Géis Tóo'e': King Salmon River
2006 Michie Creek Chinook Salmon Field Investigations

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ABSTRACT

This report details the stewardship and research activities that were conducted in upper Michie Creek during the open water season of 2006. The primary purpose of the project is to maintain salmon habitat in this watercourse by monitoring beaver activity and other potential barriers and breaching them when required. Research included the collection of benthic organisms and the monitoring of flow and temperature in upper Michie Creek. In addition, the relative health and abundance of both wild and enhanced juvenile Chinook salmon populations that utilize upper Michie Creek was investigated.

It is believed that water flow conditions in 2006 in the upper Michie Creek spawning area were more than adequate to allow spawning success of Chinook salmon. Very little remedial effort was needed to assure access of migrating Chinook salmon to traditional spawning habitat in upper Michie Creek. Surface temperatures in upper Michie Creek and at the Whitehorse fish ladder were somewhat cooler than in previous years, especially when compared to 2004. Juvenile salmon investigations concluded that there was no apparent effect of hatchery plantings on the survival or growth of wild juvenile Chinook salmon, at densities of wild salmon found in upper Michie Creek and under the environmental conditions that occurred during the open water season of 2005. As in previous years, the bulk of the hatchery juvenile Chinook salmon (jcs) planted into upper Michie during 2006 most likely began downstream movement shortly after release. There is some indication that growth of wild jcs over the summer period is inversely related to their relative abundance in upper Michie Creek. A poor relationship exists between adult Chinook salmon counts through the Whitehorse Fish ladder and resulting yearly CPUE statistics for jcs in upper Michie Creek. Generally, catches of wild juvenile Chinook salmon captured in minnow traps are consistently low during the summer months and increase dramatically in the late fall.

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INTRODUCTION

This project is a continuation of a multi-year program of stewardship activities and related research on Chinook salmon that utilize habitat located in upper Michie Creek, a tributary of the M'Clintock River. The watershed lies within the Traditional Territory of the Kwanlin Dun First Nation and is located in the southern Yukon Territory. The M'Clintock River represents a portion of the headwaters of the Yukon River Basin and supports one of the longest spawning runs of anadromous Chinook salmon in North America, with annual migrations of over 3,000 km. The continued maintenance of the Michie Creek Chinook salmon population is an important management objective for both the Kwanlin Dun people and the Department of Fisheries and Oceans Canada.

The salmon have long been important to the people of the Kwanlin Dun First Nation (KDFN) whose traditional territory encompasses the watershed. For generations, the rich salmon resources associated with the Yukon and McClintock River provided food for many families. Early explorers also noted the abundant salmon of the area in the late 1800's (Dawson 1887; Cox 1997). In recent times, the salmon population has declined and the Kwanlin Dun people are no longer able to harvest this food source. Causal factors have been largely speculative, although over-harvesting during migrations and disruption of habitat caused by the construction of the Whitehorse Rapids dam have been implicated.

BACKGROUND

With the building of the Whitehorse Rapids dam and hydroelectric station in 1957, historic Chinook salmon migrations into the upper Yukon River had an uncertain future. The dam was a complete barrier in 1958 and by the spring of 1959 a fish ladder was constructed to allow passage of migrating fish past the dam (Gordon *et al* 1960; Williams, pers. com., 2002). The Whitehorse Rapids fish ladder, a structure that is 366 meters long and rises over 15 meters, has been in operation since. Technical details of the ladder are described in Gordon *et al* (1960). Each year spawning Chinook salmon ascend the fish ladder to access spawning habitat primarily in Michie Creek, a major tributary of the M'Clintock River. During their migration through the fish ladder they are enumerated each year with the data serving as an index of the relative health of this genetically distinct population.

In 1984 a hatchery was constructed as a mitigative response to the installation of a forth turbine at the Whitehorse Rapids dam. Since construction, annual releases have ranged between 84,000 and 441,500 Chinook salmon fry. Release locations have primarily been above the dam and particularly in the M'Clintock River and in upper Michie Creek. The primary purpose of the hatchery is to offset perceived mortalities of juvenile Chinook salmon passing over the dam's spillway and particularly, through the turbines. Over the longer term it is anticipated that these supplemental releases will increase the spawning population above the dam. Currently, all hatchery origin fish are adipose clipped and coded wire tagged for identification.

Chinook spawning migrations through the fish ladder have averaged about 900 fish since annual counts were established in 1961 (Appendix III). The lowest count of migrating adults was recorded in 1976 and was only 121 fish. The highest count of 2,958 fish was recorded in 1996. The large year to year fluctuations in counts make long term trends difficult to interpret. None-the-less, numbers of migrating fish through the ladder appear to have increased in recent times based on the 1996-2005 average of 1,538 fish. Returning adults originating from hatchery plantings are also variable. Based on counts through the fish ladder from 1992 to 2005, hatchery fish now account for 60 percent of the adult spawning migration. The sex ratio of the adult spawning migration through the fish ladder is also highly skewed in favour of jacks and small males (Milligan, pers. com., 2005).

Since the construction of the Whitehorse Rapids dam Chinook salmon has been a focus of study in the upper Yukon River basin. Investigations have included the study of juvenile out-migration (von Finster *et al* 1988; Moodie *et al* 2000), juvenile habitat preferences and distribution (Hunka and Schuyler 1988; Bradford *et al* 2001; Pumphrey 2003), estimates of juvenile turbine mortality (Hryciuk 1973), adult enumeration in the M'Clintock River (Matthews 1994; Matthews 1999a), adult radio tagging (Cleugh and Russell 1980; Mathews 1999b), biophysical inventories (Brown 1976; Cleugh *et al* 1978) and archival research of salmon stocks of the upper Yukon River basin (Cox 1997). In addition, numerous foot and aerial surveys have been conducted at known and potential spawning locations in the upper watershed (Milligan, pers. com., 2003).

OBJECTIVES

In keeping with its vision of resource stewardship and to continue to build capacity, the Kwanlin Dun First Nation (KDFN) is continuing studies to successfully understand salmon resources in their Traditional Territory. The long term goal of the First Nation is to participate with management agencies to rebuild salmon populations to sustainable levels, and protect salmon habitat from conflicting land uses. KDFN continues to train people in fisheries field techniques and involve staff in field investigations and project management; the First Nation taking on an increasing role in the stewardship and management of land and resources within its Traditional Territory. The following were specific objectives of the 2006 Michie Creek Chinook salmon field investigations:

1. To examine, document, and maintain access to Michie Creek spawning habitat by adult Chinook salmon in this watercourse;

2. To continue field research and perform watershed monitoring through data collection and analysis of the interactions between wild and hatchery juvenile Chinook salmon in Michie Creek;

3. To undertake adult spawning enumerations, dead pitch, CWT recoveries and redd surveys in upper Michie Creek.

The First Nation has also commenced a watershed planning initiative for the M'Clintock drainage which encourages participation of community members. This planning initiative will address various management issues and risks to salmon and their habitat in the watershed. It is anticipated that the project will also increase awareness of this unique population amongst the Kwanlin Dun people.

STUDY AREA

The M'Clintock River watershed rises in the mountains of the Yukon Plateau north of Marsh Lake, about 110 km east of Whitehorse. The drainage basin is in KDFN traditional territory and lies within the Boreal Cordillera ecozone that is composed of rolling hills and plateaus that are dissected by streams. The region has been previously glaciated and contains widespread deposits of glacial origin. A detailed description of the surficial geography is included in the M'Clintock Watershed Management Plan (KDFN 2003).

The watershed contains several lakes (5-500 ha), numerous tributaries, and wetlands to form a drainage area of approximately 1,650 km^2. Surface waters originating in the M'Clintock watershed flow into Marsh Lake, a large headwater lake of the Yukon River basin. Information is limited about the distribution of freshwater fish species in much of the drainage. Cleugh *et al* (1978) reported catches of northern pike, lake or humpback whitefish, longnose sucker, Arctic grayling and slimy sculpin in the Michie Creek drainage. In a recent study of M'Clintock and Michie lakes, the presence of lake trout, round whitefish and burbot have also been confirmed (KDFN 2003).

White and black spruce are the most common forest type of the ecozone with sedge tussocks and/or sphagnum common in the wetlands. At higher elevations, scrub birch and willow occur in subalpine sections. The climate in this region is characterized as an interior subalpine type with long cold winters and summers that are brief and cool (Environment Canada 2003).

Michie Creek is the largest tributary in the M'Clintock drainage basin and is the primary spawning area of migrating Chinook salmon above the Whitehorse Rapids dam. Physical and vegetative habitat descriptions of upper Michie Creek have been previously described (KDFN 2003, KDFN 2005). Stewardship activities associated with this project are primarily conducted in a reach of Michie Creek between the outlet of Michie Lake and the Byng Creek confluence, a distance of about 5 km of stream (Figure 1).

METHODS

Six field surveys and two aerial flights were made into the upper Michie Creek Chinook spawning area between May and October, 2006. Field surveys were completed on June 6, June 27, July 19, August 5, September 7 and October 4. An aerial enumeration survey required the use of a helicopter and was flown on September 3. For each ground survey access was gained into the Michie Creek spawning site using ATV's. Field equipment and camp supplies were transported by ATV trailer to a staging area on the west basin of Michie Lake (Figure 1).

Instantaneous water discharge in upper Michie Creek was estimated during each field survey at site M1. A section of stream channel that had a uniform cross section was used for the estimate. A Global Flow Probe was used to assess mean column velocities of the stream. Discharge was subsequently calculated using measured velocities and cross-sectional areas. A Solinst combination water level and temperature data logger and a Solinst atmospheric barometer were used to monitor stream temperature and level at site M1 in upper Michie Creek. Installation methodology is described in KDFN (2004). Hobo® Water Temperature Pro data loggers were installed during the spring of 2006 at two locations including the Whitehorse Rapids fish ladder and in the Yukon River mainstem downstream of the Whitehorse Rapids dam. Each data logger was attached to a brick and secured with aircraft cable to the closest bank or stationary object. Locations were marked with flagging tape and GPS coordinates were noted. Loggers were retrieved in September and data was downloaded onto a desktop computer. Mean daily surface water temperatures were computed from hourly measurements and presented graphically.

Benthic organisms were collected during 5 of the 6 field trips at site M1. Collections were made in triplicate with a 500 micron mesh surber sampler. The stream bed material within the sampler frame was cleaned by hand to a depth of approximately 10 cm. All captured invertebrates and associated detritus were placed in labeled one litre containers and preserved with 10% formalin. Sample collections were shipped to an invertebrate biologist for sorting, identification and enumeration. As in previous years, benthic invertebrate data was analyzed using the Shannon Wiener Diversity Index as described by Pielou (1966).

A minimum of 10 Gee type minnow traps were utilized during each field survey. Minnow traps were constructed of _ inch galvanized mesh and were throughout the project with the exception of early June when _ mesh traps were used. Minnow traps were set in a variety of habitat features including root wads, cutbanks and woody debris. Soak times were recorded for each individual trap. All captured juvenile Chinook salmon were sampled in accordance with the *Yukon River Panel Protocol for collection and* *reporting of data from juvenile salmon sampled in Canadian R&E Projects* (Yukon River Panel 2005a). Age was determined by using length frequency distributions described by Duncan and Bradford (2004). For comparative purposes a sub-sample of hatchery reared juvenile Chinook salmon were measured at the Whitehorse Rapids fish hatchery on June 5. Condition factors were calculated using methods described in Everhart (1975). A growth curve of wild jcs was derived from linear regressions of log transformed mean fork lengths that were plotted with capture date.

For dead pitch, CWT recovery and redd surveys, upper Michie Creek was walked on September 6, 7 and 10. Spawning habitat below the M'Clintock River waterfall and the Michie Creek confluence was surveyed by boat on September 3. Redd locations were identified in the stream bed by their oval shape, size and distinct appearance free of algae and sediment. Redds and carcasses were enumerated, sampled and heads from hatchery origin fish containing CWT tags were removed and labeled.

A foot survey on August 4 and 5 was used to identify potential barriers that would limit upstream access of Chinook salmon to known spawning sites on Michie Creek and the M'Clintock River. This survey was timed to correspond with observation from years past of the first migrating salmon to reach the upper Michie Creek spawning area. All identified potential barriers during this project were managed in accordance with the *Yukon River Panel's Protocol for Obstruction Management* (Yukon River Panel 2005b). The aerial flight on September 3 was used to confirm the absence of barriers in upper Michie Creek.

RESULTS

Water Flow and Temperature

The combination level/temperature recorder in upper Michie Creek functioned normally throughout the summer of 2006. Calculated average daily flows and instantaneous measurements taken at site M1 in Michie Creek during each field trip in 2006 were used to compare discharge data recorded for the same site in 2004 and 2005 (Figure 2). The discharge pattern in 2006 was similar to the pattern in 2004 with peak flow recorded in late May. Discharge in 2006 was significantly greater than in 2004 and thought to be comparable to 2005 based on several instantaneous measurements during that year. Sustained flows of approximately 2.38 m^3 sec^{-1} through the peak Chinook spawning period from approximately August 15 to September 15 was recorded in 2006. Flows for the same period in 2004 were significantly less approximating 1.48 m^3 sec^{-1}. Rainfall during the months of June, July and August recorded in Whitehorse during 2004 were well below the 30 year average reported by Environment Canada (2006).

On average, water temperatures in Michie Creek were generally cooler in 2006 than those recorded in either 2003 or 2004 for the period between July 21 and September 15 at site M1 (Figure 3). In 2006 a single thermal peak occurred in early July followed by a slow and steady decline into the cooler climatic conditions of the fall. The maximum stream temperature at site M1 in 2006 was 18.3 º C recorded on July 3. The average daily temperature during the Chinook spawning period (August 15 to September 15) was 12.0 º C in 2006 compared to 15.3 º C for 2004. Although there are no recorded stream temperatures for upper Michie Creek during the summer of 2005, fish ladder temperatures recorded in the same year would infer cooler stream conditions in comparison to 2004.

Similar to Michie Creek, water temperatures recorded at the Whitehorse Rapids fish ladder were generally cooler throughout the summer period compared to previous monitoring years (Figures 4). The exception was a brief period in mid June when temperatures exceeded all those previously recorded. For the balance of the summer and throughout the Chinook migration period (July 29 to September 6) water temperatures were slightly lower than either 2005 or 2003 and about 2º C lower than those recorded in 2004. Overall, water temperatures were more consistent with much less variation than those recorded during 2004. A single summer thermal peak can be seen in Figure 4 during mid July. Water temperatures in the fish ladder during the adult Chinook migration between August 3 and September 5 averaged 13.5 º C, ranging from 11.9 º C to 15.0 º C. The temperature logger deployed in the mainstem of the Yukon River below the Whitehorse Rapids dam during the spring could not be located in September despite several searches. Data comparisons of this location to previous years therefore could not be made.

Benthic Organisms

Enumerated benthic organisms and their taxonomic groupings from 2006 field collections at site M-1 in upper Michie Creek are presented in Appendix I. Subsequent analyses of each collection episode are summarized in Table 1. Benthic density in May was an order of magnitude lower than in September. Diversity remained consistently high from late June through to the September sampling period. Streambed invertebrate density ranged from 6,183 (m^2) organisms in early June to a high of 59,678 organisms (m^2) in September.

The dominant benthic group during sampling in May through August was diptera representing 38 to 55 percent of the organisms collected. The subdominant groups during these sampling periods were represented by bivalves (mollusks), ephemeroptera (mayflies) and hydracarina (water mites). During September ephemeropterans (mayflies) were the dominant group representing only 32 percent of the organisms collected. Subdominat groups included diptera (flies) and tricoptera (caddisflies). Overall, benthic analysis suggests species richness continues to be relatively high at site M-1 in Michie Creek with 68 identified taxonomic groups representing 37 different families.

Juvenile Chinook Salmon (jcs)

Morphological data for sampled Chinook juveniles is presented in Appendix II. Hatchery jcs of age 0^+ averaged 64 mm in fork length and 3.0 gm in weight just prior to release into the wild in 2006 (Table 2). The average size of wild 0^+ jcs in Michie Creek on June 6 just prior to the introduction of hatchery juveniles was 39 mm in fork length and 0.6 gm in weight. During the 120 days of growth between June 6 and October 4, the average fork length and weight of sampled wild jcs in Michie Creek increased by 36 mm and 3.6 gm, respectively. A comparison of growth curves of wild 0^+ jcs that were minnow trapped in upper Michie Creek from 2003 to 2006 is presented in Figure 5. Juvenile Chinook salmon (0+) in 2006 reached a similar size class as those recorded in 2004. The largest size attained for jcs after a summer of growth since monitoring began in 2003 was during 2005.

In 2006, and in previous years, jcs dominated the catch in minnow traps at site M-1 in upper Michie Creek with a total of 744 captured. About 50 percent of all captures were during a single minnow trapping episode on October 4 (Table 2). Hatchery origin fish were nearly absent in the overall catch with a single 0+ aged fish captured on June 27 (Table 3). Older wild Chinook juveniles were also not well represented in the overall catch. A single wild age 1+ juvenile was captured on June 6. Other fish species captured during the summer of 2006 included longnose sucker (37), slimy sculpin (11) and burbot (6). Excluding catch data from the late fall to allow for year to year comparisons, juvenile CPUE during the summer months (May to August) suggests a poor relationship with brood strength based on counts at the Whitehorse Fish ladder (Figure 7). The lowest and highest jcs CPUE statistics since 2003 were recorded in 2005 and 2006, respectfully.

A comparison of jcs catches for each minnow trapping episode for each survey year is presented in Figure 8. In 2006 jcs catches ranged from an average of 3.5 to 44.2 fish per trap over a 24 hour soak period (Table 3). The high of 44.2 jcs per trap on October 4 represents the highest CPUE recorded since the minnow trapping project was initiated in 2003. Generally, high jcs catches are apparent in those years when a trapping episode was completed after September 15 (Figure 8).

While it has been shown that condition factors derived for such small fish are intrinsically less accurate than for larger fish (Murphy and Willis 1996) the average condition factor determined for wild jcs aged 0^+ on June 6 was 0.97 (Table 3). Average condition for this age class reached a high of 1.09 during mid July and into early August and dropped to 0.99 by early October. The single wild jcs aged 1^+ captured on June 6 had a condition factor of 1.11. The average condition factor determined for jcs from a sample of 302 fish from the Whitehorse Rapids hatchery on June 5 was 1.15.

Adult Chinook Salmon

The first Chinook salmon to migrate through the Whitehorse Rapids fish ladder in 2006 did so on August 3. The migration at the fish ladder in 2006 began about a week later than normal (Milligan, pers. com., 2006). A foot survey of upper Michie Creek on August 5 observed no adult salmon. On August 10 several adult salmon had arrived at site M1 on upper Michie Creek and 6 were counted staging in a deep pool at the Michie-Byng confluence. By August 17 salmon had arrived at the lake outlet and were constructing redds. About one dozen migrating adults were counted in a foot survey from the outlet to the Byng Creek confluence.

The aerial over-flight of upper Michie Creek on September 3 enumerated 34 adult live salmon between Michie Lake and the Byng Creek confluence. Salmon redds at this time were clearly discernable from the air. A subsequent redd survey by foot of this section of stream on August 31 enumerated 73 redds. A float survey of M'Clintock River on September 3 from below the waterfall barrier on the M'Clintock River mainstem to the Michie Creek confluence, enumerated 18 adult Chinook salmon and 10 salmon redds. The last adult Chinook salmon that migrated through the Whitehorse Rapids fish ladder did so on Sept 5.

In total, 23 salmon carcasses of hatchery origin were sampled and whose heads were retained for the purpose of extracting contained coded wire tags (CWT). At the time of writing no analysis had yet been received from the laboratory. The majority of recovered tags were from carcasses collected from Michie Creek.

Only a single beaver dam posed as a potential obstruction in upper Michie Creek in 2006 (Figure 9). The dam was breached on several occasions just prior to and throughout the Chinook migration period. Other locations where active beaver dams were located in past years did not show any sign of activity in 2006. While beaver continued to be active in upper Michie Creek, as evidenced by fresh cuttings along the bank, their presence did not pose any threat to the passage of migrating adult salmon. Past remediation efforts in the form of notching trees that formed a mainstem logjam in 2004 resulted in a clear and free channel throughout the 2006 open water period.

DISCUSSION

Water Flow and Temperature

Studies have previously established that the annual flow regime does reflect the quality of salmonid spawning habitat in any specific year (Smith 1973; Bjornn and Reiser 1991). It has been reported that optimal usable spawning and egg incubation velocities for Chinook salmon is thought to range from 0.3 to 0.9 m sec^{-1} based on habitat suitability indices (HSI) produced from published reports primarily on streams in south western North America (Raleigh *et al* 1986). While spawning and incubation flow preferences for Yukon River Chinook have yet to be established, the single measurement of 0.94 m sec^{-1} as an average velocity August 4 at site M1 in 2006 slightly exceeded those purported in the literature. The site where average velocity and discharge is determined each year (M1) is not utilized as spawning habitat by Chinook salmon. The primary and most concentrated spawning location is located at the lake outlet where the gradient is much less and average water velocities presumably lower. The average velocity of Michie Creek at site M1 during August was the highest recorded for this temporal period since 2003 and is reflective of the higher flows experienced throughout the summer of 2006.

Yearly water discharge comparisons in upper Michie Creek suggest much drier climatic conditions were experienced in 2004 relative to 2005 and 2006. Reduced flow can encourage the construction of beaver dams especially during the fall as waters levels recede. Lower flow regimes can reduce the total availability of fish habitat and can also be a factor influencing egg and fry survival especially during low flow conditions in the winter. The poor correlation between juvenile abundance and escapement through the fish ladder appears to substantiate the premise that in some years factors other than brood year strength may be more influential to fry abundance.

The cooler thermal regime in upper Michie Creek in 2006 is likely indicative of greater contributions of ground water relative to 2004. Surface temperatures during the spawning and incubation periods of 12° C were well below the upper threshold of tolerance for Chinook eggs. Temperature extremes as high as 22-24 º C are considered life-threatening for salmon species (Walthers and Nener 1997). The Whitehorse Rapids fish ladder recorded cool temperatures throughout the summer of 2006. Water temperatures averaged 13.5 º C in the fish ladder during the adult migration in 2006. This average temperature is within the preferred range for migration of 10.6 to 19.4 º C reported for other populations of Chinook salmon that migrate in the fall (Bjornn and Reiser 1991). Unlike other years water temperatures in the fish ladder throughout the Chinook migration period were very stable in 2006. Sharp declines of several degrees that were characteristic of the thermal regime in years previous were absent in 2006. With the loss of the Yukon River temperature logger no conclusions can be drawn about the thermal regime of the Yukon River below the Whitehorse Rapids dam. However, it is likely that the thermal regime of the river would be similar to the fish ladder as this relationship has been well demonstrated in past years.

Benthic Organisms

Spring is generally thought to be outside the window of maximum benthic production (Davidge, pers. com., 2004) and collected data appears to support this concept. However, the higher water levels may have been a factor during the early June sampling episode such that obtaining a sample from the deeper potions of the stream was more difficult where presumably a more diverse and abundant benthic community was established. Both the benthic diversity and abundance in upper Michie Creek was maintained from mid June through to September. The highest density of organisms was recorded on September 6.

As in all other benthic monitoring years upper Michie Creek continues to display a diverse benthic community, having upwards to 68 taxonomic groups represented by 37 different families. Calculated Shannon-weaver benthic diversity indices for Michie Creek ranged from 1.28 to 1.39 in 2006. These values are high when compared to diversity indices reported for other Chinook spawning streams in the Yukon River basin (KDFN 2005). There is little indication that hatchery plantings are negatively influencing the benthic diversity or density in upper Michie Creek.

Juvenile Chinook Salmon

As in years past, minnow trapping resulted in the capture of two age classes (0^+ and 1^+) of wild juvenile Chinook salmon although the yearling fish were not well represented. Age 0^+ fry dominated the catch during all sampling episodes. These fish originated from the 2005 brood year having incubated, hatched and overwintered in the watershed. Hatchery origin fish were completely absent in the catch except for a single capture during the June 27 sampling episode. Its size suggests it originated from the hatchery origin jcs that were planted into upper Michie Creek in early June. The hatchery juvenile appeared in good health based on a high condition factor and was noticeably larger than the average size of captured wild jcs of the same age. The low catch rate is suggestive that the majority of hatchery origin fish move away quickly from release sites, likely downstream.

The low catches of hatchery origin and wild 1+ jcs throughout the summer of 2006 in upper Michie Creek is consistent with previous findings in all other sampling years. Low catch rates of hatchery origin juveniles supports the hypothesis that they begin out-migration soon after release in the wild. It is believed the large size of the hatchery fry may be a factor in triggering out-migration as they average just under twice the length of either wild fry or those raised in stream side incubation boxes (KDFN 2005). Wild fry attain a comparable length only after a summer period of growth. Scale patterns of hatchery origin adult Chinook taken from the Whitehorse Rapids fish ladder also show a limited freshwater residency period (Etherton, pers. com., 2003). However, the low catch rate of wild 1+ jcs throughout the summer supports the hypothesis that out-migration of this age group from upper Michie Creek likely occurs before minnow trapping is initiated in late May. It is believed that high densities of 1+ jcs use upper Michie Creek as an overwintering location based on exceptionally high catch rates in the late fall based on several years of data.

Growth of upper Michie Creek Chinook fry expressed as length at age in 2006 approximated that determined in 2004, a year of lower discharge, higher stream temperatures but low abundance. While many variables effect growth, the competitive environment of higher juvenile densities in 2006 may have had a negative influence.

In summary, there was no apparent affect of hatchery plantings of jcs on the survival or growth of the wild jcs, at the densities of wild jcs found in Michie Creek and under the environmental conditions that occurred during the summer of 2006. The fact the high relative discharge occurring in conjunction with an above average run, would result in high jcs abundance as may be the case in 2007.

Adult Chinook Salmon

From the various visitations to the upper Michie spawning site, the spawning period in 2006 was thought to commence upon the arrival of adults around August 10. The digging of redds began shortly after this date. It is believed that spawning was largely concluded by September 3 based on the numerous redds and carcasses that were observed. The distribution of redds between the Michie Lake outlet and the confluence with Byng Creek was similar years past. In most cases spawning sites were either single redds or compound, with several egg pockets in a single disturbed area. A series of spawning dunes was observed just downstream of the Michie Lake outlet, comprising of gravel bars extending most or all the way across the channel and at right angles to the direction of flow.

With the timing of the larger than average run of Chinook through the Whitehorse Fish ladder a week later than average, the timing of carcass recovery was delayed and less successful in 2006. None-the-less, a total of 23 hatchery origin carcasses was sampled from Michie Creek and the M'Clintock River in 2006.

Remedial efforts to remove potential obstructions in upper Michie Creek were few in 2006. While beaver activity was apparent it is believed that higher water levels in 2006 were a deterrent prohibiting dam construction. Based on the distribution of redds and field observations, no obstructions that restricted movement of migrating adult Chinook salmon to upper Michie Creek in 2006.

CONCLUSIONS

1. Water discharge in the upper Michie Creek spawning area was significantly greater than those recorded in 2004 from late May to the end of August.

2. Upper Michie Creek water temperatures were cooler in 2006 compared to 2004 during the Chinook spawning period.

3. Water temperatures in the Whitehorse Rapids fish ladder were cooler in 2006 than in previous monitoring years especially compared to 2004.

4. Michie Creek continues to display one of the most diverse benthic communities in the Whitehorse region.

5. Data suggests benthic density and diversity is lowest during the spring and increases during the summer months in upper Michie Creek.

6. There is little indication that hatchery plantings of Chinook juveniles influenced the benthic diversity or density in upper Michie Creek in 2006.

7. There is some indication that growth of wild jcs over the summer period is inversely related to their relative abundance in upper Michie Creek.

8. A poor relationship exists between adult Chinook salmon counts through the Whitehorse Fish ladder and resulting yearly CPUE statistics for jcs (0+) in upper Michie Creek.

9. Hatchery reared juvenile Chinook salmon were about twice the size of wild juveniles in early June of 2006.

10. As in previous years, the bulk of the hatchery juvenile Chinook salmon planted into upper Michie during 2006 most likely began downstream movement shortly after release.

11. There was no apparent affect of hatchery plantings of jcs on the survival or growth of the wild jcs, at the densities of wild jcs found in Michie Creek and under the environmental conditions that occurred during the summer of 2006.

12. Catch of wild juvenile Chinook salmon captured in minnow traps are consistently low during the summer months and increase dramatically in the late fall.

13. Condition factors of individual jcs reach their highest value in late summer.

14. There were no obstructions that restricted movement of migrating adult Chinook salmon to upper Michie Creek in 2006.

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AUTHORITIES CONSULTED

Davidge, D. 2004. Environmental Assessment Officer, Environmental Protection, Environment Canada, 91782 Alaska Highway, Whitehorse, Yukon Y1A 5B7 Tel: (867)667-3409 E-mail: doug.davidge@ec.gc.ca

Etherton, P. 2003. Stock Assessment Technician. Department of Fisheries and Oceans Canada, 100-419 Range Road, Whitehorse, Yukon Y1A 3V1, E-mail: ethertonp@PAC.DFO-MPO.GC.CA

Milligan, P. 2003. Stock Assessment Biologist, Department of Fisheries and Oceans Canada, 100-419 Range Road, Whitehorse, Yukon Y1A 3V1, E-mail: milliganp@PAC.DFO-MPO.GC.CA

Williams, S. 2002. Canadian Dam Safety Inspector. Retired engineer. Pers. Comm. With Nick de Graff, Consultant, Kwanlin Dun First Nation.