HOOKING MORTALITY OF FLY-CAUGHT DUNCAN RIVER RAINBOW TROUT *(Salmo gairdneri)* IN HARPER LAKE, BRITISH COLUMBIA

by

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INTRODUCTION

The need for a varied angling experience on reasonably accessible lakes has increased with the steadily increasing number of anglers in British Columbia. One way to vary the angling experience is through special regulations, such as, reduced kill limits, seasonal closures and gear restrictions on some lakes. An example is the "trophy fishery", where generally there is a daily kill limit of 2 fish, icefishing closure and fishing is restricted to artificial flies. These regulations are intended to increase both the catch per unit effort and the size of fish. Rainbow trout may be caught and released several times before reaching trophy size, so hooking mortality may be a major factor in the success or failure of trophy fisheries.

STUDY AREA

Harper Lake (50° 44'20", 119° 42' 40") is 8 km south of Chase, British Columbia and drains into the South Thompson River. The lake has a surface area of 28.5 hectares, elevation of 671 meters, maximum depth of 22.9 meters, mean depth of 12 meters and a TDS of 150 ppm (Fish and Wildlife Branch). The inlets and outlet provide very little spawning area but some natural reproduction does occur. In 1977, Harper was stocked with yearling Duncan River (adipose clip) and Mission Creek (right maxilla clip) rainbows. There was a second stocking of yearling Duncan River rainbow (adipose and right pelvic clip) in 1978.

METHOD

Duncan River and Mission Creek rainbow were angled by fly fishing with single barbed hooks. Fish were played out as in a normal fishery and did not receive special handling when landed. A trap net was set with the centre lead anchored to shore and the trap box set near the edge of the shoal. Separate holding pens were set up for each stock and various fin clips were used to separate each day's catch and angled and trap caught fish. Captured fish were transported in a 130 L garbage bucket to the holding pens. Fish were held for 2 days except those caught on the last sampling day which were held for 1 day only. Lengths and weights (Pesola balance) were taken on dead fish only. Temperature and oxygen profiles of the lake were taken with a YSI model 54 oxygen-temperature meter.

There were two experiments, one in June 1981 and the other in May 1982.

Holding pens were set in shallow and deep water during the first experiment. Shallow pens were set in 1.3 meters of water and deep pens were set on the lake bottom at a depth of 6 meters. Badly hooked fish were specially clipped so they could be identified. Oxygen and temperature changes in the transportation bucket were monitored with a YSI model 54 oxygen-temperature meter. Dead fish were frozen with dry ice and tissue samples from these fish were checked for disease by the Fish and Wildlife Branch fish pathologist.

The procedure for the second experiment was set by results of the first experiment and availability of equipment.

RESULTS

The trap net set caught only 2 Mission Creek spawners during the first experiment. Results of the hooking mortality of fly caught rainbow in June 1981 are given in Table 1.

Table 1. Per cent mortality during June 1981 experiment. Sample size in brackets.

Stock	Holding Period	Per Cent Mortality Pen Type Shallow	Deep	Combined
Duncan	2 days	10% (10)	70% (10)	40% (20)
Duncan	1-2 days	13% (15)	53% (17)	34% (32)
Mission	2 days	33% (3)	50% (2)	40% (5)
Mission	1-2 days	17% (6)	50% (2)	25% (8)

A G-test (Sokol and Rolf 1982) was performed on the raw data. There was no significant difference between mortality rates between stocks but the difference in the mortality rates between shallow and deep pens was significant at 0.05.

Mortality in the deep pens (12°, 6.5 ppm O_2) was much higher than in the shallow pens (17°, 8.0 ppm O_2). The reason for this is not clear, possibly it is related to a change in temperature combined with exhaustion. The fish were hooked near the surface in 17° C water and then put in 12° C water to recover. Marnell and Hunsaker (1970) found no temperature effects on lure-caught cutthroat trout (Salmo clarki) over a range of 3° C to 18° C. In a fishery, fish would be released over deep water and exhausted fish may sink to the bottom, so the deep pens are thought to be part of the normal situation.

Of the 8 Duncan fish that died amongst the group of 20 that were held for 48 hours, 7 died within 12 hours of capture and 1 died between 24 and 36 hours after capture. Other studies on salmonids have found that nearly all hooking mortalities occurred within 24 hours (Warner and Johnson 1978; Marnell and Hunsaker 1970). The combined mortality rate of 34% for Duncan River rainbows held for at least 1 day is considered a reasonable estimate.

Two Duncans were considered seriously hooked, but neither of them died. All angled Duncan's were immature 4 and 5 year old fish. The mean length and weight of the Duncans that died was 47.1 cm and 1406 g respectively. Water temperature in the transporting bucket rose from 17° C to 19° C and the oxygen level dropped from 8 ppm to 6 ppm during the separate transporting of 2 fish. Tissue samples taken from the dead fish indicated that pathogenic organisms were not a factor in any of the deaths (pers. comm. Terry Shortt). However, the pathologist that took the tissue samples commented on the unusually large fat deposits in the body cavity.

During the second experiment only shallow holding pens were used. Results are given in Table 2.

Table 2. Per cent mortality during May 1982 experiment. Sample size in brackets.

Stock	Holding Period	Per Cent Mortality Angled	Trap Net
Duncan	1-2 days	38% (8)	0% (12)
Mission	1-2 days	0% (1)	0% (6)

Transportation conditions for fish caught in the trap net were worse than those of fly caught fish; up to 10 fish were transported in a single garbage bucket. None of the trap caught fish died or showed signs of dying after being in a holding pen for 1 day. This indicates that transporting in itself did not cause the fish to die. All trap net fish were spawners.

Angled Duncan River rainbow showed a similar hooking mortality rate to the 1981 experiment. Of the 3 Duncans that died, 2 were immature and one was in spawning condition. Marnell and Hunsaker (1970) found no evidence that spawning cutthroat trout (Salmo clarki) were any less resistant to the effects of hooking and handling than non-spawning adults.

Of the 40 Duncan River rainbow caught on flies during the two experiments, 35% died (mean length 47.8 cm). Mission Creek rainbow had a lower hooking mortality (22%) but only 9 were caught.

DISCUSSION

Hooking mortality may be an important factor in the success of fisheries where a large proportion of small fish that are caught, are released in anticipation of catching larger fish.

Table 3. A comparison of hooking mortality studies on fly-caught salmonids.

Source	Species	Location	Mean Fish Length (cm)	Hooking Mortality
Cartwright '61	S. gairdneri	Bonaparte R.	17.8	2%
Stringer '67	S. gairdneri	Pennask L.	29.1	8%
Warner & Johnson '78	S. salar	Kenebec R.	31.3	4%
Hunsaker, Marnel & Sharpe '70	S. clarki lewisi	Yellowstone L.	35.6	4%
Present study	S. gairdneri Duncan R.	Harper L.	47.8	35% (22%)*

*Mortality in shallow pens only (sample size, 23 fish). This is more comparable to the procedures in other studies.

All of the studies in Table 3, except this study, support Stringer's (1967) statement that death resulting from hooking with a fly is in the order of 10% or less, as is associated with physical trauma.

Hooking mortality may also be associated with physiological stress. Delayed mortality due to physiological stress (6-24 h post-exercise) after short periods (~ 5-10 min) of exercise is a well known phenomena in rainbow trout. Older literature (eg. Black 1957) suggested that this mortality is due to lactic acid build up in the blood but Wood *et al.* (1983) believe that a more complex mechanism is involved.

The high mortality in this study was probably due to physiological stress. No pathogenic organisms were found in these fish, the two severely hooked fish did not die and death from physical trauma has been low in other studies on fly-caught rainbow. It is difficult to understand why high mortality due to physiological stress occurs only in some hooking mortality studies. Although mortality in many studies of fly-caught fish is usually < 5%, Bouck and Ball 1966 report a mortality of 85% in lure caught fish played to exhaustion (not including bleeders) and a mortality of ~ 40% occurred in a laboratory study of fish exercised vigorously for 6 min (Graham et al. 1982). I have two suggestions which may warrant further study. High mortality may be associated with more complete exhaustion. The fish in this study were the largest of those in Table 3 and the extra time required to land these fish may have resulted in more complete exhaustion. Marnell and Hunsaker (1970) did not find evidence in cutthroat trout to support the idea that a longer fight on a fishing line increases mortality. The second suggestion is that some strains of rainbow may be more susceptible to mortality from physiological stress but it should be noted that different strains were used by Bouck and Ball (1966), Graham et al. (1983) and in this study. In a study currently underway, various blood parameters will be compared in four strains of rainbow trout (Duncan, Thompson River steelhead, Domestic, Pennask) following vigorous exercise (R. Weinz, pers. comm.).

Flies are generally accepted as the least harmful of sport fishing gear (Stringer 1967). If Duncan River rainbow in general (irrespective of size) have a 35% hooking mortality from flies, they would not be suitable for fisheries where catch and release is encouraged.

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APPENDIX

Appendix 1. Data for hooking mortality study.

a) June 1981, angled fish only.

Stock	Date	Shallow Pen Lightly Hooked Caught	Shallow Pen Lightly Hooked Died	Shallow Pen Seriously Hooked Caught	Shallow Pen Seriously Hooked Died	Deep Pen Lightly Hooked Caught	Deep Pen Lightly Hooked Died	Deep Pen Seriously Hooked Caught	Deep Pen Seriously Hooked Died	Length of Time Held
Duncan	Jun 23	5	0	-	-	6	5	-	-	48 hr
Duncan	Jun 24	4	1	1	0	3	2	1	0	48 hr
Duncan	Jun 25	5	1	-	-	7	2	-	-	24 hr
Mission	Jun 23	-	-	-	-	1	1	-	-	48 hr
Mission	Jun 24	3	1	-	-	1	0	-	-	48 hr
Mission	Jun 25	3	0	-	-	-	-	-	-	24 hr

b) May 1982, angled and trap net fish

Stock	Date	Angling Caught	Angling Died	Trap Net Caught	Trap Net Died	Length of Time Held
Duncan	May 25	3	1	-	-	48 hr
Duncan	May 26	1	0	-	-	48 hr
Duncan	May 27	4	2	12	0	24 hr
Mission	May 25	-	-	-	-	48 hr
Mission	May 26	1	0	-	-	48 hr
Mission	May 27	-	-	6	0	24 hr

Appendix 2. Lengths and weights of fish that died.

a) June 1981

Stock	Clip	Length (cm)	Weight (gr)	Age
Duncan	Adipose	44.0	1190	5
Duncan	Adipose	45.2	1290	5
Duncan	Adipose + Right Pelvic	45.3	1280	5
Duncan	Adipose + Right Pelvic	49.5	1680	4
Duncan	Adipose + Right Pelvic	48.0	1550	4
Duncan	Adipose + Right Pelvic	48.0	1650	4
Duncan	Adipose + Right Pelvic	47.8	1402	4
Duncan	Adipose + Right Pelvic	50.4	1508	4
Duncan	Adipose + Right Pelvic	47.7	1440	4
Duncan	Adipose + Right Pelvic	45.0	1350	4
Duncan	Adipose + Right Pelvic	45.0	1230	4
Duncan	Adipose + Right Pelvic	49.5	1300	4
Mission	Right Maxilla	49.5	1500	5

b) May 1982

Duncan	Adipose + Right Pelvic	51.6	1800	5
Duncan	Adipose + Right Pelvic	53.0	2170	5