Ministry for Primary Industries
Manatū Ahu Matua

# GUIDE TO ASSESSING THE EFFECTS OF AQUACULTURE ACTIVITIES ON FISHERIES RESOURCES

New Zealand Government

*Growing and Protecting New Zealand*

## Publisher

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## Disclaimer

This guide is intended to give general technical guidance on aspects of marine-based aquaculture. It is not legal advice. For legal advice on any aspect of assessing the effects of aquaculture activities on fisheries resources you should consult your lawyer.

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Front cover image: Phil Kirk (MPI).

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# INTRODUCTION

Regional councils and unitary authorities can perform their functions in relation to the coastal marine area, as specified in section 30(1)(d) of the Resource Management Act 1991 (RMA) "to control aquaculture activities for the purpose of avoiding, remedying, or mitigating the effects of aquaculture activities on fishing and fisheries resources" (section 30(3)).

This guide has been developed to assist regional councils and unitary authorities in assessing and making decisions on consent applications for aquaculture activities, particularly with regard to the assessment of effects on fisheries resources. The Ministry for Primary Industries (MPI) undertakes an undue adverse effects test on fishing (the UAE test). To learn more about the UAE test see section 1 of this guide.

There are a number of analogies between the effects that aquaculture activities can have on fisheries resources and broader assessments of environmental effects (AEE), for example, effects on marine ecosystems. The purpose of this guide is to provide guidance to regional councils and unitary authorities as to how these effects impact fisheries resources.

In this guide, the term "regional council" includes both regional councils and unitary authorities.

# 1. RESPONSIBILITIES OF REGIONAL COUNCILS AND MPI

Prior to the 2004 aquaculture legislation reforms, MPI assessed the impact of aquaculture activities on fisheries resources for all marine farming and spat-catching applications under section 67J and 67Q of the Fisheries Act 1983. This included the requirement that a Fisheries Resource Impact Assessment (FRIA) was provided by applicants. The purpose of the FRIA was to provide information for an assessment of the effects of the proposed aquaculture activity on the sustainability of fisheries resources.

The 2004 aquaculture legislation reform amended section 30 of the RMA to allow regional councils to assess the adverse effects of aquaculture activities on fishing and fisheries resources when assessing consent applications for aquaculture activities. It also removed the requirement for MPI to assess effects of aquaculture activities on fisheries resources.

The 2011 aquaculture legislation reforms amended section 30(2) and (3) of the RMA to clarify the drafting of these provisions.

Both "fishing" and "fisheries resources" are defined in the Fisheries Act 1996 as follows:

> *"**fisheries resources** means any 1 or more stocks or species of fish, aquatic life, or seaweed"*
>
> *"**fishing** means the catching, taking, or harvesting of fish, aquatic life, or seaweed; and*
>
> *includes –*
>
> *any activity that may reasonably be expected to result in the catching, taking, or harvesting of fish, aquatic life, or seaweed; and*
>
> *any operation in support of or in preparation for any activities described in this definition."*

These definitions are incorporated into the RMA (section 2, RMA).

MPI undertakes an assessment of the effects of proposed aquaculture activities on fishing. This assessment, known as the UAE test, assesses the effects of an aquaculture activity on commercial, recreational and customary fishing. The UAE test requires the effects of the aquaculture activity to not be undue in order for the activity to proceed.

MPI, however, does not have the statutory ability to perform the UAE test on subsequent applications for aquaculture activities (unless the original UAE decision was tied to one of the conditions to be changed[1]).

The following sections provide an outline of what an assessment of effects on fisheries resources might contain and guidelines on how regional councils might assess such effects.

1 In making a determination as a result of a UAE test, MPI may "tag" any conditions in the coastal permit which are material to the aquaculture decision and relate to the character, intensity, or scale of the aquaculture activity (section 186H(1A) Fisheries Act). The purpose of tagging the conditions is to ensure that the activity cannot be altered in a way that may change the impact on fishing without undergoing a further UAE test.

## 2. DESCRIPTION OF THE PROPOSED AQUACULTURE ACTIVITY

The description of the proposed aquaculture activity should contain enough information to enable the regional council to have a detailed understanding of the overall proposal. This will allow an informed assessment of the effects the proposal will have on fisheries resources, as well as any other effects on the environment.

The regional council should require that the following information be included in the application:

- proposed design details, size, culture methods, structures, species to be cultured (common and scientific names), stocking density, and source of farm stock;
- the nature of the proposed activity (new site, extension, variation, renewal, experimental);
- the nature of any discharges;
- the location and dimensions of the proposed application site must be accurately identified on appropriately scaled topographic or hydrographic maps (co-ordinates must be provided using the preferred co-ordinate system of the regional council) and include the minimum distance to the shoreline and the proximity to other aquaculture activities.

In addition, it is also important that the application outlines the extent of the aquatic environment potentially affected by the proposed aquaculture activity (for example, identifies the "effects footprint"). This area may not necessarily be restricted to the area directly beneath the boundaries of the site. To determine the effects footprint of the activity the application should document the physical conditions (such as, hydrodynamics, bathymetry, and local weather conditions and climatology) of the site.

## 3. ASSESSMENT OF EFFECTS ON FISHERIES RESOURCES

Site-specific information about the likely effects of all marine farming and spat-catching applications on fisheries resources was historically required by MPI[2] to be provided by applicants in a FRIA. These FRIAs were guided by the MPI document *A Guide to Preparing a Fisheries Resource Impact Assessment* (2002), which outlined the manner in which a FRIA was expected to be undertaken. This section has been guided by the above document, and updated where appropriate.

An assessment of effects on fisheries resources, as part of a broader AEE, should clearly determine the effect of a proposed aquaculture activity on:

- the biological diversity of the aquatic environment;
- the productivity and biological abundance of fisheries resources; and
- habitats of known significance for fisheries management.

A proposed aquaculture activity can affect each of the above matters through several types of positive and/or adverse effects (such as, physical, chemical and biological changes to the aquatic environment). The potential effects that should be focused on specifically are:

- discharge and deposition of contaminants;
- uptake of phytoplankton and zooplankton;
- effects on local marine ecosystem;
- hydrodynamic effects;
- nutrient cycling;
- water clarity;
- genetic effects;
- unwanted and exotic species;
- biosecurity; and
- effects on associated and dependent species.

Each of the above matters should be considered relative to all the species (or types of species, for example, filter-feeders, feed-added species and lower trophic levels) to be farmed on a marine farm.

The consideration of cumulative effects is a key requirement in the assessment of effects on fisheries resources. The application should assess the cumulative effects of aquaculture on habitats, fisheries resources, hydrodynamics, and uptake of phytoplankton and zooplankton populations.

2 Note that the merger of the Ministry of Agriculture and Forestry with the Ministry of Fisheries occurred on 1 July 2011. The Government publicly announced the renaming of the Ministry of Agriculture and Forestry to the Ministry for Primary Industries on 6 March 2012. For practical purposes we have replaced Ministry of Fisheries with Ministry for Primary Industries in this document.

## 3.1 MATTERS TO BE CONSIDERED WHEN ASSESSING THE POTENTIAL EFFECTS THAT AQUACULTURE ACTIVITIES CAN HAVE ON FISHERIES RESOURCES

### 3.1.1 Discharge and deposition of contaminants

Marine farms can discharge and deposit fine-grained organic particles (for example, food and faeces), live farmed species, shell litter and other biota to the seafloor. The material settles below and beyond the marine farms at rates that depend on particle size and shape, stocking density, feeding rates, depth and current flows.

Over time, increased sedimentation and organic enrichment can change habitats and communities and reduce species diversity (Forrest 1995, Mattsson & Linden 1983)[3]. This deposition can cause significant damage to habitats with coarser substrates such as sand, pebbles, cobbles and rock (Forrest 1995). Species adapted to coarser substrates may subsequently be lost if there are adverse effects on this habitat type. Deposition or enrichment from marine farms usually has little impact on mud or silt habitats, but excessive rates of this deposition or enrichment can adversely affect species that live within or on soft sediments.

### 3.1.2 Uptake of phytoplankton and zooplankton

Uptake of phytoplankton and zooplankton by farmed filter-feeding species can reduce plankton availability for other species. The amount of plankton uptake/depletion by filter-feeders depends on the filtration rate of the farmed species and the water flow through and around the marine farm.

Because marine farms are stocked with species at high concentrations, plankton depletion can affect natural communities and neighbouring marine farms. For example, if the local system is already at carrying capacity, more marine farm development could decrease the abundance and condition of other plankton-feeders.

Localised depletion of phytoplankton resources within marine farms has been seen (Grange & Cole 1997), but, the degree of impact that farmed filter-feeders have on zooplankton resources is more uncertain. The effects of marine farms on plankton levels (on both an individual farm and cumulative basis) are a high priority for research.

### 3.1.3 Effects on the local marine ecosystem

The local marine ecosystem (which includes, but is not limited to species abundances, diversity and habitats) may be altered by the artificial structures of marine farms. Artificial structures provide new habitat that can support new communities, and subsequently change community composition and initially increase biomass. New communities that establish may interact with existing communities and potentially affect fisheries resources either positively or negatively.

The effect of any potential community changes is highly debatable (Bohnsack 1989). One result may be changes to predator-prey interactions. For example, concentrations of predatory species (such as, spotties, leatherjackets and eleven-armed starfish) have been seen within marine farms (Cole 2002). Increased predator populations within these farms may impact upon local fisheries resources, especially following harvest of the farmed species when food at a marine farm is limited.

Marine farm structures and the communities they carry can also shade adjacent areas, thereby decreasing light available for photosynthesis. This decreased light availability could particularly affect algae communities.

### 3.1.4 Hydrodynamic effects

Marine farm structures can alter wave and current dynamics within and adjoining a marine farm site. The structures change water flow and speed by increasing drag on water, which in turn reduces current flow within farms and increases velocities under farms (Ogilvie 2000).

Currents carry food (such as, plankton) and oxygen to marine farms and other communities, remove wastes, and affect sedimentation rates. Plankton uptake by farmed filter-feeders may be increased by slower movement of water through marine farms, which in turn can reduce food availability to subtidal ecosystems. On the other hand, marine farm structures can potentially enhance water column mixing and consequently increase nutrient availability (such as, nitrogen) for plankton growth.

Subtidal communities inshore from marine farms are adapted to varying degrees of wave intensity. Therefore, marine farm development may cause

3 Papers and other documents referenced in this section can be found in Appendix A.

changes in species composition within the existing community as a result of changes to wave action.

For an accurate assessment of effects of marine farming on the sustainability of fisheries resources, the hydrodynamics of the area must be understood.

### 3.1.5 Nutrient cycling

Marine farms can cause changes to nutrient cycling within the sediment layer and water column. Farmed species excrete wastes (such as, faeces and pseudofaeces) in the form of soluble nutrients into the water column, or as organically enriched particulate material that gets deposited on the seafloor (Forrest 1995). Similarly, marine farms with fed species (for example, finfish) can deposit waste that comes from uneaten feed, in addition to faeces. Likely effects of marine farming on nutrient cycling include excretion of nutrients in more bioavailable forms, concentration of nutrients in biodeposits below farms, and loss of nutrients due to harvesting.

Good water circulation minimises the potential impacts from the concentration of nutrients around marine farms. Good water circulation distributes and dilutes soluble nutrients over a wide area and also encourages oxygen and nutrient exchange between the seabed and the water body.

Water movement is relatively high in most areas where marine farming occurs in New Zealand, and hence nutrient cycling has been little affected by marine farming to date. Marine farming in some situations, however, has altered nutrient concentrations. For example, Kaspar et al. (1985) measured elevated concentrations of ammonium and sulphides below a mussel farm in the sheltered waters of Kenepuru Sound.

Existing literature suggests the proportion of nutrients extracted from the ecosystem by harvesting from marine farms is relatively insignificant compared to the total available nutrients (MacKenzie 1998). However, if large-scale farming of filter-feeders occurs in a coastal embayment, the cumulative effect of this could significantly threaten nutrient availability for natural populations and existing marine farms.

### 3.1.6 Water clarity

Marine farms with filter-feeders may increase water clarity through removal of particulate matter (Cole 2002). But, changes to current speed around marine farm structures may also increase turbulence and re-suspended sediment in the water column. These kinds of changes can affect light penetration to the underlying environment and potentially change community composition for example by changes in algal composition or decreasing the effectiveness of visual predators.

### 3.1.7 Genetic effects

Introduction of new genetic material by marine farms can pose a risk to fisheries resources. Marine farm stock is either sourced from the wild or a fish farm (hatchery or holding facility). Where the genetic profile of a farm stock differs to that of a wild stock, mixing of the two populations may affect the genetic fitness, adaptability, diversity or survival of the wild population.

The use of selectively bred green-lipped mussel spat presents a low risk to wild populations of these mussels. The risk associated with other species commercially farmed within New Zealand, however, is less certain, in particular in relation to the farming of native finfish.

### 3.1.8 Unwanted and exotic species

Marine farm activities (such as, movement of gear, stock and spat; transport to and from and between marine farms) can be vectors for transporting unwanted and exotic species to new localities. There is potential for unwanted and exotic species to migrate from marine farms and colonise the surrounding natural environment, causing changes to existing communities. For example, sea squirt (*Styela clava*) has the potential to proliferate in nutrient rich areas.

### 3.1.9 Biosecurity

Marine farm activities are also a potential vector for transporting diseases and parasites around New Zealand. It is therefore important to ensure that farmed stock comes from a healthy source.

In addition, the artificially high densities of stocks on marine farms increase the risk of a potential diseases or parasite outbreak (Cole 2002). A concern is that diseases and parasites may spread to wild populations and between existing farms.

### 3.1.10 Effects on associated and dependent species

Marine farms may have effects on associated and dependent species, for example, marine mammals and seabirds. Marine farms can provide food sources for some species, or may block access to food sources for other species such as, dolphins feeding on fish.

Marine farms may also pose risks of entanglement, habitat exclusion and noise disturbance.

Effects on the sustainability of fisheries resources can also affect fishing, for example, if there is a decrease in the abundance of fisheries resources the opportunity to catch fish/catch rates may be reduced. Case studies 2, 3 and 4 in section 6 show examples of how adverse effects of marine farms on fisheries resources could impact fishing.

## 3.2 OPTIONS TO MITIGATE THE EFFECTS OF MARINE FARMS ON FISHERIES RESOURCES

The table below shows examples of how some of the adverse effects of marine farms on fisheries resources can be mitigated. Note the options for mitigation assume a marine farm site has already been chosen or applied for by a marine farm applicant which means only some types of mitigation are possible. For example, relocation of the farm to an area with higher flow velocity is not an option to mitigate plankton depletion or nutrient enrichment effects.

| Potential adverse effect | Mitigation options |
|---|---|
| Plankton depletion | Reduce stocking density/increase long-line spacing<br>Set a percentage of decrease that is acceptable |
| Nutrient enrichment of water column | Set a yearly production/feed input limit (for fed species such as finfish) |
| Sedimentation and seabed enrichment | Reduce stocking density<br>Control feed quantities (for fed species)<br>Set a buffer area if there is a sensitive habitat near<br>Implement a fallowing regime |
| Changes to hydrodynamics | Reduce stocking density<br>Reduce surface structures<br>Place structures parallel to flow |
| Build-up of toxins, chemicals in sedi-ments | Ensure feed is free of chemicals<br>Require fallowing<br>Control chemicals that can be used |
| Changes to genetics | Obtain broodstock from same geographical locality or with same genetics<br>Ensure good stock containment |
| Introduction of diseases, pests and exotic organisms | Require protocols to ensure stock is disease and pest free before introductions/transfers are conducted<br>Require protocols for maintenance and hygiene of boats and equipment used on and between farms |
| Entanglement of marine mammals | Require structures/ropes to be well maintained and under tension |

# 4. CONSULTATION

As with other aspects of the resource consent application, consultation with potentially affected parties with respect to fishing and fisheries resources is important.

Consultation with tangata whenua and recreational, commercial and environmental stakeholder groups with an interest in the application area will provide applicants with useful information to input into their assessment of effects on fishing and fisheries resources.

Consultation may provide information on habitats and fisheries resources of value to iwi and interest groups at the application site and in the local water body. As such, it is important that regional councils encourage applicants to consult with relevant groups during the preparation of the AEE.

# 5. USEFUL INFORMATION AND REFERENCES

Applicants for marine farming permits historically commissioned science providers to develop a FRIA given the level of technical expertise required. FRIAs were the primary source of information for MPI about the effects of a marine farm application on fisheries resources. The credentials of the person or organisation that carried out the FRIA were important. It is expected that science providers will also be used to develop the AEE for consent applications for aquaculture activities.

The Aquaculture Unit of MPI is working with science providers to develop ecological guidance to assist councils in their role of authorising and managing the effects of aquaculture activities. The guidance seeks to develop approved methodologies and provide relevant information to assist in determining the environmental effects of new aquaculture development.

In addition to the information provided in the AEE, additional information can be obtained from scientific papers and other relevant reports, as well as the personal knowledge of experts within agencies, such as MPI, Department of Conservation (DOC), and research providers such as NIWA and the Cawthron Institute.

A list of generic papers and reports about the effects of marine farming that MPI historically used in the assessment of fisheries resources is attached as Appendix A. Other resources have also been used for region-specific information and any other issues relevant to a proposed marine farm. In addition, the New Zealand Fisheries Management Research Database has an extensive range of reports and papers.

In most cases, the Spatial Allocations Team in MPI is able to provide the evaluation report it prepared as a result of the UAE test for existing aquaculture activities.

# 6. CASE STUDIES

The following case studies are excerpts from evaluation reports by MPI for marine farming permit applications. The excerpts show a range of issues identified in UAE assessments of effects on the sustainability of fisheries resources. The full reports are available by request from the Spatial Allocations Team in MPI.

The contact details for the Spatial Allocations Team are:

Private Bag 14
Port Nelson 7042
Phone: (03) 548 1069
Email: UAE@mpi.govt.nz

Note the assessments were done on a case-by-case basis and in no way should they predetermine the outcome of future assessments of effects on the sustainability of fisheries resources.

## CASE STUDY 1

**Issue: Deposition effects on ecologically important species (red macroalgae, parchment tubeworms and horse mussels).**

**Assessment: Discharge of wastes and contaminants**

MPI was concerned about the application's potential adverse effects on ecologically important densities of horse mussels because:

- they provide a substrate for attachment of corals and sponges;
- they provide shelter and habitat for other species, and increase biodiversity;
- they alter the topography of the seafloor and change water flows over the seabed; and
- they are a key indicator species for monitoring habitat conditions.

Likewise, MPI was concerned about adverse effects on high-density parchment tubeworm beds because:

- they provide sediment stability, a substrate for algal attachment, and habitat and food for other vertebrate and invertebrate species; and
- they can be an important habitat for juvenile crustaceans (Cawthron, pers. comms.).

MPI was concerned about adverse effects on high densities of red macroalgae because:

- seaweed beds provide refuges, habitat, and feeding grounds for fish and other species; and
- they provide food for herbivorous fish and other grazers.

High densities of parchment tubeworms and red macroalgae are also important because they are not a common feature in the Marlborough Sounds. Apart from in Port Underwood, high densities of parchment tubeworms and red macroalgae appear to be uncommon in the Marlborough Sounds. The rarity of high parchment tubeworm and macroalgae densities in the Marlborough Sounds suggests Port Underwood is likely an important area for sustaining high densities of these taxa.

Port Underwood may also be an important area for the sustainability of the *Chaetopterus* sp. found by Cawthron (2005). This *Chaetopterus* sp. has been identified as different from the *Chaetopterus* sp. found in Hauraki Gulf. It is likely the Port Underwood *Chaetopterus* sp. is native, or has been present in the central New Zealand region for some decades.

MPI now considers the application site is likely less important for the sustainability of parchment tubeworm and red macroalgae populations than previously assessed. Confirmation of the wide distribution of the taxa along Port Underwood's coastal margin reduces the risk of substantial adverse effects on the sustainability of any fisheries resource from activities proposed by the application.

Although any further marine farm development would likely raise considerable concern about cumulative adverse effects on red macroalgae and parchment tubeworms, MPI is now satisfied the activities proposed by this application would not have an undue adverse effect on the sustainability of any fisheries resource because:

- Information suggests similar levels of red macroalgae and parchment tubeworm density and diversity to those beneath the application site are relatively common in non-marine farmed areas of Port Underwood.
- With red macroalgae and parchment tubeworm distribution widespread along Port Underwood's coastline, MPI considers it unlikely the 0.2 percent increase in marine farm area would have substantial cumulative effects on the Port Underwood's populations of these taxa.
- Information suggests the application site is not important for the sustainability of the Port Underwood *Chaetopterus* sp. tubeworm.

MPI remains concerned about the potential cumulative adverse effects of the application on horse mussels because:

- MPI is uncertain how large an adverse effect marine farm development has had on Port Underwood's horse mussel population already. Information suggests horse mussels were widespread in areas that were previously proposed marine farms sites. The proposed farms, however, have since been approved and MPI is uncertain what cumulative effect mussel farm development throughout the Port Underwood is having on the horse mussel populations over time.

- MPI is uncertain about how much remaining horse mussel area there is in Port Underwood. Horse mussels were absent in Cawthron's (2005) two control site surveys and there is not adequate information to determine the taxa's distribution over the greater Port Underwood region.
- Information suggests areas with horse mussels densities as high as the application site are not common on a bay-wide scale. In other proposed marine farm locations, horse mussel densities were low and below the DOC (1995) trigger levels.

**Outcome:** MPI considers it necessary and desirable to avoid any potential cumulative adverse effects of the application on horse mussels. MPI considers most of the potential adverse effects on the horse mussels would be avoided with removal of the most inshore row of long-lines at the site. Allowing for a 20 metre buffer between the horse mussels and any growing structures, removal of the inshore long-line would give a shore to growing structure distance of approximately 70 metres.

## CASE STUDY 2

**Issue: Potential effects on rock lobster recruitment due to puerulus settlement on marine farming structures.**

**Assessment: Effects of providing structures that support and encourage new communities**

High levels of marine farm development or large marine farms could have important adverse effects on rock lobster populations. The amount of marine farm development in the wider Houhora Bay region would still be relatively limited with the proposed farm. MPI therefore considers the proposed marine farm's cumulative effects would be unlikely to substantially affect rock lobster populations.

The local Fishing Club is concerned about the proposed marine farm's potential adverse effects on rock lobster populations at inshore reef habitat. MPI acknowledges that rock lobster puerulus can settle on long-lines and be removed from the ecosystem through the mussel harvesting process. The proposed marine farm could intercept puerulus and limit recruitment inshore, particularly during large puerulus settlement events.

Houhora Bay, however, is the only mussel farming area on the eastern coastline of the North Island, between North Cape and Auckland. In addition, Booth (pers. comms.) also states the puerulus settlement rates at Houhora Bay, like for the rest of CRA1, are usually so low that settlement is barely detectable with collectors. Booth et al. (2006) also states the highest settlement rates of puerulus are typically south of East Cape on the North Island's east coast. MPI therefore considers the cumulative adverse effect of the proposed marine farm on rock lobster populations would likely be minor.

Monitoring of the Houhora Bay's settlement rates was started in 2000 at an existing marine farm. The monitoring recorded a low settlement rate, but only 18 months' data was collected so it is difficult to tell how often large settlement events occur. Booth (pers. comms.), however, suggests large puerulus settlement events would occur irregularly. And, puerulus settlement rates vary widely from year to year (*Plenary Report*, 2007). These factors make an assessment of the effects of marine farms on rock lobster populations difficult because it would be hard to see any trends. Subsequently, MPI is not aware of any study focusing on the effects of Houhora Bay's existing marine farms on rock lobster populations.

MPI acknowledges the proposed marine farm could potentially have localised effects on puerulus recruitment within Houhora Bay. Nonetheless, MPI notes that as an offshore extension to an existing farm, the proposed site would not increase the extent of marine farm area that extends across the width of Houhora Bay. Of the 14-km length of coastline the Fishing Club is concerned about, mussel farms (including the application site) front approximately 650 metres of the coast. The proposed farm would affect only a small portion of the coastline. Also, the application site is not offshore of rocky substrate where puerulus would likely settle. MPI considers these factors limit the extent of the effects the proposed marine farm would have on puerulus recruitment within Houhora Bay.

The Fishing Club asks how the take of puerulus can be authorised for mussel farming. MPI notes that marine farmers have no rights to harvest the pueruli/juveniles for the purpose of marine farming. The take of puerulus is not authorised in mussel farming activities because the puerulus catch is incidental and not used by marine farmers for any purpose under the Fisheries Act 1996.

Currently, there is no mechanism to impose mitigation methods around puerulus settlement on marine farms because no one has rights to recover the pueruli/juveniles that settle. Instead, the question of rock lobster settlement on marine farms is considered separately for each marine farming permit application, where relevant, as part of the undue adverse effects assessment. If MPI considers an application would have an undue adverse effect, the farm cannot progress. MPI is satisfied this application would not have an undue adverse effect on rock lobster populations.

**Outcome:** MPI is satisfied the proposed activity would not have an undue adverse effect on the sustainability of any fisheries resource.

## CASE STUDY 3

**Issue: Risk of disease introduction and spread and potential flow-on effects on scallop fishing.**

**Assessment: Introduction of pests and diseases**

Spat-catching activities can result in the drop-off of large quantities of undersized scallops and mussels beneath marine farming sites. Spat accumulation below the proposed spat-catching site could potentially increase disease risks for commercial, recreational and customary scallop fisheries in Tasman Bay and Golden Bay (for example, cause a population decrease or inedible fish). Because the application site would catch spat already in the area, the risk of disease introduction is low.

High spat densities on the seabed, however, could increase the risk of disease outbreak. High spat densities can potentially increase stresses on the shellfish and increase their vulnerability to diseases already present in the water column.

Cawthron suggests the long-term survival of scallop and mussel spat beneath the application site is likely to be limited by the Motueka River plume. Spat densities beneath the application site could be reduced intermittently by the river plume's sediment effects.

Results from spat density monitoring at the adjacent spat-catching site MF 430 show relatively fast declines in seabed spat densities at the end of the spat-catching season. MPI notes year-round occupation of the application site suggests elevated spat levels would remain beneath the site due to continuous spat drop off. Also, the volume of spat accumulated below large, year-round spat-catching sites could potentially be larger than spat volume of spat accumulated beneath smaller, seasonal spat-catching sites.

MPI has managed disease outbreak risks in Tasman Bay and Golden Bay scallop populations by requiring adaptive management programmes or shellfish density and health monitoring plans for spat-catching sites. Typically, marine farmers must undertake shellfish health assessments if shellfish spat (mussel and scallop) densities exceed a trigger density. If a potential disease risk is identified, a disease response plan is put into action.

The application proposes use of a shellfish health programme. Shellfish health assessments are proposed if shellfish spat (mussel and scallop) densities reach greater than 150/m$^2$ on the seabed beneath the spat-catching site. If the monitoring identifies a potential disease risk, the risk would be assigned a rank (level of seriousness) and an appropriate response would be activated.

In the preliminary decision, MPI considered the proposed shellfish trigger density was not low enough to reduce the risk of substantial adverse effects from disease spread; the trigger level was higher than what had been applied to previous decisions. Also, MPI was concerned the proposed trigger level was not low enough because the application's large scale, year-round spat-catching activity likely poses a greater likelihood of an increase in disease risk than smaller, seasonal spat-catching sites.

Since the preliminary decision, however, MPI has obtained further information on what shellfish spat densities and trigger levels could still ensure disease risks are not substantial. The new information suggests that strict adherence to the proposed shellfish health programme and a trigger density of 150 shellfish/m$^2$ would allow potential disease risks to be adequately identified and addressed.

MPI has provided adherence to the Shellfish Health Management Programme as a condition, to ensure monitoring and responses to any potential disease risk occurs.

**Outcome:** MPI is satisfied the potential adverse effects from the activities proposed in the application site would not have an undue adverse effect on the sustainability of any fisheries resource, providing adherence to the proposed shellfish health programme. Adherence to the proposed shellfish health programme would reduce the risk of disease spread as a result of spat accumulation beneath the application site.

## CASE STUDY 4

**Issue: Plankton depletion effects on fisheries resources through consumption of zooplankton by farmed mussels.**

**Assessment: Uptake of plankton**

NIWA (2003) considers there is potential for marine farming in Pegasus Bay to affect zooplankton populations and reduce potential recruitment to benthic communities of certain species through depletion of planktonic eggs and larvae of fish, surf clams and other benthic invertebrates in the area. Assuming mussels remove a portion of existing zooplankton communities, MPI considers some changes in zooplankton community structure in Pegasus Bay could occur.

MPI has no modelling data of zooplankton depletion at the proposed farm, but given the site is likely to be over part of a flatfish spawning ground, there would likely be at least some degree of uptake of fish eggs by farmed mussels; although the true vulnerability of fish eggs and larvae to predation by mussels and the rate or quantity of uptake is unknown.

Because of the transport of eggs and larvae northward by the Southland Current, however, fish spawning in the Canterbury Bight would provide eggs and larvae to the areas near Banks Peninsula and nearby bays and those spawning near Akaroa Heads would provide eggs and larvae settling in Pegasus Bay (Colman 1978). So, given there are other spawning grounds to the south of Pegasus Bay that likely contribute eggs and larvae to Pegasus Bay, the effects of the proposed farm over a spawning ground are less than if there was only one spawning ground being affected.

Surf clam species have a free-swimming larval stage of between 20 and 30 days and the larvae may potentially spread widely if conditions allow (Cranfield and Michael 2001). If surf clam eggs and larvae are dispersed to the proposed farm site they may be consumed by mussels.

NIWA (2003) notes planktonic eggs and larvae of surf clam species are possibly retained within or entrained towards shore by the predominant current within the bay, the Southland Current. The proposed farm site is likely to be influenced by the Southland Current so there is potential for uptake of surf clam zooplankton as water passes through the site. MPI, however, considers the distance of the site (approximately 14 km) from the subtidal beach areas of Pegasus Bay where the surf clam populations are would mean there is a low risk of the farmed mussels consuming substantial quantities of surf clam eggs and larvae.

As with phytoplankton uptake, the wide spacings of the long-lines may mitigate adverse effects on zooplankton uptake. NIWA considers the rapid flushing of the site, and regeneration and replenishment of plankton reduce the risk of depletion to levels that would have consequences for higher trophic levels (such as, fish populations).

**Outcome:** On balance of information, MPI is satisfied that the effects of plankton uptake from mussel farming within the proposed farm would not be so excessive or disproportionate as to constitute an undue adverse effects on the sustainability of any fisheries resource.

## CASE STUDY 5

**Issues: Effects on the genetics of local populations from farmed stock.**

**Assessment: Effects on heterogeneity of location populations**

Risks to the heterogeneity of local populations depend on the source of stock for each species. The applicant proposes to potentially farm a wide range of species. The applicant states only endemic New Zealand species occurring in the Wellington area would be collected from the wild or held on the site, although NIWA states that stock may be sourced from other areas of New Zealand. The applicant has specified the source of stock for each of the potential species as being from "NIWA hatchery/ wild", "wild via NIWA" or "NIWA hatchery".

NIWA considers escape of caged stock (and therefore potential mixing of genetics with natural populations) unlikely because of the small size of the culture and the close monitoring of stock generally required in experimental studies. They consider, however, that dispersal of eggs and larvae of stock is possible for some taxa, particularly bivalves. NIWA proposes that experimental culture and harvest of stock should be carried out in ways that minimise the risk of escape.

Following the preliminary decision, NIWA provided additional information on the effects of aquaculture on the heterogeneity of local populations. NIWA indicates that in some cases it would be impractical to obtain broodstock from local sources, particularly for growth trials with selectively bred stock. Given the experimental nature of the site, NIWA indicates this would potentially restrict some experiments NIWA wish to carry out.

MPI has reassessed the risks associated with effects on the heterogeneity of local populations from the proposed farm, taking into account the additional information. MPI now considers there would be a low risk of the genetic integrity of local marine populations being adversely affected by farming the proposed species. The relatively low quantities of each species likely to be held at the site and the low risk of escaped stock mixing with wild stock successfully indicates there would be a low risk of adverse effects on local population genetics.

In addition, good farm management of the site as outlined in the risk management strategy would also minimise the potential effects of stock escaping from the site and the potential mixing of wild and farmed stock.

MPI recommends, however, that NIWA should use locally sourced stock at the site wherever practical. Sourcing stock from the local area would ensure stock held on the farm is genetically similar to local wild fish stock populations, minimising the risk of altering heterogeneity of local populations.

**Outcome:** MPI considers, with the additional information provided following the preliminary decision, the activities contemplated in this application would pose a low risk of adverse effects on the heterogeneity of local populations.

## CASE STUDY 6

**Issue: Deposition effects on ecologically important species and habitat.**

**Assessment: Discharge of wastes and contaminants**

It is likely the proposed extension would adversely affect ecologically significant brachiopods and horse mussels found nearer to and beneath the application site, as well as important coarse substrates that support these species.

Coarse substrates and horse mussels are important for the sustainability of fisheries resources.

Coarse substrates are important for sustaining fisheries resources because:

- they provide important fish feeding and recruitment zones, shellfish habitats (for example, scallops and horse mussels), and habitats for other species of conservation importance (for example, lampshells); and
- they are less common than mud/silt habitats in the Marlborough Sounds, where they are typically restricted to a narrow coastal band.

Horse mussels are important for sustaining fisheries resources because:

- they provide a substrate for attachment of corals and sponges, shelter and habitat for other species, and increase biodiversity;
- they alter seafloor topography and change water flows over the seabed; and
- they are a key indicator species for monitoring habitat conditions.

1. East Bay's giant lampshells (*N. lenticularis*) are an important fisheries resource because:

- the species is relatively rare and is not a common feature of the Marlborough Sounds – East Bay appears to be a "stronghold" for the species in the Marlborough Sounds (Davidson, pers. comms.);
- East Bay is also one of few places in New Zealand where this species can be found at safe diving depths and this has been recognised as being "internationally significant" (Hardy, 2004) – other than in Queen Charlotte Sound, it is only recorded elsewhere at the top of South Island at depths 60 to 70 metres offshore of Stephens Island (DOC, 1995b);
- most of New Zealand's brachiopod species have extremely patchy distributions and some populations could be described as "vulnerable" (MfE, 1997) – *N. lenticularis* has a restricted distribution in the shallow subtidal environment of the Marlborough Sounds and New Zealand (DOC, 1995b); and
- *N. lenticularis* is endemic to New Zealand and is the largest brachiopod found here.

The proposed extension would increase the area of localised adverse effects on coarse substrate, horse mussel and brachiopod habitat. Information suggests that sand substrates and giant lampshells seaward of 30 metres depth are already being adversely affected by deposition effects from the existing and neighbouring marine farms at, and near, the application site.

It is highly probable that marine farms have had cumulative adverse effects on coarse substrates and potential horse mussel and giant brachiopod habitat in East Bay's coastal band already.

Stewart (2004) calculates that between 8 to 18 percent of this important habitat may have been lost to existing marine farms within Onauku Bay.

MPI considers it important to avoid substantial cumulative and localised adverse effects on the habitats of East Bay where coarse substrates and ecologically significant densities of horse mussels and lampshells occur. Given the limited range and distribution of *N. lenticularis*, MPI is concerned about substantial adverse effects on this species particularly.

The application site is located in an area of East Bay's coastal band recognised as being ecologically important at the international level by DOC (1995b). The application site is also moderately large (2.925 hectares), relative to East Bay's marine farm free area of coastal band, and represents giant lampshells and horse mussels well. Information suggests giant brachiopods and horse mussels meet or exceed the DOC (1995a) trigger levels beneath the application site. Horse mussels are spread beneath the entire width of the application site, frequently exceeding the DOC (1995a) trigger levels. Giant brachiopods were recorded below 32 metres deep.

Given the large size of the application site, and the high densities of the likely ecologically significant taxa beneath it, MPI considers the proposed extension is an important area for the sustainability of coarse substrates, giant lampshells, horse mussels, and any associated species.

**Outcome:** MPI is not satisfied that deposition from the application would not have undue adverse effects on the sustainability of any fisheries resource.

# APPENDIX A – REFERENCES

Battershill, C.; Miller, K.; and Cole, R. (1998). The understorey of marine invasions. *Seafood New Zealand* 6(2): 31-33.

Bohnsack, J. A. (1989). Are high densities of fishes at artificial reefs the result of habitat limitation or behavioural preference? *Bulletin of Marine Science,* 44: 631-645.

Booth, J., McKenzie, A., Forman, J., and Stotter, D. (2006). Monitoring puerulus settlement in the red rock lobster (Jasus edwardsii), 1974–2005, with analyses of correlation between settlement and subsequent stock abundance, *Final Research Report for Ministry of Fisheries Research Projects CRA2004-02,* National Institute of Water and Atmospheric Research.

Booth, J. (2008). Email. 22 August 2008.

Cawthron. (2009). Review of the ecological effects of farming shellfish and other non-finfish species in New Zealand. *Cawthron Report* No.1476 prepared for MPI.

Cole, R. G. (2002). Impacts of marine farming on wild fish populations. Draft research report for MPI Research Project ENV2000/08 Objective one.

Colman, J.A. (1978). *Tagging Experiments on the Sand Flounder, Rhombosolea plebeian (Richardson), in Canterbury, New Zealand, 1964 to 1966.* Fisheries Research Division, Ministry of Agriculture and Fisheries, Wellington.

Cranfield, H.J.; and Michael, K.P (2001). The surf clam fishery in New Zealand: description of the fishery, its management, and the biology of surf clams. *New Zealand Fisheries Assessment Report* 2001/62.

Davidson, R. (2010) Email. 18 November 2010.

Department of Conservation (DOC). (1995a). Guideline for ecological investigations of proposed marine farm areas, Marlborough. *Occasional publication 25, Nelson/Marlborough Conservancy.*

Department of Conservation (DOC). (1995b). Ecologically important marine, freshwater, island and mainland areas from Cape Soucis to Ure River, Marlborough New Zealand, Recommendations for protection. *Occasional Publication 16, Nelson/ Marlborough Conserva*ncy.

Forrest, B. (1995). Overview of ecological effects from shellfish farms in the Marlborough Sounds: background information for marine farm applicant. *Cawthron Report* No. 282 prepared for Sanford South Island Limited.

Grange, K. & Cole, R. (1997). Mussel farming impacts. *Aquaculture update,* 19:1-3.

Hardy, M. (2004). *East Bay mussel farming – a case study in resource management,* Auckland Zoo, electronic resource: **http://www.aucklandzoo.co.nz/aucklandzoo/news_max_essay.php**.

Kaspar, H. F., Gillespie, P. A., Boyer, I. C. & MacKenzie, A. L. (1985). Effects of mussel aquaculture on the nitrogen cycle and benthic communities in Kenepuru Sound, Marlborough Sounds, New Zealand. *Marine Biology,* 85: 127-136.

MacKenzie, A. L. (1998). Blowing the budget? Nutrient resources and the Marlborough mussel crop. *Seafood New Zealand,* March 1998: 41-44.

Mattsson, J. & Linden, O. (1983). Benthic macrofauna succession under mussels, Mytilus edulis L. (Bivalvia), cultured on hanging long-lines. *Sarsia* 68: 97-102.

Ministry for the Environment (MfE) (1997). *The State of the New Zealand's Environment*, Ministry for the Environment and GP Publications, Wellington.

Ministry of Fisheries (2007). *Mid-Year Plenary, CRA 08.* Ministry of Fisheries, Wellington.

National Institute of Water and Atmospheric Research Limited (NIWA) (2003). *Marine Farming in Canterbury: biophysical issues associated with suggested aquaculture management areas.* Prepared for Environment Canterbury. NIWA Client Report: CHC2003-045, May 2003. NIWA Project ENC03512.

Ogilvie, S. C. (2000). *Phytoplankton Depletion in Cultures of the Mussel Perna canaliculus.* PhD Thesis, University of Canterbury, Christchurch.

Stewart, B. G. (2004) (unpublished). *Statement of Evidence by Brian George Stewart for Environment Court* (RMA 845/01 & RMA 861/01), East Bay Conservation Society and Schwass Family Partnership & East Bay Holdings.