Slocan River Rainbow Trout Capture and Telemetry Implant Project: 1997

1.0 Introduction

The intent of this project was to capture 30 rainbow trout *Oncorhynchus mykiss* suitable for implanting with a Lotex Engineering MCFT - 3 BM coded radio transmitter. The study area was considered that portion of the Slocan River from Lemon Creek down to the confluence with the Kootenay River. Rainbows found immediately downstream from Slocan Lake to Lemon Creek were considered unacceptable for the purposes of this project as it was felt that they may be lake residents which drop down into the river during the summer/fall months.

The capture and implanting of individuals will then be followed up with telemetry monitoring to determine fish locations throughout the winter season and into the spawning period in early summer. It is hoped that information gathered from this project will assist managers in developing strategies to improve the indigenous stocks.

2.0 Methods

Angling was employed to capture fish, commencing in mid August and finished by late September. Fly fishing with dry flies tied on barbless hooks was favoured in hopes of reducing the potential for hooking mortality. Fish capture was intended to be evenly distributed throughout the study with a target of 10 fish in each of the three designated reaches. Reach designations were; the lower reach from the Kootenay River up to Slocan Park, the mid reach from Slocan Park to the Winlaw Bridge, and the upper reach from the Winlaw Bridge to Lemon Creek.

The original intent was to capture fish and on the same day, after allowing sufficient time for the fish to recover from capture, surgically implant the transmitter. Due to what appeared to be insufficient oxygen levels in the water, the fish could not recover quick enough from capture, necessitating the need to have fish hold over night inside in-stream sleeves. This would effectively reduce their oxygen demand by allowing a flushing of lactic acid from the muscles as well as reduce their metabolic needs by allowing full digestion of their stomache contents. This was then followed by surgery the next day. A detailed description of the surgery can be found in the Appendices along with a video tape fully documenting the procedure. Photos 1 through 12 in the Appendices show various aspects of the surgery.

Most often the river was floated in boats to cover sufficient habitat to optimize fish capture. The surgeon could successfully operate on 3 to 4 fish per day, which became our target for capture. Floating was supplemented by bank angling when targets were not met or time did not allow for a full day on the river.

For each fish captured scale samples for aging as well as fin clipping for genetic analysis were collected. In addition the following data was recorded;

- capture location,
- date,
- genetic sample number,
- sex,
- maturity,
- length (cm),
- weight (grams),
- radio tag number,
- radio tag frequency,
- spaghetti tag number,
- scale sample number, and
- additional comments.

From this data fish capture location maps were created using TRIM based 1:20,000 maps (see appendix 3). Each location was identified by the fish's spaghetti tag number. The scale samples were analyzed to determine fish age and was added to the spread sheet with fish capture data. A fork length/frequency histogram was also constructed from the above data and is presented in the results section.

3.0 Results

All thirty fish were captured; however, the lower reaches of the river were in poor angling condition for most of the season due to a slide depositing material into the Little Slocan River which subsequently flowed into the study area. In total 7 fish were captured in the lower reach, 11 in the mid section and 12 in the upper reach. The distribution of capture likely reflects fish density by reach. The upper section of the river was by far the most productive and held what was considered to be the best habitat, consisting of numerous log jams and deep pools. Habitat complexity decreased down stream with slower water found below Perry's Bridge, lacking in deep pools and large organic debris (LOD). Stream velocity increases below Winlaw in the mid and lower reaches with less LOD holding in the faster water. The lower reaches do provide some very deep bedrock pools which held good fish as did many of the long runs and riffles but the good habitat was not found in the frequency as was found in the upper reaches. Water volume also increases as the river moves down stream, changing the character of the river and making dry fly tactics less effective, especially this year with predominantly high water conditions experienced throughout the season.

It was determined that a candidate fish was an individual which weighed at a minimum approximately 540 grams and measured 35 cm, with the intent that the transmitter did not

exceed approximately 1% of the fishes weight. Larger fish were preferred over the minimum size class. Table 1 shows all of the fish captured for the project (the complete data base can be found in Appendix 4 along with an electric copy on disc). All fish meeting the minimum size requirements were held in sleeves allowing the surgeon to chose the best candidates for implanting the following day, releasing those felt in poor condition or marginal in size. Having more than one fish at a given location was always desirable, reducing set up time of the operating equipment per fish, increasing the likelihood of implanting more than 3 fish in a day. It was determined that holding more than one fish per sleeve was unacceptable, especially a male and female. The resulting aggression between the individuals often left one or both fish in very poor shape, loosing an opportunity to implant these fish.

Table 1. Slocan River Rainbow Trout Radio Telemetry Project Fish Collection Data.

	Date	Sex	Maturity	Length cm	Weight gms	Spaghetti Tag #	Age	Comments
km 20.0	Aug. 27/97	male	maturing	42.5	952.6	C000228	3+	
km 19.0	Aug. 28/97	female ?	maturing	36.5	567.0	C000229	3+	(1st fish left overnight for surgery)
km 29.1	Aug. 29/97	female ?	maturing	38.0	544.0	C000230	2+	km 29.1
km 30.2	Aug. 30/97	female ?	maturing	36.0	544.0	C000231	3+	14.5 degrees C. 0930
km 19.0	Aug. 30/97	male ?	maturing	36.5	544.0	C000232	3+	15.5 degrees C. 1045
km 23.1	Sept. 2/97	male	kelt 97?	35.5	544.0	C000233	3+	19.0 degrees C. 1200
km 22.2	Sept. 2/97	female	kelt 97?	42.5	816.5	C000234	4+	dark/thin fish
km 43.9	Sept. 3/97	male ?	maturing	35.0	544.0	C000235	3+	16.5 degrees C. 1340
km 41.0 (approx.)	Sept. 3/97	female	maturing	37.0	589.7	C000236	3+	16.5 degrees C. 1500
km 41.0 (approx.)	Sept. 4/97	female	kelt?	39.5	725.8	C000237	3+	15.5 degrees C. 1130
km 40.1 (approx)	Sept. 4/97	female	maturing	37.5	635.0	C000238	2+	
km 22.0	Sept. 5/97	female	maturing	40.5	793.8	C000239	3+	
km 18.6	Sept. 6/97	male ?	maturing	35.5	544.0	C000240	3+	(held 2 nights - lightning storm)
km 41.0	Sept. 8/97	female	Kelt 97?	40.5	680.4	C000241	3+	15.5 degrees C. 1045
km 40.2	Sept. 8/97	male	kelt 97?	38.5	635.0	C000242	2+	S/C up river fr. farmers field
km 39 (approx.)	Sept. 8/97	female	Kelt 97?	43.0	816.5	C000243	3+	
km 13.8	Sept. 10/97	female	maturing	38.5	589.7	C000244	2+	
km 11.0	Sept. 10/97	male	maturing	36.0	567.0	C000245	3+	
km 9.1	Sept. 10/97	female	maturing	41.5	816.5	C000246	4+	farmfield
km 8.5	Sept. 10/97	male	maturing	36.5	589.7	C000247	2+	
km 0.5	Sept. 10/97	female	maturing	36.5	544.3	C000248	3+	
km 0.5	Sept. 11/97	female ?	maturing	36.5	544.3	C000249	3+	
km 1.1	Sept. 11/97	male	maturing	37.0	589.7	C000250	4+	
km 41.0 (approx.)	Sept. 13/97	female	maturing	44.5	816.5	C000201	4+	
km 40.5 (approx)	Sept. 13/97	male	maturing	37.5	589.7	C000202	3+	
km 30.2	Sept. 16/97	female	maturing	38.0	589.7	C000203	4+	
km 37.9	Sept. 24/97	female	maturing	47.5	1043.3	C000204	4+	
km 20.5	Sept. 26/97	male	maturing	34.5	499.0	C000205	3+	
km 42.5	Sept. 26/97	female	maturing	38.5	680.4	C000206	4+	
km 42.5	Sept. 26/98	female	maturing	41.0	635.0	C000207	4+	

The scale analysis results have been included into the above table for completeness. The scales have been archived for future reference and can be found in the appendices. The majority of fish were in the 3+ age class (n=17) and were considered maturing. It is likely that most of these fish will spawn in the 1998 season. The fork length/frequency for all fish captured is presented in Figure 1.

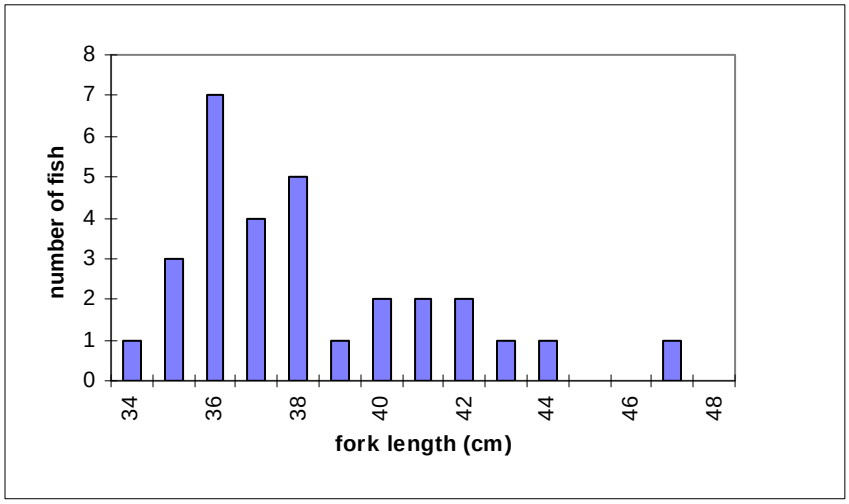

Figure 1. Fork length Frequency for Captured Rainbow Trout. The Slocan River telemetry project, 1997.

The mean length of captured fish by age class is as follows; 2+ = 37.8 cm $\pm$ 0.7 (n=5), 3+ = 37.6 cm $\pm$ 1.3 (n=17), and 4+ = 41.3 $\pm$ 2.4 (n=8). When the fork length/frequency is summarized by age class (Fig. 2) the variation in length is evident.

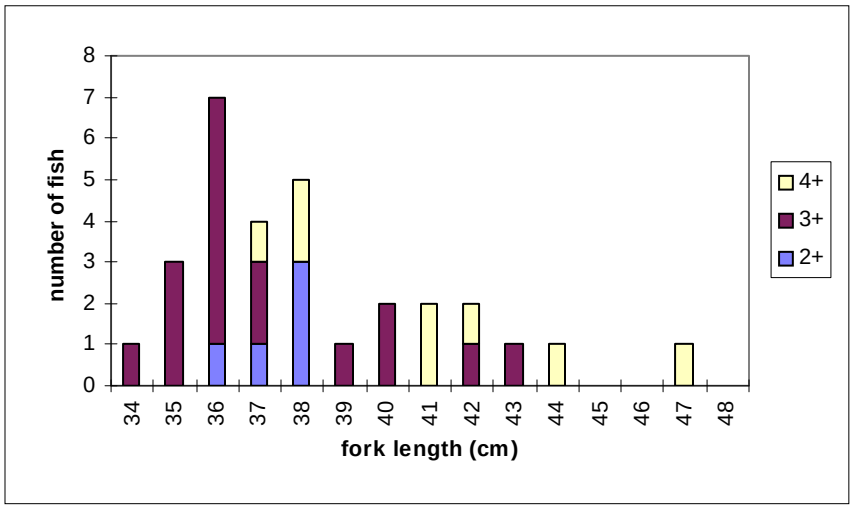

Figure 2. Fork Length Frequency for Captured Rainbow Trout by Age Class. The Slocan River telemetry project, 1997.

Although no accurate records were kept, the number of fish which did not meet the requirements for implanting far exceeded the number of fish captured for the purposes of this project. An empirical estimate would be a 3:1 ratio of undersized versus acceptable fish. This would be a conservative estimate, especially when taking into account that the water we angled would rarely have been considered optimum rearing habitat and that many of the fish which rose to our flies were not successfully hooked because of their small size.

The food base for trout in the river was observed to be very abundant. The dominant order of invertebrate present were the Plecoptera (stoneflies) and the Trichoptera (caddisflies). Most of the stoneflies had emerged by the time the project was underway but many cases were observed along with a few adults. The golden stonefly (*Acroneuria calineuria* or *Hesperoperla* spp.) appeared to be the dominant species of stonefly while some salmonflies (*Pteronarcys californica*) were observed. Of the caddisflies the most obvious species was the large fall caddis (*Discosmoecus spp*.) also referred to as the giant orange sedge or October caddis. Because of the size of this caddis and the skating motion it uses to move across the water during ovidepositing, the trout readily feed on the surface for these insects. A number of much smaller caddisflies were also observed in good numbers although not taxonomically identified. Also abundant on the river was the terrestrial order Orthopter (grasshoppers), especially along reaches dominated by pasture. Both the grasshopper and the fall caddis where imitated during angling with the greatest capture success. In addition to the above dominant food groups, other items were also available to trout. Hymenoptera (ants), especially in the log jams, Odonta (dragonflies and damselflies), Ephemeroptera (mayflies), Diptera (midges) were all present as well as forage fish from the family Cottidae (sculpins) and Cyprinidae (minnows) and young salmonids.

There was good habitat throughout the river for both rearing and adult fish. As stated earlier, the best habitat observed was that of the upper reaches below Lemon Creek down to the Perry Siding Bridge. Both water volume and stream gradient are optimum with large concentrations of LOD in association with deep pool habitat types dominating. Most of the west side of the river at this location has not been developed into pasture, providing many opportunities for LOD recruitment.

The section from Perry's Siding to Winlaw moves much slower and is associated with large areas of riparian flats which have been developed into pasture. The availability of LOD both at present and into the future is very low and may be limiting to trout production.

The lower sections from Winlaw down to the Kootenay River is dominated by deep pool and riffle habitat. Stream gradient increases as does water volume. A reduction in LOD is evident and may be a result of the increase stream velocity and volume, moving LOD through the system quicker. This factor may be compounded by a reduction in LOD recruitment due to valley bottom development. One of the highest densities of adult fish

in the lower reach was associated with a recent mass wasting event which deposited many trees into the system (see photo no.15) demonstrating the value of LOD even in systems dominated by deep bedrock pools and large riffle and run habitat. The habitat created by LOD may well be more favourable for trout than the deep pools of the lower reaches where water currents were heavy, often with swells and whirlpool-like characteristics, conditions which are often not associated with good trout habitat. These same deep pools, once water has dropped considerably, may provide good over-wintering habitat for fish which may not be as available in the upper reaches.

As expected, species other than trout were caught. Northern sqawfish (*Ptychocheilus oregonensis*) were most abundant. Mountain whitefish (*Prosopium williamsoni*), both the pinocchio and normal forms, were also captured. No bull trout were captured until water temperatures dropped to below 15 degrees C. and then only in the pool immediately below Lemon Creek on September 16th. Three adult fish were captured and were presumed to be staging for the fall spawn in Lemon Creek.

4.0 Discussion

A number of issues have arisen from this project which may be useful for others whom are undertaking a similar study or for the purposes of future management of the river. The two categories will be discussed independently.

4.1 Study Considerations

Water temperature, as a measure of oxygen availability, appeared to be a critical factor regarding surgery success. As stated previously, the metabolic oxygen requirements of the trout should be reduced by holding the fish over night in the river prior to surgery. The first fish operated on were in waters in excessive of 18 degrees C and failed. In the same water temperatures, fish held over night successfully recovered from the surgery.

More than one fish should not be held in the same sleeve. In all cases where this was done, one or both of the fish were in poor condition the following day and in one case mortality was experienced. Judging from the scars on many of the fish, it would appear that they had struggled to get out of the sleeve via the front mesh cover as their snouts were severely injured.

Care should be given when choosing a holding location, with enough current to continue to deliver oxygen to the fish but not in an area where sediment loading may occur. One captured fish may have been over stressed from sediment loading in the sleeve and was released without installing a transmitter. Inconspicuous holding locations should also be used wherever possible. One fish was taken from the sleeve at the Lemon Creek pool, a popular fishing hole despite the angling closures on the river.

A degree of hooking mortality was experienced, especially where fish experienced bleeding in the mouth. The rate of mortality may have been a product of the fish's inability to recover adequately in the sleeve. Fish may have a better chance to recover on its own if allowed to seek out favourable conditions for recuperation. Any fish which had evidence of bleeding from the mouth were immediately released during the later part of the project. In a number of cases where the fish was hooked in a manner which made fly retraction difficult, but was not bleeding, the fly was cut from the line and left in the fishes mouth and removed at the time of surgery. Needless to say, barbless hooks were used throughout the project. Dry fly angling techniques were favoured in an attempt to reduce the number of fish hooked deeply in the trout's mouth. Every possible step was taken to provide the surgeon with fish in optimum condition to ensure the highest recovery rate from surgery as possible.

Finally, be prepared to change plans and strategies on a daily basis to meet the ever changing field conditions and newly encountered problems. To this end team communication is very critical and was certainly a factor in the success of this project.

4.2 Management Considerations

Although the intent of this project was not to develop management recommendations, a number of issues came to light during our time on the river. Some of these have come from our own observations while others came from the many discussions we had with local residents throughout the course of the project.

Many theories regarding the depleted rainbow trout stocks were brought forward and discussed. One common element shared by most theories from the local angling residents was that over harvesting was not to blame. These theories appeared to contradict the many stories we heard regarding use of gill nets being strung across the river in the past or stories of fish outings where 50 fish or more were caught and killed in a single day. The resulting reduction of fish stocks, both from the hydro-electric projects on the Columbia and Kootenay Rivers and from the local harvesting practices, appeared to do little to stop the fishing pressure. Even today many residents did not question our fishing on the river; in fact there were a few who assumed we were poaching and admitted to us that they still did as well. Those residents who voiced a concern over our activities were often willing to share their stories of illegal angling or past environmental abuse once they realized our interested were with responsible fish management. Evidence of poaching is still quite common. Evidence ranged from encountering people angling to finding lure wrappers, beer cans and missing fish from holding sleeves. There is little wonder why the stocks have suffered in the past.

It is clear to us that the past abuses to the river and its fish must be a significant factor in the condition of the stocks today. With that said, we were surprised at the number of good fish in the river as well as the large number of younger 1+ and 2+ age class fish, especially in the upper reaches. On a single angling day on the upper reaches, over 30

fish were landed with many lost. Of the 30 fish, 11 were in the 35 to 48 cm range in length and none of the 10 previously tagged fish were captured. These conditions could be associated with a healthy population of trout. Although there is some evidence of unoccupied habitat, for the most part we caught fish where we anticipated we would. In addition, we often caught fish in the upper reaches where we did not anticipate catching fish, demonstrating that our perceptions of habitat selection may be skewed when assessing habitat occupancy.

The most common theories as to the decline in stocks, excluding over-harvesting, have been; reduction in nutrients, loss of habitat, competition with other species, and higher sedimentation loads in the river. These will be discussed independently below.

Reduction In Nutrients

It is clear that since salmon have been restricted from the river a major nutrient and subsequent food source has been lost. With this nutrient loss came the loss of the large trout which were often in excess of 7 lbs. Similar types of trout have often been associated with salmon bearing systems, especially rivers with a lake for a source (e.g. Horsefly River). It is felt that these larger fish are probably dropping down from the lake to take advantage of the super abundant food source seasonally arriving in the river. Within these systems there are still trout which are predominantly insectivores and co-exist with this other race of much larger trout. We can assume that this was the case with the Slocan River and that the insectivorous population of trout act independently from the other population and should still be sustainable in the river. Judging from the healthy invertebrate population observed on the river, nutrients do not appear to be limiting. Fish growth, based on scale samples, appears to be good and would not indicate any obvious nutrient deficiencies.

Loss of Habitat

It is difficult to determine the extent of habitat prior to present times; however, the lower portion of the river from Perry's Siding down to the Kootenay River does appear to have less LOD than the upper, less developed portion. Speaking with long time residents, they all recalled more log jams in the lower river where some of the better fishing use to be. It would seem logical, when assessing the LOD recruitment opportunities along the river, that a major source of LOD has been removed through the ruralization and agricultural development of the valley bottom. This loss of LOD can be equated to a loss of habitat complexity and pool development as well as hiding cover which is favoured by trout.

The large deep bedrock pools which are typical of the over-wintering habitat preferred by trout have not been altered and does not appear to be limiting. Spawning habitat may have been negatively impacted over the years as all of the tributaries to the Slocan River run through private property, most of which has been developed and many of the creeks diverted for domestic water use. With this said, there still appears to be high densities of

smaller 1+ age class of fish indicating that spawning success may not be a limiting factor in determining present adult populations of rainbow trout.

Interspecific Competition

It has been said that the high densities of other fish species has reduced the population of trout or is limiting the trout's ability to establish the population to former levels. Interspecific competition does occur between the species in the fish assemblage of the Slocan River during a variety of life stages of the trout; however, habitat partitioning does occur and in the water where trout were expected to be found they most often were with little evidence of other fish present as supported by the very low incidental catch of other species during this project. Even in the very upper portions of the river where large schools of squawfish and whitefish could be seen, very good trout were captured (see photos no.18 and 22), often associated with good hiding cover along the log jams created by the old barge pilings. This evidence would appear to indicate that competition is not significantly limiting trout production in the river.

Increased Sediment Loading

It has been proven over time that roads and forest development increases sediment transport to streams. This effect is somewhat reduced in rivers with large lake headwater sources such as the Slocan. Sediment loading to the tributaries may have an adverse impact on spawning and rearing fish and has probably influenced productivity to the system to some degree. More recently, a slide in the Little Slocan River has produce very turbid water down stream in the Slocan River. These conditions were persistent throughout the year and may have influenced fish distribution this year. It may also have an influence of insect productivity in the lower reaches as much of the in-stream insect habitat has been covered with sediments. This may flush out with spring freshet and may produce only a short term impact. These type of events have been naturally occurring in the system for many years, reflecting the unstable nature of the area and is responsible for much of the LOD recruitment to the stream. There is little evidence of high sediment loads in the upper reaches above the Little Slocan River indicating that there does not appear to be an unnatural increase in sediments throughout the river and that the lower reaches are experiencing a somewhat isolated event. Persistent levels of unnatural sediments could have a negative impact of trout production but is unlikely responsible for the decline in the population in the Slocan River.

5.0 Conclusions

It is the authors opinion that the decline in stocks has resulted from extensive harvesting of trout. The loss of LOD will have an influence on the population's ability to return to former densities but is not the cause for the decline. A strategy to rehabilitate stream bank habitat would be beneficial in conjunction with increasing a presence on the river to reduce angling mortality. This presence could be in the form of an upscale enforcement strategy or to open the river to catch and release fishing whereby angles will attempt to educate and police other anglers. Spawning habitat, as it is influenced by private land, may be a key issue. Hopefully some enlightenment will come from the next phases of this project, indicating critical spawning areas and assisting with the development of strategies to mitigate any impacts. With greater management emphasis being given to, some confidence can be obtained from these preliminary results that the indigenous genetic stock of rainbow trout is not lost and appears to be in a healthy condition which could lead to a return to its former glory.

Appendices

Appendix 1: Surgical Implantation of Radio Tags in Rainbow Trout: Slocan River, August/September 1997

Appendix 2: Video Tape of Surgical Implantation Procedure.

Appendix 3: Capture Location Maps, 1:20,000 TRIM base.

Appendix 4: Fish Collection Data Form, 1 hard copy, 1 digital copy (a digital copy of the report is also on this disc)

Appendix 5: Archived Scales

Appendix 6: Project Photos.