

Eradication of one-spot livebearer, *Phalloceros caudimaculatus*, at Long Reef Golf Course. A post-eradication report, June 2009

Introduction

One spot livebearers, *Phalloceros caudimaculatus*, (also known as speckled mosquitofish) are believed to have been introduced to water hazards on Long Reef Golf Course (LRGC; Collaroy, Sydney) just prior to December 1999. With the nearest known wild population 1600km away, the most likely vector of introduction is release from home aquarium. A hardy omnivore from the Poeciliid family, with a broad tolerance of water quality, the one-spot livebearer has a high invasive potential. It is listed as a noxious species Class 2 in NSW, requiring destruction if not confined to an aquarium.

LRGC includes twelve ponds which form a series of water hazards, and also serve as water storage for irrigation purposes (Fig. 1). The ponds, which are linked either by drains or sub-surface pipes, are fed by a small catchment draining urban runoff. When full, volumes vary from 0.2 ML to 12 ML, with excess flow discharging across Long Reef Beach to the ocean.

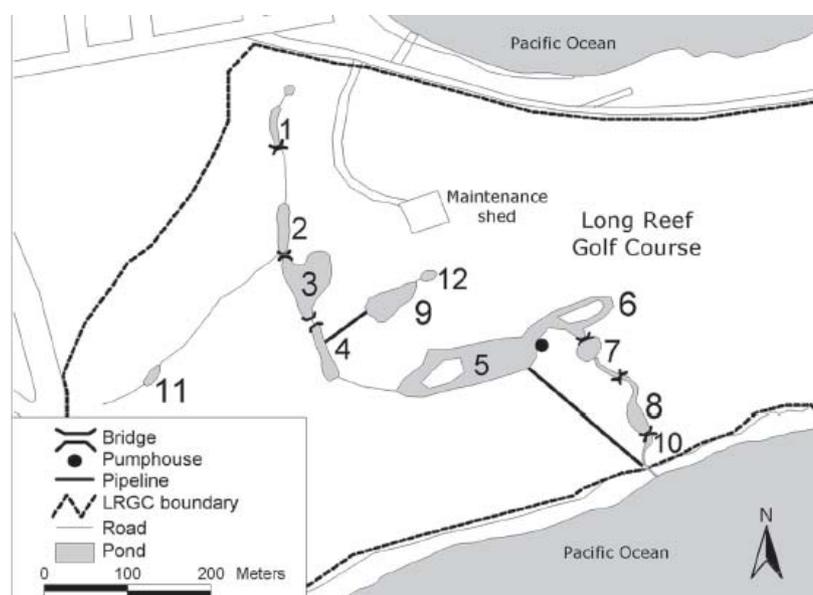


Figure 1. Layout and numbering of ponds on LRGC

A survey of 12 locations in the Collaroy area in 2002 indicated the population of one-spot livebearers was restricted to the ponds on LRGC. An eradication was attempted by NSW Fisheries (now NSW DPI) in 2002. Although a considerable population reduction was achieved, the attempt was unsuccessful, highlighting the hardy nature of the species.



Figure 2. Macrophyte growth in Pond 4.

Several factors are likely to have contributed to the failure of the first attempt. These included an insufficient amount of rotenone used, ineffective mixing of the rotenone throughout the ponds, havens formed by fresh water seeping from the bank, too brief a time frame for effective application, and heavy macrophyte growth (Fig. 2). LRGC also expressed disappointment with the inadequate level of communication and planning. Additionally, a large number of eels evacuated the ponds, and died on the fairways, causing a nuisance.



Figure 3. One-spot livebearer (photo: J. Rowley)

Previous faunal surveys had indicated only three species of fish were present in the ponds. In addition to the one-spot livebearers, the system contained indigenous common jollytail, *Galaxias maculatus*, and short-finned eel, *Anguilla australis*. These common species are migratory, spending early life stages in the marine environment before recruiting into freshwater environs. It is expected that both of these species would re-recruit to the system post treatment.

Materials and Methods

A second eradication was undertaken in June 2006. This attempt again used rotenone as the piscicide, requiring the issue of a "Permit to Allow Minor Use and Supply" from the Australian Pesticides and Veterinary Medicines Authority (Permit No. PER8926).

Preparations incorporated experiences learned from the previous attempt. Sufficient rotenone powder (600 kg) was purchased to treat all ponds three times at the target concentration of 3 mg/L (active ingredient). A fire tanker, borrowed from the Rural Fire Service, effectively delivered rotenone throughout the ponds. The pressure of delivery allowed penetration into macrophyte growth, and the ability to thoroughly spray the bankside reduced the opportunity for fish to find haven in untreated influent groundwater. Prior to the eradication attempt, eels were intensively trapped with baited eel traps and unbaited fyke nets, and transferred to the ocean. Electrofishing and baited and unbaited traps were used to collect other native species so they could be relocated prior to the rotenone treatment.

Timing

Timing of the eradication attempt was dictated by frog breeding seasons, and the irrigation requirements of the golf course.

Previous fauna surveys had revealed several native frogs inhabiting the water hazards (common eastern froglet, dwarf tree frog, striped marsh frog, Perron's tree frog). Rotenone should not harm adult frogs, but tadpoles could be impacted. Although these species of frogs are locally and regionally abundant, and any possible effects were regarded as negligible, treatment was timed to have least impact on juvenile frogs (as advised by Graham Pyke, Australian Museum). A Section 121 Occupier's Licence was obtained from the National Parks and Wildlife Service to cover the possibility of harm to

any of these species of frogs.

Also present on LRGC is an introduced population of green and golden bell frogs. The likelihood of the eradication impacting this population was considered as minimal, as their habitats did not overlap with the one-spot livebearers.

Additionally, LRGC requested that the attempt be made toward the start of winter, to offset the impact of the subsequent inability to use treated water for irrigation purposes for a period of 33 days. Consequently, the starting date was three weeks later than originally scheduled. This strategy proved unfortunate when, in the interim period, the ponds which had been at record low levels were filled to capacity by unpredicted heavy rains. Ponds required considerable pumping to reduce volumes to treatable levels. This pattern repeated on several occasions throughout the exercise, stopping operations, and eventually dictating modification of the planned treatment schedule.

Environmental Precautions

Several measures were implemented to safeguard against the escape of rotenone-treated water to the ocean. Ponds were pumped down as low as practical. The monk height at the terminal end of the pond chain was raised, increasing storage capacity. The catchment area was greatly reduced by redirecting the drainage network to circumvent the ponds, shipping water directly to the ocean. Finally, potassium permanganate to neutralize rotenone was obtained in the event that unpredicted rains threatened to exceed pond capacity (Fig. 4). This was used as a precaution in Pond 8, but proved unnecessary when rain passed without threatening to overflow the ponds.



Figure 4: Neutralisation of rotenone with potassium permanganate

Treatment Regime

Where possible, ponds were isolated from each other through construction of temporary dams, by sealing off interconnecting plumbing, or by lowering volumes until natural barriers formed. This allowed ponds to be treated as discrete units, minimizing the opportunity for fish to move away from treated areas.

The initial intention was to divide the ponds into three groups, and treat ponds within each group for three consecutive days (Fig. 5). The first group (Ponds 1- 4) was treated in this way. However, intermittent heavy rainfall halted treatments on several occasions, and also necessitated further pumping to reduce pond volumes. These interruptions resulted in the remaining ponds only receiving two treatments.

Pond volumes were calculated using a measured surface area and a generous estimate of depth to ensure target concentration was reached. Nominal concentration of rotenone in the stock powder was 8.8%, requiring application of 36 kg/ML of powder to deliver the required 3 mg/L of active ingredient.

The dose to be delivered was divided into portions (generally thirds, unless a large volume was being treated) and measured into 20 L buckets. A small amount of wetting agent was added to the bottom of each bucket, and water was stirred in to create a slurry. The slurry was added to the tanker, which was equipped with a return hose that stirred the rotenone, and helped maintain it in suspension.

The tanker volume was 800 L, meaning that a minimum of 2 400 L of stock solution was used to deliver a given dose. This ensured rotenone was spread evenly throughout the ponds. In Pond 5, which required numerous bags, product was delivered in half bags per tank. Mixing in Pond 5 was assisted by LRGC's water mover, which generated strong circulation.

Staffing

The treatment was comfortably undertaken by three staff. Two staff operated a 30 m hose each, while the third oversaw the pump, assisted dragging hoses through reeds, and mixed the next batch of rotenone. During treatment, staff wore waders, raincoats, broad hats, long gloves, eye protection, and respirators. The general public was alerted to proceedings by a media release, a flyer distributed through LRGC pro shop, and signage posted around the ponds.

Results

Large numbers of one-spot livebearers, such as were observed during sampling in the warmer months, were not apparent. No healthy fish were seen prior to treatment. Mortalities were observed on the bottom of Pond 4, and moribund fish were observed in Pond 6. A sample of moribund fish was removed to untreated water. Although the one-spot livebearers persisted longer than the native species in the treated water, they failed to recover when placed in untreated water.

The eels that were not removed through trapping seemed particularly susceptible to rotenone. All eels died rapidly within the confines of the ponds. This contrast from the previous attempt was interpreted as resulting from a more effective treatment method. Eel mortalities (estimated at 30 kg total biomass) were collected and buried in a pit with lime.

Six mortalities in common jollytail mortalities were seen in Ponds 6 and 7. These were removed as quickly as possible, and placed into untreated water, but failed to recover.

No frog mortalities were observed, however, LRGC later reported the mortality of a number of turtles after the event.

Discussion

As at 1 November 2006, (five months post-treatment) LRGC staff had not visually detected the presence of one-spot livebearers in the ponds. Follow up monitoring to gauge the success of the attempt was undertaken in December 2007 by NSW DPI staff. The lapse of time between eradication attempt and follow up surveys was intentional, to allow any remnant population to increase in numbers to a detectable level. Over a two day period 18 months post-treatment (11-12 December 2007), all accessible ponds were intensively sampled with a backpack electrofisher. In addition, 35 bait traps (half baited, half unbaited) were set overnight for 18 hour period and a spotlight search of each pond was undertaken after dark. No one-spot livebearers were detected. The 18 months post-treatment survey indicated that the one-spot livebearer had failed to re-establish in detectable numbers in the Long Reef Golf Course drainage system. Since the rotenone treatment, the system appeared to return to a functioning aquatic ecosystem with good water quality and a range of aquatic species.



Figure 5. Pond 6 rotenone application

The final survey to assess the success of the one-spot livebearer eradication program was undertaken by NSW DPI on 9-11 April 2008, (22 months post-treatment). Despite intensive sampling effort, which included two hours of spot lightings, the setting of 36 traps overnight for 19 hours, and 2343 seconds (approximately 40 minutes) of electrofishing, no livebearers were captured or observed. The only fish species recorded was the short-finned eel, which was relatively more abundant during this sampling occasion than the previous in December 2007. A total of 20 eels were caught or observed in April 2008 compared to five in December 2007 (similar sampling effort was invested on both sampling occasions). Eels were recorded from four of the 12 ponds in December 2007 (ponds 1, 3, 4 and 5) compared to seven ponds in April 2008 (ponds 2, 3, 5, 6, 7, 9, 10).

The results of both the 2007 and final 2008 survey indicate that the one-spot livebearer has failed to re-establish in detectable numbers in the Long Reef Golf Course drainage system since the eradication attempt undertaken in June 2006. This is despite the opportunity for the species to breed over two spring/summer spawning seasons. Since the eradication programme, the system appears to have returned to a functioning aquatic ecosystem with good water quality, and a range of abundant aquatic species.

Acknowledgements

Several organisations were instrumental in the planning and implementation of this eradication. The supply of the fire tanker by Warringah Pittwater Rural Fire Service greatly improved the efficiency of chemical delivery. Graham Pyke, of the Australian Museum, provided comment on planning and timing of the operation.

Bill Bardsley worked tirelessly to manage, coordinate and undertake the eradication attempts. Luciana Bucater provided technical expertise, and worked tirelessly through long hours in testing conditions. Roger Laird and Tony Fowler conducted faunal surveys prior to the eradication attempt.

The staff and management of LRGC were particularly accommodating. Given previous experience with an unsuccessful effort, and the degree of disruption to course operations, they were unstinting with provision of equipment and staff. Their expertise and enthusiasm was greatly appreciated.