MANAGEMENT OF RUDD IN TRAVIS WETLAND, CHRISTCHURCH

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Mature rudd (photograph by Helen McCaughan).

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1. BACKGROUND

Travis Wetland is a Christchurch City Council (the Council) owned Nature Heritage Park that has been set aside to preserve and develop the wetland for the education and enjoyment of everyone. Covering 119 hectares, it is the largest freshwater wetland remaining in Christchurch. It is a modified wetland, consisting of a main pond (4.0 hectares), with a complex of smaller ponds, waterways and dry areas that all play an important role in the protection and restoration of lowland wetland plant and animal communities (Plate 1). The Wetland is connected to the Ōtākaro/Avon River via Corsers Drain and Lake Kate Sheppard.

Plate 1: Aerial view of Travis Wetland showing interconnected waterways and dry areas, with the main pond at centre left (photograph by Phil Teague).

Although originally a wetland, the area was farmed from the 1850s to the 1970s. A public campaign to prevent further development led to the Travis Wetland Trust being formed in 1992 and they now manage the reserve in partnership with the Council. A Development Plan was written and major work was initiated in 1998. Initial priorities included earthworks to establish the main pond and other drainage areas, planting, and pest plant and animal control. More recently there have been re-introductions of pāteke (*Anas chlorotis*) and Canterbury mudfish (*Neochanna burrowsius*).

In February 2008, John Skilton, Council Ranger, contacted the Department of Conservation after he found a dead rudd (*Scardinius erythrophthalmus*) near the main pond. A photograph of the specimen was confirmed as rudd and this led to sampling work being carried out in April 2008 by the Department of Conservation and the Council. Several rudd were caught, as well as two indigenous species: common bully (*Gobiomorphus cotidianus*) and shortfin eel (*Anguilla australis*). A short report was prepared by the Department of Conservation to address rudd impacts and options for their control at this site (McCaughan 2008).

Since 2008, a comprehensive rudd control programme has been undertaken jointly by the Department of Conservation and the Council, with work being carried out every summer. The Council has now commissioned Wildland Consultants Ltd to summarise the results of this programme and provide some recommendations for future work.

2. RUDD BIOLOGY AND THEIR IMPACTS

Rudd are a freshwater fish native to temperate Europe that are found mostly in still or slow-flowing waters, especially those with prolific weed beds. Their preference is for warmer waters, when they become more active, but they are tolerant of a wide temperature range (McDowall 1990, 2000). Rudd are in the cyprinidae family, which includes goldfish (*Carassius auratus*), tench (*Tinca tinca*), koi carp (*Cyprinus carpio*), orfe (*Leuciscus idus*), grass carp (*Ctenopharyngodon idella*) and silver carp (*Hypophthalmichthys molitrix*) (Hicks 2003; McDowall 1990).

Rudd eat a wide variety of submerged aquatic vegetation (macrophytes), crustaceans and other invertebrates, and general detritus. Juvenile fish feed predominantly on invertebrates, and older fish predominantly on macrophytes with a preference for native species. Rudd are crepuscular feeders so most of their feeding activity is focussed around dusk and dawn. (Lake *et al.* 2002; Hicks 2003; Wise 1990; Lane 1983).

Rudd can grow to 400 mm long, but are more commonly between 200 and 300 mm long. Rudd spawn in spring and summer, when warmer temperatures stimulate them to move inshore and lay their eggs amongst macrophytes. Breeding can start as early as one year old and is instigated once water temperatures reach about 16°C. (Tarkan 2006; Lake *et al.* 2002; Hicks 2003; McDowall 1990; Lane 1983).

Through their feeding activity and ability to breed quickly, rudd can have direct impacts on the survival of macrophytes and invertebrates, and indirect impacts on other fish through reduction of food and habitat availability. Rudd can also negatively affect water quality by removing submerged macrophytes, releasing nutrients and increasing turbidity, and they can modify macrophyte communities through selective grazing (Lake *et al.* 2002; Hicks 2003; Wise 1990; Lane 1983).

Due to their negative impacts, rudd are classified as a Noxious Species under the Freshwater Fisheries Regulations 1983 (Schedule 3), in all regions of New Zealand except the Auckland/Waikato Fish and Game region. This classification means that it is illegal to possess, have under control, rear, raise, hatch, or consign rudd, without written authorisation from the Director-General of Conservation (Regulation 65). Despite these regulations, rudd have been spread illegally throughout the North Island and in parts of the Nelson, Canterbury and West Coast regions.

3. RUDD CONTROL PROGRAMME

3.1 Aim

The aim of the Department of Conservation and Council rudd control programme has been to reduce the population within Travis Wetland to zero density in order to:

- Reduce impacts on biodiversity and water quality in the wetland; and
- Reduce the likelihood of rudd spreading throughout the Avon/Heathcote catchment and into other catchments.

3.2 Methods

Control work was carried out during the warmer months of each year. Negative impacts of rudd have been well researched elsewhere and so were not monitored at this site, but additional data was collected to better inform the control programme.

3.2.1 Rudd control

Panel gill nets (Plate 2) and Gee minnow traps (Plate 3) were used for the control work. The use of panel gill nets is well proven for catching juvenile and adult rudd, with Gee minnow traps ideal for very small fish such as young-of-the-year rudd (Grainger *et al*. 2014; Neilson *et al*. 2004; Studholme 2002). Nets were set in the late afternoon and lifted either after dark or at dawn. These times were targeted because of the known peak in fish feeding activity at dusk and dawn. Nets were monitored during daylight hours following best practice guidelines to avoid inadvertent capture of waterfowl (Grainger and McCaughan 2014).

In the first year, 2008, nets and traps were set throughout the wetland complex, to assess how widespread rudd were. From 2009 nets and traps were set in a consistent pattern and at regular intervals in the main pond, with extra traps occasionally set in connected waterways and waterbodies. Net locations were chosen to target all water depths, with emphasis on the deeper areas where rudd were likely to congregate. Refer to Appendix 1 for details on net and trap specifications and layout in the main pond. All rudd caught were recorded, had their length measured and were killed.

3.2.2 Water temperature and rudd spawning

Water temperature was recorded for two reasons:

- Firstly, rudd are more active in warmer waters and that makes it easier to catch them using set netting.
- Secondly, spawning is triggered as water temperatures increase and removal of individuals before they spawn is a very effective way to control a population.

A temperature logger (Onset HOBOware® tidbit) was installed in the deepest section of the main pond, at net site G3 (refer to appendix 1). The recorder was suspended approximately 300 mm below the water's surface and water temperature was recorded on a continuous half-hourly basis. Water temperature was recorded from October 2010 until April 2014 and the data points were averaged over all years.

As fish become reproductively mature, the size and weight of their gonads increases. A common way to assess reproductive maturity is to calculate an index using the weight of their gonads in relation to the weight of their body (gonadosomatic index, GSI; Crim and Glebe 1990). To do this, whole fish were weighed (g), lengths were recorded to the nearest whole millimetre (mmFL), and gonads were dissected fresh. Total body weight (g) and dissected gonad weight (g) were recorded to two decimal places. The following standard GSI calculation formula was used (D. West, Science Advisor, Department of Conservation, pers. comm.):

$$GSI = (\text{gonad weight} / (\text{total body weight} - \text{gonad weight})) \times 100$$

3.2.3 Indigenous fish monitoring

Gee minnow traps (Plate 3) are ideal for catching small fish, particularly in wetland habitats, and so were used to monitor indigenous fish presence (Grainger *et al*. 2014; Grainger *et al*. 2013; Ling *et al*. 2009). Monitoring was initiated in the main pond in 2011 and this has been repeated annually. Refer to Appendix 1 for further information on trap specifications and layout in the main pond. All indigenous fish caught were identified, had their length measured and then were released.

Plate 2: Panel gill net being set in deep area of main pond (photograph by John Skilton).

Plate 3: Gee minnow trap set at edge of main pond (photograph by John Skilton).

3.3 Results

3.3.1 Rudd control

A large number of rudd (382) were caught in the main pond in April 2008, but very few were caught in the smaller waterways and waterbodies elsewhere in the wetland.

Because of this, the control work was focussed on the main pond population, with checks every few years being made in other areas. This same trend has continued throughout the programme, with little to no rudd being caught outside the main pond.

Rudd catch fluctuated somewhat in the first few years but, overall, has shown a steady decline (Figure 1) and there has now been three consecutive summer seasons with no rudd being caught in the main pond: 2013/14, 2014/15 and 2015/16. Rudd caught over the entire control period were between 85 mm and 251 mm long, with no small juvenile fish caught.

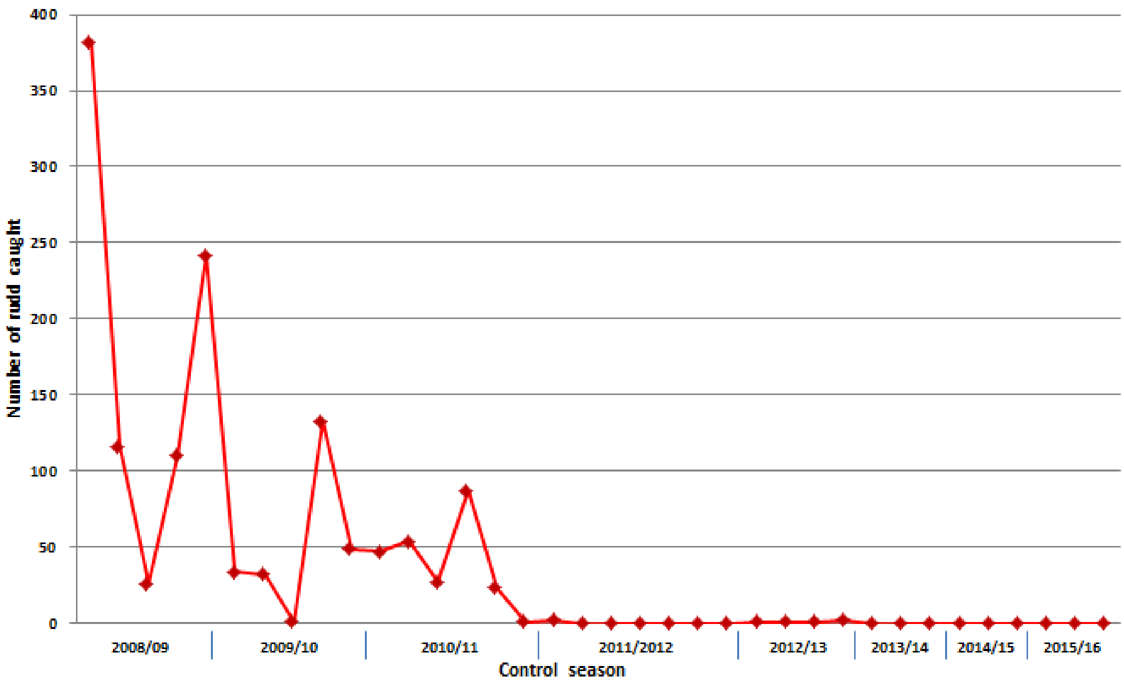

Figure 1: Numbers of rudd caught in the main pond, from April 2008 to April 2016.

3.3.2 Water temperature and rudd spawning

During 2010 to 2014 the water temperature ranged from 5 to 24°C (Figure 2). Maximum daily water temperature was mostly at or above 15°C from mid-October to early April. Control work was therefore carried out during those months because rudd activity would be increasing, but they would be unlikely to have spawned.

Whole fish were required to enable collection of data for GSI calculations and this proved problematic because of the high incidence of eels attacking rudd in the nets. This made it difficult to get enough spawning data for Travis Wetland, so the data collected was combined with data from two other South Island sites: Canterbury and West Coast. The combined data showed that main spawning activity would be occurring during October to November, with additional spawning in December and April (McCaughan 2015). This enabled refinement of the target control sessions to one each in early November, January/February, and April. Refer to McCaughan (2015) for the detailed rudd spawning data.

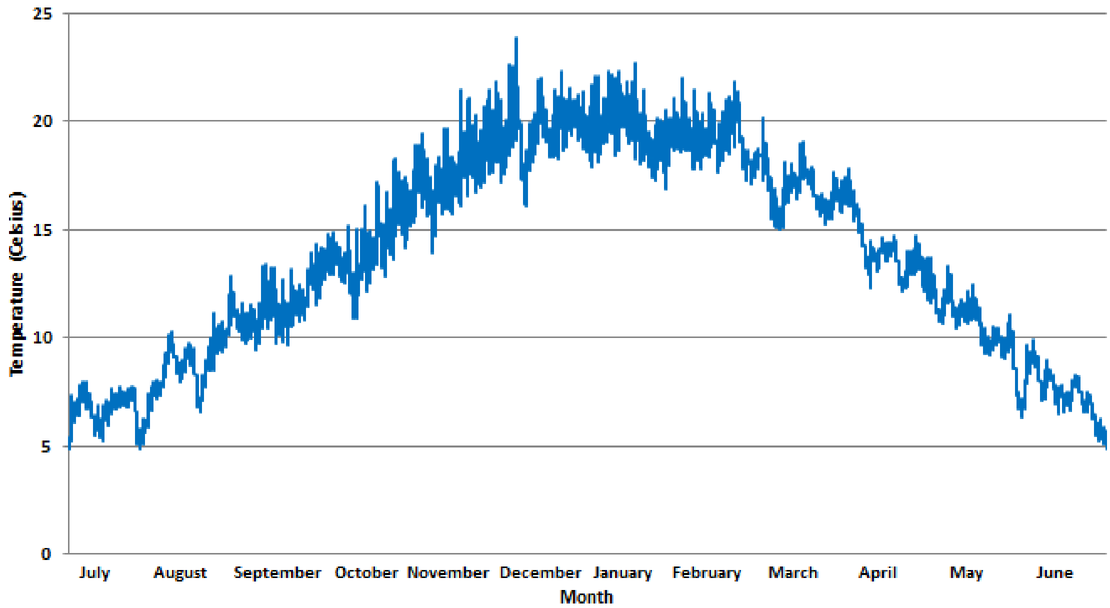

Figure 2: Mean daily water temperature in the main pond from October 2010 to April 2014.

3.3.3 Indigenous fish monitoring

Six species of indigenous fish were caught at various sites throughout the wetland complex (Table 1). These are all species expected in this type of modified lowland wetland that is connected to the marine environment. Most of the species have special cultural significance, with giant bully (*Gobiomorphus gobioides*) (Plate 4) being a taonga species.

Table 1: List of indigenous fish species caught in Travis Wetland, with their conservation status and cultural significance.

Common Name	Scientific Name	Conservation Status[1]	Cultural Significance[2]
Shortfin eel	*Anguilla australis*	Not Threatened	Mahinga kai
Inanga	*Galaxias maculatus*	At Risk-Declining	Mahinga kai
Common bully	*Gobiomorphus cotidianus*	Not Threatened	
Giant bully	*Gobiomorphus gobioides*	Not Threatened	Taonga
Common smelt	*Retropinna retropinna*	Not Threatened	Mahinga kai
Black flounder	*Rhombosolea retiaria*	Not Threatened	Mahinga kai

[1] Source: Goodman *et al*. (2014).
[2] Indicates species collected as food (mahinga kai) or treasured species designated as taonga under the Ngai Tahu Settlement Act 1998 (Schedule 98).

Plate 4: Giant bully caught in the main pond (photograph by John Skilton).

4. DISCUSSION

Travis Wetland is a very important site, both for its role in the protection and restoration of lowland wetland plant and animal communities, and as a public recreation and education resource. The presence of rudd in Travis Wetland will have both direct and indirect negative impacts on this freshwater ecosystem, and could adversely affect possible future indigenous species reintroduction options, such as giant kōkopu (*Galaxias argenteus*) or aquatic plants. Rudd could also move into connected waterways or be spread to other catchments.

The rudd control programme at Travis Wetland has been very successful to date, with no rudd having been caught during the last three summer seasons. Monitoring of water temperature and collection of rudd spawning data has meant that the control work has been programmed in a more targeted fashion. It is important that water temperature continues to be recorded each time that netting work is carried out, but it is not necessary to re-install a temperature logger.

Travis Wetland is connected to other waterways so some form of control or continued surveillance for rudd will need to be carried out indefinitely. Rudd numbers are now so low that they may be difficult to detect, making it important that work is focused during months of the year when the water is warm and rudd are more active. Rudd breeding patterns mean that populations can recover quickly and any increased catches will need to be responded to immediately with increased control effort.

5. RECOMMENDATIONS

The following approach is recommended for future work in the rudd control programme at Travis Wetland:

- Regular control work should continue to be undertaken in the main pond, as follows: panel gill nets and Gee minnow traps set once a year, during the height of summer (between December and February), using the same layout as used previously. A range of mesh sizes must be used to ensure detectability of both juvenile and adult rudd. Nets should be set in the mid to late afternoon, monitored for bird activity until after dark, and then lifted the following dawn.

- Other areas within the wetland complex and surrounding waterways should be surveyed on a three-yearly cycle. Overnight set netting, using panel gill nets, Gee minnow traps, and/or fyke nets should be undertaken, supplemented with seine netting where possible.

- The control programme should be reviewed on an ongoing basis, to ensure that the rudd population is not able to increase and to ensure that effort is not expended unnecessarily. For example:

  (a) If two or more rudd are caught during an annual February net set, then netting should be repeated the following April. Netting should then be carried out twice in the following season. If two or more rudd continue to be caught per netting event, then the control efforts need to be sustained at the higher level, or increased if five or more rudd are caught per netting event. If less than two rudd are caught, then the control effort could reduce to once a year.

  (b) If less than two rudd are caught during the annual February net set, then netting work can continue on an annual basis.

  (c) If rudd catch remains at zero for three more consecutive seasons, then efforts can be reduced to setting nets once every two years.

- Monitoring of indigenous fish species in the main pond should continue, using Gee minnow traps and following the established trap layout. This can be carried out at the same time as the rudd control work.

- Educational opportunities could be enhanced. Any opportunity to help raise public awareness on the impacts of invasive fish and how everyone can help to stop the spread should be taken advantage of. Activities that could be built into the Council's existing education programme includes those that focus on: not spreading fish between waterways, keeping rivers and riverbanks free from rubbish, not dumping aquarium contents, cleaning gear between waterways (Check, Clean, Dry), and preventing contaminants from entering waterways.

ACKNOWLEDGEMENTS

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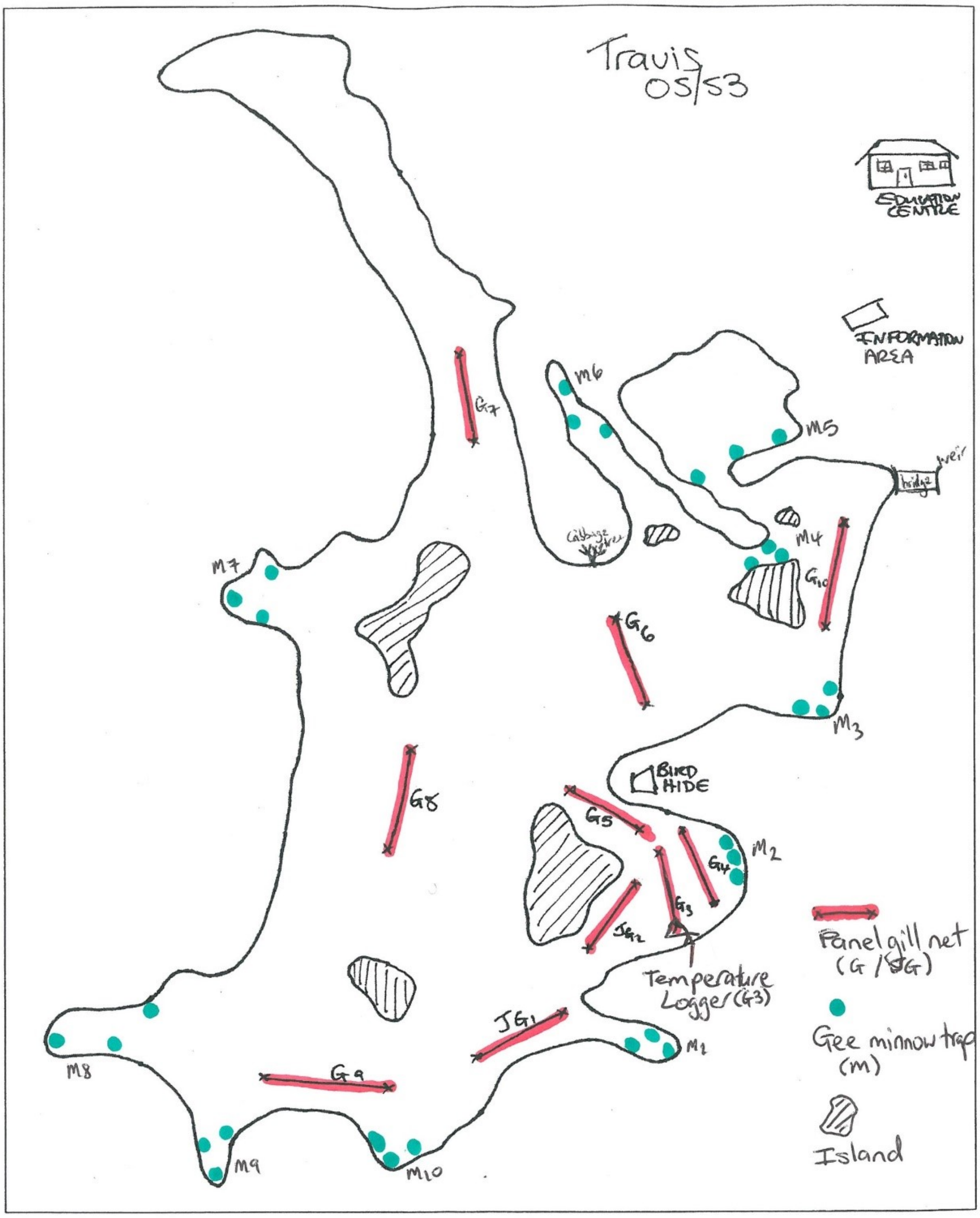
NET AND TRAP SPECIFICATIONS AND LAYOUT IN MAIN POND

Specifications of nets and traps used in Travis Wetland.

Type	Mesh Size	Other Details
Panel gill net (JG)	10 mm, 13 mm and 25 mm	Monofilament, 10 m panels, total length 30 m, depth 1.8 m
Panel gill net (G)	25 mm, 38 mm, 50 mm	Monofilament, 10 m panels, total length 30 m, depth 1.8 m
Gee minnow trap (M)	3 mm	Steel cylinder, inverted cone ends

Layout of nets and traps as set in the main pond.



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