The Styx

Pūrākaunui

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A E L
Aquatic Ecology Limited

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A Consideration of its Ecology and Habitat Access

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Background

The Regents Park waterways were converted from pastoral drains when the area was subdivided from rural land. This conversion was a joint project between the Christchurch City Council and the private landowner in an effort to restore both ecological and aesthetic values to these waterways.

There are effectively 3 spring-fed tributaries of the Styx River. One system rises within the Regents Park reserve, culverted under the Styx Mill Road, and discharges into the Styx Mill Basin Reserve pond complex (Blue, Fig. 1). This waterway, which has good fish access (reportedly trout), is not considered further in this report. Another short section rises south of the subdivision, is piped north under Barnes Road into a pond, and then joins the railway drain just upstream of an intake structure described below (Red, Fig. 1). This new section does not have extensive riparian plantings yet, is exposed to building construction impacts, and its bed is quite heavily silted. Its mentioned briefly in this report.

Another spring-fed tributary flows to the east of the subdivision adjacent and parallel to the Main North Railway (White, Fig. 1). Formerly a drain, some of which is concrete-lined, a proportion of the flow has been diverted (Fig. 2) through a constructed watercourse along Regents Park Drive. The riparian zone of this diversion was initially vegetated in native plants in about 1994, and these have become well established in the downstream reaches (Fig. 3). The diversion rejoins the railway drain through private property, passes through a boxed drain and then piped for approximately 87m, before discharging into the Styx River through a culvert under the Main North Road Bridge (Fig. 4). The fall of water from the culvert to the Styx River is approximately 0.7m at normal river levels.

Introduction

Owing to rapidly increasing traffic volumes along the Main North Road, it is proposed to widen this carriageway, and the Styx River bridge, to a width that can accommodate 4 traffic lanes. The construction work has implications for the aquatic ecology in the area, both for the Styx River mainstem, and the waterway which drains the planted area through the Regents Park subdivision.

The bridge work site on the Styx River mainstem is near the downstream limit of the brown trout spawning area, and suspended sediment, as a consequence of work could inhibit the migration of spawning trout as they swim upstream. For this reason, it is understood that construction activities will not take place between May 1st and August 31st. Further, filter screens will be used to stop sediment runoff from the construction site. Good examples of the use of filter screens are depicted in Appendix I. Bank alignment may be required on the true left bank of the Styx River, but otherwise the river course will be left unaltered.

The waterway which drains the Regents Park subdivision may require further piping upstream of the existing length where the water course passes close to the ramparts of the proposed new bridge. This is because the water level is significantly below the level of the road, and maintaining an open water course would make the banks unsuitably steep to doubly serve as a load-bearing slope for the 4-lane bridge. The free-fall of water at the end of the culvert (c.a. 0.7m) is likely to be maintained owing to the cost of realigning the culvert

There is a lack of ecological information about the waterways which drain the Regents Park subdivision (although some invertebrates were collected, but not examined in the past (S. McMurtrie pers. comm.). Therefore, it was considered worthwhile by CCC to commission a brief evaluation of the fish and invertebrate fauna in the diverted waterway alongside Regent Park drive to assess its value, and to determine what migratory fish species can negotiate the free-fall of water at the culvert entrance, and the culvert itself. It was also requested that, based on these ecological values, a consideration by made on the benefits of attempting to maintain or improve Styx River access to the restored areas, in an effort to realise the ecological potential of the restoration project.

Methods

Two short (7m) representative study sections were selected (by random number generator) from the watercourse alongside Regents Park Drive. Three combined invertebrate kick-net (420 micron mesh) samples were obtained from the substrate; equidistantly across the stream profile, and just downstream of these sections. The invertebrate fauna was identified by naked-eye inspection and a low-power magnifying glass.

A Kainga EFM 300 packset was used to electric fish these 2 sections, and the narrow channel downstream of the pond adjacent to Regent Park Drive. Electric-fishing is the conventional and appropriate fishing technique for wadeable waterways of this nature. Operating voltage setting was set at 200V. Electric fishing serves only to briefly (approx. 3 seconds) render fish unconscious to facilitate their capture in nets for identification. A downstream hand-held stopnet was used in conjunction with electric fishing to capture electro-narcotised fish. Overall, conditions for fish capture using electric fishing were generally good.

A number of basic hydraulic parameters were also evaluated in both the 2 study sections, and the waterway generally. These were channel width variation, thalweg depth variation, and maximum depth.

The New Zealand Freshwater Fish Database (NZFFDB), which is administered by NIWA (National Institute of Water and Atmospheric Research Ltd.) was accessed for information on the local fish fauna in the catchment. Geo-referencing was achieved using a Garmin 12 Channel GPS receiver interfaced to TopoMap Pro ver. 2.0, and AerialMap Pro software.

Results

Hydromorphological variation and substrate

While channel width varied little (CV Coefficient of Variation of 8.4%), along the section that follows Regency Park Drive, there was more variation in thalweg depth (CV 27%), which ranged from 9cm to 28cm, with relatively deep water (60cm) located at the plunge pools downstream of the impoundment weirs. The substrate along the channel (with the exception of the pond) was largely comprised of small cobbles obscured with a thin layer of sediment except in limited areas where faster flows kept the cobbles clear.

The diversion watercourses both to and from the railway drain were much narrower in width (c.a. 0.8m), with correspondingly faster flows, and cleaner cobble substrate (Fig. 5).

Aquatic macrophytes

Potamogeton crispus dominated the substrate in most areas, with the alga *Spirogyra* present in the ponds and sluggishly-flowing regions. Despite the channel being 'cleaned' a week prior, there was a good deal of *Potamogeton crispus* root mass still present, and a reasonable amount of leaf foliage.

Invertebrates

The invertebrate fauna was fairly consistent across all 3 invertebrate samples taken from the waterway parallel to Regents Park Drive, and was dominated by chironomid larvae, oligochaetes, ostracods, with *Sigara* sp.(backswimmers) actively swimming in the water column. The algae-piercing caddis-fly larvae *Oxyethira*, and *Paraoxyethira* were also common, whereas the snails *Physa* sp. and Sphaeridae were numerically dominated by *Potamopyrgus*. Platyhelminthes (flatworms), and some caddis-fly larvae (*Hudsonema amabile, Triplectides cephalotes)* were present. Blue damselfly larvae (*Austrolestes colensonis*) were caught during electric-fishing, and both adult red (*Xanthocnemis zealandica*) damselflies and blue damselflies were observed in flight.

The invertebrate fauna was characteristic of that typically found in still and sluggishly-flowing waters, and was generally unremarkable. It was dominated by algal grazers, algal piercers and detritovores. This was consistent with the observation that invertebrate samples contained substantial amounts of coarse and fine particulate organic matter. No mayfly larvae were recorded.

Upland Bully

The 2 randomly-selected sections had relatively low and approximately equal densities of upland bullies, but the density of upland bullies in the narrow pond outlet channel had a much higher density (approx. threefold) than the wider channel flowing alongside the road (Table 1). The bullies from the pond outlet also had a much greater size range, ranging from approximately 20 mm in length to a very large adult male which was measured at a remarkable 112 mm in length (Fig. 6). There were a number of other very large bullies present. Many bullies were exhibiting spawning colours, with some gravid females identified.

Table 1. Upland bully density from the 3 electric-fished sections.

Section No.	**Mean width (w)**	**Mean depth (m)**	**Fished area (m^2)**	**Upland bully nos.**	**Upland bully/m^2 (*Upland bully/min*)**
1	2.16	0.184	15.1	4	0.33 (*0.8*)
2	3.01	0.253	21.1	6	0.28 (*0.8*)
Pond outlet	0.8	c.a. 0.2	32	30	0.94 *(6.0)*
Above Culvert	1.0		35	8	0.23 *(0.9)*

Shortfin eel

Shortfin eels were commonly identified upstream of the Main North Road culvert, upstream of the boxed section, although 1 elver was obtained from the pond outlet. No eels were caught in the 2 sections alongside Regents Park Drive, although 1 unidentified eel was observed near the fished sections the day before. Eels are also known to be observed in the pond.

Captured eels ranged in length from approximately 110mm to 800mm, with a mean length of approximately 440mm. Only the 1 elver (110mm) was identified, and this was from the pond outlet.

Birdlife

With the development of the riparian vegetation, and an abundant small fish population, predatory birds are becoming common along the waterway. White-faced herons were seen feeding, but the waterway is also reportedly visited by scaup, Paradise ducks, shoveller ducks, and N.Z. teal. White swan, possibly itinerants from the Willowbank Reserve, have also been seen.

Discussion

Despite a reasonable amount of fishing effort in habitat suitable for juvenile eels, the relatively high numbers of larger and older eels, and the paucity of elvers, indicates possible eel recruitment problems into the culvert. The larger eels are likely to have entered the tributary before the culvert outlet was installed. This suggests that even shortfin eels, which are capable climbers, are having difficulties in colonising the Regents Park waterway. This is likely to be caused by mainly the length and laminar nature of the water flow through the culvert . Many of the shortfin eels captured were at or above the size where they would migrate to the sea to sea. Male eels migrate when approximately 14 years old, and over 440mm long, while female shortfins migrate when approximately 20 years, and over 600mm in length (Todd, 1980). Downstream egress through the culvert is unlikely to present a problem for large eels, and it is therefore probable that the population of shortfin eels will gradually decline as the larger fish migrate to sea, without a compensating upstream recruitment of glass eels from the Styx River.

As the eel population declines, it will allow more habitat space and food resources for the non-migratory resident upland bully population. These reached particularly high densities below the pond on Regents Park Drive, where they were spawning prolifically. The 112mm male specimen found there is larger than any measured upland bully currently listed on the New Zealand Freshwater Fish Database, and could be as much as 4 years old. It has only been in the last 2 years that upland bullies larger than that recorded here have been reported (McDowall, 2000).

Given that upland bullies spawn prolifically here, and trout (and presumably eels) can access other waterways in the Regents Park subdivision, there is an argument for maintaining this habitat as a relatively predator-free environment for native fish, particularly so, as the native fish are growing to a large size. This habitat may also have ecological potential as a reservoir habitat for threatened small native fish species, especially the Canterbury mudfish. These 2 species co-habit in may areas of their natural range, and mudfish could well have occurred naturally in the Styx catchment in the past. It is also recommended that the general ecology and channel morphology in the pond outlet be examined more closely to determine aspects of its ecology which have made this reach so eminently suitable for native fish.

It is clear that the a degree of substrate siltation occurs, and that the waterway profile along Regents Park Drive is too large in respect to the flow available. Being almost entirely spring-fed, the system lacks flushing flows to remove sediment. The intake structure (Fig. 2) appears to diverting only a small proportion of the flow of the railway drain, and it may be possible to augment the diverted flow by modifying or unclogging this structure. Conceivably, over time, the channel could be effectively narrowed by emergent vegetation like the native rush *Juncus pallidus* or the planting of raupo.

Some care needs to be taken by building contractors to prevent materials from being blown into the waterway from adjacent building sites. A significant amount of fibreglass insulation material was found in the upper reaches, potentially injurious if ingested by birds (Fig. 7). However, upon request, it was pleasing to see contractors remove this material from the waterway. Some local residents also (reportedly) dump grass clippings into the waterway, which may explain the significant amount of fine organic material observed. Clearly this could lead to further nutrient enrichment of the aquatic habitat, and excessive aquatic weed growth.

Acknowledgements

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Literature Cited

McDowall, R. M. 2000. The Reed Field Guide to New Zealand Freshwater Fishes. Reed Books, Auckland. 224p.

Todd, P. R. 1980. Size and age of migrating New Zealand freshwater eels (*Anguilla* spp.). *New Zealand Journal of Marine and Freshwater Research, 14(3)*:283-293.

Figures

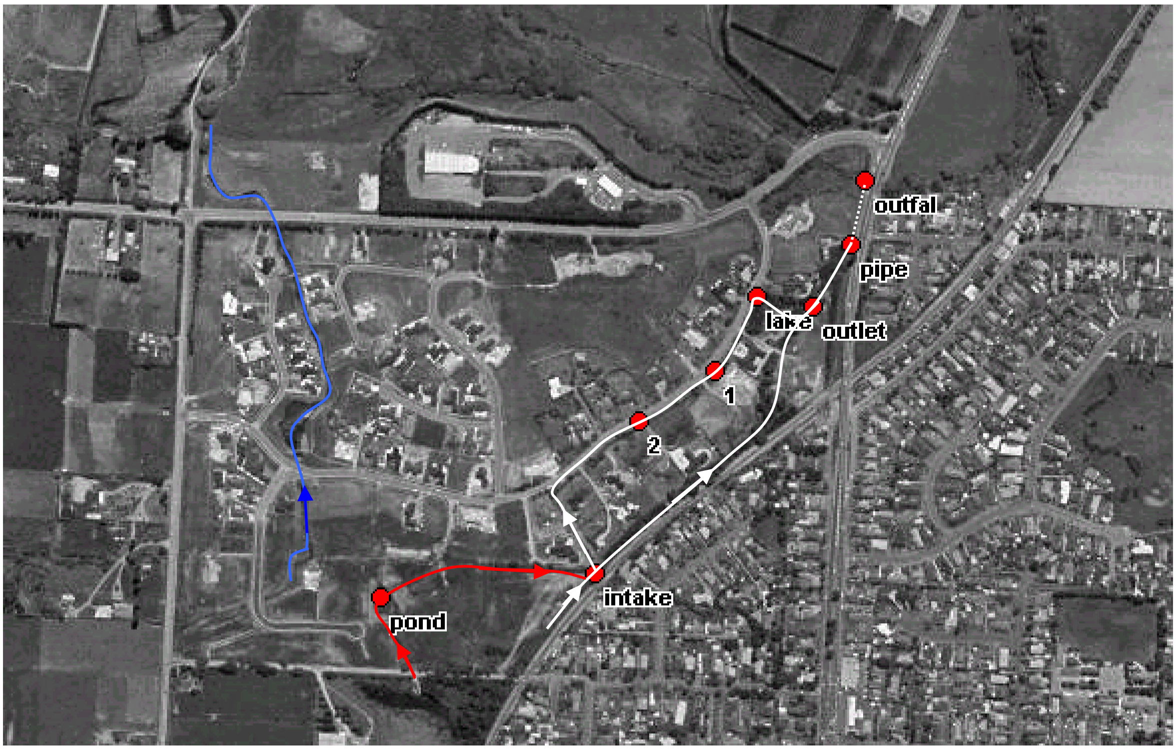

Figure 1. The three known waterways in the Regents Park subdivision. The one under consideration in this report is depicted in white. The 2 numbered sampling sites are indicated alongside Regents Park Drive. The dashed white line indicates the path of the existing 85m culvert.

Figure 2. The concrete intake which diverts flow through a pipe (under the garden seat) into the vegetated channel in the background.

Figure 3. Site 2 , a random 7m section of the diverted channel which flows parallel to Regents Park Drive. The Waratahs indicate the section boundaries, and the electric fishing machine is in the foreground.

Figure 4. Outfall of the Regents Park culvert into the Styx River. Note the damp spray zone which may allow partial upstream access for eels into the culvert.

Figure 5. Heavily vegetated waterway on the pond outlet. Upland bullies were abundant here. Note the extent of luxuriant over-hanging vegetation.

Figure 6. A 112mm male upland bully obtained from the outlet of the pond on Regents Park Drive. Upland bullies of this size are very rare.

Figure 7. Pink fibreglass insulation material (and its wrapping) has blown into the waterway from adjacent building sites. Upon request, this rubbish was removed by contractors.

Appendix 1.

Bridge works in the Pauatahanui River DoC reserve, Kapiti Coast.

Screening of soil piles to prevent silt runoff during rain events.

Screening of bridge ramparts to prevent spoil entering the river.

Gravel and screen filter trap to reduce silt from pump water.

Detail of pump water filter utilising crushed gravel and filter cloth.