



Gitanyow Fisheries Authority



Kitwanga River Fisheries Treaty Related Measure #2:

The Upper Kitwanga River Beaver and Coho Salmon Management Plan



By: Natureworks, 2000

Submitted to: Her Majesty the Queen in Right of the Province of British Columbia & Her Majesty the Queen in Right of Canada

Submitted by: Mike McCarthy, H.B.Sc. and Eric Hamelin, B.Sc.
Gitanyow Fisheries Authority
P.O. Box 148
Kitwanga, BC
VOJ 2A0

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Abstract

Coho salmon are native to the Upper Kitwanga River, however since at least 1998, beaver proliferation in the area has resulted in a beaver dam complex that restricts adult coho migration into upstream reaches. Several projects have been initiated to provide an unimpeded migration route for coho salmon (beaver dam breaching), and to reduce the beaver population to sustainable levels (trapping); however, these efforts were undertaken without a clear long-term vision. This report was prepared to provide the framework for a comprehensive beaver and coho salmon management plan that will ensure these two species coexist to each others benefit. It was recommended that beaver dam breaching and beaver trapping was the most effective short-term solution. In the long term, riparian-restoration would provide the most benefit.

Acknowledgements

On behalf of the Gitanyow Fisheries Authority we would like to thank both Canada and British Columbia for providing funds again in 2002/03 through their respective Treaty Related Measures to help rebuild Kitwanga River salmon stocks. Once again this year we would like to acknowledge all the hard work of both the Federal and Provincial Treaty Negotiators who believed in our cause and who worked diligently to make their supervisors understand the importance of our rebuilding initiatives. Special acknowledgement is in order for Dave Miranda, Mike Haberl, Lee Montgomery, Norman Marcy and Charlotte Bell for all their hard work, which often went beyond the call of duty. This exceptional team always kept a positive attitude, even when funding did not seem possible for this fiscal year. We must once again acknowledge the hard work of the Gitanyow Hereditary Chiefs and their negotiating team. A special thanks to Glen Williams, Greg Rush and Herb Russell, for without their support and focus these important works would have not taken place. We would also like to thank Fisheries and Oceans Canada for their technical support, special recognition of Lana Miller on the beaver management plan is in order. Thanks to Lorne Campbell of the Gitanyow Hereditary Chiefs GIS department for producing excellent descriptive maps often on short notice and very little guidance. Finally, we would like to acknowledge Dr. Allen Gottesfeld of the Gitksan Watershed Authorities for taking the time to act as a technical advisor when called upon.

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Executive Summary

In 2002, the Gitanyow Fisheries Authority (GFA), for the second year in a row, acquired funds from the Treaty Related Measures (TRM) through the Gitanyow Treaty Negotiations Table to study and rebuild salmon populations within the Kitwanga Watershed. TRM's were awarded based on the premise that the Gitanyow, Canada and B.C. would benefit from the initiatives, through an increased understanding of the dynamics of the Kitwanga salmon stocks. The focal species of the Kitwanga River has been sockeye salmon (*Oncorhynchus nerka*) due to extremely low returns in recent years. More recently, efforts have been put towards studying coho salmon (*O. kisutch*) abundance and distribution in an attempt to restore stocks to more historical levels.

It is accepted among fisheries experts that salmonid numbers were substantially higher in the Skeena Watersheds (with the possible exception of the Babine River) prior to the introduction of the mixed stock commercial fisheries at the mouth of the Skeena River. Unfortunately, accurate escapement data for Kitwanga coho stocks at the turn of the century are relatively non-existent. Traditional Gitanyow Knowledge speaks of specific fishing sites that yielded quite substantial returns of Kitwanga River coho salmon (pers. comm. Robert Good 2001). It is was predicted that Kitwanga coho numbers hit an all time low in the 1960's and have since then slowly rebounded, hitting estimated highs in 2002 of over 3500 fish. Although the carrying capacity of the Kitwanga has yet to be determined, it is believed that the system in its current state produces coho well below its potential. In 1998, it was discovered that the an extensive series of beaver dams in the Upper Kitwanga River has eliminated access for coho salmon to reach their native spawning grounds upstream. The Upper Kitwanga River contains over 15 kilometers of excellent spawning and rearing habitat between Kitwancool Lake and a 8-meter waterfall located near the headwaters.

Kitwanga River Salmonid Rebuilding and the Treaty Process

The Gitanyow Fisheries Authority initiated "The Kitwanga River Salmonid Rebuilding Program" in 1999, which consisted of numerous projects funded by multiple funders. In 2001/02 and 2002/03, the rebuilding process was greatly accelerated through Treaty Related Measures made possible from Tri-party negotiations between the Gitanyow, Canada and British Columbia. TRM funding has allowed GFA to further their studies on sockeye, coho, chinook, and chum salmon stocks as well as steelhead. The information collected has benefited the treaty table through:

1. An increased understanding of the Kitwanga River fisheries resources.
2. The development of useable salmonid escapement methods, which will help, determine post-treaty salmonid allocation numbers for the Gitanyow.
3. The determination of salmonid escapement numbers currently returning to the Kitwanga River, which could potentially allow treaty negotiators to determine how many fish could be sustainably harvested post-treaty by Gitanyow on a yearly basis.
4. An increased understanding of Kitwanga sockeye. More specifically pre-TRM implementation it was thought that juvenile rearing grounds and spawning areas could be a limiting factor. However, preliminary results from TRM studies have shown that this is not the case and that the stock could possibly be enhanced yielding historical escapement numbers (25,000-75,000 sockeye per year).
5. The enhancement of salmonids (i.e. Fry and smolt salvages, habitat expansion and Kitwanga River Mouth Monitoring), which will potentially yield more salmon in the Kitwanga River in the future benefiting all three parties.

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1. INTRODUCTION

The purpose of this report is to describe the relationship between the beaver (*Castor canadensis*) and coho salmon (*Oncorhynchus kisutch*) in the Upper Kitwanga River, particularly to describe how a proliferation of beavers in recent years has impacted the coho salmon population that historically occupied these waters. Presented is a summary of relevant literature pertaining to the following topics:

- The life cycle and habitat requirements of the beaver and their distribution and influence on coho salmon in the Upper Kitwanga River,
- The life cycle and habitat requirements of coho salmon and their distribution in the Kitwanga River Watershed,
- Past logging within the Upper Kitwanga River riparian corridor and its influence on the beaver population,
- Hydrology of the Upper Kitwanga River,
- Beaver management prescription for the Upper Kitwanga River.

The ultimate aim of the proposed beaver management plan presented in this report is restore coho salmon migration routes in the Upper Kitwanga River, while maintaining the beaver population at manageable levels.

Coho salmon returns in the Kitwanga River have been considered low for much of the last 40 years, however they appear to be currently on the rise. Escapement numbers of the past 3 years are over three times higher than escapements recorded in the 1960's (Kingston, 2002). However, an area of special concern is in the Upper Kitwanga River where an absence of coho was recently documented in what was once a highly productive spawning and rearing area. The Upper Kitwanga River historically provided coho for the Gitanyow, but it has been abandoned as a fishing site due to a lack of fish returning to the area. In response, GFA focused some of their attention to the Upper Kitwanga River to determine the reasons why coho were absent. Though various studies, which began in 1998, GFA determined that an extensive series of beaver dams was stopping coho from migrating to their native spawning ground upstream. These findings prompted a closer examination of the beaver population currently residing in the Upper Kitwanga River basin. Until migratory access is reestablished and maintained, the carrying capacity of the Kitwanga River to support coho salmon will be below its potential.

Since at least 1998, beaver dams have restricted access to key coho salmon habitat in the Upper Kitwanga River. Therefore, to study the problem and suggest some possible restoration options, GFA formed a team of accredited scientists to address the issue: a GFA fisheries biologist, a GFA wildlife biologist, a Gitksan Watershed Authority hydrologist, and a DFO restoration biologist. This report will provide a summary of relevant information collected by the research team in an attempt to better understand the dynamics associated with beaver and coho salmon. This information will aid in implementing a cost-effective management plan that will allow the two species to co-exist. This report is considered the first phase of a more comprehensive beaver management plan that will progressively build as new information is gained.

2. DESCRIPTION OF THE STUDY AREA

The Kitwanga River drainage is a tributary to the Skeena River located approximately 250 km northwest of Prince Rupert, B.C. (Figure 1). The drainage encompasses an area of 83,000 hectares and has a mainstem length of approximately 67 kilometers. The river is comprised of two main sections that are separated by Kitwancool Lake: the Upper Kitwanga River (north) and the Lower Kitwanga River (south). The Kitwanga River Watershed is coded 40-2200 by the B.C. Watershed Code Classification System. The UTM coordinates at the confluence of the Skeena River are 09055840 N, 6106300 E. The four major tributaries and their Watershed Code of the Lower Kitwanga River are: Tea Creek (40-2200-010), Deuce Creek (40-2200-020), Kitwancool Creek (40-2200-030) and Moonlit Creek (40-2200-040). There are no major tributaries to the Upper Kitwanga River. The bottom reaches of the Upper Kitwanga River consist of multiple channels, which meander through a network of beaver dams. The entire Kitwanga River was broken into 14 reaches with differing habitat characteristics (Figure 2). Reaches 1 to 7 are located in the Lower Kitwanga River, Reach 8 represents the lake, and Reaches 9 through 14 are located in the Upper Kitwanga River.

The Kitwanga River drainage is known to contain all five species of Pacific salmon, which include: coho salmon (*Oncorhynchus kisutch*), pink salmon (*O. gorbuscha*), chum salmon (*O. keta*), chinook salmon (*O. tshawytscha*), and sockeye salmon (*O. nerka*). Numerous other species of fish are found in this system, including: rainbow / steelhead trout (*O. mykiss*), cutthroat trout (*O. clarki*), Dolly Varden char (*Salvelinus malma*), bull trout (*Salvelinus confluentus*) Mountain whitefish (*Prosopium williamsoni*) and various other species of coarse fish.

The main areas of focus in this report are Reaches 9 and 10 where a high concentration of beaver dams exists and where coho salmon migration is impeded. This area is bounded by the Kitwancool Forest Service Road (FSR) to the south, Highway 37 North to the east, and the Weber FSR to the west. The river within this area meanders through low-gradient forested wetlands created by extensive beaver activity.

Reach 9 is low gradient section (<1%) located between Kitwancool Lake and extends upstream to a point approximately 600 meters downstream of the Weber FSR bridge crossing (4.4 kilometer total distance). The area with highest concentration of beaver dams extends from approximately 600 meters upstream of the Kitwancool FSR Bridge to the uppermost end of the reach. Fish habitat consists mainly of beaver ponds connected by slow moving glides and shallow riffles. Substrate composition varies from fines in the beaver ponds to sands and gravels on the glides and shallow riffles.

Reach 10 is 1.6 kilometers in length, and extends from approximately 600 meters downstream of the Weber FSR Bridge to 1000 meters upstream of the bridge. Beaver activity is fairly localized within the lower 200 meters of the reach. Within this reach, the channel gradient increased to approximately 2% and the stream channel became more clearly defined. Habitat characteristics include small to medium size gravelly substrate, and a complex of deep pools, riffles and glides. The area also contains good spawning gravel and some excellent juvenile rearing habitat.

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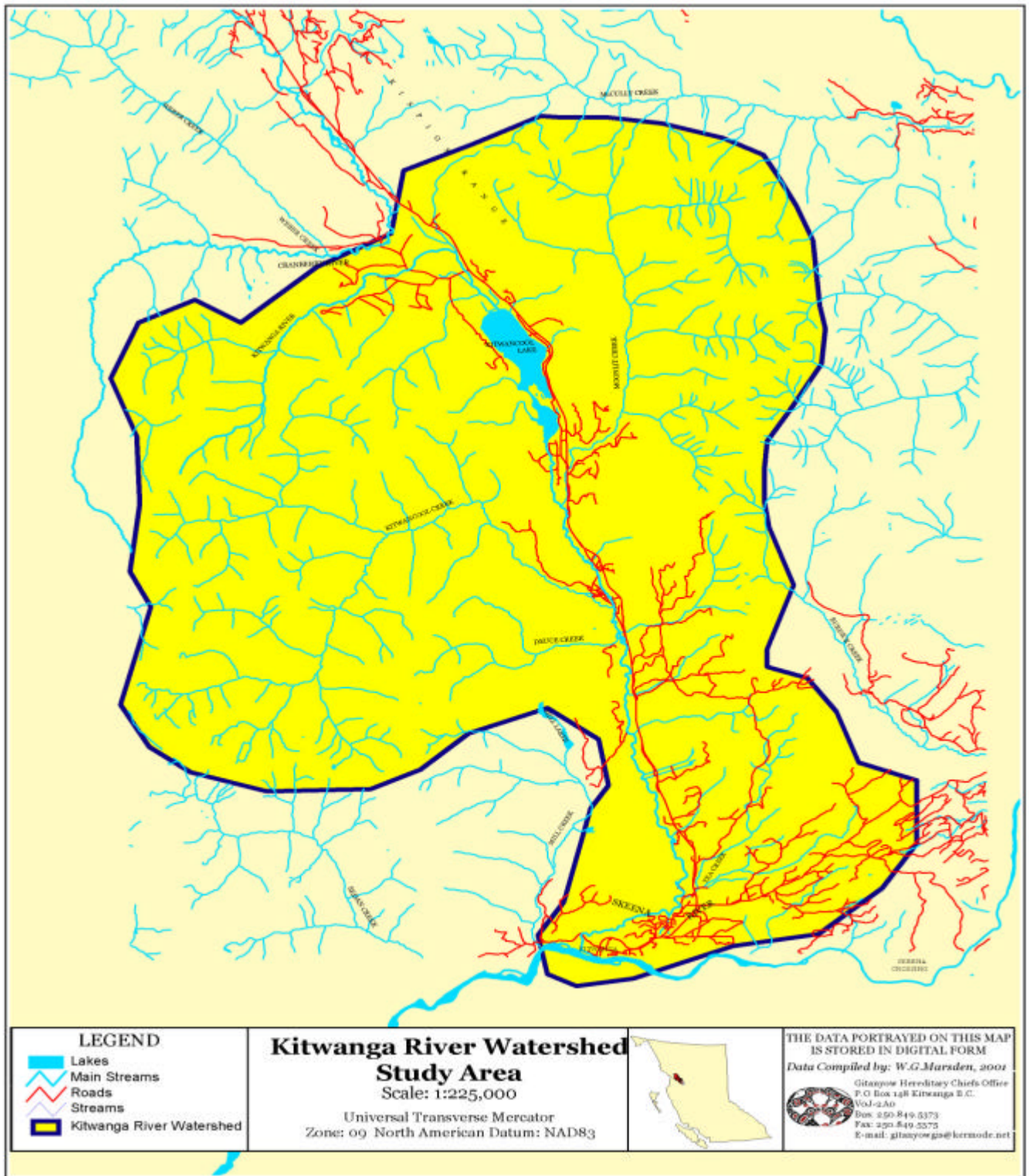


Figure #1: Kitwanga River study area.

Figure 2: Map of Upper Kitwanga watershed with reach breaks.

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Reaches 11 and 12 extend further upstream for a distance of 6.5 kilometers. As the average gradient increases towards the upper boundary of reach 12, habitat types change from predominantly pools to predominantly riffles. The riparian habitat appears undisturbed for the most part, however several logging related slides were identified in the area. A confirmed fish barrier consisting of an 8-meter waterfall is located at the upstream boundary of Reach 12 (BioLith Scientific, 1999).

3. LITERATURE REVIEW

3.1 *Beaver*

The beaver is a very important wildlife species for many reasons, but of most interest is their ability to build dams and impound large volumes of water that is of most interest in this report.

Through the examination of historical air photos taken in 1950, only two beaver lodges can be observed along the main stem of the Kitwanga River and one in an abandoned channel of the mainstem (air photo source: Skeena Project Services, Terrace, B.C.; File # BC 1255:50). These air photos showed that the riparian zones of the Reaches 9 and 10 consisted of mature cottonwoods and mixed conifer trees.

Since studies were initiated in 1998, the number of beaver lodges in the same area has been estimated at over 10 active lodges, and the number of beaver dams has exceeded thirty.

The downturn of the fur industry in the later part of the 1900's has probably lead to an increased in population size throughout their range. Traplines located in the Upper Kitwanga River would have been abandoned soon after the downturn due to the river's remoteness and difficult access.

The following sections describe the life history and the positive and negative aspects of the beaver population currently in the Upper Kitwanga River basin.

3.1.1 Life History and Habitat Requirements

Referred to as a colony, the basic beaver family usually consists of a pair of adults and one or two generations of offspring. The adults may weigh over 40 pounds, and mate for life after reaching sexual maturity at the age of 2 ½ years. In fact, beavers are one of the few monogamous wildlife species. Both parents care for the kits (usually one to four), which are born in the spring (April or May) after a gestation period of 3 months (Palmer, 1982). The young normally stay with their parents for two years, and the yearlings act as "babysitters" for the new litter. The two-year-old juvenile beavers then set out on their own, just before the birth of the colony's next litter. This eases the pressure on the food supply and leads to colonization of new territories (Slaney and Zaldokas, 1997; see Photos 1 and 2 for examples of beaver lodges).



Photo #1. A large beaver lodge found on the bank of the Upper Kitwanga River (summer photo).



Photo #2. A large beaver lodge found on the bank of the Upper Kitwanga River (winter photo).

“Beavers prime habitat is along the slower-moving sections of rivers and streams, in existing ponds, and along shores of small lakes not exposed to wave action” (Slaney and Zaldokas, 1997). Beavers prefer the groundwater-fed side channels and the channels that drain small lakes, which are better suited than where the water levels and velocities fluctuate widely. The foraging area used by a colony on flowing streams will usually extend a greater distance upstream from the lodge than downstream, probably because it is easier to move food and building material with the flow (Slaney and Zaldokas, 1997). They den in the banks of streams and rivers or build lodges. Beavers also form dams out of branches, logs and mud to create deep-water ponds. These ponds not only create safe areas for the beavers but the diverse wetland systems created support a wide variety of fish, amphibians, birds and mammals (Stenberg, 2001). “In cold climates where ponds freeze over in winter, sufficient depths must exist beneath the ice cover to provide the beavers access to their cache of woody vegetation” (Slaney and Zaldokas, 1997).

Beavers feed on a variety of aquatic plants including grasses, skunk cabbage, and sedges, leaves of shrubs, and the roots and leaves of pond lilies. The bark and tender twigs of deciduous trees and shrubs, such as aspen, alder, cottonwood, and willow are their main food source, especially during the winter season. “The most productive food sources include stands of cottonwood and alder that naturally regenerate on old sedimentation bars along large rivers and in forest clearings created by fire, blowdown, insect-kill and logging” (Slaney and Zaldokas, 1997). In moist and nutrient-rich soil conditions on the banks of beaver ponds, willow thrives and its growth is often vigorous enough to extend the beaver’s food supply a few more years after their main food source has exhausted (Slaney and Zaldokas, 1997). Tree cutting and pruning by beavers stimulate the growth of willows, poplars and other deciduous plant species.

Beavers feed close to the water where they are safer from predators; therefore, feeding activity is restricted to a relatively narrow riparian strip where important trees can be easily accessed (Stenberg, 2001). In order to be safe and efficient, beavers usually build their lodges within 50 m from the water’s edge (Slaney and Zaldokas, 1997). The many predators of kits include hawks, owls and otters. Bears, wolves, dogs and coyotes can also take adults that are especially vulnerable each spring, when the two-year-olds seek new territories. Accidents are another frequent cause of mortality, including falls into lake overflows and abandoned wells, and traffic accidents. Trapping is perhaps the most common source of mortality (Beavers: Wetland & Wildlife)

3.1.2 Positive Impacts of Beavers:

Beaver ponds are of great benefit to a wide variety of fish and wildlife species that depend on its habitat for some or all of their life cycle. One obvious benefit to fish is the creation of beaver ponds that provide critical rearing habitat. Beaver dams create deep pools, which provide excellent over-wintering habitat for juvenile and adult salmonids. During the winter, beaver ponds can provide critical refuge areas that will not freeze to the bottom (Grieve, 2000).

The relationship between beavers and other wildlife species has also been studied in some detail by numerous authors and are often described as being mostly productive and beneficial (Grieve, 2000). For instance, beavers produce valuable wetland habitat

that benefits ducks and other water-dwelling birds during migration, breeding, and brood rearing. As well, wetlands created by beavers provide other vertebrates and invertebrate species with cover, forage opportunities, and protection from predators (Grieve, 2000).

Beaver ponds wetlands can reduce the damage caused by high water events by acting as an energy dissipater and a sediment sink, thereby reducing erosion and turbidity in downstream reaches. Beaver pond wetlands can also improve the water quality for downstream users by filtering silt, metabolizing toxins such as pesticides; water downstream of the dams is cleaner and requires less treatment than water sources without (Beavers: Wetland & Wildlife).

Some streams may also be subjected to extremely low flow conditions such as spring-fed, lake-fed, and intermittent streams. Beaver ponds located within these stream types can stabilize the stream flow by acting as slow-release reservoirs that will maintain some level of flow during long drought periods. A water depth of even a few centimeters will enable some fish to survive until fall rains replenish the flow.

Beaver ponds can improve the quality and diversity of riparian habitat, which can benefit a wide variety of fish and wildlife species. As the water table in the adjacent forestland rises, water intolerant vegetation is gradually replaced by water tolerant vegetation. Nearby riparian vegetation may be flooded and die, or be used for food or dam building. Aquatic plants may eventually become established, along with water-tolerant shrubs including willow and alder. A diverse aquatic and riparian vegetation community contributes to fish production by providing escape from predators and habitat for prey (aquatic and terrestrial insects).

Beaver ponds can enhance nutrient cycling and fish production by increasing water temperatures in otherwise cold-water streams. Increased productivity in turn results in an overall larger body size of an individual, which can improve overall survival rates of the species. Vegetation that died by flooding will decompose and release the key elements such as phosphorous and nitrogen into the aquatic ecosystems. These elements are initially bound-up in the pond substrate then slowly released into the water column providing the essential nutrients for primary producers (algae species). In turn, this benefits stoneflies, midges, caddisflies, and other aquatic insects and invertebrates. Beaver droppings provide another source to the nutrient cycle.

Most species of fish native to stream environments will colonize beaver ponds if accessible. In B.C., these include chinook salmon, cutthroat trout, rainbow trout, grayling, and char. Juvenile fish may enter into beaver ponds from waters downstream by ascending small rivulets flowing over or around dam, or they may descend from waters upstream. Passage for both upstream and downstream migrating fish improves during freshet when dams are overtopped. Coho salmon, which typically spawn during the fall rainy season, can successfully ascend beaver dams if dam height does not exceed the maximum jump height of a fish.

3.1.3 Negative Impacts of Beavers

While positive aspects of beaver activities are numerous, there are negative influence to the environment as well, particularly when beaver populations become excessively large. A significant impact to fish is the creation of large beaver dams that can block migration to native spawning beds and juvenile rearing grounds. Beaver dams can produce steep, fast flowing waterfalls, or they can reduce the flow to subsurface leakage. In many cases, beaver dams are only maintained on a seasonal basis and are often washed-out with spring and fall flood events. However, beaver dams can persist for many years and will progressively change the habitat in which they reside by expanding their waterways and flooding forestlands. Beaver dams can causes flooding of roads, timberlands, farms and other public and private property. Beavers residing along roadways can block culverts and bridges causing road washouts, displacement of fish into adjacent ditchlines, or act as barrier to migrating fish.

In the Upper Kitwanga River, the extensive beaver dam complex in Reach 9 has frequently blocked access for spawning coho salmon into the upper reaches. When this occurred, coho salmon were seen frequenting non-conventional spawning sites such as the 26-Mile FSR ditch-line. Offspring of fish that spawn in these sub-optimal areas likely have lower survival rates.

Beaver and other wild and domestic animals are carriers of the protozoan parasite *Giardia lamblia* via feces. In humans, this parasite causes giardiasis (beaver fever), a disease marked by chronic diarrhea, abdominal cramps, fatigue, and weight loss. Giardiasis is easy to catch if you drink untreated water from within or downstream of beaver ponds.

As well, beaver ponds may increase the water temperature of the system causing distress to fish stocks. Since water remains stagnant in beaver ponds for extended periods, this directly impacts the dissolve oxygen levels for the system. Since the beaver dams minimize flow, the oxygen level is greatly reduced. Resident rainbow and juvenile steelhead trout, which prefer riffle dominated oxygen-rich waters and may not survive in an oxygen deficient beaver pond.

3.1.4 Beaver management projects to date

Since 1998, GFA has undertaken two beaver management initiatives: beaver dam breaching to provide unimpeded passage to migrating coho salmon and harvesting to reduce the over-all numbers of beavers. A summary of these projects is as follows:

3.1.4.1 Beaver dam breaching

NewGen Resource, a consulting company hired by GFA in 1998, implemented a beaver dam breaching program in the upper reaches of the Kitwanga River. This program was supported by the Gitanyow Hereditary Chiefs who recognize the importance of restoring access to native spawning and rearing grounds of coho salmon. Breaching activities were carried out beginning in late September, which coincided with the coho migration period (see Photographs 3 through 6). Active dams were visited every two days to

ensure proper passage was maintained throughout the season. NewGen Resources reported that numerous coho were spawning in the ditchline of the Kitwancool Forest Service Road (942-8687-01) within reach 9, but no adults were seen in reach 10 or above. Through these initial assessments it was strongly recommended to continue beaver dam breaching during the coho spawning period, and that works be performed to “re-instate present channels to their original drainage” (Jacobs and Jones, 1999).

From 1999 to 2002, GFA continued with the beaver dam breaching. Each year, commencing in late August or early September, crews breached beaver dams bi-weekly to maintain unrestricted access for spawning coho through Reaches 9 & 10 (Williams and Cleveland, 2000; Cleveland 2001). Initially, fish passage could be maintained only for short periods as field crews often could not keep-up with the rebuilding effort of the beaver. By 2002, crew efficiency greatly improved due to the establishment of a well-worn foot trail, and the decreased number of dams that required breaching. In 1999, 35 beaver dams required maintenance, and by 2002 they numbered below 15 dams. At first, the efforts required to maintain continuous fish passage would exceed the man-power budget, but currently this program is considerably more cost efficient.

3.1.4.2 Beaver Population Control

In addition to beaver dam breaching, GFA implemented a nuisance beaver removal program during the winter of 2002-2003 in order to mitigate the effects of beaver dams (Photos 7 and 8). For this program, GFA employed three trappers from the local community. Over the course of this initiative, trappers were successful at capturing nine beavers in addition to an unfortunate by-catch of one river otter (*Lutra canadensis*). Trapping took place from January 15 to March 12 2003, when the pelt value is highest, and every captured beaver were sold to the fur industry. All edible portions of the beavers were distributed to elders within the community who value the high fat content of the meat. The success of this initiative will not be determined until the spring, when visual observation of the lodges will determine the status of the beaver colony. Therefore, an in-season report will be submitted on the progress of this initiative, and recommendations for future works will be proposed.

3.2 Coho Salmon

The Upper Kitwanga River is home to a variety of salmonids including coho salmon, cutthroat trout, and Dolly Varden char. Of these, coho salmon are the only anadromous species, and the only anadromous species native to the Kitwanga River known to spawn upstream of Kitwancool Lake.

3.2.1 Life History

Generally, coho spawn in swift flowing, shallow waters where gravels and cobbles dominate the substrate. Spawning usually takes place from mid-September to late-October; in the Kitwanga River the peak spawning time occurs usually in mid-October. The most productive spawning grounds occur in the mainstem of the Kitwanga River

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Photo #3. Beaver dam breaching initiative. Photo taken before breaching.



Photo #4. Beaver dam breaching initiative. Photo taken after breaching.

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Photo #5. GFA worker breaching a beaver dam in the Upper Kitwanga River.



Photo #6. View of a breached beaver dam.

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Photo #7 & #8. Beaver trapping, view of different ladder sets, placed in the channel of an active beaver lodge.

between Kitwancool Lake and the confluence of Moonlit Creek located approximately 4 kilometers downstream (Kingston, 2002-TRM#1), however, adults have been seen spawning throughout the watershed. Most female coho in B.C. lay an average of 2100 to 2800 eggs, which may be laid in as many as 4 different nests (Scott and Crossman, 1973). The female will guard her nest until she eventually perishes soon after spawning (Scott and Crossman, 1973). Eggs remain in the gravel nests called redds where they are exposed to inter-gravel flow of water rich in oxygen. Eggs hatch in the spring, usually in April, and the alevins will remain in the gravel for 2-3 weeks. Once their yolk sacks are completely absorbed, they wiggle their way out of the gravel and become active feeding fry (Scott and Crossman, 1973). These fry will then remain in freshwater streams or lakes associated with the system for at least 1 year. Usually, juveniles will exit freshwater rearing areas the following spring as smolts. They migrate to the ocean to feed for an additional two to 3 years before returning as adults to their natal streams to spawn as three or 4 year olds.

3.2.2 Previous Research

Between 1998 and 2001, several studies found that coho salmon were absent above Reach 9 (BioLith 1999, Kingston 2002, McCarthy 2003; see Figure 2 for reach locations). This finding was of great concern for the Gitanyow who once harvested coho salmon in these waters, as far upstream as the uppermost end of Reach 12 where an 8-meter waterfall is located. Subsequent studies in 2000 determined that the absence of coho was due to an extensive series of beaver dams located within Reach 9 that blocked upstream migration of both juvenile and adult coho. In 2000 and 2001, GFA conducted intensive electrofishing, gee-trapping, and stream walk surveys and no juvenile or adults coho found (Kingston, 2002 -TRM#1). These assessments strengthen the assertion that the multiple beaver dams within Reach 9 were preventing migrating coho salmon from accessing upstream reaches.

In 2001, GFA attempted a study to determine if the Upper Kitwanga River currently provides suitable habitat that will support the various coho salmon life stages (eggs, alevins and juveniles). In early October 2001, GFA transplanted 46 adult coho salmon (26 males and 20 females) upstream of the beaver dam complex at the Weber FSR bridge site (Photos 9 and 10). Transplanted fish were captured at the enumeration fence located approximately 4 km downstream of Kitwancool Lake and then were transported successfully into the upper Kitwanga River at the Weber FSR Bridge crossing. After a few days following the transplant, GFA crews witnessed the coho salmon pairing up over several hundred meters of stream near the Weber FSR bridge site, however none were observed actually spawning (Kingston, 2002 -TRM#1). The program was implemented with the support of Fisheries and Oceans Canada (DFO) and was viewed as an inexpensive means of acquiring vital data that would give direction to all future coho rebuilding plans in the Upper Watershed.

Subsequent juvenile coho surveys in 2002 revealed that juvenile coho were present above the beaver dams, where they were not found from 1998 to 2001. In a 2002 presence/absence study, the average catch per unit of coho juveniles was 3.3 / trap / 24 hours for 11 sites sampled above the beaver dams. The furthest upstream location where coho were observed was approximately 3 kilometers upstream of the adult coho

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Photo #9. Coho relocation initiative. View of the coho transport box.



Photo #10. Coho relocation initiative. GFA staff releasing coho salmon into the Upper Kitwanga River (above the beaver dam complexes).

release site at the Weber FSR Bridge (McCarthy 2003). Further evidence of the success of the transplant initiative was obtained during The Kitwanga River Juvenile Coho Synoptic Survey program, which is an annual assessment of permanent sample sites located throughout the Kitwanga River. One site, established in 2001 in the Upper Kitwanga River immediately upstream of the Weber FSR Bridge, did not yield any coho (Kingston 2002). In 2002 however, the same site yielded juvenile coho salmon, as did another site newly established approximately 300 meters upstream (McCarthy 2003). GFA concluded that the transplanted fish successfully reproduced and that habitat conditions above the dams were adequate to support juvenile coho salmon.

A review of Historical SEDS (Salmon Escapement Data System) provided escapement data for the years 1961 to 1994. Annual escapement estimates were below 1000 fish throughout this period, except in 1978 when the escapement was estimated at 2000 fish (Table 1). These estimates were based on extrapolations from select spawning areas, and these were considered adequate for showing general trends in population status. In some years, the estimates were not completed and certain inconsistencies likely existed between different surveyors. Declines in coho stocks in the 1990's prompted GFA to incorporate coho escapement estimates in their yearly activities to collect the most accurate estimate possible. Escapement surveys were initially conducted in 1998 and 1999 by tallying coho at spawning sites. In 2000, 2001 and 2002 stream walk surveys were complimented by counts obtained from a temporary adult enumeration fence initially installed to enumerate sockeye salmon migrating to Kitwancool Lake. The fence was located approximately 4 kilometers downstream of Kitwancool Lake and provided an accurately count all adult coho accessing the upper reaches, including the Upper Kitwanga River. Escapement estimates over the past 3 years are over three times higher than most of the escapement estimates recorded since the 1960's (Kingston, 2002).

Table 1. Historical SEDS Adult Coho Escapement Estimates.

Year	Estimate	Estimated Average per Decade
1919-1960	No information available	N/A
1961	C	~300
1962	D	
1963	D	
1964	C	
1965	B	
1966	C	
1968	D	
1969	D	
1970	D	~600
1971	E	
1972	E	
1973	E	
1974	D	
1975	D	
1976	D	
1977	D	
1978	F (2000)	
1979	B	
1980	700	~600
1981	C	
1982	D (475)	
1983	1000	
1984	E (600)	
1986	1000	
1987	1500	
1988	75	
1989	450	
1991	500	~750
1992	400	
1994	2000	
1998	1900	3014
2000	2300	
2001	3226	
2002	3515	

Bold figures derived from the GFA temporary enumeration fence and stream walks.
 Estimated number of fish code: A=1-50; B=50-100; C=100-300; D=300-500;
 E=500-1000; F=1000-2000 fish

3.3 Impacts from Logging Activities

Although the reasons why beaver population are seemingly high is unclear, a link may exist between logging activities which occurred since the 1960's and a rise in the beaver population that benefited from the regeneration of mainly deciduous vegetation that followed after logging. Forest harvesting has occurred at various intensities in upland areas adjacent to Reaches 9 through 12, and possibly within the riparian zone.

After reviewing the available information on forest harvesting and road building activities in the Kitwanga Watershed that date back to the 1960's it becomes apparent that some fish habitat has been degraded. The most detailed survey of these impacts can be found in Level I Field Assessment of Aquatic and Riparian Habitat for the North Kitwanga River Sub-Basin Upper Kitwanga River (BioLith 1999). The most significant impacts were identified as:

- Increased sedimentation from slides, road building, and bridge construction,
- A rise in the water table in Reach 9,
- Poor conifer regeneration and a proliferation of deciduous species favored by beavers.

The combined impacts of these factors have eliminated approximately 8.2 kilometers of valuable coho spawning and rearing habitat contained in parts of Reach 9 and in Reaches 10, 11, and 12 (BioLith Scientific, 1999)

Most of the impacts caused by road building and bridge construction were observed in Reach 10 where an aggradation of sediment occurred in the lower portion of the reach. A slide in Tributary 69, which flows into reach 12, released a large of sedimentation to the lower reaches as far downstream as the Weber FSR Bridge in Reach 10 (BioLith Scientific, 1999). This slide may have been responsible for the aggradation of sediment in the lower portion of Reach 10, which shows as an abrupt gradient change between Reach 10 (2%) and Reach 9 (less than 1%).

Research has shown that harvesting activities, at least for the short term, can significantly raise the water table in downstream areas (source). An increased water table can inhibit the growth of some plants and promote the growth of others. Several water-tolerant plant species are the preferred source of food for beaver, such as willow dogwood, and alder. These plants provided beavers with an abundance of food and a perfect opportunity to establish widespread colonies in the area. Even if logging did not occur within the immediate riparian zone, encroachment of beavers can occur from adjacent wetlands where beaver have benefited from logging activities.

4. HYDOLOGICAL ASSESSMENT

The critical issue in restoring streams is whether self-maintaining channels of suitable morphology can be created. Self-maintaining channels are capable of transporting the water and sediment delivered to them from upstream sources. Each stream has unique capabilities to move sediment. The most important parameters are the intensity of flood discharges, the width of the stream and the stream gradient. These stream characteristics are natural and are mostly difficult to change. Nevertheless, mechanical equipment may be used to alter the channel widths of a stream. Furthermore, although flood discharges are climatically controlled, clear-cut logging may influence the pattern of flood flows, especially from snow melt. As for the overall gradient of a stream, it cannot be effectively changed.

Pool-riffle sequence streams, with typical gradients ranging from 0.5% to 2.5%, are the most productive streams for juvenile coho. Ideally, GFA would envision the restoration of Reach's 9 and 10, which have been severely impacted by beavers, to a gravel-bed pool-riffle stream. In order to determine if a stable pool-riffle configuration could be established, a leveling survey was conducted for these reaches. In October of 2002, Adam Engineering Ltd. was hired to perform this survey. The gradients obtained are presented in Figure 3. Throughout the survey, numerous survey points were surveyed and subsequently mapped. The data collected at each station included distance traveled and elevation, which allowed GFA to calculate the changes in gradient between stations. The gradient change was calculated by dividing the distance between each point with the change in gradient recoded to the nearest centimeter ($\% \text{ gradient} = \text{rise/run} \times 100$).

The analysis presented, divided the river into three sections. The first section, which extended from Kitwanga Lake upstream to the Kitwancool FSR (lower half of Reach 9), had a gradient of 0.11%. The second section found along the Kitwanga River between the bridge on the Kitwancool FSR (Plot #4) and a point (Plot #21) approximately 1161m upstream of plot #4 has an average gradient of 0.53%. The third section, extended from Plot #21 to the Weber Bridge a distance of approximately 2585 meters. Within this section, an average gradient of 0.81% was calculated. The overall gradient of the reach from the Kitwancool FSR to the Weber Bridge is 0.72%. The gradient along the more direct Forest Service Road, between the two bridges is 1.03%.

Dr. Allen Gottesfeld, a geomorphologist with experience in local streams and fish habitat, suggested that the reach above the Kitwancool FSR Bridge could be restored to a forest pool-riffle configuration. However, the lower portion of Reach 9 (below the Kitwancool FSR bridge) should remain as a single channel with a relatively deep stream incised in the wetlands. Furthermore, the beaver-damming problem must be overcome prior to the completion of any in-stream works. If beavers are removed as effective geomorphologic elements, then a single channel pool-riffle stream can be created in the 2.7 km reach above the Kitwancool FSR Bridge. In order to maintain a single channel stream and proper fish passage in section 1, a reduction in beaver abundances should suffice.

Figure 3: Map of Hydrology Stations

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on disk provided.

Filename: wangriver_hydrosurvey.pdf

Presently, efforts to restore the stream to its original channel would be futile unless an effective beaver dam management plan could be put in place. Once the beaver population has been controlled, managers must allow the system to re-channelize and flush itself-out, a process that may take up to 5 years, depending on the magnitude of the seasonal floods. Following this process, Dr. Gottesfeld suggested placing large woody debris (preferably cedar logs/stumps) or large boulders throughout the impacted area. The intention is to use these obstacles to create a forced pool-riffle sequence. The target density should be from 0.2 to 6 pieces per channel width, with preferred densities toward the higher part of this range. The placement of large woody debris and boulders will allow the development and maintenance of the desired forest pool-riffle morphology and create excellent cover for adult salmonids and nursing juveniles.

5. BEAVER MANAGEMENT OPTIONS FOR THE UPPER KITWANGA RIVER

5.1 Option 1: No Further Actions

Taking no beaver management actions would likely result in the repeat of events that lead to this study; i.e. coho salmon would lose access to Reaches 10, 11, and 12. This would reduce the productive capacity of the Kitwanga River quite considerably, considering that these reaches represent over 8 kilometers of spawning and rearing habitat. Furthermore, if no actions are taken it is possible that the beaver population will continue to grow in numbers and expand in range resulting a higher density of beaver dams for coho to navigate through. Presently, the beavers have only blocked the middle and upper section of Reach 9, but it is possible that they will spread to the lower section of Reach 9 above Kitwancool Lake. This could essentially eliminate another 2 kilometers of coho habitat.

5.2 Option 2: Manage mainstem reaches for beavers, allow beavers proliferation in small tributaries

Once all the initial assessments of beaver population status, impacted areas, and hydrology, the extent of the threat to coho salmon migration will be determined. With this information, managers can prescribe a management plan specific to the Upper Kitwanga River. Depending on project funding, it may be more feasible to only concentrate efforts in certain areas. In areas where beavers are negatively impacting coho migration routes, prescriptions could be developed to rehabilitate only mainstem reaches, while allowing beaver proliferation in minor tributaries. However, the problem with this option is that surrounding beaver populations will continuously try to reestablish themselves in the mainstem.

5.3 Option 3: Seasonal Dam Breaching

Seasonally breaching of beaver dams along coho migration routes is a worthwhile exercise, but requires extensive amounts of labor to maintain fish passage on a yearly

basis. Dam breaching should take place twice a week during the entire coho salmon run, usually from early September to late October. Breaching should be done by hand and not by machine to minimize site disturbance. All provincial guidelines must be followed, which include

- lowering the water table in 20 cm intervals to allowing water levels to stabilize prior to next beaching event,
- ensuring natural stream vegetation remains intact and,
- placing sediment control devices if needed.

Seasonal dam breaching was undertaken by GFA from 1999 to 2002 on the Upper Kitwanga River and the amount of effort required often exceeded the manpower budget. The area was hard to access and contained up to 35 dams of which many were rebuilt between breaching sessions.

5.4 Option 4: Fish Passage at Beaver Dams:

Presently, there are small-sized fish-ways on the market that allow for fish passage through beaver dams and a steady water flow without compromising the beaver pond ecosystem. Such a device was tested and proved successful in small, spring-fed tributary of the Telkwa River in northern British Columbia. Although this system has proven effective in some beaver pond, they are labour intensive and costly to set-up. Erecting this type of fish-way in the Upper Kitwanga River mainstem is probably unfeasible given the remoteness of the area and the dozen or more dams requiring passage. However, fish-ways could be practical and feasible at some stage of a beaver management plan in another areas that easily accessible and consist only one or two dams. .

5.5 Option 5: Beaver Population Control

To eliminate “nuisance beavers” several population control measures can be implemented. Several techniques used to reduce beaver numbers include trapping (conibear and leg-hold traps, snares, and live traps), habitat manipulation, and beaver-proof drain devices in dams and culverts (Bookhout, 1996). Throughout his review Grieve (1999), compared reports on the effectiveness of these population control techniques and suggested that trapping is the best technique to use for beavers. This method is relatively cost-efficient compared to habitat manipulation or installing physical structures.

5.6 Option 6: Riparian Prescriptions to Increase the Conifer Content

Beavers depend on a wide variety of deciduous plant species (e.g. poplars, willows, and alders) for food and to build lodges and dams (Hamelin, 2000). These areas are usually found in early forest successional stages. Since beaver activity is restricted to riparian corridors (usually with 75 meters of a waterbody), they can maintain the forest in an early successional state by continuously consuming new plant growth (Stenberg, 2001).

A long-term approach may involve altering the current vegetation composition within the riparian zone to reduce its desirability for beavers. More particularly, this plan would to increase the conifer content of the riparian forest, which will eventually suppress the more desirable deciduous species. Vegetation and soil surveys that concentrate within the riparian corridor would provide the necessary information to prescribe a reforestation plan. Initial assessments will identify all areas, in close proximity to beaver colonies, where conifer species are rare or absent, and where logging has occurred in the past. Conifer species native to the forest in the Upper Kitwanga River watershed include white spruce (*Picea glauca*), western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), and subalpine fir (*Abies lasiocarpa*), and lodgepole pine (*Pinus contorta*). Each species has its unique site requirements, which depend mainly on soil texture, moisture regime, and competing vegetation. Before any species is chosen, survival plots containing all the above-mentioned conifer species would be established on a wide variety of site conditions. The results of this assessment would provide silviculture foresters with a better understanding of what tree species would be best suited for each site condition.

6. MONITORING OF PROGRAM EFFECTIVENESS

The Upper Kitwanga River should be monitored throughout the coho salmon spawning period to assess if fish migration is impeded by beaver dams. These monitoring activities could be undertaken by the Gitanyow fish and wildlife biologists, fisheries monitors (guardians), or fisheries technicians to ensure that all objectives of the program are being met. Adult escapement and juvenile density surveys should continue in Reaches 9 and above to determine the effectiveness of beaver dam breaching.

Currently, water temperature and discharge regimes are being monitored using Aquarods in the Upper Kitwanga River by GFA. Aquarods meters were placed above and below the beaver dam complexes and they have been collecting hydrology data since August 2002. Presently GFA recommends that hydrology monitoring be continued in the future as this data is also used in the Sockeye Salmon rebuilding program.

All restoration projects should include the monitoring of its effect on other wildlife species, particularly if habitat alteration was expected. To accomplish this, ground and aerial flights surveys would be carried out to determine the distribution, abundance, and habitat preference of wildlife species occupying the study area. Throughout the



Photo #11. Demonstration of the determination of the beaver.

project, the Gitanyow wildlife biologist would monitor and report on any negative impacts to other wildlife species because of an implemented restoration plan.

7. CONCLUSIONS AND RECOMMENDATIONS FOR 2003 AND BEYOND

Over the past 8 years, GFA has been implementing numerous fisheries related projects within the Kitwanga Watershed, including several coho salmon enumeration and enhancement initiatives. Throughout these projects, the importance of the coho salmon has been emphasized for their historical value to the Gitanyow community. In the Upper Kitwanga River, beaver dams continue to be a central issue because they can restrict passage for migrating adult coho. Based on its historical significance, the Upper Kitwanga River should have a comprehensive management plan that aims to ensure unrestricted access for coho to migrate to their native spawning and rearing grounds.

In the short term, GFA recommends that beaver population control and beaver dam breaching is the most viable options that would benefit coho salmon. In the summer of 2003, before coho arrive into the Kitwanga River, a survey should be conducted to determine the number and location of active beaver lodges and dams between Kitwancool Lake and the Weber Forest Service Road Bridge. This information will be used to budget the necessary manpower needed to breach all the dams during the coho spawning period. In addition, this information will be used to allocate the number of

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trappers required during the fur harvesting season to reduce the population to manageable levels.

Over the long term, habitat alteration is recommended in the highest beaver prone areas. This requires a considerable amount of data collection to warrant a comprehensive action plan. A thorough review of the ecological history of the area would provide an accurate account of the environmental changes that occurred in the Upper Kitwanga River watershed since the advent of commercial logging in the 1960's. Information gathering, site restoration, and monitoring require a long-term commitment to ensure that coho salmon and beavers can co-exist in the Upper Kitwanga River.

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