CRE-27-98

WOLF AND MICHIE CREEK

CHINOOK ENUMERATION WEIRS

1998

- Wol and Weir n.
1993 ✓
1994
1999 ✓

Prepared for:

YUKON FISH AND GAME ASSOCIATION

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1.0 ABSTRACT

In the past, surveys by air and foot have proved ineffective in assessing the numbers of chinook returning to Michie Creek and Wolf Creek. Consequently, enumeration weirs were operated on Michie Creek in 1993 and 1994, and on Wolf Creek since 1995. Both of these locations have been release sites for chinook salmon fry reared at the Whitehorse Rapids Fish Hatchery. Obtaining accurate counts of returning salmon is an important part of assessing the overall success of the hatchery program. In 1998, 147 chinook migrated to Michie Creek which was 31% of the Whitehorse Fishway escapement. This is lower than the average contribution of 50% of the Fishway escapement for 1993 and 1994. It is hypothesised that very low water levels and above average water temperatures may have contributed to pre-spawn mortality, especially of smaller male chinook. This is supported by a comparison of fish size data and adipose clip observations between the Fishway and weir escapements. Wolf Creek returns comprised only 1.9% of Fishway escapement, compared to an average of 7.3% for the previous three years. This low return may have been due in part to a speculated reduction in the five year age class of the 1998 Whitehorse run. It is also possible that reduced hatchery fry releases into Wolf Creek may have affected numbers of returning chinook.

2.0 INTRODUCTION

Chinook fry reared at the Whitehorse Rapids Fish Hatchery have been released into Wolf and Michie creeks every year since 1985. Prior to the adult returns from the Wolf Creek releases, Michie Creek was the only known spawning location above Whitehorse (Figure 1). Consequently this location has been the primary site with annual releases ranging from 51,000 to 340,000 fry. Numbers of fry put into Michie Creek have been reduced since 1996 with the introduction of several other releases sites. Hatchery releases in Wolf Creek have ranged from 5,000 to 50,000 fry for the last 13 years and adults have been observed returning to this creek since 1989 (Appendix 1).

To assess the success of these enhancement programs it is important to monitor the numbers of adults returning to these release sites. An enumeration weir was operated on Michie Creek in 1993 and 1994, and on Wolf Creek since 1995. Both programs have demonstrated the advantages of enumeration weirs on these systems, over aerial or foot surveys, in obtaining accurate escapement counts. When used in the past, aerial and foot surveys have achieved limited success in estimating numbers of returning chinook. Water conditions and the extensive stream cover from fallen trees and thick vegetation make observation difficult. In conjunction with the 1998 weir projects, a chinook radio tagging project was undertaken at the Whitehorse Fishway (Matthews 1999). Results from this radio tagging project, along with the enumeration weir data, provided a clearer picture of migrating chinook distribution in the upper Yukon River drainage.

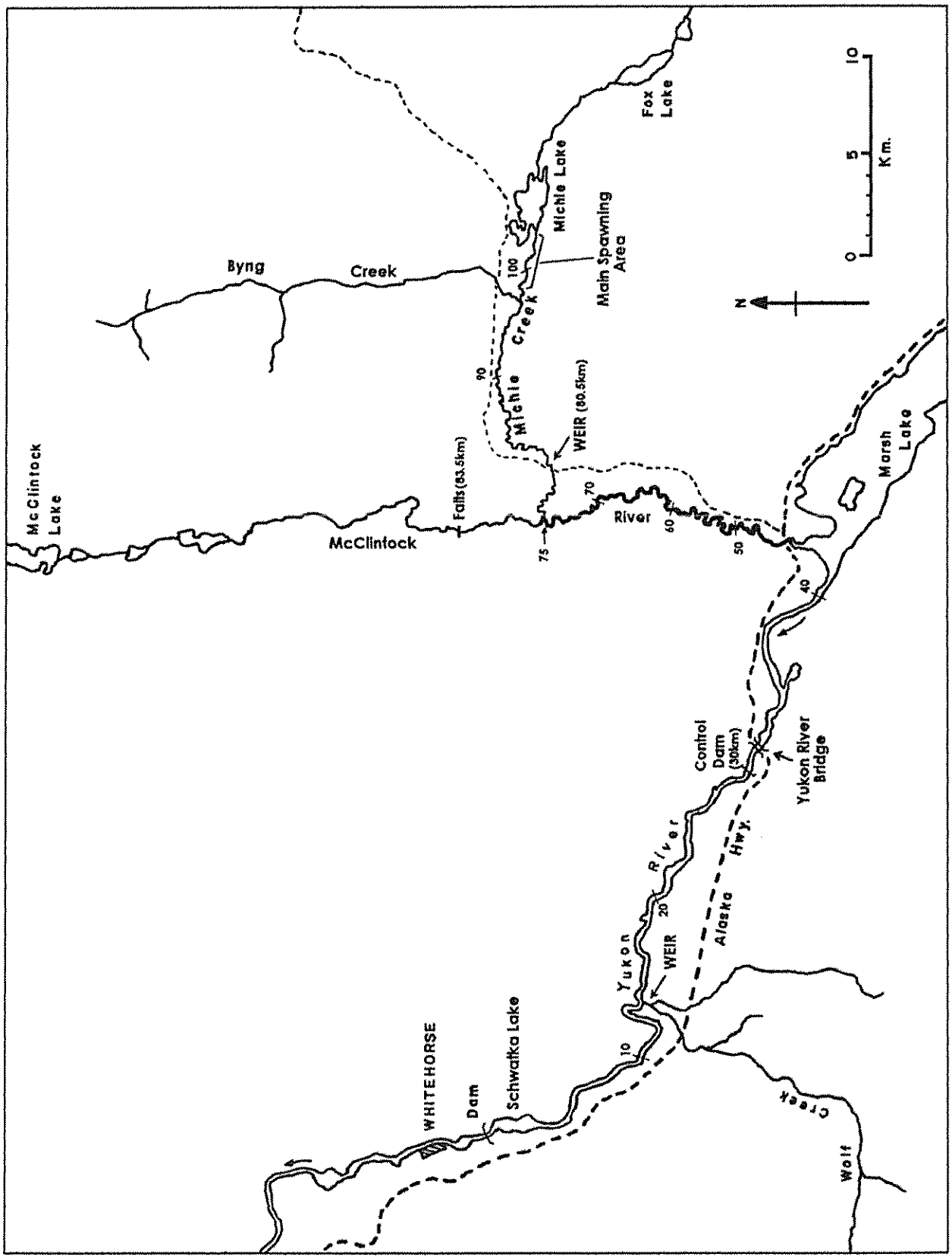

Figure 1. Michie Creek and Mclintock River systems in relationship to Whitehorse. Numbers indicate distances in kilometres upstream from the release site.

3.0 METHODS

3.1 Michie Creek

3.1.1 Site Selection and Logistics.

In 1993 and 1994 the weir was located 0.6km upstream of the confluence with the McClintock River. This site required access by jet boat. It was decided to move the weir to a new location close to the trail crossing 5.5km upstream from the McClintock River (Figure 1). This permitted the use of a 4x4 truck and ATV to setup and supply the camp. Weir material and sections of the wall tent frame were moved by helicopter from the old site. It should be noted that all distances mentioned in this report are in river kilometres.

The new weir was positioned approximately 75 metres upstream from the trail crossing. At this location a substrate of sand and gravel provided a stable base for the weir. Small log jams and associated pools provided good cover for migrating chinook immediately above and below the site.

3.1.2 Weir Construction.

The weir consisted of six wooden tripods spaced three metres apart and placed in a shallow "V" pointing upstream. Two parallel stringers were attached to the upstream legs of the tripods forming a fence across the creek. One and a half metre lengths of 19mm diameter thin-walled electrical conduit were inserted through the upper and lower stringers at 48mm intervals thus forming a fish tight barrier. A counting pen formed with horizontal stringers and vertical conduit, measuring 1.2 metres wide by 2.2 metres long, was placed at the apex of the "V". This pen was located in the deepest part of the creek. Vexar fencing was used to join both ends of the completed weir to the creek banks and to seal the conduit to the stream substrate . A plywood platform was built beside the counting pen to facilitate weir operation.

3.1.3 Weir Operation.

Enumeration was achieved by removing two or three pieces of conduit from the downstream end of the counting pen. The pen was quickly closed when chinook entered permitting the sex and presence of an adipose clip to be determined. The salmon was then allowed to continue by carefully removing several pieces of conduit from the upstream end of the pen. Live sampling was performed at the weir. Chinook to be sampled were carefully removed from the pen, up to ten scales taken from the preferred area, and length data recorded. A paper punch was used to mark the caudal fin of all sampled fish. No anaesthetic was used and the salmon were released as quickly as possible upstream of the weir.

The weir was operational from August 4th to September 6th. Personnel were on site 24 hours a day except during the stream surveys performed towards the end of the study. The counting pen was kept closed at all times when the weir was not monitored. On September 6th the weir was disassembled and the materials stored on the creek bank.

3.1.4 Stream Surveys and Sampling.

Surveys for spawning activity and carcass sampling were started on 26th August (Table 1). A 4x4 truck or ATV were used from camp to reach the part of the trail closest to the section of creek being surveyed. This helped to reduce the amount of time the weir was left unattended. All sections of Michie Creek, from the confluence with McClintock River to Michie Lake, were surveyed at least once. Sections of the creek where the majority of spawning activity was observed were surveyed several times. All carcasses were sampled for length, scales, sex and presence or absence of adipose fin. Heads were also collected from adipose clipped fish for recovery of CWT's.

Table 1. Summary of Michie Creek stream surveys, 1998.

Date	**Section Surveyed** (confluence = 0km, Michie Lake outlet = 27.5km)
26 Aug.	From weir downstream to previous weir site.
27 Aug.	Weir upstream for approximately 5km.
28 Aug.	Michie Lake downstream to Byng Creek confluence.
30 Aug.	Weir downstream to previous weir site.
1 Sept.	Weir downstream to McClintock confluence
2 Sept.	Kilometre 15 downstream to weir.
3 Sept.	Kilometre 15 upstream to Byng Creek confluence.
5 Sept.	Weir downstream to McClintock confluence.
6 Sept.	Kilometre 14 to kilometre 19.

3.1.5 Physical Parameters.

A staff gauge was setup ten metres downstream of the weir and water depth readings were taken morning and evening for the duration of the weir operation. Water temperature was also recorded at the same time using a hand-held thermometer.

3.2 Wolf Creek

3.2.1 Site Selection and Logistics.

The weir on Wolf Creek was located approximately 50 metres upstream from the Yukon River at the same site used for the past three years. This placed the weir in the faster current of Wolf Creek above the water level of the Yukon River. All weir materials were stored on site from the previous season's operation. Personnel accessed the site via a hiking trail from Wolf Creek campground.

3.2.2 Weir Construction.

The weir consisted of two tripods 3 metres apart, and a counting pen 1.2 metres wide by 2.2 metres long. Construction materials and methods for the weir and counting pen were the same as that used for Michie Creek. The counting pen was placed between one of the tripods and the bank in the deepest part of the creek. Vexar fencing was used to seal both ends of the completed weir to the creek banks. A plywood platform was built beside the counting pen to facilitate weir operation.

3.2.3 Weir Operation.

Enumeration was achieved by removing two or three pieces of conduit from the down stream end of the counting pen. The pen quickly was closed when chinook entered permitting sex and presence or absence of an adipose clip to be determined. The salmon were then allowed to continue upstream by carefully removing several pieces of conduit from the upstream end of the pen.

The weir was operational from August 9th to September 5th. Personnel were on site from 7:00 am till 10:00 pm every day during this period. The pen was kept closed whenever personnel were not on site. On September 5th the weir was disassembled and the materials stored on the creek bank.

3.2.4 Stream Surveys and Sampling.

On September 6th a survey was completed by foot from the Alaska highway crossing downstream to the weir site to recover and sample any carcasses. This survey also provided the opportunity to assess the extent and location of spawning activity.

3.2.5 Physical Parameters.

A staff gauge was setup immediately below the weir and water depth readings were taken morning and evening for the duration of the weir operation. Water temperature was also recorded at the same time using a hand held thermometer.

4.0 RESULTS

4.1 Michie Creek Weir.

4.1.1 Enumeration and Live Sampling.

A total of 131 chinook were counted through the weir between August 4th and September 6th (Appendix 2). These comprised 39 male jacks (30%), 64 adult males (49%) and 28 females (21%). The Whitehorse Fishway escapement comprised 400 (85%) males and 73 (15%) females. Sixty one (47%) of the chinook counted through the weir were of known hatchery origin with clipped adipose fins[1]. The Fishway escapement was comprised of 330 (70%) adipose-clipped chinook. Weir personnel were unable to determine the clipped or unclipped status of four enumerated salmon.

The first chinook moved through the weir on August 16th (Figure 2). Fifty percent of the run was completed by August 24th and 90% by August 30th. There were six live chinook observed below the weir when it was removed from the creek on September 6th, five of these were holding on redds. Ten carcasses were recovered on stream surveys below the weir, which gave a total known escapement to Michie Creek of 147 chinook. This was 31% of the chinook escapement through Whitehorse Fishway (777 count, less 155 hatchery brood stock and 150 Fishway mortalities).

Twenty two chinook were live sampled at the weir; these were comprised of 20 males and two females (Appendix 3). All but one male and one female in the live sampled group were adipose clipped. Post orbital hypural lengths (POHL) for the two females were 500mm and 650mm. For the males, POHL ranged from 415mm to 645mm and averaged 514mm. Results from scale analysis were unavailable at the time of report preparation.

[1] A significant proportion of the Whitehorse Rapids Hatchery releases were not marked with adipose clips in some of the principle brood years. The proportion of hatchery releases which were unmarked in 1992, 1993 and 1994 were 62.2%, 65.8% and 51.2%, respectively.

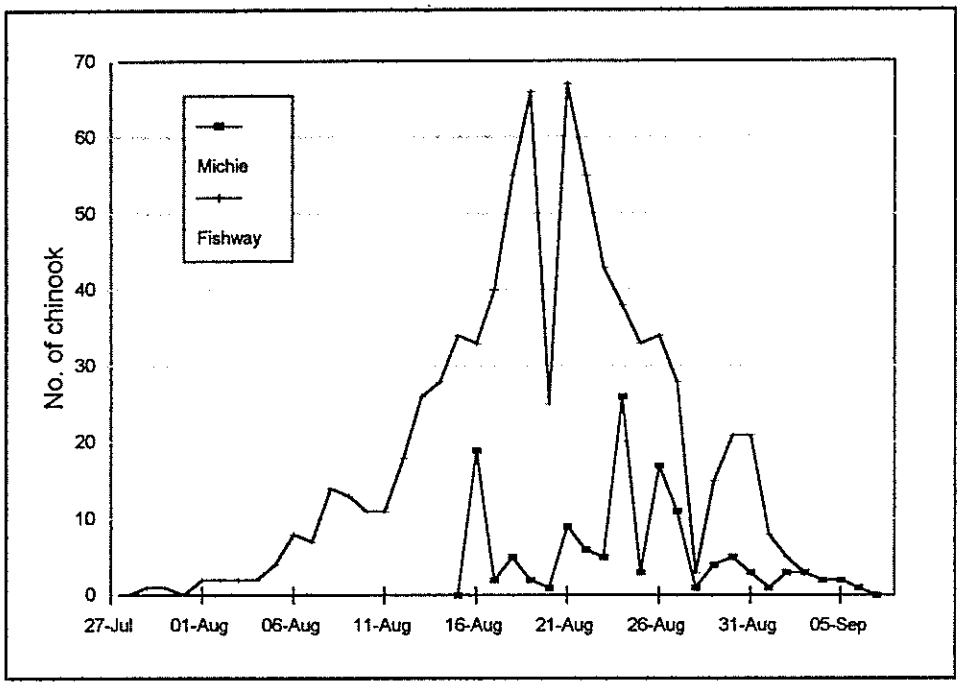

Figure 2. Comparison of daily counts from Whitehorse Fishway and Michie Creek weir.

4.1.2 Carcass Recovery.

The stream surveys yielded 15 carcasses, which equates to 10.2% of the total chinook escapement to Michie Creek (Appendix 3). These comprised eight males (53%) and seven females (47%). Post orbital hypural lengths (POHL) for the females ranged from 665mm to 755mm and averaged 723mm. For the males, POHL ranged from 415mm to 630mm and averaged 500mm. Two female and three male carcasses were partially consumed by predators and it was not possible to take a POHL. Heads were collected from seven adipose clipped males and one clipped female. Two of the adipose clipped carcasses (a male and a female) had no head remains due to scavengers. Results from scale analysis and CWT recovery were unavailable at the time of report preparation.

4.1.3 Physical Parameters.

Average daily water depths ranged from a minimum of 405mm to a maximum of 458mm and are illustrated in Figure 3. Water depths increased in the latter half of weir operation when there was an increased amount of precipitation.

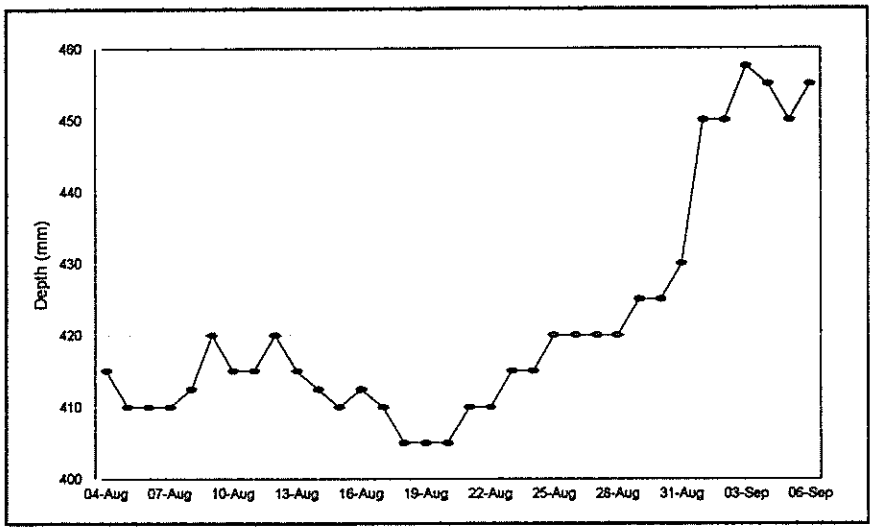

Figure 3. Average daily water depths at Michie Creek weir for 1988 season.

The average daily water temperatures ranged from a high of 13.5°C on August 4th to a low of 5.3°C on September 3rd. There was general cooling trend in the water temperatures during the operation of the weir reflecting a close link with a decrease in day time heating (Figure 4). Diurnal fluctuations in water temperature varied as much as 5°C (Appendix 4).

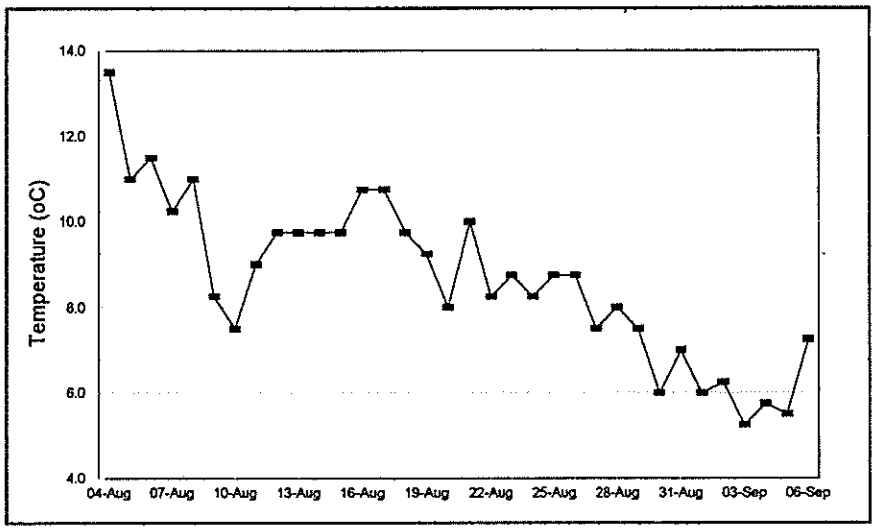

Figure 4. Average daily water temperatures measured at Michie Creek weir, 1998.

4.2 Wolf Creek Weir.

4.2.1 Enumeration.

Only seven chinook, two females and five males (two of them jacks), were counted through the weir. Only one of these seven, a male, had an adipose fin. All these salmon moved through the weir between August 30th and September 2nd. The day the weir was removed a clipped male was observed moving into the creek, and on September 7th a radio tagged clipped male was located two kilometres upstream of weir site. This gave a total known escapement of nine chinook to Wolf Creek. No live sampling was performed at the weir.

4.2.2 Carcass Recovery.

The survey of Wolf Creek on September 6th yielded no carcasses, and no live chinook were observed. There were no signs of recently disturbed substrate indicating attempts by female chinook to dig redds. Partial remains of egg filled skeins were found approximately one kilometre below the campground.

4.2.3 Physical Parameters.

Average daily water depths ranged from a minimum of 222mm on August 19th to a maximum 238mm on September 4th (Figure 5). Fluctuations in water flows generally reflect periods of precipitation.

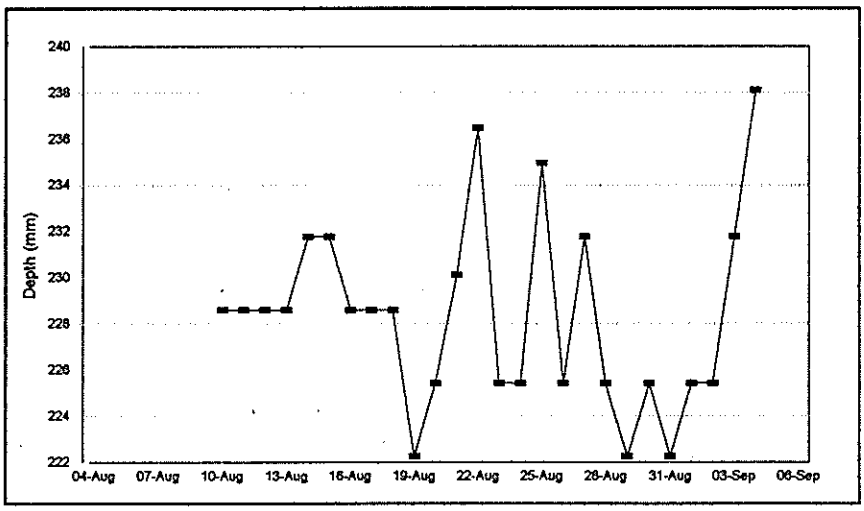

Figure 5. Average daily water depths at Wolf Creek weir, 1998.

The average daily water temperatures ranged from a minimum of 6.3°C on August 30th and September 3rd, to a maximum of 10.8 °C on August 17th. Figure 6 shows a trend toward cooler temperatures during the period of weir operation. Diurnal temperature fluctuations varied as much as 3°C (Appendix 4) and generally reflected the extent of solar heating.

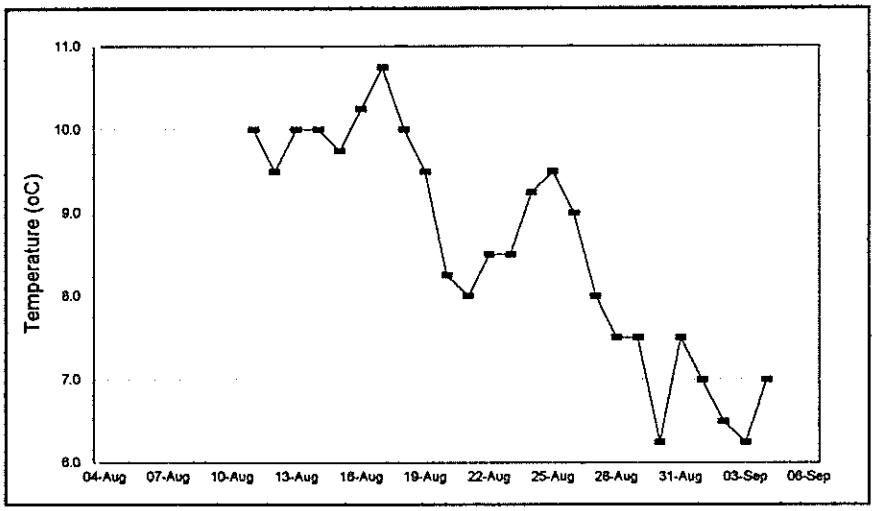

Figure 6. Average daily water temperatures at Wolf Creek weir, 1998.

5.0 DISCUSSION

5.1 Michie Creek Weir.

In 1993 and 1994 the escapements to Michie Creek comprised 56% and 44%, respectively, of the chinook escapement through the Whitehorse Fishway (Matthews 1994). In 1998 Michie Creek escapement was only 31% of the Fishway escapement. The reasons for this are not clear but water levels in the McClintock / Michie system were considerably lower than levels observed during 1993 and 1994; approximately 0.5 of a metre lower at the current weir site. In conjunction with low levels the water was also exceptionally clear with no noticeable sediment load. In 1993 and 1994 visibility was often less than 0.4 of a metre (Matthews 1994). These two factors could add to predation rates on migrating chinook and may account for some of the reduced escapement to Michie Creek. Predation and scavenging by bald eagles was observed by weir personnel during stream surveys. Carcass remains were also found in the first 6km of Michie Creek where none were observed in 1993 and 1994. This section is 15km downstream of the primary spawning grounds, consequently the presence of these carcasses may be indicative of increased pre-spawn mortality.

Data from the concurrent radio tagging project indicated that 80 or more chinook could have migrated into the section of McClintock River upstream of the Michie Creek confluence (Matthews 1999). This would bring the McClintock / Michie system escapement up to almost 48% of the Fishway escapement, which is closer to the average of previous weir data. There is very little historic information concerning chinook utilization of this section of the McClintock River upstream to the falls. Boat and foot surveys during the 1993 and 1994 programs produced counts of two and ten chinook respectively, with four locations where redd digging was observed. It is possible this years extremely low water discouraged some returning chinook from entering Michie Creek which generally has lower flows than McClintock River.

The Fishway escapement comprised 84.7% (400) males and 15.3% (72) females. This compares to 78.6% (103) males and 21.4% (28) females enumerated at Michie Creek weir. The higher percentage of females at the weir is most likely explained by the difference in ratio of jacks; chinook, primarily male, with POHL's of ≤ 420mm. These smaller chinook accounted for 44% of the males counted through the Fishway, but at the weir 30% of the males were jacks. It is hypothesised that a higher rate of pre-spawning mortality occurs in these smaller salmon, resulting in fewer jacks that survived to reach Michie Creek weir and ultimately the spawning grounds.

Since 1996 approximately 300,000 of the chinook fry released from the Whitehorse Hatchery each year have been coded wire tagged (CWT) and their adipose fins removed. Prior to 1996 150,000 of the fry each year were tagged and adipose clipped before release. The lower percentage of adipose-clipped chinook at the weir (47% as compared to 70% of the Fishway escapement) could also be explained by the hypothesised higher mortality rate of jacks. Over 95% of adipose-clipped fish counted through the Fishway were males, therefore a higher rate of pre-spawn mortality for the jacks would have a direct effect on the percentage of adipose-clipped chinook reaching Michie Creek weir.

The intention had been to live sample most of the adipose-clipped chinook that passed through the weir. Ages established via scale analysis in conjunction with adipose fin clip data would have enabled overall survival rates to be calculated for the various groups of hatchery chinook released between 1990 and 1995. Unfortunately very little sampling was possible as any excessive activity, such as dipnetting, caused chinook immediately below the weir to move back downstream to the deeper pools and log jams. Presumably this was attributable to their greater degree of exposure in the shallow clear water conditions prevailing this year. Consequently sampling was only performed when individual adipose-clipped chinook approached the weir, while groups were allowed to move through the pen without being handled. This minimized any potential delay to their upstream migration.

Michie Lake is situated 27.5km upstream from McClintock River and the primary spawning grounds are located in the first five kilometres downstream from the lake to Byng Creek (Figure 1). The first stream survey of this stretch of Michie Creek was undertaken on 28th August (Table 1). During this survey no chinook, alive or dead, were observed. A subsequent

survey on 3rd September revealed a substantial beaver dam at kilometre 19 on Michie Creek that likely formed a blockage to chinook migration. This was supported by radio tracking data as no tags were located upstream of this point. The majority of chinook spawning activity observed during stream surveys occurred in the first few kilometres downstream of this dam. Throughout this area many sections of the creek substrate appeared suitable for chinook spawning, and it was generally in these sections that redds were observed.

5.2 Wolf Creek Weir.

Chinook returning to Wolf Creek in 1998 comprised only 1.9% of the Fishway escapement. This was a reduction from the last three years in which chinook migrating to Wolf Creek have ranged from 3.0% (68 fish) to 11.5% (242 fish) of the respective Fishway escapements. There is no clear explanation for this, but it is possible the reduction in numbers of hatchery reared fry released into Wolf Creek is having an effect. From 1991 to 1994 50,000 fry were released in to this creek each year. This was reduced to approximately 19,000 fry in 1995 and 10,000 fry in 1996 (Appendix 1). Although five year old chinook would be returning from the last 50,000 fry release group in 1995, there were indications this year of a poor return for this age class. Past data has indicated that hatchery origin females reaching this part of the Yukon River system are primarily five years old; for example 100% of the ageable female scale samples from Wolf Creek in 1995. Generally females constitute 30% to 35% of the chinook counted through the Fishway, but this year they comprised only 20% of the run (I. Boyce, per. comm., Stock Assessment Biologist, DFO). This reduction in the percentage of females could be partly explained by a poor return of the five year age class. Age data from scale samples would help to confirm or refute this but analysis was not completed at the time of report preparation.

Water levels in Wolf Creek were low this year compared to observations from the last three years and may have been a deterrent to some chinook entering the creek. However, in the past three years chinook have been observed schooling off the mouth of Wolf Creek for up to two weeks prior to moving through the weir (Matthews 1996). However, this year several boat surveys in late August and early September indicated that no chinook were holding of the mouth of Wolf Creek. This suggests a lack of returning spawners rather than a low-water deterrent as the primary reason for the poor return to Wolf Creek.

6.0 ACKNOWLEDGEMENTS

I am grateful for the assistance of the individuals who helped to make this study possible. I would like to thank Kari Long, Martin Boulerice, Mike Lake and Lesia Hnatiw who admirably performed the bulk of the field work. My thanks to Lawrence Vano who prefabricated weir components and assisted with Michie Creek weir site selection. Technical assistance was provided by Ian Boyce who also, along with George Cronkite, Pat Milligan and Al von Finster, gave editorial comments and advice. I would also like to thank Al von Finster with DFO who helped provide transportation for Michie Creek weir relocation and camp operations. Finally I would like to thank the Yukon Fish and Game Association who contributed office time and administration and the Yukon River Restoration and Enhancement Fund for financially supporting this program.

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APPENDIX 1.

WHITEHORSE RAPIDS FISH HATCHERY

CHINOOK FRY RELEASE NUMBERS AND LOCATIONS

1985 TO 1998

Whitehorse Hatchery fry release numbers and locations.

YEAR	MICHIE Cr.	WOLF Cr.	FISHWAY	JUDAS Cr.	FOX Cr.	BYNG Cr.	McCLIN-TOCK R.	TOTAL
1985	116,800	10,520						127,320
1986	78,170	5,720						83,890
1987	263,427	27,117						290,544
1988	329,387	25,986						355,433
1989	197,923	22,388	51,020					271,331
1990	51,398	11,969	50,376					113,743
1991	136,379	49,477	52,948					238,804
1992	302,755	48,239	49,455					400,449
1993	340,816	50,248	50,391					441,455
1994	209,093	50,407	50,540					310,040
1995	55,448	19,353						74,801
1996	152,382	10,233		50,614	35,452	25,779	50,283	324,833
1997	100,289	45,492		45,299	50,490	20,184	50,432	312,186
1998	100,448	46,048		46,037		25,540	50,313	268,386

APPENDIX 2.

MICHIE CREEK WEIR ENUMERATION DATA

1998

Michie Creek enumeration data, 1998

DATE	MALE			FEMALE			JACK			DAILY	CUM.
	CLIP	UNCLIP	UKN	CLIP	UNCLIP	UKN	CLIP	UNCLIP	UKN		
04-Aug											
05-Aug											
06-Aug											
07-Aug											
08-Aug											
09-Aug											
10-Aug											
11-Aug											
12-Aug											
13-Aug											
14-Aug											
15-Aug										0	0
16-Aug	3	8		1	2		3	2		19	19
17-Aug		2								2	21
18-Aug	1	2			1		1			5	26
19-Aug				1			1			2	28
20-Aug		1								1	29
21-Aug		1			1		4	3		9	38
22-Aug	3				1			2		6	44
23-Aug	1	2	1		1					5	49
24-Aug	5	6		2	2		8	3		26	75
25-Aug	1	1							1	3	78
26-Aug	4	7			2		4			17	95
27-Aug		4		1	6					11	106
28-Aug	1									1	107
29-Aug	1				1		2			4	111
30-Aug	1	1		1	1		1			5	116
31-Aug				1					2	3	119
01-Sep	1									1	120
02-Sep	1				2					3	123
03-Sep	2	1								3	126
04-Sep	1						1			2	128
05-Sep	1			1						2	130
06-Sep							1			1	131
07-Sep				WEIR PULLED						0	131
Totals	**21**	**36**	**1**	**8**	**20**	**0**	**26**	**10**	**3**	**131**	**131**

APPENDIX 3.

MICHIE CREEK CARCASS RECOVERY
AND LIVE SAMPLING DATA

1998

Carcass recovery data from Michie Creek, 1998

DATE	POHL	Sc. Bk. #	ROW #	AGE	HEAD #	SEX	ADIPOSE	COMMENTS
18-Aug	665	75157	11-20		n/a	F	UC	D/S
29-Aug	745	71597	1-10		n/a	F	UC	D/S 50% spawned
30-Aug	500	71597	11-20		#1	M	CL	D/S
31-Aug	755	71597	21-30		n/a	F	UC	D/S 100% spawned
02-Sep	750	-	-		n/a	F	UC	U/S RT# 23
02-Sep	415	71597	31-40		#3	M	CL	U/S
01-Sep	-	-	-		#2	M	UKN	D/S
02-Sep	-	-	-		no head	F	CL	U/S
01-Sep	-	-	-		n/a	F	UC	D/S RT# 28
03-Sep	500	71599	1-10		#4	M	CL	U/S
05-Sep	-	71599	11-20		#5	M	CL	D/S Unspawned
06-Sep	-	71599	21-30		no head	M	CL	U/S Head eaten
06-Sep	700	71599	31-40		n/a	F	UC	D/S Unspawned
09-Sep	630	42302	1-10		425182	M	CL	U/S
09-Sep	455	42302	11-20		425183	M	CL	U/S

Table Summary

Males = 8
Females = 7

Unclipped = 6
Clipped = 8
UKN = 1

Key

CL = adipose clipped
UC = unclipped
UKN = unknown
D/S = downstream of weir
U/S = upstream of weir

Live sampling data from Michie Creek weir.

DATE	POHL	Sc. Bk. #	ROW #	AGE	SEX	ADIPOSE	COMMENTS
17-Aug	575	75157	1-2		M	CL	
18-Aug	444	75157	21-25		M	CL	
19-Aug	500	75157	31-38		F	CL	
19-Aug	415	75157	41-50		M	CL	
21-Aug	416	75158	1-9		M	CL	
21-Aug	435	75158	11-13		M	CL	
21-Aug	455	75158	21-28		M	CL	
21-Aug	445	75158	31-40		M	CL	
22-Aug	545	75158	41-42		M	CL	
22-Aug	435	75159	1-5		M	CL	
26-Aug	617	75159	17-20		M	CL	
26-Aug	530	75159	21-23		M	CL	
26-Aug	510	75159	29-30		M	CL	
26-Aug	545	75159	31-34		M	CL	Spag. tag # 00941
26-Aug	622	75159	39-40		M	CL	
27-Aug	665	75159	41-43		F	UC	
28-Aug	645	75160	1-4		M	CL	
01-Sep	515	75160	11-16		M	CL	
02-Sep	430	75160	21-26		M	CL	
02-Sep	455	75160	31-36		M	CL	
03-Sep	635	75161	1-6		M	UC	
03-Sep	615	75161	11-16		M	CL	

Table Summary

Males = 20
Females = 2

Unclipped = 2
Clipped = 20

Key

CL = adipose clipped
UC = unclipped

APPENDIX 4.

WOLF AND MICHIE CREEK WEIRS

WATER DEPTH AND TEMPERATURE DATA

1998

Michie Creek

	DEPTH (mm)			TEMPERATURE (°C)		
DATE	a.m.	p.m.	avg.	a.m.	p.m.	avg.
01-Aug			0			0.0
02-Aug			0			0.0
03-Aug			0			0.0
04-Aug	415	415	415	12.5	14.5	13.5
05-Aug	410	410	410	9.0	13.0	11.0
06-Aug	410	410	410	10.0	13.0	11.5
07-Aug	410	410	410	9.5	11.0	10.3
08-Aug	410	415	413	9.0	13.0	11.0
09-Aug	420	420	420	7.5	9.0	8.3
10-Aug	415	415	415	6.0	9.0	7.5
11-Aug	415	415	415	7.5	10.5	9.0
12-Aug	420	420	420	7.5	12.0	9.8
13-Aug	415	415	415	7.5	12.0	9.8
14-Aug	415	410	413	7.5	12.0	9.8
15-Aug	410	410	410	8.0	11.5	9.8
16-Aug	415	410	413	9.0	12.5	10.8
17-Aug	410	410	410	9.0	12.5	10.8
18-Aug	405	405	405	10.0	9.5	9.8
19-Aug	405	405	405	7.5	11.0	9.3
20-Aug	405	405	405	5.5	10.5	8.0
21-Aug	410	410	410	5.0	9.0	10.0
22-Aug	410	410	410	7.5	9.0	8.3
23-Aug	415	415	415	6.5	11.0	8.8
24-Aug	415	415	415	7.5	9.0	8.3
25-Aug	420	420	420	7.0	10.5	8.8
26-Aug	420	420	420	8.0	9.5	8.8
27-Aug	420	420	420	5.5	9.5	7.5
28-Aug	420	420	420	5.5	10.5	8.0
29-Aug	425	425	425	7.0	8.0	7.5
30-Aug	425	425	425	4.5	7.5	6.0
31-Aug	425	435	430	6.5	7.5	7.0
01-Sep	450	450	450	5.5	6.5	6.0
02-Sep	450	450	450	6.0	6.5	6.3
03-Sep	455	460	458	4.5	6.0	5.3
04-Sep	455	455	455	4.5	7.0	5.8
05-Sep	450	450	450	4.0	7.0	5.5
06-Sep	450	460	455	6.5	8.0	7.3

Wolf Creek

	DEPTH (mm)			TEMPERATURE (°C)		
DATE	a.m.	p.m.	avg.	a.m.	p.m.	avg.
08-Aug						
09-Aug						
10-Aug	229	229	229			
11-Aug	229	229	229		10.0	10.0
12-Aug	229	229	229	8.0	11.0	9.5
13-Aug	229	229	229	9.0	11.0	10.0
14-Aug	235	229	232	9.0	11.0	10.0
15-Aug	235	229	232	8.5	11.0	9.8
16-Aug	229	229	229	9.5	11.0	10.3
17-Aug	229	229	229	10.0	11.5	10.8
18-Aug	229	229	229	10.0	10.0	10.0
19-Aug	222	222	222	9.0	10.0	9.5
20-Aug	229	222	225	7.0	9.5	8.3
21-Aug	232	229	230	7.0	9.0	8.0
22-Aug	232	241	236	8.0	9.0	8.5
23-Aug	222	229	225	7.5	9.5	8.5
24-Aug	229	222	225	8.5	10.0	9.3
25-Aug	229	241	235	9.0	10.0	9.5
26-Aug	222	229	225	9.0	9.0	9.0
27-Aug	216	248	232	7.0	9.0	8.0
28-Aug	222	229	225	7.0	8.0	7.5
29-Aug	229	216	222	7.0	8.0	7.5
30-Aug	222	229	225	5.0	7.5	6.3
31-Aug	222	222	222	7.0	8.0	7.5
01-Sep	235	216	225	6.0	8.0	7.0
02-Sep	216	235	225	6.0	7.0	6.5
03-Sep	229	235	232	5.5	7.0	6.3
04-Sep	235	241	238	6.0	8.0	7.0
05-Sep	0	0				
06-Sep	0	0				