate species of kelp (*Ecklonia radiata*) found growing among tropical species of corals.

Macroalgae are one of the three key primary producer groups in the benthic marine environment of the Abrolhos Islands. The plants may be consumed directly by animals or, alternatively, after they are detached from the bottom, the plants are broken down by a combination of physical and biological actions and form the basis of marine foodwebs (being consumed by animals which are in turn eaten by species higher up the food chains). A recent compilation (Huisman, 1997) recorded 260 species of macroalgae in the Abrolhos Islands.

2.2.2.2 Seagrasses

Compared to macroalgae, seagrass meadows occupy a much smaller area of the Abrolhos Islands. Seagrasses are marine flowering plants, or angiosperms, which grow in protected, shallow coastal areas. Approximately 50 species are known worldwide, a third of which occur in Western Australia.

Unlike macroalgae, seagrasses have a root system that allows them to grow in sandy areas. The plants have a very high productivity and constitute a key source of primary production in the Western Australian marine environment.

Few animals feed directly on seagrasses. Instead, as the leaves are shed, or the plants die, they are broken down by a combination of physical and biological factors, as happens with macroalgae.

The resulting detritus forms the basis of a detrital foodweb, being consumed by animals which are, in turn, eaten by other animals. The decomposing plant material is moved about extensively by winds and waves, providing a food source for animals which may be some distance from where the plants grew.

Seagrass communities provide habitat to a rich variety of invertebrates and fish. They are known to be a nursery area for juvenile rock lobsters (Chittleborough, 1976; Joll and Phillips, 1984).

Ten species of seagrasses have been recorded from the Abrolhos Islands (Brearley, 1997). The most obvious are species of *Posidonia* and *Amphibolis* which occur in shallow water and form dense meadows. Other seagrasses, such as *Halodule*, are small, delicate species which do not form large beds.

2.2.2.3 Corals

Although they are animals, corals also play a major role in primary production. Their tissues harbour substantial numbers of symbiotic single-celled algal species known as zooxanthellae, which have a complex relationship with the corals. The corals provide protection and nutrients to the zooxanthellae, while the zooxanthellae in turn provide nutrition and oxygen to the corals. Giant clams have a similar relationship with zooxanthellae (*Tridacna* species).

Despite the high latitude at which the Abrolhos Islands is located, the coral fauna is diverse, with 201 species of hermatypic, or reef building, corals and 10 species of ahermatypic corals having been recorded. All but two of the corals are tropical species (Veron and Marsh, 1988).

Extensive coral development occurs in the Abrolhos Islands, particularly on reef slopes, shallow reef perimeters and the sheltered northern and eastern sides of the three island groups (Wilson and Marsh, 1977). The corals can be overgrown by macroalgae, but populations of the macroalgae are controlled by herbivorous fish (Hatcher *et al.*, 1988).

2.2.2.4 Other Benthic Invertebrates

Molluscs (492 species; Wells and Bryce, 1997), echinoderms (172 species; Marsh, 1994) and crustaceans (no numbers available) are all diverse in the Abrolhos Islands and occur in all the marine habitats. A complex mixture of tropical, temperate and Western Australian endemic species occurs in all three groups. In contrast, most of the 37 species of hydroids recorded from the islands are temperate species (Watson, 1997).

Sponges, soft corals and gorgonians are also diverse and abundant in the Abrolhos Islands, but have not been studied in detail. Species of these groups may be ecologically important and provide a vertical relief that can be colonised by other animals. It is believed that many of the sponges are unique to the islands.

2.2.2.5 Fish

A total of 389 species of fishes have been recorded from the Abrolhos Islands (Hutchins, 1997a). As with other species groups, tropical species dominate, but substantial numbers of temperate and endemic species are also present.

Populations of large fish, particularly coral trout and baldchin groper, are significant and large individuals are frequently seen.

Many of the tropical species at the Abrolhos Islands apparently do not spawn there. Instead, larvae are carried from areas further to the north such as Shark Bay or North West Cape by the Leeuwin Current. The larvae settle in the Abrolhos Islands as juveniles and may eventually become adults. The populations are dependent on a constant influx of larvae from the north (Hutchins, 1997a).

2.2.2.6 Marine Mammals

Striped, common and bottlenose dolphins and Australian sea-lions occur in the islands throughout the year. Humpback whales move through the region on their annual migrations between April and October and can sometimes be seen in the lagoons.

2.2.2.7 Reptiles

Green turtles are the most abundant turtles in the Abrolhos Islands. They are not known to breed in the islands. No resident populations of seasnakes occur in the islands, but occasional individuals are found which have been carried southwards by the Leeuwin Current.

2.3 Social Features

The Abrolhos Islands are a unique part of Australia's heritage, a feature recognised in *Management of the Houtman Abrolhos System* (Fisheries WA, 1998). The primary heritage interest lies in historic shipwrecks, guano mining and the rock lobster industry.

2.3.1 Historic Shipwrecks

Historic shipwrecks and their associated land sites are the most important part of the cultural heritage of the Abrolhos Islands. Two of the shipwrecks, *Batavia* (1629), on Morning Reef near Beacon Island, and *Zeewijk* (1727), near Gun Island, were Dutch East Indiamen.

These and associated land sites on nearby islands are protected under the Western Australian *Maritime Archaeology Act 1973* and the Commonwealth *Historic Shipwrecks Act 1976*. The wrecks of the *Ocean Queen* (1842), *Hadda* (1877), *Ben Leddi* (1879), and *Marten* (1879) are also protected under both acts. The wreck of the *Windsor* (1908) is protected only under the Commonwealth Act, since it occurred after 1900.

2.3.2 Guano Mining

Small-scale guano mining probably started in the Pelsaert Group in about 1847, but it was not until 1883 that large-scale mining occurred. Rat Island, Gun Island, part of Pelsaert Island, and several other islands were mined extensively until the 1920s when chemical fertilisers replaced guano.

An attempt was made to resurrect the industry during World War II when supplies of guano were short, but this stopped shortly after the war. A number of sites in the Abrolhos Islands are listed as being of heritage interest by Green and Stanbury (1988) and Stanbury (1993).

2.3.3 Other Historic Sites

Some of the fishermen's huts in the Abrolhos are recognised as having heritage value, as being representative of the way in which the rock lobster industry has evolved.

2.4 Conservation Importance of the Abrolhos Islands

The importance of the marine and terrestrial environments of the Abrolhos Islands has long been recognised. The uninhabited islands and portions of the inhabited islands are a Class A reserve (No. A20253) vested in the Minister for Fisheries for "*conservation of flora and fauna, tourism and for purposes associated with the fishing industry.*"

In 1994, CALM examined the entire coastline of WA to determine areas that should be further considered for conservation as marine parks and reserves. Of the 72 areas recommended, the Abrolhos Islands were ranked as the most important area in WA (CALM, 1994).

Reef Observation Areas were established in several areas of the Abrolhos Islands by the then Fisheries Department in 1995, one in each island group.

The new *Fish Resources Management Act (1994)* established an Abrolhos Islands Management Advisory Committee (AIMAC) to provide advice on the management of the Islands to the Minister for Fisheries. In 1998, the finalised plan *Management of the Houtman Abrolhos System* (Fisheries Management Paper No. 117 – Fisheries WA, 1998) was released by the Minister.

The plan called for the marine waters surrounding the islands to be declared a Fish Habitat Protection Area, which was done in February 1999. Management arrangements will be put into place to protect important conservation areas within the Abrolhos Fish Habitat Protection Area.



Section 3

Other Human Uses of the Abrolhos Islands

3.1 Fishing

Commercial fishing is the main industry in the Abrolhos Islands. Three major commercial fisheries operate in the islands for rock lobster, scallops and finfish.

3.1.1 Rock lobster

The western rock lobster, *Panulirus cygnus*, is Australia's largest single species fishery with a 10 year average catch of around 10,800 tonnes.

The fishery for western rock lobster extends along the west coast of the State, between Cape Leeuwin and Shark Bay. The Houtman Abrolhos Islands is one of the key areas of the fishery, with 15 per cent of the catch originating in the islands during the season, which extends from 15 March to 30 June. The average annual Abrolhos Islands catch is worth around \$45 million.

In contrast to animals along the continental coastline, lobster populations in the Abrolhos Islands mature before they reach the minimum legal size. Partly because of this, the Abrolhos Islands is the key area for production of rock lobster larvae, and it has been estimated that 50-80 per cent of the total reproductive effort in WA of rock lobsters comes from the islands.

One hundred forty-eight rock lobster fishers have an A-zone endorsement on their licence that allows them to fish in the Abrolhos Islands. Camps are maintained on 22 of the islands for this purpose.

The camps are spread over the entire range of the Abrolhos Islands, from Pelsaert Group to North Island. A substantial infrastructure of camps is maintained, with some 1,200 separate buildings, jetties, moorings, and other facilities.

Separate carrier boats operate to each Abrolhos island group during the season, ferrying supplies from Geraldton to the Abrolhos Islands and returning with the catch of live rock lobsters. During the season, an estimated 900 people associated with the rock lobster industry live on the islands.

Fishers catching other species in the Abrolhos Islands are not permitted to maintain camps.

3.1.2 Scallops

Scallops are filter-feeding bivalve molluscs. They live on sandy bottoms and their population densities fluctuate considerably from year to year. The Western Australian fishery for the saucer scallop, *Amusium balloti*, is centred in Shark Bay, but the Abrolhos is an important secondary portion of the fishery.

The scallop fishery is the second most important fishery in the Abrolhos Islands, though it is well behind the rock lobster fishery in dollar value.

Catches of scallops vary considerably on a worldwide basis, and the Arolhos fishery is no exception. The total Western Australian catch in the last 15 years has fluctuated between 10 and 500 tonnes. In 1994, a good year, the Arolhos catch was worth \$3 million.

In the Arolhos Islands, scallops are fished primarily in the channels between the island groups.

3.1.3 Finfish

Finfish fishing in the Arolhos Islands declined as the rock lobster fishery developed and increased in value. In 1995, 16 boats obtained a major portion of their catch in the Arolhos Islands. The total value of the finfish fishery was approximately \$1 million.

Finfishing in the Arolhos Islands is primarily by hook and line, and reef species are targeted, including pink snapper (*Pagrus auratus*), baldchin groper (*Choerodon rubescens*), Westralian dhufish (*Glaucosoma hebraicum*), and coral trout (*Plectropomus leopardus*).

3.2 Aquaculture

Two licences for growing blacklip pearl oysters (*Pinctada margaritifera*) are currently operated in the Pelsaert Group.

There are currently four applications for new aquaculture licences in the Arolhos Islands for blacklip pearl oysters lodged with Fisheries WA (Figures 2-4). These applications have undergone a full public consultation process in accordance with Ministerial Policy Guideline No. 8.

This policy guideline provides a comprehensive consultation process and defines a timeframe in which the applications should be assessed. However, the Minister for Fisheries has requested the Executive Director of Fisheries WA, within the limits of administrative law, to manage the determination of new application licences in light of responses received to the draft aquaculture plan.

3.3 Tourism

In recent years, tourism in the Arolhos Islands has increased substantially, both through private visits to the islands and commercial tourism ventures, which operate charter boat tours of the islands. No data are available on the numbers of visitors to the islands in either category.

AIMAC and Fisheries WA commissioned the development of a draft *Management Plan for Sustainable Tourism in the Arolhos Islands* (Fisheries Management Paper No. 120 – LDM, 1997); the plan was released by the Minister for Fisheries for public comment in December 1998. The plan is expected to be finalised in early 2000. Table 3 summarises the proposals in the plan. It is likely that tourism in the Arolhos Islands will increase significantly.

Table 3 Strategies for the immediate and long-term development of tourism in the Abrolhos Islands

Tourism type	Period	Strategy
Independent	Immediate	<p>Collect data on tourism – ‘where’, ‘when’, ‘how’ and numbers of people.</p> <p>Provide more information on attractions in the islands and areas to avoid.</p> <p>Encourage visitors to utilise core areas by zoning and provision of facilities.</p> <p>Avoid conflict between nature conservation, private tourism, and fishers.</p> <p>Provision of moorings which can be rented through Fisheries WA.</p> <p>Access to East Wallabi jetty for private flights.</p>
	Medium-term	Progressively provide more facilities and control access to sensitive areas.
Commercial	Immediate	<p>Any tourism must be ecologically and economically sustainable.</p> <p>Consider the development in each group of tourist ventures.</p> <p>Provide access to the airstrips on East Wallabi and Rat Islands.</p> <p>Provide for establishment of common moorings.</p>
	Medium-term	<p>Any modifications of plans to make them environmentally sensitive do not have to be expensive, but should ‘add’ to the Houtman Abrolhos.</p> <p>Possible mixing of fishers and tourism.</p> <p>Any tourism development should use ‘best practice’ techniques.</p> <p>Permanent mooring facility near Leo’s Island.</p> <p>Assess the possibility of a small, one storey high, quality international level nature-based tourism facility on East Wallabi Island in future, if demand is sufficient.</p> <p>Other options for tourism facilities to be investigated, such as use of a large catamaran from shore.</p>

* Note: This table is taken from the draft *Management Plan for Sustainable Tourism at the Houtman Abrolhos Islands* (Fisheries Management Paper No. 120)



Section 4 Constraints on Aquaculture Operations in the Abrolhos Islands

The *Management Plan for Sustainable Tourism in the Houtman Abrolhos Islands* (Fisheries Management Paper No. 120 – LDM, 1997) discussed several important physical constraints on operations in the Abrolhos Islands, which are summarised below. In addition, several constraints specific to aquaculture are also discussed.

The successful operation of several fisheries in the Abrolhos Islands, particularly the rock lobster fishery, demonstrates that these obstacles can be overcome, but the constraints add significantly to the costs of operations in the islands.

4.1 Terrestrial Environment

The fragile nature of the Abrolhos Islands terrestrial and marine systems is one of the major constraints for aquaculture in the Abrolhos Islands. In particular, many of the islands are susceptible to erosion as they have little or no vegetation cover. One of the key features for aquaculture in the Abrolhos Islands is that it must be in sympathy with the environment and be environmentally sustainable.

The seabird populations of the Abrolhos Islands are of international significance. The colonies are very vulnerable to disturbance, and protecting the colonies has a high environmental value.

Exotic species such as mice and rats have already been introduced to some of the Abrolhos Islands. An eradication programme of rats at Rat Island has been successful. Care must be exercised by all people using the islands so that rats are not re-introduced and mice not be spread to additional islands.

4.2 Marine Environment

4.2.1 Corals

The extensive coral reefs of the Abrolhos Islands have very high conservation values, covering the corals themselves and the rich assemblage of invertebrates and fish that develop with the corals. Corals are an integral part of the Abrolhos system.

There is a full range of coral cover in the Abrolhos Islands, ranging from large reefs with 100 per cent coral cover to isolated coral heads a few centimetres in diameter which are scattered on subtidal limestone platforms.

Aquaculture activities in WA, both in the Abrolhos Islands and elsewhere, must be placed in areas where there are few corals; they cannot be sited in regions of high coral cover.

4.2.2 Seagrasses

Seagrasses are diverse in WA and form extensive beds in many coastal areas. They are one of the keys to primary (plant) production on which the marine ecosystems in south-western Australia are based. For this

reason, and because of losses that have already occurred in WA as a result of human activities, aquaculture activities must be undertaken in a manner that will ensure minimum adverse effects on seagrasses.

Seagrass meadows are very limited in extent in the Abrolhos system, but those that occur are in very shallow water. They should simply be avoided by anyone proposing to carry out aquaculture in the Abrolhos Islands.

4.2.3 Non-endemic species

Endemic species are organisms which occur naturally in an area. Over 1,500 species of fish, marine invertebrates and plants have been recorded from the waters surrounding the islands and there are undoubtedly many more that have not yet been recorded. Many of the WA marine species that have been considered for aquaculture occur naturally in the Abrolhos Islands, but some do not.

Introducing a non-endemic species to the islands presents potential risks to the high conservation values of the system. There are instances of species being brought into an area for aquaculture and then escaping and establishing wild populations.

Once a species becomes established in the marine environment, it is very difficult, or impossible, to remove. Additionally, a non-endemic species might introduce pests or parasites.

Aquaculture of a non-endemic species must be undertaken with great care in any marine area of Western Australia, but especially so in an area such as the Abrolhos Islands.

There are species which live on the west coast of WA that are suitable for aquaculture, but which are not known to live in the Abrolhos Islands. These species may in fact have populations in the Abrolhos Islands which have not yet been found, or the species' larvae may simply not have reached the islands, or some aspect of the marine environment of the Abrolhos Islands makes the region unsuitable for wild populations of them.

4.3 Water

No known sources of fresh water exist on the islands. The coral shingle and limestone base present on most of the islands means little, if any, fresh water will be trapped as ground water. While it is possible that fresh (or brackish) ground water exists on the larger, continental islands, the amount present would be small and it would probably not be environmentally acceptable to utilise it for human consumption.

Almost all of the water used on the Abrolhos Islands comes from rain water. The mean rainfall of 469 mm per year is gathered from the roofs of huts and stored in water tanks. Normal precautions in collecting and using water from this source must be observed. The roofs must be cleaned periodically of bird droppings and storage tanks must be maintained in good condition.

Rainfall is seasonal, with the great majority falling during the winter; little replenishment occurs over the summer, but aquaculture would probably be undertaken on a year-round basis. This problem is not unique to the Abrolhos Islands, and is faced by many coastal settlements in Western Australia, so it can be managed.

A third possibility for supplementing freshwater supplies is desalination. This is an attractive option in an area such as WA where coastal water supplies are limited. Many boats operating in WA already use desalination for at least part of their water supplies.

4.4 Weather

One of the key constraints for any operations in the Abrolhos Islands is the weather. The low-lying islands are very exposed, and offer little natural shelter from the winds and rain. The open crossing of over 60 km from the mainland to the islands can be very rough, and is uncomfortable to many people on all but the calmest of days.

4.5 Sanitary Waste Disposal

The hard limestone base of most of the Abrolhos Islands does not allow the installation and use of septic tanks. Many fishers have toilets along the shore (where the cliff is undercut) or on the ends of jetties, providing direct access to the underlying seawater.

In both cases, raw sewage is released directly into nearshore waters, and no treatment is undertaken. The development of a waste management strategy which produces the most environmentally-acceptable waste management procedure is a key strategy of the management plan for the Abrolhos Islands.

4.6 Infrastructure

Virtually no public infrastructure is available on the Abrolhos Islands. The few facilities that are present have been developed by fishers at their own expense, to support the fishing industry. All the jetties, with exception of the public jetty on East Wallabi Island, are privately owned, either by individual fishers or small groups. No medical facilities exist except for a Silver Chain nursing station on Rat Island, which operates only during the fishing season. No conventional navigational aids have been installed, though informal markers by fishers have been developed. A seaphone service is available, but there are no land or public satellite lines.

Airstrips on the islands were built and maintained by fishers with permission from the Minister for Fisheries. In 1996, the airstrips were upgraded with substantial financial assistance from the State Government.

The East Wallabi Island airstrip has most recently been upgraded, with toilet facilities and a waiting area for passengers now provided. A parking area for four aircraft has also been constructed.

4.7 Existing Uses

While the Abrolhos Islands is in many ways an isolated area with substantial problems in gaining access, it is already extensively utilised by the commercial fishing industry, primarily for western rock lobster. There is a small, but growing, commercial tourism industry using the islands, and many recreational visitors visit the islands.

The developing aquaculture industry is therefore not 'opening a new area' where there are no existing users, and aquaculture ventures must be sited and developed in harmony with existing uses of the area.



Section 5

Management Structure

As indicated in section 2.4 of this document, uninhabited islands and portions of inhabited islands are a Class A reserve (No. A20253) vested in the Minister for Fisheries for conservation of flora and fauna, tourism and for purposes associated with the fishing industry. The Minister also has responsibility for the State Territorial Waters surrounding the islands.

The draft *Management of the Houtman Abrolhos System* (Fisheries Management Paper No. 104 – Fisheries WA, 1997a) issued by the Minister in December 1997 outlined in detail proposed management arrangements for the Abrolhos Islands. Following an extensive period of comment, the Minister released the final plan *Management of the Houtman Abrolhos System* (Fisheries Management Paper No. 117 – Fisheries WA, 1998).

Implementation of the management will be the responsibility of the proposed Abrolhos Islands Management Authority, which will be formally established under section 122 of the *Fish Resources Management Act 1994*. In the interim, the islands will continue to be managed by Fisheries WA, with input and advice from the Abrolhos Islands Management Advisory Committee.

5.1 Fisheries Western Australia

Fisheries WA, operating under the *Fish Resources Management Act 1994*, is the lead management agency in the Abrolhos Islands. The relevant objectives of the *Fish Resources Management Act 1994* include:

- to conserve fish and protect their environment; and
- to enable management of fish habitat protection areas and manage the Abrolhos Islands reserve.

Under section 11 of the Act, Fisheries WA may regulate to manage the Abrolhos Islands.

Fisheries WA maintains operations in the Abrolhos Islands throughout the year, with increased activity during the rock lobster season of 15 March to 30 June. To fulfil its commitments in the Abrolhos Islands, Fisheries WA has the following facilities available:

- a 20 metre patrol vessel;
- an 11 metre jet boat;
- four camps in different areas of the Abrolhos Islands; and
- staff at the Geraldton District Office.

5.2 Abrolhos Islands Management Advisory Committee

Under section 42 of the *Fish Resources Management Act 1994*, the Minister for Fisheries established the Abrolhos Islands Management Advisory Committee (AIMAC) to provide information and advice to the Minister about all aspects of management of the Abrolhos Islands, including:

- the management of all fish and fisheries within the Abrolhos Islands;
- the management of the Abrolhos Islands for activities related to fishing, conservation and nature-based tourism;
- appropriate development of, and access to, the Abrolhos Islands;
- the impact on the Abrolhos Islands of proposed aquaculture developments;
- any plan of management for the Abrolhos Islands;
- how to promote public understanding, knowledge and appreciation of the natural and cultural resources of the Abrolhos Islands and the conservation of those resources;
- a consultative process which ensures the community, State and local government agencies and tertiary institutions have an ongoing involvement in the planning for and management of the Abrolhos Islands; and
- a consultative process with other regulatory bodies concerned with fishing and other relevant activities within the Abrolhos Islands, including the Rock Lobster Industry Advisory Committee, Western Australian Fishing Industry Council, Recreational Fishing Advisory Committee, and Recfishwest.

5.3 Abrolhos Islands Land Management Sub-committee (AILMSC)

The Abrolhos Islands Land Management Sub-committee was established by AIMAC to advise on the management of fisher-inhabited islands. The sub-committee is chaired by AIMAC and has two representatives from each island group, including North Island. It is currently being expanded to include representatives from the tourism industry. AILMSC reports directly to AIMAC. The sub-committee's terms of reference are to:

- identify issues relevant to the seasonal habitation of the Abrolhos Islands by rock lobster fishers;
- advise the Minister for Fisheries through the Abrolhos Islands Management Advisory Committee (AIMAC) on matters relating to the management of the Abrolhos Islands Reserve and the State Territorial Waters, as they relate to the Western Australian rock lobster industry;
- advise the Minister for Fisheries through the Rock Lobster Industry Advisory Committee (RLIAC) on matters relating to the Abrolhos Islands and rock lobster fishing in the State Territorial Waters of the Abrolhos Islands on which the advice of the sub-committee is sought by the Minister;
- advise the Minister for Fisheries through AIMAC on matters relating to the maintenance and improvement of the Abrolhos marine and terrestrial environments;
- develop mechanisms to assist the resolution of community or infrastructure-related disputes that may arise on the fisher-occupied islands;
- assist Fisheries WA and other relevant State agencies to develop minimum standards for buildings, jetties, moorings, waste disposal, public facilities, utilities, and power generation;

- determine arrangements for emergency management procedures for the Abrolhos Islands as part of the Geraldton-Greenough Local Emergency Management Plan;
- assist in the management of heritage/historic sites if required;
- liaise with and advise Fisheries WA staff on issues relating to the *Fish Resources Management Regulations 1995*, Part 9, Abrolhos Islands Reserve; and
- review the *Abrolhos Islands Regulations (1995)* which govern the use of occupied islands by fishers.

5.4 Other Agencies and Relevant Acts

Other State agencies with legislative responsibilities at the Abrolhos Islands are the Department of Conservation and Land Management, the Western Australian Museum, the Department of Transport, the Department of Minerals and Energy and the Department of Environmental Protection.

The **Department of Conservation and Land Management (CALM)** administers the *Wildlife Conservation Act and Regulations (1980)*, which aims to conserve Western Australia's native flora and fauna. In the Abrolhos Islands, these responsibilities are primarily for the native flora and fauna on the islands, including seabirds, marine mammals and reptiles. CALM also administers the recent *Acts Amendment (Marine Reserves) Act 1997*, which provides for the establishment and management of marine reserves.

The **Western Australian Museum**, through the Western Australian Maritime Museum, administers the State's *Maritime Archaeology Act (1973)* and the *Commonwealth Historic Shipwrecks Act (1976)*.

The **Department of Transport** administers the *Western Australian Marine Act (1982)*, and, as such, has responsibility for ensuring the safety of all vessels in State Territorial Waters, including the administration of moorings.

The **Western Australian Department of Minerals and Energy**, through the *Petroleum Act (1967)* and the *Western Australian Petroleum (Submerged Lands) Act (1982)*, has the responsibility of overseeing the petroleum industry and is the body which handles permit applications for oil and gas surveys on or adjacent to the Abrolhos Islands.

The **Environmental Protection Authority (EPA)** was established under the *Environmental Protection Act (1986)* to provide advice on environmental matters to the Minister for the Environment. The Department of Environmental Protection provides advice and support to the EPA. Division IV of the Act outlines the process by which development applications may be referred to the EPA for environmental impact assessment.

The **Western Australian Police Service** administers a number of acts, in particular the *Police Act 1892*, and is the lead agency in the Abrolhos Islands for emergency procedures, especially the Abrolhos Islands Tropical Cyclone Plan.

5.5 Register of the National Estate

The Australian Heritage Commission Act 1975 defines the Register of the National Estate as:

“those places being components of the natural environment of Australia, that have aesthetic, historic, scientific or social significance or other special values for future generations as well as the present community.”

The portions of the Abrolhos Islands above the low water mark were listed in the Register of the National Estate in 1978 and an interim listing of the marine areas surrounding the Abrolhos Islands was made in 1997. The listings do not necessarily restrict use of a site, rather the listing serves as an alerting device so that places of heritage value are not inadvertently destroyed or degraded.

5.6 Management of the Houtman Abrolhos System

As one of its first activities, the Abrolhos Islands Management Advisory Committee developed a draft management plan for the Abrolhos Islands, *Management of the Houtman Abrolhos System* (Fisheries Management Paper No. 104 – Fisheries WA, 1997a). The plan has now been finalised and released by the Minister for Fisheries (Fisheries Management Paper No. 117 – Fisheries WA, 1998). The role of AIMAC in the implementation of the plan will be superseded once the Abrolhos Islands Management Authority is established.

The management plan provides a comprehensive outline of management policies and strategies for maintaining the unique features of the natural and cultural environment of the islands and using them rationally. The plan (p. 83) makes the following statement regarding the possible use of the Abrolhos Islands for aquaculture:

“The State Government has recently initiated a major program of developing aquaculture throughout the State to provide an additional industry and source of high quality food for the local and export markets. The clean, pristine waters of the Abrolhos Islands offer potential for development of aquaculture for a variety of high value species. Limited studies of pearl oysters have already commenced.

“It is apparent that some types of aquaculture operating in other parts of the world can have an adverse environmental impact. Before further aquaculture is undertaken in the Abrolhos Islands, appropriate examination of potential impacts – both beneficial and adverse – must be undertaken. All aquaculture proposals will also be subject to the established Statewide consultative arrangements outlined in Ministerial Policy Guideline No. 8.

“Land-based infrastructure for use in aquaculture projects will only be considered on islands which are already inhabited.”

The management plan also includes the following strategies in relation to aquaculture:

- Ensure any non-endemic species considered for aquaculture at the Abrolhos Islands undergo adequate risk assessment in accordance with established translocation protocols.
- Ensure all aquaculture proposals for the Abrolhos Islands undergo adequate environmental impact assessment in accordance with DEP/EPA processes.
- Identify suitable areas within each Abrolhos Island group where aquaculture projects may be established.
- Develop an aquaculture plan for the Abrolhos Islands which is consistent with the intrinsic values and uses of the area.

It should be noted that *Management of the Houtman Abrolhos System* is an overall plan for the management of the islands that sets out goals and strategies. The basic mechanism for protecting the Abrolhos Islands marine system is the declaration of a Fish Habitat Protection Area (FHPA) under the *Fish Resources Management Act (1994)* for all State Territorial Waters of the Houtman Abrolhos Islands. Any proposals for aquaculture in the islands must be consistent not only with the overall management plan, but also with the Fish Habitat Protection Area and management regulations currently being developed.

In addition, in 1997 AIMAC commissioned a draft *Management Plan for Sustainable Tourism at the Houtman Abrolhos Islands, Western Australia* (LDM, 1997). The draft plan was made available for public comment in December 1998 (as Fisheries Management Paper No. 120). It is expected that a final plan will be released in early 2000.

5.7 Reef Observation Areas

A major development in managing the marine system of the Abrolhos Islands occurred in 1994 with the introduction of Reef Observation Areas (ROAs), with one ROA being declared in each island group, including North Island.

Except for the use of rock lobster pots, fishing by both recreational and commercial fishers was prohibited in the ROAs. The ROAs were developed to provide areas where finfish populations could recover towards their original state, and areas where divers could observe large fish that were not frightened by their approach.

It is also expected that, as populations of fish in the ROAs increase, some individual fish will be forced by increasing population pressures to move into adjacent areas outside the ROA where they can be fished. The increasing numbers of large fish within the ROAs will produce substantial amounts of eggs, as the number of eggs produced by an individual typically increases exponentially with size.

The Reef Observation Areas are (Figures 2-4):

- North Island ROA: off the southern end of North Island;
- Wallabi Group: Beacon Island ROA: the Beacon Island platform and coral bombies off the northern end of Long Island;
- Easter Group: Leo's Island ROA: surrounds Leo's Island, White Island and Bynoe Island; and
- Pelsaert Group: Coral Patch ROA: the coral patch area in the eastern part of Pelsaert Group.



Section 6

The Aquaculture Plan

6.1 Objective of the Aquaculture Plan

The objective of the aquaculture plan is to:

Provide a sound basis for developing future aquaculture activities in the Abrolhos Islands, while at the same time conserving the unique environment of the islands for present and future generations, and minimising conflict between aquaculture and existing and future users of the islands.

6.2 Underlying Assumptions

As has been discussed in the above sections, aquaculture in the Abrolhos Islands is being proposed in an environment where there are considerable natural and social heritage values and existing fishing and tourism industries. These values and uses impose a set of pre-existing commitments within which the aquaculture plan must be developed, including:

6.2.1 Management of the Houtman Abrolhos Systems

Goal: To ensure future aquaculture activities are consistent with the overall management plan for the Houtman Abrolhos Islands.

Management of the Houtman Abrolhos System (Fisheries Management Paper No. 117 – Fisheries WA, 1998) is the overall management plan for the Abrolhos Islands. Any proposals made in the aquaculture plan for the Abrolhos Islands must be consistent with the overall plan.

Management of the Houtman Abrolhos System imposes a number of constraints on aquaculture and other human activities in the Abrolhos Islands, in order to protect the high environmental and cultural values of the archipelago.

One of the key decisions in the plan is that land-based infrastructure for use in aquaculture projects must be restricted to islands or parts of islands already used by the fishing industry. Terrestrial space in the islands is limited, and this recommendation was put into place to protect the environment.

The plan advocates sea-based aquaculture for the islands, which formalises the existing nature of Abrolhos Islands aquaculture. Clearly, land facilities such as accommodation, a jetty and storage areas will be needed, but these will be placed on islands already used by the rock lobster industry.

Increasing the use of existing land-based development or any new development to 12 months will increase the potential for adverse environmental impacts. Therefore, extended use of existing facilities should only be considered where effluent and waste disposal is appropriately managed to avoid adverse environmental impacts. All new developments must comply with agreed standards for any development in the Abrolhos

Islands (i.e. using alternate effluent disposal systems currently being investigated such as composting or dry toilets or pumping out effluent and returning to the mainland).

Strategies

Short Term

Recommendation 2

Ensure that the management strategies in the plan, *Management of the Houtman Abrolhos System* (Fisheries Management Paper No. 117 – Fisheries WA, 1998), and future management strategies to protect specific areas, are taken into account when assessing future aquaculture proposals. (FWA)

Recommendation 3

Modify existing management arrangements to allow holders of aquaculture licences in the Abrolhos Islands to purchase, or make use of, existing facilities in the islands if they become vacant, subject to the development of guidelines as to tenure. (FWA)

Recommendation 4

Ensure that the extended use of existing land-based facilities and any new land-based facilities is subject to appropriate licence conditions to protect the environment, including an agreed waste disposal management program consistent with the objectives of the plan *Management of the Houtman Abrolhos System* (Fisheries Management Paper No. 117 – Fisheries WA, 1998). (FWA)

6.2.2. Abrolhos Island Regulations

Goal: To ensure facilities constructed for aquaculture are of a standard consistent with that required of other island users.

The management plan for the Abrolhos system calls for the upgrading of the Abrolhos Island Regulations so all new structures comply with Australian Standards and are consistent with the values of the Abrolhos system.

Development of the commercial rock lobster industry in the Abrolhos Islands occurred largely on an *ad hoc* basis, with many of the initial practices developing as the industry grew rapidly after the end of World War II. In recent years, awareness has developed that some of the practices once permissible are no longer acceptable in a modern society, and activities on the islands have become increasingly formalised. The Abrolhos Island Regulations, introduced in 1995, provide the basis for managing the day-to-day activities on the Islands.

The Abrolhos Island Land Management Sub-committee (AILMSC) provides recommendations to the AIMAC on the Abrolhos Island Regulations. The AILMSC reports to the AIMAC and has representatives of the fishing industry from each island group.

Approval in principle has been given to expanding the AILMSC to include representatives of the tourism industry. It is recommended here that membership in the AILMSC be expanded to include aquaculture interests. If this is done, it is suggested that the AILMSC develop draft regulations concerning the use and storage of chemicals, other hazardous chemicals, boat maintenance and other important issues, so that aquaculture in the Abrolhos Islands is managed in an appropriate manner. These issues are not specific to the management of aquaculture operations, and could also apply to the management of the rock lobster industry.

It is anticipated that new facilities will be required due to the need for large areas to store necessary materials used in aquaculture operations. Under current regulations, existing facilities can only be used by licensed A-zone rock lobster fishers to the exclusion of all others, including other commercial fishers, tourists and aquaculturists. Consideration should be given to the means in which these facilities may be utilised by aquaculturists.

The change in use of these facilities from seasonal (as currently occurs with the rock lobster fishery) to all year round will raise further issues related to the management and maintenance of these structures, and the requirement for other services and infrastructure on the islands.

Moorings and navigational markers in the Abrolhos Islands will be installed under the supervision of Fisheries WA. Preference will be given to permanent moorings that will not 'drag' in heavy seas, causing damage to biota on the sea bottom.

Strategies

Short Term

Recommendation 5

Ensure that:

1. all land-based structures associated with aquaculture activities are consistent with established building standards; and
2. any aquaculture infrastructure placed in the marine environment is approved by the Executive Director, Fisheries WA, until such time as suitable standards for marine infrastructure are developed. *(FWA)*

Recommendation 6

Expand the membership of the Abrolhos Island Land Management Sub-committee to include representation from the aquaculture industry. *(AIMAC/FWA)*

6.3 Species Suitable for Aquaculture in the Abrolhos Islands

6.3.1 Species Selection Criteria

Goal: To develop a list of potential aquaculture species in the Abrolhos Islands which meet all or most of the criteria for aquaculture in the islands.

Four criteria were used to develop a list of potential aquaculture species for the Abrolhos Islands:

- potential species which have already been identified as having aquaculture potential in WA;
- whether the species are cultivated on land or in fresh water;
- species with high-value; and
- species endemic to the Abrolhos Islands

6.3.2 Potential Aquaculture Species in Western Australia

Aquaculture Planning in Western Australia (Fisheries WA, 1997b) contains a list of all species of animals and plants which are cultured, or considered to have a potential for aquaculture, in Western Australia.

6.3.3 Land and Freshwater Species

The absence of fresh water on the islands is an obvious restriction to the culturing of freshwater species. Hence, only species grown in the sea have been considered for aquaculture, although it is recognised that such aquaculture will still require shore-based facilities.

A requirement of *Management of the Houtman Abrolhos System* (Fisheries Management Paper No. 117 – Fisheries WA, 1998) is that any shore-based facilities for aquaculture be placed on islands or portions of islands currently inhabited by fishers.

6.3.4 High Value Species

As described above, the Abrolhos Islands are remote and operating costs in the region are high. Due to the added costs of working in such a locality, only high-value species have been considered for aquaculture.

No objective measure has been found by which to fairly measure the value-status of a species in aquaculture. Therefore, the perceived likelihood of commercial success, with a significant consideration for the current market value of a species, was used as an index of each animal's economic attractiveness as a culture species in an area where considerable competition for resources, including space, can be expected.

6.3.5 Endemic Species

This plan advocates only the use of aquaculture species that occur naturally in the Abrolhos Islands. The introduction of non-endemic species to the islands would come with an acknowledgement of some level of risk, which would seem in contradiction to the purpose for the establishment of the Fish Habitat Protection Area.

However, if a proponent were to apply for an aquaculture licence for non-endemic species in the Abrolhos, Fisheries WA would be obliged to assess the application on its merits, through the Ministerial Policy Guideline No. 8 process. The application would be unlikely to be approved unless the proponent could demonstrate that the introduction of non-endemic species would not cause any adverse environmental impacts and specific approval had been granted from the EPA.

6.3.6 Species with Aquaculture Potential in the Abrolhos Islands

Species considered to have potential for aquaculture in the Abrolhos Islands are shown in Table 1. These are all species endemic to the Abrolhos Islands (Hutchins, 1997a and Wells and Bryce, 1997). The list of fish in Table 1 is only of reef fish; pelagic species occur wherever conditions are suitable and would thus be found in the Abrolhos Islands. It should be noted that this is a broad listing of species currently considered to have potential. More detailed assessment may reduce the list considerably.

One species, the blacklip pearl oyster, satisfies all of the criteria established in the *Draft Management Plan for Aquaculture in the Houtman Abrolhos Islands* (Fisheries WA/Enzer, 1999); it has established production techniques and enough knowledge exists to permit successful aquaculture operations to commence.

The remaining species on the list are considered by aquaculture professionals to have the potential to support a commercially viable aquaculture industry. Such species comply with most of the recommendations contained in the *Management of the Houtman Abrolhos System* (Fisheries WA, 1998) and have a reasonable chance in the future of satisfying any criteria which they do not currently satisfy.

However, in recognition of the sensitive nature of the environment of the Abrolhos Islands, community concerns about the potential impacts of finfish aquaculture in particular, and the current state of finfish production technology, it is proposed that applications for finfish undergo a more stringent environmental assessment process than required for other potential species.

While all aquaculture applications are currently referred to the DEP under the Ministerial Policy Guideline No. 8, it is proposed that Fisheries WA will make a specific recommendation to the DEP that finfish applications be formally assessed by the EPA, in accordance with section 40 of the *Environmental Protection Act 1986*. This will ensure that the potential environmental effects of the aquaculture proposal are fully assessed by the EPA through a rigorous public process.

Table 1 Species with potential for aquaculture in the Abrolhos Islands

Species with potential for aquaculture in the Abrolhos Islands	
Molluscs	Blacklip pearl oyster (<i>Pinctada margaritifera</i>)
	Shark Bay pearl oyster (<i>Pinctada albina</i>)
	Giant clam (<i>Tridacna maxima</i>)
	Rock oyster (<i>Saccostrea</i> sp.)
	Saucer scallop (<i>Amusium balloti</i>)
Crustaceans	Western rock lobster (<i>Panulirus cygnus</i>)
Fish*	Snapper (<i>Pagrus auratus</i>)
	Black bream (<i>Acanthopagrus butcheri</i>)
	Yellowtail kingfish (<i>Seriola lalandi</i>)
	Yellowfin tuna (<i>Thunnus albacares</i>)
	Mahi mahi (<i>Coryphaena hippurus</i>)
	Bar-cheeked coral trout (<i>Plectropomus maculatus</i>)
	Coral trout (<i>Plectropomus</i> spp.)
	Estuary cod (<i>Epinephelus coioides</i>)
	Breaksea cod (<i>Epinephelides armatus</i>)
	Baldchin groper (<i>Choerodon rubescens</i>)
	Westralian dhufish (<i>Glaucosoma hebraicum</i>)
	Tropical snappers (<i>Lutjanus</i> spp.)
	Parrot fishes (Family Labridae, multiple local species)

* Note: Proposals for aquaculture of non filter-feeding species will be subject to a rigorous assessment of the potential environmental impacts. Fisheries WA will forward all applications for such aquaculture to the DEP, with a recommendation that the application be formally assessed by the EPA, in accordance with section 40 of the *Environmental Protection Act 1986*.

6.3.7 Translocation

Translocation is the movement of a species beyond its natural range and/or into areas within its natural range that have genotypes and/or populations that are distinct from the source area. Translocation brings with it the risk of potentially serious impacts such as the introduction of disease or parasites into areas where they previously did not exist; impacts on the genetic diversity of the species; and impacts on the natural environment and biodiversity of endemic species.

The translocation of live non-endemic fish into and within Western Australia requires the written approval or authority of the Executive Director of Fisheries WA, in accordance with Regulation 176 of the *Fish Resources Management Regulations 1995*. Fisheries WA is a signatory to a Memorandum of Understanding with the EPA, which clarifies the arrangements between the two agencies for the environmental assessment of translocation proposals.

Specific translocation protocols have been developed by Fisheries WA to assist the Executive Director when considering translocation requests for silver perch, redclaw crayfish and *Pinctada maxima* pearl oysters. Additional protocols are currently being developed for barramundi, salmonids, *Artemia sp.* and several Murray-Darling finfish species (Australian bass, golden perch and Murray cod).

To maintain the genetic diversity of endemic species used for aquaculture, it is important that aquaculture broodstock used in the Abrolhos Islands either originates from local broodstock or has a similar geotype. Any applications to translocate broodstock which have genotypes distinct from Abrolhos Islands populations must prove that the translocation presents a low risk to the Abrolhos Islands environment.

There is little information available on the genetic structure of the Australian stock of pearl oyster. Research on the genetic structure of the silver lipped pearl oyster (*Pinctada maxima*) has been conducted by Dr John Benzie from the Australian Institute of Marine Science.

Advice from Dr Benzie indicates that there is only minor genetic variation between physically isolated stocks of *P. maxima* from around Australia. This is possibly due to the fact that pearl oysters are broadcast spawners and have a larval period of 2-3 weeks, in which larvae may be carried some distance on ocean currents. Dr Benzie indicates that it is likely that this situation would also occur with the blacklip pearl oyster *P. margaritifera*.

Given this information, it is considered that the translocation of blacklip pearl oyster represents a low risk to the Abrolhos Islands environment and it is likely that there would be little, if any, impact, if aquaculture licence holders were permitted to farm oyster spat that originate from broodstock captured from areas outside of the Abrolhos Islands.

Strategies

Short Term

Recommendation 7

Accept species listed in Table 1 as potential species for aquaculture in the Abrolhos Islands, noting that any applications for non filter-feeding species will be referred by Fisheries WA to the DEP with a recommendation that the application be formally assessed by the EPA, in accordance with section 40 of the *Environmental Protection Act 1986*. (FWA/proponents/EPA)

Medium Term

Recommendation 8

Consider applications for endemic species not listed in Table 1 on an individual case basis when a proponent lodges an application for a licence for their aquaculture in the Abrolhos Islands. (FWA)

Recommendation 9

Prohibit aquaculture of non-endemic species in the Abrolhos Islands, unless specific approval has been granted by the EPA. (FWA/EPA)

Recommendation 10

Ensure that broodstock for aquaculture species listed in Table 1 either originates from the Abrolhos or have similar genotypes. If broodstock for shellfish and finfish, with the exception of blacklip pearl oyster, does not originate from the Abrolhos and have genotypes distinct from Abrolhos populations, ensure that the translocation of the species is subject to Fisheries WA's translocation protocol. (FWA)

Recommendation 11

Allow broodstock for the aquaculture of blacklip pearl oysters in the Abrolhos Islands to be sourced from the Shark Bay area. (FWA)

6.3.8 Characteristics of Individual Species

6.3.8.1 Molluscs

Pearl culture using *Pinctada margaritifera* is generally acknowledged as having potential for profitable aquaculture in WA based on information from the black pearl industry in the Central Pacific. However, it should be noted that no significant commercial pearl production has yet occurred in WA using *P. margaritifera*, and that the commercial viability of pearl production in WA from that species is currently being assessed.

Pearl culture using *Pinctada albina* enjoys a relatively low popularity in WA compared with that using other species of pearl oyster. Absence of adequate information on the viability of this species makes the

justification of the inclusion of the *P. albina* in the list of preferred species for the Abrolhos Islands difficult. It has been included at this stage due to the existence of a number of licence holders in WA waters, but further information on the commercial viability of pearl production from *P. albina* is required.

Giant clam culture using *Tridacna maxima* is currently being trialled at the Cocos (Keeling) Islands. The inclusion of *T. maxima* is based on the reported high values of its flesh. As with pearl oysters, the technical aspects of clam farming appear to be understood, but the commercial viability of clam production in WA remains to be determined.

The culture of edible oysters, probably growing species of *Saccostrea*, (although other genera and species exist at the Abrolhos Islands) is considered likely to be a commercially viable industry, based on observations of edible oyster industries in other Australian states.

6.3.8.2 Finish

Pink snapper (*Pagrus auratus*) are farmed commercially near Jurien and are included as candidates at this stage due to reported viability of their culture.

Black bream (*Acanthopagrus butcheri*) are currently cultured in a number of locations in WA, including at marine sites at Fremantle and near Jurien.

The potential for this species to satisfy all of the criteria to permit culture at the Abrolhos Islands requires further investigation.

The culture of mahi mahi (*Coryphaena hippurus*) and yellowtail kingfish (*Seriola lalandi*) has been demonstrated to be technically feasible overseas, but the market value of the products and commercial viability of their culture remains to be demonstrated in Australia.

The ranching of yellowfin tuna (*Thunnus albacares*) may be proved feasible, based on the success of the South Australian Southern Bluefin Tuna (SBT) industry. All of the major technical criteria are satisfied by this species, but no information can be found on their commercial production. The market value of yellowfin tuna is known to be below that of the SBT, but is high enough to warrant consideration.

The remaining marine finfish listed as candidates for aquaculture at the Abrolhos Islands are included primarily due to their *perceived* potential, particularly for export as live fish, while technical success in their culture has still not been achieved. The perceived likelihood of technical success and the market value for wild-caught specimens makes them attractive species for aquaculture generally, and their satisfying of the other prerequisites for aquaculture at the Abrolhos Islands helps them to qualify for inclusion.

6.3.8.3 Crustaceans

The aquaculture of western rock lobster (*Panulirus cygnus*) is not currently practised in WA and it is likely to be a number of years before it occurs. It is reasonable to expect that medium-to-long term storage of rock lobsters will occur well before the aquaculture of this species. As one of the most valuable of all marine species in Western Australia, the western rock lobster deserves inclusion in the list of candidates for aquaculture at this stage, despite the likelihood of a long period elapsing before technical success in its culture is achieved.

6.3.8.4 Other Species

The above list is not exhaustive. New species that have not been previously found at the Abrolhos Islands may be discovered in the area in the future. If this is the case, subject to the species satisfying the other criteria for aquaculture, they should be assessed on their own merits.

Similarly, the development of new, more valuable markets for some of the aforementioned species, and other species excluded on the basis of current market value, may result in the need to reassess the list of candidate species using the same criteria as has been used on the currently-listed species.

6.4 Types of Aquaculture for the Abrolhos Islands

6.4.1 Aquaculture

The constraint on developing infrastructure for aquaculture only on islands which are already occupied effectively precludes land-based aquaculture in the Abrolhos Islands. The potential for competition with pre-existing users for space and other resources would make the development of significant land-based aquaculture unattractive. For that reason, only in-sea marine aquaculture is considered acceptable for the Abrolhos Islands.

Pearl culture with both *Pinctada margaritifera* and *Pinctada albina* uses surface longlines, sub-surface longlines or bottom-culture methods. Each species requires special equipment and the selection of a culture method is generally based on considerations for the local physical environment. More exposed waters generally necessitate the adoption of methods which protect the culture equipment and stock from adverse sea conditions.

The physical environment at the Abrolhos Islands will generally dictate the employment of sub-surface longlines for pearl culture to avoid excessive exposure to rough seas, while some isolated locations will permit surface longlines to be used. The extra costs and risks associated with bottom-culture methods is likely to make them unattractive.

Giant clam culture is conducted in shallow waters over firm seafloor, as the clams require sunlight for the photosynthesis of the zooxanthellae in their mantles. Early stages of culture require protection from predation for young animals in the form of trays or racks; the older larger animals are able to live unprotected on the seafloor.

The density requirements of *Tridacna maxima* are currently the subject of trials being conducted at the Cocos (Keeling) Islands, but trials with other *Tridacna* species in Queensland indicate that they can be cultured in close proximity to each other, provided that other environmental requirements of the species are satisfied.

The culture of edible oysters will probably use conventional oyster culture tray systems similar to those used in South Australia. Such systems are established in the intertidal areas.

Finfish culture, including the ranching of wild-caught fish such as yellowfin tuna, will probably be limited

to the use of floating seapens or cages. The inability to develop onshore culture methods will almost certainly preclude the use of tank-culture techniques for finfish and also the culture of aquarium fish, including seahorses.

6.4.2 Aquaculture-related Activities

The production of the saucer scallop (*Amusium balloti*) is currently being investigated at a land-based hatchery in Geraldton and Fisheries WA recently issued an aquaculture licence for the growout of this species in the Geelvink Channel. Hatchery production of spat for the replenishment (reseeding) of the natural scallop grounds at the Abrolhos Islands is accepted as a potentially-viable aquaculture activity, subject to the necessary approvals being granted by Fisheries WA.

Such replenishment of wild-stock is practised in other scallop fisheries around the world with significant success. Any such activity will need to be conducted from a hatchery on the mainland, and reseeding would normally be expected to occur over existing scallop grounds only.

It should be noted that the potential environmental impacts of reseeding are relatively unexplored. These potential impacts should be understood prior to allowing these activities to occur.

Reseeding should not be seen as a cheap or easy alternative to proper management of a particular fish stock. The fundamental cause of stock depletion should be well understood before reseeding is selected as a possible means of stock replenishment. Any reseeding programs should be coupled with adequate educational programs to promote habitat protection and the sustainable utilisation of stocks.

The medium-to-long term holding of western rock lobster (*Panulirus cygnus*) from the wild rock lobster fishery, in the event that such an activity is permitted at any time in the future, will be subject to considerable research and development as methods for this are yet to be developed. The development of such an industry would be subject to control by the managers of the western rock lobster fishery, but a contingency needs to be made for such a development in the overall planning of aquaculture uses for the region.

Recommendation 12

Consider applications for wild-stock enhancement in the Abrolhos Islands on an individual case basis.

(FWA/proponents)

6.5 Environmental Management of Aquaculture

6.5.1 Environmental Impacts of Aquaculture

Goal: To manage aquaculture developments to minimise their effect on the environmental and cultural values of the Abrolhos system.

An understanding of the environmental impacts, both actual and potential, of aquaculture is required in planning aquaculture in the Abrolhos Islands. This section provides general information about the impacts of the major types of aquaculture which can be undertaken in the islands.

There are several potential impacts that will occur in aquaculture, regardless of the type of aquaculture undertaken. In addition, there are environmental impacts which will be specific to different types of aquaculture.

Aquaculture activities in the Abrolhos Islands can be divided into three categories:

- bivalve molluscs;
- abalone; and
- finfish.

6.5.1.1 General Impacts

A recent study of the environmental impacts of the pearl (*Pinctada maxima*) industry (Wells, 1998) examined a variety of general impacts:

- waste disposal involving the removal of packaging wastes, biodegradable materials, old ropes, floats, and other discarded items;
- grey water from toilets and sinks, either on boats or from camps on shore;
- fuel, oil, and chemical storage and handling (presenting problems of handling and potential small-scale spills and low levels of seepage from equipment);
- oil disposal after use; and
- boat paints (which have anti-foulant compounds embedded in their chemical composition.)

Poorly managed aquaculture activities may also have poor aesthetic effects, caused by visible infrastructure associated with certain operations. There are several well developed management techniques which can ameliorate these impacts.

While proper handling of these impacts is important to maintaining the Abrolhos environment, none of them are unique to aquaculture activities. The same management issues arise in the fishing and tourism industries and with other visitors to the islands. These issues are best addressed under the Abrolhos Island Regulations, as part of the overall management of the islands.

One additional universal feature of aquaculture is the use of moorings and anchors. Permanent moorings are required for boats and aquaculture cages or longlines. Longlines are maintained in a constant position, with anchors at either end. In contrast to boats, longlines are maintained taut in the same position. This means they do not swing about on the tides or winds and their environmental effects are therefore minimised.

An alternative aquaculture mechanism for pearl oysters is to use star pickets embedded in the substrate. Again, the effects are minimal, as the same picket is used for several years. In fact, the pickets develop an attached biota which attracts a number of fish species to the area (Wells, 1998), in a similar fashion to the way an object on the sea surface will act as a fish attraction device.

6.5.1.2 Bivalve Molluscs

The environmental effects of culturing the proposed species of bivalve molluscs, pearl oysters, edible oysters, giant clams, and scallops, are all similar. The key feature is that they are all sedentary, filter-feeding species.

Single celled algae and other particles are filtered from large quantities of sea water that are moved through the animals. As the animals are not fed, there is little accumulation of wastes on the sea bottom or addition of nutrients to the water column in comparison to species that are fed.

There is speculation that introduction of large numbers of filter feeders, such as oysters, may reduce food availability for downstream wild filter feeders by 'scrubbing' the water of food detritus and plankton.

The study of the environmental effects of the *Pinctada maxima* industry (Wells, 1998) examined in detail the actual and potential effects that are specific to the industry, particularly growing animals on farms and hatchery production of juveniles.

The primary effects of growing relate to anchors, as discussed above. However, there may also be subtle effects such as changes to benthic organisms beneath the farms due to nutrient input.

6.5.1.3 Finfish

Potential finfish species for aquaculture at the Abrolhos Islands are all carnivores and would require feeding of either processed foods or bait fish. As finfish would be caged in the water column, there would be a potential for uneaten food to accumulate below the cages where it would deteriorate if not eaten by resident wild fish.

A careful feeding regime in aquaculture cage systems can reduce the amount of food wasted to a minimum. Actively swimming fish have a much higher metabolic rate than bottom-living molluscs and therefore produce greater amounts of bodily wastes. Food requirements and waste production vary between species.

Uneaten food and fish wastes from finfish aquaculture can be a problem in still waters. As the uneaten food breaks down, silt accumulates and oxygen can be removed from the bottom waters. When the water is mixed, during a storm for example, the silt can clog the gills of the fish or the deoxygenated water can kill them.

6.5.2 Regulatory Mechanisms

In all areas of WA, aquaculture is subject to a variety of regulatory mechanisms that have been developed to ensure, as far as is practicable, that adverse environmental effects are minimised or managed. In view of the unique environment of the Abrolhos, effective environmental management of any aquaculture

ventures in the islands is vital. A number of procedures are recommended for environmental management of aquaculture ventures in the Abrolhos Islands.

The key process in ensuring that environmental effects of human activities in WA are understood and properly managed is the carrying out of an Environmental Impact Assessment. Development proposals must be forwarded by Fisheries WA to the EPA for consideration and determination of the level of assessment required for a project, in accordance with section 40 of the *Environmental Protection Act 1986*. There are three levels of formal assessment:

- Environmental Review and Management Plan;
- Public Environmental Review; and
- Consultative Environmental Review.

All three levels require the proponent to prepare a detailed report describing the proposal; the physical, biological and social environment of the area where it is proposed; actual and potential environmental impacts of the proposal; and mechanisms to be used to minimise or ameliorate these effects.

Reports presented for all three levels of formal assessment are advertised for public comment and comments are requested from government agencies and stakeholders. Note that of the three levels of assessment, the Environmental Review and Management Plan is the most detailed report and has the longest period set aside for public comment.

Projects where environmental effects are considered likely to be small are assessed informally.

The DEP provides the EPA with information and assistance in setting the levels of assessment and in assessing the projects.

Once assessment of a project has been completed, the EPA recommends to the Minister for the Environment that a project be accepted or rejected and, if it is accepted, what environmental conditions (if any) should be attached to the proposal. Once the Minister approves a project, the Ministerial Conditions are legally binding.

Independent environmental monitoring of the effects of larger projects may be required as a condition of the licence. Such monitoring may also be required for smaller projects if there is concern over the potential effects of the operation.

Proponents are cautioned that a pre-installation examination of the area will be required to establish a baseline to evaluate changes that might occur after the venture starts. This will be at the licensee's expense.

There may be a requirement for the monitoring programme to continue after the facility ceases operation in order to measure recovery of the area. The programme will be tailored to the particular activity and include three aspects:

- physical environment;
- biological environment; and
- socio-economic factors.

6.5.3 Distance Between Lease/Licences Sites

A mechanism for separating farm sites is in place for the pearling industry. Substantial mortality of pearl oysters (*Pinctada maxima*) occurred during the late 1970s and early 1980s, leading to concern over the possible transmission of diseases from one farm to another. This led to the pearl industry requesting a mechanism for separating farms from each other.

Additional reasons for having a clear separation between operators include providing each farm with opportunities for expansion and security of their equipment and stock of oysters. The following guidelines apply to the issue of new pearl oyster farm leases (FWA, 1997b):

“Where an application is made for the issue of a Pearl Oyster Farm Lease and the proposed boundaries of the proposed farm lease lie within five nautical miles of the nearest boundary of any pre-existing farm lease area or any holding area, the application should be refused unless:

- 1) there is a clear geographical division between the pre-existing and proposed farm lease area; or
- 2) the holder of such a pre-existing farm lease provides written consent to the application.”

The original licensee has the right to expand within the five nautical mile exclusion zone towards a new farm lease, provided a minimum separation of two nautical miles is maintained from the new lease area. Distances between boundaries of adjacent leases are measured over water rather than across land formations.

These policy guidelines now include all species of pearl oyster.

In addition to the desired goals of the separation mechanisms, the procedures will have the effect of substantially limiting the number of pearl licences that can occur in the Abrolhos Islands.

Strategies

Recommendation 13

Take into account Fisheries WA's two to five nautical mile separation guideline in the assessment of new applications for pearl oyster aquaculture licences in the Abrolhos Islands. (FWA)

6.6 Areas Where Aquaculture Can Occur

Goal: To ensure that aquaculture developments occur only in suitable areas of the Abrolhos Islands and approved licence areas are fully utilised.

Fisheries WA has developed usage maps to indicate the agency's understanding of where activities are currently occurring in the Abrolhos Islands (Figures 5-7). It is acknowledged that these maps are imperfect, and they will be improved over time. Note that different aspects of the usages have different levels of accuracy. For example, historic wreck sites such as the *Batavia* and *Zeewijk* are accurately known, as are the locations of the Reef Observation Areas.

It will be up to the proponent to determine where proposals for aquaculture are made and to examine in their application the competing usage of the areas by other interests. Extracts of applications are sent to other interested parties as a matter of course during the public comment phase of the application.

Most of the suitable areas for aquaculture in the Abrolhos Islands are within the island groups. The channels between islands are exposed to different weather conditions during the year. While there may be small areas of waters protected from most of the likely storm and swell conditions, the majority of protected areas will be within the island groups.

In developing proposals for aquaculture in the Abrolhos Islands, proponents should consider the criteria listed in Table 2, outlined below:

- sites that cannot be used for aquaculture;
- sites where approval of aquaculture is unlikely; and
- sites that may be considered favourably for aquaculture.

Table 2 Site selection criteria for aquaculture in the Abrolhos Islands

Sites which cannot be used for aquaculture
Reef Observation Areas and protected shipwreck sites cannot be used for aquaculture (Figures 5 – 7).
Sites where approval of aquaculture is unlikely
<p>Sites where aquaculture is unlikely to be approved include: areas of high conservation value and locations already extensively utilised by other interests, such as navigation areas; and locations extensively used by commercial fishermen, tourist operators or private visitors to the islands (Figures 5 – 7). High conservation areas include:</p> <ul style="list-style-type: none"> • mangroves, significant seagrass meadows and coral reefs; • major habitats of significant fauna, such as seabirds and marine mammals; and • any other areas which might later be set aside for the protection of flora and fauna or habitats. <p>Sites located in areas adjacent to, or otherwise able to affect, areas of high conservation value are also unlikely to be approved, i.e. waters adjacent to important seabird nesting areas. Also, sites with significant social importance or high visual amenity values are unlikely to be approved for aquaculture operations.</p>
Sites which may be considered favourably for aquaculture
All other areas may be considered favourably for aquaculture, but a detailed habitat description is required as part of an aquaculture proposal. The application will also be required to provide information on the existing uses of the proposed area, by people such as recreational fishers, tourism operators and private users.

6.6.1 Effective Utilisation of Space

Different types of aquaculture have different space requirements. For example, pearl farming generally requires a larger water area for a commercially viable operation than finfish cage aquaculture.

Experience from elsewhere (Westaway, pers comm) is that a finfish farm may require approximately 30 ha of water area, however only about one-third of the site is used for farming in any given year to allow for ‘fallowing’ of the remainder of the site. Improvements in environmental management techniques for finfish culture may see these space requirements change over time.

The Abrolhos Islands have considerable natural and cultural values, and the primary goal of the aquaculture management plan is that aquaculture be developed without alienating these values. Space available for aquaculture in the Abrolhos Islands is at a premium.

It will be up to the proponents to determine site requirements necessary for their particular type of aquaculture and to justify the requirements in their applications.

Proponents should also be aware of the possibility that their operations will affect the visual amenity of the area where they are sited, particularly for tourism. This is important for both private visitors to the Abrolhos Islands and tourists visiting through organised operations.

Fisheries WA is currently developing performance criteria to ensure effective use of farm sites. The *Fisheries Resources Management Act 1994* also provides that the Executive Director may cancel, suspend or refuse to renew a licence if the holder has not used the licence in the previous two years.

Strategies

Short Term

Recommendation 14

Use the criteria listed in Table 2 in determining where potential licence sites may be located.

(proponents/FWA)

Recommendation 15

Ensure that licence conditions for aquaculture address the issues of removal of infrastructure, reinstatement of the area disturbed by environmental impact, and performance criteria to measure whether licences are being used by licensees in the manner they were intended.

(FWA)

Section 7

Procedures for Applying for an Aquaculture Licence

Goal: To ensure applications for aquaculture in the Abrolhos Islands comply with procedures required for applications elsewhere in Western Australia and undergo a transparent process of evaluation.

Applications for aquaculture licences in the Abrolhos Islands will not be automatically approved simply because they are in accordance with the recommendations outlined above. This plan provides only a guide to proponents to aid the decision-making process.

Prior to lodging an application, proponents should examine the *Aquaculture Plan for the Houtman Abrolhos Islands* (i.e. this document) and discuss their proposal with Fisheries WA aquaculture development officers. There is a Statewide procedure for assessing applications which is outlined in detail in Ministerial Policy Guideline No. 8 ‘*Assessment of applications for authorisations for Aquaculture and Pearling in coastal waters of Western Australia*’.

Completion of the approved application form is required. Once an application is received, it is examined by officers of Fisheries WA to determine whether it is competent and contains all reasonable information to enable a decision to be made. If this is the case, the application is referred to relevant decision-making authorities, including the DEP (and, if appropriate, the EPA), CALM (for proposals within gazetted marine reserves) and other bodies.

The Executive Director of Fisheries WA will also consult with involved agencies and peak industry groups which may have expertise in the area or which may be affected by the proposal.

It is also a requirement that aquaculture applications be advertised for public comment. However, where the proposal is in accordance with a plan (such as the *Aquaculture Plan for the Houtman Abrolhos Islands*) for an area where the plan has been adopted by a competent authority after public consultation, the Executive Director will:

- consult with relevant decision-making authorities, other involved agencies and representative community and industry groups for a 60 day period; and
- for public notification purposes, advertise in the press the receipt of the application.

Ministerial Policy Guideline No. 8 outlines the timeframe for the decision-making process, along with mechanisms for determining whether applications can be approved.

As noted in section 6.3.6, Fisheries WA will refer all applications for finfish to the DEP, with a recommendation that the application be formally assessed by the EPA.

Strategy

Short Term

Recommendation 16

Ensure that all aquaculture proposals continue to be subject to the established Statewide consultative arrangements outlined in Fisheries WA's Ministerial Policy Guideline No. 8. (FWA)

Recommendation 17

Advertise for public comment all applications for aquaculture leases and licences, in accordance with Fisheries WA's Ministerial Policy Guideline No. 8. (FWA)

Recommendation 18

Ensure that all proposals for non filter-feeding species are forwarded to the DEP, with a recommendation that the application be formally assessed by the EPA, in accordance with section 40 of the *Environmental Protection Act 1986*. (FWA/EPA)

Section 8 Plan Implementation and Review

Goal: To implement the management strategies outlined in this plan and to review the plan as required.

This plan for aquaculture in the Abrolhos Islands provides a comprehensive approach for obtaining best practice management of aquaculture in the Abrolhos Islands.

The strategies are divided into three groups: ‘ongoing’ (already implemented, or to be implemented as required); ‘short term’ (to be implemented as soon as possible); or ‘medium term’ (to be implemented later). These categories are based on current priorities, but may change as necessary during the five years of the plan.

The implementation plan for the *Management of the Houtman Abrolhos System* is currently being developed. The implementation plan will be reviewed annually, progress assessed, new information analysed, and the implementation plan modified if necessary. The aquaculture plan for the Abrolhos will be incorporated into this process.

The AIMAC advises the Minister for Fisheries on the management of the Abrolhos Islands. The AIMAC will monitor the implementation of the aquaculture plan.

Although this is a non-statutory plan, it is intended that the aquaculture plan will be effective for five years from the date it receives Ministerial endorsement, and will practically remain in effect until the plan for the subsequent five years is prepared and approved. Amendments can be made to the plan while it is in effect, but only after the proposals undergo some form of public consultation process. The five year review of the aquaculture plan should evaluate:

- the successes and failures of the first five year plan;
- new information with the potential to affect management practices and strategies for aquaculture in the Abrolhos; and
- new proposals for the management of aquaculture in the Abrolhos Islands.

Strategies

Medium Term

Recommendation 19

Develop performance criteria upon which to judge the success of this plan. (FWA)

Recommendation 20

Review the success and appropriateness of the management strategies contained in this plan in five years. (FWA)



Section 9

Glossary of Terms

As readers may not be familiar with some of the terms in this document, definitions of the following key words are provided here.

ahermatypic	a group of corals that are not reef building species.
anti-foulant	a chemical added to boat paints to stop or slow the settlement of fouling organisms such as barnacles, oysters, marine plants, etc.
benthic	includes all the bottom terrain of the sea, from the shoreline to the greatest depths.
broodstock	mature animals used for spawning to produce young animals to grow-out.
detritus	microscopic pieces of plant and animal material which have been broken down by a combination of physical and chemical processes.
Coriolis	a physical effect which causes currents in the southern hemisphere to move counter-clockwise.
diurnal	daily.
endemic species	species occurring naturally in an area.
flushing time	a measure of the time required for the volume of water in a given area to be completely replaced.
hermatypic	corals that accumulate large amounts of calcium carbonate and build reefs.
macroalgae	large species of algae, or seaweeds.
mesoscale	referring to oceanic eddies of the Leeuwin Current, mesoscale means a distance of 10 to 100 km.
semi-diurnal	twice a day.
stratification	division of a water body into two discrete components by depth; usually refers to the effects of differing water temperatures, in which a warm, light water mass overlies a colder, dense mass.
translocation	moving a plant or animal from one place to another.
upwelling	an oceanic phenomenon which brings water from mid levels (about 1,000 to 1,500 m) to, or near to, the surface.



Section 10

Glossary of Acronyms

ACWA	Aquaculture Council of Western Australia
ADC	Aquaculture Development Council
AIMAC	Abrolhos Islands Management Advisory Committee
AILMSC	Abrolhos Islands Land Management Sub-committee
AISFDC	Abrolhos Islands Sport Fishing Development Committee
AMWING	Representative Body for Non-maxima Pearl Producers
AUF	Australian Underwater Federation WA
CALM	Department of Conservation and Land Management
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEP	Department of Environmental Protection
EPA	Environmental Protection Authority
FHPA	Fish Habitat Protection Area
FWA	Fisheries WA
GPFA	Geraldton Professional Fishermen's Association
LDM	Le Provost Dames and Moore
RLIAC	Rock Lobster Industry Advisory Committee
ROA	Reef Observation Area
PPA	Pearl Producers' Association
SBT	Southern Bluefin Tuna
WAFIC	Western Australian Fishing Industry Council
WATC	Western Australian Tourism Commission



Section 11

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In particular, we thank the people who participated in the robust discussion in Geraldton, Mr Robert Mosel for arranging the venue and Mr Brian Billi of the Geraldton Offshore Fishing Club for generously providing the use of their facilities.

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The draft report was written by consultants Dr Fred Wells and Mr Rick Scoones, with the final report compiled by Fisheries WA staff, Ms Jo Bunting and Ms Robin Clark.



Section 12

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Appendix A

List of People Consulted

Organisations and individuals who responded to the initial letters or with whom the project was discussed:

Mr Alan Bradley, Department of Environmental Protection, Geraldton
Mr Kelly Gillen, Department of Conservation and Land Management, Geraldton
Mr Alan Gooch, Department of Transport
Mr Kim Nardi, Fisheries WA, Geraldton
Mr Dan Machin, Fisheries WA, Geraldton
Mr Randall Owens, Fisheries WA, Geraldton
Mr Frank Prokop, Recfishwest
Mr Fred Tucker, A-zone rock lobster fisher
Ms Lesleigh Clarke, WA Tourism Commission, Geraldton
Mr Mike Meinema, Department of Conservation and Land Management, Geraldton
Mr Rebecca Moore, Geraldton Midwest Development Commission
Ms Caroline Seal, Fisheries WA, Perth
Mr Richard Sellers, Fisheries WA, Perth
Dr Chris Simpson, Department of Conservation and Land Management
Mr Cameron Westaway, Fisheries WA, Perth

Participants in the stakeholders meeting held in Geraldton:

Mr Charlie Arnold, Geraldton Professional Fishermen's Association
Mr Darren Bailey, A-zone rock lobster fisher
Mr Terry Basile, A-zone rock lobster fisher
Mr George Bass, Shire of Irwin
Ms Lesleigh Clarke, WA Tourism Commission, Geraldton
Mr Rod Dransfield, A-zone rock lobster fisher
Mr Ron Franceschi, A-zone rock lobster fisher
Mr Robert Mosel, Geraldton Professional Fishermen's Association
Mr Michael O'Brien, Latitude Fisheries
Ms Leonie Noble, Friends of the Abrolhos
Mr Gary Parker, President, Dongara Professional Fishermen's Association
Mr Justin Pirrottina, A-zone rock lobster fisher
Mr John Ritchie, A-zone rock lobster fisher
Mr Dennis Schram, A-zone rock lobster fisher

Mr Roger Shields, Committee, Dongara Professional Fishermen's Association

Mr John Thorn, A-zone rock lobster fisher

Mr Dan Machin, Fisheries WA, Geraldton

Mr Kim Nardi, Fisheries WA, Geraldton

Mr Randall Owens, Fisheries WA, Geraldton

Appendix B

Analysis of Public Submissions

The draft *Management Plan for Aquaculture in the Houtman Abrolhos Islands* was released for public comment in July 1999 (Fisheries WA/Enzer, 1999). Sixteen submissions were received on the plan. An independent consultant, Enzer Marine Environmental Consulting (Enzer) was engaged by Fisheries WA to prepare a summary of the comments contained within those submissions (Table A1).

While the number of submissions was low, the quality of the submissions was high. Some submissions were complimentary of the plan and essentially accepted it in full, although most suggested some amendments to the text or recommendations. The submissions were reviewed by the Abrolhos Islands Management Advisory Committee (AIMAC) which recommended to Fisheries WA that a number of changes be made to the draft plan.

Fisheries WA have analysed the public submissions and subsequent comments from AIMAC and the Environmental Protection Authority, and have made several amendments to the plan. Many of AIMAC's recommendations have been adopted in full or with minor amendment. Other recommendations have not been accepted by Fisheries WA. Table A2 outlines the nature of the comments received and Fisheries WA's response.

Table A1 Summary of individual submissions on the draft management plan for aquaculture in the Houtman Abrolhos Islands

	Organisation	Response
1	Conservation Council of WA	<ul style="list-style-type: none"> • Conservation Council concerned about aquaculture in the Abrolhos as it is recognised as an important area and it is thought that aquaculture will put further pressure on this area. • The draft plan should have been referred to the EPA for strategic assessment under Section 16(e) of the <i>Environmental Protection Act</i> due to high ecological significance. • Recommendation 1 – flushing times in the Wallabi and Pelsaert Groups needs to be gathered prior to ANY aquaculture developments. • Recommendation 8 – Concerned about the culturing species which require feeding potentially resulting in accumulation of nutrients and deoxygenation of bottom layer and accumulation of silt. Also finfish appear to be not commercially viable. • Recommendation 10 – Broodstock should originate from the Abrolhos. • Recommendation 13 – Recommendations 22, 24, 25 and 26 of the Management of the Houtman Abrolhos Systems need to be fulfilled before any further projects are implemented. Recommendation 13 cannot be fulfilled until these have taken place, particularly 25 and 22. • Recommendation 15 – Proposals should expect formal assessment under Part IV of the EP Act, in the absence of proper planning base.
2	Kailis Seafoods	<ul style="list-style-type: none"> • Plan presents an accurate reflection of the needs of both current and predicted users of the Abrolhos Islands. • Recommendation 3 – Sees merit in allowing aquaculture proponents the opportunity to purchase existing infrastructure. Suggests that there may be opposition from other potential users of the islands to not be given this opportunity. The issue of equity would need to be carefully considered by AIMAC before making any decision. • Recommendation 7 – same comments as above • Recommendation 8 – The list is self-evident as to those with a suitable market value for aquaculture. Western rock lobster as a candidate may not be pertinent due to the rock lobster fishery – FMP 122 deals with this issue. • Issues such as the definition of what constitutes aquaculture still needs to be resolved before adopting such a species as suitable.
3	Geraldton Professional Fishermen’s Association Inc.	<p>Overview – plan is insufficient in:</p> <ul style="list-style-type: none"> • planning of introduction of aquaculture to the Abrolhos; • failing to identify suitable areas for aquaculture; • criteria for evaluating high value species; • providing recommendations for access, security, exclusion zones and navigational problems; • considers development of aquaculture would be <i>ad hoc</i>, inefficient use of space and does not take notice of past mistakes. Fears encroachment into areas not presently regarded as likely to be accepted for aquaculture; • potential threats to highly successful rock lobster fishery; • Recommendation 1 – agrees more data required on flushing times. Further studies required of how nutrient rich waters occur in a nutrient poor environment; • Recommendation 2 – emphasises importance of rock lobster breeding grounds and believes nothing should be done to compromise breeding grounds. Emphasises importance of natural and economic constraints on aquaculture.

Table A1 Summary of individual submissions on the draft management plan for aquaculture in the Houtman Abrolhos Islands

	Organisation	Response
		<ul style="list-style-type: none"> • Recommendation 3 – disagrees with recommendation that Fisheries WA modify regulations to allow aquaculturists to use existing facilities. Wants consultation if it occurs. • Recommendation 4 – disagrees with extended use of land-based facilities. If it occurs, proponents must agree to agreed waste disposal management procedures. Needs evaluation of impact of 12 month use. • Recommendation 5 – all new marine and land based facilities comply with established building standards – agrees. • Recommendation 6 – agrees to expansion of Land Management Sub-committee. • Recommendation 7 – disagrees with use of existing facilities. If it happens, stakeholders should be consulted. • Recommendation 8 – disagrees with majority of species proposed. Should be only endemic filter-feeders. • Recommendation 9 – against translocation of any non-endemic species. • Recommendation 10 – broodstock should originate from the islands. Controls should be in place on amount of broodstock taken. • Recommendation 11 – agrees with reseeded of scallops. • Highlights problems of uneaten food and strains susceptible to disease. • Recommendation 12 – present Fisheries WA policies on separation inconsistent. Five nautical miles should be minimum separation. Questions whether plan envisions use of holding sites (no). • Recommendation 13 – plan does not specify where aquaculture could occur. Agrees with need for proponent to detail use by other users, but wants specification of commercial lobster and wetline fishermen and any other user group. • Recommendation 14 – welcomes establishment of performance criteria for determining that licences are being used for purpose for which they were approved. Wants input into criteria. • Recommendation 15 – aquaculture proposals continue to be undertaken using Statewide protocols. Wants name of operator specified. Supports fixed times for applications, such as 30 June. • Recommendation 16 – supports public advertisement of all applications. Present summary sheets insufficient. • Recommendation 17 – supports use of independent consultants. • Recommendation 18 – supports development of performance criteria for determining success of plan. • Recommendation 19 – supports review of success of strategies after five years.
4	Australian Marine Conservation Society WA.	<ul style="list-style-type: none"> • ACMSWA advises against the development of aquaculture at the Abrolhos given the acknowledged uniqueness of this area. • The area should be the subject of strategic assessment in accordance with Section 16E of the <i>Environment Protection Act</i>, prior to any significant developments. • All activities at the Abrolhos should meet higher standards of precaution and assessment than those in the plan. • All new developments with potential for significant impact should be the subject of full environmental assessments.

Table A1 Summary of individual submissions on the draft management plan for aquaculture in the Houtman Abrolhos Islands

	Organisation	Response
5	Friends of the Abrolhos Islands	<ul style="list-style-type: none"> • Human activities involving addition of nutrients (fish farming) to the waters should not be permitted because of uncertain impacts. • Translocation of non-endemic species should not be permitted. • Before an activity under the responsibility of Fisheries WA is approved, Fisheries WA should state and determine the areas it considers appropriate for that activity. • Criteria for defining or determining high conservation areas should be stated. • High conservation value areas should be identified and mapped prior to any significant developments occurring. • No developments should be permitted in areas which have not received independent assessment for the presence of high conservation values. • ‘Significant’ flora and fauna should be defined and the criteria on which their significance is determined should be stated. • Consideration of significant development with potential for environmental impact is not justified until Recommendation 22 and 26 (Management of the Houtman Abrolhos System) have been completed. This should have been recognised as a constraint on aquaculture. <ul style="list-style-type: none"> • Flushing – Recommendation 1 – It is essential for agencies to gather relevant information on water circulation and flushing in the Wallabi and Pelsaert Islands areas. An immediate time frame is critically essential. • Nutrient Levels – Given that the Abrolhos is in a poor nutrient environment – what guarantees are in place to ascertain that the introduction of aquaculture ventures will not upset the balance of nutrients currently sustaining the Abrolhos ecosystem? • Biological Environment – In relation to ‘sites where aquaculture is unlikely’ with respect to areas adjacent to high conservation areas and areas already extensively utilised by other interest groups – what is the standard distance required for areas adjacent to high conservation sites? Also, the word ‘unlikely’ is non-specific and there should be a specific policy in regard to this matter. • Summary of Recommendation Nos 3, 4 and 7 • Rec. 3 – (1) This is in direct conflict with the Abrolhos Island Management Plan; (2) Concerned at impacts which will occur due to an increase from 14 weeks to year round use of the islands. Studies to assess the impact of 52 weeks a year usage need to be done before allowing aquaculture; (3) Concern that allowing land-based aquaculture will cause other industries to demand the same right of access. • Non-endemic species – FOA insists that only endemic species be considered for aquaculture. • Species suitable for aquaculture – FOA insist that species must meet ‘all’ (not most) criteria for aquaculture at the islands. • Table 2 – FOA would like to see that Table 2 be restricted to filter-feeders only and are concerned at the proposal to farm finfish. • Translocation – Concerned that the Executive Director of Fisheries WA has authority to translocate potentially diseased fish/species from outside the endemic area. Also concerned about how the policy is to be policed and enforced in the best interests of the environment. Suggests this can only be done by preventing the translocation of species into this area.

Table A1 Summary of individual submissions on the draft management plan for aquaculture in the Houtman Abrolhos Islands

	Organisation	Response
		<ul style="list-style-type: none"> • Environmental Impacts of Aquaculture – The draft plan does not adequately cover the issues of aquaculture impacts – the potential risks must be fully documented and explored before any further aquaculture activity is endorsed for Abrolhos. • Expect that management of aesthetics will be a licence condition. • Grateful that the plan recognises the need to monitoring any impacts of operations. • Recommends that the five mile exclusion zone between sites becomes the minimum. • The draft plan falls short of its objectives and does not go far enough in terms of: <ul style="list-style-type: none"> • planning for the introduction of aquaculture at the islands; • identifying specific areas suitable for aquaculture; • scientific and environmental impacts of the translocation policy; and • impact and implications of allowing land-based infrastructure policy to be changed. • Mechanisms to be put in place to counteract word structures such as ‘preferred, most and should’.
6	Australian Marine Conservation Society	<ul style="list-style-type: none"> • This is a policy statement and doesn't meet the basic requirements of a management plan. • Site specific information collected by a proponent cannot be assessed without oceanographic modeling. Also need an accurate benthic habitat map. It is unlikely there are any areas of low conservation values suitable for habitat altering aquaculture. • Recommendation 1 – oceanographic work needs to be done before attempting an aquaculture plan. • Recommendation 8 – finfish should be removed from list of potential species. • Recommendation 13 – unable to determine high conservation areas in absence of systematic marine biological surveys. • Recommendation 15 – proponents should expect formal assessment by EPA. There should be a Strategic Environmental Assessment by the EPA. • Recommendation 17 – there are no independent consultants in a proponent driven environmental assessment system.
7	Western Australian Tourism Commission	<ul style="list-style-type: none"> • Access – major issue at multi-use destinations; important that all users are sympathetic to the needs of the others. Care should be taken in placement to minimise obstruction and do not deter recreational users from entering the area. • Visual amenity – negative effects particularly important in a wilderness area. • Environmental impacts – should be minimised, including use of beaches to dump fuel and equipment. Litter hazard. • Safety – ensure safety of other users. • Recommendations 1 and 8 – concerned over feeding of aquaculture species. Flushing times in lagoons will be a key consideration. Support detailed study of flushing times in Wallabi and Pelsaert groups. • Recommendation 13 – plan accounts for present uses but is deficient in planning for future uses, particularly tourism. Wants WATC to advise Fisheries WA on where tourism will occur. • Reiterates potential for tourism and aquaculture to develop a positive working relationship.

Table A1 Summary of individual submissions on the draft management plan for aquaculture in the Houtman Abrolhos Islands

	Organisation	Response
8	Betty col Fishing Company	<p>Plan falls short of its goals in that it:</p> <ul style="list-style-type: none"> • Fails to identify suitable areas for aquaculture; • does not provide real on-the-ground planning for aquaculture; • does not provide criteria for determining endemic species; • does not provide criteria for determining high value species. • no information on access, security rights, possible exclusion zone and navigational problems. • Recommendation 1- agree. Should be undertaken before approving further applications. • Nutrient levels – detailed study necessary. • Recommendation 2 – concerned over breeding grounds for western rock lobster. Against introduction of non-endemic species. • Recommendation 3 – disagrees with proposal to allow access to existing facilities. • Recommendation 4 – concerned over impacts of 12 month use, possible use of desalination and vandalism or theft from existing facilities. • Recommendation 5 – agrees. • Recommendation 6 – yes, subject to aquaculturists obtaining licences enabling them to use existing facilities. • Recommendation 7 – disagree, but if it happens all stakeholders on the islands in question must be consulted. • Recommendation 8 – disagree, wants list restricted to endemic filter-feeders. • Recommendation 9 – disagrees with introduction of non-endemic species. Concerned over introduction of diseases or parasites. • Recommendation 10 – agrees with broodstock originating in islands; disagrees with translocation. • Recommendation 11 – agrees with reseedling of scallops after consultation with all user groups. • Recommendation 12 – agrees with provision with five nautical mile rule unless pre-existing lease holder gives written consent. • Recommendation 13 – agrees with principles for proponents determining where they should apply. • Recommendation 14 – agrees with performance criteria for determining that leases are being used for purposes for which they applied. <p>Other user groups should be consulted on developing criteria.</p> <ul style="list-style-type: none"> • Recommendation 15 – aquaculture subject to Statewide policies. Agrees. • Recommendation 16 – agrees with public consultation on aquaculture proposals but wants more information provided. • Recommendation 17 – agrees with independent consultant to provide environmental description and assessment. • Recommendation 18 – agrees Fisheries WA should develop performance criteria to judge success of plan, but wants user consultation. • Recommendation 19 – agrees with re-evaluation of plan after five years.
9	Abrolhos Pearls	<ul style="list-style-type: none"> • Recommendation 10 – does not adequately address possible adverse effects of translocating pearl shell into the Abrolhos.
10	Polleo Pty Ltd	<ul style="list-style-type: none"> • Lease in Southern Group is positioned on a direct course into the anchorage. Concerned over visual pollution.

Table A1 Summary of individual submissions on the draft management plan for aquaculture in the Houtman Abrolhos Islands

	Organisation	Response
11	Owner/Skipper, Sundance	<ul style="list-style-type: none"> No finfish aquaculture should be undertaken. Disease risk too high. Essential area for production of puerulus of western rock lobster.
12	Shark Bay Tuna Farms Pty Ltd	<ul style="list-style-type: none"> Concurs with overall thrust of plan. Discusses in detail their application for an aquaculture site in Easter Group. Equity is an issue – islands should not be confined to one user group. Fully support recommendations 3 and 6.
13	University of Western Australia	<p>General philosophy:</p> <ul style="list-style-type: none"> Abrolhos is first Fish Habitat Protection Area; implies a ‘special’ area, deserving of ‘special’ protection. Opposes plan in principle – Abrolhos should be given significant protection because of its acknowledged values. No further aquaculture should be permitted. Existing operations should be phased out as licences expire. Acknowledges in short term aquaculture will proceed. Environmental impacts should be absolute minimum. Plan is pro-aquaculture. Recommendation 13 and Section 6.6. Vague and ambiguous. System should be mapped before aquaculture can proceed. Unclear what level of habitat description and monitoring is required by proponent. Executive Summary states all aquaculture proposals undergo environment impact assessment in accordance with DEP/EPA procedures, but no specific recommendation for this. Recommendation 15 – already in place. No specific recommendation for ‘sensitive’ Abrolhos. Recommendations 16 and 17 go part way but do not mention EPA or DEP. Present applications assessed informally- who decides? All aquaculture proposals require a formal review. Recommendation 1 – data on water circulation times in Wallabi and Pelsaert Groups. Easter Group also needs information as existing study done in one place. Recommendation 8 – species list far too extensive. Text that more detailed consideration may reduce list needs more prominence. Finfish should be removed; limit to filter-feeders. Also questions pearl farms – effect on benthic community below them not adequately assessed. Unwisely. Recommendation 9 – limit to endemic species. Recommendation 10 – broodstock should originate from islands. Recommendation 12 – separation mechanisms should always be five nautical miles. Section 6.2.1 acknowledges aquaculture will alter way islands are used. Should minimise use of Abrolhos – may be able to come over every 3-4 weeks for cleaning and maintenance. Recommendation 14 – Fisheries WA must have power to close down unprofitable operations and remove all traces of activities.
14	Secretary, The Wilderness Society of WA Inc.	<ul style="list-style-type: none"> Aquaculture in the region is not environmentally acceptable. Management plan should have come at a later date because of lack of environmental information. Should be a Section 16e assessment under the <i>Environmental Protection Act</i>.

Table A1 Summary of individual submissions on the draft management plan for aquaculture in the Houtman Abrolhos Islands

	Organisation	Response
		<ul style="list-style-type: none"> • Recommendation – water circulation studies must be completed before aquaculture areas are developed. • Recommendation 8 – concerned about any aquaculture which requires feeding. • Recommendation 10 – concerned over introduction of non-endemic species. • Recommendation 13 – more environmental data required to assess potential aquaculture areas. Data should be available for public comment. • Recommendations 22, 25 and 26 must be implemented before aquaculture proceeds. • Aesthetics have not been taken into account.
15	Marine Parks and Reserves Authority	<ul style="list-style-type: none"> • Abrolhos one of the most important marine environments in Western Australia. A unique biogeographic region under the national IMCRA system. • Aquaculture will put further competition for resources, including space. • Plan needs to be reviewed by the EPA. • Recommendation 1 – data on water circulation need to be gathered prior to aquaculture development. • Recommendation 8 – species requiring supplementary feeding should not be included. • Recommendation 10 – should not translocate exotic species or broodstock. List in Table 2 should be reviewed to ensure all occur in the Abrolhos. • Recommendation 13 – Recommendations 22, 24, 25 and 26 must be implemented before any further aquaculture licences are awarded and projects implemented. Recommendation 13 cannot be implemented until habitat maps (Recommendation 25) and criteria to monitor health of ecosystem (Recommendation 22) have been fulfilled. • Recommendation 15 – should be a strategic environmental assessment.
16	Marine Conservation Branch, CALM	<ul style="list-style-type: none"> • Recommendation 10 – No non-native species should be farmed in the Abrolhos. Broodstock should be from the Abrolhos only. No definition of a distinct genotype. Questions validity of black bream. • Recommendation 13 – Further information is required on biological and social resources for adequate planning. Habitat maps, significant fauna, tourism and areas of high recreational usage should be included. • Section 6.6.2 should include areas of high tourism and recreational value.

Table 2 Fisheries WA's response to public submissions

Issue	Submissions commenting	Proposed action
Concerned about aquaculture proceeding because of the sensitivity of the area.	1,4,5,13,14,15	The plan advocates aquaculture of endemic species only. Each aquaculture application will go through a rigorous assessment process to ensure environmental impacts are addressed.
Should have been a Section 16e strategic assessment under the <i>Environmental Protection Act</i>	1,4,6,14,15	The draft plan was referred to the Environmental Protection Authority. Fisheries WA have taken the EPA's comments into account in reviewing the plan.
Plan an accurate prediction of needs of current and predicted users of Abrolhos Islands	2,12	No change required.
All activities in the Abrolhos Islands should meet higher standards of precaution and assessment.	4	Comments noted. Fisheries WA will refer all applications for finfish aquaculture to the Department of Environmental Protection, with a recommendation that the application be formally assessed by the EPA.
All new activities with potential for significant impact should be subject to full environmental assessment.	4	Comments noted. Fisheries WA will refer all applications for finfish aquaculture to the Department of Environmental Protection, with a recommendation that the application be formally assessed by the EPA.
Before an activity under the responsibility of Fisheries WA is approved, Fisheries WA should state and determine the areas it considers appropriate for that activity. Consideration of significant development with potential for environmental impact is not justified until Recommendations 22 and 26 (Management of the Houtman Abrolhos System) have been completed. This should have been recognised as a constraint on aquaculture. Policy statement – doesn't meet the basic requirements of a management plan.	4	Comments noted. In the absence of a specific proposal, it is difficult to estimate how much area a proponent will require. Fisheries WA has adopted an alternative approach of identifying exclusion areas through constraints mapping.
Abrolhos requires high level of protection as a Fish Habitat Protection Area.	6	Comments noted.
	13	Agreed.

Table 2 Fisheries WA's response to public submissions

Issue	Submissions commenting	Proposed action
<p>No clear recommendation that environmental assessment proceed in accordance with EPA/DEP procedures.</p>	<p>Comments noted.</p> <p>Fisheries WA will refer all applications for finfish aquaculture to the Department of Environmental Protection, with a recommendation that the application be formally assessed by the EPA.</p>	<p>Comments noted.</p> <p>Fisheries WA will refer all applications for finfish aquaculture to the Department of Environmental Protection, with a recommendation that the application be formally assessed by the EPA.</p>
<p>Plan insufficient:</p> <ul style="list-style-type: none"> • planning of introduction of aquaculture to the Abrolhos; • fails to identify suitable areas for aquaculture; • criteria for evaluating high value species; • providing recommendations for access, security, exclusion zones and navigational problems; and • considers development of aquaculture would be <i>ad hoc</i>, inefficient use of space, does not take notice of past mistakes. Fears encroachment into areas not presently regarded as likely to be accepted for aquaculture. <p>Potential threats to highly successful rock lobster fishery.</p>	<p>3</p> <p>3,5,8</p> <p>3,8</p> <p>5,8</p> <p>3,8</p> <p>3</p> <p>3</p>	<p>Comments noted.</p> <p>In the absence of a specific proposal, it is difficult to estimate how much area a proponent will require. Fisheries WA have adopted an alternative approach of identifying exclusion areas through constraints mapping.</p>
<p>1. In partnership with other appropriate agencies, Fisheries WA should seek funding to gather data on water circulation and flushing times in the Wallabi and Pelsaert Groups.</p>	<p>1,6,14,15 – should be obtained before aquaculture proceeds</p> <p>3,5,8,13 – agree, also question of nutrient supply include Easter Group.</p> <p>7 – agree.</p>	<p>Fisheries WA supports more research on water circulation and flushing times, but consider that the proponent also has a responsibility to collect sufficient data to demonstrate that the proposal will not have an adverse effect on the environment.</p>

Table 2 Fisheries WA's response to public submissions

Issue	Submissions commenting	Proposed action
2. Fisheries WA to ensure management strategies in the plan, <i>Management of the Houtman Abrolhos Systems</i> , and future management strategies to protect specific areas are taken into account when assessing future aquaculture proposals.	3 – agrees. 3,8 – importance of rock lobster breeding grounds.	Comments noted. No change required.
3. Fisheries WA to modify existing management arrangements to allow holders of aquaculture licences in the Abrolhos to purchase existing facilities in the islands if they become vacant.	2 – sees merit in proposal. Equity issues. Probable opposition from other groups. 3 – disagrees. Consultation if it occurs. 8 – disagrees. 12 – agrees.	Comments noted. No change required.
4. The extended use of existing land-based facilities and any new land-based facilities must be subject to an agreed waste disposal management program consistent with the objectives of <i>Management of the Houtman Abrolhos System</i> (Fisheries 1998).	3, 5, 8 – disagrees. Standards must be maintained particularly if facilities used over a 12 month period. Need to evaluate impacts of extended use. 8 – concerned with desalination and vandalism. 13 – will change in which islands will be used. Come over every 3-4 weeks for cleaning and maintenance?	Comments noted. No change required.

Table 2 Fisheries WA's response to public submissions

Issue	Submissions commenting	Proposed action
5. Fisheries WA to ensure all new marine and land-based structures associated with aquaculture activities are consistent with established building standards.	3,8,12 – agree.	Different standards will apply to marine and land based infrastructure. Need new recommendation for marine infrastructure.
6. Expand membership of the Abrolhos Islands Land Management Sub-committee to include representation from the aquaculture industry.	3,8 – agree.	Agreed.
7. Consider mechanisms to allow aquaculture operators to make use of the facilities at the Abrolhos Islands.	2 – sees merit in proposal. Equity issues. Probable opposition from other groups. 3,8 – disagrees. If it happens, stakeholders should be consulted.	No change required. Comments noted. Combine with Recommendation 3.
8. Fisheries WA to accept species listed in Table 2 as potential species for aquaculture in the Abrolhos.	1,4,6,7,11,14,15 – concern over feeding of fish. 2 – list self-evident, issue of what constitutes aquaculture of rock lobster. 3,5,8,13 – endemic filter-feeders only.	Comments noted. In recognition of community concerns regarding finfish aquaculture, Fisheries WA will refer all applications for finfish aquaculture to the Department of Environmental Protection, with a recommendation that the application be formally assessed by the Environmental Protection Authority.
9. Consider other species on an individual case basis when a proponent lodges an application for a licence for their aquaculture in the Abrolhos.	3,4,8,14,15 – no translocation of non-endemic species. 5 – no translocation. 3,5,8,13 – endemic only.	Comments noted. The plan advocates the use of endemic species only, but Fisheries WA cannot prevent an applicant from applying for non-endemic species. If such an application is received, Fisheries WA must assess it on its merits.

Table 2 Fisheries WA's response to public submissions

Issue	Submissions commenting	Proposed action
<p>10. Broodstock for the aquaculture species listed in Table 2 should originate from the Abrolhos Islands. If broodstock do not originate from the islands and have genotypes distinct from Abrolhos populations, the translocation of the species will be subject to the translocation protocol.</p>	<p>1,3,8,13,15 – broodstock should originate from the Abrolhos. 3,8 – control amount. 5,9 – more scientific information needed. 3,8 – agrees.</p>	<p>Comments noted. Research on the genetic structure of shellfish suggests that the environmental risk of translocating blacklip pearl oyster broodstock is low. Add new recommendation to allow blacklip pearl oyster broodstock to be sourced from Shark Bay area.</p>
<p>11. Consider activities involving the reseeded of scallops in the Abrolhos only following examination of environmental effects of this activity, and in conjunction with appropriate educational programs.</p>	<p>3,8 – agrees.</p>	<p>Agreed. No change required.</p>
<p>12. Fisheries WA to assess new applications for aquaculture licences in the Abrolhos to enforce the separation mechanisms.</p>	<p>3 – present Fisheries WA actions inconsistent. 3,5,8,13 – five nautical mile separation.</p>	<p>Policy applies to shellfish farms only. Amend wording of recommendation.</p>
<p>13. Proponents should use the following principles in determining where potential licence sites may be located: Licence sites cannot be located in Reef Observation Areas or on protected shipwreck sites. Sites where aquaculture is unlikely to be approved include areas of high conservation value, navigation areas, and locations already extensively utilised by the rock lobster industry. High conservation areas include:</p>	<p>1,13,15 – Recommendations 22, 24, 25, 26 should be fulfilled before projects proceed. 3 – does not specify where aquaculture can occur. Agrees with need to detail uses of area by others – add</p>	<p>Comments noted. No change required.</p>

Table 2 Fisheries WA's response to public submissions

Issue	Submissions commenting	Proposed action
<ul style="list-style-type: none"> • mangroves, seagrasses or significant coral reefs; • major habitats of significant fauna such as seabirds and marine mammals; and • any other areas which might later be set aside for the protection of flora and fauna or habitats. 	<p>commercial and wetline fishers and any other user group.</p> <p>9 – lease in Southern Group on direct course to anchorage.</p> <p>8 – agrees with principles.</p> <p>5 – a more specific term should be substituted for ‘unlikely’</p> <p>4 – criteria for defining or determining high conservation areas should be stated.</p> <p>These should be identified and mapped prior to any significant developments occurring.</p> <p>‘Significant’ flora and fauna should be defined and the criteria on which their significance is determined should be stated.</p>	

Table 2 Fisheries WA's response to public submissions

Issue	Submissions commenting	Proposed action
<p>Sites in areas adjacent to, or otherwise able to, affect areas of high conservation value are also unlikely to be approved. For example, waters adjacent to important seabird nesting areas. Also, sites with significant social importance or high visual amenity values, are unlikely to be approved for aquaculture operations.</p> <p>All other areas may be considered favourably for aquaculture, but a detailed habitat description is required as part of an aquaculture proposal.</p> <p>The application will also be required to provide information on uses by other people, such as recreational fishers, tourism operators, and private users.</p>	<p>6 – benthic habitat map needed.</p> <p>5 – management of aesthetics should be a licence condition.</p> <p>5 – what distance is required from areas of high conservation value?</p> <p>7 – plan fine for present users, but deficient for future uses.</p> <p>Access major issue for tourism at multi-use destinations.</p> <p>Visual amenity, litter on beaches.</p> <p>Safety of other users.</p> <p>9,13,14 – visual amenity.</p> <p>12 – equity an issue.</p> <p>13 – system should be mapped before aquaculture proceeds.</p>	

Table 2 Fisheries WA's response to public submissions

Issue	Submissions commenting	Proposed action
14. Fisheries WA to establish performance criteria to measure whether licences are being used in the manner in which the applications were originally made.	3,8 – agree. Wants input to criteria. 13 – Fisheries WA should have power to close unprofitable operations and clean up.	Comments noted. No change required. Performance criteria are already included in aquaculture licence conditions.
15. In accordance with Fisheries WA policy, all aquaculture proposals should continue to be subject to the established Statewide consultative arrangements outlined in Ministerial Policy Guideline No. 8.	3 – wants name of operator specified; common application date. 6 – should be formal assessment of applications. 8 – agrees. 13 – already in place, no specific statement about Abrolhos.	Comments noted. No change required. Recommendation reinforces Fisheries WA's existing practices in relation to community consultation.
16. In accordance with Fisheries WA policy, and because of the sensitive nature of the environment of the Abrolhos, continue to advertise for public comment all applications for aquaculture licences and licences.	3,8 – agree. Present summary sheet insufficient.	Comments noted. No change required. Recommendation reinforces Fisheries WA's existing practices in relation to community consultation.
17. Again because of the sensitive nature of the environment of the Abrolhos, the environment descriptions and assessment of potential environmental effects of all applications for aquaculture in the Abrolhos must be undertaken by an independent consultant.	3,8 – agree. 6 – no independent consultants in proponent driven system.	Comments noted. Comments noted.

Table 2 Fisheries WA's response to public submissions

Issue	Submissions commenting	Proposed action
18. Fisheries WA to develop performance criteria upon which to judge the success of the plan.	3,8 – agree.	No change required.
19. Fisheries WA to review the success and appropriateness of management strategies contained in this plan in five years after Ministerial approval.	3,8 – agree.	Recommendation reinforces Fisheries WA's existing practices. No change required.

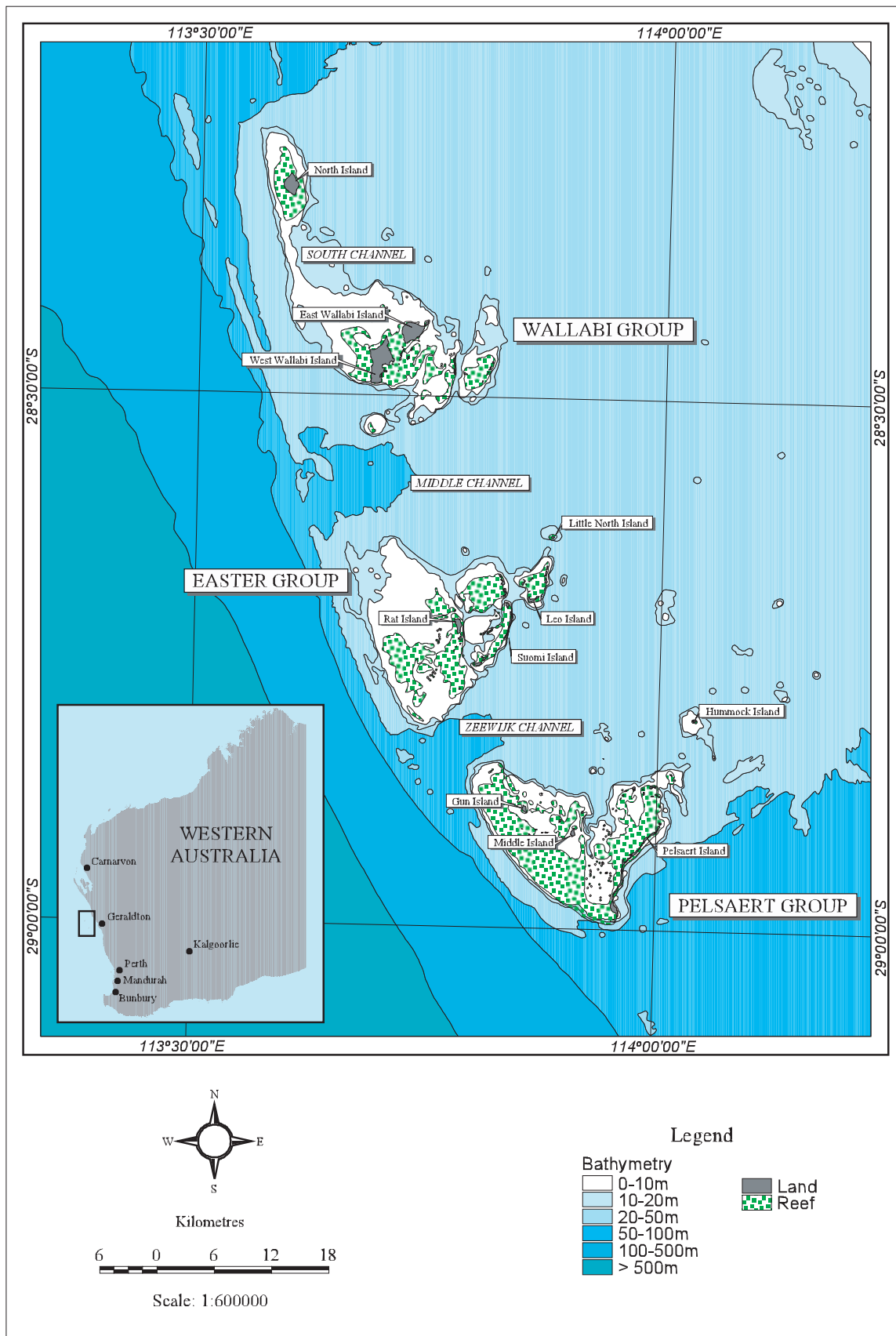


Figure 1: Map of Houtman Abrolhos Islands

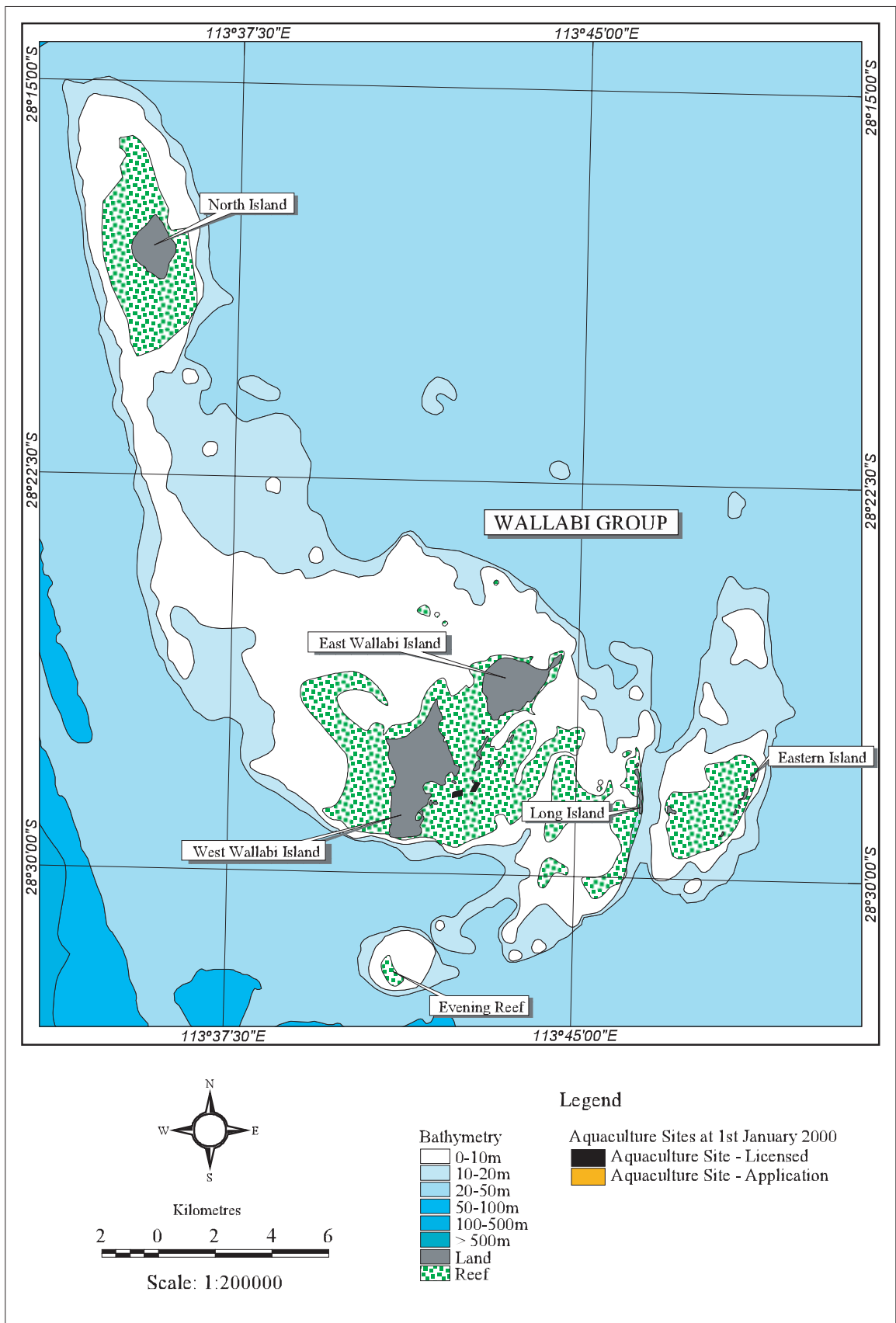


Figure 2: Existing Aquaculture Licences and Applications – Wallabi and North Island

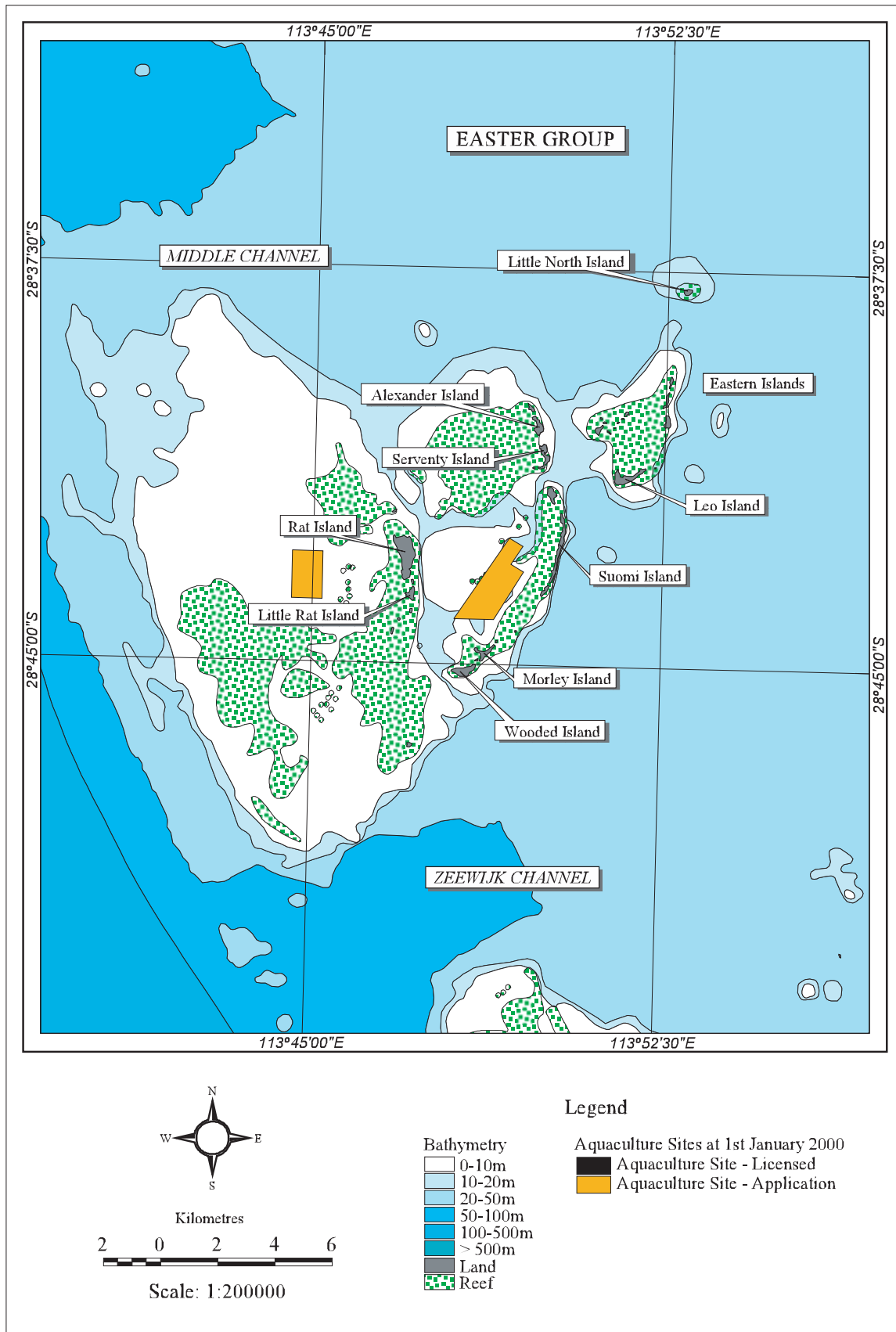


Figure 3: Existing Aquaculture Licences and Applications – Easter Group

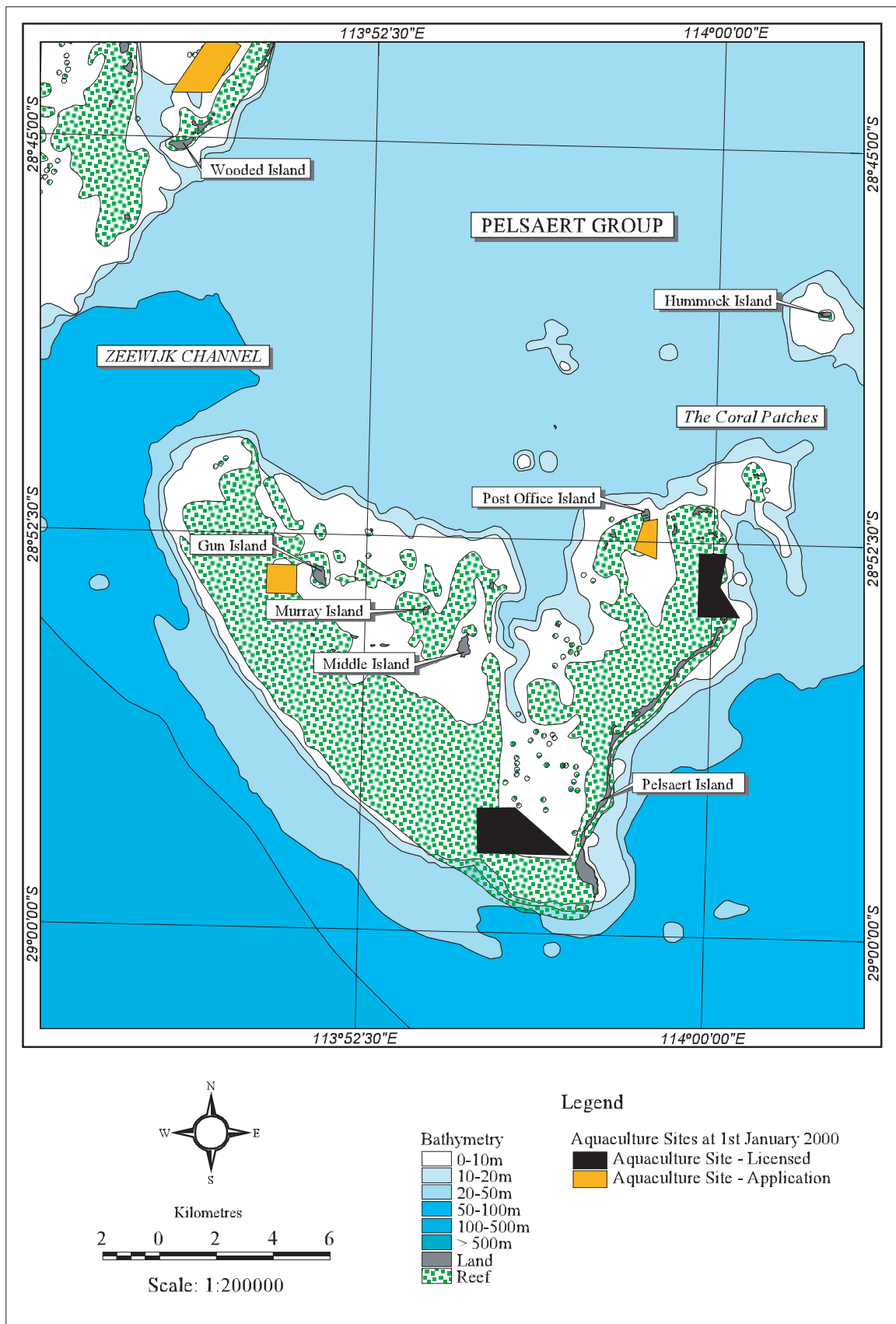


Figure 4: Existing Aquaculture Licences and Applications – Pelsaert Group

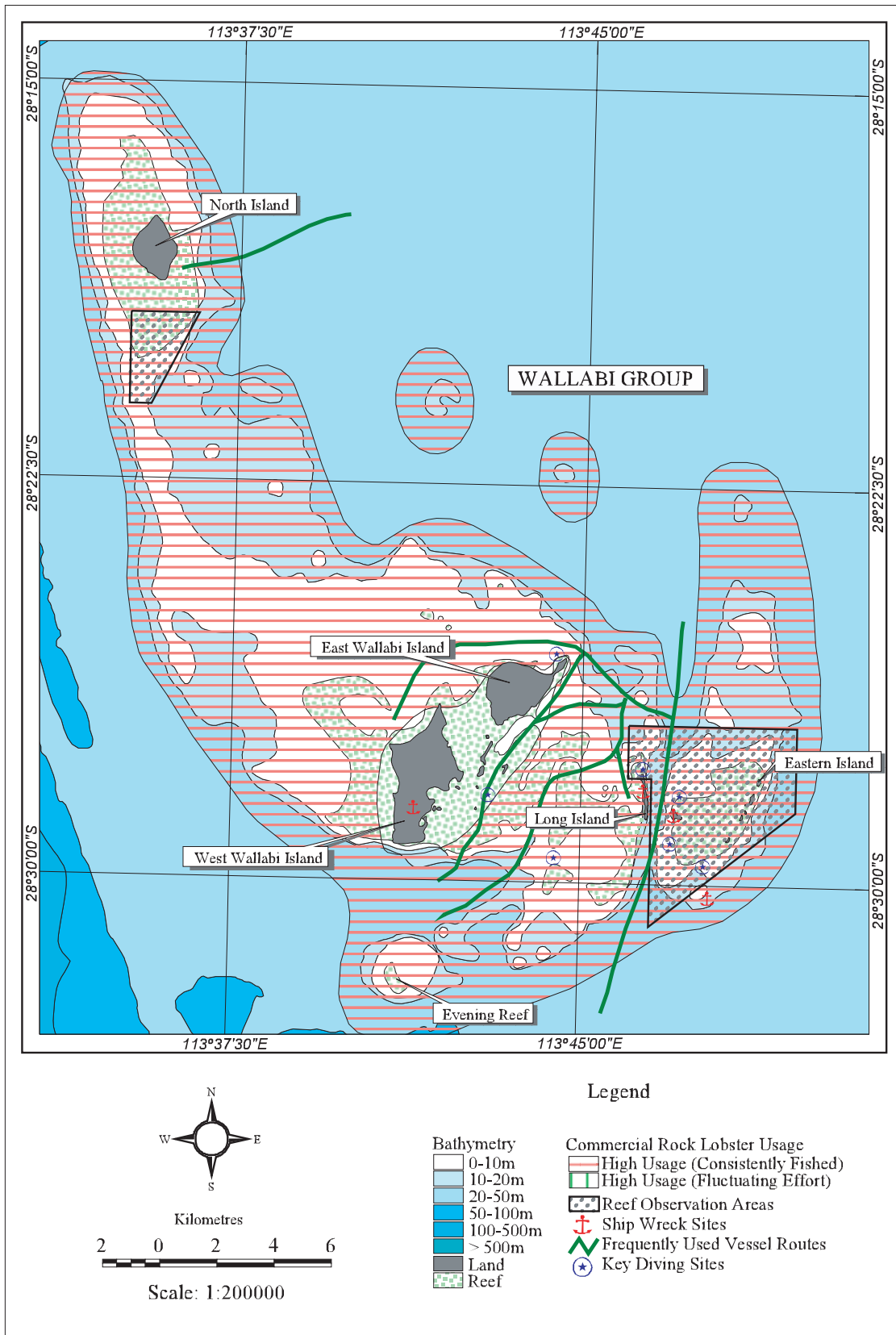


Figure 5: Other Uses Which May Constrain Aquaculture – Wallabi Group and North Island

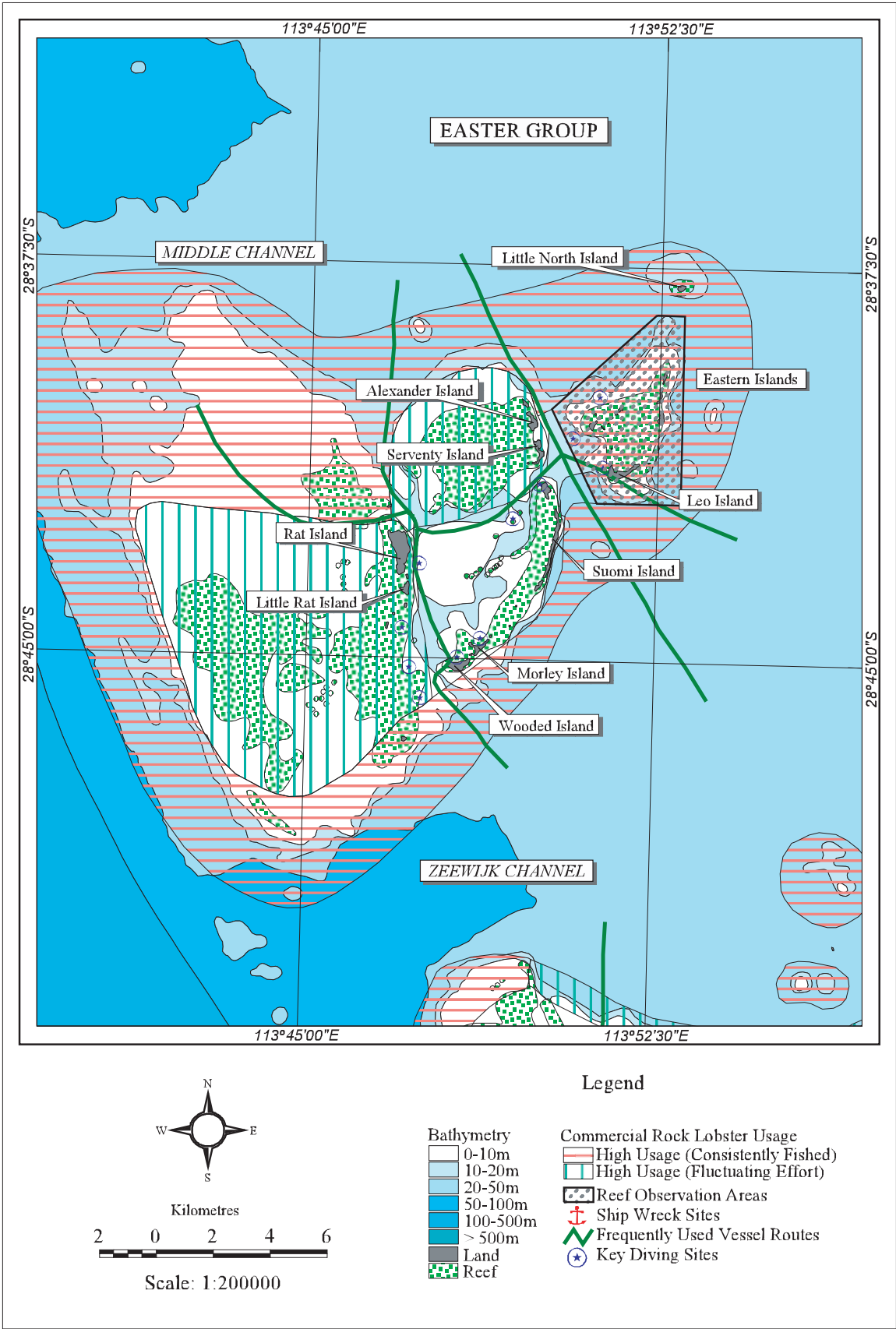


Figure 6: Other Uses Which May Constrain Aquaculture – Easter Group

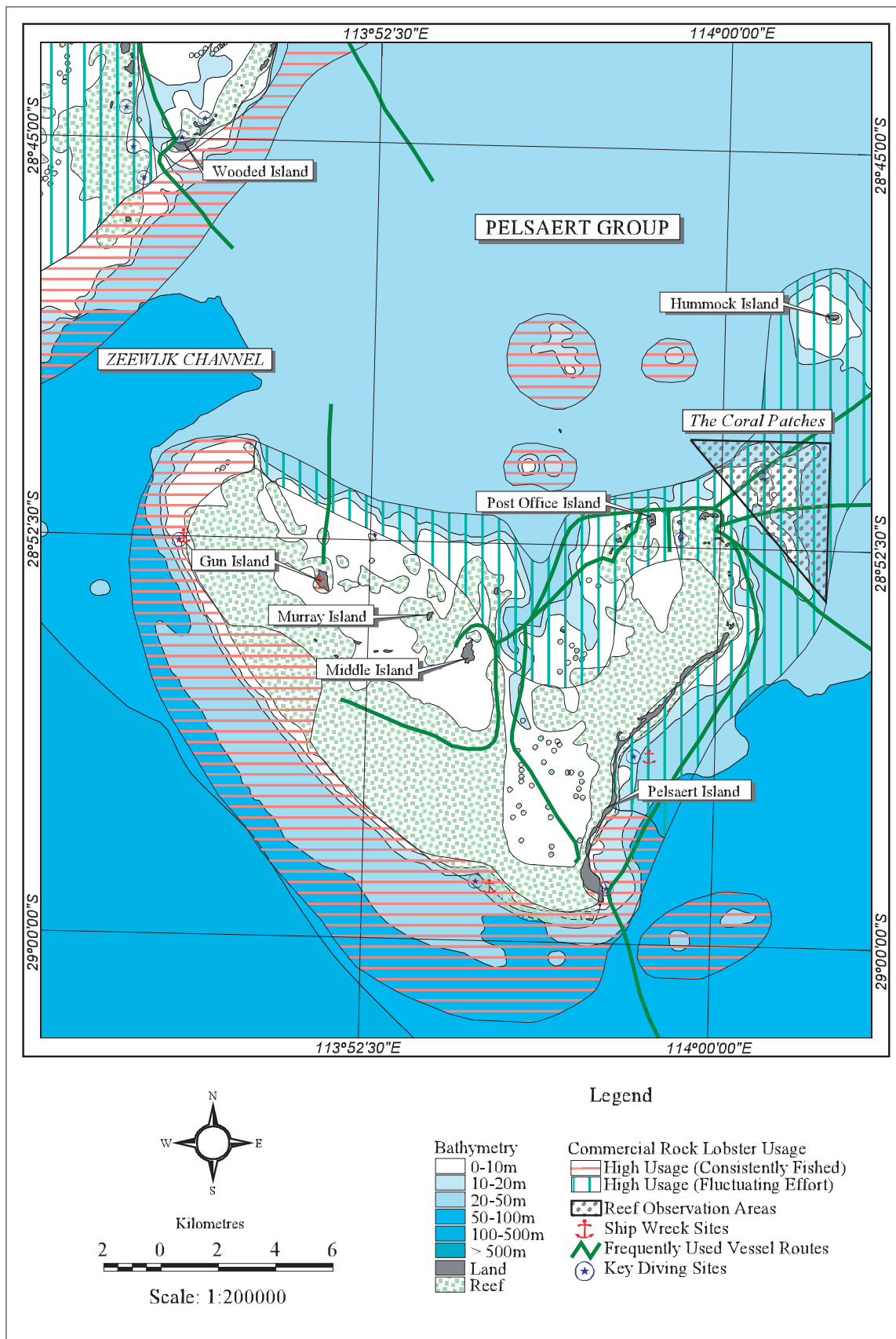


Figure 7: Other Uses Which May Constrain Aquaculture – Pelsaert Group

Fisheries Management Papers

- No. 1** The Report of the Southern Western Australian Shark Working Group. Chairman P. Millington (1986).
- No. 2** The report of the Fish Farming Legislative Review Committee. Chairman P.Rogers (1986).
- No. 3** Management Measures for the Shark Bay Snapper 1987 Season. P. Millington (1986)
- No. 4** The Esperance Rock Lobster Working Group. Chairman A. Pallot (1986).
- No. 5** The Windy Harbour - Augusta Rock Lobster Working Group. Interim Report by the Chairman A. Pallot (1986).
- No. 6** The King George Sound Purse Seine Fishery Working Group. Chairman R. Brown (1986).
- No. 7** Management Measures for the Cockburn Sound Mussel Fishery. H. Brayford (1986).
- No. 8** Report of the Rock Lobster Industry Advisory meeting of 27 January 1987 . Chairman B. Bowen (1987).
- No. 9** Western Rock Lobster Industry Compensation Study. Arthur Young Services (1987).
- No. 10** Further Options for Management of the Shark Bay Snapper Fishery. P. Millington (1987).
- No. 11** The Shark Bay Scallop Fishery. L. Joll (1987).
- No. 12** Report of the Rock Lobster Industry Advisory Committee to the Hon Minister for Fisheries 24 September 1987. (1987)
- No. 13** A Development Plan for the South Coast Inshore Trawl Fishery. (1987)
- No. 14** Draft Management Plan for the Perth Metropolitan Purse Seine Fishery. P. Millington (1987).
- No. 15** Draft management plan, Control of barramundi gillnet fishing in the Kimberley. R. S. Brown (1988).
- No. 16** The South West Trawl Fishery Draft Management Plan. P. Millington (1988).
- No. 17** The final report of the pearling industry review committee . F.J. Malone, D.A. Hancock, B. Jeffriess (1988).
- No. 18** Policy for Freshwater Aquaculture in Western Australia. (1988)
- No. 19** Sport Fishing for Marron in Western Australia - Management for the Future. (1988)
- No. 20** The Offshore Constitutional Settlement, Western Australia 1988.
- No. 21** Commercial fishing licensing in Western Australia. (1989)

- No. 22** Economics and marketing of Western Australian pilchards. SCP Fisheries Consultants Pty Ltd (1988).
- No. 23** Management of the south-west inshore trawl fishery. N. Moore (1989)
- No. 24** Management of the Perth metropolitan purse-seine fishery. N. Moore (1989).
- No. 25** Rock Lobster Industry Advisory Committee report to the Minister for Fisheries November 1988. (1989)
- No. 26** A report on marron fishing in Western Australia. Chairman Doug Wenn MLC (1989).
- No. 27** A review of the Shark Bay pearling industry. Dr D.A.Hancock, (1989).
- No. 28** Southern demersal gillnet and longline fishery. (1989)
- No. 29** Distribution and marketing of Western Australian rock lobster. P. Monaghan (1989).
- No. 30** Foreign investment in the rock lobster industry. (1989)
- No. 31** Rock Lobster Industry Advisory Committee report to the Hon Minister for Fisheries September 1989. (1989)
- No. 32** Fishing Licences as security for loans. P. Rogers (1989)
- No. 33** Guidelines for by-laws for those Abrolhos Islands set aside for fisheries purposes. N. Moore (1989).
- No. 34** The future for recreational fishing - issues for community discussion. Recreational Fishing Advisory Committee (1990).
- No. 35** Future policy for charter fishing operations in Western Australia. P. Millington (1990).
- No. 36** Long term management measures for the Cockburn Sound restricted entry fishery. P. Millington (1990).
- No. 37** Western rock lobster industry marketing report 1989/90 season. MAREC Pty Ltd (1990).
- No. 38** The economic impact of recreational fishing in Western Australia. R.K. Lindner, P.B. McLeod (1991).
- No. 39** Establishment of a registry to record charges against fishing licences when used as security for loans. P. Rogers. (1991)
- No. 40** The future for Recreational Fishing - Forum Proceedings. Recreational Fishing Advisory Committee (1991)
- No. 41** The future for Recreational Fishing - The Final Report of the Recreational Fishing Advisory Committee. Recreational Fishing Advisory Committee (1991).
- No. 42** Appendix to the final report of the Recreational Fishing Advisory Committee. (1991)

- No. 43** A discussion of options for effort reduction. Southern Gillnet and Demersal Longline Fishery Management Advisory Committee (1991).
- No. 44** A study into the feasibility of establishing a system for the buy-back of salmon fishing authorisations and related endorsements. (1991)
- No. 45** Draft Management Plan, Kimberley Prawn Fishery. (1991)
- No. 46** Rock Lobster Industry Advisory Committee, Chairman's report to the Minister (1992)
- No. 47** Long term management measures for the Cockburn Sound restricted entry fishery. Summary of submissions and final recommendations for management. P. Millington (1992).
- No. 48** Pearl oyster fishery policy guidelines (*Western Australian Pearling Act 1990*). Western Australian Fisheries Joint Authority (1992).
- No. 49** Management plan, Kimberley prawn fishery. (1992)
- No. 50** Draft management plan, South West beach seine fishery. D.A. Hall (1993).
- No. 51** The west coast shark fishery, draft management plan. D.A. Hall (1993).
- No. 52** Review of bag and size limit proposals for Western Australian recreational fishers. F.B. Prokop (May 1993).
- No. 53** Rock Lobster Industry Advisory Committee, Chairman's report to the Minister for Fisheries. (May 1993)
- No. 54** Rock Lobster Industry Advisory Committee, Management proposals for 1993/94 and 1994/95 western rock lobster season (July 1993).
- No. 55** Rock Lobster Industry Advisory Committee, Chairman's report to the Minister for Fisheries on management proposals for 1993/94 and 1994/95 western rock lobster seasons (September 1993).
- No. 56** Review of recreational gill, haul and cast netting in Western Australia. F. B. Prokop (October 1993).
- No. 57** Management arrangements for the southern demersal gillnet and demersal longline fishery 1994/95 season. (October 1993).
- No. 58** The introduction and translocation of fish, crustaceans and molluscs in Western Australia. C. Lawrence (October 1993).
- No. 59** Proceedings of the charter boat management workshop (held as part of the 1st National Fisheries Manager Conference). A. E. Magee & F. B. Prokop (November 1993).
- No. 60** Bag and size limit information from around Australia (Regulations as at September 1993) F. B. Prokop (January 1993).
- No. 61** Economic impact study. Commercial fishing in Western Australia Dr P McLeod & C McGinley (October 1994)

- No. 62** Management arrangements for specimen shell collection in Western Australia. J. Barrington, G. Stewart (June 1994)
- No. 63** Management of the marine aquarium fish fishery. J. Barrington (June 1994)
- No. 64** The Warnbro Sound crab fishery draft management plan. F. Crowe (June 1994)
- No. 65** Not issued
- No. 66** Future management of recreational gill, haul and cast netting in Western Australia and summary of submissions to the netting review. F.B. Prokop, L.M. Adams (September 1994)
- No. 67** Long term management strategies for the Western Rock Lobster Fishery. (4 volumes) Evaluation of management options Volume 1. B. K. Bowen (September 1994)
- No. 68** Long term management strategies for the Western Rock Lobster Fishery. (4 volumes) Economic efficiency of alternative input and output based management systems in the western rock lobster fishery, Volume 2. R.K. Lindner (September 1994)
- No. 69** Long term management strategies for the Western Rock Lobster Fishery. (4 volumes) A market-based economic assessment for the western rock lobster industry, Volume 3. Marec Pty Ltd (September 1994)
- No. 70** Long term management strategies for the Western Rock Lobster Fishery. (4 volumes) Law enforcement considerations, Volume 4. N. McLaughlan (September 1994)
- No. 71** The Rock Lobster Industry Advisory Committee Chairman's Report, October 1994, The Western Rock Lobster Fishery - Management proposals for the 1994/95 and 1995/96 seasons (November 1994)
- No. 72** Shark Bay World Heritage Area draft management plan for fish resources. D. Clayton (November 1994)
- No. 73** The bag and size limit review: new regulations and summary of submissions. F. Prokop (May 1995)
- No. 74** Report on future management options for the South West trawl limited entry fishery. South West trawl limited entry fishery working group (June 1995)
- No. 75** Implications of Native Title legislation for fisheries management and the fishing industry in Western Australia. P. Summerfield (February 1995)
- No. 76** Draft report of the South Coast estuarine fishery working group. South Coast estuarine fishery working group. (February 1995)
- No. 77** The Offshore Constitutional Settlement, Western Australia. H. Brayford & G. Lyon (May 1995)

- No. 78** The Best Available Information - Its Implications for Recreational Fisheries Management. Workshop at Second National Fisheries Managers Conference, Bribie Island Queensland. F. Prokop (May 1995)
- No. 79** Management of the Northern Demersal Scalefish Fishery. J. Fowler (June 1995)
- No. 80** Management arrangements for specimen shell collection in Western Australia, 1995. J. Barrington & C. Campbell (March 1996)
- No. 81** Management Options (Discussion Paper) for the Shark Bay Snapper Limited Entry Fishery. Shark Bay Snapper Limited Entry Fishery Working Group, Chaired by Doug Bathgate (June 1995)
- No. 82** The Impact of the New Management Package on Smaller Operators in the Western Rock Lobster Fishery. R. Gould (September 1995)
- No. 83** Translocation Issues in Western Australia. Proceedings of a Seminar and Workshop held on 26 and 27 September 1994. F. Prokop (July 1995)
- No. 84** Bag and Size Limit Regulations From Around Australia. Current Information as at 1 July 1995. Third Australasian Fisheries Managers Conference, Rottnest Island. F. Prokop (July 1995)
- No. 85** West Coast Rock Lobster Fishery Management Plan 1995 - Draft for Public Comment. Edited by M. Moran (August 1995)
- No. 86** A Review of Ministerial Policy Guidelines for Rock Lobster Processing in Western Australia from the Working Group appointed by the Minister for Fisheries and chaired by Peter Rich (December 1995)
- No. 87** Same Fish - Different Rules. Proceedings of the National Fisheries Management Network Workshop held as part of the Third Australasian Fisheries Managers Conference. F. Prokop
- No. 88** Balancing the Scales - Access and Equity in Fisheries Management - Proceedings of the Third Australasian Fisheries Managers Conference, Rottnest Island, Western Australia 2 - 4 August 1995. Edited by P. Summerfield (February 1996)
- No. 89** Fishermen's views on the future management of the rock lobster fishery. A report. Prepared on behalf of the Rock Lobster Industry Advisory Committee by The Marketing Centre. (August 1995)
- No. 90** A report on the issues effecting the use of the Dampier Archipelago. Peter Driscoll, Landvision Pty Ltd (March 1996)
- No. 91** Shark Bay World Heritage Property - Management Paper for Fish Resources. Kevin A Francesconi (September 1996)
- No. 92** Pearling and Aquaculture in the Dampier Archipelago - Existing and Proposed Operations. A report for public comment. Compiled by Ben Fraser (September 1996)

- No. 93** Shark Bay World Heritage Property - Summary of Public Submissions to the Draft Management Plan for Fish Resources. Kevin A Francesconi (September 1996)
- No. 94** Rock Lobster Industry Advisory Committee Report - Management arrangements for the Western Rock Lobster Fishery for the 1997/98 season. Frank Prokop (May 1997)
- No. 95** Australian Salmon and Herring Resource Allocation Committee. P McLeod & F Prokop (in press)
- No. 96** Summary Report of the Freshwater Aquaculture Taskforce (FAT) by Chris Wells (in press)
- No. 97** (in press)
- No. 98** A Pricing Policy for Fisheries Agencies - Standing Committee on Fisheries and Aquaculture Management Committee. P Millington (March 1997)
- No. 99** Management of the South Coast Purse Seine Fishery. J Fowler, R Lenanton, Kevin Donohue, M Moran & D Gaughan.
- No. 100** The Aquaculture of non-endemic species in Western Australia - Redclaw crayfish (*Cherax quadricarinatus*). Tina Thorne (June 1997)
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- No. 104** Management of the Houtman Abrolhos System (draft). Prepared by the Abrolhos Islands Management Advisory Committee in conjunction with Fisheries Western Australia (October 1997)
- No. 105** Plan for the Management of the Houtman Abrolhos Fish Habitat Protection Area (draft). Prepared by the Abrolhos Islands Management Advisory Committee in conjunction with Fisheries Western Australia (October 1997)
- No. 106** The impact of Occupational Safety and Health on the management of Western Australian Fisheries. Cameron Wilson (in press)
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- No. 110** Proposed Voluntary Fishery Adjustment Scheme - South Coast Purse Seine Managed Fishery Report by Committee of Management (October 1997)
- No. 111** Management Options for Pilbara Demersal Line Fishing. Gaye Looby (December 1997)
- No. 112** Summary of Submissions to Fisheries Management Paper No. 108 - issues affecting Western Australia's inshore crab fishery. Compiled by Cathy Campbell (April 1998)
- No. 113** Western Rock Lobster Management - Options and Issues. Prepared by Kevin Donohue on behalf of the Rock Lobster Industry Advisory Committee. (June 1998)
- No. 114** A Strategy for the Future Management of the Joint Authority Northern Shark Fishery. Prepared by Tim Bray and Jo Kennedy. (June 1998)
- No. 115** Guidelines for granting Aquaculture Leases. Prepared by Fisheries WA, the Aquaculture Development Council & the Aquaculture Council of WA. (July 1998)
- No. 116** Future Management of the Aquatic Charter Industry in Western Australia - Final Report. By the Tour Operators Fishing Working Group (September 1998)
- No. 117** Management of the Houtman Abrolhos System. Prepared by the Abrolhos Islands Management Advisory Committee in conjunction with Fisheries Western Australia. (December 1998)
- No. 118** Plan for the Management of the Houtman Abrolhos Islands Fish Habitat Protection Area (Schedule 1)
- No. 119** Access to Wildstock for Aquaculture Purposes (not published)
- No. 120** Draft Management Plan for Sustainable Tourism at the Houtman Abrolhos Islands. Prepared by LeProvost, Dames and Moore for the Abrolhos Islands Management Advisory Committee in conjunction with Fisheries WA. (December 1998)
- No. 121** Future Directions for Tourism at the Houtman Abrolhos Islands - Draft for Public Comment. Prepared by LeProvost, Dames and Moore for the Abrolhos Islands Management Advisory Committee in conjunction with Fisheries WA. (December 1998)
- No. 122** Opportunities for the Holding/Fattening/Processing and Aquaculture of Western Rock Lobster (*Panulirus cygnus*). A discussion paper compiled by Fisheries WA. (November 1998)
- No. 123** Future directions for the Rock Lobster Industry Advisory Committee and the Western Rock Lobster Managed Fishery. A discussion paper prepared by Kevin Donohue on behalf of the Rock Lobster Industry Advisory Committee. (December 1998)
- No. 124** A Quality Future for Recreational Fishing in the Gascoyne. Proposals for Community Discussion. A five-year management strategy prepared by the Gascoyne Recreational Fishing Working Group (May 1999)

- No. 125** Changes to Offshore Constitutional Settlement Arrangements; North West Slope Trawl Fishery and Western Deepwater Trawl Fishery. A discussion paper by Fiona Crowe and Jane Borg (May 1999)[not published]
- No. 126** The South Coast Estuarine Fishery. A discussion paper by Rod Pearn and Tony Cappelluti. (May 1999)
- No. 127** The Translocation of Barramundi. A discussion paper by Makaira Pty Ltd.[July 1999]
- No. 128** Shark Bay Pink Snapper Managed Fisheries in WA
- No. 129** Review of the Western Australian Pilchard Fishery 12 - 16 April 1999. Prepared by K.L. Cochrane, Fisheries Resource Division, Food and Agriculture Division of the United Nations (November 1999)
- No. 130** Developing New Fisheries in Western Australia. A guide to applicants for developing fisheries Compiled by Lucy Halmarick (November 1999)
- No. 131** Management Directions for Western Australia's Estuarine and Marine Embayment Fisheries. A strategic approach to management (November 1999)
- No. 132** Summary of Submissions to Fisheries Management Paper No. 126 - The South Coast Estuarine Fishery - A Discussion Paper. Compiled by Rod Pearn (November 1999)
- No. 133** Abalone Aquaculture in Western Australia, A Policy Guideline (December 1999)
- No. 134** Management Directions for WA's Coastal Commercial Finfish Fisheries. Issues and proposals for community discussion (March 2000)
- No. 135** Protecting and Sharing Western Australia's Coastal Fish Resources. The path to integrated management. Issues and proposals for community discussion (March 2000)
- No. 136** Management Directions for WA's Recreational Fisheries (March 2000)
- No. 137** Aquaculture Plan for the Houtman Abrolhos Islands (April 2000)