# Aquaculture within the Great Barrier Reef Marine Park

(Revision 0) 2004

***To provide:***

- ***a brief background on actual and potential aquaculture operations in the Great Barrier Reef Marine Park (GBRMP); and***
- ***a guiding statement of the approach that the Great Barrier Reef Marine Park Authority (GBRMPA) will take in assessing applications for aquaculture operations in the GBRMP.***

## Summary Statement

At a national and international level, interest in aquaculture is increasing and is expected to continue to increase in the future.

In assessing the impact or likely impact of aquaculture, a fundamental concern of the GBRMPA must be the maintenance of natural systems. In order to address this concern the GBRMPA must, where possible, ensure that ecological risk is minimised.

In relation to aquaculture, there are three activities that pose threats to the natural systems of the GBRMP. These are cage culture, restocking or reseeding, and artificial habitat development associated with aquaculture. Proponents of such activities would need to demonstrate that the operational procedures and technologies employed substantially mitigate ecological risk.

## 1. General

Aquaculture is Australia's fastest growing primary industry, accounting for about 30 % of Australia's fisheries production (Aquaculture Yearbook 2002, National Aquaculture Council). Over the last decade there has been a substantial growth of land-based aquaculture adjacent to the Great Barrier Reef Marine Park (GBRMP), with the value of prawn and barramundi aquaculture production doubling in this period. In contrast, aquaculture within the GBRMP has remained at a relatively low and static level.

However, there is increasing interest in establishing aquaculture operations within the GBRMP, driven by increased demand for seafood products, developing markets, advances in aquaculture technology and perceived employment and investment opportunities.

Currently, there are four pearl oyster culture facilities in the GBRMP (two at Fantome Island and one each at Arlington Reef and Walker Bay). There is also one cage culture facility (managed under Queensland legislation) for the production of barramundi in the Hinchinbrook Channel, which is outside the GBRMP, but in the Great Barrier Reef World Heritage Area.

Several production systems and species are in the research and development phase, e.g. culture of giant clams, edible oysters and tropical abalone (JCU), and culture of marine sponges as bath sponges and as a source of commercially significant biological compounds (AIMS).

Production systems that have been developed and used successfully overseas or in other parts of Australia over the last decade are in the scoping phase for commercial development in tropical waters, including in the GBRMP, e.g. cage culture of reef and pelagic fish and the culture of corals for research, medical, marine aquarium and ornamental use.

## 2. Zoning requirements

The Great Barrier Reef Marine Park zoning plan indicates that extensive aquaculture may be conducted, subject to permission being granted, in General Use, Habitat Protection and Conservation

Park Zones. Intensive aquaculture may only be conducted, subject to permission being granted, in General Use Zones.

Aquaculture is not allowed in:

- Buffer Zones;
- Scientific Research or Preservation Zones;
- Marine National Park Zones;
- Preservation Zones;
- Special Management Areas;
- Within 'No Structures' Sub-Zones (if a structure is proposed); and
- The Whitsundays Plan of Management Area.

Applications for operations in the General Use, Habitat Protection and Conservation Park Zones are assessed on a case-by-case basis

## 3. Assessment of applications—the approach the GBRMPA will take

**3.1.** It is likely that the GBRMPA will be required to assess two basic types of aquaculture operation in the GBRMP:

a) **Extensive aquaculture** that does not include the addition of feed; and

b) **Intensive aquaculture** that does include the addition of feed.

**3.2.** Operational technologies relevant to each type of aquaculture differ fundamentally.

a) In general, extensive aquaculture involves filter-feeding organisms. It may be undertaken in open waters or in semi-protected waters such as in the lee of reefs or islands. It is normally a stationary operation and usually the organisms are grown on the seabed or are suspended or supported off the seabed, generally in wire or plastic baskets or frames and are connected by ropes and floats to some form of anchoring or attachment system. Depending on the characteristics of the location, sea water flows freely around the organisms delivering nutrients and assisting in the removal of waste. Baskets or other grow-out containers may afford predator protection.

b) Intensive aquaculture may be undertaken in open waters or in semi- protected waters such as in the lee of reefs or islands. The organisms are contained within cages or other structures to which feed is added. The structures usually are stationary but can be moved if required. Sea water generally flows through these structures and assists in the removal of waste and uneaten feed. Other structures, such as floating ponds, hulls, tanks or locks that contain or impound seawater may also be used, with pumps (or other means) used to facilitate water circulation and waste removal.

**3.3.** The ecological risks and the potential impacts on the values of the GBRMP posed by these two types of aquaculture differ substantially and will determine the assessment approach by the GBRMPA. A more detailed account of the ecological risks to the GBRMP associated with different production systems and species is presented in sections 4, 5 and 6.

a) Extensive aquaculture of filter feeders (e.g. pearl oysters) already occurs within the GBRMP. The existing assessment and approval frameworks under the Great Barrier Reef Marine Park Regulations 1983 [Division 2.3 of Part 2 and Regulation 117] and GBRMPA policies for Environmental Impact Management and Structures are considered adequate for the assessment of extensive aquaculture operations.

With the increasing development and refinement of aquaculture management practices and methodologies designed to promote ecologically sustainable aquaculture, it is likely that existing assessment criteria will require review. The Environmental Management Charge

(EMC) regulations will require amendment; in their current form they do not reflect emerging aquaculture practices[1].

Statements on best practice management of extensive aquaculture need to be developed. Once developed, these will be incorporated into future GBRMPA aquaculture policy and associated assessment guidelines.

b) Intensive aquaculture does not occur within the GBRMP. Current Australian and international experience with intensive aquaculture indicates that the ecological risks associated with this type of aquaculture (at the current level of technological development) are likely to be unacceptable in the GBRMP.

Consequently, it is likely that permissions for intensive aquaculture in General Use Zones in the GBRMP would be granted only if the applicant can demonstrate, to the satisfaction of the GBRMPA, that there have been operational and technological advances that substantially mitigate ecological risk.

Guidelines for the assessment of applications to conduct intensive aquaculture in the GBRMP need to be developed.

## 4. Environmental issues associated with aquaculture in the GBRMP

Aquaculture operations in the GBRMP may impact on the GBRMP by:

**4.1.** Nutrient enrichment of the water

The release of uneaten food, dissolved nutrients and fish faeces in the water column may result in nutrient enrichment and may lead to local algal blooms and direct impacts on benthic organisms such as hard corals. A recent study in the Red Sea has shown that fish-farm nutrients have caused algal blooms, coral mortality and reduced calcification (J. Erez, Hebrew University of Jerusalem, pers. comm.).

Intensive aquaculture such as cage culture of fish will lead to a significant net input of dissolved nutrients because of the addition of fish feed. The effects of increased nutrient supply from a variety of sources on the health of GBR ecosystems are discussed in detail elsewhere (e.g. Devlin et al. 2001, Haynes 2001, Schaffelke et al. 2001).

**4.2.** Organic enrichment of the benthos

Localised enrichment of the seafloor with organic matter from fish excretions and excess fish feed can produce changes in the physical and biological characteristics of the seabed. These changes are considered to be the most important environmental impacts of aquaculture in marine systems, in particular intensive aquaculture that includes a net input of organic matter through addition of feed (Gowen & Bradbury 1987). Under low energy conditions, organic matter is deposited on the seafloor and accumulates directly below the aquaculture structure or near to it depending on the direction of the prevailing current. In principle, the effects of organic enrichment from intensive cage culture are similar to organic pollution from other sources. This enrichment leads to anoxic sediments, resulting in decreased oxygen concentrations in overlying water, increased sulphate reduction, and changes in benthic faunal assemblages (Gray et al. 2002).

**4.3.** Potential impacts on wild fish populations

### a. Introduction of disease and parasites

In high-density stocking situations, such as in cage culture, fish may become stressed, thereby making them more susceptible to diseases and parasites that can be transmitted easily to wild stocks with consequent serious impacts. The industry practice of treating disease or parasitic

[1]Regulation 136 (d) refers to the establishment or operation of farming facilities for the culture of pearls or clams. This regulation requires revision to accommodate the potential range of 'in park' aquaculture.

infection with antibiotics or disinfectants and the subsequent release of these therapeutic agents into the marine environment may result in environmental impacts.

The Northern Hemisphere salmon industry has had severe environmental problems with farm-borne parasites decimating wild salmon populations (Heuch 2000). In Norway, stringent parasite controls have since been implemented. Although the mean salmon lice infection incident rate has been reduced from approximately 7 per fish in 1997 to 0.5 per fish in 2001, the numbers present in farmed salmon still appear to pose a problem for wild salmon stocks (Holst et al. 2002).

There is a risk that endemic but translocated organisms may carry a pathogen that could be transmitted to populations that have not been exposed to it previously and have no resistance to it. Juvenile and adult molluscs moved from one location to another may carry shell- fouling organisms into an area where these organisms do not occur naturally.

Given these risks, management measures such as mandatory health certification and the use of hatchery-reared juvenile stock would need to be considered if movement of stock from one location to another is contemplated.

### b. Genetic pollution of wild stocks by non-local escapees and organisms associated with them (see also restocking at section 7)

Genetic contamination of wild stocks by farmed stock is a major concern. Selectively bred or genetically modified aquaculture stock may escape and breed with wild stock and lead to genetic dilution or alterations of the gene pool of natural populations. The transmission of disease or parasites to wild fish may also have serious impacts on wild stocks.

## **4.4.** Attraction of predators

Aquaculture in the GBRMP may attract predators, commensals and other species to areas where they do not aggregate normally. This may affect the balance and natural behaviour of species in the area, as well as the amenity value.

## **4.5.** Structures in the GBRMP

Impacts of structures include but are not limited to:

- entanglement/entrapment of organisms, especially turtles and cetaceans;
- modifying habitat;
- impeding or modifying instinctive responses or behavioural characteristics of organisms;
- limiting habitat access (fish spawning aggregation sites, breeding and foraging sites);
- amenity impacts; and
- hydraulic impacts. The effect on water movement may be particularly relevant in a channel or tidal stream gutter where the structure occupies a significant proportion of the width of the channel or gutter.

The impacts of structures are discussed more fully in the GBRMPA Structures policy.

## **4.6.** Cumulative Impact

The cumulative impacts of proposed aquaculture operations in the GBRMP require consideration. A 'plan of management' for aquaculture may need to be developed so that permit considerations, although done on a case-by-case basis, are guided by a strategic plan that takes into account cumulative and amenity impacts.

# 5. Species and/or production system risk assessment

*Pearl oyster*

- Low risk of nutrient enrichment;
- Translocation issues may pose high risks because most broodstock is either harvested in the Torres Strait or produced in hatcheries in tropical Western Australia;
- Potentially high risk of disease transmission to wild stocks;
- Unknown risk to coral reefs by depleting natural food source, but likely to be low risk;
- Risk of impact of structures;
- Established production system, minor R&D requirements.

*Other Filter feeders (edible oysters, giant clams, corals, sponges)*

- Low risk of nutrient enrichment;
- Potentially high risk of translocation of non-endemic stock, especially if restocking/reseeding of cultured propagules is considered;
- Potentially high risk of disease transmission to wild stocks;
- Unknown risk to coral reefs by depleting natural food source;
- Risk of impact of structures;
- Some R&D required, e.g. to adapt southern Queensland techniques for oysters.

*Cage culture of reef and pelagic fish*

- High risk of significant input of organic matter and nutrients;
- High risk of disease transmission to wild stocks;
- High risk of escape;
- Potentially high risk of translocation of non-endemic stock;
- Risk of impact of structures;
- Substantial R&D required;
- Technological development may decrease risks.

# 6. Environmental Impact Management

- The control of naturally-occurring predators, commensals and other species around aquaculture facilities may require a formal predator control management plan.
- Taking account of cross-shelf, latitudinal and bioregional differences, broodstock would need to be collected from the nearest viable population. Appropriate consideration (if applicable) should be given to the planktonic life cycle of the species and the hydrodynamics of the aquaculture site.
- Genetic homogeneity—in circumstances where data published in the scientific literature have established that stock of a particular species is genetically homogenous within its natural range, broodstock collected from within that range is likely to be acceptable.
- To minimise the risk of disease and pest introduction to wild populations, the identification and establishment of genetic low-risk zones or corridors for species (or groups of species) may need to be considered. For example, restrictions on the movement of filter feeding or other organisms

may be necessary to minimise the risk of the spread of diseases and pests into areas where those diseases and pests do not occur naturally.

- Sediment removal or cleaning procedures (e.g. defouling of structures and stock) should be done in a manner that minimises environmental and amenity impacts, with all procedures documented and approved by the GBRMPA on a case-by-case basis.
- Aquaculture operations are likely to require ongoing independent environmental monitoring at the expense of the operator.

## 7. Other issues associated with aquaculture or aquaculture-related operations (such as stock or habitat enhancement) that may impact on wild stocks, habitats, and the equitable use of the GBRMP

### **7.1.** Conflict of use, exclusive use over an area, security

These matters may become pertinent as an operation moves to full production, particularly where the product is high value/low volume. For example, there are significant security issues associated with pearl production. The degree to which security requirements may seek to restrict access and impact on the amenity value of an area needs to be considered as part of the business planning and assessment processes.

### **7.2.** Restocking

Species restocking, as a method of resource management in an open system, carries with it extreme levels of genetic and ecological risk and is in conflict with the fundamental objective of conserving natural systems. Calls for restocking may be indicative of the failure, for example, of fisheries management strategies to achieve ecological sustainability. In such cases, the solution to the problem should be a reduction in fishing pressure rather than the introduction of hatchery-produced fish. It is unlikely that the GBRMPA would permit restocking as a method of resource management.

## 8. Definitions

**Aquaculture operation in the GBRMP**

Means an operation for the propagation, rearing, keeping or breeding of an aquatic organism (including but not limited to fish, crustaceans, reptiles, corals, molluscs and plants).

**Broodstock collection**

Means the taking of adult breeders for aquaculture purposes.

**Extensive aquaculture**

Means an aquaculture operation that does not includes the addition of feed, such as pearl oyster, oyster, clam and sponge aquaculture.

**Habitat enhancement**

Regarding aquaculture or aquaculture-related operations, means the provision of artificial or enhanced habitat for the settlement of larvae or grow-out of juvenile animals and/or the attraction and retention of animals.

**Intensive aquaculture**

Means an aquaculture operation that includes the addition of feed.

**Restocking**

Means the release of aquatic animals or plants reared in captivity (hatchery, nursery) or collected elsewhere.

## 9. References

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## 10. Further information

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