State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

M

Region: Southcentral

USGS Quad(s): Seward D-5, D-6

Anadromous Waters Catalog Number of Waterway: 247 -60 - 10220 -2027 -3014-4046 -0010

Name of Waterway: Williwaw Pond II

☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination #	130080		
Revision Year:	2014	Fisheries Scientist	8/27/13 Date
Revision to: Atlas ___ Catalog ___ Both Y		Habitat Operations Manager	8/27/13 Date
		AWC Project Biologist	6/13/13 Date
Revision Code:	B-1	Cartographer	9/12/13 Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
Chinook Salmon	11/04/12, 11/18/12, 3/17/13, 4/21/13		X		☑
					☐
Add Chinook Salmon Rearing to 247-60-10220-2027-3014-4046-0010					☐
Add Chinook Salmon present to 247-60-10220, 247-60-10220-2027-247-60-10220-2027-3014, 247-60-10220-2027-3014-4046					☐

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:

Chinook salmon were caught in baited 10" minnow traps in Williwaw pond II throughout the 2012-2013 winter. 34 were caught on 11/4/12 ranging in size from 85-140 mm in length. 11/18/12 - 1 (110 mm), 3/17/13 - 3 (~110 mm), 4/21/13 (~114 mm). This groundwater fed pond is a reconstructed gravel pit which flows into Williwaw Creek and then into Portage Creek.

The traps were set opportunistically at shore before freeze up in November, and then were placed in augered holes throughout the pond until april.

Name of Observer (please print): Maio Nishkian

Signature: [signature] Date: 5/13/2013

Agency: Student - UAA

Address:

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: David E. Bosch Date: 6/13/2013 Revision 05/08

Name of Area Biologist (please print):

N

N

UNIVERSITY OF ALASKA ANCHORAGE

EXPLORATION ECOLOGY

Distribution and species composition of juvenile salmonids in Portage Valley, Alaska

By Maio Nishkian

The following project represents only the beginning of a series of data sets needed to understand the life history and habitat use of juvenile fish in Portage Valley. I believe it would beneficial to continue this project into the spring of 2013, and beyond. In addition to the continuation of the previous study, I hope to expand the number of study sites in order to explore other areas with the potential for high quality overwintering habitat. Detailed, systematic sampling is needed in order to observe trends and develop theories for future management of Portage Valley. I therefore hope to include data loggers or hach test kits to record dissolved oxygen, pH, alkalinity and hardness of streams in order to study water composition and quality. Water depth, substrate type and condition, turbidity and current velocity will be recorded and compared to species presence and absence to determine habitat preference. This baseline data is essential for determining species composition and developing possible enhancement projects in a valley that could play a key role in Chinook salmon recovery. This glacially fed valley also acts as an indicator for global changes in climate, and expansion of current knowledge will allow the effects of these changes to be monitored.

Table of Contents

Introduction **3**
Literature Review 3
Site Description 6
Research Importance 8
Materials and Methods **9**
Results **10**
Conclusion and Discussion **14**
Significance 19
Acknowledgements 20
References **20**

Introduction

Salmon are a vital component in Southcentral Alaska's freshwater and marine ecosystems. Understanding wild salmon migration, over winter habitat use, diet, spawning patterns and juvenile rearing are crucial when determining management plans, recording harvest data, and implementing conservation efforts. Gathering baseline data is the first step in any sampling effort in order to develop a framework with which to incorporate future data collection. This historical reflection is necessary in order to avoid an automatic shift in the baseline to current standards.

Our research concerns the abundance, migration patterns, habitat use, and behavior of fish in the Portage River watershed and the Placer River watershed including coho salmon, *Onchorynchus keta*; Chinook salmon, *Onchorynchus tshawytscha*; rainbow trout, *Onchorhnychus mykiss*; as well as Dolly Varden char, *Salvelinus malma*. Baseline data collection has been established in the Portage Valley area in 1976 and 1977 in studies done by the Bureau of Land Management (Browning 1976 and Krueger 1977), and since then no studies have been conducted.

Portage Valley incorporates three river systems that drain into Turnagain Arm and Cook Inlet; all active fisheries that support the subsistence lifestyle of many Alaskans. All five salmon species are found in Turnagain Arm, and with the exception of hatchery raised coho salmon stocked in Bird Creek, all are wild or native(M. Chilcote, personal communication). Current era baselines must be established in order to make proper conservation and management decisions for fish species in this area.

Previous data has been collected and compiled throughout the state of Alaska, but not much in the Portage Valley area, and essentially none during the winter. Both the 1976 and 1977 papers highlighted the importance of continuing research to determine overwintering areas for these species of concern (Browning 1976; Krueger 1977). After freeze up, we predict that Dolly Varden and coho will be found in deep pools and lakes. All species will likely be found near ground water sources, as this keeps the water temperatures higher during the winter. Fish will also look for deep, ice-free pockets in main river channels. Anywhere with structure such as logs, debris, and large boulders will also make prime habitat. Evaluating the basic life histories of fishes is necessary to understand the impact of ongoing climate change on fisheries of Alaska, anthropogenic impacts on watersheds and fish populations, and management factors including habitat enhancement and potential harvest.

Literature Review

Browning 1976 and Krueger 1977 were useful for our study in determining strategic sampling sites, as well as giving a baseline as to what is found in Portage Valley. These previous studies were conducted in order to establish this baseline, to observe the effect of beaver activity and damming on running salmon, the effect of culverts on fish passage, possible enhancement

projects to increase juvenile salmonid overwintering habitat, amendments in harvest quotas, and to observe mining and gravel pits and their effects on fish populations.

Beaver dams were looked at as a hazard to fish passage and upstream migration. Removal of dams or the implementations of fish ladders at dams were suggested, though we find this to be a detrimental disturbance of a natural habitat which in fact purifies streams (C. Annett, personal communication, November 2012) and provide excellent habitat for juvenile coho salmon (Polluck et al. 2004).

Gravel mining has been going on in Portage Valley since 1964 (Graham 2011). Since this was before any fish surveys had been done in the area, it is hard to tell what impact this might have had on populations. Historically, Williwaw Creek was a high water side channel of Portage Creek where constant flooding helped improve spawning sites, keeping them silt and debris-free. In 1964 the headwater gravel pond was excavated, and the stream began flowing from the pond (Browning 1976). This completely cut off Williwaw Creek from Portage Creek so that fish were no longer able to move through Williwaw Creek from Portage. This could have had significant impact if Williwaw Creek was used as spawning grounds, or had good overwintering habitat. Gravel pits existed in several locations in the valley including Williwaw Creek area, and previous studies suggested habitat enhancement of these pits for overwintering juveniles. Four Williwaw ponds were established from this mining operation (Figure 1), one of which was sampled in this 2012 study. Though it was found that these pits now make good overwintering habitats for juvenile salmon, it is *not* recommended that additional dredging occur in order to create more habitat as implied in Krueger (1977).

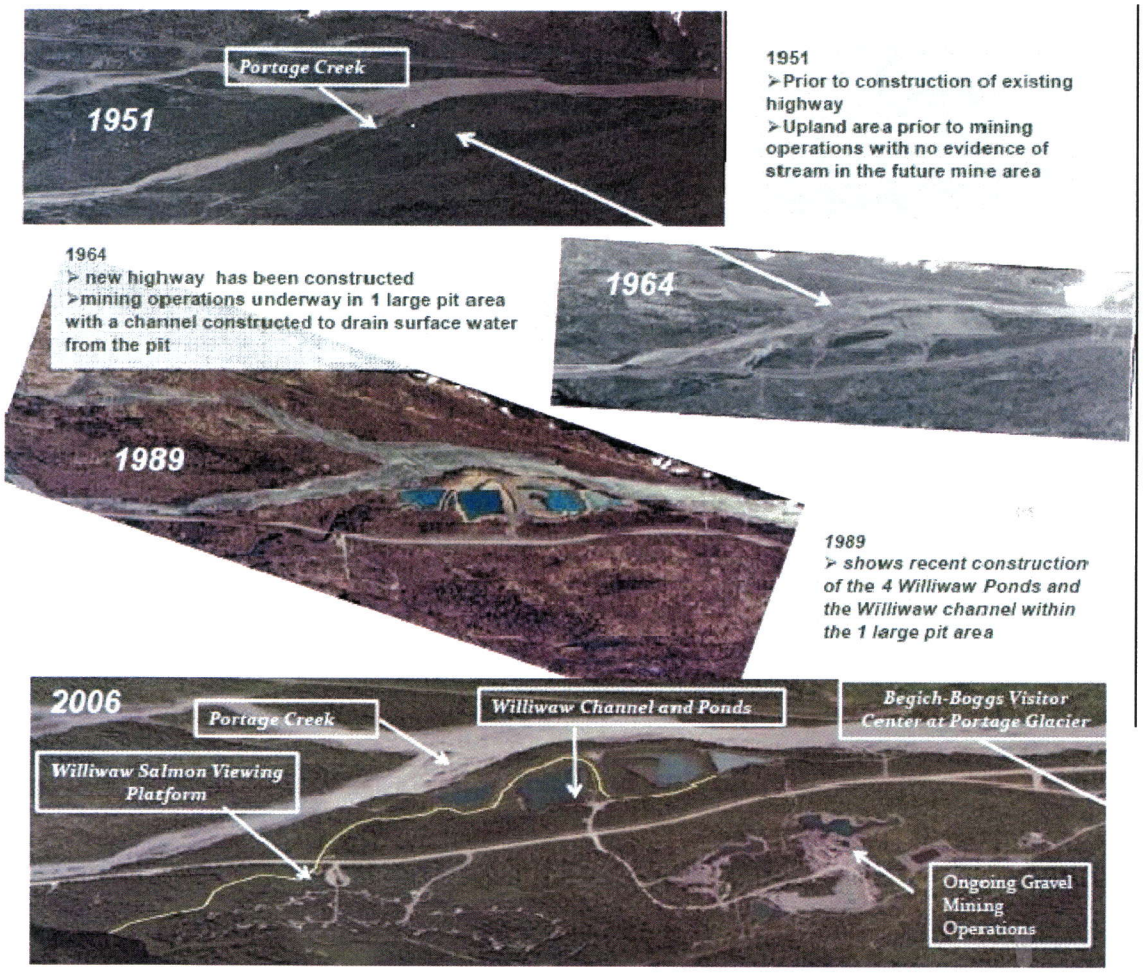


Figure 1. Portage Valley Gravel Operations (Graham 2011)

Fishing regulations were recommended in the form of complete closures of streams. We realize that harvest quotas are a better form of regulation than complete closures unless population data indicates a threat to a certain species.

The work that Browning (1976) reported was conducted mid-May to mid-September, while the surveys of Krueger (1977) were performed from late-May to mid-November. This was an important difference because Krueger (1977) was able to observe the coho running and spawning, and also began to look at juvenile overwintering habitat. 2012 research began in mid-October and went through mid-November. The movement of the fish as freeze up began and winter set in has been observed, but over-wintering surveying still needs to be done in Portage Valley.

Site Description

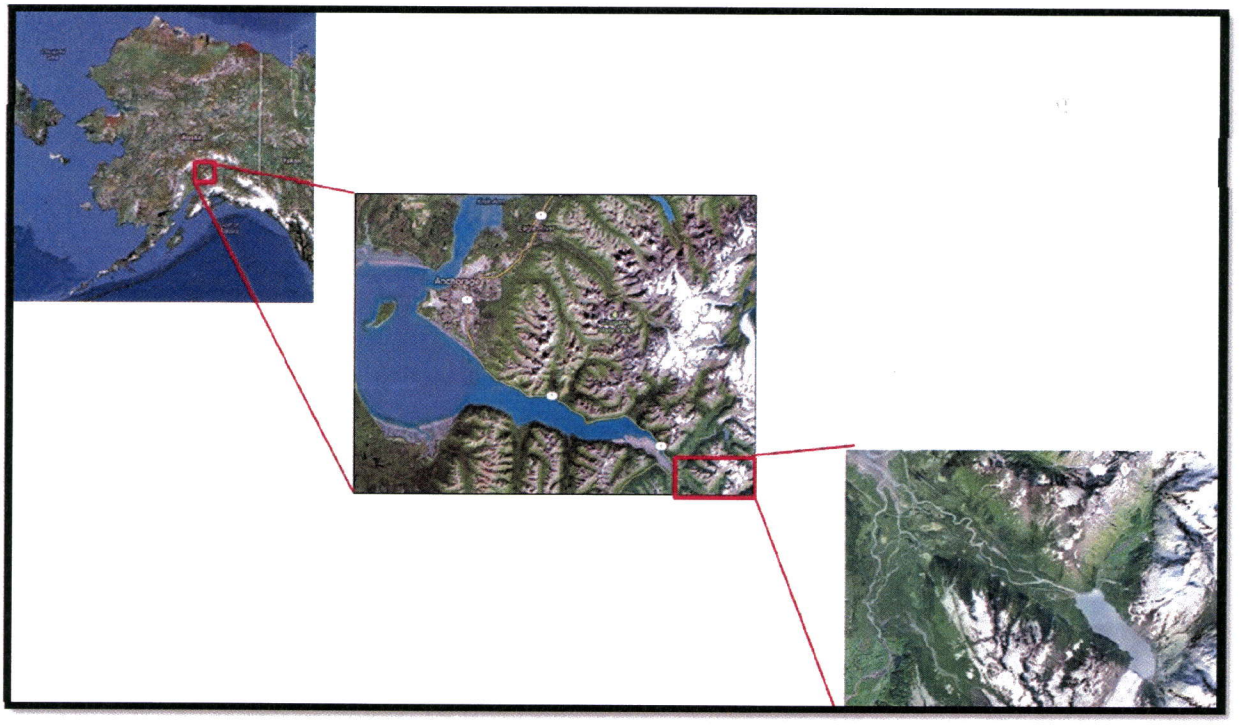


Figure 2. Portage Valley site in reference to Alaska

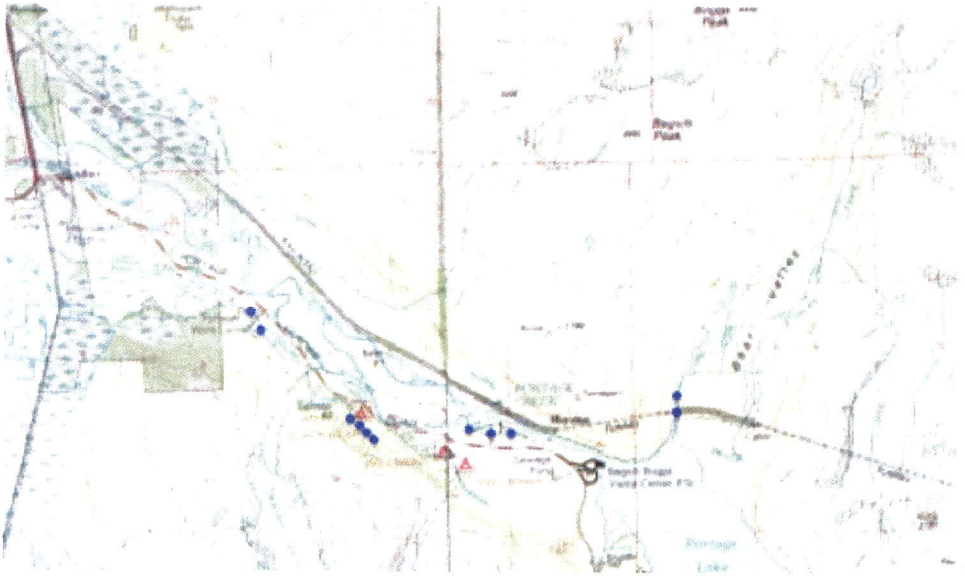


Figure 3. Portage Valley Topographic map (blue dots indicate trap sites within the study area)

Figure 4. Map of Portage Valley including sampling site areas

Glacier fed rivers comprise most of the freshwater runoff in the Cook Inlet region of South Central Alaska (Dorava and Milner 2000). Historically, the terminus of Portage Glacier was on the west end of Portage Lake. Right now it sits on the eastern end, and has receded almost 5 kilometers (Figure 4). Retreat of the glacier began in the late 1800's and early 1900's due to climate change and began an unstable calving environment as it pulled back into the lake(Kennedy 2006). The greatest glacier recession was between 1939 and 1950 when it was receding between 140 and 160 meters per day (Kennedy 2006). Glaciers can, initially, have detrimental effects on the fish species that live in the drainages because as the glaciers retreat large amounts of gravel are deposited in lakes. This gravel creates complicated sections of streams and riparian vegetation which are important features of good fish habitat. As the glaciers retreat farther, the streams cut through the sediment and create larger, more defined bodies of water that become some of the most suitable fish habitat (Blanchet 2006). This habitat in Portage Valley is currently in a more stable position due to the terminus being located at a land based environment.

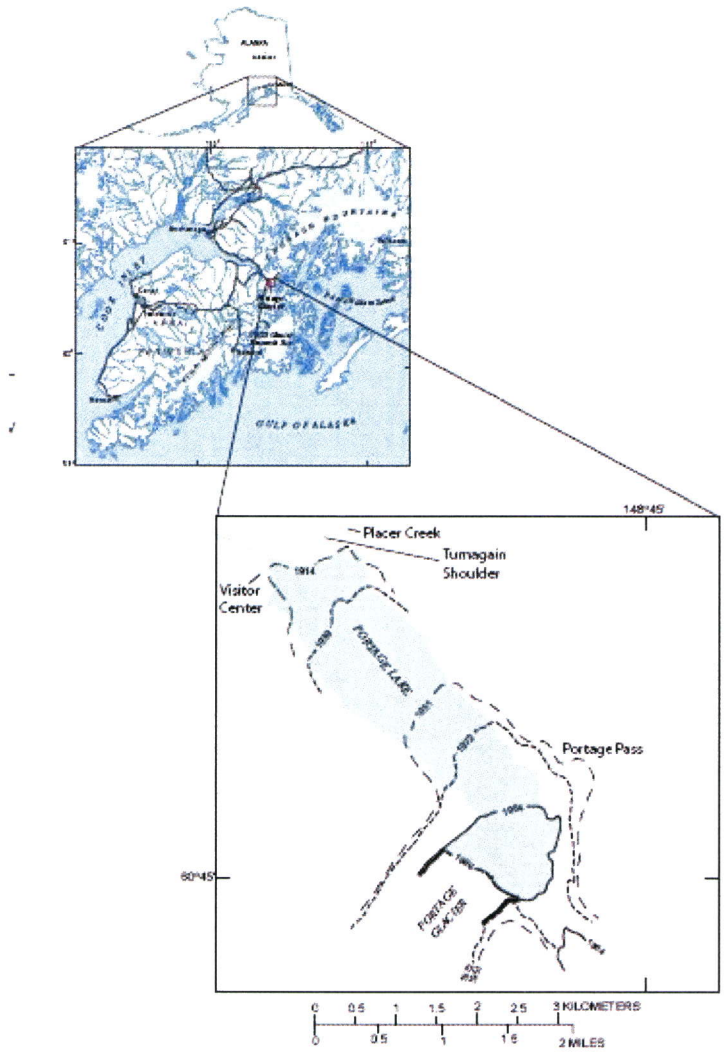


Figure 5. Approximate terminus positions of Portage Glacier 1914-1999 (Figure 1 in Kennedy 2006)

Rivers that flow from glacier fed lakes create some of the most stable and least disturbed salmonid habitats with increased water temperatures, defined streams, and improved winter water flow (Dorava and Milner 2000). The Explorer Creek and Explorer Pond sites are part of the Placer River watershed while all other sites are part of the Portage River watershed, but both are glacier fed. Both of these drainages can, potentially, have very different habitats and species of fish that can be sampled in very close proximity to each other. Due to the importance of glacially fed rivers for fish habitat, baseline definitions become even more crucial as the formidable changes occur in these areas due to climate change.

As reported by Mantua (2010), glacial melting and depletion in Washington state will create loss of water storage, leading to low flows and higher temperatures in the summer, as well as increase in flows due to melt during the winter and spring. In the eastern Bering Sea, rising

temperatures negatively affect energetic status of juvenile sockeye salmon(*Onchorhynchus nerka)*, resulting in increased over winter mortality (Farley et al. 2011). It is probable that glacially fed streams in Portage Valley are directly affected by similar circumstances. In order to assess effects of climate change, data collection on fishes, stream flows, water temperatures and a survey of other species in this area are essential.

Research Importance

Turnagain arm is a bay of Cook Inlet into which Placer, Portage, and 20 Mile Rivers of the Portage area flow. The watershed associated with Cook Inlet encompasses 47,000 square miles of Southcentral Alaska (Helvoigt et al. 2010). In 2007, salmon harvests in Cook Inlet had an estimated wholesale value of over $61 million, a total economic impact of almost $100 million, and employed more than 1,000 people (Helvoigt et al. 2010). Commercial salmon drift gillnetting occurs every year in this area and is a source of income for many Alaskans. Production in 2002 was 12.6 million pounds of fish, with drift fishing fleets earning a total of $5.7 million with 409 permits released. This is down from the 45.3 million pounds harvested in 1992, with earnings totaling $66.4 million with 580 active permits (ADF&G 2004; Alaska Commercial Fisheries Entry Commision 2004). This substantial decrease shows an immediate economic need to study and conserve sport fishes in this area in order to extend the success of Alaskan commercial fishing and its effect on the state's economy.

Offshore oil and gas industry began in Cook Inlet in 1967, and is central to the local economy (Gjerde et al. 1983). With the ongoing demand for petroleum products, future drilling is imminent and poses a threat to salmonid populations and commercial and subsistence fishermen of the region. Understanding the anthropogenic effects of drilling and mining on the aquatic ecosystem is only possible if the local populations are studied.

Conserving these wild salmonid populations is critical. Hatcheries may be able to reestablish populations, but hatchery raised fish can never be as productive as a wild salmonid fishery due to high inbreeding, depression of survival and growth rates, and other factors that are not fully understood (Gjerde et al., 1983; Kincaid, 1983; Su et al., 1996; Chilcote et al. 2011). This decrease in genetic variability can be avoided by managing and conserving our wild populations and the habitats that they live in (Norris et al. 1999).

A species of major concern for this study would be the Chinook salmon. Chinook are listed under the Endangered Species Act (ESA) throughout Eastern Oregon, Washington, most of Idaho and California (NOAA 2012). A decline in Chinook salmon has been reported in the western Cook Inlet and Matanuska-Susitna area rivers by Alaska Department of Fish and Game (ADF&G) Biologist Sam Ivey. 12 of the area's 17 Chinook Salmon escapement goals (the number of fish able to move upstream to reproduce) were not met in 2011. In recent years, significant restrictions were put in place on Chinook fisheries causing revenue loss for many commercial and subsistence fishermen, as well as revenue lost by ADF&G from Chinook tags.

Ivey said that similar restrictions will take place next season for Chinook as well as for coho (Dischner 2012). The commercial coho salmon harvest in the Upper Cook Inlet (UCI) was approximately 45% lower than the recent 10-year average annual harvest. The estimated Chinook harvest throughout the UCI was about 85% less than the 1966-2011 average annual harvest (Table 1). The two most important fisheries for commercial harvest of Chinook Salmon in the UCI are the Upper Subdistrict of the Central District and the Northern District. Harvest in the Northern District in 2012 was about 57% less than the previous 10-year average (ADF&G News Release 2012). Harvest in the Upper Subdistrict was approximately 95% less than the previous 10-year average (ADF&G News Release 2012). Due to the recent decline in salmon fisheries of this area, studies must continue to be conducted in order to understand the implications of salmon harvest on the population and fisheries.

Table 1. Upper Cook Inlet commercial salmon harvest by species, 1966-2012

Year	Chinook	Sockeye	Coho	Pink	Chum	Total
1966-2011 Avg	15,706	2,950,675	302,426	463,242	438,984	4,171,033
2002-2011 Avg	16,518	3,445,491	186,655	216,363	120,689	3,985,717
2012[a]	2,358	3,093,825	103,452	471,468	278,938	3,950,041

[a] 2012 data preliminary.

(Table 3 in ADF&G News Release 2012)

Materials and Methods

The ADF&G issued a fish resource permit for scientific/education purposes authorizing the trapping and sampling of fish in the Portage Valley area. The Institutional Animal Care and Use Committee also issued a permit that allowing for the handling of the captured fish.

Fyke minnow traps with 10 cm diameter openings on each end were baited with salmon eggs and placed in areas along Portage Glacier Road where juvenile fish were expected to reside. We set traps at Placer Creek, Placer Creek Bridge, the upper North Fork of Williwaw Creek, North Williwaw Pond, the lower North Fork of Williwaw Creek, the Eastern South Fork of Williwaw Creek, Eastern South Williwaw Pond, South Williwaw Pond, the South Fork of Williwaw Creek, Explorer Pond, and Explorer Creek (Figures 2&3). All traps were set for two to three hours before being retrieved. Water temperatures were also taken at revisited sites.

Fish were anesthetized with tricane methanesulfonate to ease handling after capture. Fork length was measured, and species were identified using *Field Identification of Coastal Juvenile Salmonids* by W. R. Pollard *et al.* (1997). Before releasing the fish, they were revived in a bucket of fresh water taken from the collecting locality. Collected data was organized as histograms using Microsoft Excel and as tables using Microsoft Word.

Results

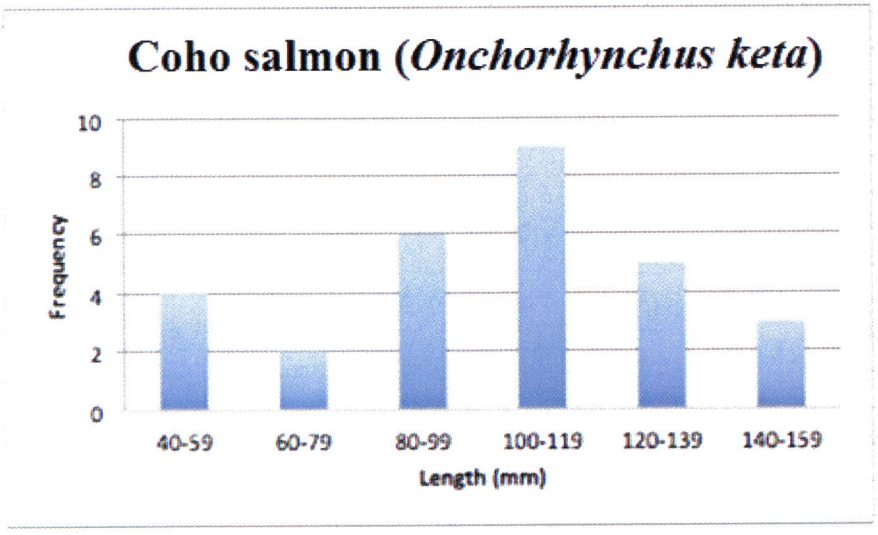


Figure 6. Lengths of all captured coho salmon

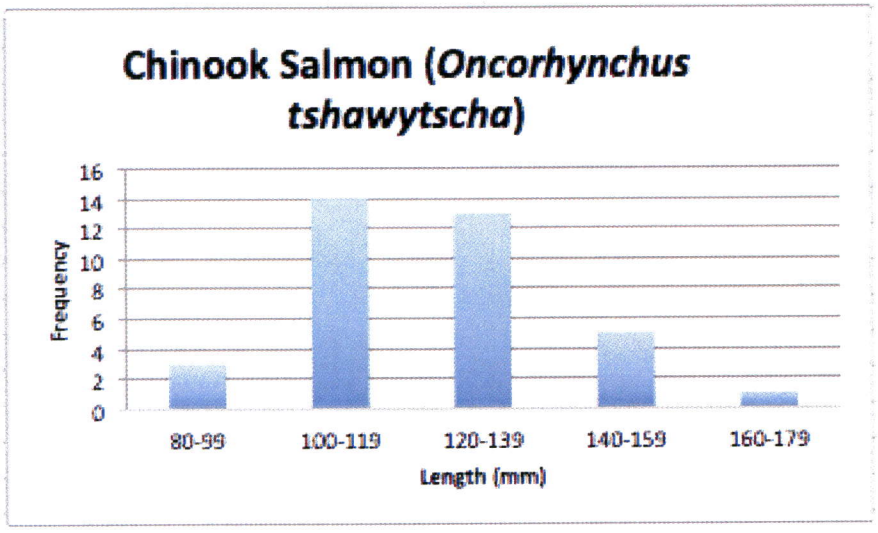


Figure 7. Lengths of all captured Chinook salmon

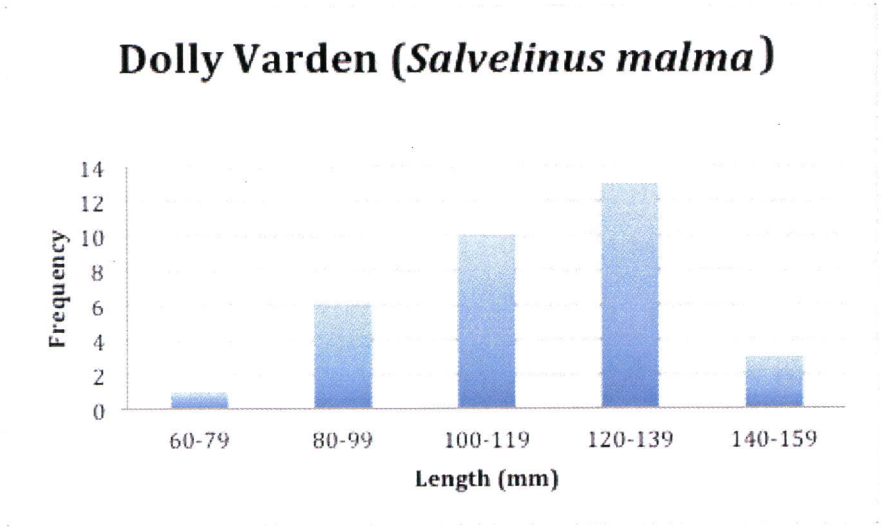


Figure 8. Lengths of all captured Dolly Varden

Table 2. Water temperatures

Site Name	Water Temperature (°C) November 4.	Water Temperature (°C) November 18.
Placer Creek	na	0°
Placer Creek Bridge	na	0°
Upper North Fork of Williwaw Creek	5°	1°
North Williwaw Pond	4°	2°
South Williwaw Pond	2°	na
South Fork of Williwaw Creek	3°	na
Explorer Pond	1°	0°
Explorer Creek	0°	1°

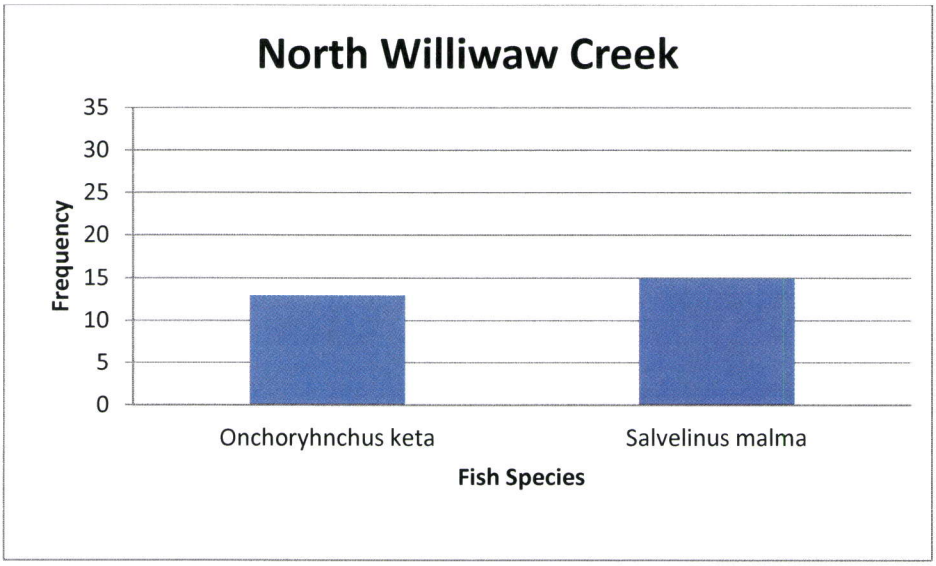


Figure 8. North Williwaw Creek species frequency

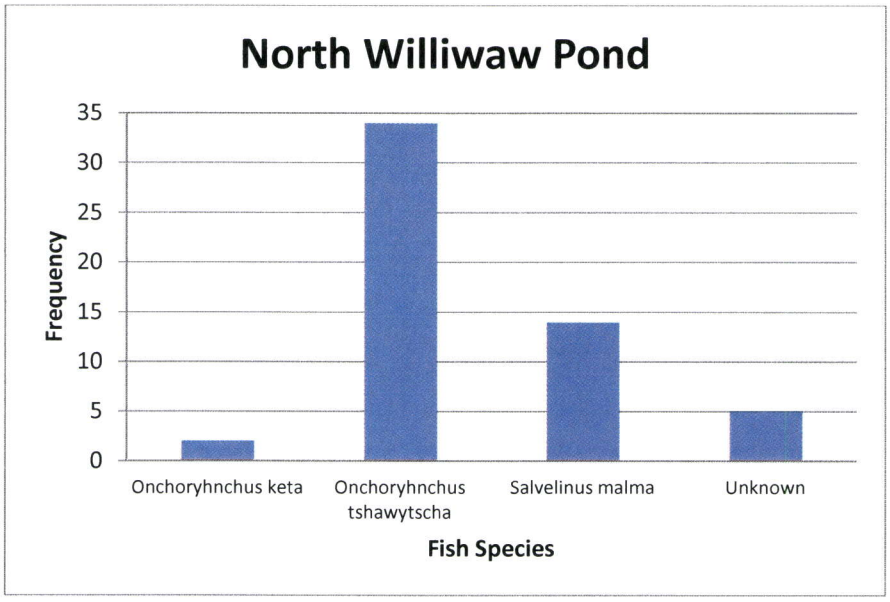


Figure 9. North Williwaw Pond species frequency

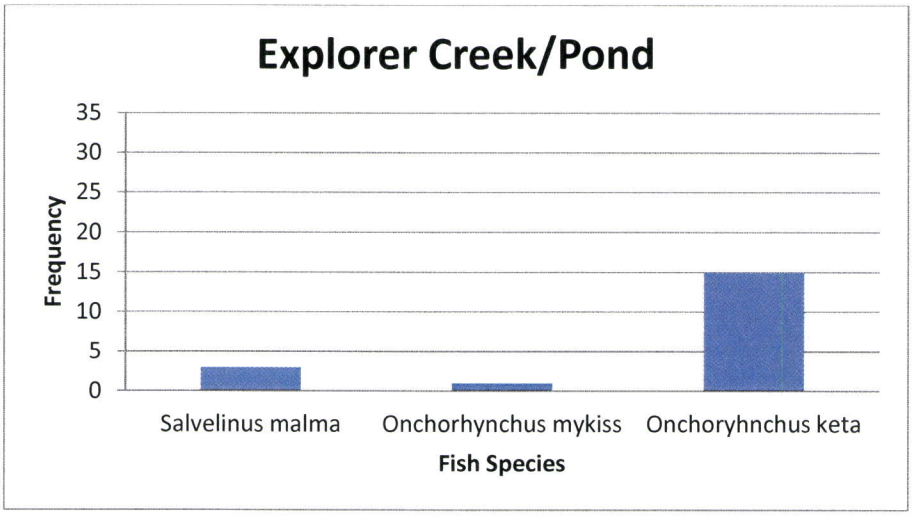


Figure 10. Explorer Creek/Pond species frequency

Throughout South Williwaw Creek sampling sites, no salmonid species were found, but approximately 120 stickleback (*Gasterosteus spp.*) were sampled on November 4. On October 14, one stickleback was found at Explorer Creek.

In this study it was found that rainbow trout, Dolly Varden, and coho salmon live in the portion of the sites that were found in the Placer River Drainage. In the Portage River drainage, sculpin (*Cottoidea spp.*), coho salmon, Chinook salmon, Dolly Varden, and stickleback were discovered.

Conclusions and Discussion

The following comparisons between current and previous studies done in Portage Valley will be based on the surveying done in 1977 because of its similar timing to that of our research. Krueger 1977 sampling went into October and November which is the same time of year as our research, where Browning 1976 ended in September. The time of year is relevant because of the seasonally dependent migration of salmonids into this area.

Figure 11. Explorer Pond and Glacier (facing South)

Figure 12. Explorer Pond and Glacier October 14 and November 4, 2012

Explorer Pond is a glacially fed pond at the base of Explorer glacier which runs down Portage Valley from the southeast to the northwest. The outlet of the lake had adult coho Salmon spawning near the beach. This is a pretty unusual place for coho salmon to spawn, as they normally spawn in the gravel of small streams or rivers. It is probable that there is stream flow downwelling at this outflow site providing an environment that is conducive to egg incubation and survival Kruger (1977) indicates spawning occurring in the same area. In mid-October, no

fish were retrieved in 2012 studies. A decrease in 0+ coho density was noted in this area in Krueger 1977 as well. One would think that with all the sockeye spawning in this area, there would be many juveniles trying to feed on the eggs, but it is reasonable to conclude that low flows triggered movement of juveniles to overwintering areas. In November 2012 sampling efforts however, two juvenile coho were captured indicating that this may be a useful juvenile overwintering area.

Figure 13. Rainbow Stocking in Alder, Airstrip and Tangle Ponds in Portage Valley. Location of sampled rainbow at Explorer Pond.

The site at Explorer Creek was downstream from the pond (Figure 11), and sampled in an area where habitat restoration had occurred in the form of logs for structure and creation of pools for overwintering. In October, stickleback and Dolly Varden were found in Explorer creek in current and previous studies. In November 2012, the number of species increased, and many juvenile coho were sampled and seen in areas with structure and slow flowing pools. Coho were the most frequent species occurring at the Explorer sites (Figure 10), indicating its importance in juvenile coho rearing.

One juvenile rainbow trout was sampled in Explorer Creek on October 14. This was the only occurrence of rainbow trout throughout 2012 sampling, and had not been found in previous studies (Krueger 1977 and Browning 1976). Rainbow trout have been stocked in Airstrip/Willow Pond, Tangle Pond and Alder Pond near Explorer Pond (Figure 13). It is unclear whether these ponds are connected and would allow fish to migrate between them but it is likely that they have outlets into other water sources. This fish could be evidence that rainbow trout are beginning to colonize this watershed, or it could be that they have been in the basin all along, but at densities so low that previous surveys have failed to catch them. Triploid rainbows have been stocked in these ponds recently, but previous diploids have been introduced as well(ADF&G 2012 Fish

stocking update), meaning that this rainbow could be the product of reproduction of stocked species.

Figure14. Williwaw sites

The Portage River system runs through locations at the head of the basin at Williwaw Creek which flows into the mainstream and also through the rest of the 2012 sampling sites, excluding Explorer. Williwaw creek has two forks, one goes North to some artificial ponds and one goes South (Figure 14). These forks have two different delivery methods of water; North is groundwater which is characterized by higher temperatures, increased nutrients, and increased inorganic ions compared to the surface water systems (Hayashi and Rosenberry 2002) such as in the South Fork. These conditions create favorable habitats for overwintering fish. Our sampling data confirm these characterizations; North Williwaw Creek and Pond had many more species than the South Fork of Williwaw Creek.

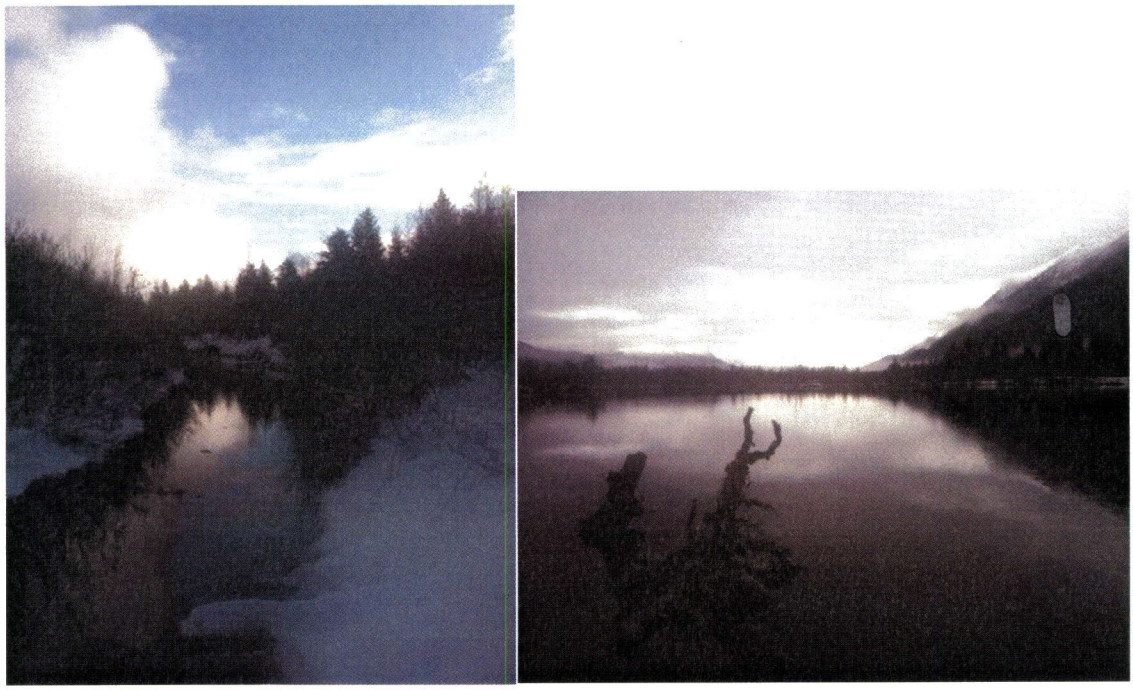


Figure 15. North Williwaw Creek (left) and North Williwaw Pond (right) on October 14, 2012

In our October sampling, five coho salmon were found in North Williwaw Creek, but no fish were captured in North Williwaw Pond (Figure 15). This could be attributed this to the seasonal migration of juveniles, and was confirmed when on November 4th there were no fish found in North Williwaw Creek, but there were 33 Chinook salmon, two coho salmon, 13 Dolly Varden, and one sculpin found in North Williwaw Pond. Additionally, the November 18 sampling efforts revealed four coho salmon and 14 Dolly Varden in North Williwaw Creek, and three coho, one Chinook, and one Dolly Varden in North Williwaw Pond. In a previous study coho, sockeye and Dolly Varden were found in North Williwaw Creek (Krueger 1977). The fact that there were no fish found in North Williwaw Pond on October 14, but that there were many fish found there on November 4 and 18 (Figure 9) suggests that fish moved from North Williwaw Creek into North Williwaw Pond for overwintering as the temperatures in the creek dropped and temperatures in the pond were higher (Table 2).

It is important to note that the only time that Chinook salmon have been found in this area in previous studies was in the 1977 study in Portage Creek (Krueger 1977). Chinook are at risk in this region and have had declining numbers in western Cook Inlet and the Matanuska-Susitna area rivers (ADF&G 2012). Chinook Salmon are using this area as juvenile habitat so it is important to work on the improvement and conservation of these habitats in order to assist in the rise of Chinook numbers.

On October 14th, no fish were found anywhere in either South Williwaw Pond or South Williwaw creek, but on November 18th approximately 120 Stickleback were found in the

Eastern portion of South Williwaw Pond. It may be that the stickleback moved into this region for overwintering, which could be the reason that they were not found during the first sampling excursion, but were found after snow had fallen and ice had formed. In the previous study performed by Krueger (1977) coho, Dolly Varden, and sculpin were found in South Williwaw Creek. The absence of any salmonid species during our sampling efforts displays the complex and ever changing characteristics of aquatic ecosystems. In fact, the South Williwaw Creek site was completely frozen over during November sampling, with absolutely no habitable water. The lack of water could have been caused by current mining projects going on near South Williwaw Creek or caused by climate change, but conclusions cannot be drawn with so few sampling sessions.

No fish were found in Placer Creek on October 14 and one coho was found on November 18. The quick flow of the river may be too strong for juveniles to use for overwintering. The sites are also located in close proximity to Portage Lake so many more juveniles may be found in Portage Lake due to deep, slow moving water creating great juvenile habitat.

Significance

There were many significant findings of this study. The most important of which is the finding of Chinook salmon in North Williwaw Pond. The decline in Chinook within the past few years has been detrimental to the fishing industry in Alaska. Finding juvenile Chinook that have not been found in North Williwaw Pond before can be beneficial to the rise in their population. It is also significant a juvenile rainbow was found in Explorer Creek when they were not found in either of the previous studies (Browning 1976; Kruger 1977). Lastly, the fact that many fish were initially found in creeks, but then moved into ponds as ice began to form, snow began to fall, and temperatures began to drop is evidence of which areas are favorable habitats for overwintering juvenile fish.

Acknowledgements: I would like to thank Mark Chilcote of the U.S. Forest Service for all of his help in fish identification, sample site determination, project planning, and the invaluable insight he has given to us throughout our research. I would also like to thank Cynthia Annett, research faculty member of University of Alaska Anchorage and Kansas State University for her help in compiling and discussing our results. Additionally, I would like to thank Douglas Causey for making this project possible.

References

Alaska Department of Fish and Game (2012) Factsheet: Fish Species Found in Alaska,. N.p., n.d. Web. 30 Oct. 2012.<http://www.adfg.alaska.gov/index.cfm?adfg=animals.listfish>.

Alaska Department of Fish and Game (2012) Fish stocking update. Web. 30 Oct 2012. <http://www.adfg.alaska.gov/index.cfm?adfg=SportStockingHatcheriesSearch.main>

Alaska Department of Fish and Game (2012) News Release: 2012 Upper Cook Inlet commercial salmon fishery season summary. Division of Commercial Fisheries.

Alaska Department of Fish and Game (2006) Anchorage Lake Fishing Fact Sheet. SouthCentral Region ADF&G Division of Sport Fish.

Blanchet, Dave (2006) Portage Pond Project Water Resources Report on Affected Environment.

Browning, Ralph (1976) Portage area fisheries habitat inventory and analysis. Bureau of Land Management Wildlife Program, Anchorage District Office, Anchorage Alaska.

Chilcote, M.W.; Goodson, K.W.; Falcy, M.R. (2011) Reduced recruitment performance in natural populations of anadromous salmonids associated with hatchery-reared fish. Can. J. Fish. Aquat. Sci. 68:511-522

Dischner, Molly (2012) Northern District salmon not faring better than Kenai, Y-K. Alaska Journal of Commerce. November Issue 4

Dorava, J.M. and Milner, A.M. (2000). Role of lake regulation on glacier fed rivers in enhancing salmon productivity: The Cook Inlet watershed, south-central Alaska, USA. *Hydrological Processes* 14: 3149-3159.

Farley, E. V., Starovoytov, A., Naydenko, S., Heintz, R., Trudel, M., Guthrie, C., Eisner, L., Guyon, J. R. 2011. Implications of a warming eastern Bering Sea for Bristol Bay sockeye salmon. – ICES Journal of Marine Science, 68: 1138–1146

Graham, Dan (2011) Mining Operations and Fish Habitat. How we work together in Alaska. Presentation to Fairbanks Branch - AMA.

Gjerde, B., Gunnes, K., Gjedrem, T., 1983. Effect of inbreeding on survival and growth in rainbow trout.Aquaculture 34, 327–332.

Hayashi, M. and Rosenberry, D.O. (2002). Effects of ground water exchange on the hydrology and ecology of surface water. *Ground water* 40(3): 309-316.

Helvoigt, Ted L; Schwoerer, Tobias; Charlton, Diane (2010) Economic Analysis of the Chuitna Watershed & Cook Inlet. ECONorthwest: Economic, Finance, Planning.

Kennedy, Ben W; Trabant, Dennis; Mayo, L.R. (2006) A century of retreat at Portage Glacier;, south-central Alaska. USGS Fact Sheet.

Kincaid, H.L., 1983. Inbreeding in fish populations used for aquaculture. Aquaculture 33, 215–227.

Krueger, Steven W. (1977) Portage area fisheries habitat inventory and analysis. (Bureau of Land Management Wildlife Program, Anchorage District Office, Anchorage, Alaska)

NOAA Fisheries (2012) [http://www.nmfs.noaa.gov/pr/species/fish/chinooksalmon.htm] Office of Protected Resources.

Norris, A.T.; Bradley D.G. and Cunningham, E.P. (1999) Microsatellite genetic variation between and within farmed and wild Atlantic salmon (*Salmo salar*) populations. *Aquaulture* 180(3-4):247-264.

Pollard, W. R., *et al.* (1997) Field Identification of Coastal Juvenile Salmonids.

Polluck, Michael M.; Pess, George R.; Beechie, Timothy J. (2004) The Importance of Beaver Ponds to Coho Salmon Production in the Stillaguamish River Basin, Washington, USA. Department of Earth and Space Sciences, University of Washington, Seattle.

Su, G.-S., Liljedahl, L.E., Gall, G.A.E., 1996. Effects of inbreeding on growth and reproductive traits in rainbow trout_*Oncorhynchus mykiss*.. Aquaculture 142, 139–148.

Distribution and species composition of juvenile salmonids in Portage Valley, Alaska

By Maio Nishkian

Fall and Winter 2012/2013

Introduction:

Salmon are a vital component in Southcentral Alaska's freshwater and marine ecosystems. Understanding wild salmon migration, over winter habitat use, diet, spawning patterns and juvenile rearing are crucial when determining management plans, recording harvest data, and implementing conservation efforts. Gathering baseline data is the first step in any sampling effort in order to develop a framework with which to incorporate future data collection. This historical reflection is necessary in order to avoid an automatic shift in the baseline to current standards.

Our research concerns the abundance, migration patterns, habitat use, and behavior of juvenile salmonids in the Portage River watershed and the Placer River watershed including coho salmon, *Onchorynchus keta*; Chinook salmon, *Onchorynchus tshawytscha*; rainbow trout, *Onchorhnychus mykiss*; as well as Dolly Varden char, *Salvelinus malma*. Baseline data collection has been established in the Portage Valley area in 1976 and 1977 in studies done by the Bureau of Land Management (Browning 1976 and Krueger 1977), and since then no studies have been conducted.

Portage Valley incorporates three river systems that drain into Turnagain Arm and Cook Inlet; all active fisheries that support the subsistence lifestyle of many Alaskans. All five salmon species are found in Turnagain Arm, and with the exception of hatchery raised coho salmon stocked in Bird Creek, all are wild or native(M. Chilcote, personal communication). Current era baselines must be established in order to make proper conservation and management decisions for fish species in this area. This glacially fed valley also acts as an indicator for global changes in climate, and expansion of current knowledge will allow the effects of these changes to be monitored.

Methods

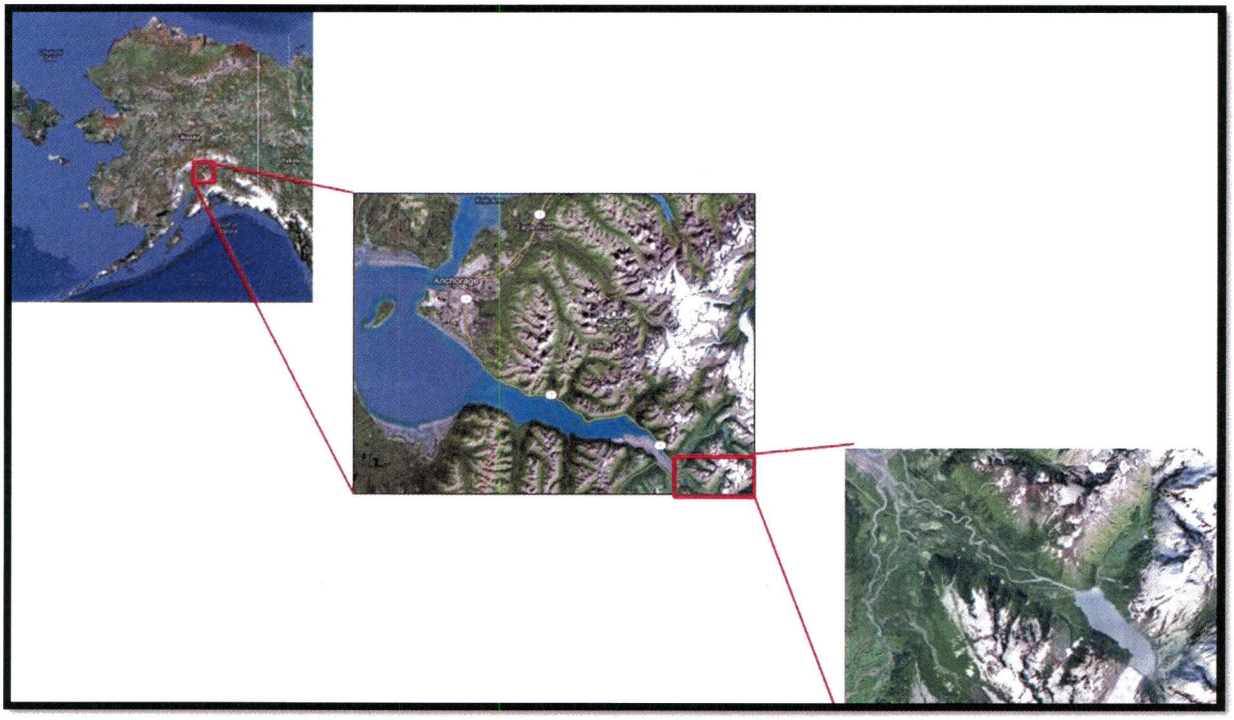


Figure 1 Portage Valley site in reference to Alaska

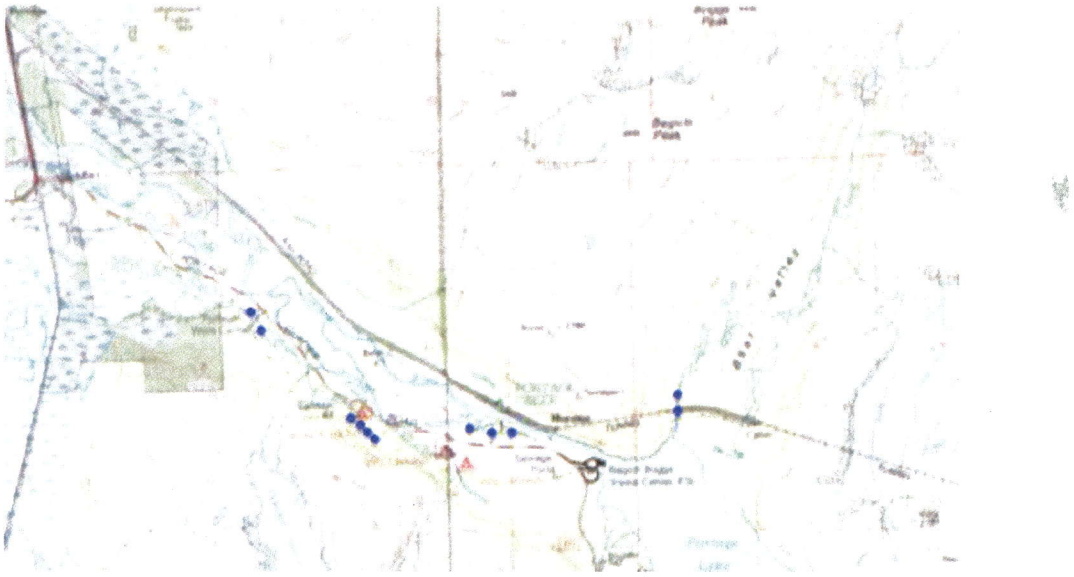


Figure 2. Portage Valley Topographic map (blue dots indicate trap sites within the study area)

Figure 3 Map of Portage Valley including sampling site areas

10 inch minnow traps with 10 cm diameter openings on each end were baited with salmon eggs and placed in areas along Portage Glacier Road in Portage Valley, Alaska (Figure 1). We set traps at Placer Creek, Placer Creek Bridge, the upper North Fork of Williwaw Creek, North Williwaw Pond, the lower North Fork of Williwaw Creek, the Eastern South Fork of Williwaw Creek, Eastern South Williwaw Pond, South Williwaw Pond, the South Fork of Williwaw Creek, Explorer Pond, and Explorer Creek (Figure 2 & 3). North Williwaw Pond (Portage river drainage) and Explorer Pond (Placer river drainage) were narrowed down as our target sites and were sampled more heavily towards the end of our studies. All traps were set for one to three hours before being retrieved. Temperature, dissolved oxygen, pH and conductivity were taken opportunistically. Temperature was the only consistent and reliable data collected throughout our sampling, so other data will be omitted in this report.

It should be noted that minnow traps baited with salmon eggs are biased toward carnivorous fish, and are usually ineffective in trapping sockeye salmon who are planktivores.

Fish were anesthetized with tricane methanesulfonate to ease handling after capture. Fork length was measured, and species were identified using Pollard 1997. Before releasing the fish, they were revived in a bucket of fresh water taken from the collecting locality. Collected data was organized as length frequency histograms using Microsoft Excel.

The ADF&G issued a fish resource permit for scientific/education purposes authorizing the trapping and sampling of fish in the Portage Valley area. The Institutional Animal Care and Use Committee also issued a permit that allowing for the handling of the captured fish.

Results:

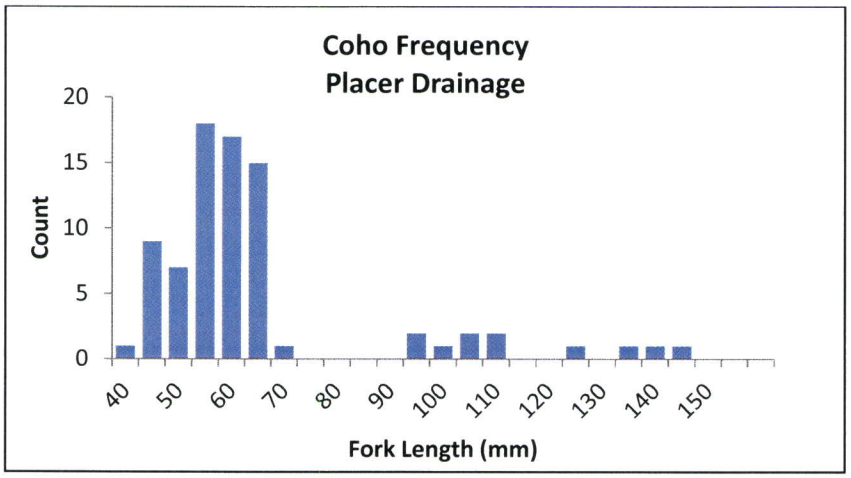


Figure 4 Length distribution of coho salmon in the Placer Drainage, Portage Valley, Alaska.

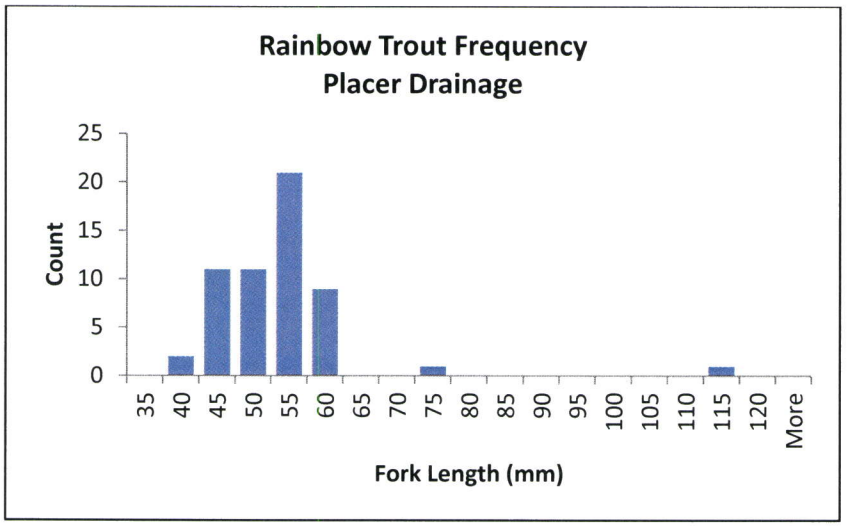


Figure 5 Length distribution of rainbow trout in the Placer Drainage, Portage Valley, Alaska.

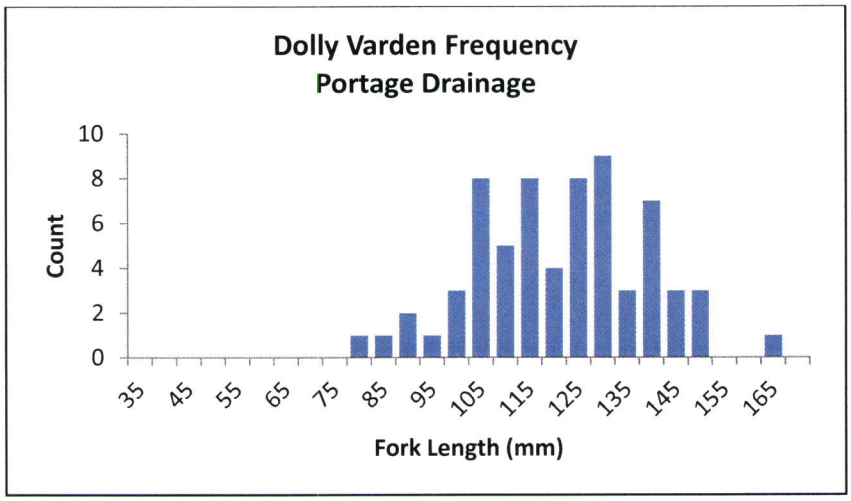


Figure 6 Length distribution of dolly varden char in the Portage Drainage, Portage Valley, Alaska.

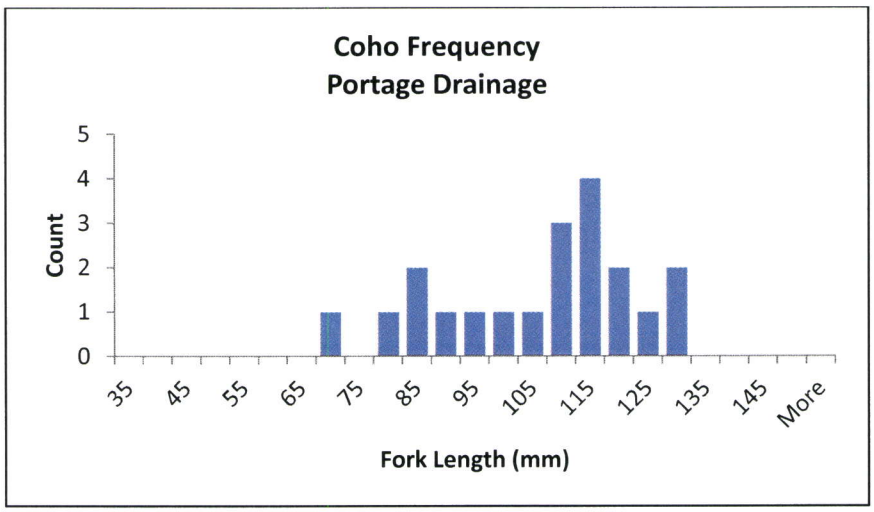


Figure 7 Length distribution of coho salmon in the Portage Drainage, Portage Valley, Alaska.

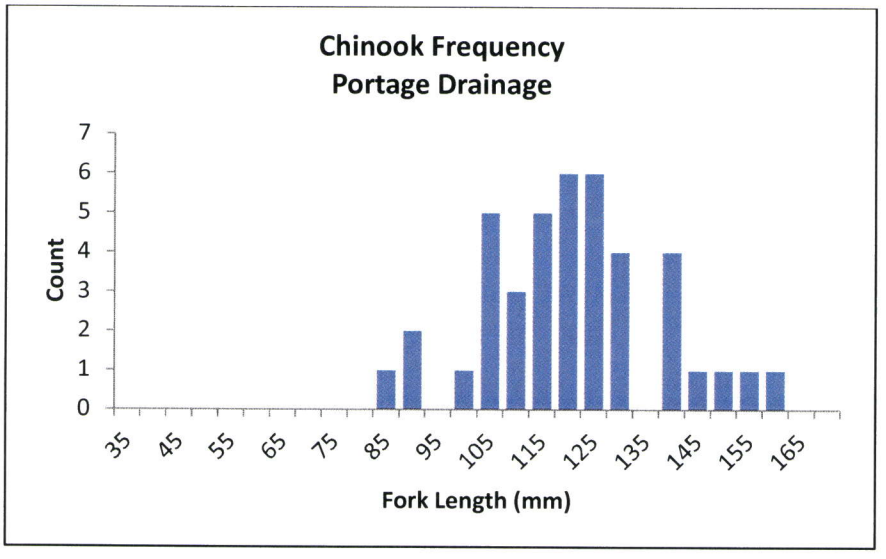


Figure 8 Length distribution of chinook salmon in the Portage Drainage, Portage Valley, Alaska.

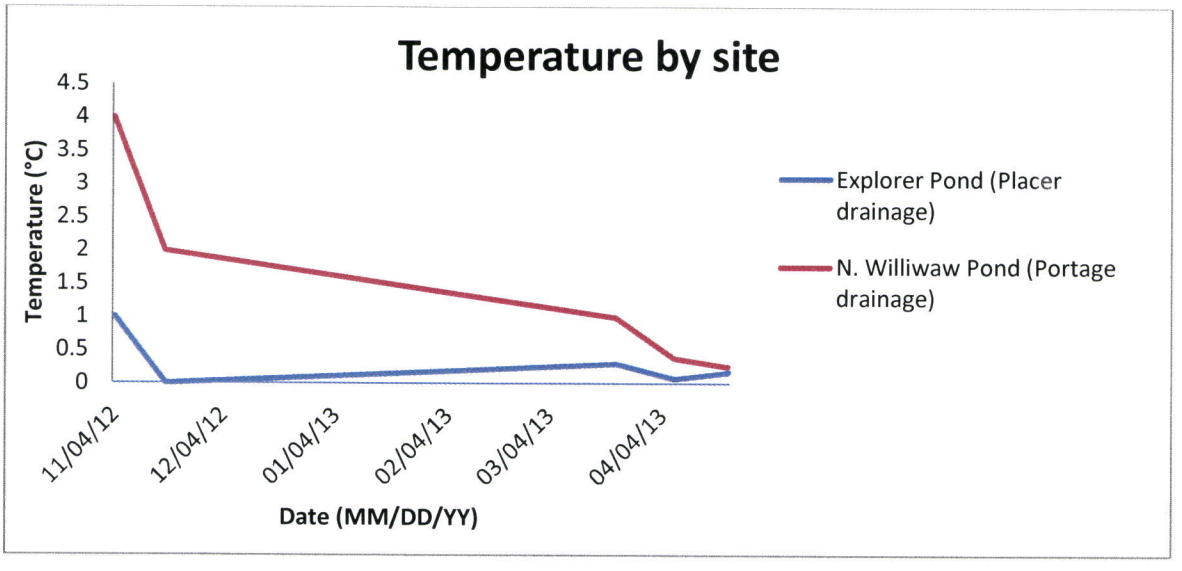


Figure 9 Temperature change at two main sampling sites Explorer Pond (Placer drainage) and North Williwaw Pond (Portage drainage) in Portage Valley, Alaska.

Discussion/Conclusions:

Groundwater:

Portage Valley has very deep alluvial deposits consisting of porous rock and gravel with plentiful ground water extending up to 600 feet in depth (Blanchet 1979). The shallow depths of the water table allow places like North Williwaw Pond, an old gravel mining pit, to fill up with ground water. Surface water temperatures tend to vary more than ground water temperatures, so the water emerging from below ground will have differing temperatures than that of the water

already present in ponds and streams. This can lead to ground water based refuges for juvenile salmonids, especially in the winter when emerging ground water increases surrounding water temperatures and keeps the water from freezing (Quinn 2005). Increased temperatures were witnessed in North Williwaw Pond (Figure 9), where extensive work was done in the 1980's in order to create these rearing habitats (Blanchet 1989).

Site Comparison:

There is a definite trend in size and age class in selecting for habitat. The Portage drainage (which is overwhelmingly from North Williwaw Pond) has coho salmon all larger than 70 mm (Figure 4), while the Placer drainage (overwhelmingly from Explorer Pond) has coho mostly less than 70 mm (Figures 7). Coho in the Portage drainage are larger than those in the Placer drainage, with mean lengths of 99 and 79 mm (p=.013). In other words, the larger fish are selecting for Explorer Pond. There are a few different reasons for why this may be. Age-1+ coho salmon have been observed in the Anchor River, Alaska to increase in abundance in areas with greater groundwater input. In this same study, age-0 coho salmon distributed elsewhere, in areas with less groundwater input (Gutsch 2012). North Williwaw Pond, which has a higher groundwater input, would therefore be a more likely habitat for age-1+ coho salmon as indicated by our data. It is also possible that the increased temperatures (Figure 9) due to higher groundwater input in North Williwaw Pond led to increased growth rates, although it is unknown whether this growth could have taken place over the winter. Metcalfe and Thorpe 1992 found that salmon growth may be negligible, zero or negative over the winter due to the increased cost of feeding and metabolizing in such cold temperatures.

Coho Salmon:

Another interesting aspect of these data is the size classes displayed by coho length frequencies. In the Placer drainage, there seem to be three distinct size/age classes (Figure 4). Though coho usually spend only 1-2 years in freshwater, they tend to extend this residence in northern streams. They can stay 2, 3 or even 4 winters in freshwater before migrating as smolts into the ocean (Groot and Margolis 1991). Because we are finding fish all above 40 mm in length, it is likely that this year's young of the year have not yet emerged (Chilcote 2013, personal communication), so our data show three size/age classes of 1.0. 2.0. and 3.0.

In the Portage drainage (Williwaw Pond), coho are divided into only two size/age classes (Figure 4). The smallest or youngest class that is present in the Placer drainage is absent in the Portage, as talked about above in the site comparison. These fish would have emerged one year ago during the spring/summer of 2012 and would be age 0.0.

Chinook Salmon:

We have only found more chinook salmon since our initial discovery of their continued existence in the Portage drainage (North Williwaw Pond) during the fall of 2012. The size/age

classes are less distinct for chinook (Figure 8) than coho, and it is hard to say whether one or two size/age classes exist due to our small sample size and the varying length of chinook smolts. In British Columbia, chinook smolts have been sized at varying lengths ranging from 45-100 mm (Groot and Margolis 1991). In studied Cook Inlet rivers, 97-99% of chinook are stream type, while 1-3 % ocean type (Healy and Heard 1984). Stream-type chinook have a freshwater residence of 1-2 years as juveniles (Groot and Margolis 1991). The chinook in Portage Valley are stream-type due to their large size, the likelihood that they genetically similar to other Cook Inlet chinook, and the fact that they are overwintering in freshwater.

Chinook are found mainly in large streams and riverine habitat and infrequently in off-channel sloughs and backwaters (Groot and Margolis 1991). Habitat segregation between chinook and other stream salmonids is also common, with chinook inhabiting the lower reaches, and other salmonids further upstream (Quinn 2005). Chinook fry in the Big Qualicum River, British Columbia, inhabit the same habitat as coho fry at a given size, however chinook moved out of those habitats as they increased in size. Due to their larger overall size and faster growth rate, chinook inhabited faster moving waters and larger streams (Lister and Genoe 1970). Past research all points towards the unlikelihood of chinook inhabiting off-channel ponds like Williwaw pond, however little is known about freshwater habitat use of chinook.

Figure 10 Stocked ponds: Alder, Airstrip and Tangle Ponds in Portage Valley, Alaska.

Trout and Char:

Dolly Varden are present in high numbers in the Portage drainage, at both North Williwaw Pond and Placer Creek at the Portage Lake inlet (Figure 6). Their co-occurrence with coho is consistent with previous reports from Krueger 1977. Dolly Varden usually spend three or four years in freshwater before migrating to sea, and have variable migration times (Morrow 1980) consistent with our data.

The first wild (not stocked) rainbow trout to be recorded in Placer drainage was by our field crew in the winter of 2012. Since then we have found numerous juvenile rainbows in the Placer drainage (Explorer creek). It is unknown yet whether these fish are freshwater rainbow or anadromous steelhead, and at this age and size there is no way to visually distinguish the difference. If these parr are resident rainbow trout, they would have emerged during the summer of 2012 from last year's spawning in spring or early summer.

Rainbow trout have been stocked in Airstrip/Willow Pond, Tangle Pond and Alder Pond near Explorer Pond (Figure 5) since 1996. It is unclear whether these ponds are connected and would allow fish to migrate between them, but it is likely that they have outlets into other water sources. This fish could be evidence that rainbow trout are beginning to colonize this watershed, or it could be that they have been in the basin all along, but at densities so low that previous surveys have failed to catch them. Diploid (fertile) rainbow trout have been stocked from 1996-2006 in both Tangle and Alder Ponds (ADF&G 2012 Fish stocking update), meaning that these rainbow are likely the product of reproduction of stocked species. Because nothing is known about the wild rainbow trout in this area, we will be keeping a vigilant eye in continued sampling to monitor their life cycles.

Conclusion/Future Research:

Krueger 1977 found two chinook salmon in Portage Creek; a detail that was overlooked in our previous paper. This means that chinook could have been in this drainage in some number, although small, for over 40 years. Further investigation has revealed that 1,154 diploid (fertile) chinook salmon were also stocked in Tangle Pond in 1996. Although ADF&G maps this pond with no outlet, it appears as though there may currently be channels that link Tangle Pond to Portage Creek. Known chinook salmon runs are found in the Twentymile river system, so it is possible that these chinook in Portage actually hatched in Twentymile, and have been displaced into Portage Valley. All of this information points out that we have little idea of where the chinook that we are currently finding in the Portage drainage have come from.

During the summer of 2013 we will collect 30-40 fin clips of chinook salmon from the Portage and Twentymile river systems. Through genetic analysis, we will find out if these fish are differentiated from each other in order to gain insight to their origin. We will start with ANOVA analysis, using F_{ST} to measure the proportion of the total genetic variance contained within each population. Single nucleotide polymorphisms (SNPs) are DNA nucleotide variations

at a single nucleotide, which can differ among individuals. We will use SNPs in accordance with ADF&G baseline genetic studies done in the Upper Cook Inlet (Barclay et al 2012). We will expand this genetic analysis to other salmonid species as well. We will start fyke netting in the main tributaries in spring and summer while most species are outmigrating in order to obtain our fin clips.

What we have found in our overwintering study is that repeated sampling efforts have been variable, which solidifies the complexity of salmonid freshwater habitat use. We will continue establishing a baseline of fish species for Portage Valley, and incorporate the Twentymile river system as well. Seining will be done in several ponds in the area including the reconstructed Williwaw ponds, Explorer ponds and Portage Lake. Juvenile fish will continue to be monitored, in particular in Williwaw ponds. Chinook salmon habitat use will be of particular interest, along with general life history patterns of all salmonid species in the area such as emergence time, outmigration time, abundance and distribution.

Acknowledgements: I would like to thank Mark Chilcote of the U.S. Forest Service for all of his help in fish identification, sample site determination, project planning, and data analysis. I would also like to thank Dan Rinella professor at University of Alaska Anchorage and Aquatic Ecologist at the Alaska Natural Heritage Program for his help in data analysis and the insight he has given throughout my research. Additionally, I would like to thank Douglas Causey for initially organizing this project and my work with the Forest Service through his Exploration Ecology class at UAA, and for making the connections and formalities that were needed for the project to continue. This research was funded through the University of Alaska Anchorage, and a Climate Science Center fellowship through the Department of Interior.

References:

Alaska Department of Fish and Game (2012) Fish stocking update. Web. 30 Oct 2012. http://www.adfg.alaska.gov/index.cfm?adfg=SportStockingHatcheriesSearch.main

Barclay, A.W., Habicht, C., Merizon, R.A., Yanusz, R.J. (2012) Genetic Baseline for Upper Cook Inlet Chinook Salmon: 46 SNPs and 5,279 Fish. Alaska Department of Fish and Game, Divisions of Sport Fish and Commercial Fisheries.

Blanchet, D., 1979. Hydrologic and Geomorphic Overview of Portage Valley. USDA Forest Service, Chugach National Forest, Anchorage, AK.

Chilcote, Mark (2013) Personal Communication. U.S. Forest Service Fish Biologist, Girdwood Alaska.

Groot, C. and Margolis, L. (1991) Pacific Salmon Life Histories. UBC Press, Vancouver.

Gutsch, M. K. (2012). Identification and Characterization of Juvenile Coho Salmon Overwintering Habitats and Early Spring Outmigration in the Anchor River Watershed, Alaska (Doctoral dissertation, University of Alaska Fairbanks).

Healy, M.C., and Heard, W.R. (1984) Inter0 and intra-population variation in the fecundity of chinook salmon (*Onchorhynchus tshawytscha)* and its relevance to their life history theory. Candian Journal of Fisheries and Aquatic Science. 41:476-483.

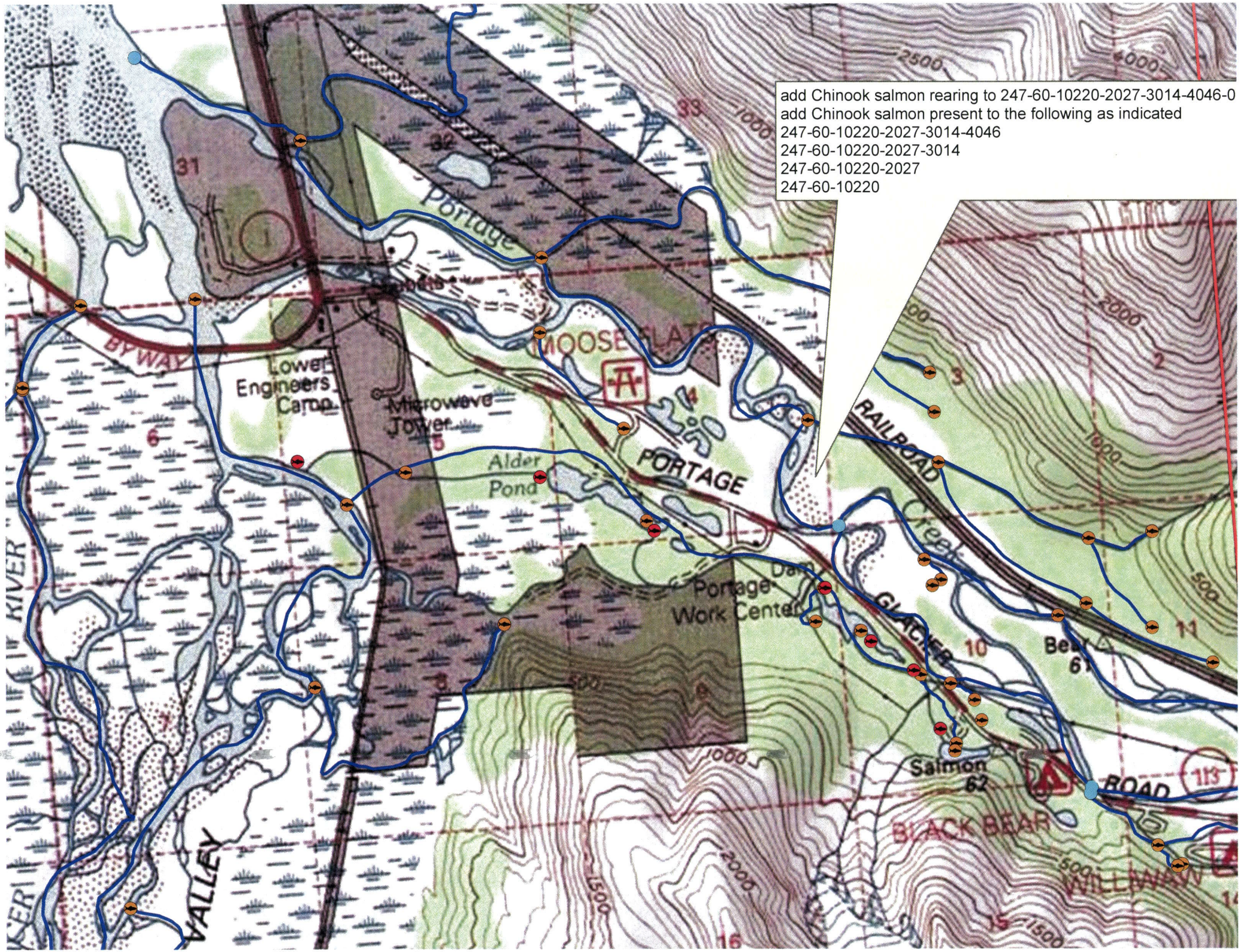
Krueger, Steven W. (1977) Portage area fisheries habitat inventory and analysis. (Bureau of Land Management Wildlife Program, Anchorage District Office, Anchorage, Alaska)

Lister, D. B., Genoe H. S. (1970) Stream Habitat Utilization by Cohabiting Underyearlings of Chinook (*Oncorhynchus tshawytscha*) and Coho (*O. kisutch*) Salmon in the Big Qualicum River, British Columbia. Journal of the Fisheries Research Board of Canada, 27(7): 1215-1224, 10.1139/f70-144

Metcalfe, N. B. and J. E. Thorpe. 1992. Anorexia and defended energy levels in over-wintering juvenile salmon. Journal of Animal Ecology 61:175-181.

Pollard, W. R., Hartman, G.F., Groot, C., Edgell, P. (1997) Field Identification of Coastal Juvenile Salmonids. Harbour Publishing. BC, Canada.

Quinn, T.P (2005) The Behavior and Ecology of Pacific Salmon and Trout, University of Washington Press. American Fisheries Society.


add Chinook salmon rearing to 247-60-10220-2027-3014-4046-0
add Chinook salmon present to the following as indicated
247-60-10220-2027-3014-4046
247-60-10220-2027-3014
247-60-10220-2027
247-60-10220
Portage
MOOSE FLATS
Lower Engineers Camp
Microwave Tower
Alder Pond
PORTAGE
RAILROAD
Portage Work Center
Dam
GLACIER
Creek
Bear 61
Salmon 62
ROAD
BLACK BEAR
WILLIWAW
VALLEY
RIVER
BYWAY
2500
4000
2000
1000
500
1500