2002 McQuesten River Chinook Salmon Spawner Survey CRE 23-02

Prepared for:

YUKON RIVER PANEL

Box 20036
Whitehorse, Yukon
Y1A 7A2

Prepared by:

Patrick Tobler
EDI ENVIRONMENTAL DYNAMICS INC.
Suite 206-4133 4th Avenue
Whitehorse, Yukon
Y1A 1H8

On behalf of:

THE FIRST NATION OF THE NACHO NYAK DUN
P.O. Box 280
Mayo, Yukon
Y0B 1M0

March 2003

ABSTRACT

The McQuesten River, a tributary to the Stewart River, is an important chinook spawning stream that the First Nation of the Nacho Nyak Dun has a keen interest in. In the last 50 years, a significant amount of development has occurred in the watershed; however, monitoring of the chinook population has been sporadic. This project has collected the existing data on chinook spawning in the watershed and included two overview flights to locate spawners. The results of the project found that the McQuesten River mainstem, below the confluence of the North and South McQuesten Rivers, is the primary spawning area in the watershed. Several other areas were identified as spawning areas or potential spawning areas; however, there is no evidence of annual spawning in these locations. Future works were recommended to monitor numbers using the primary spawning location (as an index area) as well the other locations in the watershed.

ACKNOWLEDGEMENTS

The Restoration and Enhancement Fund, a salmon restoration partnership between the State of Alaska and Yukon Territory, provided funding for this project (Project Number CRE-23-02). Pat Milligan, Stock Assessment Biologist, Fisheries and Oceans Canada, Whitehorse, provided technical expertise and guidance. Kate Maddigan, Fisheries and Oceans Canada, Whitehorse reviewed a draft version of the report and provided editorial comments.

Staff members of the First Nation of Nacho Nyak Dun, Mayo, contributed to this project. Sue Lucas, Lands Manager, Lands and Resources Department, provided project organization and assisted with the management of the project. Millie Olsen, GIS Technician, Lands and Resources Department, completed the mapping component of this project. Sam Peter and Lisa Rear participated in field components of this project.

Robin Sharples, Biologist, EDI Environmental Dynamics Inc., participated in the field components of this project (aerial surveys) and assisted with data compilation.

TABLE OF CONTENTS

Page
ABSTRACT i
ACKNOWLEDGEMENTS ii
TABLE OF CONTENTS iii
LIST OF TABLES iii
LIST OF FIGURES iii
1.1 Project Scope 1
1.2 Project Objectives 1
2.0 LOCATION OF STUDY AREA 1
3.0 METHODOLOGY 3
3.1 Scientific Data 3
3.2 Traditional and Local Knowledge 3
3.3 Aerial Surveys 3
4.0 RESULTS 3
4.1 Scientific Data 3
4.1 Traditional and Local Knowledge 5
4.2 Aerial Flights 6
Gravels only extend for approximately 0.5 km downstream from lake. 7
5.0 DISCUSSION 8
6.0 LITERATURE CITED 10

APPENDIX A: 12

LIST OF TABLES

Page
Table 1. Tributary Basins in the McQuesten Watershed. 2
Table 2. Spawning data on the McQuesten River mainstem. 4
Table 3. Spawning data on the North McQuesten River 4
Table 4. Spawning data on the South McQuesten River. 4
Table 5. Traditional and local knowledge of chinook salmon in the McQuesten River Watershed. 5
Table 6. Results of August 9, 2002 aerial survey in the McQuesten Watershed. 6
Table 7. Results of August 23, 2002 aerial survey in the McQuesten Watershed. 7

LIST OF FIGURES

Page
Figure 1. McQuesten study area map. 2
Figure 2. Distribution of chinook observed during August 4, 1990 aerial survey of the McQuesten River mainstem (adapted from DFO Stream files, 2002). 9

1.0 INTRODUCTION

1.1 Project Scope

The Yukon River Restoration and Enhancement (R&E) Fund was established by the Yukon River Panel for the conservation of salmon stocks originating from the Yukon River. The purposes of the R&E Fund are to: 1) support programs, projects and associated research and management activities on both sides of the Alaska-Yukon border directed at the restoration, conservation and enhancement of Canadian origin salmon stocks of the Yukon River and 2) support programs and projects that are directed at developing stewardship of salmon habitat and resources and maintaining viable salmon fisheries in the Yukon River in Canada.

The First Nation of Nacho Nyak Dun (NND) is dedicated to natural resource stewardship within their Traditional Territory. In and likely prior to the early 1900's, the McQuesten River was an important source of chinook salmon (*Oncorhynchus tshawytscha*) to the NND people. Duncan (1997) reports that in 1901 there were 250 First Nations people hunting, fishing and living in the vicinity of the McQuesten Post. A First Nation fish camp was located near the mouth of the McQuesten and recorded that catches of salmon ranged from 3,334 pounds in 1909 to 14,000 pounds in 1914 (Seigel and McEwen 1984).

In recent history, a significant amount of development associated with mining and forestry activity has occurred within the McQuesten River Watershed. This activity has likely impacted the chinook spawning habitat in the watershed. As there was limited collective knowledge regarding chinook spawning locations, spawning numbers and health of the populations, this study was designed to collect all the existing information and provide baseline data for both NND and Fisheries and Oceans Canada (DFO). Ultimately, this study will assist resource managers with the management of the McQuesten chinook populations and guide future land-use decisions. This project was conducted concurrently with another project, the McQuesten River Watershed Assessment (Tobler and Sharples 2003), and as such the spawning dynamics of chinook salmon found in this study will have a large bearing on assigning priorities in the watershed assessment.

1.2 Project Objectives

The objectives of this project included:

1. Determining specific chinook salmon spawning locations in the McQuesten River Watershed.
2. Determining the numbers of the spawning population(s).
3. Determining the suitability of the McQuesten River as an index area and if suitable, establish an escapement monitoring index so that the NND and Fisheries and Oceans can monitor the run size in future years.
4. Providing training, employment, build technical capacity and foster stewardship for NND citizens.
5. Providing critical information to guide habitat restoration and long-term sub-basin management planning in the McQuesten River Watershed.

2.0 LOCATION OF STUDY AREA

The McQuesten River watershed is located approximately 330 km north of Whitehorse, YT, near Mayo, YT (Figure 1). The McQuesten River drains an area of 4,800 km^2, and flows into the Stewart River, approximately 120 km upstream from the confluence of the Yukon and Stewart rivers. The elevation range in this watershed varies from 1, 200 to 1,500 metres (David Hedmann and Associates, 1995). The South McQuesten and North McQuesten rivers join approximately in the middle of the watershed to form the McQuesten River mainstem. As many tributaries to these three rivers make up the watershed, Tobler and Sharples (2003) divided up the McQuesten River watershed into eight tributary basins for discussion purposes. These basins are outlined in Table 1 and are mapped on Figure 1.

Table 1. Tributary Basins in the McQuesten Watershed.

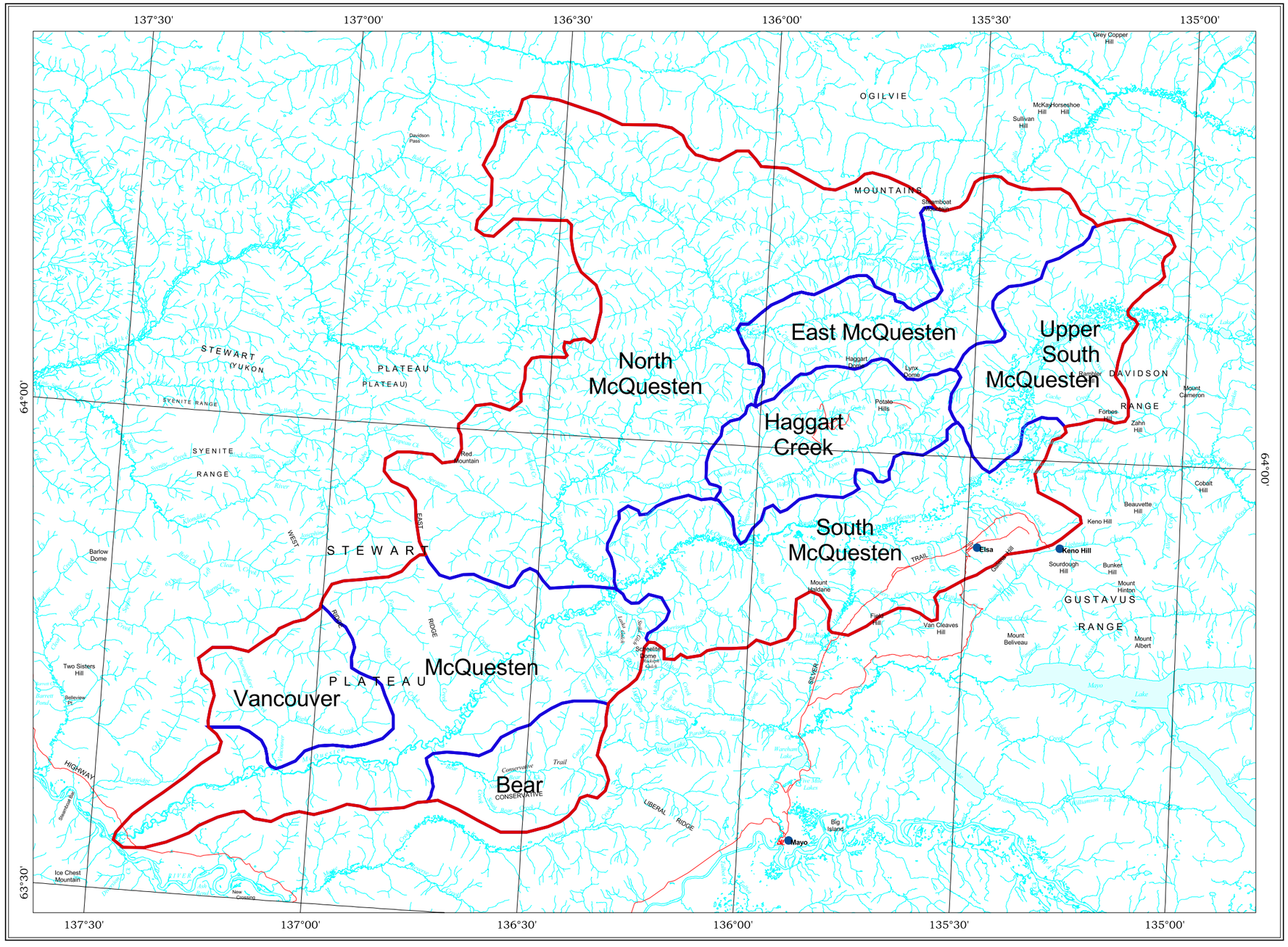
Tributary Basin	Brief Description	Area (square km[1])	Stream Length (km)[1]
McQuesten River	McQuesten mainstem and minor tributaries	799.9	499.6
Vancouver Creek	Tributary to McQuesten	245.0	144.5
Bear Creek	Tributary to McQuesten	216.9	127.5
North McQuesten River	North McQuesten (excluding East McQuesten)	1603.3	1601.7
Haggart Creek	Tributary to South McQuesten	343.3	358.9
East McQuesten River	Tributary to North McQuesten	445.7	432.7
South McQuesten River	Lower portion of the South McQuesten	762.7	554.8
Upper South McQuesten River	Upper portion of the South McQuesten	392.7	320.1

[1]As determined from digital 1:50,000 Natural Resources Canada (NRCAN) maps.

There has been major mineral and resource development in the McQuesten River area. Hard rock and placer mining has occurred since the late 1800's. United Keno Hill Limited, located in the Lower South McQuesten Basin, was established as a major hard rock ore mine in 1920 by the Yukon Gold Company and operated until 1989. Many McQuesten River tributaries have been placer mined or are presently being placer mined. Mining of the Haggart Creek basin has occurred since 1895 (Pentz 1996); several abandoned mine sites are scattered along Haggart Creek, consisting of exposed mine tailing piles and effluent ponds. Placer mining has occurred on various streams in the South McQuesten and Vancouver Creek basins, as well as, to a lesser extent in the Bear Creek and North McQuesten basins (Lipovsky et. al. 2001).

Most forest harvesting activity in the McQuesten watershed has occurred to support mining activity (David Hedmann and Associates 1995). Roads were constructed to support mining activities and wood provided fuel for heat and was used in steam-fired boilers as electricity for mining. Northern Design Consultants (1993) has documented significant forest harvesting in the McQuesten, Vancouver Creek, Bear Creek, South McQuesten and North McQuesten basins between 1947 and 1970.

Figure 1. McQuesten study area map.



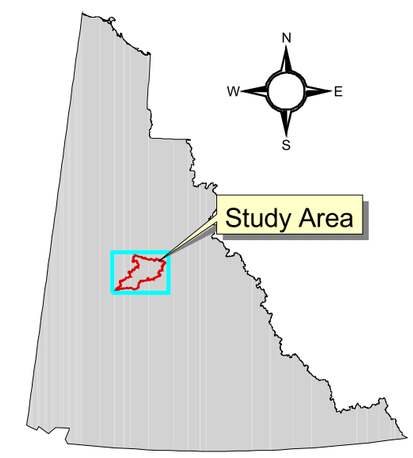
McQuesten Watershed Study Area

Scale 1:500,000

5 0 5 10 15 Kilometers

Albers Equal Area projection (standard parallels: 61°40'N & 68°00'N)

- Study Area
- McQuesten Watershed Basins
- Community
- Major Roads
- Watercourse
- Waterbody



DIGITAL DATA SOURCES AND DISCLAIMERS

National Topographic Data Base (NTDB) compiled by Natural Resources Canada at 1:50,000. Reproduced under license from Her Majesty the Queen in Right of Canada, with permission of Natural Resources Canada.

Map Compiled By:
Millie Olsen
GIS Technician
Lands and Resources Department
Nacho Nyak Dun First Nation
Mayo, Yukon
05 December 2002

3.0 METHODOLOGY

This study was conducted in three main steps (the collection of existing scientific data, the collection of Traditional and local knowledge, and an aerial survey).

3.1 Scientific Data

Biologists from *Environmental Dynamics Inc*. (EDI) gathered and researched existing literature and data that had been conducted by government agencies, consultants, and developers. Information pertaining to chinook salmon and spawning documentation was recorded and mapped where applicable

3.2 Traditional and Local Knowledge

A biologist from EDI and a technician from the NND conducted informal Traditional and local knowledge interviews with elders and other community members on August 8, 2002. During these interviews, information pertaining to salmon in the McQuesten River was recorded and mapped.

3.3 Aerial Surveys

Two biologists from EDI and technicians from the NND conducted two aerial flights of the McQuesten watershed on August 9 and August 23, 2002. The purpose of these flights was to conduct an overview assessment of the watershed (as part of the McQuesten River Watershed Assessment project; Tobler and Sharples 2003) and to pinpoint spawning locations, spawning timing and count the number of spawning fish in each location. The locations of the spawning fish were recorded and mapped.

Both helicopter flights originated from the Mayo airport, with the first flight focusing on a reconnaissance of the watershed (for the watershed assessment; Tobler and Sharples 2003) with a secondary objective of looking for spawning salmon. The upper basins of the McQuesten watershed (Upper South McQuesten, South McQuesten and North McQuesten) were flown before the McQuesten mainstem, Vancouver and Bear basins. In the lower basins, the helicopter flew at a slower speed and at a lower elevation to increase the likelihood of seeing spawning or spawned out salmon.

The second helicopter flight concentrated mainly on adult salmon reconnaissance and was generally flown at a lower altitude and at slower speeds than the first flight in an attempt to increase the effectiveness of the survey.

4.0 RESULTS

4.1 Scientific Data

Scientific data on spawning chinook is present for several years (1974, 1977, 1990, 1998) from a number of information sources. For clarity purposes, the study area was separated to the McQuesten mainstem, the North McQuesten, and the South McQuesten rivers. Table 2 summarizes the scientific information, which outlines the chinook spawning locations in the mainstem McQuesten River.

Table 2. Spawning data on the McQuesten River mainstem.

Year	Location	Comments	Source
1974	Not Specified	Forty chinook were counted during ground survey.	Brock 1974
1977	Lower 16 km	Thirty-one spawning chinook were observed.	Beak 1978
1990	Mouth to Oliver Creek (lower 60 km)	Spawning survey on August 7, counted 294 live chinook, 26 carcasses, and 62 redds. Thought to be a conservative estimate due to speed and flight path (likely explanation for low count compared to August 4 survey).	Seakem Group 1992
1990	Entire mainstem. (100 km)	Spawning survey on August 4, found 819 live chinook, 14 dead carcasses	DFO Stream Files 2002
1998	Mainstem	94 chinook salmon and 36 carcasses were observed. Many Redds observed between mouth and sunshine Creek (Aug 12 or 14)	NND 1998

While not surveyed as often as the mainstem McQuesten, the North McQuesten also has a significant amount of information regarding spawning chinook salmon (Table 3). All of the spawning information present is for the lower 40 km of the North McQuesten.

Table 3. Spawning data on the North McQuesten River

Year	Location	Observations	Source
Not specified	10.6 km upstream from mouth.	Observed spawning chinook	FISS 2002
1986	North McQuesten mouth to mouth of Sprague Creek (18 km)	Fishery Officer (chinook spawning surveys) noted 17 chinook. (Aug, 17)	DFO Stream Files 2002
1987	North McQuesten mouth to mouth of Sprague Creek (18 km)	Fishery Officer (chinook spawning surveys) noted 50 chinook. (Aug 18)	DFO Stream Files 2002
1997	Between Ballard and Red creeks	Two carcasses observed.	NND 1998

Scientific chinook salmon data for the South McQuesten is limited; however, there is documented information from 1997 (Table 4).

Table 4. Spawning data on the South McQuesten River.

Year	Location	Observations	Source
1997	Near mouth of Haggart Creek, upstream of the logjam	One chinook was observed on a large redd.	NND 1998

In addition to the data listed above, David Hedmann and Associates (1995) describe DFO helicopter surveys (38 chinook) in 1982, 275 in 1984, and an estimate of 200 chinook in 1985; however, no locations are listed.

4.1 Traditional and Local Knowledge

Traditional and local knowledge on chinook salmon collected during this study is presented in Table 5. Knowledge of adult salmon is also mapped in Appendix A.

Table 5. Traditional and local knowledge of chinook salmon in the McQuesten River Watershed.

Stream Name	Comments	Source
McQuesten River	People camped at the mouth of the McQuesten and built rock fences to capture salmon.	Buyck pers. comm. 2002.
McQuesten River	Sam Peter, Jimmy Lucas and David Mosses all remember fish traps being used on the McQuesten River to catch chinook (these traps could capture 50 salmon in one night).	Duncan 1997.
McQuesten River	People camped at the mouth of Forty Mile Creek and caught salmon.	Buyck pers. comm. 2002.
Vancouver Creek	Salmon used to migrate up Vancouver Creek; juveniles may still be using the creek.	Buyck pers. comm. 2002.
North McQuesten River	Miners would fish for salmon in North McQuesten.	Klippert pers. comm. 2002.
Haggart	Found chinook above Dublin Gulch.	Buyck pers. comm. 2002.
South McQuesten River	Thought to be a natural spawning area just above where Crystal Creek comes into McQuesten.	Buyck pers. comm. 2002.
South McQuesten River	Elders have mentioned Chinook at lower end of Haldane Creek.	Buyck pers. comm. 2002.
South McQuesten River	What appears to be old spawning dunes have been reported at the outlet of McQuesten Lake.	DFO Stream Files 2002, and NND 1998.
South McQuesten River	Anonymous report of sighting of 20 to 30 adult chinook above the South McQuesten Bridge (around 1991 or 1992).	DFO Stream Files 2002.
South McQuesten River	Used to gaff salmon near Proctor Lake (sounded like it may be Flat Creek) in the 1950's.	Germaine pers. comm. 2002.

4.2 Aerial Flights

During both helicopter flights of the McQuesten Watershed, only a total of 11 chinook salmon were spotted. All chinook were observed in the McQuesten River mainstem (i.e. below the confluence of the North and South McQuesten rivers). During the first flight (August 9/02), all of the chinook were observed between the Klondike Highway bridge crossing and the McQuesten River confluence with Vancouver Creek (Table 6). During the second flight, all of the chinook were observed between the mouth and the McQuesten River confluence with Bear Creek (Table 7). Water clarity/visibility was not optimal for spotting chinook during the aerial surveys (Table 6).

Table 6. Results of August 9, 2002 aerial survey in the McQuesten Watershed.

Stream	Area Surveyed	Visibility (poor/fair/moderate/good)	Chinook Sightings	Comments
McQuesten River	From McQuesten mouth to Vancouver Creek	Moderate	8	3 live, 5 dead; all fish observed in the lower 13 km.
McQuesten River	Vancouver Creek to Bear Creek	Fair	0	
McQuesten River	Bear Creek to North McQuesten	Fair	0	
Vancouver Creek	Mouth upstream for 5 km	Fair to Moderate – water clear; however small stream, view often obstructed	0	
Bear Creek	Lower 5 km	Poor – turbid water	0	
North McQuesten River	Mouth to East McQuesten	Good	0	Low intensity survey due to limited time/ budget.
South McQuesten River	Crystal Creek to McQuesten Lake	Fair – deep sections.	0	Low intensity survey due to fair visibility, few sections with appropriately sized gravels.
		TOTAL	**8**	**5 live, 3 carcasses**

Table 7. Results of August 23, 2002 aerial survey in the McQuesten Watershed.

Stream	Area Surveyed	Visibility (poor/fair/moderate/good)	Chinook Sightings	Comments
McQuesten River	Mouth to Klondike Highway Bridge	Fair to poor, high water levels, deep pools present.	0	
McQuesten River	From mouth to Vancouver Creek	Fair, high water levels.	1	Two bears were seen crossing McQuesten River. Bald eagles were seen adjacent to McQuesten River.
McQuesten River	Vancouver Creek to Bear Creek	Fair to moderate	1 (carcass)	Bald eagle observed.
McQuesten River	Bear Creek to North McQuesten	Lower section - fair to moderate Upper – poor water turbid	1	Several eagles spotted.
Vancouver Creek	From mouth to 5 km upstream	Poor –water turbid (appeared to be from natural source in alpine, likely permafrost melting)	0	
South McQuesten River	Mouth to Seattle Creek	Poor – very turbid	0	
South McQuesten River	From McQuesten Lake extending 1 km downstream	Moderate	0	Gravels only extend for approximately 0.5 km downstream from lake.
Haggart Creek	Swede Creek upstream for 10 km	Moderate	0	Did not survey downstream of Swede Creek as water was turbid.
North McQuesten River	Mouth to East McQuesten	Moderate to good	0	Two eagles observed. Spawning gravels appeared to be present throughout this section.
East McQuesten River	Lower 2 km	Moderate to good	0	
		TOTAL	**3**	**2 live; 1 carcass**

5.0 DISCUSSION

The results of the 2002 aerial survey were severely limited due to high flow conditions in the McQuesten Watershed during the time of survey. The Mayo area experienced a very wet summer, and there were reports from local residents of rainfall everyday in the month of August. This high rainfall contributed to higher water levels and appeared to contribute to higher turbidity levels as well. These combined affects made the effectiveness of the 2002 surveys poor; therefore, it is likely that chinook numbers and spawning locations were significantly underestimated. Evidence of this includes the results of Yukon River radio telemetry study, which found seven radio-tagged chinook in the McQuesten River mainstem (Osborne pers. comm. 2003). As only a small percentage of chinook were radio tagged, many more untagged chinook were likely present in the McQuesten Watershed.

The review of scientific, local and traditional information indicates that the McQuesten mainstem, the lower portions of the North McQuesten and unspecified portions of the South McQuesten appear to be the main spawning areas in the watershed. Of these, the lower sections of the McQuesten mainstem appear to be the most significant spawning areas, as large numbers of chinook have been documented in 1990 (294 live chinook on Aug 7 and 819 live chinook on Aug 4; see Table 2) and in 1998 (94 live chinook), in addition to lower numbers in 1974, 1977 and 2002. The lower portion of the North McQuesten also appears to be a significant spawning location, as adults have been documented in this section in three separate years (1986, 1987 and 1997; Table 3). The information for the South McQuesten is less specific, and although a number of sightings have been made, specific spawning locations and densities are not as clear. Possibly the most compelling evidence of regular chinook spawning within the South McQuesten may be local knowledge of chinook in several locations as well as the repeated captures of juvenile chinook in the Haggart Creek Watershed. Juvenile chinook have been documented in the Haggart Creek watershed in 1995 (Hallam Knight Piesold Ltd. 1996) and in 2002 (Tobler and Sharples, 2003).

From the data present, it is apparent that chinook runs in the McQuesten River, especially in the mainstem in recent times, are quite significant in size. While it is difficult to determine if the size of the chinook runs have decreased over time, there are definitely changes occurring in the watershed. The McQuesten River Watershed has undergone a significant amount of development in the past 100 years and forestry, hard rock and placer mining all have likely impacted habitat quality (both rearing and spawning) within the watershed. For example, water quality has been influenced by the United Keno Hills Mine (elevated metal levels) and placer mining (elevated turbidity levels) throughout the watershed. In addition, channel assessments conducted during the concurrent McQuesten River Watershed Assessment have shown significant changes in channel morphology and thus fish habitat in a number of streams throughout the watershed (Tobler and Sharples 2003). These changes may not only impact the success of spawning and incubation but also the success of chinook rearing.

In terms of the North McQuesten, the lower 18 km (below Sprague Creek) is potentially an important spawning location; however, evidence of repeated annual use does not exist. While significant numbers were present in 1986 and 1987, it is odd that no fish were observed in the 1998 and 2002 surveys. There could be a number of possible reasons for this, including that this area is typically used by low densities of fish that were not detected in 1998 and 2002, the area is only used during years of high escapement, or there has been change in the habitat that has made the area unsuitable to successful spawning or incubation. According to a preliminary review of 1995 air photo versus historic photos there appears to

be significant morphologic changes that have occurred to the North McQuesten stream channel (Miles pers. comm. 2002), which may be the result of forestry activities (harvesting occurred in the North McQuesten area in 1954 to 1964; Northern Design Consultants 1993) and fire activity in the watershed. This area should be monitored in the future for chinook spawning and habitat changes.

As there is even less information available for the South McQuesten, this area should be monitored in future years for chinook salmon spawning, especially in light of recent restoration works that were completed in 2002. These works involved the construction of a channel to bypass a large logjam on the South McQuesten River (upstream of the Haggart Creek confluence; developed as a result of forest harvesting activities), which was thought to restrict fish passage (DFO Stream Files, 2002). Additional work should be conducted to determine if chinook are using the South McQuesten on an annual basis, and efforts should be made to locate specific spawning locations. Now that the logjam has been removed, there may be increased salmon use of this portion of the watershed.

The results of the this study were consistent with past records in concluding that the lower portion of the McQuesten mainstem is the most significant chinook spawning location in the watershed. More specifically the area between 10 km and 50 km (as measured upstream of the mouth) appears to be the most productive as measured in 1990, when 55% (453) of the live chinook counted in the McQuesten mainstem were observed in this area (DFO Stream Files 2002; Figure 2).

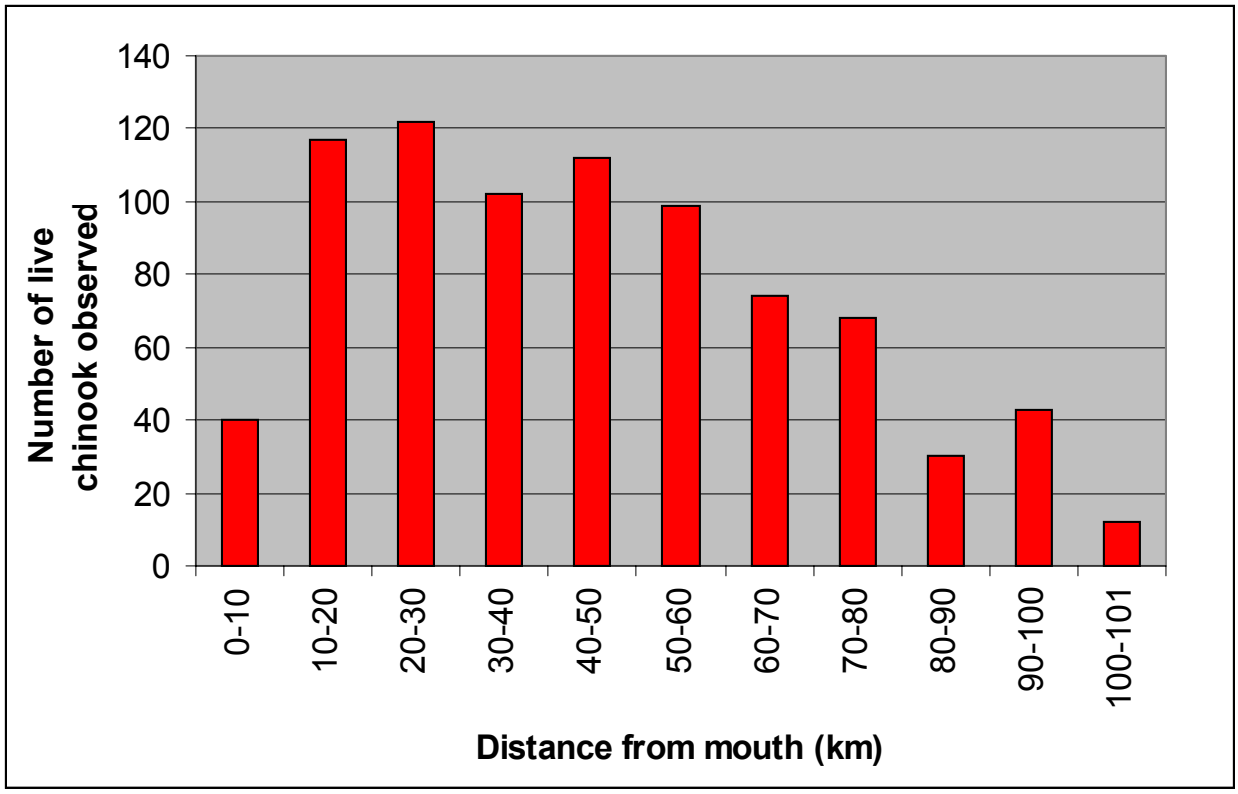


Figure 2. Distribution of chinook observed during August 4, 1990 aerial survey of the McQuesten River mainstem (adapted from DFO Stream files, 2002).

Despite the poor survey results in 2002, the McQuesten River could be a suitable candidate for an index area to determine relative escapement in this watershed. The most suitable location would be the lower

sections of the McQuesten mainstem as it appears that there is a significant annual run in this area and with the exception of 2002 the visibility appears to be adequate. However, before setting up a specific index area, it would be beneficial to survey the majority of the watershed again (in a low flow year) to confirm the patterns found in 1990. This will ensure that accurate escapement numbers are generated.

Another option may be to operate a weir/fish fence on the McQuesten mainstem near the Klondike Highway. This option, if feasible, would give a more reliable and accurate indication of escapement each year and could provide excellent stewardship, training and employment opportunities for NND people. Both these options should be considered as a means to provide an indication of escapement within the Stewart River system.

6.0 LITERATURE CITED

Beak Consultants Ltd. 1978. *Fisheries Investigations Along the Klondike Highway Section of the Prospective Dempster Lateral Pipeline Route, Yukon Territory, Summer and Fall, 1977.* Prepared for Foothills Pipe Lines Ltd.

Brock, D.N. 1974. *Distribution and Abundance of chinook (Oncorhynchus tshawytscha) and chum (Oncorhynchus keta) in the Upper Yukon River System in 1974 as Determined by a Tagging Program*. Prepared by Canada Fisheries and Marine Service and Environment Canada. 56 pp.

Buyck, S. 2002. Personal Communications - August 8, 2002. Game Guardian, Lands and Resources Department, First Nation of the Nacho Nyak Dun, Mayo, Yukon Territory.

David Hedmann and Associates. 1995. *Compilation of Environmental Information Pertaining to the McQuesten River Watershed - DRAFT*. Prepared for Water Resources Division, Northern Affairs Program, DIAND, Whitehorse, Yukon.

DFO Stream Files 2002. Fisheries and Oceans Canada Habitat Stream Files. Located at Fisheries and Oceans Canada, Whitehorse, Yukon Territory. Miscellaneous Memos and letters pertaining to the McQuesten River, Reviewed in 2002.

Duncan, J. 1997. *Summary of Streams in the Tr'on dek Hwech'in Traditional Territory: A search for Candidate Streams to Support a Program based on a Klondike Area Central Incubation/Outplanting Facility*. Prepared by Duncan Contracting.

FISS 2002. FISS (Fisheries Information Summary System) Database Search Engine Webpage: http://habitat.rhq.pac.dfo-mpo.gc.ca/cfdocs/fiss/dcf01.cfm Fisheries and Oceans Canada. Viewed December 11, 2002.

Germaine, C. 2002. Personal Communications - August 8, 2002. Member of First Nation of Nacho Nyak Dun, Mayo, Yukon Territory.

Hallam Knight Piesold Ltd. 1996. *Dublin Gulch project: Initial Environmental Evaluation*. Prepared for First Dynasty Mines Ltd.

Klippert, D. 2002 Personal Communications - August 8, 2002. Mayo Renewable Resource Council, Mayo, Yukon Territory.

Lipovsky, P., W. LeBarge, J. Bond, and G. Lowey. 2001. *Yukon Placer Activity Map*. Indian and Northern Affairs Canada, Exploration and Geological Services Division, Yukon Region.

Miles, M. 2002. Personal Communications – December 3, 2002. Principal, M. Miles and Associates Ltd. Victoria, BC.

Nacho Nyak Dun First Nation. 1998. *Chinook Salmon (Oncorhynchus tshawytscha) Stock and Habitat Assessment in the McQuesten River Drainage Basin and Recommendations for a Stock Restoration Plan*. Prepared for the Yukon River Panel.

Northern Design Consultants 1993. *A History of Logging in the Yukon 1896-1970*. Prepared by Northern Design Consultants, March 30, 1993.

Osborne, C. 2003. Personal Communications. Email to P. Tobler dated January 7, 2003. Principal, Haldane Environmental Services, Whitehorse, Yukon Territory.

Pentz, S.B. 1996. *Flow and Suspended Sediment Transport in a Drainage Basin Affected by Placer Mining, Central Yukon, Canada*. Master of Science Thesis, University of Guelph.

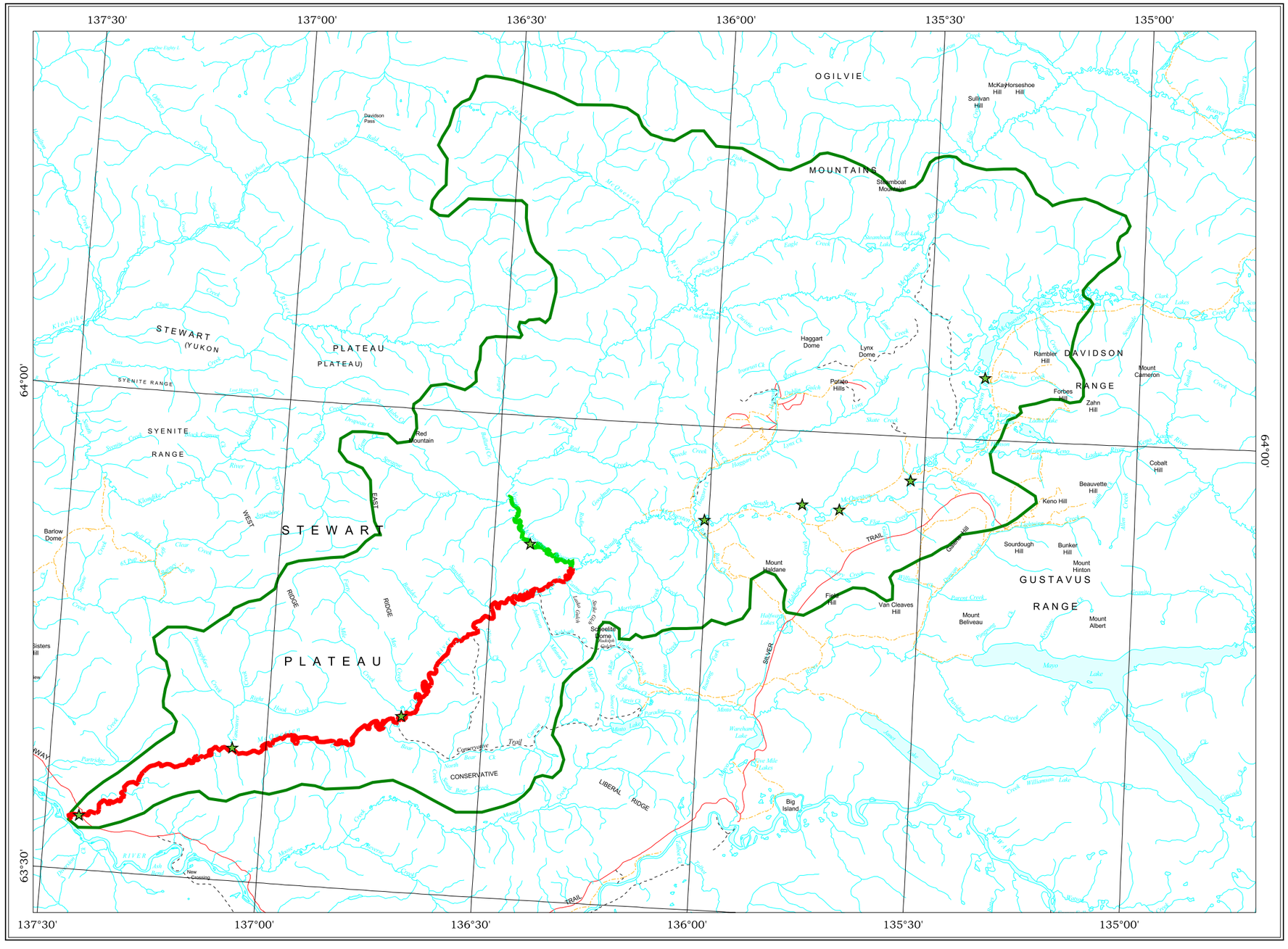
Seakem Group Ltd. 1992. *Yukon Placer Mining Study*. Prepared for Yukon Placer Implementation Review Committee. Prepared by Seakem Group Ltd., Sidney, BC.

Seigel, N. and C. McEwen. 1984. *A Historical Overview of Fishing in the Yukon*. Prepared for Department of Fisheries and Oceans, Pacific Rim Division. Prepared by Northern Biomes Ltd., Whitehorse, Yukon Territory.

Tobler, P. and R.J. Sharples 2003 (in prep). *McQuesten River Watershed Assessment*. Prepared for the Yukon River Panel. Prepared by Environmental Dynamics Inc., Whitehorse, Yukon Territory, in association with the First Nation of the Nacho Nyak Dun First Nation, Mayo, Yukon Territory.

APPENDIX A:

CHINOOK SPAWNING INFORMATION MAP



Chinook Spawning Information
McQuesten River Watershed

Scale 1:500,000

5 0 5 10 15 Kilometers

Albers Equal Area projection (standard parallels: 61°40'N & 68°00'N)

McQuesten River Watershed

Spawning Areas

Primary spawning

Secondary spawni

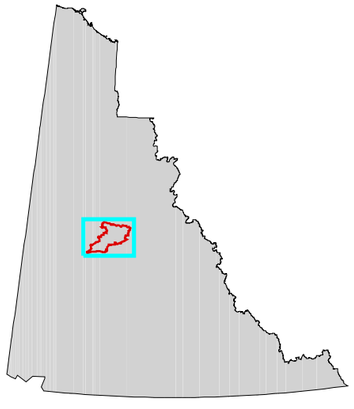
Transportation

LIMITED-USE ROAD

ROAD

TRAIL

Local and Traditional Knowledge of adult chinook - refer to table 5 for more details



DIGITAL DATA SOURCES AND DISCLAIMERS

National Topographic Data Base (NTDB) compiled by Natural Resources Canada at 1:50,000. Reproduced under license from Her Majesty the Queen in Right of Canada, with permission of Natural Resources Canada.

Map Compiled By:
Millie Olsen
GIS Technician
Lands and Resources Department
Nacho Nyak Dun First Nation
Mayo, Yukon
05 December 2002