

9. Conclusion

9.1 ADVERSE EFFECTS OF MUSSEL FARMING

“Absence of evidence of an effect is not evidence of absence of the effect”

The only reported adverse effects of mussel cultivation on marine mammals or seabirds in New Zealand are the exclusion of dusky dolphins from mussel farms (Markowitz et al. in press), and the entanglement and deaths of two Bryde’s whales in mussel spat-catching lines. Unfortunately, absence of evidence for other adverse effects can not be interpreted as evidence that there are none, as there have been no concerted attempts to investigate the effects of mussel cultivation (or any other form of aquaculture) on wildlife or biodiversity *per se*, either in New Zealand or overseas. Although there has been considerable effort to monitor and model the environmental effects of aquaculture (Morrisey & Swales 1997; Silvert & Cromey 2001; Broekhuizen et al. 2002), this effort has been almost exclusively undertaken from the point of view of the seafood industry, not the environment. In New Zealand, monitoring and modelling have focused on determining the carrying capacity of the environment for the farmed animal (Morrisey & Swales 1997) and more recently identifying far-field effects on wild catch fisheries resulting from the cumulative effects of extensive areas of aquaculture (Broekhuizen et al. 2002).

The available information, presented in this report, indicates that there are reasonable grounds to believe that, mussel cultivation has adverse effects on marine mammal and seabird populations in New Zealand. Wildlife and mussel farms are in direct competition for space in the shallow, sheltered and most productive coastal waters (Würsig & Gailey 2002). Loss and degradation of wildlife habitat may be a consequence of either exclusion by the mussel farm structures, or by changes to the ecosystem, rendering habitats unsuitable. Although declines in marine mammal and seabird populations resulting from loss and degradation of habitat are not as dramatic or as easily documented as fishing by-catch mortality, they are serious threats to these populations (Whitehead et al. 2000). When large areas of mussel farms intrude into important wildlife habitat, there is potential for reduction in biodiversity as the farms affect populations of marine mammals and seabirds (and presumably other natural biota). Indeed, because resources are removed for human consumption and replaced by a waste-stream, aquaculture usually reduces biodiversity (Beveridge et al. 1994).

Proposed large offshore mussel farms along the east coast of the two main islands of New Zealand represent a special threat to large whales, because the proposed farms lie across their seasonal migratory routes and in historic calving areas. Entanglement of endangered southern right whales or other large whales in mussel farms in New Zealand waters would be damaging to New Zealand’s international credibility as a proponent of cetacean conservation.

Ecotourism is an important component of the New Zealand tourism industry, which is one of New Zealand’s most lucrative industries. According to the World Tourism Organization, ecotourism is the fastest growing sector of the

tourism market, growing 5% annually worldwide (www.gdrc.org/uem/ecotour/etour-define.html). New Zealand's marine mammals and seabirds are significant attractions for many ecotourists (i.e. whale-watching, swimming with dolphins, and bird watching). Widespread detrimental effects on marine mammal and seabird resulting from the expansion of aquaculture could have detrimental effects on the ecotourism industry.

9.2 ENVIRONMENTAL DEGRADATION CAUSED BY AQUACULTURE

Aquaculture, most commonly in the form of mussel farming, is now an established use in many of New Zealand's sheltered coastal waters. The industry engenders significant economic benefits and has the potential to become an ecologically sustainable industry, providing a harvest of high-quality protein from the sea to replace declining harvests from wild fisheries (Naylor et al. 2000). Although there is potential for aquaculture to be ecologically sustainable, experience outside New Zealand has shown that this is often not the case. Rapid expansion of aquaculture in recent years has frequently caused large-scale environmental degradation. Large areas of mangroves have been converted to shrimp farms (Choo 2001; Kaiser 2001). Surplus nutrients and toxic chemicals used on fin-fish farms have caused localised marine pollution (Pearson & Black 2001). The cultivation of carnivorous fish fed on fishmeal has contributed to declining wild fisheries (Naylor et al. 2000) and salmonid cultivation is believed to have contributed to the decline of local wild salmonid populations (Pearson & Black 2001). There have been culls of marine mammals and seabirds to prevent predation on cultivated species (Nature Conservancy Council 1989; Davenport et al. 2003). Predator exclusion nets around fin-fish enclosures have caused significant numbers of entanglements and death of marine mammals and seabirds (Gibbs & Kemper 2001). Cetaceans have been forced to abandon extensive areas (>3 km) around fish farms by the use of underwater acoustic harassment devices (Johnston 2002; Morton & Symonds 2002; Olesiuk et al. 2002; Davenport et al. 2003).

The absence of similar examples of environmental degradation in New Zealand probably reflects the low input requirements for bivalve cultivation (green-lipped mussels and oysters) which dominates the local industry. However global trends of increasing demand for seafood, and declining wild fisheries (Naylor et al. 2000), ensure expansion of aquaculture in New Zealand. This will entail increases in both the extent of coastal areas devoted to aquaculture and the variety of cultivated species. As the New Zealand aquaculture industry grows and diversifies, the potential adverse effects of aquaculture on marine mammals, seabirds, and other aspects of marine biodiversity will become more severe.

9.3 ECOLOGICAL SUSTAINABLE AQUACULTURE

There is growing international awareness of the need for aquaculture to be ecologically sustainable (Black 2001). The Code of Conduct for Responsible Fisheries produced by the Food and Agriculture Organisation of the United Nations (Food and Agricultural Organisation 1995) encourages governments to ensure that aquaculture development is ecologically sustainable. The New Zealand Biodiversity Strategy (Anon 2000), drafted to fulfill the New Zealand government's commitments under the Convention of Biological Diversity, Rio de Janeiro 1992, recognises the need for harvesting or development in the marine environment to be undertaken in an informed, controlled and ecologically sustainable manner.

Although there has been some debate over definitions of ecological sustainability, there is general acceptance that an ecologically sustainable industry should only exploit environmental resources in ways that: do not interfere with other users of the environment; do not reduce the scope for future users to benefit from the environmental resources; and do not significantly alter environmental quality and biodiversity (Black 2001).

9.4 MONITORING AND MODELLING

Monitoring and modelling the ecological effects of aquaculture are essential components of the process of planning and regulating aquaculture to achieve sustainable outcomes (Donnan 2001; Silvert & Cromey 2001). Properly designed monitoring programmes provide a method to determine: whether there are detrimental effects on the environment; whether the effects are significant, or acceptable and reversible; and how any effects can be minimised (Fernandes et al. 2001). Predictive models based on empirical evidence obtained by scientifically rigorous monitoring programmes can provide the best advice on possible results from different management decisions (Silvert & Cromey 2001). To be effective, monitoring programmes should be informed by research to develop suitable methodologies (Fernandes et al. 2001). Different forms of aquaculture affect the environment in different ways; therefore monitoring programmes must be tailored to suit the form of aquaculture as well as natural characteristics of the local environment (Fernandes et al. 2001).

Because green-lipped mussel cultivation is by far the most common form of aquaculture in New Zealand, development of a programme to monitor and model its environmental effects should be accorded the highest priority. The programme's objective should be to provide information to ensure that further expansion of mussel farming is regulated and managed to achieve a sustainable industry with minimal effects on environmental quality and biodiversity, not just those components of the environment that influence productivity of farmed and wild-caught fisheries. A successful high-quality monitoring programme for mussel farming is likely to provide a model for future programmes to monitor other forms of aquaculture.

9.5 AQUACULTURE LAW REFORM

The current aquaculture law reform process provides an opportunity to design a legislative framework to ensure that further development of New Zealand's aquaculture industry is ecologically sustainable. Thus far, aquaculture law reforms focus on the approval process for new aquaculture areas to be administered by local councils under the RMA. The strategy depends on anticipating detrimental effects and avoiding placing aquaculture in areas where it is likely to have adverse environmental effects. It is unrealistic to expect to anticipate all detrimental effects. Thus, it is important to ensure that there are legislative powers to regulate aquaculture methods in order to remedy or mitigate detrimental effects whenever they become evident. This is most likely after aquaculture ventures are operational. To ensure that aquaculture develops in New Zealand in a sustainable manner, reformed legislation should:

- authorise and resource effective monitoring of the effects of aquaculture on all aspects of marine biodiversity
- regulate aquaculture methods to remedy or mitigate any detrimental effects whenever they become evident.

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