Criteria for Management of Mangroves in New Zealand

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1. Introduction

Environment Waikato contracted Beca to prepare a resource consent application to clear mangroves (*Avicennia marina*) from Whangamata Harbour. To this end, Beca sub-contracted Wildland Consultants Ltd to assess the ecological effects of mangrove clearance scenarios at Whangamata (c.f. Basheer 2007).

Brian T. Coffey and Associates reviewed the Wildlands report in December 2009 and the three reports (Beca 2009: Wildland Consultants 2009: and Coffey 2009) were received at an Environment Waikato Council Meeting on 10 December 2009.

Having considered and debated the content of these three reports, Environment Waikato resolved that:

1. *Council instruct staff to prepare an application to obtain a Resource Consent for the clearance of mangroves in the Whangamata Harbour to the seaward side of what is known as the 1944 line.*

- *That staff work with Beca Carter and Brian T. Coffey and Associates Limited to:*
  - *establish agreed criteria for the removal of mangroves in the Whangamata Harbour;*
  - *apply agreed criteria to the Whangamata Harbour and establish a common position on the location and quantum of mangroves for removal along with agreed justification for the proposed removal;*
  - *complete an AEE and Resource Consent Application on the basis of a. and b. above for approval by Council at its next meeting.*
- *The AEE and Resource Consent Application was to:*
  - *be on a staged basis according to a. and .b;*
  - *have robust conditions relating to monitoring for adverse effects;*
  - *allow for an adaptive management plan which allows for the speed of the clearance to be accelerated or slowed and even stopped if necessary, depending on any effects found during the monitoring and to allow for the variation of method of clearance and disposal as new ways of achieving this arose and provided that the monitoring did not reveal any adverse effects any more than minor. This provides total control over the project;*
  - *provide for the historic stands of mangroves to remain and provide an area for education.*

This report summarises the outcomes of a workshop between William Shaw, Emily O'Donnell, and Brian Coffey at Whangamata on 28 January 2010 where they discussed and developed draft criteria for the future management of mangroves.

Whilst the technical brief was to *"establish agreed criteria for the removal of mangroves in the Whangamata Harbour",* the meeting considered that where possible, management criteria for mangroves should be applicable more widely in the Bay of Plenty, Waikato, Auckland, and Northland Regions. However, it was recognised that any generic management criteria would still need to be applied on a case-by-case basis.

In terms of the Resource Management Act (1991), the test is of achieving the purpose of sustainable management, which, in this case, requires balancing a range of considerations including tangata whenua values. The New Zealand Coastal Policy Statement also requires a precautionary approach when managing the Coastal Marine Area.

2. Background

Long-established, closed-cover mangrove communities are a unique, indigenous community type that has been present in New Zealand for a very long time (millions of years - Sutherland [2003]) and make a valuable contribution to estuarine ecology in northern New Zealand harbours, estuaries, and river mouths. Mangroves are frost-sensitive and mangrove-dominant communities occur north of Ohiwa Harbour on the east coast of the North Island (38^{o}S), with local specimens occurring south of Ohiwa on the east coast and to the Tongaporutu River mouth on the west coast.

The need to develop criteria for the management of mangroves has resulted from their relatively rapid expansion in recent decades. Aerial photographic records have enabled the documentation of this expansion since the 1940s.

The most commonly accepted influence associated with the increased rate of mangrove spread since the 1940s has been increased sediment input to the Coastal Marine Area from developed land catchments. With this in mind it is generally accepted that management of mangrove expansion must not focus solely on mangrove removal, but work in parallel with comprehensive land and river management to decrease sediment and nutrients entering estuarine receiving environments.

Demand for mangrove management (generally removal) has most commonly come from human users of the Coastal Marine Area who wish to maintain and/or regain traditional access to intertidal areas for food gathering, active and passive recreation pursuits, maintenance of open vistas, and other social/cultural activities. Ecological triggers for mangrove management may include the reduction of open intertidal areas traditionally used by migrant wading birds (for example at the head of the Firth of Thames) due to mangrove encroachment. Moreover, mangrove encroachment around or onto high tide bird roosts is also considered to be an ecological concern in northern harbours and estuaries.

In New Zealand harbours and estuaries where mangroves are not present, the lowest biodiversity and abundance of intertidal benthic biota generally occurs between the high water mark and the upper limit of the cockle community that covers with water for more than four hours per tide (Belton, 1986; Larcombe, 1971; Grant and Hay, 2003). This is the depth range within the intertidal zone where mangroves generally establish and flourish, therefore they can enhance both biodiversity and benthic abundance when occupying this niche. However, when they expand their range further down the intertidal zone, and displace mid- to low-tide shellfish beds, mangroves are displacing existing intertidal communities that can be, arguably, of greater ecological value.

Environment Bay of Plenty, Environment Waikato, Auckland Regional Council, and Northland Regional Council have all recognised that the rapid expansion of mangrove communities can be managed by granting of resource consents for annual seedling removal to "hold the line" in terms of continued mangrove spread into other ecologically valuable open intertidal areas (e.g. Coffey [2008] in the case of Whangamata Harbour).

The evaluation criteria for mangroves discussed in subsequent sections of this report focus therefore on mature or established mangroves that are more than one year old. They are "management criteria" rather than "removal criteria" as there are ecological, conservation, and educational imperatives to maintain areas of mature mangrove communities. In the case of Whangamata Harbour, it is proposed to protect and manage the on-going viability of mangroves north of the Forest Services Headquarters. Boardwalks and educational material are planned in this mangrove conservation area

(Coffey, 2002; Basheer, 2007).

Although it can be argued that there may be ecological benefits associated with the removal of mangroves from some locations, it also needs to be considered that their removal could have unanticipated effects. Most obviously, if mobilised, the silt retained by mangrove stands must go somewhere and may, in the natural course of events, continue to smother the niche otherwise occupied by the mangroves. In such circumstances, the removal of mangroves may result in an open mud substrate.

3. Non-ecological Considerations

There is a range of considerations other than ecological factors that can be taken into account when requirements for mangrove management are assessed:

- Landscape/seascape vistas and values;
- Navigational access (safety and use);
- Erosion and flood mitigation; and
- Land tenure (private land can extend well into inter-tidal habitats).

4. General Ecological Factors

4.1 Knowledge of Ecological Processes

This report addresses mangrove management criteria in the context of ecological function. However, as cautioned by Morrisey *et al.* (2007) and Swartz (2003), it is often necessary to state the assumptions on which the ecological functions of mangroves are based and where necessary identify what additional research is required to test the assumptions made.

4.2 Latitude

Mangroves at their southern distributional limit are subject to periodic dieback due to frosts and have limited stature and ability to form a closed canopy. For these reasons, the requirement to control mangroves south of Tauranga Harbour may be reduced.

5. Ecological Evaluation Criteria

Eleven criteria are provided below for the evaluation of the ecological functions and values associated with mangrove stands:

- Time of Occupation
- Formal Protection status, in terms of land status (e.g. reserve, or other protection provided in a statutory plan on the basis of special scientific/conservation value within the Coastal Marine Area).
- Known / recognised ecological value of the site (e.g. Recommended Area for Protection [RAP]).
- Habitat value of mangroves at the site:
  - Contributes to the completeness of a good quality vegetation sequence that includes coastal forest/shrub, saltmarsh, mangroves, open intertidal flats (at and above the upper tidal limit of cockles) and a low tide channel;
  - Use by mangroves by threatened taxa (e.g. banded rail);
  - Effects of mangroves one indigenous vegetation mosaics;
  - Protection of high tide bird roosts;
  - Mangrove use by fish and other benthos.
- Coastal margin erosion buffering.

- Habitat connectivity and ecological buffering around margins of the CMA. Coastal margin access or disturbance buffer; discouraging human access to the Coastal Marine Area through saltmarsh. Provision of a disturbance barrier for mid to low-tide intertidal flats offshore of development adjacent to the harbour/estuarine margin.
- Sediment stabilisation role: stabilising sediment that is likely to be mobilised following mangrove clearance and smother or potentially poison adjacent and downstream habitats.

5.1 Time of Occupation

Criterion (a): The relative age and time of occupation of the site by mangroves, particularly if that is more than 30 years.

Explanation

- Greater consideration should be given to the potential benefits of maintaining mangrove cover that is greater than 30 years old. It takes time for a mangrove community to establish and mature to an essentially closed-canopy system (with algal associates such as *Caloglossa leprieurii* and *Catanella nipae*) and with a characteristic assemblage of associated estuarine animals).
- Workshop participants generally agreed that mangroves that had been present in an area for 30 years or more (as supported by aerial photographic evidence) should generally be given a higher ecological value than mangroves that had spread into an area more recently.
- Time of occupation is also likely to be a consideration in terms of landscape features and navigational access, for example.

5.2 Formal Protection of Site

Criterion (b): All or part of a site has some level of formal protection, either as a gazetted reserve or in a coastal protection zone in a regional plan.

Explanation

Some formally protected areas extend into the Coastal Marine Area, specifically to protect representative examples of estuarine vegetation and habitats. Some coastal plan zones also specifically include examples of habitats such as mangroves.

5.3 Known/Recognised Ecological Value of the site

Criterion (c): Site recognised previously as being of ecological significance.

Explanation

Sites previously recognized as being of significant ecological value or conservation value within the Coastal Marine Area, e.g. a RAP, in a Protected Natural Area Programme (PNAP) survey report.

5.4 Habitat Value of Mangroves

The number of species found in mangrove stands and associated sediments is lower than on adjacent intertidal flats (Schwartz, 2003). Sandflat communities have a higher proportion of shellfish than muddy areas, but relatively more worms live in mud, therefore they have a different ecological function and their community composition is quite different. It is not necessarily defensible to assign greater habitat value to either community type, and they both have intrinsic values.

There is a case to halt the spread of mangroves that are and have been displacing other intertidal communities of intrinsic value. However, the extent to which the existing distribution of mangroves should be reduced is a function of the following considerations.

5.4.1 Completeness of vegetation sequences

Criterion (d): The extent to which mangroves form part of a natural sequence that includes coastal forest, shrubland, saltmarsh, and/or open intertidal flats.

Explanation

Vegetation sequences or zones are normally described across the key gradient or dominant factor delimiting/determining community/habitat types in a particular area. In the case of the Coastal Marine Area, the key factor is tidal height and water depth and so vegetation sequences form from landward to seaward where conditions are suitable for their colonisation and growth.

Where mangroves are present in a vegetation sequence that includes coastal forest/shrub, saltmarsh, mangroves, open intertidal flats (at and above the upper tidal limit of cockles) and a low tide channel there would be a higher value placed on maintenance of the mangrove community (in the absence of other values).

Where a mangrove community occupies most of the intertidal range, and is not contiguous with saltmarsh, there would be a lower value placed on maintenance of the mangrove community.

5.4.2 Use of mangrove stands by threatened taxa

Criterion (e): The degree to which the retention / protection of mangroves in a particular area is needed to sustain obligate or associated taxa, particularly threatened species.

Explanation

The presence of tall stature vegetation within the intertidal zone provides cover and feeding opportunities for a different range of taxa than open intertidal flats that are preferred by other taxa (waders tend to avoid tall stature vegetation that provides cover for predators).

Banded rail (*Gallirallus philippensis assimilis*) is the taxon most commonly quoted as benefitting from the expansion of mangroves as they forage away from salt marsh vegetation under the cover of mangroves, for distances of nearly 300 m. However, it should be noted that neither banded rail nor any other taxa other than a moth (*Planotortrix avicenniae*) and an eriophyid mite (*Aceria avicenniae*) have an obligate association with mangrove communities (Morrisey *et. al*. 2007). Banded rail are common in Nelson, for example, where mangroves do not exist.

5.4.3 Effects of mangroves on indigenous vegetation mosaics

Criterion (f): The extent to which mangroves will invade and spread within a vegetation mosaic with salt meadow, sea grass and/or saltmarsh.

Explanation

Vegetation mosaics can occur within a comparable intertidal/depth zone parallel to the shore within the Coastal Marine Area where there are differences in factors such as substrate and exposure. Within saltmarsh, mosaics of sea rush and jointed rush may occur due to very subtle differences in sediment elevation for example. Such mosaics are particularly characteristic of the mid to lower tide zone that is variously occupied by sea grass which displays a "pattern and process" colonisation sequence. Seagrass colonises relatively clean sand/shell substrate but dies off with age as the bed accumulates excess mud and organic matter. When seagrass dies off, open intertidal sand flats replace it.

Mangroves are a natural part of mosaics with sea grass and saltmarsh, occupying particular niches. Mangroves may be of 'lower' ecological value when they are actively invading such vegetation mosaics if there is a likelihood of spread at the expense of lower-stature indigenous-dominant vegetation communities and resulting in elevation of

bed levels within shorter time frames than the system that is being displaced. There needs to be evidence of the active invasion and expansion of mangroves, from aerial photographs or other monitoring.

5.4.4 Protection of High Tide Bird Roosts

Criterion (g): The extent to which mangrove expansion may compromise avifauna habitats with special values, such as high tide roosts.

Explanation

Marine bird use of harbours and estuaries can be limited by the availability of high tide roosting sites. Where mangroves have or are about to spread onto or around these roosting sites, there would be ecological grounds for their clearance.

5.4.5 Mangroves us by fish and other benthos

Criterion (h): The extent to which the mangroves in this location are likely to provide habitat to aquatic species.

Explanation

This is an area of current investigation but it appears that, as mangrove communities are dewatered twice a day, they have limited value in terms of provided cover for fish (particularly juveniles at high tide.) At other times during the tidal cycle juvenile fish must survive without mangrove cover.

5.5 Coastal Margin Erosion Buffering

Criterion (i): The extent to which mangroves provide a physical barrier to erosion and protect against the effects of climate change.

Explanation

Mangroves have the potential to form a "soft erosion control" barrier around the margins of harbours and estuaries. This role should be supported by the opinion of a coastal processes engineer are providing a "soft erosion control" barrier around the margins of harbours and estuaries, unless compensatory mitigation measures are implemented.

By raising bed levels at and about the high tide mark, they may also contribute to the potential expansion of saltmarsh areas.

5.6 Habitat Connectivity of Ecological Buffering within CMA

Criterion (j): The extent to (a) which mangroves provide a buffer to sensitive ecological areas from the activities people, animals, and other threats. (b) Shoreline connectivity between upper and high tide habitats (i.e. provide cover for animals moving around the shoreline).

Explanation

An intact band of mangroves offshore of saltmarsh is a 'barrier' that has the potential to discourage walking (and vehicle) access to the Coastal Marine Area through areas of saltmarsh, which has the potential to be beneficial to the conservation of saltmarsh. An education or awareness programme may be required to support the ongoing protection of saltmarsh.

A barrier of mangroves between the high tide mark and the upper limit of the cockle community may also serve to buffer/isolate mid to low tide intertidal habitat from human development on adjacent flat land (and access by people on foot and in vehicles, and dogs). There may be situations where this would improve the use of the mid to lower intertidal zone by wading birds, for example.

5.7 Sediment Stabilisation Role of Mangroves

Criterion (k): The extent to which it is likely that removal of mangroves at a site will result in silt remobilisation, with resultant adverse effects.

Explanation

One of the chief characteristics of mangrove occupation within the Coastal Marine Area is that the architecture of a mangrove community stills wave action, slows water currents and results in the deposition of silt and mud within mangrove stands.

It is necessary to consider the potential re-mobilisation of these fine muds following the removal of established mangroves (adjacent and downstream sedimentation effects). It is also necessary to consider whether some of the fine material trapped within mangrove communities that are to be cleared may contain potential toxins that also need to be removed at the time mangroves are removed (potential toxicity to adjacent and downstream habitats). In this instance, dredging and the appropriate disposal of such sediment would be required as a mitigation measure for mangrove clearance.

6. Discussion

There would be less ecological concern with the clearance of mangroves that:

- have spread, over the previous 30 years or so, across a disproportionate area of a particular harbour or estuary. The case for removal is even stronger for very young mangroves less than 10 years old (as established by evaluation of photographs or other verifiable plans),
- are not utilised by banded rail,
- are not part of a vegetation sequence that includes coastal forest / shrub, saltmarsh, salt meadow, open intertidal flats (at and above the upper tidal limit of cockles), and a low tide channel,
- in the opinion of a qualified and experienced coastal processes engineer, are not providing a "soft erosion control" barrier on the margins of a harbours or estuary,
- are not within sites of special ecological, scientific, or conservation value within the Coastal Marine Area, and / or
- are not stabilising sediment that, in the opinion of a coastal processes engineer, is likely to be mobilised following mangrove clearance and adversely affect adjacent and downstream habitats.

There may be ecological justification to clear mangroves (subject to a case-by case assessment) that:

- are colonising or spreading adjacent to high tide bird roosts,
- occupy the intertidal zone below the upper level of the cockle community, and
- that are actively invading vegetation mosaics (rather than steady-state saltmarsh-mangrove mosaics).

7. Process for Application of Criteria

- Compile relevant existing information, particularly historical aerial photographs.
- Divide a harbour/estuary into discrete units/areas.
- Multidisciplinary team of specialist/stakeholders undertake site visit(s) and evaluate mangrove functions and values within each management unit/area.
- Evaluate values on case-by-case basis.
- Recommend a management approach for particular harbour/estuary.
- Make informed decision for each mangrove management unit/area.

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