

**Steelhead Living Gene Bank – Quinsam and Puntledge
Steelhead Stock Rebuilding Project (01.V1.6)
B.C. Hydro Bridge Coastal Fish and Wildlife Restoration
Program
Final Report
May 2001 to March 31, 2005**



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Introduction

1.0 Background

Steelhead stocks along the East Coast of Vancouver Island have been in serious decline throughout much of the 1990's. Freshwater habitat loss, changed ocean conditions and fisheries impacts have all played a part in this decline. A new technique that has been tested by BC Fisheries (Ministry of Water, Land and Air Protection) is the use of Living Gene Banks (LGB) to produce steelhead progeny from wild stocks and re-introduce these fish back to their native streams for stock rebuilding.

The East Coast Vancouver Island steelhead LGB program involved capturing wild steelhead smolts (juveniles) as they migrate from freshwater to the ocean and then culturing these fish until they reach maturity and are spawned. The eggs and resulting fish can then be reared to a desired life stage and released back to their native habitats. This program is considered experimental as it has never before been tested on wild steelhead populations. The LGB wild smolt capture program continued for one steelhead generation or about 5 years.

Benefits of this kind of steelhead supplementation program include the use of a larger number of genetically diverse juvenile fish for future broodstock than regular hatchery enhancement programs which rely on fewer wild adults as brood fish. This program will quickly produce significant numbers of juveniles for release and therefore minimize the risk of domestication and genetic drift that can occur with longer term captive breeding programs.

The objective of the LGB is to help rebuild 3 wild steelhead populations (Little Qualicum River, Quinsam River and Keogh River) to self-sustainable levels while maintaining the genetic diversity found within these stocks. A similar captive breeding program is also in place for both Puntledge River summer-run and winter-run steelhead stocks. The primary purpose of this Puntledge River program is to also rebuild these two steelhead populations to self-sustainable levels. However, maintaining genetic diversity is not a main priority of this program as both Puntledge summer-run and winter-run stocks have suffered irreplaceable loss of genetic diversity due to many years of very low steelhead returns.

BC Hydro Bridge Coastal Fish and Wildlife Restoration Program has been a funding partner in this steelhead rebuilding project since March 2000. In May 2001, the Bridge Coastal Restoration Program (BCRP) agreed to co-fund this five year project. The

following is the final report that summarizes all 5 years of production at the hatchery for the project.

2.0 Deliverables Completed

2.1. Juvenile Steelhead Collections

The collection of wild steelhead smolts began in the spring of 1998 and lasted for the 5 year period. In the case of the Puntledge River because of low or non existant wild smolts in most years, we put in place a captive breeding program that was derived from wild, hatchery and reconditioned adults. Spring of 2002 was the last year of juvenile steelhead collections to be completed for both Quinsam and Puntledge River steelhead stocks. These juveniles (eggs and smolts) were reared to maturity at the Vancouver Island Trout Hatchery (VITH) in Duncan and later spawned. For Quinsam wild smolts an extensive fish culture feeding strategy was incorporated to adapt the wild smolts to artificial feed. This included feeding a mixture of krill, shrimp and semi-moist Bio-Organ commercial feed in ice cubes so that the food delivery was slow and available to the fish for a longer period.

From a hatchery perspective it has been a very successful program to be able to take wild steelhead smolts from the river and convert them to artificial feed and rear them to maturity over a two to three year period. All smolt collection goals were met for each of these systems except for the Puntledge summer run in 1999 and 2000 where hatchery adults and reconditioned captive adults were used to achieve production targets. A summary of the 5 years of juvenile steelhead collections is found in Table 1.

Table 1. Summary of Juvenile Steelhead Collected Since 1998

| Stock | Smolt Collection Goal | 1998 | 1999 | 2000 | 2001 | 2002 | Origin of Juveniles |
|----------------------|-----------------------|------|------|------|------|------|----------------------------------|
| Quinsam Winter-run | 130 | 200 | 101 | 130 | 130 | 132 | Wild smolts |
| Puntledge Winter-run | 130 | 125 | 122 | 145 | 161 | 147 | Hatchery smolts or eggs |
| Puntledge Summer-run | 130 | 192 | 43 | 31 | 147 | 181 | Hatchery and wild smolts or eggs |

2.2 Egg Collections from LGB Broodstock

All eggs were collected at the Vancouver Island Trout Hatchery and then either reared for transfer in the fall or shipped as eyed eggs. In the case of Puntledge Summer Run and Winter Run Steelhead progeny, they were reared at the Vancouver Island Trout Hatchery until November and then transferred to the Federal Government's Puntledge

River Hatchery to be reared through the winter and then volitionally released in the spring of the following year as a smolts to the Puntledge River. With Quinsam Steelhead the eggs were collected and incubated to the eyed stage before they were inventoried and shipped to the Federal Government's Quinsam River hatchery. In some cases when the individual females had a large egg lot the eggs would be "equalized". "Equalization" means eggs above a pre-determined median eyed egg number are removed from the smolt production group to avoid genetically over contributing eggs from any one female. Along with this technique and with having the spawning fish originate from the wild the resulting progeny represent a varied cross section of the wild population. To actually have these fish produce a viable egg and then progeny to stock back into their parent stream shows that the program to date has been a success.

Table 2. Egg Incubation Summary - Summarizes the number of eggs collected from each steelhead stock and their respective egg survivals.

| Stock | # Females Spawned | Total Green Eggs | Total Eyed Eggs | % Survival To Eye | Fecundity | Total Ponded | % Survival To Pond |
|------------------------|-------------------------|------------------------|-----------------------|-------------------------|--------------|------------------|--------------------------|
| Quinsam '98 | 18 | 26,671 | 17,552 | 66% | 1,482 | 16,146 | 61% |
| Quinsam '98/99 | 28 | 50,879 | 26,230 | 52% | 1,882 | 22,161 | 44% |
| Quinsam '98/99/00 | 36 | 60,098 | 33,955 | 56% | 1,669 | 29,680 | 49% |
| Quinsam '00/01 | 49 | 101,956 | 70,046 | 69% | 2,081 | 65,106 | 64% |
| Quinsam '00/01/02 | 43 | 96,970 | 66,799 | 69% | 2,255 | 59,879 | 62% |
| Puntledge-SR/WR '98 | 2 | 4,005 | 3,726 | 93% | 2,003 | 3,656 | 91% |
| Puntledge-WR '98 | 44 | 110,480 | 72,654 | 66% | 2,511 | 57,615 | 52% |
| Puntledge-WR '98/99 | 49 | 117,162 | 84,938 | 72% | 2,391 | 73,862 | 63% |
| Puntledge-WR '99/00 | 61 | 77,895 | 59,991 | 77% | 1,277 | 56,291 | 72% |
| Puntledge-WR '00/01 | 71 | 150,764 | 124,263 | 82% | 2,123 | 120,342 | 80% |
| Puntledge-WR '02 | 46 | 92,539 | 58,608 | 63% | 2,012 | 54,431 | 59% |
| Puntledge-SR '98 | 54 | 126,783 | 100,224 | 79% | 2,348 | 65,259 | 51% |
| Puntledge-SR '98/99 | 60 | 198,907 | 139,693 | 70% | 3,978 | 125,739 | 63% |
| Puntledge-SR '98/99/00 | 53 | 187,216 | 128,769 | 69% | 3,532 | 107,583 | 57% |
| Puntledge-SR '00/01 | 83 | 260,822 | 160,844 | 62% | 3,142 | 137,627 | 53% |
| Puntledge-SR '02 | 65 | 117,550 | 82,316 | 70% | 1,808 | 77,256 | 66% |
| TOTAL | 762 | 1,780,697 | 1,230,608 | 69% | 2,337 | 1,072,633 | 60% |

2.3 – Steelhead Parr and Smolt Production

The survival and the growth of the offspring indicate that an LGB program is an effective way to eliminate much of the mortality that can occur from egg to smolt stage in the wild. This may be effective in the conservation of steelhead stocks if it helps in rebuilding the wild population.

Fish surplus to the smolt production goals were used for fry stocking into both the Campbell/Quinsam and Puntledge River systems. In addition to this, any large egg lots coming from individual Quinsam River female steelhead broodstock were “equalized” and the remaining eggs also used for fry stocking. These eggs were incubated separately, resulting fry marked with a fin clip to differentiate from other year classes and later released into the Campbell/Quinsam system. The eggs destined for smolt were transferred to the Quinsam Hatchery at the eyed stage and then reared to smolt. The smolts were all clipped with an adipose clip at the Quinsam Hatchery to distinguish them from wild fish returning to the river but were also tagged in alternating years with a coded wire tag to distinguish between year classes.

All steelhead fry and smolts reared at Vancouver Island Trout Hatchery to be finclipped were completed in June and July before they were either transferred or released. In the case of the Puntledge Summer and Winter Run captive program, all smolts were adipose clipped to distinguish them from wild fish returning to the river. The Puntledge winter run fry were alternately clipped with a left maxillary clip one year and then a right maxillary clip the following year to not only distinguish different year classes but also to distinguish them from the non clipped summer run fry released in the upper Puntledge watershed .

Table 3,4,5 & 6 summarize the production and survival of the Puntledge Stocks.

Puntledge River Steelhead Production

Table 3. Puntledge SR/WR (Captive & Wild) released as fry because of winter and summer cross.

| Brood Year | Females Spawmed | Green Eggs | Eyed Eggs | Avg Fecundity | Equalization Number | % GE to EE Survival | % Survival GE to VITH Transfer | Fry Released | Transferred from VITH | Smolts released | Smolt Goal |
|--------------|-----------------|--------------|--------------|---------------|---------------------|---------------------|--------------------------------|--------------|-----------------------|-----------------|------------|
| 2000 | 2 | 4,005 | 3,726 | 2,003 | - | 93.0% | 86.0% | 3,443 | - | - | - |
| TOTAL | 2 | 4,005 | 3,726 | 2,003 | - | 93.0% | 86.0% | 3,443 | - | - | - |

Table 4. Puntledge WR (Captive & Wild)

| Brood Year | Females Spawned | Green Eggs | Eyed Eggs | Avg Fecundity | Equalization Number | % GE to EE Survival | % Survival GE to VITH Transfer | Fry Released | Transferred from VITH | Smolts released | Smolt Goal |
|--------------|-----------------|----------------|----------------|---------------|---------------------|---------------------|--------------------------------|---------------|-----------------------|-----------------|------------|
| 2000 | 44 | 110,480 | 72,654 | 2,458 | - | 65.8% | 48.8% | - | 53,902 | 51,316 | 50,000 |
| 2001 | 49 | 117,162 | 84,938 | 2,391 | - | 72.5% | 57.1% | 14,796 | 52,120 | 35,000 | 50,000 |
| 2002 | 61 | 77,895 | 59,991 | 1,277 | - | 77.0% | 56.0% | - | 43,643 | 43,363 | 50,000 |
| 2003 | 71 | 150,764 | 124,263 | 2,123 | - | 82.4% | 79.5% | 67,479 | 52,396 | 52,545 | 50,000 |
| 2004 | 46 | 92,539 | 58,608 | 2,012 | - | 63.3% | 56.4% | - | 52,176 | 51,753 | 50,000 |
| TOTAL | 271 | 548,840 | 400,454 | 2,052 | - | 73.0% | 61.3% | 82,275 | 254,237 | 233,977 | - |

Table 5. Puntledge SR (Captive & Wild)

| Brood Year | Females Spawned | Green Eggs | Eyed Eggs | Avg Fecundity | Equalization Number | % GE to EE Survival | % Survival GE to VITH Transfer | Fry Released | Transferred from VITH | Smolts released | Smolt Goal |
|--------------|-----------------|----------------|----------------|---------------|---------------------|---------------------|--------------------------------|----------------|-----------------------|-----------------|------------|
| 2000 | 54 | 126,783 | 100,224 | 2,262 | - | 79.1% | 50.5% | 18,676 | 45,376 | 44,899 | 40,000 |
| 2001 | 60 | 198,907 | 139,693 | 2,996 | - | 70.2% | 57.7% | 73,116 | 41,577 | 41,497 | 40,000 |
| 2002 | 53 | 187,216 | 128,769 | 3,532 | - | 68.8% | 56.1% | 60,005 | 45,084 | 45,010 | 40,000 |
| 2003 | 83 | 260,822 | 160,844 | 3,142 | - | 61.7% | 49.1% | 76,206 | 51,974 | 49,963 | 50,000 |
| 2004 | 65 | 117,550 | 82,316 | 1,808 | - | 70.0% | 63.0% | 22,900 | 51,160 | 50,340 | 50,000 |
| TOTAL | 315 | 891,278 | 611,846 | 2,748 | - | 68.6% | 54.5% | 250,903 | 235,171 | 231,709 | - |

Table 6. Puntledge Stocks Combined (Summer-run and Winter-run)

| Brood Year | Females Spawned | Green Eggs | Eyed Eggs | Avg Fecundity | Equalization Number | % GE to EE Survival | % Survival GE to VITH Transfer | Fry Released | Transferred from VITH | Smolts released | Smolt Goal |
|--------------|-----------------|------------------|------------------|---------------|---------------------|---------------------|--------------------------------|----------------|-----------------------|-----------------|------------|
| TOTAL | 588 | 1,444,123 | 1,016,026 | 2,456 | - | 70.4% | 57.2% | 336,621 | 489,408 | 465,686 | - |

Quinsam River Steelhead Production

Table 7 summarizes the production and survival of the Quinsam Stock

Table 7. Quinsam

| | Females Spawned | Green Eyes | Eyed Eggs | Avg Fecundity | Equalization Number | % GE to EE Survival | % Survival GE to VITH Transfer | Fry released | EE transferred from VITH | Smolts Released | Smolt Goal |
|--------------|-----------------|----------------|----------------|---------------|---------------------|---------------------|--------------------------------|---------------|--------------------------|-----------------|------------|
| 2000 | 18 | 26,671 | 17,552 | 1,482 | 1,400 | 65.8% | 64.5% | 725 | 16,478 | 12,188 | 25,000 |
| 2001 | 28 | 50,879 | 26,230 | 1,817 | 1,050 | 51.6% | 51.8% | 5,406 | 20,933 | 14,557 | 25,000 |
| 2002 | 36 | 60,098 | 33,955 | 1,669 | 1,000 | 56.5% | 50.4% | 6,180 | 24,132 | 18,379 | 25,000 |
| 2003 | 49 | 101,956 | 70,046 | 2,081 | 600 | 68.7% | 66.1% | 39,142 | 28,275 | 22,335 | 25,000 |
| 2004 | 43 | 96,970 | 66,799 | 2,255 | 1,050 | 68.9% | 64.6% | 31,971 | 30,677 | 24,500 | 25,000 |
| TOTAL | 174 | 336,574 | 214,582 | 1,934 | - | 63.8% | 60.6% | 83,427 | 120,495 | 91,959 | - |

Combined 5-Year Totals for Quinsam, Puntledge-SR, and Puntledge-WR Steelhead for the five year Project.

| Brood Year | Females Spawned | Green Eggs | Eyed Eggs | Avg Fecundity | Equalization Number | % GE to EE Survival | % Survival GE to VITH Transfer | Fry Released | Transferred from VITH | Smolts released | Smolt Goal |
|--------------|-----------------|------------------|------------------|---------------|---------------------|---------------------|--------------------------------|----------------|-----------------------|-----------------|------------|
| TOTAL | 762 | 1,780,697 | 1,230,608 | 2,337 | - | 69.1% | 57.8% | 420,048 | 609,903 | 557,645 | - |

2.4 Steelhead Fry and Smolt Releases

Most Quinsam LGB steelhead fry were scatter planted by hand to the Campbell River side channels except for the 2003 fry releases (39,142) that were air lifted by helicopter to the Quinsam River and distributed from Middle Quinsam Lake to the Quinsam Hatchery in the last week of June. All Quinsam LGB smolts were volitionally released from the Quinsam Hatchery over the five year period in the first week of May.

Puntledge winter run steelhead fry were released by hand in 2001 and then by helicopter in 2003 to the Puntledge River and tributary streams in late June and early July. The Puntledge WR smolts were all volitionally released from the lower Puntledge Hatchery in late April.

Puntledge summer run steelhead fry were all released by helicopter to the Cruickshank River and tributary streams in late June. The Puntledge SR smolts were all volitionally released from the upper Puntledge Hatchery in mid April. All smolt releases were volitionally released so release numbers are estimates from the federal facilities.

Table 8. Steelhead Fry and Smolt Releases to the Puntledge and Campbell/Quinsam Rivers over the five year project.

| Stock | Life Stage | 2000 | 2001 | 2002 | 2003 | 2004 | Release size ranges (g) | Fry Release Totals | Smolt Release Totals |
|-----------------|------------|--------|--------|--------|--------|--------|--------------------------------|--------------------|----------------------|
| Quinsam | Fry | 725 | 5,406 | 6,180 | 39,142 | 31,971 | 2 – 4 | 83,427 | 91,959 |
| | Smolt | 12,188 | 14,557 | 18,379 | 22,335 | 24,500 | 60 – 80 | | |
| | | | | | | | Quinsam Totals | 83,427 | 91,959 |
| Puntledge-SR/WR | Fry | 3,443 | | | | | 3.2 | 3,443 | |
| Puntledge-WR | Fry | | 14,796 | | 67,479 | | 2 – 4 | 82,275 | 233,977 |
| | Smolt | 51,316 | 35,000 | 43,363 | 52,545 | 51,753 | 60 - 75 | | |
| Puntledge-SR | Fry | 18,676 | 73,116 | 60,005 | 76,206 | 22,900 | 2 - 4 | 250,903 | 231,709 |
| | Smolt | 44,899 | 41,497 | 45,010 | 49,963 | 50,340 | 60 - 80 | | |
| | | | | | | | Puntledge Totals | 336,621 | 465,686 |
| | | | | | | | Totals for all 3 Stocks | 420,048 | 557,645 |

3.0 Conclusions

The Living Gene Bank project for Quinsam River and the Captive Brood Program for Puntledge River indicated that we were able to hold viable genetic material at the hatchery of endangered populations and produce large numbers of fish to be released back to their parent streams. The intent was to increase the likelihood of these populations surviving through a period of possible extinction due to poor marine survivorship. We have released all five year classes to these systems as fry and smolts and now are monitoring adult returns to the two systems. Adult LGB steelhead have returned although early indications in 2004 and 2005 tend to indicate the numbers are still extremely low. Stock assessment will continue through fence returns by the federal facilities and angling and snorkel surveys by the Provincial Government.

4.0 Media

Local Campbell River and Courtenay news papers did news articles on the fry stocking and the LGB smolt program through out the 5 year project. Regional Biologists at numerous public meetings up and down Vancouver Island have given recognition to the Bridge Coastal Restoration Program and BC Hydro in general for supporting two of the four steelhead recovery brood programs. The Bridge Coastal restoration Program is also listed and recognized on the Greater Georgia Basin Steelhead Recovery web site and the Government's BC Fisheries web site below for their contribution to the program.

HYPERLINK "http://www.bcfisheries.gov.bc.ca/rec/hatch-stock/new/steelhd.html" <http://www.bcfisheries.gov.bc.ca/rec/hatch-stock/new/steelhd.html>

HYPERLINK "http://www.bccf.com/steelhead/living-gene-bank.htm" <http://www.bccf.com/steelhead/living-gene-bank.htm>

5.0 Funding Administration

The funding for the Quinsam LGB project and the Puntledge Captive Brood Project was supplied by a combination of organizations and they are the Provincial Ministry of Water, Lands and Air Protection (Vancouver Island Trout Hatchery), the Federal Facilities (Quinsam Hatchery and Puntledge Hatchery) and the Bridge Coastal Fish and Wildlife Restoration Program. There has been quarterly reports completed throughout the five years along with invoices and statements of expenditures detailing the money spent from B.C.Hydro. The total expenses that have been funded through the Bridge Coastal Fish and Wildlife Restoration Program are summerised in table 9.

Table 9. Summary of expenditures for 2001/2002 to 2004/2005

| Budget Year | First Quarter | Second Quarter | Third Quarter | Forth Quarter | Total Spent | BCFWRP Funding |
|--------------------|----------------------|-----------------------|----------------------|----------------------|--------------------|-----------------------|
| 2001/2002 | | 18,652 | 25,410 | 38,280 | 82,342 | 82,342 |
| 2002/2003 | 14,443.83 | 25,371.62 | 19,126.70 | 23,156.83 | 82,098.98 | 82,342 |
| 2003/2004 | 18,828.64 | 20,959.63 | 13,004.03 | 15,589.63 | 68,381.93 | 70,000 |
| 2004/2005 | 18,938.21 | 23,062.66 | 9,232.85 | 4,342.81 | 55,576.53 | 66,000 |
| 2005/2006 | Program ended | 0 | 0 | 0 | 0 | 28,000 |

6.0 References

None

7.0 Appendix 1 ----- Photographs



**Figure 1 – Puntledge SR Steelhead
air spawning**



**Figure 2 – Puntledge SR Steelhead
milt fertilization**



Figure 3 – VITH egg incubation



**Figure 4 – Incubating LGB
Quinsam eyed eggs**



Figure 5 – VITH LGB adult holding & Spawning



Figure 6 – VITH adult holding



Figure 7 – Jack Creek Rearing Channel at Puntledge Hatchery



Figure 8 – Quinsam Rearing Channel at Puntledge Hatchery



Figure 9 – Puntledge SR Fry helicopter releases



Figure 10 – Puntledge WR smolt volitional release



Figure 11 – Quinsam LGB Smolt



**Figure 12 – Quinsam LGB ST returning
adult 2005**