DEATH OF MANGROVES: UPPER WHANGAREI HARBOUR

By

NMU CLUNIE

Clunie & Associates
Environmental Consultants
P O Box 48 177
Blockhouse Bay
Auckland
phone (09) 627 8539

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INTRODUCTION

1. Die-off of mangroves on several scales of spatial pattern, intensity and duration have become the subject of recent concern on the estuarine fringes of the upper Whangarei Harbour.

2. Dramatic, locally catastrophic die-off events have occurred recently on two sites (at Kissing Point, and on the George Point-Sherwood Creek mudflats), and on another site (the boardwalk site adjacent to the Olympic Pool) there is a more diffuse and less intensive dieback. Each of these situations was assessed, and is the subject of this report.

SITE VISIT

3. On Thursday 20 May 1993, I inspected the three sites with Messers Ray Pierce (Conservation Advisory Scientist) and Neville Saunders of Department of Conservation (DoC) Northland Conservancy, and Glen Mortimer (Coastal Planning Officer) of Northland Regional Council (NRC).

SITE 1: UPPER HATEA RIVER (MANGROVE WALK)

4. This site, which is traversed by a boardwalk, is on low-lying land on the eastern side of the Hatea River immediately north of the Olympic Pool. Only part of the mangrove stand is subject to regular tidal flooding. Air photos indicate that mangrove was well established on much of the site by 1942.

5. On the lower-lying parts of the site subject to regular tidal inundation the mangrove trees (*Avicennia marina*) are larger (average c. 9m tall x 23-30(-36)cm d.b.h.[1]). Macrophyte vegetation (other than mangroves) largely is absent from the floor, which is densely stocked with pneumatophores (vertically protruding air roots).

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[1] d.b.h. stem diameter at breast height

6. On slightly higher ground towards the banks, which is not inundated regularly, the mangrove trees generally are of smaller stature (mostly c. 4.6m tall). The floor has a dense cover of jointed rush (*Leptocarpus similis*), except on shaded areas (eg, under relatively dense canopy or under the boardwalk). Mangrove seedlings and saplings establish only where the *Leptocarpus* is absent or sparse (on shaded areas).

7. The trees on the bare flooded sites appear to be in better health: The foliage is greener, stocking is more regular, and canopy cover more dense and regular. In contrast, mangrove trees on the *Leptocarpus* sites have thinner, yellower foliage, in some areas many are stunted and spindly, stocking is less regular, and canopy cover is patchy and less dense. There are open patches where trees appear to have been displaced, and in these patches the *Leptocarpus* is especially dense, and mangrove regeneration is absent or negligible.

8. Twig dieback and some branch-end dieback is widespread, affecting > 30% of trees to varying degrees. Branch-end dieback is patchy in the crowns, and often affects isolated segments of the crown. It appears to be more prevalent on the *Leptocarpus* sites. The severity of dieback is patchy in the stand, with some areas being relatively free.

9. A high percentage of trees in the stand have holes in the stems caused by wood-boring insects. The severity of borer damage varies in the stand. Often the borer holes have been the site of fungal infestation, and a proportion of stems are hollow of have considerable wood rot.

10. Where the branch-end dieback is most severe borer infestation, especially of the dead and dying wood, is more dense and extensive locally in the vicinity of the dieback.

11. There is evidence of earlier dieback, with a few standing dead trees, and some large old stumps which are hollow and partly rotten but have resprouted.

12. No direct evidence of possum browse was seen.

<u>Conclusions:</u>

13. The generally higher degree of morbidity and growth suppression of mangrove trees on the sites on marginally higher ground in which *Leptocarpus* has established appear to be part of a natural sere (a phase of succession). It appears that mangrove trees are being displaced from these sites as a result of changing environmental conditions, probably including direct competition with the *Leptocarpus,* which also prevents regeneration.

14. Branch dieback has occurred in the past, and some trees in the stand have died

(and on marginally higher ground not been replaced). Current dieback is substantial, but at this stage I could see no indication that it is likely to lead to heavy or catastrophic mortality. Whether or not the current episode of branch-end dieback is more severe and potentially more damaging than ' normal' could probably be assessed by a comparative examination of this and several other (including apparently healthy) stands.

15. Although there is an association between intensity of stem boring and dead branches, this does not necessarily indicate that stem borers and/or the associated fungal infestation are the primary cause of branch-end dieback (borers could, for instance, infest already stressed or dying or dead tissues more intensively). Further study, over a more extended period, would be needed to assess potential causal interrelationships.

16. Possum browsing cannot be dismissed as a possible cause of dieback on this site without more extended observation. However, the pattern of dieback, which is more diffuse than that usually associated with possum browsing, leads me to think that possums are unlikely to be a substantial causal factor.

SITE 2: KISSING POINT

17. Death of trees is concentrated in a fringe of mangrove extending for approximately 400 metres westwards alongside the southern bank of the causeway from the Awaroa River road bridge to the Kissing Point area adjacent to the junction of the Awaroa and Hatea Rivers.

18. Air photos indicate that mangrove was well established on the estuarine fringe in 1942 (before construction of the present causeway). The trees are of tall stature - averaging c.4.6m tall x 10-20cm d.b.h. (larger on the outer fringe - 5.5m x 36cm d.b.h.).

19. The stand averages roughly 9 metres wide in the central area (for c.240m), narrowing to one tree wide at either end.

20. Die-off of trees affects most of the stand. Trees at the eastern extremity of the stand (1 tree wide x for c. 17m) are healthy. Westward for roughly 290 metres almost all trees are dead, with only wide-scattered moribund survivors (< 10% of trees) with very thin, yellowed foliage. Westward from here to the end of the stand opposite the junction of the Awaroa and Hatea Rivers (c.94m) more than 50% of trees are dead. A high proportion of survivors are moribund, with thin yellow foliage. Some trees carry recently-dead leaves, and appear to be dying. A small proportion of surviving trees have many young epicormic shoots.

21. The sediment surface is bare of macrophytes; a condition not unusual in

mangrove stands. There are many pneumatophores, many of which are dead. The site is flooded regularly by tides.

22. Under pressure the sediments ooze dark black material consistent with decaying organic matter, especially from holes around the dead pneumatophores. There are crab holes, and some live crabs were seen. Herons are reported to still feed on the mudflats alongside the stand (G. Mortimer; pers comm).

23. There is considerable borer damage to the trunks and branches of many trees in the stand. The extent and intensity of borer damage did not appear to be much different from borer damage in the other stands we inspected. Borer damage is widespread in the affected stand, in both living and dead trees, and there did not appear to be any obvious correlation between intensity of borer damage and dead trees. An earlier entomological study of the affected stand had identified lemon tree borer (*Oemona hirta*) as a cause of extensive borer damage (reported in Mortimer 1992:2).

24. Stands of mangrove trees of comparable stature growing near the affected stand are healthy, and show no signs of the die-off. One such stand is on the inner (northern) side of the causeway adjacent to the western part of the affected stand, flooded by tidal water of the Awaroa River passing under the Awaroa Bridge. The other extensive stand is on the estuarine mudflats on the opposite (southern) side of the Awaroa River - some 100 metres away directly across the river from the affected stand.

<u>Previous studies:</u>

25. The results of an earlier investigation of the die-off in the affected stand are presented in a report to the Northland Regional Council (Mortimer 1992). Some relevant findings were as follows:

26. Die-off was first reported in October 1991. Oil contamination of the sediments was suspected to be the cause of die-off. Oil slicks in the upper harbour had been reported in previous weeks.

27. lntertidal sediments from the affected stand were analyzed and found to contain anthropogenic hydrocarbons (as cf natural oils produced by plants) at considerably higher levels than those reported for other sites on the upper harbour.

28. The report noted that there had been no herbicide spraying on the road verge prior to the die-off.

Conclusions:

29. The concentrated pattern (adjacent stands are not affected), timing, and intensity of die-off suggest that the primary cause was a very localised pollution event.

30. It is most likely that the causal agent was water-borne. Plants on the adjacent bank of the causeway were not affected. There is no die-off in nearby mangrove stands which would have been in the same general air stream, eg., if air-borne contaminants such as sulphur dioxide or fluorides had blown in on southwesterly winds from the fertiliser works.

31. The effects are entirely consistent with contamination of the intertidal sediments by a localised oil spill, as suggested by the results of the earlier study and conclusions presented in the NRC report (Mortimer 1992).

32. If, as seems very likely, contamination by a localised oil spill was the primary cause of die-off, then it is very unlikely that the die-off will spread beyond the currently affected stand.

33. Mangrove may or may not reestablish on the site. Most of the trees on the site were old-established, and there was little evidence of recent regeneration.

SITE 3: GEORGE POINT - SHERWOOD CREEK

34. Mangrove covers extensive mudflats between headlands east of the mouth of the Hatea River. An old-established (? pre-1900) disused rail causeway runs between the headlands, more-or-less bisecting the mangrove-covered mudflats.

35. Mangrove of taller stature grows on a narrow fringe along the harbour edge, in an old-established area in the corner alongside the George Point headland, and along drainage channels associated with Sherwood Creek and Sherwood Creek itself, which is the tidal floodway for much of the mudflat. Elsewhere the mangrove is of low stature (often 1-1.3m tall) and the plants are spindly.

36. Effluent from a long-established sewerage treatment plant discharges into Sherwood Creek.

37. Die-off occurs in two relatively large and two small discreet patches towards the George Point end of the inner (inland of the causeway) mudflats, well to the north of Sherwood Creek.

38. Copies of air photos from 1942 and 1970 (which I was able to view) show that on the inner mudflats (inland of the causeway) mangrove was well established in 1942 near the George Point headland and in a wide fringe alongside the causeway, but was sparse along the landward side ($>1/2$) and to the south.

39. Die-off occurs in both the older-established mangrove of relatively tall stature and the stands of lower stature.

40. The large die-off patch (A) nearest George Point is largely in old-established mangrove of relatively tall stature, with larger trees to 4.6m tall (x 15cm d.b.h.) scattered among trees from 1.5m to 2m tall. The branches are heavily infested with lichen. The die-off patch is of irregular roughly elongate-oval outline.

41. The large patch (B) some 40 metres to the south (and mostly c. 30-35m from the causeway) affects mangrove of relatively low stature, most of the plants being lm to 1.3m tall and spindly, with scattered specimens to 1.7m. The patch is a regular narrow-crescent shape, which appears to roughly skirt the outer edge of taller mangrove growing towards the causeway.

42. Brief inspections were made of sites A and B. On both sites mangrove is the only macrophyte. Many of the features of the die-off are similar.

43. Towards the centre of the die-off patches all trees/shrubs are dead. Many of the trees still hold small **(3^0)** twigs - indicating that the die-off is a recent, locally catastrophic event.

44. Die-off is spreading. Towards the edges of the die-off patches there is a band of recently-dead specimens still holding sparse dead leaves. Beyond this is a fringe of dead and moribund individuals with thin yellowing foliage and much stem tip wilting and dieback.

45. Stem borer damage is extensive, both in die-off patches and healthy stands. A substantial proportion of stem wood is hollow, and trunks have many borer holes. There is a particularly dense infestation of borer in the dead upper branches in the die-off areas.

46. Mangrove seedlings (mostly 10cm to 30cm tall) are plentiful to abundant throughout most of the healthy stands. Seedlings are absent to sparse in the central parts of the die-off patches. Towards the edges of the dead patches there are scattered live seedlings, but seedlings are much more dense in healthy areas beyond the fringes of the die-off patches.

47. Towards the centre of the die-off patches the sediments are foul-smelling, and under pressure emit dark black material - features consistent with a high level of organic decay under anaerobic conditions. There are very few holes in the sediments, and dead crabs were evident.

Previous observations:

48. Field observations by DoC staff in March 1993 and observations by a local

resident (Mr Buys of 84 George Point Road) of the rate of establishment of die-off are recorded in a DoC Field Centre report (Randall 1993). Die-off is reported to have increased from $40m^2$ in a single patch in January 1991 to a combined area (in four discreet patches) of $660m^2$ by March 1993. The reported rate of establishment of die-off is:[2]

Die-off area (m^2) Jan 1991	Die-off area (m^2) Mar 1993
40	200
nil	400
nil	40
nil	20
Total: 40	660

Conclusions:

49. Die-off appears to have arisen recently and expanded rapidly (over c.2 years) to represent a catastrophic demise of mangrove locally in discreet patches, two of which are substantial (c. $200m^2$ to $400m^2$).

50. From the rapid field investigation and qualitative evaluation, I was unable to detect any relationship between habitat features and the spatial pattern of die-off which was suggestive of a causal interaction.

51. The die-off patches are far-removed from the old-established sewerage treatment outflow and appear to bear no relation to it.

52. I was unable to detect an obvious relationship between die-off and ground-surface levels or drainage and flooding patterns. The very regular crescent shape of one of the large (and one small) die-off patches is suggestive of an underlying regular topographic feature or associated flood/drainage pattern. Small quantitative differences in ground-surface levels and associated flooding and drainage patterns can have substantial effects on vegetation patterns in estuaries. 'Salt pan' effects can displace mangrove, particularly on marginally higher ground where drainage is impeded or irregular. Accurate measures of ground-surface levels would be needed to determine whether or not there is any relationship between the die-off pattern and ground-surface features.

53. Although borer holes are more intensive on dead wood in the die-off patches,

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[2] table extracted from Randall (1993)

borer damage is widespread also in unaffected stands. There is no obvious suggestion of a primary causal interrelationship.

54. The ongoing spread of dieback in discreet patches outwards from epicentres is consistent with the pattern sometimes observed when soil-borne root-rot pathogens are a primary cause of dieback. Buildup of innoculum potential on the ' disease front' leads to ongoing spread from epicentres following an outbreak in response to some local triggering condition(s). Die-off in mangrove associated with a species of *Phytophthora* was demonstrated in the Thames area. If the die-off continues on a larger scale, the possible involvement of soil-borne pathogens might warrant further investigation.

55. The concentration of die-off in discreet patches on the extensive mudflats suggests that the involvement of water-borne contaminants or indrift of air-borne chemicals is unlikely to be a significant factor (although it does not discount the possible involvement of contaminants as triggering factors in a disease syndrome). A possibility (that presumably is very remote but should be borne in mind) could be discharge of pollutants (eg, flushing of herbicide cleanings) from aircraft tanks.

56. The anoxic and presumably very acidic and reducing conditions in the surface sediments resulting from the concentrated decay of dead mangrove tissues may be a factor preventing recolonisation of the sites. If this is the case, it is possible that mangrove may reestablish on the sites from which they are being displaced at a later date (when the decay subsides). Alternatively, if the primary causal factor of die-off persists and is responsible for death of seedlings, recolonisation of the sites by mangrove will not occur.

57. I was not able to determine whether the die-off is a (locally dramatic) manifestation of a natural 'sorting' of plant communities in the course of succession on the estuarine mudflats, or is a potentially more serious short- or long-term displacement of mangroves caused by an outbreak of disease or by contamination of the habitat. Locally dramatic events can arise during the course of succession when gradual cumulative changes to the habitat or requirements of the communities reach a threshold level.

58. It is important that the die-off situation here be kept under observation and monitored. Initially it would be useful to install reference stakes on the site and map die-off features to measure spread.

59. Measures of fundamental features of the habitat (eg, sediment surface levels, flood and drainage patterns, sediment salinity and chemistry, etc.,) would be a useful and probably necessary aid to a successful outcome in determining the primary cause of die-off. This is a prerequisite to evaluating likely long-term outcomes and the requirements for control procedures.

REFERENCES

Mortimer, G. 1992: *Mangrove die-off at Kissing Point.* Unpublished internal report, Northland Regional Council, File 620.5, 17 February 1992. 3 pp.

Randall,A. 1993: *Mangrove. die-off - Whangarei Harbour.* Unpublished report to Field Centre Manager, Department of Conservation, Whangarei, 5 March 1993. 2pp.

N M U CLUNIE
(MSc Hons-Botany, PhD Forestry)
Clunie & Associates
Environmental Consultants
P 0 Box 48 177
Blockhouse Bay
Auckland 7 Phone: (09) 627 8539

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