Fisheries discussion paper

Abalone Aquaculture in Western Australia

Discussion Paper and Draft Policy Guidelines

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Would You Like To Comment?

The development of abalone aquaculture in Western Australia raises a number of issues in relation to its potential interaction with commercial and recreational fisheries and the broader community. Policy and associated management guidelines for abalone aquaculture need to be developed which facilitate industry development, whilst taking into account the interests and concerns of other community sectors.

The purpose of this discussion paper is to highlight relevant issues associated with abalone aquaculture development and outline a set of draft policy guidelines. The paper is being disseminated to members of the aquaculture industry, commercial and recreational fishing bodies and the broader community to allow comment. The Fisheries Department would like to know what you think about the contents of this paper.

POINTS TO CONSIDER

To ensure that your comments are as effective as possible, please:

- clearly and briefly describe each separate subject you wish to discuss;
- assist us by referring to the relevant section/s and page numbers in the paper;
- tell us whether you agree or disagree with any or all of the issues identified under each heading, or are simply commenting on those of special interest to you;
- clearly state your views and feel free to quote from other documents/sources of information, where appropriate; and
- feel free to suggest ways of resolving any of the issues you have raised.

WHERE AND WHEN TO SEND YOUR SUBMISSION

Any submissions on this paper must be made, in writing, to the Fisheries Department by the close of business on 7 December 1997. Please send your submission before this date, along with your full name, address, and association details (if applicable) to:

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Content

1.0 Introduction

There is an increasing interest and investment in abalone aquaculture throughout the world. Chinese and Taiwanese abalone aquaculture production combined for example was in the order of 2000 tonnes in 1994 (Hone and Maguire 1996). This production is highly significant considering that world production from wild abalone fisheries was approximately 14,000 tonnes in 1991 (Rudd 1994) and Australian wild fishery production is approximately 5000 tonnes per annum (ABARE, 1995).

This increasing interest is reflected in Western Australia although to date there has been no abalone aquaculture production from this State. As of 20 August 1997 no licences to culture abalone had been issued, although there were six applications for licences to culture abalone before the Inter Departmental Committee for Aquaculture (IDCA). There are also three applications to vary existing aquaculture licences to include abalone and two scientific permits have been issued to take wild abalone for culture research purposes.

The three main species of interest are those that form the basis of the commercial fishery, the green lip (*Haliotis laevigata*), the brown lip (*H. conicopora*) and Roe's abalone (*H. roei*). Brown lip may be regarded as conspecific with black lip abalone (*H. rubra*) from south eastern Australia (Shepherd 1975, Brown 1991b, Brown and Murray 1992a). There is also some interest in other species, either as stand alone species or as candidates for cross-breeding. Examples include the tropical abalone *H. asinina* and the elegant abalone (*H. elegans).*

There has been considerable investment and research into abalone aquaculture in Tasmania and South Australia. The research has been coordinated and partly funded by the Commonwealth Fisheries Research and Development Corporation (FRDC) and the Aquaculture Cooperative Research Centre (ACRC). The research has produced some promising results and is generally leading to more cost effective grow out systems. This information is providing impetus for the interest in WA and should provide WA farmers with faster development time frames.

1.1 Wild Fishery

The Western Australian commercial abalone fishery exploits green lip, brown lip and Roe's abalone. The Fishery is managed via the Abalone Management Plan under Part Six of the *Fish Resources Management Act 1994* (FRMA). The fishery is divided into three Zones with Zone 1 divers taking all three species east of Shoal Cape, Zone 2 divers taking brown lip and green lip abalone between Shoal Cape and the Busselton Jetty, and Roe's abalone between Shoal Cape and Cape Leeuwin and Zone 3 divers restricted to the take of Roe's abalone with access to all areas of the coast excepting marine reserves and certain areas set aside for recreational fishing. Zones 1 and 2 are further divided into sub Zones.

The fishery is primarily managed through minimum size limits, individual quotas for divers and total allowable catches for each Zone or sub Zone. Total commercial catches, in whole weight, across the Zones for the three species in 1995 were:

- green lip 169.4 tonnes,
- brown lip 29.5 tonnes and
- Roe's 121.2 tonnes.

There is also a recreational fishery for all three species. The recreational sector is a major component of the Roe's abalone fishery. Roe's abalone is found on shallow reef areas and as such is easily accessed by recreational fishermen. This fishery is controlled by minimum sizes, fishing licences and restricted open seasons for popular reefs such as the metropolitan area and the Greenough to Flat Rocks reefs. The total recreational take is difficult to determine although the take of Roe's abalone in the Metropolitan area, is estimated to be in the order of 20 tonnes per annum.

1.2 Culture Methods

Abalone can be cultured using a variety of methods and as there may be different policy ramifications when considering each method, it is useful to divide culture methods into the following categories:

Land based:

- hatchery
- grow out

Marine based:

- enclosed culture (barrels, cages etc.)
- culture on artificial substrate
- seeding of reefs on which wild stocks of abalone do not occur
- reseeding of reefs on which wild stocks of abalone do occur.

1.2.1 Land Based and Enclosed Marine Systems

Land based tank culture and enclosed marine culture systems each have economic and biological advantages and disadvantages and there is a healthy debate about which system offers the best chance of commercial success. Land based systems offer a higher level of control over the operation, however they usually require a high capital investment in tanks and water intakes. Recent developments in tank design however have lowered both the costs of the tanks and the water requirements. Enclosed marine systems can have significantly lower capital requirements, although they offer little control over environmental parameters and labour costs for feeding, cleaning and harvest can be high.

1.2.2 Reseeding and Artificial Substrate Culture

The commercial and/or biological viability of culture on artificial substrate and seeding of reefs (whether or not they already support wild populations) is yet to be determined in Australia and is likely to be extremely site dependent.

Spat in the wild can be subject to low survival due to predation, and growth can be highly variable due to food availability. Artificial substrate or "vacant" reefs would need to be located in an area with sufficient natural food supplies. If a reef does not currently support an abalone population then it could be hypothesised that it is unlikely that it would support seeded populations. There may be some vacant reefs which have previously supported populations which died out due to a one off event and have not since been re-colonised. However identifying these reefs is likely to be difficult and these reefs may contribute to the wild fishery in the future.

Overseas the reseeding of areas which already contain abalone makes a significant contribution to the take of abalone, especially in Japan. It should be noted however, that there is traditional individual ownership of reef areas in Japan and the reseeding program is heavily subsidised. The South Australian Research and Development Institute (SARDI) in conjunction with the Fisheries Research and Development Corporation (FRDC) has been conducting trials on larval reseeding of green lip and black lip abalone. The results of this trial will be released as an FRDC report in August 1997 and should provide an indication of the likely commercial and biological benefits of reseeding natural populations in Western Australia.

The reseeding of areas which already contain wild stocks of abalone raises issues relating to access and ownership of stock. In situ identification of seeded stock and differentiation from naturally recruited stock is not possible. All stock on the seeded reef may therefore, be regarded as natural stock for the purposes of ownership and access. This means that the benefits from the investment required to seed stock may be shared by fishermen, both recreational and commercial, who did not contribute to the seeding program.

Changes to any access, quota arrangements or total allowable catch for a reseeded area, would require an amendment to the Abalone Management Plan and recreational fishery Notices. Amendments to Fisheries Management Plans are the responsibility of the Commercial Program of the Fisheries Department who must undertake consultation with existing fishermen before seeking Ministerial approval. Consequently it may be that in the medium term, the only benefit to those investing in reseeding would be an improvement in the catch per unit effort. Given the legislative requirements for amending the Abalone Management Plan, the opportunities for reseeding areas which already contain abalone may be limited to commercial fishermen already fishing in that area.

1.3 Feed inputs

The culture method also has implications for the type and amount of feed used in the system. Raceway or barrel culture can utilise either a full artificial diet or an artificial diet combined with natural seaweed supplement. Some in water systems rely on catching drift weed while

reseeding proposals are totally reliant on the available natural feed. This has obvious implications for site selection and associated environmental impact.

2.0 Key Issues

The following key issues relate mainly to the potential interaction between the aquaculture industry and the wild fishery. Some of the issues relate to the industry as a whole and others are specific to particular culture techniques.

2.1 Risk of disease introduction or increase in the wild fishery

There are two possible avenues whereby the culture of abalone could introduce pathogens into wild abalone stocks.

Firstly there is the risk that non endemic, pathogenic organisms may be introduced into an area by the translocation of abalone from other areas. Any proposal for translocation of abalone would need to be assessed through the translocation assessment protocol currently being developed by the Department in liaison with the Environmental Protection Authority. Any successful proposal would then include a rigorous disease testing and quarantine protocol.

The second area of risk is the possibility of an increase in endemic disease in wild stocks due to the proximity of cultured animals. Due to the higher animal density and subsequent stress of a culture situation, levels of disease causing organisms can increase. A culture environment may therefore act as a reservoir of pathogens which could increase the level of pathogens in the wild. It should be noted that once a pathogen is released from the culture situation it is no longer in the environment which caused its numbers to increase, ie. higher density, and survival of the pathogen is therefore at the same level as that in the wild. It could be hypothesised that in terms of transfer of endemic disease, wild stocks pose a greater threat to cultured stocks than vice versa. The risk of disease interaction between cultured and wild stocks can be further minimised by regular disease testing and sound management practices.

Two possible areas of concern to abalone are perkinsiosis, caused by the protozoan *Perkinsus olseni* and shell infestations of polychaete mudworms. Perkinsiosis has caused mortalities of abalone along the coast of South Australia, however the organism occurs along the coasts of all mainland states and has been isolated from a large range of molluscs in northern WA where no disease was apparent. As the organism is ubiquitous it is likely that mortalities are due to environmental stresses lowering resistance, however there is a low risk of the introduction of more pathogenic strains.

The polychaete mudworm *Polydora websteri* causes significant economic damage to the Sydney rock oyster industry and two similar species, *Polydora hoplura* and *Boccardia knoxi*, have caused mortalities in abalone in Tasmania. Again these organisms are ubiquitous and mortalities can be correlated to environmental stresses, especially high rainfall events and associated increases in silt loads.

2.2 Risk to the genetic integrity of the wild fishery

Aquaculture poses two risks to the genetic integrity of wild stocks; (1) the introduction of new genetic material and (2) a reduction in the heterogeneity (diversity) of existing genetic material. These events could only occur where there is a genetic contribution to the wild pool from farm stocks ie. cultured stock or larvae from cultured stock escaping and surviving in the wild.

These issues were the subject of a consultancy conducted by Dr. John Benzie of the Australian Institute of Marine Science for Primary Industries South Australia. In the report Dr. Benzie (1996) found that there is evidence that abalone (green lip) stocks are genetically differentiated, that interaction (larval dispersal) between these differentiated populations is restricted and that significant differences can be found over very small distances (less than 1km).

It should be noted that significant difference in this case, refers to the level of confidence that observed differences are real and does not indicate the quantity of genetic difference. The most commonly used measure in estimating the quantity of genetic difference is mean F_{ST}, the standardised genetic variance among populations.

Brown (1991a), using a larger data set, estimated the mean F_{ST} for green lip abalone for 10 sites between southern Western Australia and Tasmania, separated by about 2,400 km, was 0.016. This is quite a low value for such a wide geographical region. Therefore while significant genetic differences can be found in green lip abalone over small distances, the amount of difference is very small, both locally and over its whole range.

Genetic studies for black lip abalone (=brown lip abalone) show that it has less geographical differentiation than green lip. Brown (1991b) sampled seventeen localities from southern Western Australia to New South Wales, including Tasmania, and concluded that "Zones of 500 km of coastline, corresponding to 'neighbourhood size', could be recognised for the conservation of regional gene pools".

Authors appear to be divided over ecological evidence concerning the extent of dispersal of green lip and black lip abalone larvae. Some favour restricted dispersal (Prince *et al.* 1987, 1988, McShane *et al.* 1988) while others consider widespread dispersal possible (McShane 1992, Fallu 1994). Shepherd and Brown (1993, p. 2004) conclude that "these ecological studies are not definitive". . A recent trial by SARDI suggested that larvae are actively geo-negative, ie. they swim away from the bottom, for at least three days. This would mean that larval dispersion of hundreds of kilometres is possible.

Only a small genetic data set exists for Roe's abalone. Brown (1991a) compared 15 individual abalone from southern Western Australia with 15 individuals from South Australia. The sample localities were separated by about 1500 km. A moderate F_{ST} of 0.048 is estimated. The limited data set does not indicate a high level of genetic subdivision, but more information is required before reliable conclusions can be reached. Wells and Keesing (1990) suggested that larval recruits replenishing heavily fished reef stock travelled at least several kilometres.

Genetic differences that have been detected between populations are based on neutral markers. The adaptive, or fitness value of the observed differences are unknown. The adaptive value effects the survivability of genetically altered escapees and therefore their ability to interact with wild stock. The wild stock are the product of a long process of evolutionary forces preserving the genes of the best adapted abalone, and so are likely to have a greater level of fitness than genetically altered escapees. This suggests that escapees should not persevere at the expense of the fitter wild stocks. The outcome depends on the difference in fitness between the two stocks.

Dr Benzie's report concluded that there was minimal genetic risks to wild stocks from marine based farming if:

1. production batches use progeny derived from a sufficient number of parents (minimum of 25 broodstock);

2. the broodstock are obtained from local populations; and

3. the sea-culture facility is located 2km or more from a wild population.

Benzie reported that these measures limit the risk of genetic material from cultured animals interacting with wild populations, ensure that if such interaction did occur then; no new genetic material would be introduced and the heterogeneity of the introduced material would be similar to that in the wild stock.

Benzie's report divided green lip abalone stocks in South Australia into genetic zones and recommended on going monitoring and research of the genetics of both farmed and wild stocks.

2.3 Consequences to Aquaculture of Genetic Risk Minimisation

These risk minimisation measures place two significant restrictions on abalone aquaculture. Firstly they do not allow sea based farmers to breed selectively for better performance (growth, flavour etc.) and secondly, they may severely restrict the area available for culture sites. Finding a site where no wild abalone exist within 2kms may be difficult especially where small populations are widely dispersed. Farming abalone in areas close to wild populations also has obvious benefits in terms of water quality parameters. There is also evidence to suggest that larvae can disperse over distances greater than 2kms.

An alternative method of minimising genetic risk is to prevent genetic inputs from farmed stocks via either triploidy or harvesting animals before they reach sexual maturity. There are two major problems with this approach. Firstly 100% triploidy is difficult to achieve and it is possible for some animals in a population to reach sexual maturity at a smaller size. Secondly, imposing size limits or insisting on triploidy in aquaculture limits production options, increases production costs and may prevent farmers growing an animal to suit the market.

2.4 Compliance Issues

The "laundering" of illegally caught wild stock through an aquaculture operation is a risk to the management of wild abalone stocks. Laundering avenues include farmers on-growing illegally caught wild stock or wild animals (especially undersize) being passed off as farmed stock.

Currently all wild caught abalone have to be processed at a premises which holds a Processors Licence endorsed for abalone. This system includes an auditable documentation trail to ensure the integrity of quota management. An aquaculture licence enables the holders of the licence to process, on the licensed site, stock which have been cultured on that site. Each aquaculture licence issued increases the number of sites where abalone is legally permitted to be processed and this has obvious implications for compliance.

In order to prevent laundering it will be necessary to have a mechanism to identify "farmed" abalone and to have a comprehensive compliance program which includes audits, inspections and a document trail giving prior notification of harvest and processing activities.

Identifying farmed abalone is possible via a diet marker at the hatchery stage. This marker leaves a detectable band on the shell. Any farmed abalone which is to be processed at a site which also processes wild caught abalone would have to be sent to the processor in shell.

An alternative to diet markers is the use of genetic markers. Micro satellite DNA testing techniques may offer an avenue for identifying abalone from discrete populations and some work has been done in this area by Deakin University in Victoria. The technique could have obvious benefits for the management of the wild fishery as well as aquaculture. The technique, however, will be expensive and must stand up in court. Separating wild stock from aquaculture stock, bred from the same genetic, Zone will not be possible using genetic markers and this may limit the usefulness of the technique in aquaculture.

2.5 Resource Sharing (Stock and Water)

These are general issues which relate to all aquaculture industries and are normally dealt with through the aquaculture licence application and associated consultative process.

In terms of specific issues relating to abalone, commercial fishery participants have raised issues of concern with respect to the take of wild stock for broodstock or trial purposes. Whilst the requirements for abalone broodstock are only in the order of several hundred animals per locality and several thousand animals overall, the issue of aquaculturists gaining access to wild stock is one that requires a high level of consultation and consideration.

The Fisheries Department is currently preparing a discussion paper on the issue of access by aquaculturists to wild stock of all species which will be disseminated to all interested parties for comment once finalised. The paper will outline the possible legislative and policy avenues that may be used by aquaculturists to obtain stock necessary for their operations in a manner consistent with equitable resource sharing principles.

The current avenues for aquaculturists to access stock for broodstock or trial purposes are purchase from licensed commercial fishermen or a Ministerial Exemption under section 7 of the FRMA. As stated above access arrangements other than purchase from commercial fishermen or Ministerial Exemption would require amendments to the Abalone Management Plan.

There are also concerns regarding the size of marine licence areas, especially in areas subject to commercial or recreational fishing. The size of a licence area should be directly related to the biological requirements of the species to be grown and the economics of its production. For enclosed marine culture (barrels or cages) an area of 10 to 20 hectares would be a viable production unit. The area required for seeding of artificial substrate or reef is site dependent and needs to be assessed on a case by case basis.

3.0 Other issues

The effect of farmed abalone on the market for wild caught abalone and the lack of an abalone hatchery are two issues which, although primarily a matter for industry, are worthy of discussion.

Both positive and negative effects have occurred in other fisheries where aquaculture production has become significant, eg. prawns. The market usually differentiates between the two sources of stock and this is already taking place in the abalone market with Chinese cultured product being regarded as a different product to Chinese wild caught abalone (Johnston 1996). In general terms farmers will be seeking to grow an animal to suit the market eg. small and live, and farmed product may therefore attract a premium.

The demand for abalone is increasing with continuing economic growth in Asia and the international wild fishery is not expected to increase significantly. Subsequently any market effect of increased farmed abalone production in Western Australia is unlikely to be dramatic and any effect would come from increased production by overseas farms rather than Western Australian production.

Encouraging investment by wild fishermen into the culture industry and market promotion of wild caught product in a similar fashion to the prawn industry are possible avenues for the commercial sector to maintain and increase their involvement in the abalone market.

The lack of a commercial abalone hatchery to supply stock is a major impediment to the development of the industry in WA. It has meant that farmers wishing to trial techniques have had to rely on scientific permits or Ministerial Exemptions. Scaling up to commercial production and addressing the genetic issues will not be possible without the development of quality commercial hatcheries in WA. One licence has been issued for a research hatchery at Fremantle Maritime Centre and two applications for hatchery licences are before the IDCA. Methods of facilitating further development of hatcheries should be investigated.

A third issue is who pays for the costs associated with compliance and research required to establish and monitor genetic Zones. Aquaculture is not currently a “cost recovery fishery”, however in the medium to long term it could be expected that compliance and research costs will be recovered after consultation with industry.

4.0 Research Required

The division of wild abalone stocks in Western Australia into genetic Zones needs to be further researched. This research should include the degree of linkage and gene flow between populations so as to determine a definition of what constitutes a separate population.

There is also a need for the on going monitoring of the genetic constitution of cultured batches so as to ensure that the management strategies are achieving their goal of minimising the risk of genetic impacts.

Investigation of the use of genetic marker technology to identify the origin of abalone would have considerable value to the management of both the aquaculture industry and the wild fishery.

There is also considerable research which could be undertaken to enhance the development of appropriate culture methodologies for Western Australia. This is especially applicable for the culture of Roe's abalone and crosses of Roe's with other species. Roe's abalone displays characteristics in the wild, such as high temperature tolerance and rapid growth up to 50mm, which could be advantageous in a culture situation. Conversely its restricted habitat preference and maturity at a relatively small size may prove difficult to deal with in culture. In order to assess the aquaculture potential of Roe's abalone quality research into nutritional requirements, larval culture, tank design and environmental parameters needs to be undertaken.

Any research into abalone aquaculture in Western Australia should be undertaken in conjunction with the ACRC and FRDC abalone aquaculture sub programs. This will avoid duplication and facilitate access to the latest research and technological advances.

5.0 DRAFT POLICY GUIDELINES

The following draft policy guidelines seek to address the issues outlined in the discussion paper. As for the discussion paper comments and suggestions are invited.

In summary, the policy guidelines allow land based sites to culture animals from any Western Australian genetic Zone provided the water discharge system is capable of preventing the release of genetic material.

Marine based operations will only be permitted to culture animals which are spawned from broodstock of sufficient numbers to achieve the appropriate heterogeneity and are from the same genetic Zone. Marine based cage or barrel operations will have a maximum licence area of 20 hectares. The effect of a marine operation on commercial and/or recreational fishing will be a major consideration in the approval process. Applicants are encouraged to consult with local fishing groups and associations prior to selecting a site.

Proposals for reseeding of reefs where abalone already exist will not be assessed by the IDCA. They are more properly assessed through the Abalone Management Plan amendment process. Applications for research trials to assess the possible benefits of reseeding these areas may be assessed provided the proposal has the support of commercial fishermen from the relevant zone and has the endorsement of the relevant Recreational Fishing Advisory Committee regional sub-committee.

It is anticipated that the final policy guidelines would be implemented as:

- Ministerial guidelines under Section 246 of the FRMA to assist the Executive Director of Fisheries in making decisions on applications for licences or access to stock; and

- Licence conditions under Section 95 of the FRMA

5.1 Hatchery Operations

Licence applications for hatcheries will be assessed on a case by case basis subject to the usual consultation and approval process (ie. through the Inter Departmental Committee for Aquaculture).

Water discharge systems must be capable of preventing the release of genetic material (larvae) into the wild. They must keep records of the source and number of broodstock for each batch. For sales to marine based grow out systems the number of broodstock per batch must be sufficient to maintain a level of genetic heterogeneity similar to the wild stock (minimum of 25 broodstock per batch). Where only a small number of broodstock successfully spawn for a given batch then, provided broodstock come from the same source, batches may be mixed to achieve the desired heterogeneity. Sales of spat to marine based systems must utilise broodstock from the same “genetic Zone” as the system they are destined for.

Mortality rates for each batch will be recorded and 300 spat per batch will be submitted for health certification prior to any sale. The hatchery must supply a declaration with every sale setting out the source and number of broodstock, and the batches health status. Spat may only be sold when they have taken artificial feed containing a marker which is detectable in the shell. Any abalone leaving the licenced area must be accompanied by one copy of a consignment note stating the number of abalone consigned. One other copy must be lodged with the local Fisheries Office within 7 days of the consignment while a third copy must be retained by the licence holder.

5.2 Land Based Tank or Raceway Culture

Licence applications for land based grow out operations will be assessed on a case by case basis through the IDCA.

Water discharge systems must be capable of preventing the release of genetic material (larvae) into the wild. Licence holders must submit animals for health certification on a regular basis. Land based systems may utilise spat spawned from any number of broodstock from any Western Australian genetic Zone provided they have health certification.

Land based systems intending to utilise supplementary feeding of sea weed must designate the amount and source of that seaweed and must have approval for the harvest from the relevant agencies.

Licence holders must keep records of each batch including mortality and growth and must give prior notification of harvest and processing activities to the Fisheries Department. Any abalone to be processed at a site which also processes wild stock must be sent to the processor in shell. Any abalone leaving the licenced area must be accompanied by one copy of a consignment note stating the number of abalone consigned. One other copy must be lodged with the local Fisheries Office within 7 days of the consignment while a third copy must be retained by the licence holder.

5.3 Marine Based Barrel or Cage Culture

Applications for licences for barrel or cage culture will be assessed on a case by case basis through the IDCA. The effect of the operation on navigation and recreational and commercial fishing will be a major consideration in the assessment process.

The maximum size of a licence area will be 20 hectares. Operations wishing to expand beyond 20 hectares must clearly demonstrate why they require a larger area.

The operation may only utilise spat which are spawned from broodstock of sufficient numbers to achieve the appropriate heterogeneity and are from the same genetic Zone.

Systems intending to utilise supplementary feeding of wild sea weed must designate the amount and source of that seaweed and must have approval for the harvest from the relevant agencies.

Licence holders must keep records of each batch including mortality and growth and must give prior notification of harvest and processing activities to the Fisheries Department. . Any abalone to be processed at a site which also processes wild stock must be sent to the processor in shell. Any abalone leaving the licenced area must be accompanied by one copy of a consignment note stating the number of abalone consigned. One other copy must be lodged with the local Fisheries Office within 7 days of the consignment while a third copy must be retained by the licence holder.

5.4 Marine Based Culture on Artificial Substrate

Applications for licences for culture on artificial substrate will be assessed on a case by case basis through the IDCA. The effect of the operation on navigation and recreational and commercial fishing and the broader community will be a major consideration in the assessment process as will the effect of the artificial substrate on the geomorphology and surrounding ecology.

The operation may only utilise spat which are spawned from broodstock of sufficient numbers to achieve the appropriate heterogeneity and are from the same genetic Zone.

Licence holders must keep records of each batch including mortality and growth and must give prior notification of harvest activities to the Fisheries Department. . Any abalone to be processed at a site which also processes wild stock must be sent to the processor in shell. Any abalone leaving the licenced area must be accompanied by one copy of a consignment note stating the number of abalone consigned. One other copy must be lodged with the local Fisheries Office within 7 days of the consignment while a third copy must be retained by the licence holder.

5.5 Seeding of Reefs Where Wild Abalone Stocks Do Not Occur

Licence applications for seeding of reefs where wild abalone stocks do not occur will be assessed on a case by case basis through the IDCA. The effect of the operation on recreational and commercial fishing will be a major consideration in the assessment process as will the effect of the operation on the surrounding ecology. Proof that the reef does not support wild abalone stocks and an assessment of the likelihood of wild stocks becoming established on the site will be required.

The operation may only utilise spat which are spawned from broodstock of sufficient numbers to achieve the appropriate heterogeneity and are from the same genetic Zone.

Licence holders must keep records of each batch including mortality and growth and must give prior notification of harvest activities to the Fisheries Department. . Any abalone to be processed at a site which also processes wild stock must be sent to the processor in shell. Any abalone leaving the licenced area must be accompanied by one copy of a consignment note stating the number of abalone consigned. One other copy must be lodged with the local Fisheries Office within 7 days of the consignment while a third copy must be retained by the licence holder.

5.6 Seeding of Reefs Where Wild Abalone Stocks Do Occur

Due to the complex issues raised by this type of abalone culture, licence applications for reseeding of reefs where wild abalone do occur will not be assessed by the IDCA.

An aquaculture licence would not allow for any changes to access or quota arrangements in a reseeded area. Any such changes would require amendments to the Abalone Management Plan. Changes to fishery management plans Under Part 6 of the FRMA require a separate consultation and assessment process. Proponents should contact the Commercial Program of the Fisheries Department for information.

Applications for Scientific Permits for reseeding trials on areas where abalone do occur may be assessed by the Fisheries Department on a case by case basis providing the following criteria are met prior to the application being lodged:

1. the proposal had the support of commercial fishermen from the relevant Zone;

2. the proposal had endorsement from the relevant Recreational Fishing Advisory Committee regional sub-committee;

3. the proposal utilises spat or larvae which are spawned from broodstock of sufficient numbers to achieve the appropriate heterogeneity and are from the same genetic Zone.

The application would then be assessed on the quality of its' experimental design.

5.7 Genetic Zones

Further research is required to properly establish genetic Zones for abalone in Western Australia. A post graduate study is currently being undertaken into the genetics of Western Australian abalone, however the results of this study will not be available for some time. In the interim genetic Zones will be based on the quota sub Zones for green lip, black lip and Roe's south of Busselton jetty. Roe's abalone north of Busselton jetty will be also be divided into four Zones. The genetic Zones are as follows:

1. Carnarvon to Drummonds Point (Roe's only)
2. Drummonds Point to Leeman (Roe's only)
3. Leeman to Guilderton (Roe's only)
4. Guilderton to Busselton Jetty (Roe's only)
5. Busselton Jetty to Black Point
6. Black Point to Cliffy Head
7. Cliffy Head to Point Charles
8. Point Charles to Shoal Cape
9. Shoal Cape to Point Culver
10. Point Culver to South Australian Border

5.8 Access to Wild Stock

Detailed policy on access to stock for aquaculture purposes will only be finalised after the release of, and subsequent feedback from, the discussion paper on access to stock of all species for aquaculture purposes. In the interim the following policy is proposed for access to wild abalone stocks for aquaculture purposes.

In all cases aquaculturists and researchers will be encouraged to source stock from licenced commercial fishermen. Access to stock other than through commercial fishermen will only be considered where it can be demonstrated that it is not practicable for commercial fishermen to supply the particular type of stock sought (eg. condition, size, Zone, time of year).

Applications for scientific permits to access wild stock for culture trial purposes will only be assessed if; no suitable Western Australian hatchery stock are available, a clear benefit to industry can be demonstrated and the proposal has sound experimental design.

Once hatcheries are established then access to stock will be limited to hatcheries only. Access for hatcheries will be limited to 100 animals per species per genetic Zone. In order to gain access hatcheries will have to demonstrate a demand for animals from that genetic Zone. In order to access stock hatcheries will be required to apply for a Ministerial Exemption under Part 7 of the *Fish Resources Management Act (1994)*.

No commercial sale of any stock accessed under either a scientific permit or Ministerial Exemption will be permitted.

6.0 References

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