

SURVIVAL RATES OF FRY
RELEASED IN THE HEADWATERS OF
THE SUSKWA AND ZYMOETZ RIVERS
- A PRELIMINARY ASSESSMENT -

by

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Smithers, B.C.
Skeena Fisheries Report #63
1987

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Introduction

The B.C. Fish and Wildlife Branch began stocking Skeena River tributaries with juvenile summer-run steelhead (Salmo gairdneri) in 1979. Initially, both smolt releases and fry releases were attempted on an experimental basis, but in 1981 the smolt program was abandoned in favor of the fry program because:

- i) The release of fry before winter was desirable because expensive overwintering water heating costs could be avoided.
- ii) Smolts produced from fry releases were deemed more desirable both socially and biologically than hatchery produced smolts.
- iii) Fish culture facilities with smolt production capability were limited in the north.
- iv) Two-year smolt rearing programs did not produce significant returns.

The first release of 15,000 fry was a pilot project in the headwaters of the Suskwa River in 1979. The scale of the Skeena fry program was increased gradually until present production levels of approximately 350,000 fry were reached in 1985. Some fry from the 1979-1982 releases were marked with fin or maxillary clips, primarily to assess freshwater survival at the release sites.

Beginning in 1985 however, all fry were adipose clipped and implanted with a coded wire nose tag so that run timing information could be obtained from returning adults.

In order to assess the effectiveness of the Skeena fry stocking program, information of marked recaptures was examined. Sizeable returns of marked steelhead adults are not expected until 1990, but sparse data from early pilot projects was examined as a preliminary indication of the survival of fry released in Skeena River tributaries.

METHODS

Data from three sources was used to estimate the survival rate of marked fry released in the headwaters of the Suskwa and Zymoetz Rivers (Fig. 1).

Marked juvenile recaptures. (1) Release areas were sampled (electrofishing) for marked yearlings and a survival rate was determined. The expected adult returns of these yearlings was then calculated by applying observed freshwater survivals from the Kispiox River (Tredger, 1984) and Salmonid Enhancement Program Biostandards.

Marked adult recaptures at the commercial fishery. (2) Steelhead caught in the commercial fishery at the mouth of the Skeena River (Area 4) were sampled for marked (maxillary clip) adults. The total number of mark returns and survival rate was estimated by applying the run size and harvest estimation procedures described in the Skeena River run reconstruction model (Skeena model on file, B.C. Fish and Wildlife Branch, Smithers).

Marked adult recaptures at their natal stream. (3) Marked (pelvic clip) adults were recovered during broodstock collection in the Suskwa (1984 run) and a mark-recapture population estimate (1985 run). Survival rates from the 1979 fry release were estimated by applying Suskwa run size and harvest rates for each year as described in the Skeena model.

RESULTS AND DISCUSSION

Marked juvenile recapture. Forty-two yearlings were sampled of which 34 were marked. Tredger (1984) estimated the fry to yearling survival of marked fish at 18% (Table 2). An estimated 208 returning adults were expected from the marked yearlings (Appendix 1) for an overall survival of marked fry to adults of 0.4%.

This survival rate must be viewed with some caution because of the numerous variables (ocean survival etc.) that affect the estimates after the yearling stage. Average values were applied, but may vary widely between rivers and years. Although the survival rate to yearling is encouraging, it is entirely possible that adult production is limited by some other factor later in life.

Marked adult recaptures at Area 4. Three marked Zymoetz adults and one marked Suskwa adult were recovered in the commercial fishing sample (Table 3). The estimated survival rate of marked Zymoetz fry was 0.28% and the marked Suskwa fry was 0.16% (Appendix 2).

Once again, these survival rates should be viewed with considerable caution. Obviously, a survival calculated from one or three marks from a sample of 1,666 is statistically invalid. In addition, the maxillary clip proved to be a very poor choice of marks because they are difficult to detect and even when detected it may be unclear whether it is a clip or hooking/net injury. Steelhead with potential maxillary clips were discarded from the sample because they were not healed or did not appear to be a bona fide clip (J.O. Thomas, pers, comm.).

The Skeena model is a large factor in the calculation of survival with this method. Although the model is comprised of the best data available, a question of resolution of data must be considered because estimates are used to calculate more estimates.

Table 1. Skeena steelhead fry stocking summary 1979–87, and expected returns of marked adults.

Brood Year	Facility ¹	Fry Produced (000's)		Mark Type ²	Major Return Years	(Est) Marked Returns Expected	
		Total	Marked			Biostandards	Observed Survivals ³
1979	FVTH	15	15 K	RP	84–86	100	156
1980	Skilokis	11.1	0	---	85–87	66	N/A
1981	FVTH & Fossil	100.5	51.5	LM	86–88	343	144
1982	FVTH	48.3	48.3	RM	87–89	322	75
1983	FVTH	204	0	---	88–90	N/A	N/A
1984	FVTH	112	0	---	89–91	N/A	N/A
1985	FVTH & Toboggan	345.8	345.8	ADCWT	90–92	2305	---
1986	Toboggan	138.9	138.9	ADCWT	91–93	926	---
1987	FVTH & Toboggan	375.8	375.8	ADCWT	92–94	2506	---

¹ FVTH – Fraser Valley Trout Hatchery, Skilokis – gravel incubation box at Skilokis Creek (Suskwa River), Fossil – gravel incubation box at Fossil Creek (Zymoetz River), Toboggan – Toboggan Creek Hatchery at Smithers.

² RP clip - Right pelvic fin clip, RM Clip – Right maxillary clip, LM clip - left maxillary clip, ADCWT - Adipose fin clip with coded wire nose tag implant.

³ Based on marked adult returns from Skeena fry stocking.

Table 2. Estimated survival of marked steelhead fry released in Zymoetz River headwaters in September 1981, and sampled in August, 1982.

No. marked fry released	$\frac{1+ \text{parr sampled}^1}{N}$	marked	Survival to 1+ ²	Est. adult returns ³	Est. fry to adult survival
51,500	42	34	18	208	.004

¹ Stocked portion of Zymoetz River sampled the following year (1982)

² Tredger, C.D. 1984. Zymoetz River Fry Stocking Assessment Reconnaissance Report #0140-6, Fisheries Improvement Unit, Victoria, B.C.

³ Estimated from S.E.P. Biostandard survivals from 1+ to adult.

Table 3. Estimated Survival of marked fry released in Suskwa (1982) and Zymoetz (1981) River headwaters. Marked returning adults were recaptured in the Area 4 commercial fishery, 1987.

Stock	# marked fry released	% of returns expected in 1987 by age group ¹	Estimated # Of steelhead sampled ²	No. marks detected	Est. number marked fish in 1987 run	Est. fry to adult survivals (1987 only)	Est. fry to adult survival (all age grp)
Suskwa River	48,312	40%	31	1	30	0.06%	0.16%
Zymoetz River	51,500	41%	310	3	59	0.11%	0.28%

¹ Expected age groups returning to Suskwa in 1987 (3.2+, 4.1+) = 40% (Appendix 4). Expected age groups returning to Zymoetz in 1987 (3.3+, 4.2+, 5.1+) = 41% (Data on file Fish and Wildlife Branch, Smithers, B.C.).

² From Skeena River run Reconstruction Model, (on file Fish and Wildlife Branch, Smithers, B.C.).

Table 4. Survival of marked fry released in Suskwa River headwaters in 1979. Returning adults were sampled at the Suskwa River in 1984 and 1985.

#of fry released in 1979	Year of adult returns	Returning Age group (% total returns)	# Suskwa adults sampled	# marked adults in sample N	marked adults in total run ¹ %	Est. # of marked adults in total run ¹	Fry to adult survival
15,000	1984	3.2+/4.1+ (40%)	32	3	9.4%	105	.007
	1985	3.3+/4.2+/5.1+ (49%)	109	3	2.8%	32	.002
	Both years Combined	(89%)	141	6	4.3%	137	.01

¹ Total run as calculated in Skeena Steelhead Run Reconstruction Model (on file, Fish and Wildlife Branch, Smithers).

Marked adult recapture in their natal stream. A total of 6 marked adults from the 1979 fry release were recaptured at the Suskwa River; 3 from the 1984 run and 3 from the 1985 run (Table 4). The portion of marked returns expected on each of the 2 years was determined from Suskwa steelhead life history data (Appendix 3) and applied to the escapement of Suskwa steelhead as described in the Skeena model. The estimated fry to adult survival rate was 1.0%.

Of the three methods examined, this appears to be the most realistic because a greater portion of the expected returns were sampled. The Suskwa run is relatively small and was sampled over 2 years.

Fin clips may leave data and sampling somewhat open to criticism. Although each clip was closely scrutinized by Fisheries personnel, it is entirely possible that they were lost in the wild. This seems unlikely however, since all missing fins were the designated right pelvic and none were missing from non-designated fins. Conversely, clip regeneration is possible from poorly clipped fry and may have been extremely difficult to detect in the field. For this reason, survival rates of marked fry are probably conservative.

CONCLUSIONS AND RECOMMENDATIONS

Accurate survival rates of marked fry released in the Suskwa and Zymoetz Rivers were impossible to determine because sample sizes were too small and the resulting estimates were statistically invalid. Nevertheless, the data were the best available and as a preliminary evaluation of the Skeena fry program.

The analysis of data from three sources indicated that the survival rate of marked fry from the Suskwa and Zymoetz Rivers ranged from 0.0016% to 1.04% (Table 5).

More reliable data should be gathered from the larger returns of marked adults in 1990. To obtain the most information from these returns, intensive sampling of the Area 4 commercial catch should be carried out as well as natal stream sampling for returning marked adults, so that results from both sources may be compared. In addition, a well advertised head recovery program in the Skeena sport fishery may assist in the collection of data. Intensive sampling on several fronts will provide improved data on survivals of stocked fry while improving stock specific migration time data.

Table 5. Summary of three sample methods used to estimate survival of marked fry released at Suskwa and Zymoetz Rivers during 1979 - 1982.

River	Marked fry Released		Year	Sample Method	Estimated return of marked adults		Fry to adult Survival (%)	
	Year	Number (000's)			Sample year Only	All years	Sample year Only	All years
Suskwa	1979	15	1984/85	Marked spawners	137	156	9.1	1.04
Suskwa	1982	48.3	1987	Area 4 Catch	30	75	0.06	0.16
Zymoetz	1981	51.5	1987	Area 4 Catch	59	144	0.11	0.28
Zymoetz	1981	51.5	1982	Juvenile Sampling	---	208	---	0.40

REFERENCES

- Tredger, C.D. 1984. Zymoetz River Fry Stocking Assessment.
Reconnaissance Report, Fisheries Improvement Unit, Victoria,
B.C.
- Tredger, C.D. 1985. Kispiox River Steelhead Fry Population Monitoring.
Reconnaissance Report, Fisheries Improvement Unit, Victoria,
B.C.

APPENDIX 1

Calculation of fry to adult survival from juvenile sampling

In 1981, 51,500 marked (maxillary clip) steelhead fry were released into Zymoetz River headwaters. The area was sampled in the following year for the presence of marked 1+ parr. Estimation of the potential adult returns from this fry release was made using the following procedure:

No. of fry released		51,500
Observed survival to 1+	18% ¹	9,376
Estimated survival to 2+	37% ²	3,469
Estimated survival to smolt	50% ³	1,734
Estimated survival to smolt	12% ⁴	208
Fry to adult survival	208/51,500	.040%

¹. Tredger, C.D.M.S. 1984. Zymoetz River Reconnaissance Report.

². Tredger, C.D.M.S. 1983. Kispiox River Reconnaissance Report.

³. Tredger, C.D.1987. Pers. Comm.

⁴. Biostandards.

APPENDIX 2

Calculations of fry to adult survival rates

Marked fry were released in Zymoetz River headwaters in 1981 and Suskwa River headwaters in 1982. The 1987 commercial harvest of Area 4 was sampled for returning marked adults and 4 were found in the sample. The fry to adult survival was determined from the following calculations.

	<u>Suskwa</u>	<u>Zymoetz</u>	<u>Data Source</u>
No. marked fry released	48,312	51,500	Fish & Wildlife
No. marked adults recovered	1	3	Thomas & Assoc.
Proportion of Area 4 catch sampled	0.199	0.199	Thomas & Assoc.
Total Area 4 catch	157	1,556	Skeena model ¹ .
Total run (catch & escapement)	920	6,115	Skeena model
Portion of marked adults expected in sample year	40%	41%	Fish & Wildlife
No. of each stock sampled	$0.199 \times 157 = 31$	$0.199 \times 1556 =$	
	310		
% of each stock	$1/31 = 3.23\%$	$3/310 = 0.97\%$	
Est. return of marked adults	$3.23 \times 920 = 30$	$0.97 \times 6115 = 59$	
Fry to adult survival	$30/48,312 = 0.06\%$	$59/51,500 = 0.11\%$	
Total return of marked adults all years	$(30 \times 100/40 = 75$	$(59 \times 100/41 =$	
	144		
Overall fry to adult survival	<u>$75/48,312 = 0.16\%$</u>	<u>$144/51,500 =$</u>	
	<u>0.28%</u>		

¹ Skeena steelhead Run Reconstruction Model (on file B.C. Fish and Wildlife Branch, Smithers).

APPENDIX 3

Appendix 3 - Steelhead trout age groups from Zymoetz River 1978 (n = 116) and 1979 (n = 68).

Age Group	Number Steelhead			Number Male		Number Female		Percent of Total		
	1978	1979	Total	1978	1979	1978	1979	1978	1979	Total
3.1+	5	6	11	4	3	1	3	4.3	8.8	6.0
3.2+	15	12	27	5	2	10	10	12.9	17.6	14.7
3.3+	1	1	2	1	1	0	0	0.9	1.5	1.1
3.2S1+	5	2	7	1	1	4	1	4.3	2.9	3.8
4.1+	9	14	23	7	11	2	3	7.8	20.6	12.5
4.2+	50	24	74	17	10	33	14	43.1	35.3	40.2
4.3+	2	1	3	2	0	0	1	1.7	1.5	1.6
4.1S1+	3	1	4	3	1	0	0	2.6	1.5	2.2
4.1S1S1+	1	0	1	1	0	0	0	0.9	0.0	0.5
4.1S2+	1	0	1	1	0	0	0	0.9	0.0	0.5
4.2S1+	23	6	29	4	1	19	5	19.8	8.8	15.8
4.2S1S1+	1	1	2	0	0	1	1	0.8	1.5	1.1
12	16	68	184	46	30	70	38			

Numbers of male and female steelhead of different fresh water ages.
Zymoetz River 1978 (n = 116) and 1979 (n = 68).

Freshwater Age	Male	1978			1979				Grand Total	Grand Total (%)
		Female	Total	(%)	Male	Female	Total	(%)		
3.	11	15	26	22.4	7	14	21	30.9	47	25.5
4.	<u>34</u>	<u>56</u>	<u>90</u>	<u>77.6</u>	<u>23</u>	<u>24</u>	<u>47</u>	<u>69.1</u>	<u>137</u>	<u>74.5</u>
Total:	45	71	116	100	30	38	68	100	184	100

APPENDIX 4

Estimated Time Spent on the Skeena Fry Program

	Estimated Hours
Brood Stock Collection	400
Facility Monitoring	80
Egg Takes	300
Fry Releases	96
Loading and Unloading Tanks	20
Facility Start-up	10
Facility Shutdown and Disinfecting	28
Fish Culture Activities and Kispiox and Deep Creek	
	<hr/>
	997 Man Hours

3 FTE in Skeena (8/12 yr.) = 2 FTE x 1827 = 3,694 man hours

$$\frac{997}{3,694} = 0.27$$

Approximately 27% of regional technical FTE effort goes toward Skeena fry stocking

Benefit/Cost

Skeena fry stocking budget:

<u>Task</u>	<u>Source</u>	<u>Cost</u>
Toboggan Facility	SEP	\$69,000
CWT Marking	SEP	14,000
Wages	Region	15,120
Travel, etc.	Region	10,000
Total Cost		\$108,120

Adults produced from fry stocking:

- i) Low estimate 560 steelhead
- ii) High estimate 3640 steelhead

Adults available to angler after commercial and native harvests.

- i) Bulkley/Morice expl. rates (47%) 408 steelhead (high estimate)
263 steelhead (low estimate)
- ii) Suskwa expl. rates (73%) 2657 steelhead (high estimate)
1710 steelhead (low estimate)

Cost of steelhead to the sport fishery

- i) $\$108,120 \div 408 = \265 (high estimate)
 $\$108,120 \div 263 = \411 (high estimate)
- ii) $\$108,120 \div 2657 = \40.69 (high estimate)
 $\$108,120 \div 1710 = \63.23 (low estimate)

APPENDIX 5

Appendix 5 -Estimated cost of steelhead adults produced from fry stocking in the Skeena drainage. Calculations assume a fry release of 350,000 and a Regional steelhead budget of \$113,000.

Fry to Adult Survival	Estimated Adult Returns to Skeena	Cost per Adult	Estimated Adult Returns to Sportfishery ¹	Cost per Adult Available to Sportfishery
.0016 ²	560	193	296	365
.0104 ³	3640	29	1929	56 (\$40 if Suskwa exploit rates)

¹ Combined exploitation rate of commercial and native fisheries estimated at 47% for Bulkley/Morice (Suskwa is only 27% but used the worst case values).

² Lowest survival rate (calculated from marked adult recaptures in commercial fishery).

³ Highest survival rates (calculated from marked adult recaptures at their natal stream).

Estimated manpower requirements during Skeena Fry Program

	Sept.	Oct.	Nov. - Mar.	Apr.	May	Jun. - Aug.	Total
Activity	fry releases early broodstock	broodstock	facility maintenance	broodstock	egg-takes	shutdown cleaning	
Hours	280	70	50	375	420	30	1225
F.T.E.	0.91	0.23	0.16	1.22	1.36	.10	0.33

Therefore: Approximately 30% of the regional technical FTE allocation (33% technicians time) is spent on the fry program.