

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

by

C.G. Schultze and M.J. Lough

British Columbia Ministry of Environment and Parks
Fisheries Branch
Smithers, B.C.
Skeena Fisheries Report #63
1987

TABLE OF CONTENTS

| | |
|--------------------------------------|---|
| Introduction..... | 1 |
| Results and Discussion.... | 3 |
| Conclusions and Recommendations..... | 7 |
| References..... | 9 |

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 | % | 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 | 0.199x157 = 31 | | 0.199x1556 = |
| | 310 | | |
| % of each stock | 1/31 = 3.23% | | 3/310 = 0.97% |
| Est. return of marked adults | 3.23x920 = 30 | | 0.97x6115 = 59 |
| Fry to adult survival | 30/48,312=0.06% | | |
| | 59/51,500=0.11% | | |
| Total return of marked adults all years | (30x100/40 = 75 | | (59x100/41 = |
| | 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 | 7 | 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 | | | Male | 1979 | | | Grand Total | (%) |
|----------------|-----------|-----------|-----------|-------------|-----------|-----------|-----------|-------------|-------------|-------------|
| | | Female | Total | (%) | | 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:

| Task | Source | Cost |
|-------------------|--------|-----------|
| 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.