Alberta Conservation Association

2021/22 Project Summary Report

Project Name: Fish Pond Rehabilitation

Fisheries Program Manager: Peter Aku

Project Leader: Scott Seward

Primary ACA Staff on Project: Kacey Barret, Lindsay Dowbush, Kevin Fitzsimmons, Troy Furukawa, and Scott Seward

Partnerships

Alberta Environment and Parks

Key Findings

- A pilot test for alum treatment at Rainbow Park Pond indicated 25 mL of alum per litre of pond water, split over two treatments of 12.5 mL of alum, maintained favourable water quality for fish and invertebrate survival (pH of 7.5, alkalinity of 72 mg/L) while significantly reducing total phosphorus (85% reduction).
- All five ponds sampled for baseline water quality data had high total phosphorus concentrations with four ponds (Daysland Pond, Heritage Lake, Innisfree Trout Pond, and Lamont Pond) being hypereutrophic and Rainbow Park Pond being eutrophic.
- All five ponds experienced prolonged low dissolved oxygen concentrations (< 1 mg/L) throughout summer.

Abstract

Fishing pressure at ACA stocked ponds can exceed 2,000 h/ha in the summer months, indicating these ponds can be popular among anglers. However, some of these ponds may not be capable of supporting trout survival beyond mid-summer due to low dissolved oxygen (DO). Furthermore, these ponds will not overwinter trout. Five ponds, sampled for baseline water quality data over the past two years, had high total phosphorus concentrations, with four of five ponds being hypereutrophic: Daysland Pond (233 ± 67 µg/L), Heritage Lake (315 ± 158 µg/L), Innisfree

Trout Pond (112 ± 24 µg/L), and Lamont Pond (134 ± 52 µg/L); Rainbow Park Pond was eutrophic (81 ± 28 µg/L). Alum treatment will reduce bioavailable phosphorus, thereby improving water quality and DO concentration. We used Rainbow Park Pond as an alum pilot case. Through alum dosing jar tests, we determined that a total of 25 mL (59.5g Al/litre solution) of alum per litre of pond water, split over two treatments of 12.5 mL of alum, maintained favourable water quality for fish and invertebrate survival (pH of 7.5; alkalinity of 72 mg/L) while significantly reducing total phosphorus concentration (85% reduction). We are using the five ponds to conduct a before-after-control-impact experiment to determine if alum treatment can improve overall water quality and overwintering DO concentrations.

Introduction

Alberta Conservation Association (ACA) stocks ponds throughout Alberta as part of our Fish Stocking (FS) Project. Several of ACA's stocked ponds are very popular angling destinations receiving >2,000 angler h/ha. Yet, our recent data suggest that some FS ponds may not be capable of supporting trout survival beyond mid-summer due to poor water quality, particularly due to low dissolved oxygen (DO) and high temperature (Fitzsimmons and Keeling 2016). This is not surprising since most FS ponds tend to be shallow and enriched with nutrients. Low DO can be improved through minimizing in situ phosphorus (P) availability through aluminum sulphate (alum) treatment. Alum inactivates water column P and pond sediment P, limiting primary productivity and biochemical oxygen demand (BOD), thereby improving summer DO and summer-long fish survival. However, it is unclear whether alum treatment can improve winter DO concentrations. We are using a before-after-control-impact (BACI) study design with five ponds, including Rainbow Park Pond (formerly Westlock Pond), to determine if alum treatment can improve both overall water quality and overwintering DO in ACA stocked ponds with marginal trout habitat. Summer and winter DO concentration, secchi depth, BOD, and total phosphorus (TP) concentration will be used as indicators of water quality.

Methods

In May 2021, we deployed data loggers to collect hourly DO and temperature profiles from 2 m water depth within five ponds (Rainbow Park Pond, Daysland Pond, Heritage Lake, Lamont Pond, and Innisfree Trout Pond). The loggers will continue collecting data until their removal in

spring of 2022. We also collected biweekly (from May to September), vertically integrated, composite water samples from three locations within the five ponds that were analyzed by a laboratory for nutrient concentration, chlorophyll a, pH, and water hardness. This data will be used to establish baseline conditions prior to alum treatment and will act as the "before" category for our BACI study design.

We completed alum dosing jar tests, in triplicate, to determine the maximum safe dose of alum that could be applied to Rainbow Park Pond without adversely effecting aquatic life. Briefly, we added 10, 12.5, 15, 20, and 25 mL of alum (59.5 g Al/litre solution) to 1 L composite water samples taken from Rainbow Park Pond, collected in June, following the alkalinity method (Kennedy and Cooke 1982). We compared alum jar tests doses to determine which achieved maximum phosphorus precipitation while maintaining a pH >6, and a residual alkalinity ≥25%.

Results

All five ponds exhibit high TP concentrations (TP range 81 – 315 µg/L) and primary productivity (chlorophyll a range 23 – 47 µg/L), indicating they are eutrophic to hypereutrophic (Table 1). The ponds are also slightly basic (pH range 8.05 – 8.80) and alkaline (total alkalinity range 137 – 508 mg/L), with Innisfree Trout Pond being almost twice as alkaline as the other four ponds. The high alkalinity and pH indicate that the ponds can be safely dosed with a high concentration of alum without having an adverse effect on aquatic life. All five ponds experienced prolonged (> 1 week) DO concentrations < 1 mg/L (Figure 1). A large amount of data (June to mid-July) was lost at Rainbow Park Pond because someone removed the logger from the pond and placed it on shore. Jar tests indicate that the maximum safe alum dose for our pilot case, Rainbow Park Pond, is 25 mL (of a 59.5g Al/L solution) of alum per litre of pond water. At a rate of 25 mL alum/litre of pond water, we were able to maintain a pH of 7.5 and alkalinity of 72 mg/L, and reduce TP by 85%.

Table 1. Mean ± SD water quality characteristics of five ponds investigated for suitability for alum treatment in 2021

Pond	TP (ug/L ± SD)	Chlorophyll a (µg/L ± SD)	Total alkalinity (mg/L ± SD)	pH
Daysland	233 ± 67	47 ± 25	169 ± 18	8.13 ± 0.3
Heritage	315 ± 158	34 ± 31	170 ± 13	8.38 ± 0.2
Innisfree	112 ± 21	26 ± 8	508 ± 36	8.80 ± 0.2
Lamont	134 ± 84	47 ± 24	303 ± 18	8.72 ± 0.3
Rainbow Park	81 ± 28	23 ± 13	137 ± 21	8.05 ± 0.3

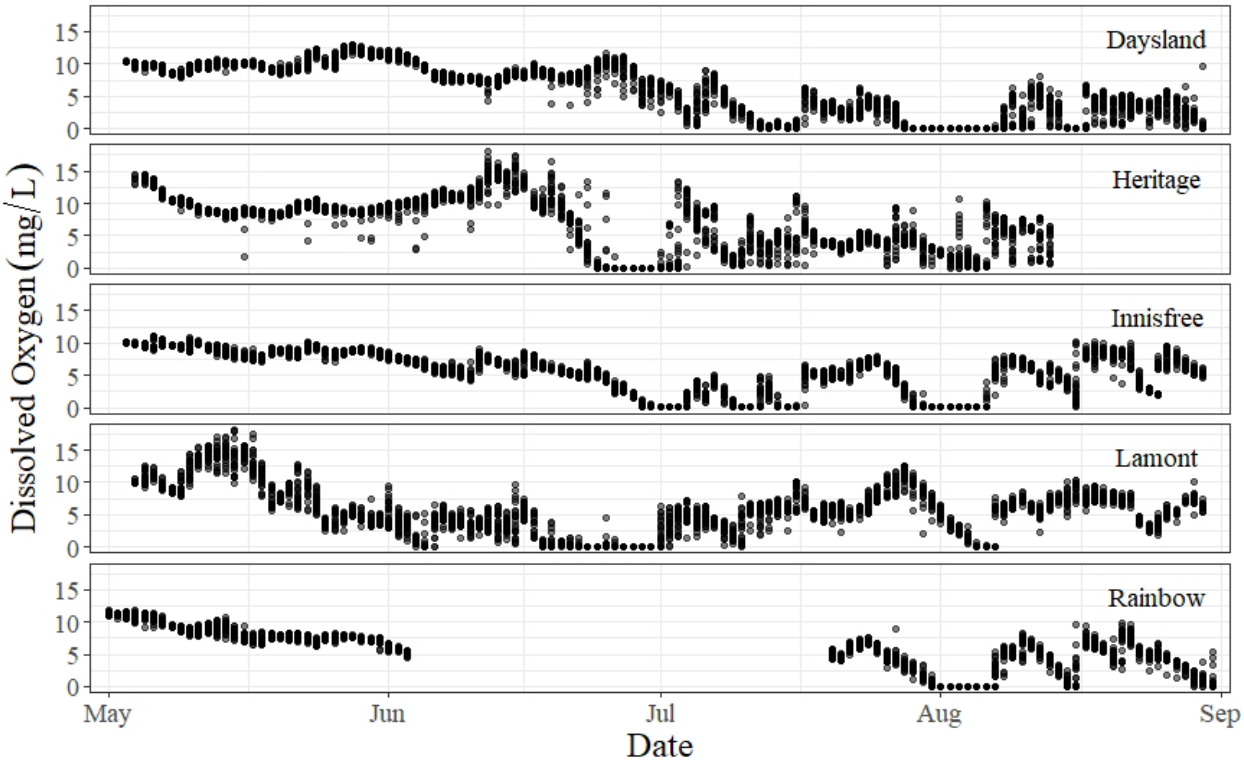

Figure 1. Dissolved oxygen concentrations (May – September 2021) recorded hourly with dataloggers, at 2 m water depth, from five ACA stocked ponds.

Conclusions

All five ponds were eutrophic-hypereutrophic with high concentrations of TP. Rainbow Park Pond is a good candidate for alum treatment because the high alkalinity/buffering capacity can accommodate a high concentration of alum dosing without having an adverse effect on aquatic

life. Rainbow Park Pond experiences low DO conditions during the summer, which may be impacting trout survival, that could be mitigated by alum treatment. We will apply 25 mL (of a 59.5 g Al/L solution) of alum per litre of pond water over two treatments of 12.5 mL of alum per treatment to improve summer and winter DO concentrations. We are working with Alberta Environment and Parks to secure permits to apply alum to Rainbow Park Pond.

Communications

Not applicable

Literature Cited

Fitzsimmons, K., and B. Keeling. 2016. *Stocked Trout Survival and Camera-based Angler Survey at Selected ACA Stocked Ponds.* Data Report, D-2016-106, produced by. Alberta Conservation Association, Sherwood Park, Alberta, Canada.. 25 pp + appendices.

Kennedy, R.H., and G.D. Cook. 1982. Control of lake phosphorus with aluminum sulfate: dose determination and application techniques. *Journal of the American Water Resources Association* 18(3): 389–395.

Photos

Photo 1. ACA staff using a hose with one-way foot valve to collect composite water sample from Rainbow Park Pond for chemical analysis. Photo: Lindsay Dowbush

Photo 2. Fluctuating water levels in Daysland Pond caused by drought conditions. Photo: Troy Furukawa