Field Performance of Two Commercial Strains of Rainbow Trout (*Oncorhynchus mykiss*) in Four Small Put-and-Take Alberta Fisheries

Alberta Conservation Association

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Mike Rodtka
Alberta Conservation Association
101 – 9 Chippewa Road
Sherwood Park, Alberta, Canada
T8A 6J7

Report Editors

PETER AKU
Alberta Conservation Association
101 – 9 Chippewa Rd.
Sherwood Park, AB T8A 6J7

GLENDA SAMUELSON
R.R. #2
Craven, SK S0G 0W0

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Alberta Conservation Association
101 – 9 Chippewa Rd.
Sherwood Park, AB T8A 6J7
Toll Free: 1-877-969-9091
Tel: (780) 410-1998
Fax: (780) 464-0990
Email: info@ab-conservation.com
Website: www.ab-conservation.com

EXECUTIVE SUMMARY

Approximately two million rainbow trout (*Oncorhynchus mykiss*) are stocked annually to Alberta waters, supporting roughly one quarter of all fishing effort in the province. A wide diversity of domesticated hatchery strains of rainbow trout are used for stocking and several strains are routinely cultured in Alberta currently, including both in-house strains maintained through the province's brood fish program and commercially produced strains. Of the commercially produced rainbow trout strains, Lyndon and Troutlodge Silver Steelhead (Silver) strains have been widely stocked in Alberta. The objective of this study was to compare two elements of the field performance of these two strains; 1) the proportion harvested by anglers, and 2) post-stocking health (i.e., condition), in four small put-and-take Alberta fisheries. I used a tag-return model to estimate angler exploitation of each strain based on angler reports of catching tagged rainbow trout during the summers of 2016 and 2017. In 2017, I used gill netting assessments of relative abundance to verify estimated exploitation rates and assess trout condition. Both strains of rainbow trout were reared under comparable conditions at the Alberta Government's Cold Lake Fish Hatchery.

In 2016, 616 trout tags were reported by 174 individual anglers, 138 individual anglers reported 461 trout tags in 2017. Estimated angler exploitation of both trout strains was typically very high (>90%) and generally comparable within a pond in a given year. Although both strains of trout were essentially removed from most ponds by the end of the summer, anglers reported tags from the Silver strain at a significantly faster rate than the Lyndon strain at most ponds. Half of all Silver strain tag reports occurred within the first two weeks after stocking, but it took nearly twice as long for the Lyndon strain to achieve a comparable rate. Condition of both trout strains declined significantly over the 56 days between hatchery and field measurements, with decline in condition of the Lyndon strain the greatest. Relative abundance of both strains declined drastically at all surveyed ponds between spring and autumn largely (but not fully) corroborating estimates of angler exploitation. Interestingly, gillnet catch of the Silver strain was two to four times that of the Lyndon strain shortly after stocking even though stocking densities were the same and crews found no evidence of the natural mortality necessary for such a large discrepancy. Anglers reported being "somewhat satisfied" or "very satisfied" with the majority of trout of either strain in both years of the study.

Different rainbow trout genotypes can vary greatly in their vulnerability to fishing gear, which could explain the apparent discrepancy between Lyndon and Silver strain capture rates

observed in this study. If correct, such pronounced differences in vulnerability to fishing gear exhibited by these two commercial strains of rainbow trout have the potential to greatly impact fisheries as a result of their stocking. Millions of rainbow trout of various strains are cultured in Alberta every year, differences in field performance among commercial strains, like those observed in this study have potentially large implications for the quality and efficiency of Alberta's trout stocking program.

Key words: rainbow trout, commercial strain, evaluation, Alberta, put-and-take, sport fishery.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY ii
ACKNOWLEDGEMENTS iv
TABLE OF CONTENTS v
LIST OF FIGURES vi
LIST OF TABLES vii
LIST OF APPENDICES viii
1.0 INTRODUCTION 1
2.0 STUDY AREA 1
3.0 MATERIALS AND METHODS 5
3.1 Study design 5
3.2 Trout culture and marking 5
3.3 Tag reporting 6
3.4 Exploitation 7
3.5 Fish condition 9
3.6 Relative abundance 10
4.0 RESULTS 10
5.0 SUMMARY 18
6.0 LITERATURE CITED 19
7.0 APPENDICES 22

LIST OF FIGURES

Figure 1. Location of the four EFS study ponds for evaluation of the field performance of the Lyndon and Troutlodge Silver Steelhead strains of rainbow trout in 2016 and 2017 and the additional seven EFS ponds where angler survey cards were distributed in 2017. Inset map shows the location within the province of Alberta. 3

Figure 2. Median (line), quartile (box), and minimum/maximum (whiskers) relative weight (Wr) of Lyndon and Troutlodge Silver Steelhead strains of rainbow trout at the hatchery and 38 days post-stocking into Nuggent Pond in 2017. Condition of both the Lyndon ($p < 0.0001$) and Troutlodge Silver Steelhead ($p = 0.0015$) strains declined significantly. 16

Figure 3. Angler reported satisfaction with Lyndon and Troutlodge Silver Steelhead strains of rainbow trout stocked into four small put-and-take Alberta fisheries in 2017. 17

LIST OF TABLES

Table 1. Characteristics of EFS study ponds selected to evaluate field performance of the Lyndon and Troutlodge Silver Steelhead strains of rainbow trout (RNTR). 4

Table 2. T-test of mean fork length (FL, mm) of Lyndon and Troutlodge Silver Steelhead strains of rainbow trout raised at the Cold Lake Fish Hatchery, measured approximately 18 days before stocking in 2016 and 2017. 5

Table 3. Number of tagged rainbow trout of Lyndon and Troutlodge Silver Steelhead strains released, and number released with tag removed by anglers, at four small put-and-take Alberta fisheries, May – October, 2016 and 2017. 8

Table 4. Number of tagged rainbow trout of Lyndon and Troutlodge Silver Steelhead strains stocked into four small put-and-take Alberta fisheries and subsequently reported as captured and kept by anglers, May – October, 2016 and 2017. 11

Table 5. Estimated exploitation rate of Lyndon and Troutlodge Silver Steelhead strains of rainbow trout stocked into four small put-and-take Alberta fisheries, May – October, 2016 and 2017. 12

Table 6. Log-rank test of Kaplan-Meier estimates of the number of days post-stocking at which 50% of all tag reports were received from anglers of four small put-and-take Alberta fisheries stocked with Lyndon and Troutlodge Silver Steelhead strains of rainbow trout, May – October, 2016 and 2017. 13

Table 7. Date of last tag report received from anglers of four small put-and-take Alberta fisheries stocked with Lyndon and Troutlodge Silver Steelhead strains of rainbow trout. Trout were stocked in early May and online reporting was open until mid-October each year. 13

Table 8. Angler reported recaptures of Lyndon and Troutlodge Silver Steelhead strains of tagged rainbow trout stocked into four small put-and-take Alberta fisheries, May – October, 2016 and 2017. 14

Table 9. Frequency of zero catch gill net sets of Lyndon and Troutlodge Silver Steelhead strains of rainbow trout at four small put-and-take Alberta fisheries, in May (shortly after stocking) and September, 2017. Emerson Pond was not included in this assessment. 15

LIST OF APPENDICES

Appendix 1. Marking scheme to distinguish between Lyndon and Troutlodge Silver Steelhead strains of rainbow trout stocked into four small put-and-take Alberta fisheries in 2016 and 2017. 22

Appendix 2. Top model resulting from the logistic regression of the predictor variables (coding): pond (Emerson/Beaumont/Ray's; 1,0/0,0/0,1), commercial strain of rainbow trout (Lyndon/Silver; 0/1), and year (2016/2017; 0/1) against tag removal (yes/no; 1/0) frequencies by anglers. Model selected using backward stepwise regression including all variables and their first-order interactions, AUC of the resulting model's ROC curve = 0.7513. (Nuggent Pond was added in 2017 and not included in this analysis). 23

Appendix 3. Example of angler survey card used to assess tag reporting rate in 2017 (modified slightly from 2016 version). Original dimensions: 215 x 140 mm. 24

Appendix 4. Detailed summary of gill netting effort to assess relative abundance and condition (Nuggent Pond only) of Lyndon and Troutlodge Silver Steelhead strains of rainbow trout in 2017. Emerson Pond was not included in this assessment. 25

1.0 INTRODUCTION

The homing behaviour of wild trout to natal streams has resulted in the evolution of many genetically distinct subpopulations within each trout species, each with precise adaptations to local environments (Pennell et al. 2001). These subpopulations, commonly referred to as strains, may vary in every conceivable biological characteristic including body size, dietary preference, and migratory behaviour (Pennell et al. 2001). Approximately two million rainbow trout (*Oncorhynchus mykiss*) are stocked annually to Alberta waters, supporting roughly one quarter of all fishing effort in the province (Alberta Environment and Sustainable Resource Development 2014). The majority of these rainbow trout are stocked by the Alberta Government, although Alberta Conservation Association (ACA) stocks approximately 120,000 catchable-sized (i.e., 20 cm total length [TL]) rainbow trout into approximately 60 ponds each year through its Enhanced Fish Stocking (EFS) project.

A wide diversity of domesticated hatchery strains of rainbow trout are used for stocking and several strains are routinely cultured in Alberta, including both in-house strains maintained through the province's brood fish program and commercially produced strains. Of the commercially produced rainbow trout strains, Lyndon and Troutlodge Silver Steelhead (Silver) strains have been widely stocked in Alberta. The Lyndon strain (all female, diploid) is believed to be derived from both steelhead and inland forms of rainbow trout and is bred by Lyndon Fish Hatcheries for favorable growth rate, late maturation, disease resistance, and egg quality (Lyndon Fish Hatcheries 2018). Troutlodge Silver Steelhead trout (all female, triploid) are bred by Troutlodge, a commercial supplier of live trout eggs, to have a distinctive silver colour and excellent growth in both seawater and freshwater (Troutlodge 2018). Both of these commercial strains are delivered to provincial and private fish hatcheries as eyed eggs and are stocked across Alberta to create recreational rainbow trout fisheries. In an effort to improve the quality and efficiency of their trout stocking activity, the Alberta Government and ACA have partnered to evaluate the Lyndon and Silver strains of rainbow trout. The objective of this study was to compare the field performance of the two commercial trout strains in Alberta's small put-and-take fisheries.

2.0 STUDY AREA

I selected four ponds stocked through ACA's EFS project to compare field performance of the two commercial strains of rainbow trout in 2016 and 2017 (Figure 1). Study ponds were selected

based on their favourable summer water quality for trout (winterkill is common in EFS ponds) and popularity with anglers (Table 1). The selected ponds have a long history of trout stocking and are managed as put-and-take fisheries (i.e., stocked annually in the spring with catchable fish for anglers to harvest) with a harvest limit of five trout and no bait restriction (Alberta Government 2017). Nuggent Pond was added as a study pond in 2017. I selected an additional seven EFS ponds where angler survey cards were distributed in 2017.

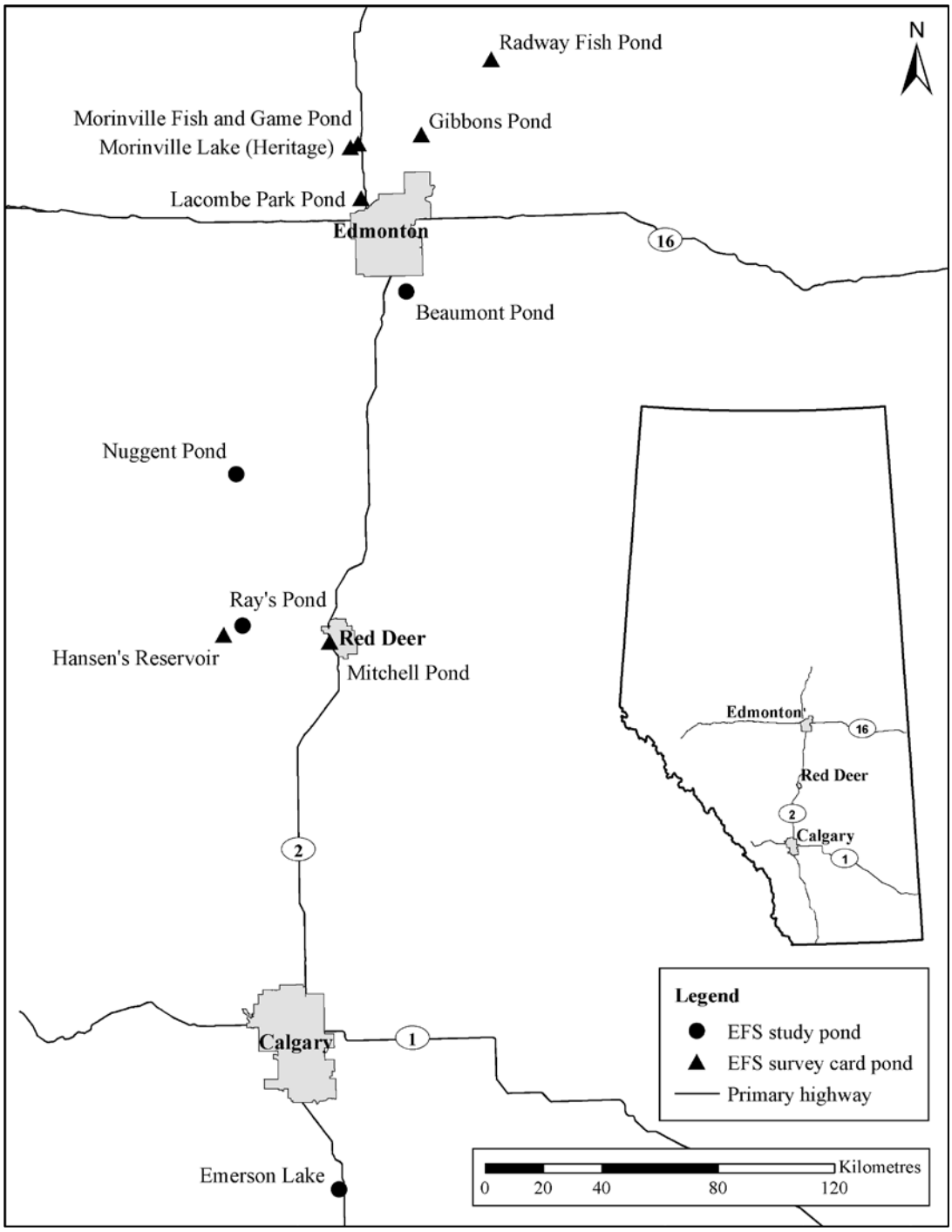

Figure 1. Location of the four EFS study ponds for evaluation of the field performance of the Lyndon and Troutlodge Silver Steelhead strains of rainbow trout in 2016 and 2017 and the additional seven EFS ponds where angler survey cards were distributed in 2017. Inset map shows the location within the province of Alberta.

Table 1. Characteristics of EFS study ponds selected to evaluate field performance of the Lyndon and Troutlodge Silver Steelhead strains of rainbow trout (RNTR).

Pond	Surface area (ha)	Average depth (m)	Max depth (m)	Summer temperature[a] (^{0}C) (mean ± SD)	Summer dissolved oxygen[a] (mg/L) (mean ± SD)	# RNTR stocked	# RNTR stocked/ strain	RNTR/ha	Angler effort[b] (hours/ha) (95% CL)
Beaumont Pond	2.3	3.0	8.3	18.0 ± 1.6	5.8 ± 2.7	2,500	1,250	1,087	2,401 (2,256 – 2,544)
Emerson Lake	4.5	3.8	8.6	18.0 ± 1.9	8.1 ± 0.7	2,500	1,250	556	586 (537 – 637)
Nuggent Pond	0.6	3.2	4.3	19.9 ± 1.4	10.3 ± 1.0	1,000	500	1,667	3,106 (2,822 – 3,407)
Ray's Pond	2.2	1.9	4.1	16.6 ± 2.7	7.9 ± 2.3	1,500[c]	750	682	5,339 (5,015 – 5,666)

[a]Measured hourly by data logger suspended at 0.5x depth at the deepest point in the pond, June – August, 2017, except Emerson Lake (2016).

[b]Kevin Fitzsimmons, Senior Biologist, ACA, personal communication. All estimates for period May 15 – August 31, 2017.

[c]Ray's Pond receives a second stocking of 1,500 rainbow trout in mid-June.

3.0 MATERIALS AND METHODS

3.1 Study design

I assessed two elements of the field performance of the two trout strains; 1) the proportion harvested by anglers, and 2) post-stocking health (i.e., condition). Trout strains demonstrating a relatively high return to creel while maintaining condition are generally considered desirable for stocking put-and-take trout fisheries (Hartman and Preston 2001). Although the study ponds are open to angling year-round, I confined my assessment to a season beginning in mid-May and ending in mid-October when the majority of angling effort occurs.

I used a tag-return model (Pine et al. 2012) to estimate angler exploitation of each trout strain based on angler reports of catching tagged trout in 2016 and 2017. In 2017, I used gill netting assessments of relative abundance to verify estimated exploitation rates and assess trout condition. Although I frame this study as an evaluation of trout strains, the two strains I compare also differ in their chromosome number (Lyndon strain is diploid while the Silver strain is triploid), which can impact fish behaviour and growth (Tiwary et al. 2004). I refer exclusively to strain effects hereafter for the sake of brevity.

3.2 Trout culture and marking

Both trout strains were reared under comparable conditions at the Alberta Government's Cold Lake Fish Hatchery. Effort was made to ensure both strains were of comparable size prior to stocking each year, as stocking larger trout has been demonstrated to increase angler harvest rates (Cassinelli et al. 2016). However, the Silver strain was significantly longer (fork length, FL) than the Lyndon strain in 2016 and the situation was reversed in 2017 (Table 2).

Table 2. T-test of mean fork length (FL, mm) of Lyndon and Troutlodge Silver Steelhead strains of rainbow trout raised at the Cold Lake Fish Hatchery, measured approximately 18 days before stocking in 2016 and 2017.

	Lyndon			Troutlodge Silver Steelhead			*p*
Year	n	Mean	SD	n	Mean	SD	
2016	48	263	± 40	50	288	± 30	<0.001
2017	100	266	± 29	100	245	± 31	<0.001

Trout were marked at the hatchery approximately two weeks prior to stocking with a fin clip or combination of a fin clip and a T-bar anchor tag. All fish were anesthetised (MS-222; 4,000 ppm) prior to marking and counted by hand. Trout were tagged on the left side just below the dorsal fin with either a blue or red T-bar anchor tag (Floy Tag FD-94) and administered an upper caudal fin clip to allow identification of tag loss. Tags were uniquely numbered and included the address of the website where tags could be reported. Forty percent of both strains were tagged in 2016. Based on the abundance of tags reported in 2016, the tagging rate was dropped to 30% in 2017. Untagged trout were given either a full- or partial-adipose clip unique to the strain. With the exception of the upper caudal clip, clips and tag colour were unique to trout strain each year, assigned randomly in the first year of the study, and switched in the second year. For a detailed description of the fish marking scheme see Appendix 1.

3.3 Tag reporting

Anglers had the option of reporting trout tags online or by phone, with phone entries entered online by ACA staff on behalf of the angler. Signs posted at key access points to the four study ponds indicated tagged trout had been stocked in the pond along with instructions on how tags could be reported. Instructions included a quick response (QR) code that would link anglers directly to the tag reporting webpage via their smartphone. On the webpage, anglers had the option of reporting trout tags, angler survey cards (see Exploitation Estimate below), or both.

Anglers were encouraged to report any tagged trout in their catch without specifically referencing the different strains in the pond to avoid biasing their response. Anglers were asked to provide the location the trout was captured, if the trout was kept (keep the fish only because it was tagged; keep the fish) or released (release the fish without tag; release the fish). Anglers could also rate their satisfaction with the trout catch on a five-level, Likert-type scale (Likert 1932) and provide supplementary comments. To encourage angler participation, a random draw was held in October of each year for angling gear gift packs ($75 approximate value). Anglers had the option on the webpage of providing their email address and/or phone number to be included in the draw. The study was promoted through ACA's online and print media throughout its duration.

Of the 680 tag reports in 2016, I removed 64 (9%) incomplete, repeat, or otherwise questionable reports from the dataset. I removed 20 (4%) of the 481 reports in the 2017 dataset. The improvement in successful tag reporting between years likely reflects anglers becoming

accustomed to online reporting procedures as, to the best of my knowledge, this study is the first of its kind in Alberta.

3.4 Exploitation

Pine et al.'s (2012) formula corrects angler tag-return estimates of exploitation rate (û) for tagging mortality (m), tag loss (t), and reporting rate ($\hat{\lambda}$):

$$\hat{u} = \frac{N_r}{N_0(1-t)(1-m)(\hat{\lambda})}$$

where,

Nr = the number of tags from harvested fish reported by anglers; and

N_0 = the number of fish tagged.

Short-term (≈14 day) tagging mortality was assessed at the hatchery and in all cases was <1% (m = 0.01). Short-term tag loss was also <1%, however, post-stocking tag loss (assessed using gill net catches) was unexpectedly high and may be the result of angler behaviour. Anglers reported removing the tag from 35% and 27% of all trout released in 2016 and 2017, respectively (Table 3). Tag removal rates were inconsistent and often the result of the actions of a few anglers. Post-hoc logistic regression of the predictor variables: pond (Emerson/Beaumont/Ray's), strain (Lyndon/Silver), and year (2016/2017) against tag removal frequencies identified all three variables were significant predictors of tag removal (Appendix 2). (Nuggent Pond was added in 2017 and not included in this analysis). Consequently I used tag removal rates specific to strain, pond, and year (t = 0.00–0.74) when calculating exploitation rate. I assumed natural tag loss was negligible, which seemed reasonable given the brief time most trout were resident in the ponds (McAllister et al. 1992).

Table 3. Number of tagged rainbow trout of Lyndon and Troutlodge Silver Steelhead strains released, and number released with tag removed by anglers, at four small put-and-take Alberta fisheries, May – October, 2016 and 2017.

	Lyndon		Troutlodge Silver Steelhead	
Pond	Total released	Tag removed	Total released	Tag removed
Beaumont				
2016	42	22	50	28
2017	23	7	39	4
Emerson				
2016	55	18	76	12
2017	27	20	43	21
Nuggent				
2017	8	1	12	0
Ray's				
2016	31	13	27	5
2017	32	2	32	3

I used a modification of Zale and Bain's (1994) tag surrogate method to estimate angler tag reporting rate. Uniquely numbered angler survey cards (Appendix 3) were distributed to anglers at EFS ponds over the course of the study to simulate the psychological environment associated with an angler's decision to report a tag (Zale and Bain 1994). Survey cards were distributed opportunistically to anglers at study ponds by ACA staff in 2016. The number of ponds eligible for card distribution was expanded in 2017 to include seven additional EFS ponds in the general vicinity of the initial study ponds in an effort to increase the number of cards distributed (Figure 1). Staff distributing cards minimized discussion with anglers to avoid influencing their decision to report a card. Of the 76 and 164 angler survey cards distributed in 2016 and 2017, respectively, 10 (13%) and 28 (17%) cards were returned. A proportions test indicated these rates were not significantly different ($p = 0.56$) so I used the combined rate when calculating exploitation rate ($\hat{\lambda} = 0.16$). Small sample sizes precluded the use of pond-specific reporting rates when calculating exploitation.

Uncertainty in estimates of tag loss and tag reporting rates were simulated (10,000 resampling events) using the binomial distribution (Haddon 2011) and combined to produce a probabilistic distribution of exploitation rate values for each combination of strain/pond/year. I report the 5th, 50th (median), and 95th percentiles of the resulting distributions. Exploitation estimates

exceeded 100% for some ponds, an impossibility likely attributable to an underestimation of angler reporting rate. In cases where $\hat{u} > 1.0$, I set $\hat{u} = 1.0$ and report the resulting corrected confidence limits.

I compared rates of tag reporting from both trout strains at each study pond in a post-hoc analysis using Kaplan-Meier curves and log-rank tests. Kaplan-Meier curves are conventionally used in ecology to estimate population survival rates using time-of-death data from individuals in the population (Krebs 1999) but the method is appropriate for comparison of any time-to-event data (Rich et al. 2010). The log-rank test is a chi-squared test of differences between survival rates (Krebs 1999). My analysis assumes tags are reported by anglers in a timely manner and angler tag reporting behaviour is independent of trout strain. Survival analyses were performed in R (R Core Team 2017) using package "survival" (Therneau 2015).

3.5 Fish condition

In 2017 a random subsample of trout from both strains were measured (FL and total length [TL], mm) and weighed (g) at the hatchery approximately 18 days prior to stocking to establish baseline fish condition. A second subsample for comparison was obtained from Nuggent Pond 38 days post-stocking (June 15), using 15-min sets of 50.8 mm and 63.5 mm (stretch measure), monofilament gill nets. I chose Nuggent Pond for this assessment because trout survival in the pond is relatively high (Fitzsimmons and Keeling 2016) and the pond lacks other fish species that might be competitive with rainbow trout. See Appendix 4 for a detailed summary of gill netting effort during the study. I used relative weight (Wr) to assess the condition of each trout strain:

$$Wr = (W/Ws) \bullet 100$$

where,

W = individual fish weight; and

Ws = a length-specific standard weight predicted from a weight-length regression developed to represent the body form of lentic rainbow trout across its geographical range.

A Wr of 100 generally describes a fish in good condition (Neumann et al. 2012). I used randomization tests (10,000 randomizations) (Haddon 2011) to determine the probability that Wr of pre- and post-stocking trout of each strain could have been drawn from the same population. I chose randomization tests over conventional parametric tests for their flexibility, particularly when sample sizes are unequal (Mewhort et al. 2009).

3.6 Relative abundance

Relative abundance of both trout strains were assessed in 2017 using gill nets. Gill netting occurred shortly after stocking in early May and again in late September. I did not include Emerson Lake in this assessment to avoid the large bycatches of longnose (*Catostomus catostomus*) and white sucker (*Catostomus commersoni*) encountered during preliminary gill netting in 2016. Gill netting consisted of alternating sets of 50.8 mm and 63.5 mm (stretch-measure), 1.82 m x 15.24 m monofilament gill nets. These mesh sizes effectively targeted trout with a modal TL of 250 – 320 mm (Lester et al. 2009) while reducing bycatch. Sets were short (15 min) to minimize trout mortality and commenced within one hour of sunrise at surface water temperatures of 10 – 15ºC to maximize capture efficiency (Ward et al. 2012). Gill nets were set perpendicular to shore, and the location and order of sets was stratified (with random start) to ensure approximately equal soak time for both mesh sizes among littoral habitats at each pond. See Appendix 4 for a detailed summary of gill netting effort during the study.

I suspected unequal vulnerability of the trout strains to gill netting gear and zero catches were common overall, so I report the frequency of zero catches as a relatively unbiased index of abundance in these situations (Hubert and Fabrizio 2007). For comparative purposes I bootstrapped (10,000 replicates) catch frequencies and report the 5th, 50th (median), and 95th percentiles of the resulting distributions. All statistical analyses were performed using the R software package (R Core Team 2017).

4.0 RESULTS

In 2016, 616 trout tags were reported by 174 individual anglers, 138 individual anglers reported 461 trout tags in 2017. With the exception of Ray's Pond in 2017, total reports of Silver strain tags outnumbered reports of Lyndon strain tags in both years (Table 4).

Table 4. Number of tagged rainbow trout of Lyndon and Troutlodge Silver Steelhead strains stocked into four small put-and-take Alberta fisheries and subsequently reported as captured and kept by anglers, May – October, 2016 and 2017.

	Lyndon			Troutlodge Silver Steelhead		
Pond	Tagged	Reported	Kept	Tagged	Reported	Kept
Beaumont						
2016	500	75	33	500	131	81
2017	375	60	37	375	76	37
Emerson						
2016	500	107	52	500	142	66
2017	375	55	28	375	74	31
Nuggent						
2017	150	39	31	150	55	43
Ray's						
2016	300	76	45	300	85	58
2017	225	51	19	225	51	19

Angler exploitation of both trout strains was typically very high, with the exception of Ray's Pond in 2017, and generally comparable within a pond in a given year (Table 5).

Table 5. Estimated exploitation rate of Lyndon and Troutlodge Silver Steelhead strains of rainbow trout stocked into four small put-and-take Alberta fisheries, May – October, 2016 and 2017.

	Exploitation rate			
	Lyndon		Troutlodge Silver Steelhead	
Pond	Median	95% CL	Median	95% CL
Beaumont				
2016	0.90	0.60 – 1.00	1.00	1.00 – 1.00
2017	0.92	0.64 – 1.00	0.70	0.53 – 1.00
Emerson				
2016	0.99	0.72 – 1.00	1.00	0.76 – 1.00
2017	1.00	1.00 – 1.00	1.00	0.71 – 1.00
Nuggent				
2017	1.00	1.00 – 1.00	1.00	1.00 – 1.00
Ray's				
2016	1.00	1.00 – 1.00	1.00	1.00 – 1.00
2017	0.58	0.44 – 0.81	0.60	0.45 – 0.85

Although both strains of trout were essentially removed from most ponds by the end of the season, it appears the Silver strain trout were depleted more rapidly. Anglers reported tags from the Silver strain at a significantly faster rate than the Lyndon strain at most ponds (Table 6). It is unclear what caused the decline in median reporting rates for both strains at Ray's Pond in 2017 relative to 2016, but the trend is also reflected in the unusually low exploitation estimates for the pond that year (Table 5). Tag reports usually did not persist past August for the Silver strain and September for the Lyndon strain (Table 7) and reports of recaptured trout were rare (Table 8), reflecting the harvest-oriented nature of these put-and-take fisheries.

Table 6. Log-rank test of Kaplan-Meier estimates of the number of days post-stocking at which 50% of all tag reports were received from anglers of four small put-and-take Alberta fisheries stocked with Lyndon and Troutlodge Silver Steelhead strains of rainbow trout, May – October, 2016 and 2017.

	Number of days post-stocking				*p*
	Lyndon		Troutlodge Silver Steelhead		
Pond	Median	95% CL	Median	95% CL	
Beaumont					
2016	15.5	14.0 – 18.0	15.0	14.0 – 18.0	0.5500
2017	22.5	18.0 – 25.0	13.0	13.0 – 15.0	0.0004
Emerson					
2016	34.0	27.0 – 35.0	10.0	7.0 – 12.0	<0.0001
2017	30.0	25.0 – 40.0	12.0	11.0 – 14.0	0.0002
Nuggent					
2017	24.0	22.0 – 30.0	20.0	19.0 – 24.0	0.1600
Ray's					
2016	22.0	17.0 – 23.0	15.0	8.0 – 16.0	0.0006
2017	12.0	10.0 – 19.0	10.0	9.0 – 11.0	0.0240

Table 7. Date of last tag report received from anglers of four small put-and-take Alberta fisheries stocked with Lyndon and Troutlodge Silver Steelhead strains of rainbow trout. Trout were stocked in early May and online reporting was open until mid-October each year.

Pond	Lyndon	Troutlodge Silver Steelhead
Beaumont		
2016	July 23	August 6
2017	September 30	July 29
Emerson		
2016	October 1	July 17
2017	September 23	September 17
Nuggent		
2017	June 27	June 27
Ray's		
2016	September 16	August 22
2017	September 4	August 19

Table 8. Angler reported recaptures of Lyndon and Troutlodge Silver Steelhead strains of tagged rainbow trout stocked into four small put-and-take Alberta fisheries, May – October, 2016 and 2017.

	Recaptures	
Pond	Lyndon	Troutlodge Silver Steelhead
Beaumont		
2016	1	3
2017	4	3
Emerson		
2016	7	10
2017	1*	3*
Nuggent		
2017	0	3
Ray's		
2016	5	6
2017	2	3

*Includes report of a 2016 tag.

Relative abundance of both strains declined drastically at all ponds between spring and autumn of 2017 (Table 9). Despite nearly four hours of combined gill netting effort, no trout of the Lyndon or Silver strains were captured in Beaumont and Ray's ponds respectively in September, 2017. These results corroborate the high estimates of angler exploitation at Beaumont and Nuggent ponds in 2017 but not the relatively low estimate at Ray's Pond. Although it is possible our autumn gill netting underestimated trout abundance, it is more likely the exploitation estimate is biased or natural mortality at Ray's Pond was unusually high in 2017.

Interestingly, gill net catch of the Silver strain of trout was two to four times that of the Lyndon strain shortly after stocking in May 2017 (Appendix 4) even though stocking densities were the same within a pond. Gill netting crews found no evidence of the natural mortality necessary for such a large discrepancy in catch rates so soon after stocking.

Table 9. Frequency of zero catch gill net sets of Lyndon and Troutlodge Silver Steelhead strains of rainbow trout at four small put-and-take Alberta fisheries, in May (shortly after stocking) and September, 2017. Emerson Pond was not included in this assessment.

Pond	Lyndon				Troutlodge Silver Steelhead			
	May		September		May		September	
	Median	95% CL	Median	95% CL	Median	95% CL	Median	95% CL
Beaumont	0.73	0.53 – 0.93	0.94	0.81 – 1.00	0.33	0.13 – 0.60	1.00	–
Nuggent	0.12	0.00 – 0.37	0.75	0.37 – 1.00	0.12	0.00 – 0.37	0.88	0.62 – 1.00
Ray's	0.40	0.13 – 0.67	1.00	–	0.27	0.07 – 0.53	0.93	0.80 – 1.00

Relative weight of both trout strains declined significantly in Nuggent Pond over the 56 days between hatchery and field measurements, although decline in condition of the Lyndon strain was most drastic (Figure 2).

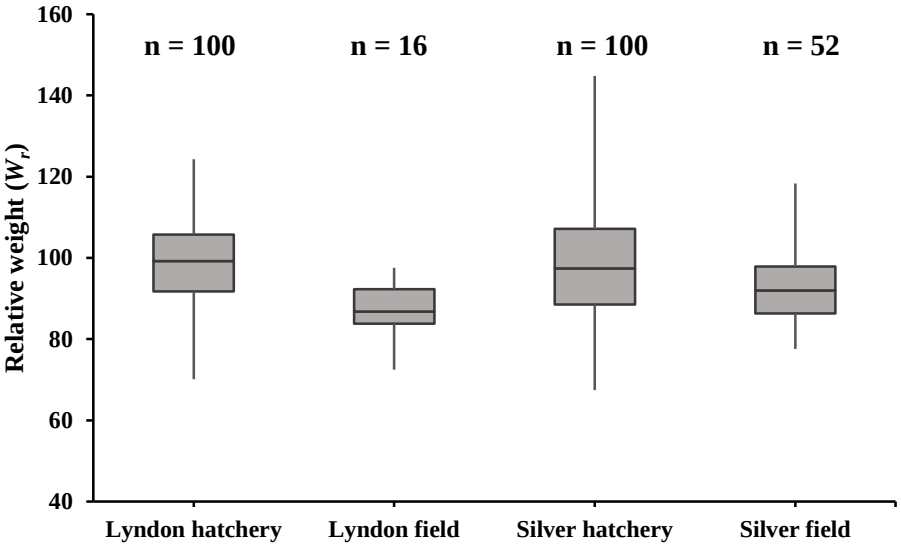

Figure 2. Median (line), quartile (box), and minimum/maximum (whiskers) relative weight (Wr) of Lyndon and Troutlodge Silver Steelhead strains of rainbow trout at the hatchery and 38 days post-stocking into Nuggent Pond in 2017. Condition of both the Lyndon ($p < 0.0001$) and Troutlodge Silver Steelhead ($p = 0.0015$) strains declined significantly.

Anglers reported being "somewhat satisfied" or "very satisfied" with the majority of rainbow trout stocked of either strain, in both years of the study. Results for angler reported satisfaction for 2017 are presented in Figure 3.

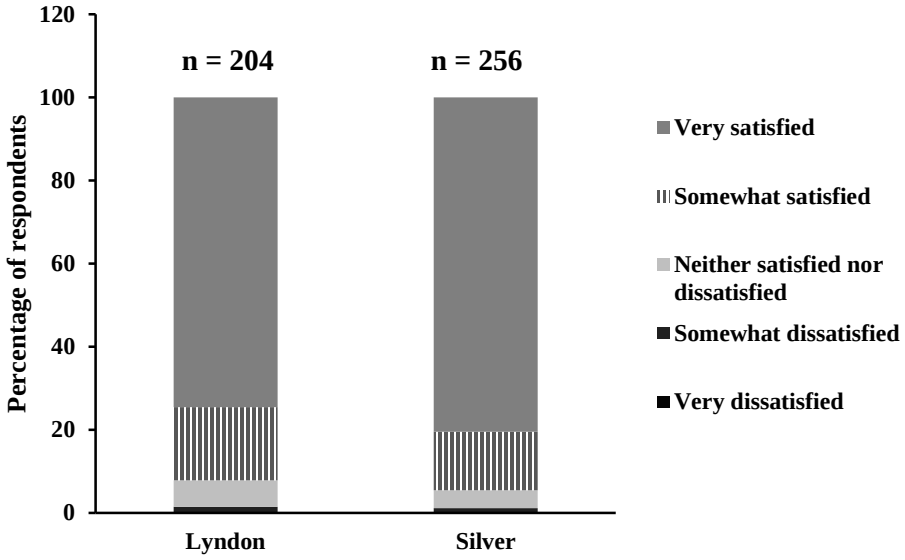

Figure 3. Angler reported satisfaction with Lyndon and Troutlodge Silver Steelhead strains of rainbow trout stocked into four small put-and-take Alberta fisheries in 2017.

5.0 SUMMARY

Both the Lyndon and Silver commercial strains of rainbow trout performed relatively well under field conditions characteristic of many small put-and-take fisheries in Alberta. There was no strong evidence of differential survival between the two strains; angler harvest alone could account for 100% of rainbow trout mortality at most ponds. Although condition of both strains declined significantly post stocking, the strains maintained acceptable condition as evidenced by reported high angler harvest and satisfaction with their catch. The most noteworthy difference between the two strains was the rate of tag reporting by anglers. Half of all Silver strain tag reports occurred within the first two weeks after stocking, but it took nearly twice as long for the Lyndon strain to achieve a comparable reporting rate. Gillnet catch of the Silver strain was also two to four times that of the Lyndon strain even when stocking densities were comparable. Different rainbow trout genotypes can vary greatly in their vulnerability to fishing gear (Biro and Post 2008), which could explain the apparent discrepancy between Lyndon and Silver strain capture rates observed in this study. If correct, such pronounced differences in vulnerability to fishing gear exhibited by these two commercial strains of rainbow trout have the potential to greatly impact fisheries as a result of their stocking. Given the relatively small size of the fisheries studied, unusual behaviour by just a handful of individuals could bias estimates based on samples aggregated across multiple ponds. Future assessments based on tag-returns should strive to obtain pond-specific rates of angler tag reporting and removal. Millions of rainbow trout of various strains are cultured in Alberta every year, differences in field performance among commercial strains, like those observed in this study have potentially large implications for the quality and efficiency of Alberta's trout stocking program.

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7.0 APPENDICES

Appendix 1. Marking scheme to distinguish between Lyndon and Troutlodge Silver Steelhead strains of rainbow trout stocked into four small put-and-take Alberta fisheries in 2016 and 2017.

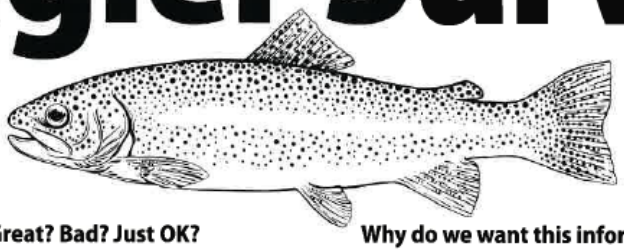
	Lyndon			Troutlodge Silver Steelhead		
Pond	Fin clip	Tag	*n*	Fin clip	Tag	*n*
Beaumont						
2016	partial adipose	none	750	adipose	none	750
	upper caudal	red anchor tag	500	upper caudal	blue anchor tag	500
2017	adipose	none	875	partial adipose	none	875
	upper caudal	blue anchor tag	375	upper caudal	red anchor tag	375
Emerson						
2016	partial adipose	none	750	adipose	none	750
	upper caudal	red anchor tag	500	upper caudal	blue anchor tag	500
2017	adipose	none	875	partial adipose	none	875
	upper caudal	blue anchor tag	375	upper caudal	red anchor tag	375
Nuggent						
2017	adipose	none	350	partial adipose	none	350
	upper caudal	blue anchor tag	150	upper caudal	red anchor tag	150
Ray's						
2016	partial adipose	none	450	adipose	none	450
	upper caudal	red anchor tag	300	upper caudal	blue anchor tag	300
2017	adipose	none	525	partial adipose	none	525
	upper caudal	blue anchor tag	225	upper caudal	red anchor tag	225

Appendix 2. Top model resulting from the logistic regression of the predictor variables (coding): pond (Emerson/Beaumont/Ray's; 1,0/0,0/0,1), commercial strain of rainbow trout (Lyndon/Silver; 0/1), and year (2016/2017; 0/1) against tag removal (yes/no; 1/0) frequencies by anglers. Model selected using backward stepwise regression including all variables and their first-order interactions, AUC of the resulting model's ROC curve = 0.7513. (Nuggent Pond was added in 2017 and not included in this analysis).

Coefficient	β	SE β	Z	p
Intercept	0.5473	0.2449	2.235	0.0254
pond (Emerson)	-1.3991	0.2990	-4.679	<0.0001
pond (Ray's)	-1.0530	0.3588	-2.935	0.0033
strain (Silver)	-0.6760	0.2177	-3.105	0.0019
year (2017)	-1.6906	0.3969	-4.260	<0.0001
pond (Emerson) x year (2017)	3.3146	0.5135	6.455	<0.0001
pond (Ray's) x year (2017)	0.0186	0.6772	0.027	0.9781

Appendix 3. Example of angler survey card used to assess tag reporting rate in 2017 (modified slightly from 2016 version). Original dimensions: 215 x 140 mm.

Angler Survey



How's the fishing? Great? Bad? Just OK?
Alberta Conservation Association wants to know!
Tell us about your day's angling experience online at:
www.ab-conservation.com or call **403-845-8366**
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Why do we want this information?
Alberta Conservation Association uses your feedback to assess the quality of the sport fishery and trout stocked at this pond. Your information helps us improve your angling experience.

SURVEY NUMBER:

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Alberta Conservation Association

Licences are cheaper than fines
What's in your tackle box? Fish Responsibly.

Always refer to the Alberta Sportfishing Regulations when fishing on Conservation Sites.

Appendix 4. Detailed summary of gill netting effort to assess relative abundance and condition (Nuggent Pond only) of Lyndon and Troutlodge Silver Steelhead strains of rainbow trout in 2017. Emerson Pond was not included in this assessment.

Pond	Date (days post stocking)	Start	End	Sets	Catch			Secchi depth (m)	Surface temperature (ºC)
					Lyndon	Silver	Other (n)		
Beaumont									
Early	May 10 (2)	7:12	11:37	15	7	29	BNTR (34) YLPR (8)	4.0	14.8
Late	September 22 (137)	7:47	11:37	16	1	0	BNTR (10) YLPR (9)	6.8	9.9
Nuggent									
Early	May 11 (3)	7:16	10:38	8	11	34	none	2.2	13.6
Condition	June 15 (38)	5:39	10:45	17	16	52	none	1.6	17.3
Late	September 20 (135)	7:55	10:57	8	3	2	none	2.1	10.0
Ray's									
Early	May 10 (2)	6:45	11:45	15	22	42	WHSC (1)	1.5	12.0
Late	September 28 (143)	7:12	10:37	15	0	1	WHSC (4)	1.5	10.0

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Alberta

Cabela's

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