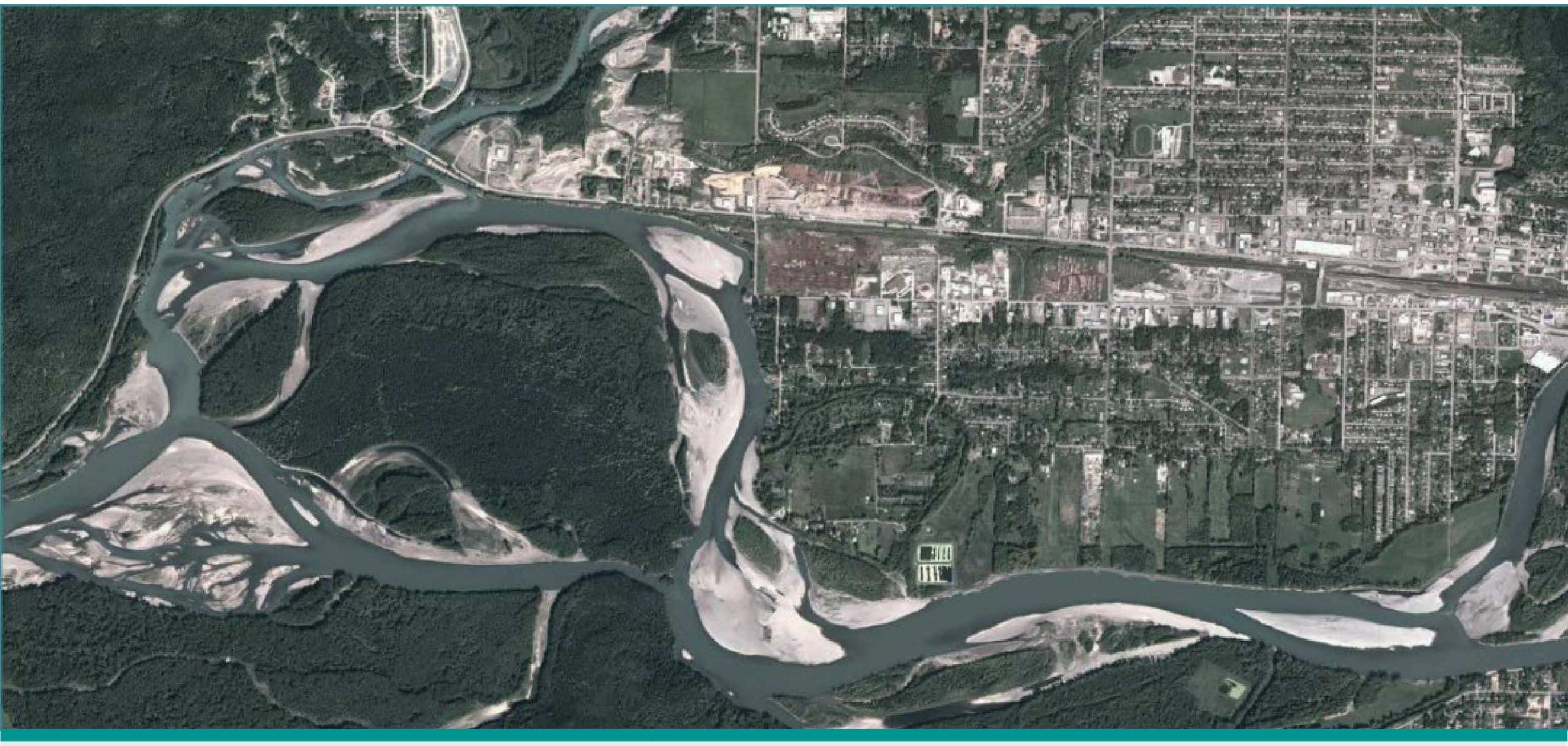

Skeena River Channel Management Phase II – Fisheries Values Assessment

September 18, 2020 | Revision #002

Submitted to: Regional District Kitimat-Stikine
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Our file: 2321-1515-01

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The preparation of this study was carried out with assistance from the Government of Canada and the Federation of Canadian Municipalities. Notwithstanding this support, views expressed are the personal views of the authors, and the Federation of Municipalities and the Government? of Canada accept no responsibility for them.

1. Introduction

In 2019, McElhanney was contracted by the Regional District of Kitimat-Stikine (RDKS) to provide consulting services in support of forward planning of flood mitigation works along the Skeena River and its tributaries near Terrace, BC. As part of flood mitigation planning, the RDKS intended to submit an application for funding assistance under the Union of BC Municipalities' Flood Risk Assessment, Flood Mapping & Flood Mitigation Planning Funding Program. Funding assistance would support the expansion of the Skeena River Channel Management Program (the Project) to include an additional length of the Skeena River and the lowest reach of the Zymoetz/Copper River. Work completed as part of the flood mitigation planning included LiDAR collection, bathymetric surveys, fish habitat assessments, hydrological analysis, channel modeling, and mapping. The following report provides a summary of fish and fish habitat assessments conducted in support of flood mitigation planning.

2. Methodology

The fisheries values component of the project was broken down into two components, the first being a desktop assessment of the study area, identifying fish species that are known to be present and summarizing their respective life histories. The second component involved consultation with local community stakeholders, First Nations groups, and other knowledgeable persons about known use sites, important habitat locations, and threats to salmonids and other fish species.

2.1. DESKTOP REVIEW AND RESEARCH

All waterbodies and tributaries within the project study area were identified using iMapBC. Historical fish presence data available for the area were then assessed using the provincial Fisheries Inventory Data Queries Tool, as well as the BC HabitatWizard Tool. This information was cross-referenced with published reports and documents of the same directive. The results were then compiled and used in conjunction with the consultation portion of the study. Life history descriptions were composed primarily based on descriptions from McPhail (2007) and Gottesfeld and Rabnett (2007), while important habitat sites and historical information was gleaned from Gottesfeld and Rabnett (2007), Hancock *et al.* (1983), and Porter *et al.* (2014).

2.2. LOCAL CONSULTATION

In order to best identify and understand the significance of the study area, various local groups, stakeholders, and First Nations were contacted to gather insight into historical and present-day knowledge of the area. The information that was sought included important fish habitat locations (both present and historical), areas of cultural or economic significance, and potential or existing concerns for the Skeena River and its fisheries. Consultations were conducted both in-person and via email to reach out to as many individuals and groups as possible.

3. Results/Discussion

The Skeena River and its tributaries are host to a multitude of fish species, ranging from the chinook salmon to the three-spine stickleback. These species all use the Skeena River in one form or another as part of their life cycle. Certain fish, such as some population of chinook salmon, utilize the mainstem and side channels of the Skeena River for most of its life stages, while other species and populations, such as some populations of sockeye salmon, use the Skeena as a means of accessing habitat further inland.

The following is a brief summary of the recorded fish species found within the study area, their life histories, preferred habitats, and associated results of the consultations.

3.1. SALMON

3.1.1.Chinook Salmon (*Oncorhynchus tshawytscha*)

3.1.1.1. Life History

Chinook salmon are the largest species of Pacific salmon, with the Skeena River (and more specifically, the lower Kitsumkalum/Kalum River) producing some of the largest chinook in the world. Chinook have two basic life history types: ocean-type and stream-type. Ocean-type chinook migrate to the Pacific Ocean in their first year after emerging. In contrast, the stream-type chinook migrate out after several years of rearing in freshwater. After reaching maturity, the chinook will return to freshwater systems for spawning. In northern populations, the peak in-migration generally occurs in June, with fish entering freshwater systems as early as April and running as late as August.

3.1.1.2. Habitat preferences

1) **Spawning**

   Spawning chinook salmon will typically spawn in larger, faster flowing, coarse-substrate streams. It has also been found, though, that chinook will spawn in smaller, shallower, streams as well as mainstems and side channels of large rivers. The primary factor determining spawning habitat suitability is sub-gravel flow. Due to the unusually large egg size of the chinook, the surface area available for oxygen diffusion is reduced, requiring greater flow around the eggs to provide sufficient oxygen for development.

2) **Rearing**

   Rearing chinook fry have been found to be associated with shallow, low flowing edge habitats, often with fine substrates. This can include channel sloughs and backwaters, as well as tributaries and tributary mouths. As the fry mature, they are known to move into deeper and faster waters.

3) Overwintering

The preferred overwintering habitat of chinook fry includes deep pools, as well as spaces between cobbles and boulders. During the shift from fall to winter habitats, the fry will generally move from tributary streams into larger river mainstems.

3.1.1.3. Areas of Significance

Chinook salmon are the most active users of the Skeena River within the study area. Due to their need for a larger size substrate for spawning, the mainstems of the Skeena and Kitsumkalum/Kalum Rivers have large amounts of historical and active spawning grounds. Our consultations reaffirmed this by identifying several high-value areas for chinook salmon. The specific areas identified can be viewed in Appendix A. Important habitat included the lower 3-9 km of the Kitsumkalum/Kalum River's mainstem, especially between the mouths of Spring and Deep Creeks, the mainstem of the Zymoetz/Copper River below the canyon, and the mainstem of the Skeena River between the mouths of the Kitsumkalum/Kalum and Zymagotitz/Zymacord Rivers (Porter *et al*., 2014). The Deep Creek fish hatchery was also identified as an important resource for chinook stocks. Previously conducted research, as well as consultations, indicated that chinook rearing and overwintering can be found throughout the study area.

Chinook were identified as the second most important fishery for local First Nations and had been considered the most important recreational food fishery until recent restrictions to recreational opportunities, though no specific important netting sites were identified within the study area. Several sites along the Skeena mainstem within the study area were considered very important locations for resident and non-resident chinook fishing until recent restrictions were set in place between Ferry Island and the mouth of the Zymagotitz/Zymacord.

3.1.1.4. Threats

Concerns were noted regarding the current extent and accessibility of chinook spawning habitat compared to the historical availability. Large amounts of chinook spawning grounds have been lost or have become inaccessible due to changing water conditions from historical channelization and recent flood mitigation works. An example expressed throughout the consultation process was the loss of chinook spawning habitat both upstream and downstream of the mouth of the Kitsumkalum/Kalum River, due to the shifting of the primary flow of the Skeena River away from the confluence with the Kitsumkalum/Kalum, through the "Hell's Gate" channel. Many of the stakeholders consulted also expressed concern regarding the Kitsumkalum/Kalum River and its importance as a chinook spawning river. Additional threats identified included historical and ongoing impacts from forestry operations, as well as impacts to water levels and temperatures due to climate change.

3.1.2. Coho Salmon (*Oncorhynchus kisutch*)

3.1.2.1. Life History

Coho salmon occur throughout the Skeena River, migrating as far as 500 km upstream the watershed's headwaters approximately, to compete their freshwater life stages. Of all Pacific salmon species, coho spend the largest proportion of their life history within the freshwater environment, often occupying very small streams. Following emergence from spawning beds, most coho salmon fry spend between one and three years in freshwater systems before beginning migration to the Pacific Ocean (McPhail, 2007). The timing of matured adults' return to freshwater systems is quite varied. Early runs generally occur in September and October, with spawning occurring in November and December. Alternatively, late runs arrive in freshwater in December or January and spawn shortly after. Certain freshwater systems have been noted to spawn into March (McPhail, 2007).

3.1.2.2. Habitat preferences

1) **Spawning**

Coho salmon spawn almost exclusively in backchannels and tributaries rather than the mainstems of rivers. Like chinook, coho prefer spawning sites with sub-gravel flow such as the top of riffles or the tail-outs of pools. Coho spawning primarily takes place in small streams (~1 m in width) with the average substrate size being 9 cm in diameter. Water velocities at spawning sites were found to range between 0.3 and 0.9 m/s (McPhail, 2007). Coho salmon are known to be one of the most secretive spawning species, with spawning events occurring primarily at night.

2) **Rearing**

Newly hatched coho fry will stay hidden in gravels during the day and emerge at night. It has been found in some streams that fry will move down into estuarine habitats where they will live out the summer. Following the summer, some fry will re-enter freshwater to overwinter, while others will proceed directly into the ocean. More typical fry behaviour involves the movement of fry from the spawning gravels into backwaters, side-channels, and shallow, quiet embayments. As the fry mature, there tends to be some emigration from the smaller channels into larger rivers, lakes, and other bodies of water. Given the proportion of the life cycle that is spent rearing in freshwater, suitable overwintering and rearing sites are particularly important to coho.

3) **Overwintering**

During the fall months, coho fry will move into off-channel winter habitats. These include beaver ponds, flooded wetlands, and deep pools. Here, they will seek cover in woody debris, undercut channel banks, cobbles, and large deep cut root wads.

3.1.2.3. Areas of Significance

Given that coho prefer lower velocity habitats for their juvenile freshwater life cycle, their habitat within the study area primarily consists of river backchannels and tributaries. Nonetheless, there were several high value habitats identified from stakeholder consultation which can be viewed in Appendix A. Important spawning sites within the study area include Spring Creek, Deep Creek and Thornhill Creek, as well as side channels of the lower Zymagotitz/Zymacord and Kitsumkalum/Kalum Rivers (Porter *et al*., 2014, Applied Ecosystem Management, 2001). As with the chinook salmon, the Deep Creek hatchery was identified as an important contributor to coho salmon stocks. While coho are a target species for many recreational fishermen, most coho fisheries target tributary rivers. Coho are identified as a secondary species for First Nations food fisheries.

3.1.2.4. Threats

Given the proportion of the life cycle spent in freshwater, coho were identified as a species of particular concern when discussing potential impacts to freshwater systems, both from instream works and climate change. Concern was expressed regarding the condition of, and access to, backchannel spawning and rearing habitats. Instream works, including historical dyking of the Zymoetz/Copper, Zymagotitz/Zymacord and Kitsumkalum/Kalum Rivers as well as development of the highway and rail corridors, were identified as having isolated side channel and back channel habitats, and having altered flows to reduce habitat suitability. More recently, impacts to coho habitat were reported in sloughs at Braun's Island, where a shift of the Skeena River's primary flow toward the Hell's Gate channel reduced water levels, minimizing habitat accessibility and suitability. Due to their preference for small tributaries, side channels and other low flow sites, coho were also considered at risk from changes in precipitation and temperature regimes due to climate change, which could reduce water levels and increase water temperatures within these sites, and could also reduce and connectivity to these habitats.

3.1.3. Pink Salmon (*Oncorhynchus gorbuscha*)

3.1.3.1. Life History

Pink salmon presence and habitat use within the study area differs substantially from other salmon species due to their life histories and spawning characteristics. Pink salmon are less capable than most other salmon species at navigating and passing velocity barriers in rivers and streams, which forces them to choose spawning grounds on the lower ends of rivers.

The timing of spawning for Skeena pink populations differs from their southern counterparts, with Skeena pinks entering freshwater earlier in the summers, between July and August. Spawning generally occurs between September and October.

After spawning, the eggs will incubate over the winter period, with hatching taking place between one and three months after deposition, and emergence from the gravels three to five months after hatching. Once their swim bladders have developed, approximately two weeks after emergence, the fry will begin to migrate downstream to estuaries. Once at sea, pink salmon only spend a year and a half maturing before they begin the return migration to spawning grounds. The two-year return period results in distinct even and odd-year pink runs in many watersheds.

3.1.3.2. Habitat preferences

1) **Spawning**

   Pink salmon prefer spawning sites that consist of clean, coarse gravel with adequate sub-gravel flow. These sites typically found in shallow riffles or channels between 20 and 100 cm deep. Water velocities in these sites have range between 0.30 and 1.0 m/s (McPhail, 2007).

2) **Rearing**

   Pink fry spend little time rearing in freshwater habitats. Newly hatched alevins remain hidden in river gravels for approximately two weeks while their swim bladders develop. Once developed into fry, they migrate directly to estuarine and ocean habitats.

3) **Overwintering**

   Due to the pink fry's direct migration to estuarine and ocean habitats, no overwintering occurs within freshwater.

3.1.3.3. Areas of Significance

Due in part to the life history of the pink salmon, habitat use within the study area is restricted to spawning sites, as well as migration through the study area. Of the areas identified during consultations and desktop research, most areas with pink presence are located near tributary confluences. This includes Thornhill Creek and Deep Creek, the Kitsumkalum/Kalum River between the Highway 16 bridge and the canyon, and the lowest reach of the Zymoetz/Copper River (Porter *et al*., 2014, Applied Ecosystem Management, 2001). It was also noted that pink salmon have been historically been observed spawning in the braided channels immediately downstream of the Hell's Gate channel. However, the suitability of this habitat is in question as the increased currents from the primary flow may be too strong for pink spawning. Pink salmon were not identified as a target species for First Nations or recreational fisheries. As a result, no sites were considered as high value fishery locations with regard to pink salmon.

3.1.3.4. Threats

Threats to pink salmon within the study area include reduced winter flows, which can result in the desiccation or freezing of spawning gravels, as well as flash floods which can result in erosion or siltation of spawning beds.

3.1.4. Sockeye Salmon (*Oncorhynchus nerka*)

3.1.4.1. Life History

Sockeye salmon have a relatively diverse set of life histories, with different populations having distinct rearing and migration factors. Typical life history involves a lake-rearing phase shortly after hatching and emergence. Certain populations, however, do not rear in lakes; these are known as river-type and sea-type sockeye. River-type sockeye will rear exclusively in streams and rivers for one to two years, whereas sea-type sockeye will migrate directly into estuarine habitats during their first summer. Freshwater entry for Skeena sockeye returning to spawning grounds peaks in July and August, with spawning taking place between August and November.

3.1.4.2. Habitat Preferences

1) Spawning

Spawning sites for sockeye generally consist of shallow riffles, outlets of lakes, or the shorelines of lakes where upwelling occurs. These sites are preferred due to their sub-gravel flow. River- and sea-type sockeye will typically choose smaller tributaries and side channels where adequate upwelling and sub-gravel flow exists. When spawning in creeks or tributaries, sockeye nesting will take place in gravel that ranges in diameter from 1 to 2.5 cm. Water depth and velocity will range from 0.15 to 0.85 m/s in depths from 6 to 37 cm (McPhail, 2007).

While some riverine spawning sites are believed to see recurring use by river-type sockeye populations, others may be used as fallback sites for lake-type populations in the case of extreme events that limit passage to preferred lake spawning sites (Porter *et al*., 2014).

2) Rearing

Lake-rearing populations of sockeye will generally remain in the littoral zone of lakes — the zone found on the edges of lakes where aquatic plant life can grow — for a period before moving to the limnetic zone, the open and well-lit area of the lake. River-rearing populations will concentrate in quieter waters such as the margins of rivers, back-channels, beaver ponds, and tributary mouths.

3) Overwintering

Overwintering generally occurs in the limnetic and littoral zones of lakes; however, for the river-type populations, overwintering occurs in waters with depths between 0.2 and 1.1 m in depth (McPhail, 2007).

3.1.4.3. Areas of Significance

While both lake-type and river-type sockeye are known to occur in the Skeena system, only two riverine habitat sites are known within the study area. One site consists of side channels of the Kitsumkalum/Kalum River near the mouth of Deep Creek which has seen confirmed spawning (Porter *et al.*, 2014). The other site was historical rearing habitat in the braided channels downstream of Hell's Gate, though increased flow through this area due to the shift in the Skeena River's current may have limited this site's suitability. Aside from the two spawning and rearing sites, important habitat within the study area incudes sites suitable for holding during migration. These sites include shallower points in the river with distinct riffles.

Given that sockeye are considered the most important food fishery for local First Nations, several sites within the study area were identified as significant fishing sites. In particular, three sites were identified near the old Skeena bridge at Terrace: two sites on the right bank, both immediately upstream and immediately downstream of the bridge, as well as the left bank immediately downstream of the bridge. Another site was identified on the right bank of the Skeena opposite the mouth of the Zymoetz/Copper River. For resident and non-resident sockeye fishing, the top end of Ferry Island was repeatedly identified as a very important site for fly fishermen.

3.1.4.4. Threats

Threats to sockeye identified during consultations and desktop review included climate change and overfishing.

3.1.5. Chum Salmon (*Oncorhynchus keta*)

3.1.5.1. Life History

Like pink salmon, chum spend relatively little time in freshwater systems compared to other salmon species. Their return to freshwater systems varies between northern and southern populations, with the northern populations (including Skeena chum) returning between late July and August. Spawning then generally occurs anywhere from September through to early January. After spawning occurs, the eggs incubate over winter for approximately two to three months before hatching. Like several other salmon species, chum alevins respond negatively to light and will remain in gravels for up to 10 weeks before emerging. Almost immediately after emergence, fry will migrate downstream into estuarine environments to begin feeding before entering the Pacific to mature.

3.1.5.2. Habitat

1) Spawning

Chum salmon spawning locations are primarily found in sites where river flows are mixed upwelling groundwater, which are often warmer than the surrounding waters. The predominant river substrates for chum redds are cobbles less than 15 cm in diameter, though the size of the substrate varies with the size of returning females (McPhail, 2007). Water velocities for spawning range from 0 to 1.7 m/s, but are usually between 0.2 and 0.8 m/s. Females will often build multiple nests within a spawning site, laying most of the eggs in the first nest, with successive nests receiving fewer and fewer eggs.

2) Rearing

Due to chum salmon migrating to estuarine environments shortly after emergence, limited freshwater rearing occurs.

3) Overwintering

Apart from egg incubation occurring over winter, no freshwater overwintering occurs.

3.1.5.3. Areas of Significance

While chum spawning habitat requirements are highly specific, historical spawning locations were scattered throughout the study area. More recently, sites known to maintain active chum spawning are limited. Known spawning reaches within the study area include the lower reaches of the Zymoetz/Copper River, Kleanza Creek, side channels of the Skeena River upstream of the old bridge in Terrace, the lower Kitsumkalum/Kalum River, and the mainstem of the Skeena River between the mouths of the Kitsumkalum/Kalum and Zymagotitz/Zymacord Rivers. Historical spawning has also been noted in the braided channels below Hell's Gate. Currently, habitat restoration works are underway within Kleanza Creek in an effort to restore historical habitat and chum stocks to the area.

3.1.5.4. Threats

Chum stocks within the Skeena watersheds are already in low numbers, so any available habitat within the system is considered very sensitive. Historical impacts to chum that were identified during consultations included the channelization of Kleanza Creek, as well as channel migration and impacts to chum migration below the highway bridge over the Zymoetz/Copper River. Current and future threats to chum salmon within the study area include reduced winter flows, which can result in the desiccation or freezing of spawning gravels, as well as flash floods which can result in erosion or siltation of spawning beds. Chum salmon are also at risk from climate change impacts in the marine environment, due to arrival there at a relatively early life stage.

3.2. OTHER SALMONIDS

3.2.1. Steelhead/Rainbow Trout (*Oncorhynchus mykiss*)

3.2.1.1. Life History

Steelhead are the anadromous population of the rainbow trout. Steelhead are then further broken down into summer and winter run populations, each with unique characteristics. Summer run steelhead enter freshwater in the summer to late fall as immature subadults and will spend up to eight months in freshwater maturing before spawning. Winter run steelhead enter freshwater systems fully mature in the winter to late spring spawning at the same time as summer run steelhead. After hatching and emergence, most steelhead populations rear for two to three years in freshwater prior migrating to the ocean, with some remaining in freshwater for up to five years before smolting. The smolt migration back to ocean habitats generally occurs in the spring months during the annual freshet.

Rainbow trout will, instead of migrating to marine environments, spend their entire lives in freshwater systems. Their habitat preferences during this time remains largely the same.

3.2.1.2. .Habitat

1) Spawning

Steelhead spawning habitat tends to be in faster waters with velocities of approximately 0.3 to 0.9 m/s and depths of 0.15 to 2.5 m (McPhail 2007). Like other salmonids, though, steelhead prefer sites with sub-gravel flow, such as upwelling sites, sites upstream of riffles, and pool tail-outs. Steelhead spawning sites usually have larger substrates than other resident species, ranging from large gravels to small cobbles.

2) Rearing

Most steelhead populations in BC rear for two to three years in freshwater before migrating to the ocean, though some may spend up to five years in freshwater before smolting. It should be noted that steelhead fry and juveniles are territorial and will establish territories shortly after hatching. These territories are typically in shallow water sites along river margins. Steelhead fry and juveniles were found to frequent logjams and riprap sites in the spring months, moving to riprap and cobble sites in the summer and winter months. As steelhead mature, they move from river margin sites into deeper mid-channel sites.

3) Overwintering

Young-of-the-year steelhead fry predominantly seek overwintering cover along stream margins in areas containing small woody debris, logjams, and riprap sites. As the fry mature, they move away from these river margin sites and into the deeper mid-channel sites with larger woody debris and large cobbles. Cover has been noted as a critical factor in steelhead fry survival during the first overwintering period.

3.2.1.3. Areas of Significance

While the mainstem of the Skeena River is primarily utilized by steelhead for migration, the Kitsumkalum/Kalum and Zymoetz/Copper Rivers are highly important steelhead streams. Steelhead have been documented spawning throughout the mainstem of the Kitsumkalum/Kalum, while Deep Creek was identified as an important spawning stream (Grieve and Webb, 1999, Lough and Whately, 1984). Back channels and groundwater creeks in the lower Kitsumkalum/Kalum watershed, including Deep Creek and Spring Creek, provide excellent and extensive rearing habitat, though overwintering habitat is primarily found upstream of Lean-to Creek. The lower Kitsumkalum/Kalum River is also considered an important site for recreational steelhead fishing in the winter and early spring, while the mainstem of the Skeena River and lower reaches of the Zymoetz/Copper River are targeted for steelhead in late summer.

3.2.1.4. Threats

Because most steelhead populations rear for at least two years in freshwater, steelhead face many of the same threats as other stream-rearing species such as coho and chinook. Given that they also utilize smaller tributaries for spawning, steelhead may also be threatened by stream quality impacts from forestry and other land uses, as well as water level and temperature impacts from climate change.

3.2.2. Coastal Cutthroat Trout (*Oncorhynchus clarkii clarkii*)

3.2.2.1. Life History

Coastal cutthroat trout have four primary life histories: an adfluvial population that migrates between streams and lakes, a fluvial population that migrates between mainstem rivers and headwaters, a resident population that remains in tributary headwaters, and an anadromous population that migrates between salt and freshwater habitats. In the Skeena system, cutthroat populations as far upstream as Cedarvale have been identified as potentially anadromous (Gottesfeld and Rabnett 2007). Coastal cutthroat trout are extremely diverse in their redd choices, as well as spawning times. The Skeena system's spawning time normally occurs between mid-May and mid-June. The emergent fry then spends anywhere between several months and several years in their original streams

3.2.2.2. Habitat

1) Spawning

Coastal cutthroat trout's spawning habits are relatively poorly understood, though it is presumed that their spawning habits are like that of other salmonids. The general redd locations for coastal cutthroats occur in small tributaries to rivers and lakes, with gravel substrate. Cutthroat trout don't appear to display spawning congregations.

2) Rearing

Coastal cutthroat trout fry typically live in low-velocity waters, along stream margins, shallow riffles, backwaters and isolated pools. While rearing, the fry may make small migrations in search of food as well as better overwinter habitat.

3) Overwintering

Preferred overwintering habitat has been recorded in large deep pools, often containing large woody debris.

3.2.3. Dolly Varden (*Salvelinus malma*) and Bull Trout (*Salvelinus confluentus*)

3.2.3.1. Life History

Both Dolly Varden and bull trout occur within the study area. These species are difficult to distinguish, even for seasoned biologists, and frequently hybridize where they overlap. As a result, distinction of important habitats and threats was considered unlikely to be reliable, and the two species were treated as one during consultations.

While both species are known to occur within the study area, bull trout are typically larger, piscivorous, migratory, and more likely to occur in mainstems of major rivers, while Dolly Varden are drift feeders that usually reside as residents within smaller streams. This difference in habitat use is frequently magnified in areas where the two species overlap, such as within the study area.

Dolly Varden have three distinct life history forms: an anadromous form, a stream resident form, and an adfluvial form which migrates from lakes into tributary streams for spawning. The Skeena system is home to all three forms of Dolly Varden. The anadromous form's seaward migration generally occurs in the spring, with the return migration occurring in the fall. The migration routes do not reach as far as other migratory fish species, such as salmon, instead preferring to stay closer to estuarine habitats. Anadromous populations in the Skeena system have been recorded up to Cedarvale, which appears to be the upper limit of the migration (Gottesfeld and Rabnett, 2007). Spawning generally takes place in smaller streams in the fall. The seaward migration for the anadromous populations generally occurs in the spring months. The stream resident forms of Dolly Varden have similar life histories to their anadromous counterparts, with the exception that they complete all rearing within the freshwater system.

Like Dolly Varden, bull trout also exhibit a variety of life history forms, including a migratory fluvial form, an adfluvial form, and a small-stream resident form. The life history forms considered most likely to utilize the study area are migratory fluvial and anadromous forms.

3.2.3.2. Habitat

1) **Spawning**

   The size and depth of redds for Dolly Varden vary with the size of individual females, and possibly with life history type. General redd construction occurs in shallow (<15 cm), low velocity (<0.40 m/s) sections of streams (McPhail 2007).

   Migratory fluvial bull trout migrate in late summer, prior to spawning, moving from large rivers to smaller rivers. They nonetheless utilize relatively large streams for spawning, compared to Dolly Varden. Within these smaller rivers, bull trout typically spawn in runs or glides near groundwater upwelling sites, usually within 5 m of cover. It is suggested that Dolly Varden may act as jacks where they overlap with spawning bull trout.

2) **Rearing**

   Newly emerged Dolly Varden fry are restricted to the bottoms of shallow, slow-moving stream edges. As the fry age, they move to slightly deeper waters, though they are still associated with slower-moving habitats with abundant cover sources. It has been suggested that anadromous Dolly Varden in the Skeena watershed will spend three years in freshwater before migrating and spending another two to three years in the Pacific.

   Bull trout fry also rear in relatively slow-moving pools and side channels with abundant cover, though they show a distinct preference for cold waters (<12^{o}C). Bull trout will spend two to four years rearing in freshwater streams.

3) Overwintering

Both Dolly Varden and bull trout fry move to deeper pools and side channels to overwinter, with many migrating to larger streams or lakes, if necessary.

3.2.4. Rocky Mountain Whitefish (*Prosopium williamsoni williamsoni*)

3.2.4.1. Life History

There are several species of whitefish identified in the Skeena watershed: the Rocky Mountain whitefish, the pygmy whitefish *(Prosopium coulteri*), and the lake whitefish *(Coregonus clupeaformis)*. The most common whitefish species in the Skeena watershed is the Rocky Mountain whitefish. Whitefish, both lake and mainstream populations, will move into small, lower-flow tributaries to spawn. Most spawning occurs between October and November, with the eggs hatching in the spring and early summer. The newly hatched fry will often drift downstream after emergence to move into shallower, low-velocity waters to mature. Fluvial whitefish populations are frequently highly migratory, performing several migrations over the course of a year (McPhail, 2007). As a result, they appear to utilize a wide variety of habitats, though preferred habitats are not well understood.

3.2.4.2. Habitat

1) Spawning

When spawning, whitefish do not build redds, and there appears to be no preference for water velocity or gravel size when spawning. It has been noted, however, that most recorded spawning occurs at the lower end of riffles or the heads of pools.

2) Rearing

Whitefish fry are often found in shallow (<50 cm), quiet waters, with a predominantly sand or silt substrate. As the fry mature, they move to deeper waters with larger substrate.

3) Overwintering

Certain populations of whitefish have been noted to conduct a post-spawning migration from spawning grounds to deeper water overwintering habitats.

3.3. NON-SALMONID FISHES

3.3.1. Threespine stickleback (*Gasterosteus aculeatus*)

3.3.1.1. Life history

Threespine stickleback are an incredibly diverse species, with multiple populations with unique spawning strategies and habitat choices. This summary will focus on the stream and river run stickleback. River run stickleback spawning generally begins when water temperatures rise above 10^{o}C. Due to this temperature dependence, spawning can begin in early spring, depending on seasonal conditions. During spawning, males will build nests to attract females. After the female deposits the eggs, the male will defend the nest and aerate the eggs by fanning them with his tail. The eggs generally hatch between four and seven days after deposition.

3.3.1.2. Habitat

1) Spawning

Spawning substrate differs among stickleback populations. Freshwater resident populations tend to prefer soft, fine substrate close to or within vegetative cover, whereas anadromous populations seem to prefer open areas with sandy substrates (McPhail, 2007). Nesting sites are most commonly found in shallower waters (<1 m), but have been found in waters as deep as 20 m.

2) Rearing

Freshwater stickleback populations tend to be benthic feeders, primarily staying in shallower areas near shore where cover is abundant.

3) Overwintering

Overwintering habitat for threespine stickleback primarily takes place in deeper pools with vegetative cover.

4. Conclusion

4.1. FISH HABITAT SUMMARY

The study area includes spawning habitat for all five Pacific salmon species, as well as steelhead, bull trout and Dolly Varden. However, rearing and overwintering values within the study area were primarily associated with chinook, coho, steelhead, and resident species. Pink and chum salmon migrate directly to the marine environment after emerging from spawning beds, while the nearly all sockeye in the Skeena system spawning in lake tributaries and along lake shores, limiting the rearing and overwintering value of the study area for these species.

Limited sockeye spawning and rearing was identified near the mouth of Deep Creek and in the braided channels of the Skeena River downstream of Hell's Gate. The braided channels below Hell's Gate were also identified as important habitat for pink and chum salmon spawning. For chinook, areas throughout the study area were considered important for all life stages, with the mainstems of the Skeena and Kitsumkalum/Kalum Rivers particularly important for spawning and rearing. Coho and steelhead preferentially utilize side channels and tributaries within the study area, both for spawning and rearing. The Kitsumkalum/Kalum watershed downstream of the canyon, including mainstem, side channels and major tributaries (i.e., Deep Creek and Spring Creek), were identified as very important habitat for chinook, coho and steelhead.

4.2. AREAS OF SIGNIFICANCE

During the consultation period, several areas of significance were identified within the study area. These areas included traditional First Nations fishing sites, important recreational fishing sites, areas of known habitat importance, proposed fish habitat enhancement areas, and areas of cultural or historical significance. Through the consultation process, it was noted that steelhead are often the most economically valuable fish, bringing in the most economic benefits to local guiding outfits, whereas sockeye salmon were noted to be the most important food fishery for First Nations, with chinook salmon being second in food fishery importance. While chinook salmon had been considered important economic drivers from a tourism perspective previously, recent regulation changes had reduced this impact.

Important First Nations fishing sites were identified at several sites within the study area. These included highly public sites such as the right and left banks of the Skeena River immediately upstream and downstream of the old Skeena bridge at Terrace, as well as some sites considered data sensitive by local First Nations. Data sensitive sites were communicated during consultations, but have not been displayed in mapping products. Sites providing boat access to the Skeena River were also considered very important for First Nations fishermen, including Fisherman's Park near the mouth of the Kitsumkalum/Kalum River, as well as the Kitselas boat launch near the mouth of Singlehurst Creek.

Important recreational or resident food fishing sites included Ferry Island, the lower Kitsumkalum/Kalum and lower Zymoetz/Copper, as well as nearly all gravel bars along the mainstem of the Skeena throughout the study area, depending on seasonal openings in fishing regulations. For steelhead, in particular, the mainstem of the Kitsumkalum/Kalum River from the highway bridge upstream to the canyon was considered important for recreational fishing, as was the Zymoetz/Copper River downstream of the canyon.

Important habitat sites included the mainstem and side channels of the Kitsumkalum/Kalum River between the canyon and the highway bridge, all major tributaries to the Kitsumkalum/Kalum along this reach, and the braided channels downstream of Hell's Gate. The mainstem of the Skeena within the study area was also considered important habitat for chinook spawning. In addition to important habitat sites, a number of historical, current and upcoming habitat restoration sites were identified within the study area. These included historical and existing hatchery sites on Deep Creek and on the floodplain of the Kitsumkalum/Kalum River near the mouth of Deep Creek, as well as recent rock weir construction on Kleanza Creek, and attempts to improve fish passage at the mouth of the Zymoetz/Copper River.

4.3. THREATS TO FISH POPULATIONS

Throughout the consultation period, respondents were asked to identify known or perceived threats to the Skeena River fish species. The most frequently identified threats were climate change, changes to water flows, and impacts to water quality from land use. It was reported that the lower water levels and increased water temperatures resulting from changing precipitation and temperature regimes are negatively affecting the survival rates of the already stressed fish populations. Concerns were also raised regarding recent erosion protection works that had either altered flows or reduced fish passage. Specific examples mentioned included the Braun's Island groynes, armouring of the Zymoetz/Copper River highway bridge, and dykes on the Zymagotitz/Zymacord River. These projects, coupled with the lower water levels, were perceived as having removed or reduced access to high value salmon habitat such as backchannels or tributaries.

4.4. IN CLOSING

The Skeena River and its tributaries support a world class salmon and steelhead fishery that has supported local ecosystems and communities for thousands of years. Skeena fish populations have historically survived a wide variety of threats and continue to face familiar and emerging risks that threaten their place as a foundation of ecosystems, communities, and economies. Considering the fisheries values identified in this document during the planning and implementation of future channel management works on the Skeena River will help to protect fish populations, facilitate community consultation, and allow for a proactive approach to flood mitigation.

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Appendix A – Species-specific Study Area Maps

Rev	Date	Description	Drawn	Design	App'd
PB	2020-03-20	REVISED PLAN	JMD	-	GK
PA	2019-12-11	ISSUED FOR INFORMATION	EW	KG	-

1:30,000 SCALE

ORIGINAL DWG SIZE: ANSI D (22" x 34")

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T 250 635 7163

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REGIONAL DISTRICT OF KITIMAT-STIKINE

SKEENA RIVER CHANNEL MANAGEMENT - PHASE 2 CONSULTATION PLAN ALL SPECIES

Drawing No. SK-001

Project Number 2321-01515-01

Rev. PB

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

DATE: 2020-09-14, 11:22 FILE: X:\2321\01500's\01515-01 RDKS Skeena River Channel Management Phase II\10.0 Drawings\10.3 Engineering\10.3.2 Sketches\Map Sheets_ALL FISH.dwg

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SKEENA RIVER CHANNEL MANAGEMENT - PHASE 2 CONSULTATION PLAN CHINOOK SALMON

Drawing No. SK-101

Project Number 2321-01515-01

Rev. PB

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DATE: 2020-09-14, 11:23 FILE: X:\2321\01500's\01515-01 RDKS Skeena River Channel Management Phase II\10.0 Drawings\10.3 Engineering\10.3.2 Sketches\Map Sheets_COHO.dwg

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SKEENA RIVER CHANNEL MANAGEMENT - PHASE 2 CONSULTATION PLAN COHO SALMON

Drawing No. SK-102

Project Number 2321-01515-01

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SKEENA RIVER CHANNEL MANAGEMENT - PHASE 2 CONSULTATION PLAN PINK SALMON

Drawing No. SK-103

Project Number 2321-01515-01

Rev. PB

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

DATE: 2020-09-14, 11:24 FILE: X:\2321\01500's\01515-01 RDKS Skeena River Channel Management Phase II\10.0 Drawings\10.3 Engineering\10.3.2 Sketches\Map Sheets_PINK.dwg

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Rev	Date	Description	Drawn	Design	App'd
PB	2020-03-20	REVISED PLAN	JMD	-	GK
PA	2019-12-11	ISSUED FOR INFORMATION	EW	KG	-

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SKEENA RIVER CHANNEL MANAGEMENT - PHASE 2 CONSULTATION PLAN SOCKEYE SALMON

Drawing No. SK-104

Project Number 2321-01515-01

Rev. PB

Rev	Date	Description	Drawn	Design	App'd
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1:30,000 SCALE

ORIGINAL DWG SIZE: ANSI D (22" x 34")

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SKEENA RIVER CHANNEL MANAGEMENT - PHASE 2 CONSULTATION PLAN CHUM SALMON

Drawing No. SK-105

Project Number 2321-01515-01

Rev. PB

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

Rev	Date	Description	Drawn	Design	App'd
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1:30,000 SCALE

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SKEENA RIVER CHANNEL MANAGEMENT - PHASE 2 CONSULTATION PLAN STEELHEAD

Drawing No. SK-106

Project Number 2321-01515-01

Rev. PA

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