Inglis Bush Scenic Reserve (Central Hawkes Bay): Impact of water race on native vegetation

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1. Summary

1.1 PROJECT AND CLIENT

Landcare Research New Zealand Ltd was requested by the Department of Conservation to investigate and report on what effect, if any, the Ashcott water race was having on the vegetation in the Inglis Bush Scenic Reserve, Central Hawkes Bay. The intake to the race is immediately beside the Reserve, and the race flows through the Reserve.

1.2 OBJECTIVES

- To appreciate and provide a working description of the sedimentation history, channel dynamics, general physiography, soils and climate of the Reserve, and so put the Reserve and its environment in context.
- To assess the history of the water race and its observed or possible impact on the forest and, if appropriate, suggest management options.

1.3 METHODS

The relevant reports and papers were read, discussions were held with those with specific interest and qualification, and the Reserve was visited on two occasions.

1.4 CONCLUSIONS

- The water race is not having any major impact on the native vegetation. The small stand of young kahikatea immediately upslope of the race and adjacent to the wetland area could have been affected by a fluctuating water level associated with poor maintenance of the race. Dieback in the crowns of canopy podocarps occurs both upslope and downslope of the race, and it is concluded to be independent of the race.
- Physiological drought is the most probable reason for the dieback that is occurring. The underpinning cause is a current rainfall regime that is significantly below the longer term average. This has been compounding since the 1950s.

1.5 RECOMMENDATIONS

- That a clear policy on race maintenance be established within the Reserve and for 300 m beyond the Reserve boundary.

- That a Staff Gauge Plate be installed in the wetland area on the south-eastern boundary for the periodic checking of water levels.

- That continuous water level recording be considered for surface water levels in the eastern wetland area, and for watertable levels in the neighbour's (pumphouse) well at the western end.

- That a quantitative study be undertaken, for the purpose of future reference, to firmly identify the current extent and development of dieback in the Reserve.

2. Introduction

In 1994 members of the public and the Central Hawkes Bay Section of the Royal Forest and Bird Protection Society expressed written concern to the Department of Conservation about the deteriorating condition of the forest in the Inglis Bush Scenic Reserve, and attributed the decline directly to the Ashcott water race and intake which are within the Reserve.

In December 1994 Landcare Research was requested by Mr John Cheyne (through Mr Geoff Walls) to provide advice on the following:

"1. In Inglis Bush Scenic Reserve, has the taking of water from the Tukituki River, and channelling of it through the Reserve, had any impact on the native vegetation?

2. Is that impact continuing?

3. What are the suggested management options to alleviate any impact?"

3. Objectives

- To appreciate and provide a working description of the sedimentation history, channel dynamics, general physiography, soils and climate of the Reserve, and so put the Reserve and its environment in context.

- To assess the history of the water race and its observed or possible impact on the forest and, if appropriate, suggest management options.

4. Method

4.1 REPORTS AND LITERATURE

Both the 1984 Management Plan (Lands and Survey 1984) and the current DoC file on Inglis Bush were viewed. Other literature pertaining to forest condition in the lower North Island was studied. Information on water race performance in Canterbury was checked. Neither of these two searches was exhaustive.

4.2 SITE INSPECTION AND DISCUSSIONS

Inglis Bush Reserve was visited on 7 December 1994 in dry conditions, and again on 22 February 1995 in even drier conditions. The latter visit was in the company of Mr Pat Bonis, the DoC District Field Officer (Ongaonga). The apparently failing condition of the Reserve was discussed with Pat Bonis, Geoff Walls, and Pat Grant (Research Fellow, Landcare Research NZ Ltd).

5. The Inglis Bush Reserve

5.1. LOCATION

Grid Reference NZMS 260, Sheet U22, 950 368 (Central Hawkes Bay).

From Highway 50, turn up the south side of the Tukituki River on Tukituki Road for 3 km. The reserve is located on a lower terrace to that of the road, but the canopy extends above the scarp and is clearly visible. Access is across the paddock.

5.2. ELEVATION

The water race follows closely to the 260 m contour.

5.3. AREA

The total area of the Reserve is 16 ha.

5.4. RAINFALL

The annual rainfall is 1200 mm (NWASCO, unpub.). The nearest and most

appropriate rainfall station is that at Blackburn (1396831; NZMS 260 U22 945 416, Bibby Road, Geoffrey Hornblow). Rainfall at Ashley Clinton (1396921 1950 - to date) and Makaretu (1396931, 1967-80) is higher by 200-400 mm respectively. The Reserve is in an area of September-February soil moisture deficit (Griffiths 1982).

5.5. VEGETATION

The reserve is a remnant stand of the podocarp forest that occupied the general area prior to deforestation in the mid to late 1800s. Its kahikatea stand is particularly noteworthy. A description of the canopy and understorey, and a species list is to be found in Lands and Survey (1984). Condition and trend of the Reserve is alluded to in this report with references to selective logging in the early days, in stocking rates of the kahikatea (60 - 150 stems/ha), and with descriptions of podocarp regeneration and understory vigour. The report suggests a trend in the future to a denser understorey dominated by titoki and taws. The "pioneering" kahikatea stand is considered in the process of reaching over-maturity and changing to a more mixed podocarp association (in order: totara, rimu, matai, miro). A pocket of younger kahikatea trees is noted in the "old flood channel". Part of this stand has now died (see below).

5.6. PHYSIOGRAPHY AND SOILS

There are three surfaces in the area:

(1) Tukituki Road is on the upper surface with soils of the Takapau Series formed from ash-dominant alluvium. In the locality this surface is now totally under pasture.

(2) The Reserve is on a lower surface. The age of this surface conforms with the Matawhero period of sedimentation (1510-1620) (Grant 1985) with podocarps 300-400 years old (dendrochronology observations, P.J. Grant, pers. comm.)

The soils here belong to the Argyl Series and are alluvial soils formed from greywacke sands and gravels. These soils are shallow and droughty except where affected by seepages.

In places on this surface the forest floor is channelled to depths of up to 1 m. Here, tree roots are buttressed and exposed, though ferns, ground cover, and litter can mask this.These features are not presently eroding and are the signature of an overspill of the main river channel some time ago. The extent to which flood waters still spill through this route during high stages in the main river channel has not been determined; the indications are that they are relice channels. Water flowing by this route in the past could have initiated and maintained the wetland area in the southeast corner now traversed by the water race.

The longitudinal slope of this surface is less than that of the present channel. It is suggested (P.J. Grant, pers. comm.) that the cause is a structural barrier in the main valley where Tukituki Road leaves Highway 50. In the past, sediments backed up behind this constriction, and the present terrace is a remnant of this period of sedimentation. The slope explains why the river banks of the terrace are higher on the eastern edge of Inglis Bush as compared with the upstream western end where the two surfaces are almost common. The overspill already mentioned is at this western (upslope) end.

Inglis Bush Reserve is exclusively located on this surface, except for an insignificant part associated with the scarp to the higher terrace.

(3) The current river bed is itself a gravel bar and channel system in which current dry channels reflect previous but recent storms. For example, some dry channels were undoubtedly formed in 1974 during Cyclone Alison. Cyclone Bola of 1988 did not significantly affect this area, being generally centred further north. Some channel engineering has been effected in recent years, the most recent in 1991 when alignment of a 75 m wide channel, removal of "congesting" trees, and associated "rope and rail" works were carried out to protect the eroding (Matawhero) bank of the Reserve at its eastern end.

6. The Ashcott Water Race

The Ashcott water race is a stock water supply. Its intake from the main channel of the Tukituki is in the Inglis Bush Reserve in a midway position on its northern edge with the river. The intake is a gravel weir that is reshaped by dozing as required by channel changes in the river. The race follows the contour through the Reserve to emerge on its south-eastern boundary close to the terrace scarp and adjacent to a wetland area. It then proceeds southeast across open paddocks to the Tukituki Road/Highway 50 junction, and then on to open channel reticulation. Construction is by cut and fill except where the race traverses the area adjacent to the wetland. Here the race is sandbagged, and the race has breached here in the past (Pat Bonis, pers. comm.).

It is understood that the race was constructed in 1965-66. Three years ago (1991?) the race was repaired to take its design capacity, having failed and not having been fixed to capacity for some considerable period.

7. Results from Inspection

There is no doubt that dieback of the vegetation, especially in the canopy, is occurring within the Reserve. Overall the Reserve appears to be suffering from a general lack of vigour.

On the occasion of the two visits, vegetative and litter on the ground surface were "crackle dry", and some understorey species were actually wilting, especially mahoe. Young tree ferns were under obvious stress and one patch of silver fern was dead. Large kahikateas in the eastern area showed dieback in the crown, while a younger stand of smaller kahikatea adjacent to the wetland area had died. Soil moisture levels were very low, except in the wetland area where it was saturated and it appeared that the water race could be leaking.

8. Discussion

In evaluating forest condition on the basis of "spot visits" there is difficulty in differentiating between the longer term trend, and the contemporary condition. The 1994 year was one of the driest on record, the drought continuing through to at least April 1995. The two visits were therefore biased in terms of seeing conditions under extreme circumstances.

The ground and understorey vegetation were certainly under stress on both visits. The level of stress or otherwise in the canopy trees could not be judged. Measures of sapflow using heat pulse techniques would be useful, but it would require an understanding of how mature podocarps behaved under non-stress conditions and thus such a technique would be inappropriate without full scientific support.

While the greater issue is the long-term trend of vegetation condition in the Reserve, the immediate issue is the influence of the water race.

Is the race "drawing water from the bush hence causing degeneration"? From the basis of fluvial and sedimentation processes, this hypothesis is difficult to support. The implication is that more water is leaving the Reserve because of the race than would if the race was not there. The volume of water leaving the reserve, in the race, would have to be greater than the water entering from the river - there would have have to be a net gain. This could be so if the race was constructed such that the cut intercepted the watertable. Inspection failed to identify any section where this was considered a possibility. A possible exception would be in the wetland area where, at times, the free water in the wetland is such that flow/leakage could occur into the race. This is a possibility, but only at times when the waterlevel was as high or higher than the level of water in the race, and not at times of drought when it is below the race level.

If, in wet conditions, it was thought that leakage was possible, the placement of a dye in the wetland area could indicate the transfer of any water into the race. But such a loss is still only a concern in dry periods, and it would require an unsealed channel.

Is the race contributing water to the Reserve causing sustained wet conditions different to those the vegetation developed in? This could occur if the channel system was leaking. This has not been proved one way or the other.

Evidence from race systems is that the sediment carried by the water settles on the wetted perimeter and initiates a self-sealing process. This is sufficient to ensure the viability of race systems, but leakage does still occur. In the Ashburton/Rakaia area, leakage from races amounts to an estimated 16% of the total groundwater recharge (Scott and Thorpe, 1986). If leakage is occurring in the Ashcott water race, the effect would be that of feeding oxygenated water into the soils and gravels of the Reserve, and thence into the watertable. This would appear to be a "plus" in favour of the race, and if it were a negative there should be a difference between the area downslope of the race and the area upslope. No such difference is apparent.

Does the race have any other impact? It is of possible concern that there has not been a stable regime in the race in recent years. A breach in the race was not repaired immediately and the race is understood to have discharged considerable water into the Reserve over an undefined period. However, there is no indication of any more tree dieback in this pathway than elsewhere. It is also possible that the race has acted as an impoundment in the wetland area with the water level backing up behind the upslope wall of the race. Certainly a stand of young kahikatea has died in this area. However, the change in water level is unlikely to amount to more than 30 cm at any time and this effect cannot be taken seriously. There remains a third possibility that the breach in the race caused an almost total washout of the system adjacent to the wetland, and that an induced lower than normal water level in the wetland was later compounded by a higher than normal water level when repairs were effected. It is only conjecture that this change in regime did occur to a degree and for a duration significant to the aforementioned stand. Tolerance of kahikatea to changing water level would be thought to be high in a species adapted to "wet feet". And it doesn't explain dieback in other areas both upslope and downslope of the race.

Most, if not all, bush stands in the Hawkes Bay area are currently showing signs of stress. This is probably best attributed to dry conditions that currently prevail and which were fairly extreme through 1994 when some areas received only half normal rainfall. The nature of annual rainfalls in the Inglis Bush area (Figure 1) provide evidence of a shift to drier conditions in recent years. At Blackburn, a rainfall record considered of direct relevance to the Reserve, drier than average conditions have prevailed through the 1960s and 1980s. The trend is also apparent in the higher rainfall Ashley Clinton record.

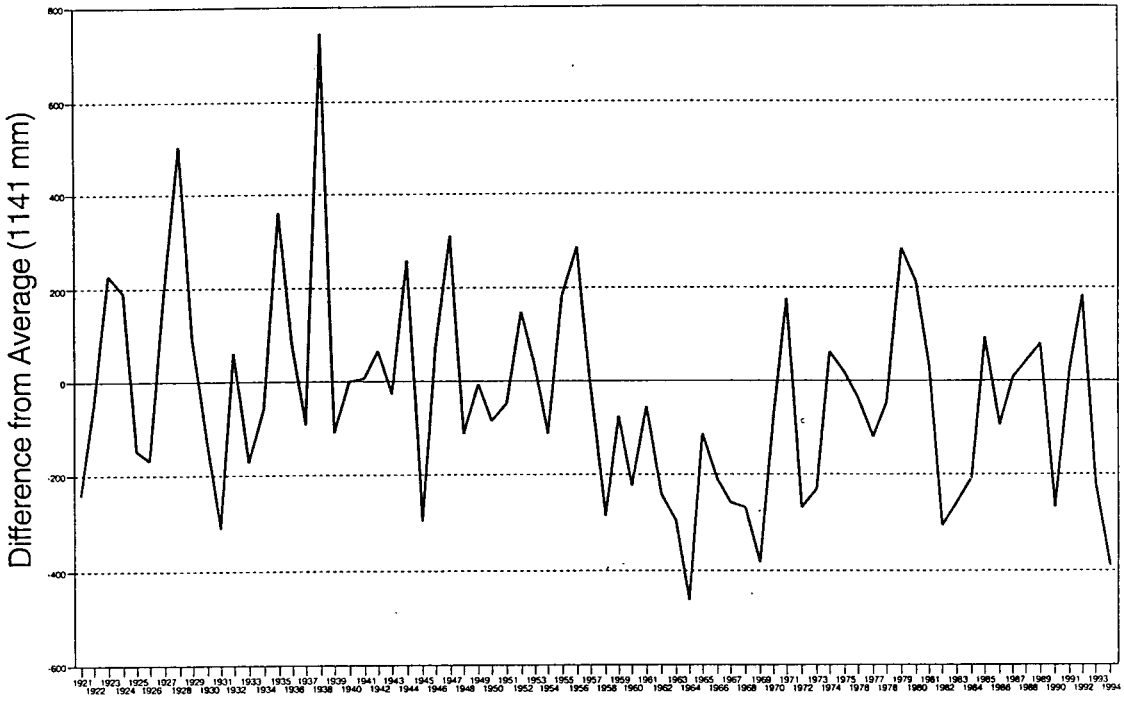
Drought damage to the crowns of podocarps (dieback) and in killing canopy trees is described by Atkinson and Greenwood (1972) in the Manawatu with respect to a specific drought in 1969-70. A full discussion on the effect of drought on the Hawkes Bay forests is provided by Grant (1991), and its probable contribution to the lowering of timberline in the Ruahine Range by Grant (1984). As Grant observes, when the drought trend is considered alongside the warmer temperature regime of recent years, "the probability increases that physiological drought may have debilitated the vegetation more often since about 1950 than is realised" (Grant 1983).

Increased exposure has also been suggested (Pat Bonis, pers. comm.). Conversion of surrounding land to pasture has increased the exposure of crowns in the reserve, and this "almost certainly accentuates mortality during droughts" (Atkinson and Greenwood 1972).

Figure is Rainfall Deviation from Average. Annual totals from the Blackburn and Ashley Clinton rain gauges. *(Source: NIWA Climate Data Base.)*

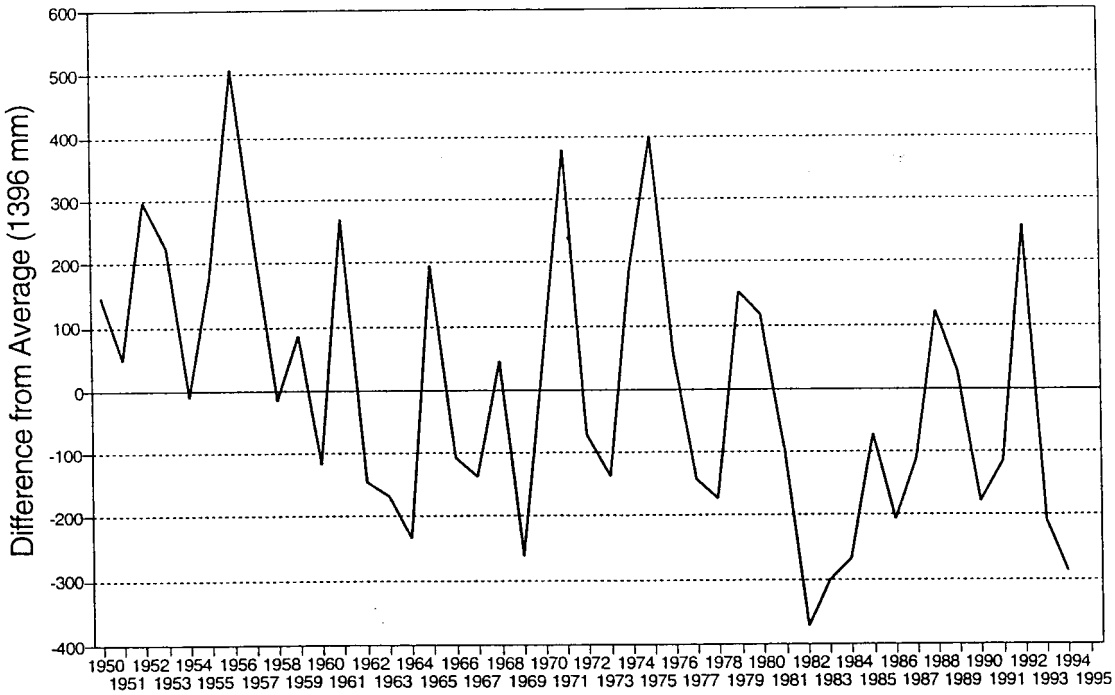
Annual Rainfall at Blackburn

(D96831) 1921-1994



Annual Rainfall at Ashley Clinton

(D96921) 1950-1994



9. Conclusions

The taking of water from the Tukituki River using a simple gravel-bar diversion, and its transport by open-channel water race through the Reserve using gravity fall, is not seen to be having any major impact on the native vegetation. The small stand of young kahikatea immediately upslope of the race and adjacent to the wetland area could have been affected by a fluctuating water level associated with poor maintenance of the race. Dieback in the crowns of canopy podocarps occurs both upslope and downslope of the race, and it is concluded to be independent of the race.

Physiological drought is the most probable reason for the dieback that is occurring. Inglis Bush Reserve is not alone in feeling this impact, and there is little that can be done other than to leave Nature to take its course. The underpinning cause is a current rainfall regime that is significantly below the longer term average. This has been compounding since the 1950s.

It is assumed that the lower rainfall has been associated with a generally lower than average watertable below the Matawhero surface. An observation well located at either end of the Reserve would provide quantitative evidence of watertable changes, and would help characterise the sub-rootzone environment, but is unlikely to significantly improve the overall information currently delivered by the Blackburn raingauge. The possibility of placing a water-level recorder at the neighbour's pumphouse located near the western boundary of the Reserve is worth consideration. A pressure transducer sensor with small data logger is a simple technology that is available and would deliver continuous data with a minimum of servicing. (NIWA (Havelock North) have an excellent option.)

The Reserve could be reasonably easily irrigated using a permanent fixed-nozzle piped system from a shallow-well pump. However, this introduces other management, economic, and ecologic issues, and is not considered further.

The wetland area in the southeast corner should be visited regularly. Where the race enters this neighbour's property the wetland appears to be being enhanced for wild-life and duck habitat. Conditions were excessively wet here on 22 February 1995.

Race maintenance within the Reserve needs a defined policy. It is recommended that DoC and the Central Hawkes Bay District Council prepare a written understanding that ensures the viability of the race system at all times, in the Reserve and for up to 300 m beyond the Reserve boundary. The race should be either totally functional, or closed, at all times; any failure of the race within the Reserve that is not quickly attended to would seem incompatible with Reserve management. Past breaches (failures) of the race are considered to have had a possible impact on the vegetation.

10. Recommendations

- That a clear policy on race maintenance be established within the Reserve and for 300 m beyond the Reserve boundary.

- That a Staff Gauge Plate be installed in the wetland area on the south-eastern boundary for the periodic manual checking of water levels. *(Contact NIWA, Havelock North, for supply.)*

- That continuous water level recording be considered for surface water levels in the eastern wetland area, and for watertable levels in the neighbour's (pumphouse) well at the western end. *(NIWA, Havelock North, can advise.)*

- That a quantitative study be undertaken to firmly identify the current extent and development of dieback in the Reserve, for the purpose of future reference. *(This could take the form of establishing the Reserve as a "monitoring site" with the establishment of reference plots.)*

11. References

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