Modification of the floodgates and drainage patterns into Lake Pounui: implications for fish passage

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The Site

Pounui Lagoon is a DoC managed wetland which drains into Lake Onoke. The lagoon was once part of Lake Onoke but has been cut off from it by a dyke, which connects with an extensive area of reclaimed land lying between the Ruamahanga River and the lagoon. The lagoon drains into Lake Onoke through two culverts set through the dyke. Floodgates on the culverts stop tidal flows moving back into the lagoon and thereby protect the dyke.

Wetlands are very productive places. Pounui Lagoon is no exception. It is an oasis of native vegetation and birdlife in an area where much of the fertile flatland has been converted to farmland. However there are concerns about fishes. Many native freshwater fishes must migrate to and from the sea to complete their life-cycles. A survey of the Lake Wairarapa wetlands (Hicks 1993) found that the fish population of Lake Pounui lacked a number of species found in Lake Onoke. Yelloweyed mullet, triplefin blennies, stargazer, *Helice crassa* and *Palaemon affinis* were not caught above the gates. Catch rates of glass eels, inanga whitebait and common smelt were much reduced above the gates.

Apart from the Lagoon, Pounui Stream drains Lake Pounui. As an unmodified lowland lake with an essentially unmodified catchment, this type of water body is relatively rare in New Zealand. Lake Pounui is a valuable research site for Victoria University. The implications of enhanced fish passage are significant for our understanding of how the ecosystems of lowland lakes once naturally functioned in New Zealand.

THE FLOODGATES

It was concluded that the floodgates on Pounui Lagoon were probably impeding fish passage (Hicks 1993). There is only a brief period over each ebbing tide when water velocities through the gates would be low enough for fish passage. For the rising and high tide phase the gates are firmly closed. Alternatively, the reduced fish diversity may reflect the effect of the gates in restricting the ingress of saline water at high tide, as the density of inanga, eels, and redfinned bullies in the inlet stream was close to the values recorded for other tributaries without floodgates. Freshwater shrimp and perch were more abundant above the floodgates.

It is proposed (T. Harington pers comm.), to cut a 100x300 mm slot in one of the floodgates. Over a normal tidal cycle this sized opening is unlikely to threaten the stability of the dyke. It will also allow a wedge of saline water to enter the lower reaches of the lagoon. It has been found that many species of native fish tend to migrate upstream on the rising tide (McDowall and Eldon 1980). Whitebait are attracted to the outlet from the lagoon and formerly were the target of a fishery just below the gates. Now they are protected by a change in the whitebait fishing regulations (whitebaiting is not permitted closer than 20 metres to a floodgate). As the tide turns these fish will be

swept into the lagoon through the slot in the floodgate, along with other species of fish and crustacea and an accompanying mass of saline water. Previously fish passage was limited to the two periods over each tide when the gates were open, but the head differential between the lake and the lagoon was too low to accelerate the water in the culverts above the maximum swimming speeds (Mitchell 1989) of these small fragile fish.

There are only two problems which may occur with this proposed slot. One is that the dyke across the mouth of Pounui Lagoon faces south. Southerly winds pile drift material brought down the Ruamahanga River and from the sea across the bar, against the dyke. Among the trees and seaweed, a dominant material is a straw-like mat of dead stems of *Juncus maritimus* and *Leptocarpus simplex*. This fibrous floating material may plug the slot as the tide rises during southerly conditions. If this fibrous wedge is sufficiently driven into the slot then it may stay in place for considerable periods. It would be important to check that the slot was clear at regular intervals. The second and relatively minor problem is one which occurs anywhere that an artificially high concentration of small fishes occurs. Predators will be attracted to the slot. At worst, longfinned eels may take up residence inside the culvert as the tide rises, to take the fish as they stream through.

INFILLING WITH GRAVEL

Pounui Stream flows into Pounui Lagoon. The major tributary of Pounui Stream is Battery Stream, which flows from steep, eroding hill country. Earthquakes and storm events destabilise the shattered argillite rocks of the catchment and send pulses of gravel down through the system. Aggradation of the lower reaches of Pounui Stream is a significant problem. The road bridge on Western Lake Road has had to be raised to cope. Silt backing up across the outlet to Lake Pounui results in flooding of the adjacent pasture. But perhaps the environmentally significant problem is infilling of Pounui Lagoon.

Lakes, and particularly shallow lagoons, are geologically very impermanent places. They are natural silt traps which can rapidly become dry land. Reclamation of the margins of the Wairarapa Lakes has accelerated this process. Concern that the aggradation of the Pounui Stream bed was resulting in flooding of the pasture close to the lagoon, led the farmer (P Walton Farming Ltd) to propose that a channel be dug leading to the lagoon.

Excavation of this channel would flush gravel and silt directly into the lagoon. Obviously the life of the lagoon would be significantly shortened. Mr T. Harington,(DoC,Wellington Conservancy) suggested an alternative approach. The farmer requires dryland, DoC requires wetland. He suggested that a deposition management zone be created in the dyked paddock bordering the DoC boundary. A series of channels would be dug over time, running parallel to the lagoon and following the contour lines. The stream will be led through these channels and the gravels will settle out. When one channel becomes filled with gravel a new channel will be excavated. As part of this process, the topsoils will be used to cover the last channel. Eventually the overall ground level will be raised and thus the drainage improved.

When the channels reach the seaward dyke they are led into a drain which runs down toward the lake before leading back along the landward side of an old stopbank built through the lake wetlands. At about the point where a direct channel would have led the stream waters back into the lake, the water would be allowed to flow across the wetland into the lagoon. The net effect of this rerouting of the lower reaches of the Pounui Stream will be to increase the path length from 400 metres to over 1900 metres.

What is the likely impact on flsh passage and on the ecology of the lagoon?

Obviously the effect of a significantly reduced gradient will be to lower average water velocities. Owing to the reduced gradient at what is the far end of a deposition fan, even water velocities in the reach flowing toward the lagoon will be less than if the stream was led straight to the lagoon as was once the case. The sections flowing along the contour lines should have much lower water velocities.

Inanga had been recorded in the Pounui Stream before any modification to the channel (Hicks 1993). They were seen at the upstream end of this diversion soon after it was completed (T. Harington pers comm.). This is essentially a lowland species and has no adaptations to allow passage upstream at high water velocities (Mitchell 1989). Therefore the presence of this fish can be taken as good indication that there will be no problems with fish passage for any other migratory native fish which may attempt to migrate upstream and into Lake Pounui.

HABITAT CREATION

Although inanga will migrate through moderately fast flowing water, they prefer slow flowing habitat (0.1 - 0 m/sec). It can be expected that the lower reaches where the drain flows parallel to the lagoon will provide significant additional habitat for this species, plus eels, common bullies and smelt.This section will become densely vegetated. Apart from the silt trapping effect of the masses of plant stems, there will probably be some nutrient stripping from the water over summer by these aquatic plants.

It is considered useful to add freshwater to the upper end of the lagoon if possible, as it will promote a flushing effect. Management techniques that act to reduce sediment and nutrient accumulation in wetlands must be considered as desirable. It was therefore suggested that the Hill cut-off drain also be diverted into the new boundary borrow pit which follows the contour through the wetland until close to the diversion of the Pounui Stream. At present the Hill cut-off drain simply discharges into the lagoon beside the outlet culverts. Redirecting this water along the boundary so that it too enters the lagoon over a kilometre above the culverts will promote further flushing. Again a significant length of additional habitat is created by this borrow pit. Allowing fresh water to flow through it will reduce the risks of stagnation and nutrient release. It will then be readily colonised by the same range of fish that will utilise the extended lower reaches of the Pounui Stream.

Another value for moving freshwater inputs as far up the lagoon as possible, is to enhance the effect of saline intrusions. If only limited volumes of saline water can be admitted through the floodgate port then it should be retained in the lagoon as long as possible over each tidal cycle. This should provide a greater diversity of habitat. The more estuarine lower reaches of the lagoon may then show this altered ecology by the appearance of fishes that are at present absent. Conditions will be closer to the natural state before the dyke and floodgates were built.

Concerns

It can be expected that significant numbers of juvenile longfinned eels will colonise the gravels of the Pounui Stream in the deposition management zone. When a channel is full and it is intended to divert the water into a new channel, the opportunity should be left for these fish to leave the old channel. It is suggested that the new channel be dug and the stream diverted into it for a period before the old channel is covered over with topsoil. As the farmer owns an excavator this time lag could be extensive and does not present the same logistic costs as using a contractor. Construction of new channels should be done in winter if possible. Fish abundance and diversity is least at this time. Plant growth in the lagoon will probably be limited by light and temperature at this time, so nutrients entering the lagoon with any disturbed sediments are less likely to cause problems.

It is understood that the farmer is eventually interested in developing dairy pasture by this process of reclamation of what is now a privately owned piece of wetland. Attempts at grazing and development over a considerable period have obviously already greatly reduced the value of this area for conservation. But as development continues a number of effects are likely to accrue. There is the problem of access by stock into the deposition management channels. They will trample the banks, resuspend sediments and add nutrients by urination and defecation into the water. Stock will be attracted to the nutrient-rich and palatable aquatic plants that will grow in the slower reaches of the channels; their grazing will nullify much of the value of these areas.

As drainage improves there is likely to be increased use of fertilizers to enhance pasture growth. The combined effect of runoff from stock and fertilizers will be to increase the nutrient loading of the lagoon. This will tend to push the lagoon ecology away from the natural state.

Therefore it is recommended that the boundary of the lagoon be permanently fenced off from stock. In addition, temporary electric fencing of the channel margins and subdivision of the deposition management area should be recommended to the farmer. Any actions which reduce the input of silt and nutrients into the lagoon should be seen as beneficial.

The proposed modifications and sediment trapping regime is likely to have beneficial effects on the diversity and abundance of fishes in the Pounui Catch-

ment. I think that it is important that DoC monitor any changes, perhaps in conjunction with Victoria University, as a long term project.

Conclusion

I consider that the proposed management of gravel inputs into Pounui Lagoon is feasible and is unlikely to have any negative impacts upon fish and fish passage. The concepts as proposed by T. Harington appear to be sound.

If the scheme can be managed to reduce the impact of stock on water quality and exclude grazing from within the DoC estate then there are further benefits.This proposed diversion of sediments from the lagoon catchment may only prolong the life of the lagoon by a century or so, but it still remains a goal worth pursuing.

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