AN EVALUATION OF CHINOOK SALMON FRESHWATER HABITAT USE IN GLACIER BAY NATIONAL PARK ALASKA

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Technical Report NPS/NRWRD/NRTR-2004/321

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AN EVALUATION OF CHINOOK SALMON FRESHWATER HABITAT USE IN GLACIER BAY NATIONAL PARK

ALASKA

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ABSTRACT

We assessed the Seclusion and Dundas rivers in Glacier Bay National Park to determine the presence of chinook salmon (*Oncorhynchus tshawytscha*). Both rivers were visually surveyed for adults, and juvenile fish were captured in minnow traps during September 2002. Seclusion River is a relatively clearwater system, whereas the Dundas River is a turbid, glacial meltwater system with minor clearwater contributions from adjacent sloughs and bogs. We failed to detect any presence of adult or juvenile chinook salmon in either river.

Visual counts of other species of adult salmon in Seclusion River included 1,173 Pink (*O. gorbuscha*), 422 Sockeye (*O. nerka*), 271 Chum (*O. keta*), and 14 Coho (*O. kisutch*) salmon. About 11,900 adult Dolly Varden (*Salvelinus malma*) were also present in the Seclusion River. Only two adult pink salmon and six adult Dolly Varden were observed in a clearwater slough of the Dundas River.

Minnow trap catches in main channel areas of the Seclusion River totaled two Dolly Varden, 16 coho salmon, and one three-spine stickleback (*Gasterosteus aculeatus*). Only one juvenile coho salmon was captured in a tributary of the Seclusion River. Twenty-one Dolly Varden and four coho salmon were captured in the Dundas River. Although we failed to find any evidence of chinook salmon, we documented salmonids in the Dundas River and identified the importance of the Seclusion River for overwintering Dolly Varden.

KEY WORDS: Glacier Bay National Park, Dundas River, Seclusion River, Chinook salmon, Dolly Varden , CPUE, minnow trap

INTRODUCTION

The purpose of this study was to evaluate the presence of chinook salmon (*Oncorhynchus tshawytscha*) stocks in selected Glacier Bay National Park (GBNP) streams. This work was initiated because anecdotal information had suggested chinook salmon presence in at least one watershed and limited information exists regarding salmonids in park streams. Moreover, chinook salmon frequent park marine waters as evidenced by commercial and recreational fisheries harvest of these species.

Thousands of chinook salmon are harvested from GBNP and adjacent waters each year. Commercial chinook salmon troll harvests have averaged 5,000 to nearly 30,000 fish annually from Districts 114 (*i.e*., Cross Sound, Icy Strait and Glacier Bay proper) and 116 (GBNPP's outer coast) combined during 1991-1995 (Alaska Department of Fish and Game, unpublished data). An average of about 400 trollers in District 114 and 200 trollers in District 116 participated in the commercial fishery annually during this period. Recreational harvests of chinook salmon for the Glacier Bay area (Area G) over the five-year (1991-95) period ranged from 600 to 2,500 chinook salmon each year (Howe *et al*. 2001). Alaska Department of Fish and Game coded wire tag (CWT) recoveries from chinook harvested in area fisheries indicate fish originate from hatcheries (*e.g.,* Hidden Falls, Snettisham, Crystal Lake, and Little Port Walter), and wild stocks in other areas (*e.g.*, British Columbia, Washington and Oregon). Because not all stocks are marked or tagged, the origin of many chinook salmon harvested from park waters remains unknown. Moreover, anecdotal evidence for at least one park chinook stock exists.

The most compelling evidence has suggested the possibility of chinook salmon presence in the Dundas/Seclusion River system. National Park Service ranger Jerome Cebula (1963), who conducted surveys of park streams during the early 1960s, noted "Mr. Harbeson reports king salmon have been taken from this river" referring to the Dundas (Buck Harbeson lived in a cabin near the mouth of the Dundas River and worked periodically in the area during 1931-1964). More recently (August, 1994), an individual participating in a 5-6 person float trip from Lake Seclusion down to the mouth of the Dundas River reported seeing two fish he reported as chinook salmon (Foster *et al.* 1994). Additionally, a salmonid collected from a stream draining a series of lakes on a small island in Adams Inlet was thought to have been a chinook salmon (Merrel 1965). Although the Adams Inlet report was likely in error, the Dundas/Seclusion River reports are much more credible. If a Dundas/Seclusion River spawning chinook population exists it would likely be small as relatively consistent use by area charter clients and local fisherman has never documented chinook presence.

Despite the fact that the most well-studied chinook populations are large, many small chinook spawning populations exist. Healey (1991) reported a positive relationship between average annual river discharge and average spawning population size for British Columbia (BC) chinook salmon populations. Nearly 20% of 84 BC chinook spawning populations numbered 100 fish or less. Moreover, the majority of these occurred in larger river systems with average annual discharge of 8.5-34 m^3/s (300-1,200 cfs). The Situk River (watershed size ca. 96 km^2) near Yakutat exhibits an average annual discharge of approximately 8.5-11.3 m^3/s (300-400 cfs; pers. com. Ed Neal, USGS hydrologist, Juneau). Thus, relatively small chinook salmon populations can occur in large, complex stream systems. Large, complex stream systems within GBNP, comparable in size to the Situk River, are limited in number. Only eight Park streams fit this size criterion (Soiseth and Milner 1995).

We used a fixed-wing aircraft to identify the most likely chinook streams because large, complex stream systems within GBNP are limited in number, widely dispersed and relatively inaccessible. Systems identified included the 1) Excursion, 2) Beartrack, 3) Godess, 4) Seclusion, 5) Dundas, 6) Dixon, and 7) Carolus rivers (Figure 1). We evaluated digital imagery from aerial surveys to assess fish presence, substrate size and cover. Due to the presence of suitable chinook habitat and the existing anecdotal information, we subsequently attempted to sample both the Dundas and Seclusion rivers using a variety of survey methods.

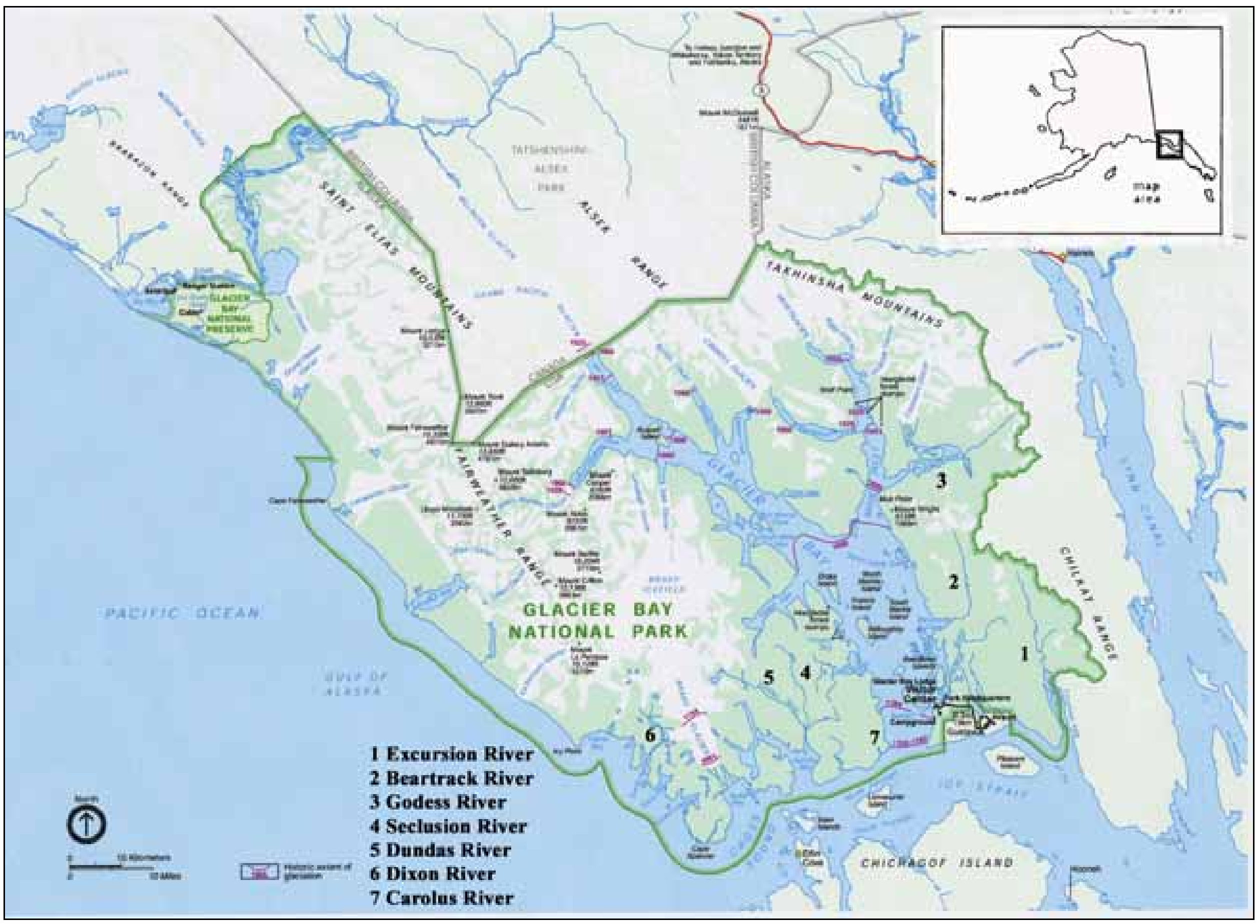

Figure 1. Sample locations in Glacier Bay National Park, Alaska. An aerial survey of seven river systems was conducted July, 2002 as noted in the legend locations. On-stream surveys were conducted on the Seclusion (#4) and Dundas (#5) rivers in September, 2002

Study Area

Glacier Bay National Park and Preserve (GBNP) encompasses 13,052 km^2 (5,039 sq mi) and is characterized by numerous glaciers, rugged mountainous terrain, and pristine streams and rivers. Nearly 2,500 km^2 of marine waters and more than 300 streams (Soiseth and Milner 1995) occur within the Park and Preserve boundaries.

The Excursion, Beartrack, Godess, Dundas, Seclusion and Dixon Rivers are the largest, most complex stream systems in GBNP (Soiseth and Milner 1995). In general, these river systems are 25-30 km in length, third order or higher in complexity and low (< 5%) gradient. The Seclusion River system is a clearwater tributary to the larger Dundas River and includes a small (0.6 km^2) headwater lake and short (6 km) inlet stream. The Beartrack, Godess, Dundas and Dixon rivers are glacial meltwater systems. The Carolus River is a much smaller (ca. 9 km long) and less complex river system. The small (0.4 km^2) lake and associated 1.3-km stream system on the island in Adams Inlet described by Merrell (1965) is a low gradient stream system.

METHODS

We conducted an aerial survey July 31, 2002 of the Excursion, Beartrack, Godess, Seclusion, Dundas, Dixon, and Carolus rivers in GBNP. We also overflew the small lake and stream system on the island in Adams Inlet. We used a Cessna 206, fixed-wing aircraft at an altitude of 500 ft. We generally flew each stream in a downstream to upstream direction. We designed this initial survey to determine whether there were systems in the park that might potentially support chinook salmon based on the previous work of Soiseth and Milner (1995). We used a hand-held GPS unit, digital camera, and digital camcorder to record observed habitat at specific locations. We later reviewed and evaluated images for potential chinook salmon spawning and rearing habitat and for determining stream selection and on-stream sampling locations.

Our on-stream chinook surveys involved floating each river with a rubber raft, visually searching for adult chinook salmon, trapping juveniles with minnow traps, limited hook and line sampling, and in one instance, attempting to collect juveniles with a beach seine. We accessed the Seclusion River by floatplane at Lake Seclusion and initiated the survey at the lake outlet on September 4-7, 2002. We floated the 18 km reach of river using two, one-person rafts and traversing by foot around and over woody debris jams as required. We accessed the Dundas River headwaters on September 13, 2002 by helicopter, and subsequently floated the 15 km down to Dundas Bay arriving September 14, 2002. Survey participants and gear were transported back to Bartlett Cove aboard the NPS vessel *Capelin*.

We used polarized glasses to enumerate fish by species during the float trip along the Seclusion River due to relatively clear water conditions. Water clarity conditions prevented visual surveys on the Dundas River because this system is glacially influenced and turbid.

We used cylindrical, wire mesh (8 mm diagonal) minnow traps measuring 41.5 cm x 22.5 cm with 2 cm openings in each inverted funnel end to capture juvenile salmonids. We used similar amounts (< 50 ml) of borax-preserved salmon roe for bait. We soaked all bait in a 10% Betadine® solution for 30 minutes to reduce disease transmission potential. We baited and set traps at selected macrohabitat types (primarily pools with associated cover) within each sampling location to insure the highest probability of capture. We fished minnow traps for a standard set of 30 to 60 minutes. We recorded fishing duration for each trap to estimate catch rates (catch per unit effort [CPUE] in number of fish per unit time).

We sampled eight locations along the main-stem reach in both the Seclusion and Dundas rivers (Figure 2). We set three to 12 traps along the shoreline at each sample location in the Seclusion River depending on location characteristics. We sometimes set traps in main and tributary channel habitats simultaneously, depending upon sampling location and tributary channel presence. We set 12 minnow traps at each location in the Dundas River. We equalized trap soak time at each sample location by setting the traps in an orderly fashion and retrieving them in the same order as they were set.

We identified minnow trap-caught fish to species using a combination of external morphological characteristics according to Pollard *et al.* (1997). We enumerated fish by species, measured them to the nearest millimeter in fork length and released them alive.

Sample locations were similar with respect to macrohabitat, cover, substrate size, temperature, water depth and velocity. We characterized macrohabitat as main channel, side channel, and tributary. We similarly characterized cover at each location by visual observation in order of predominance as: 1) no cover, 2) aquatic vegetation, 3) woody debris (*e.g.*, deadfalls, root wads, and stumps), and, 4) overhanging riparian vegetation. We similarly characterized substrate size visually as silt/sand (grains < 0.6 cm in dia.), gravel (0.6-7.6 cm), rubble (7.6-12.7 cm), cobble (12.7-25 cm), or boulder (> 25.4 cm). We recorded predominant substrate size category at each sample location. We measured air and water temperatures at each sample location using a hand-held thermometer and visually categorized water clarity and turbidity according to Reid (1961).

We estimated and recorded current velocity (m/s) and discharge (m^3/s) along with water depth, channel width, and velocity at each sample location. We used a Bushnell® range finder ($\pm$ 1 m error) to measure channel width. We used a floating object and measured the time it took to travel a specified distance to estimate current velocity and corresponding discharge. We identified each sample location by date, location number, and gear type. We used a Garmin eTrex® handheld Global Positioning System (GPS) to define all sample locations.

We used a 15-m x 1.8-m x 0.6-cm mesh, hand-held beach seine in an attempt to capture juvenile fish in a riffle-pool area of the Dundas River. However, current was generally too fast and the seine too small for effective sampling.

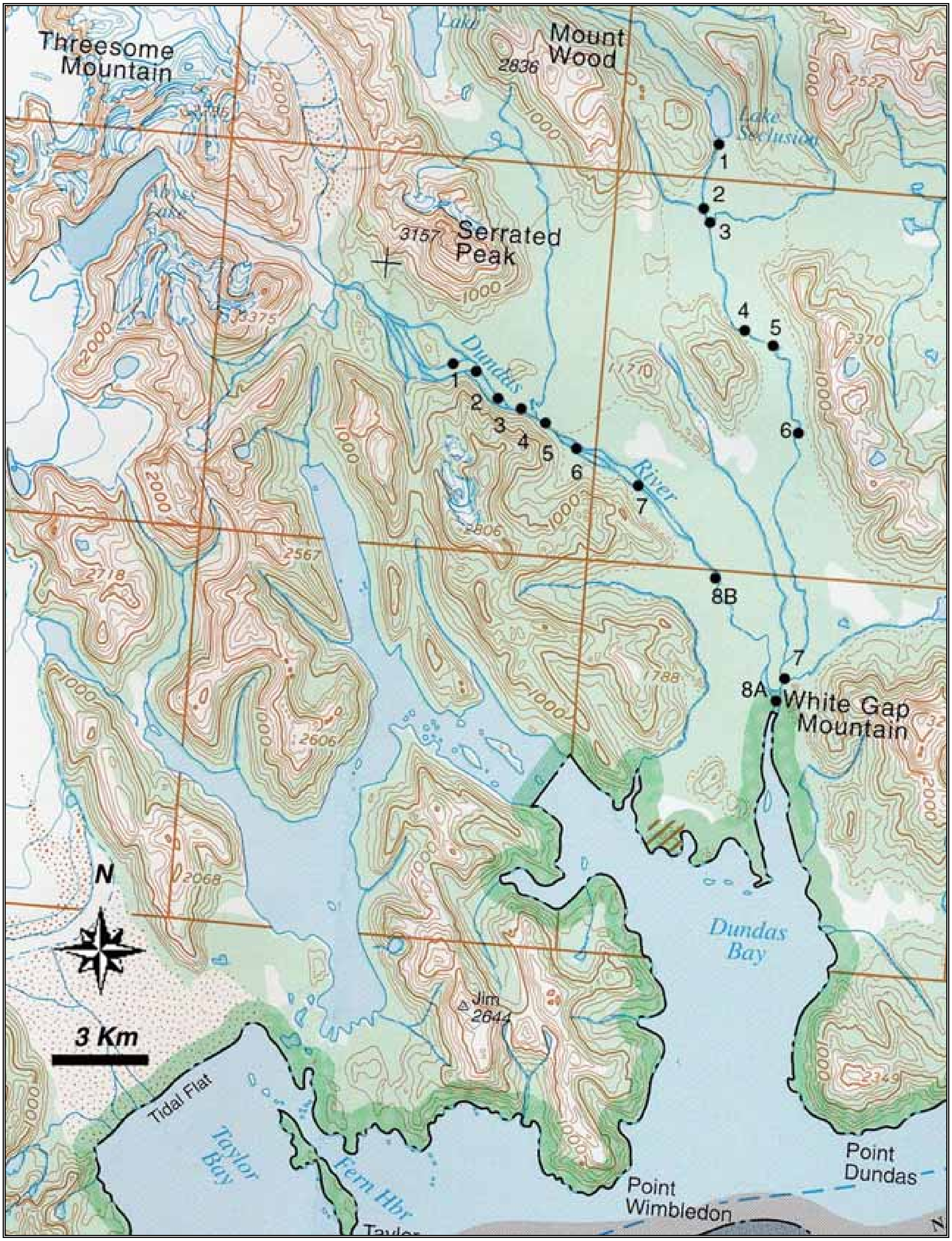

Figure 2. Approximate on-stream sample locations as indicated by GPS (NAD27 Alaska datum) on the Seclusion and Dundas rivers, September, 2002. (See also Appendix A4)

We conducted hook and line sampling primarily in pool areas when adult fish were observed. We used spinning gear and spoons with treble hooks. Fishing time was noted and a catch per unit of fishing effort (CPUE) was estimated at each location. We handled all fish in an appropriate manner for quick identification and subsequent release. No fish were killed.

RESULTS

Aerial Survey

We conducted aerial surveys of seven rivers in GBNP plus a small lake/stream system on the island in Adams Inlet to assess their potential for supporting chinook salmon. We observed extensive woody debris jams in the Excursion, Beartrack, and Carolus rivers that would pose difficult access and sampling challenges. However, these river systems are thought to perhaps contain suitable chinook salmon habitat. The Godess and Dixon rivers are characterized by high gradients (Figure 3), unstable braided channels and high sediment transport (as indicated by associated turbidity), with little indication of appropriate chinook salmon habitat.

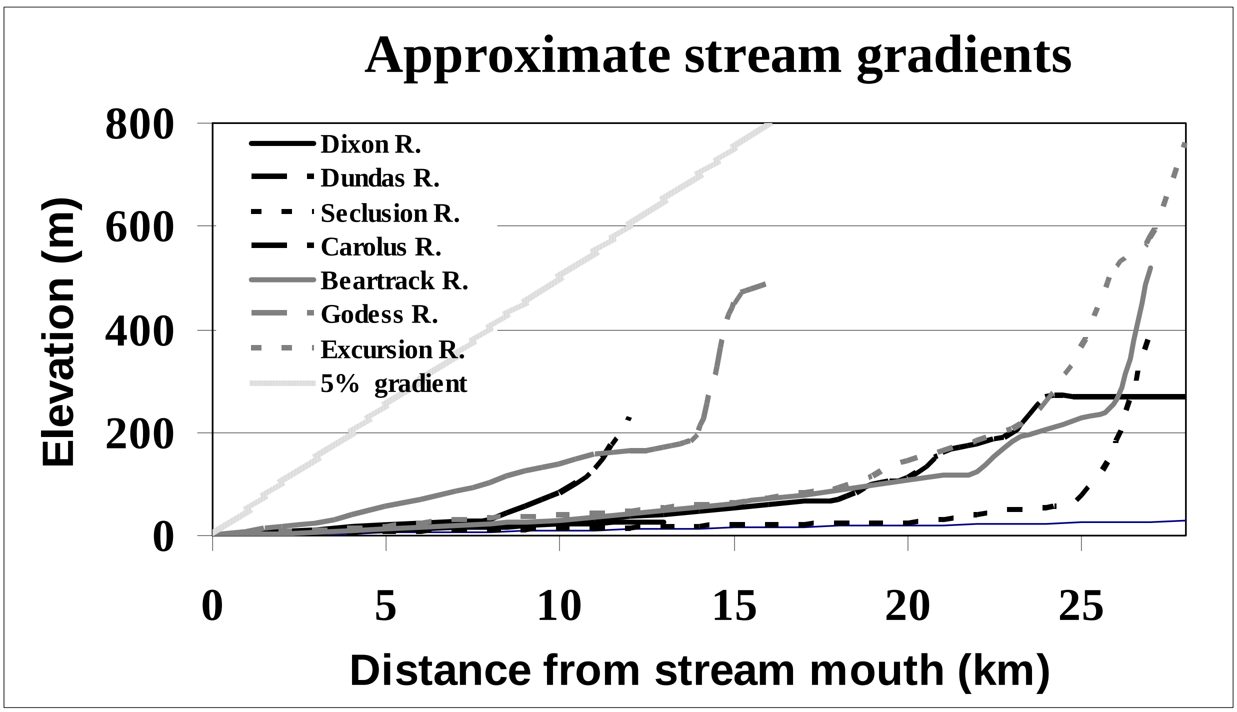

Figure 3. Stream profiles for selected streams in Glacier Bay National Park. Distance from stream mouth was measured from the upper extent of tidal influence at mean high tide.

The Adams island lake drainage was extremely small and boggy and we believe it is extremely unlikely that this small system could support chinook salmon. Aerial survey habitat evaluation results and anecdotal evidence for chinook in the Dundas River led us to search for chinook salmon in the Seclusion and Dundas rivers. These systems appeared to contain 1) woody debris in amounts that would not overly impede raft transport and survey efforts, 2) good salmon cover (*i.e.*, deep pools, riparian vegetation and woody debris), 3) suitable spawning substrate (*i.e.*, ranging in size from medium gravel (2.6-5.0 cm) to small cobble (7.6-15.0 cm), and, 4) adequate discharge and suitable gradients (*i.e.*, typically < 5%, Figure 3) that would not prohibit chinook presence.

On-Stream Surveys

Seclusion River

Initially, we made an attempt to survey the inlet to Lake Seclusion, as numerous adult sockeye and Dolly Varden were observed there. However, we opted to forego sampling there because of the presence of a large brown bear in the area.

A total of 63 trap sets were made at eight sample locations along approximately 18 km of river reach (Figure 2; Table 1 and Appendix A1). However, three of the sets at sample location 8A (SEC-08A) were made in the Dundas River at its confluence with the Seclusion, so only 60 sets (46.8 trap-hrs) were actually made in the Seclusion River proper. Main channel (65%) and tributary (35%) habitat comprised the predominant macrohabitat selected for trapping at each sampling location. Cover type was primarily characterized by overhanging, riparian vegetation. Silt/sand and gravel (< 3 cm) substrates were the predominant types where minnow traps were set. Water clarity was generally good throughout the system. However, visibility was limited to perhaps 1.5-2.0 meters depth due to ambient lighting conditions. Precipitation events hampered visibility conditions along the lower river reach and prohibited species enumerations during moderate to heavy rains while floating the river (Appendix A2). Maximum depth of some of the deeper pools likely exceeded 3 meters. Salmon holding in deep pools may have been missed or underestimated by observers.

A total of 19 juvenile fish were captured in 45.2 trap-hr of effort along approximately 15 km of river reach (Table 1). Three species of fish were captured: 16 coho salmon, two Dolly Varden, and one threespine stickleback *Gasterosteus aculeatus* (Appendix A1). Juvenile coho salmon accounted for 84.2%, Dolly Varden represented 10.5%, and threespine stickleback represented 5.3% of the total catch. Only two coho salmon were caught in all minnow trap sets combined among the four tributaries. These individuals were caught in the tributary at sample location SEC-03 and in the tributary to Lake 55 (SEC-07; see Table 1, Figure 2) both within 33 m of the confluence.

Table 1. Site characteristics of water clarity/turbidity, cover type, substrate type, temperature, water depth and flow, and catch statistics of juvenile coho salmon, Dolly Varden, and threespine stickleback (3SS) for sample locations in the Seclusion River, September 4-7, 2002. Juvenile fish were captured using salmon roe baited minnow traps over standardized 30-60 minute sets.

									Catch (number of fish) and Mean Fork Length (FL)							
									Coho Salmon			Dolly Varden				
Sample Location	# of Sets	Water Clarity/Turbidity[1]	Cover Type[2]	Substrate Type	Air (°c)	Water (°c)	Depth (m)	Flow[3] (cm/s)	#	FL (mm)	SD[4]	#	FL (mm)	SD	3SS[5]	Total
SEC-01																
Main Channel	3	Light Amber	ORV	Silt/Sand	17	11	0.9	12	0	-		1	NA		1	2
SEC-02																
Main Channel	6	Light Amber	ORV	Gravel	12	10.5	0.9	13	0	-		0	-		0	0
Tributary	3	Clear	ORV	Gravel	12	5.5	0.4	5	0	-		0	-		0	0
SEC-03																
Main Channel	6	Light Amber	ORV	Silt/Sand	12	9.5	0.8	30	4	NA		0	-		0	4
Tributary	6	Clear	ORV	Sand/Gravel	12	6	0.1		1	NA		0	-		0	1
SEC-04																
Main Channel	6	Light Amber	DRS	Gravel	11	6	1.4	38	0	-		0	-		0	0
SEC-05																
Main Channel	6	Light Amber	DRS	Gravel	12	6	1		4	49	4	0	-		0	4
Tributary	3	Clear	DRS	Silt/Gravel	12	5	0.4		0	-		0	-		0	0
SEC-06																
Main Channel	6	Light Amber	ORV	Gravel	11	6	1.4	13	6	48	4	0	-		0	6
SEC-07																
Main Channel	6	Light Amber	DRS	Silt/Gravel	14	7	0.9	105	0	-		1	NA		0	1
Tributary to Lake 55	6	Dark Brown	ORV	Silt/Sand	14	9.5	0.9		1	45		0	-		0	1
SEC-08A																
Seclusion	3	Brown	NC	Silt/Sand	14	8	0.6	57	0	-		0	-		0	0
Dundas Main Channel	3	Gray Blue/Green	DRS	Silt/Sand	14	6	NA		1	60		3	77	24	0	4
Totals	63								17			5			1	23
Percent Composition									74			22			4	
Seclusion proper	60								16			2			1	19
Percent Composition									84			11			5	

[1] Definitions derived from Reid, 1961. Ecology of Inland Waters and Estuaries. D. Van Norstrand Company, New York.

[2] Cover Type: ORV - overhanging riparian vegetation; DRS - deadfall, root wad, and stumps; NC - no cover.

[3] Crude estimates based on minimal field measurement and visual estimation of water column velocity (see methods).

[4] Standard Deviation

[5] 3SS - threespine stickleback.

The number of fish by date, sample location and trap, percent catch composition, and CPUE are summarized in Appendix A1. The CPUE for juvenile coho salmon and Dolly Varden were 0.353 and 0.044 fish per hour, respectively. No juvenile chinook salmon were captured.

Visual counts of adult salmonids were made as we floated the river and totaled 11,939 Dolly Varden, 1,173 pink *Oncorhynchus gorbuscha*, 422 sockeye *O. nerka*, 271 chum *O. keta*, and 14 coho salmon adults (Table 2 and Appendix A2).

Hook and line CPUE for coho ranged from 0.0 fish per hour at sample locations SEC-05 and SEC-07 to 18.0 fish per hour just below the confluence with Lake 55 tributary and Seclusion River (Table 2). CPUE for Dolly Varden ranged from 12.0 to 15.0 fish per hour. Most of the hook and line fishing occurred in deep pool areas.

Table 2. Visual count distribution and hook and line catch and effort statistics of salmonids observed in Seclusion River, September 4-7, 2002.

Visual Counts

		Observed Number of Fish					
Date	Location	Sockeye	Pink	Chum	Coho	Dolly Varden	Total
4-Sep	Lake Inlet	350				24	374
	Lake outlet	24		5			29
	SEC-01 to Camp 1					550	550
5-Sep	Camp 1 to SEC-02					150	150
	SEC-02 to SEC-03				6	450	456
	SEC-03 to Camp 2	37	226	16	2	7,620	7,901
6-Sep	Camp 2 to SEC-05	5	42	12		750	809
	SEC-05 to SEC-06	6	140	20	2	980	1,148
	SEC-06		180	20	4	405	609
	SEC-06 to Camp 3		175	138		800	1,113
7-Sep	Camp 3 to SEC-07		60	30		150	240
	SEC-07		350	30		60	440
Total		422	1,173	271	14	11,939	13,819

Hook and Line

			Coho			Dolly Varden		
Date	Location	Effort (min)	#	CPUE (Min)	CPUE (Hr)	#	CPUE (Min)	CPUE (Hr)
4-Sep	SEC-01	10 casts						
5-Sep	Sweeper Hole	8				2	0.250	15
6-Sep	SEC-05	15				3	0.200	12
7-Sep	SEC-07 at confluence	15				3	0.200	12
	below confluence	10	3	0.300	18			
	Dundas Main Channel	10	1	0.100	6			
Total		58	4			8		

Dundas River

A total of 96 trap sets were made at eight sample locations (Figure 2 and Table 3). Macrohabitat categories of all trap sets and sample locations combined were noted as main channel (40%), side channel (54%), and tributary (6%). The predominant cover type was characterized by overhanging, riparian vegetation. Silt/sand and gravel (< 3 cm diameter) substrates occurred most frequently at minnow trapping locations. Water clarity was approximately 0.1 m near shore. The Dundas River is glacially fed and characteristically exhibits high turbidity and a gray blue/green color. The side channels were all clear water with some light amber to brown color.

A total of 25 juvenile fish was captured in 48.4 trap-hrs (see Appendix A3) of effort along approximately 9 km of river reach (Table 3). The total catch for all traps combined was 21 Dolly Varden and four coho salmon. Juvenile Dolly Varden accounted for 84% of the total catch, and coho salmon represented 16% (Table 3). The majority of the Dolly Varden catch (14 fish, 66%) was attributable to one trap fished in the main channel at sample location DUN-03 which is located approximately 11 km upstream from the confluence of the Dundas and Seclusion rivers (Appendix A3). There were no fish caught in the tributary at sample location DUN-05. No juvenile chinook salmon were captured.

The number of fish by date, sample location and trap, percent catch composition, and CPUE are summarized in Appendix A3. The CPUE for juvenile Dolly Varden and coho salmon was 0.433 and 0.083 fish per hr, respectively.

One seine haul was attempted in a pool-riffle area at DUN-06 with no success at capturing fish. Other areas of the river were not conducive to beach seine sampling. Water velocity was considered too swift to contain rearing salmon (Hillman *et. al*., 1987) below DUN-08 to the confluence with Seclusion River.

Attempts were made throughout the Dundas River survey to visually observe adult fish, but poor water clarity (*i.e.*, high turbidity) precluded the sighting of any adults.

Table 3. Site characteristics of water clarity/turbidity, cover type, substrate type, temperature, water depth and flow, and catch statistics of juvenile coho salmon and Dolly Varden for sample locations in the Dundas River, September 13-14, 2002. Juvenile fish were captured using salmon roe baited minnow traps over standardized 30-60 minute sets.

						Temperature				Catch (number of fish) and Mean Fork Length (FL)						
			Water			Air	Water	Depth	Flow[3]	Coho Salmon			Dolly Varden			
Location		# of Sets	Clarity/Turbidity[1]	Cover Type[2]	Substrate Type	(°c)	(°c)	(m)	(cm/s)	#	FL (mm)	SD	#	FL (mm)	SD	Total
DUN-01																
	Side Channel	12	Clear	NC	Silt/Sand	14	7	0.5	30.0	0	-		0	-		0
DUN-02																
	Main Channel	8	Gray Blue/Green	ORV	Gravel	13	7	0.2	78.0	0	-		1	78		1
	Side Channel	4	Clear	ORV	Gravel	13	6	0.4		0	-		1	48		1
DUN-03																
	Main Channel	12	Gray Blue/Green	ORV	Gravel	13	7	1	77.0	0	-		14	60	7	14
DUN-04																
	Side Channel	12	Gray Blue/Green	DRS	Silt/Sand	8	6	0.7	15.2	3	86	8	4	107	29	7
DUN-05																
	Main Channel	6	Gray Blue/Green	ORV	Silt/Gravel	8	5		27.0	0	-		0	-		0
	Tributary	6	Clear	ORV	Gravel	8	4	0.2	15.0	0	-		0	-		0
DUN-06																
	Side Channel	12	Gray Blue/Green	ORV	Silt/Sand	8	5	0.3	11.0	0	-		1	65		1
DUN-07																
	Main Channel	12	Gray Blue/Green	ORV	Silt/Sand	8	7	1	11.6	0	-		0	0		0
DUN-08B																
	Side Channel	12	Gray Blue/Green	DRS	Silt/Sand	8	8	0.1	0.0	1	62		0	-		1
Totals		96								4			21			25
Percent Composition										16			84			

[1] Definitions derived from Reid, 1961. Ecology of Inland Waters and Estuaries. D. Van Norstrand Company, New York.

[2] Cover Type: ORV - overhanging riparian vegetation; DRS - deadfall, root wad, and stumps; NC - no cover.

[3] Crude estimates based on minimal field measurement and visual estimation of water column velocity (see methods).

DISCUSSION AND RECOMMENDATIONS

The aerial survey indicated that potential chinook spawning and rearing habitat is unlikely to exist in the Adams island lake system, and the Godess and Dixon rivers. The Adams lake system is contained within an extremely small, boggy catchment and the Godess and Dixon rivers are steep, unstable, glacially influenced systems. Candidate systems for Chinook salmon include Excursion, Beartrack, Carolus, Dundas, and Seclusion rivers. However, there were extensive woody debris jams observed in Excursion, Beartrack and Carolus that would make access and sampling very difficult. The Seclusion and Dundas rivers were therefore selected for on-stream sampling based on the initial aerial survey evaluation of riparian vegetation, woody debris, deep pools, and accessibility, as well as ease of sampling. In addition, reaches of each river appeared to have appropriately sized spawning substrate (cobble/rubble type) preferred by chinook salmon as noted by Chapman and Bjornn (1969). Time limitations, accessibility constraints and anecdotal evidence of chinook presence in these two systems were important additional considerations.

The Seclusion River is characterized by relatively low gradient (< 5%), good riparian cover, higher pool to run ratio, smaller gravel substrate, and low sediment transport and flow which are buffered by the lake. The Dundas River is characterized by a slightly steeper gradient, numerous large braided reaches of larger gravel substrate (cobble size) comprising gravel bars, with very little to no riparian cover, mostly run/riffle habitat, and very high sediment transport (as indicated by high turbidity). These habitat differences undoubtedly affect fish species' presence, distribution and abundance.

The results of sampling in associated main, side channel and tributary areas of the Seclusion and Dundas rivers provided limited information relative to rearing habitat utilized by coho salmon and Dolly Varden. The small sample size precludes evaluation of the relative importance of main channel, side channel and tributary habitats. Researchers sampling various habitat types in the lower Taku River reported that juvenile chinook were present mainly in riverine (main channel) habitat and seldom in beaver ponds or side sloughs (Murphy *et al.* 1989). Thus, chinook salmon, if present, were most likely to occur within main channel habitat where most of our sampling occurred. Unfortunately, we failed to detect or capture chinook salmon in either of the sampled systems.

According to Lister and Genoe (1970), juvenile chinook salmon prefer higher velocities than coho salmon in the Big Qualicum River, British Columbia. Moreover, they also report that juvenile chinook and coho both preferred microhabitats in close proximity to shelter but near relatively high velocity (40 cm/s) flow. In this study, mean flow estimates of sampled habitat in Seclusion and Dundas rivers were similar to lower (10 to 52 cm/s) and upper (64 to 150 cm/s) velocities for juvenile chinook in western Washington streams (Collings *et al.* 1972).

Information is currently lacking on the early life history, behavior, distribution, or abundance of juvenile salmonids in Seclusion and Dundas rivers. Previous salmonid surveys have occurred during August and September on the Seclusion River, but only adult salmonids were enumerated (Blackie 1989, Lentfer *et al*. 1991 and Vequist 1986; see Appendix A2). No comprehensive strategy to identify and inventory seasonal distribution and relative abundance of salmonids in these river systems has been developed. Consequently, this is the first attempt to quantify juvenile salmonid distribution and relative abundance. No previous information exists for the Dundas River, so juvenile Dolly Varden and coho salmon catches reported here expand the NPS information base.

Juvenile chinook salmon exhibit either "stream" or "ocean" type life history strategies and this may have influenced the sampling effectiveness. Stream-type juveniles remain in freshwater for a year or more whereas ocean type juveniles migrate out of freshwater in their first year (Halupka *et al.* 2000). Other studies confirm that Southeast Alaska chinook salmon are of the "stream" type and that the "ocean type" life history is not present (Der Hovanisian *et al*. 2001, McPherson *et al.* 1997 and Pahlke and Etherton 2001). Stream-type juveniles reportedly emigrate to the marine environment during their second year of life (Taylor and Larkin 1986). Thus, life-history-based behavior indicates that juvenile chinook salmon should have been present in the rivers we sampled.

Catch rates for juvenile coho salmon and Dolly Varden were very low in both river systems but are within the range for other Southeast Alaska systems with similar fall fish assemblages (*i.e.*, Kanalku, Peanut, and Eliza lakes; see Ericksen 1994). Juvenile coho and Dolly Varden abundance was likely reduced from what one might expect earlier in the season (*i.e.* when adult spawners are not present). Juvenile coho salmon reportedly move into tributaries during fall as flows increase and water temperature declines while juvenile Dolly Varden relative abundance is typically greater in tributaries year-round (Bramblett *et al*. 2002).

Seasonal survey timing and changes in juvenile chinook salmon distribution might have influenced the results of our minnow trapping. Chinook salmon tend to rear in areas of faster current relative to other juvenile salmonids and generally move from reduced velocities near channel margins to faster water offshore as they grow (Healey 1991). Shirvell (1994) determined that juvenile chinook salmon in Kloiya Creek, B.C. typically moved offshore and downstream in response to increased water volume and velocity. Juvenile chinook salmon, if present and not inordinately uncommon, should have been captured by our sampling methods. It is likely that a) either juvenile chinook were present in the stream but at unsampled locations or at such low numbers they eluded capture, or, b) chinook are absent from both watersheds.

Timing of adult chinook salmon migrations also could have been a factor in our inability to detect chinook salmon presence in the Seclusion and Dundas rivers. However, other similar sized river systems (*i.e.* King Salmon River) in close proximity to the study area exhibit spawning migrations that cover the period when we were sampling (Pahlke 2001). Approximately half of the chinook salmon commercial catch on the lower Alsek River occurs around June 19 (Pahlke and Etherton 2001). The historical average date at which 75% of the catch at Kakwan Point, Stikine River has occurred is June 21 (Der Hovanisian *et al.* 2001). Thus sampling of Seclusion and Dundas rivers probably occurred near the end of the spawning migration if timing is similar to other regional systems. Future chinook surveys should focus on earlier and more frequent sampling. Ideally, at least three complete surveys could be planned to encompass likely run timing. Additional sampling of tributaries would be critical for defining distribution within each river system.

The relatively high abundance of large Dolly Varden in the Seclusion River has never been previously documented anywhere. Dolly Varden originating from a wide variety of natal stream systems typically aggregate in stream systems containing lakes to overwinter and faithfully return to these systems each year (Bernard *et al.* 1995). Thus the Seclusion River system appears to be an important overwintering habitat for Dolly Varden originating presumably from other streams throughout the Cross Sound area. Future research on the stock composition of this unusual concentration of Dolly Varden would be very intriguing. Continued protection of this important watershed is essential.

The only way to conclusively settle the question of whether chinook salmon are present in the Seclusion and Dundas river systems would be to conduct a multiple-year, stock assessment in the form of a smolt and/or adult enumeration project using inclined plane traps for smolt and weirs or possibly sonar applications with appropriate trapping gear for adults. Such projects would require considerably more resources than this project's methodology. Seclusion River water clarity conditions would frequently allow visual observation and enumeration of salmonids. Thus a less intensive, less costly alternative solution to determining chinook salmon presence would entail multiple (seasonally and interannually) snorkel surveys in conjunction with minnow or smolt trapping. This work should occur during June to late August to encompass periods when both juveniles and spawning adult fish are likely to be present (Healey 1991).

Excursion, Beartrack, and Carolus river chinook surveys would be essential for an accurate determination of chinook salmon presence in GBNP. Those rivers apparently have habitat characteristics similar to the Seclusion and Dundas rivers. However, access logistics as well as wilderness minimal tool requirements would need to be addressed. The NPS requires a minimum tool evaluation process to justify the use of mechanized equipment and conveyances (*e.g.*, helicopter, jet boat, *etc.*) in designated wilderness. This could significantly affect feasibility of work in these less accessible river systems.

Predicated upon chinook presence, the NPS should monitor escapement and corresponding productivity of the stock to evaluate harvest concerns. A small, low productivity chinook stock would require NPS managers to determine how GBNP chinook stocks might be characterized genetically for identification in mixed stock salmon fisheries occurring within and adjacent to the national park.

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LITERATURE CITED

Bernard, D.R., K.R. Hepler, J.D. Jones, M.E. Whalen and D.N. McBride. 1995. Some tests of the "Migration Hypothesis" for anadromous Dolly Varden (southern form). Transactions of the American Fisheries Society 124:297-307.

Blackie, B. 1989. Surveys of nine salmon streams in Glacier Bay National Park, Alaska. Department of the Interior, U.S. National Park Service, Glacier Bay National Park. Gustavus, Alaska. Unpublished report. 29 pp.

Bramblett, R.G., M.D. Bryant, B.E. Wright and R.G. White. 2002. Seasonal use of small tributary and main-stem habitats by juvenile steelhead, coho salmon, and Dolly Varden in a Southeastern Alaska drainage basin. Transactions of the American Fisheries Society 131:498-506.

Cebula, Jerome, J. 1963. [Glacier Bay National Monument Stream Survey]. Glacier Bay National Park. Gustavus, Alaska. Unpublished field notes.

Chapman, D.W., and T.C. Bjornn. 1969. Distribution of salmonids in streams, with special reference to food and feeding, p. 153-176. *In*: T.G. Northcote (*ed*.). Symposium on Salmon and Trout in Streams. H.R. MacMillan Lectures in Fisheries. Institute of Fisheries, University of British Columbia, Vancouver, BC. 388 pp.

Collings, M.R., R.W. Smith, and G.T. Higgins. 1972. Hydrology of four streams in western Washington as related to several Pacific salmon species: Humptulips, Elchoman, Green and Wynoochee rivers: open file report. United States Geological Survey. Tacoma, WA. 128 pp.

Der Hovanisian, J.A., K.A. Pahlke, and P. Etherton. 2001. Abundance of the chinook salmon escapement on the Stikine River, 2000. Alaska Department of Fish and Game, Division of Sport Fish. Fishery Data Series No. 01-18. Juneau, Alaska.

Ericksen, R.P. 1994. An examination of twelve lakes in Northern Southeast Alaska for stocking with juvenile coho salmon. Alaska Department of Fish and Game, Division of Sport Fish. Fishery Data Series No. 94-2. Juneau, Alaska.

Foster, M., B. Foster, R. Perkins, and L. Greene. 1994. [Seclusion River float trip.] Glacier Bay National Park. Gustavus, Alaska. Unpublished document. 2 pp.

Groves, P.A., and J.A. Chandler. 1999. Spawning habitat used by fall chinook salmon in the Snake River. North American Journal of Fisheries Management 19: 912-922.

Halupka, K.C., M.D. Bryant, M.F Willson and F.H. Everest. 2000. Biological characteristics and population status of anadromous salmon in southeast Alaska.

U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Gen. Tech. Rep. PNW-GTR-468. Portland, Oregon. 255 pp.

Healey, M.C. 1991. Life history of chinook salmon. Pp. 311-393 *in* C. Groot and L. Margolis (*eds*.) Pacific salmon life histories. University of British Columbia Press. Vancouver, BC.

Hillman, T.W, J.S Griffith, and W.S Platts. 1987. Summer and winter habitat selection by juvenile Chinook salmon in a highly sedimented Idaho stream. Transactions of the American Fisheries Society 116: 185-195.

Howe, A.L. R.J. Walker, C. Olnes, K. Sundet and A.E. Bingham. 2001. Participation, catch, and harvest in Alaska sport fisheries during 1999. Alaska Department of Fish and Game, Division of Sport Fish. Fishery Data Series No. 01-8. Anchorage Alaska.

Lentfer, H.J., J. Rettew, C. McNeil and M. Porter. 1991. 1991 Seclusion system salmon survey. Department of the Interior, U.S. National Park Service, Glacier Bay National Park. Gustavus, Alaska. Unpublished report.

Lister, D.B., and H.S. Genoe. 1970. Stream habitat utilization by cohabiting underyearlings of chinook (*Oncorhynchus tshawytscha*) and coho (*O. kisutch*) salmon in the Big Qualicum River, British Columbia. J. Fish. Res. Board Can. 27: 1215-1224.

McPherson, S.A., D.R. Bernard, M.S. Kelley, P.A. Milligan, and P.l Timpany. 1997. Spawning abundance of chinook salmon in the Taku River in 1996. Alaska Department of Fish and Game, Division of Sport Fish. Fishery Data Series No. 97-14. Juneau, Alaska.

Merrell, T.R. 1965. Freshwater fishes. Pp. 157-159 *in* A. Mirsky (*ed*.) Soil development and ecological succession in a deglaciated area of Muir Inlet, Southeast Alaska. Ohio State University. Institute of Polar Studies Report No. 20. 167 pp.

Murphy, M.L., J. Heifetz, J.F. Thedinga, S.W. Johnson, and K.V. Koski. 1989. Habitat utilization by juvenile Pacific salmon (*Oncorhynchus*) in the glacial Taku River, southeast Alaska. Can. J. Fish. Aquat. Sci. 46: 1677-1685.

Pahlke, K.A. 2001. Escapements of chinook salmon in Southeast Alaska and transboundary rivers in 2000. Alaska Department of Fish and Game, Division of Sport Fish. Fishery Data Series No. 01-32. Juneau, Alaska.

Pahlke, K.A. and P. Etherton. 2001. Abundance of the chinook salmon escapement on the Alsek River, 2000. Alaska Department of Fish and Game, Division of Sport Fish. Fishery Data Series No. 01-30. Juneau, Alaska.

Pollard, W.R., G.F. Hartman, C. Groot, and Phil Edgell. 1997. Field identification of coastal juvenile salmonids. Department of Fisheries and Oceans, MacMillian Bloedel Ltd. Madeira Park, BC, Canada.

Reid, G.K. 1961. Ecology of Inland Waters and Estuaries. D. Van Nostrand Company, New York.

Shirvell, C.S. 1994. Effect of changes in the streamflow on the microhabitat use and movements of sympatric juvenile coho salmon (*Oncorhynchus kisutch*) and chinook salmon (*O. tshawytscha*) in a natural stream. Can. J. Fish. Aquat. Sci. 51:1644-1652.

Soiseth, C.R. and A.M. Milner. 1995. Predicting salmonid occurrence from physical characteristics of streams in Glacier Bay National Park and Preserve. Pp. 174-183 *in* D.R. Engstrom (*ed*.) *Proceedings of the Third Glacier Bay Science Symposium, 1993*. Department of Interior, U.S. National Park Service, Glacier Bay National Park. Anchorage, Alaska.

Taylor, E.B. and P.A. Larkin. 1986. Current response and agonistic behavior in newly emerged fry of chinook salmon, *Oncorhynchus tshawytscha*, from ocean- and stream-type populations. Can. J. Fish. Aquat. Sci. 43: 565-573

Vequist, G. 1986. Survey of Seclusion and Dundas Rivers. Department of the Interior, U.S. National Park Service, Glacier Bay National Park. Gustavus, Alaska. Unpublished report. 2 pp.

Appendix A1. Minnow trap catches of juvenile fish by date, sample location and trap in Seclusion River, September 4-7, 2002.

							Catch			
Date	Location		Set#	Set	Pull	Time (Min)	Dolly Varden	Coho	3-Spine Stickleback	Total
4-Sep	Sec-01	Main Channel	1	17:10	17:40	30	0	0	0	0
		Main Channel	2	17:11	17:41	30	0	0	0	0
		Main Channel	3	17:12	17:42	30	1	0	1	2
										0
5-Sep	Sec-02	Tributary	1	9:35	10:05	30	0	0	0	0
		Tributary	2	9:36	10:06	30	0	0	0	0
		Tributary	3	9:37	10:07	30	0	0	0	0
		Main Channel- above tributary	4	9:40	10:15	35	0	0	0	0
		Main Channel- above tributary	5	9:41	10:14	33	0	0	0	0
		Main Channel- above tributary	6	9:42	10:13	31	0	0	0	0
		Main Channel- below tributary	7	9:43	10:13	30	0	0	0	0
		Main Channel- below tributary	8	9:43	10:15	32	0	0	0	0
		Main Channel- below tributary	9	9:46	10:16	30	0	0	0	0
5-Sep	Sec-03	Tributary	1	12:05	13:13	68	0	0	0	0
		Tributary	2	12:06	13:14	68	0	1	0	1
		Tributary	3	12:06	13:14	68	0	0	0	0
		Tributary	4	12:07	13:14	67	0	0	0	0
		Tributary	5	12:08	13:16	68	0	0	0	0
		Tributary	6	12:07	13:16	69	0	0	0	0
		Main Channel	7	12:08	13:20	72	0	0	0	0
		Main Channel	8	12:11	13:21	70	0	2	0	2
		Main Channel	9	12:15	13:24	69	0	0	0	0
		Main Channel	10	12:16	13:26	70	0	2	0	2
		Main Channel	11	12:17	13:29	72	0	0	0	0
		Main Channel	12	12:17	13:31	74	0	0	0	0

Appendix A1 Continued

6-Sep	Sec-04	Main Channel	1	8:20	8:52	32	0	0	0	0
		Main Channel	2	8:25	8:55	30	0	0	0	0
		Main Channel	3	8:30	9:05	35	0	0	0	0
		Main Channel	4	8:19	8:49	30	0	0	0	0
		Main Channel	5	8:21	8:51	30	0	0	0	0
		Main Channel	6	8:28	8:58	30	0	0	0	0
6-Sep	Sec-05	Main Channel- above tributary	1	10:43	11:15	32	0	0	0	0
		Main Channel- above tributary	2	10:45	11:18	33	0	0	0	0
		Main Channel- above tributary	3	10:47	11:20	33	0	0	0	0
		Tributary	4	10:43	11:14	31	0	0	0	0
		Tributary	5	10:44	11:12	28	0	0	0	0
		Tributary	6	10:45	11:13	28	0	0	0	0
		Main Channel- below tributary	7	10:50	11:25	35	0	4	0	4
		Main Channel- below tributary	8	10:53	11:30	37	0	0	0	0
		Main Channel- below tributary	9	10:55	11:32	37	0	0	0	0
6-Sep	Sec-06	Main Channel	1	14:17	15:38	81	0	0	0	0
		Main Channel	2	14:18	15:35	77	0	0	0	0
		Main Channel	3	14:20	15:37	77	0	0	0	0
		Main Channel	4	14:24	15:16	52	0	6	0	6
		Main Channel	5	14:26	15:23	57	0	0	0	0
		Main Channel	6	14:26	15:23	57	0	0	0	0
7-Sep	Sec-07	Tributary to Lake 55	1	9:28	10:13	45	0	0	0	0
		Tributary to Lake 55	2	9:29	10:13	44	0	0	0	0
		Tributary to Lake 55	3	9:29	10:14	45	0	0	0	0
		Tributary to Lake 55	4	9:30	10:15	45	0	0	0	0
		Tributary to Lake 55	5	9:31	10:16	45	0	0	0	0
		Tributary to Lake 55	6	9:33	10:17	44	0	1	0	1
		Main Channel	7	9:40	10:28	48	0	0	0	0
		Main Channel	8	9:45	10:29	44	0	0	0	0
		Main Channel	9	9:46	10:29	43	0	0	0	0
		Main Channel	10	9:48	10:32	44	1	0	0	1
		Main Channel	11	9:49	10:33	44	0	0	0	0
		Main Channel	12	9:52	10:35	43	0	0	0	0

Appendix A1 Continued

7-Sep	Sec-08A	Seclusion Tributary	1	11:33	12:03	30	0	0	0	0
		Seclusion Tributary	2	11:34	12:04	30	0	0	0	0
		Seclusion Tributary	3	11:34	12:05	31	0	0	0	0
		Dundas above confluence	4	11:33	12:04	31	0	0	0	0
		Dundas above confluence	5	11:35	12:06	31	1	1	0	2
		Dundas above confluence	6	11:37	12:07	30	2	0	0	2
Totals			63				5	17	1	23
Catch Composition (%)							21.7	73.9	4.3	100.0
Minutes						2,805				
Hours						46.8				
Catch/Min (CPUE)							0.0018	0.0061	0.0004	0.0082
Catch/Hr (CPUE)							0.1070	0.3636	0.0214	0.4920
Seclusion only							2	16	1	19
Catch Composition (%)							10.5	84.2	5.3	100.0
Minutes						2,713				
Hours						45.2				
Catch/Min (CPUE)							0.0007	0.0059	0.0004	0.0070
Catch /Hr (CPUE)							0.0442	0.3539	0.0221	0.4202

Appendix A2. Index of salmonid abundance as determined by visual counts during float trips from Lake Seclusion to the Dundas River confluence. Counts were unavailable for some species although their presence was observed (P). Similarly, some surveyors reported that species were not observed (NO) despite the use of appropriate sampling methods (*i.e.* angling, minnow trapping). Presence or absence were also not reported (NR) by some surveyors.

Species:	**Waltemyer and Soiseth Sept. 4-8, 2002**	**Lentfer *et al*. Aug. 6-7, 1991**	**Blackie Aug. 27-29, 1989**	**Vequist Sept. 14-15, 1986**
Sockeye	422	1,004[1,2]	1,827[1,2]	2,200
Pink	1,173	42,371	2,909	2,600
Chum	271	73	119	4,100
Coho	14	NR	NR	400
Dolly Varden	11,939	1,600	NR	P
Cutthroat trout	NO	NR	NR	P
Steelhead	NO	NR	NR	P

[1]Includes counts from Lake Seclusion Inlet.

[2]Includes counts from Lake Seclusion.

Appendix A3. Minnow trap catches of juvenile fish by date, sample location and trap in Dundas River, September 13-14, 2002.

Date	Location		Set#	Set	Pull	Time (Min)	Catch		
							Dolly Varden	Coho	Total
13-Sep	Dun-01	Side Channel	1	2:32	3:02	30	0	0	0
		Side Channel	2	2:33	3:03	30	0	0	0
		Side Channel	3	2:33	3:03	30	0	0	0
		Side Channel	4	2:34	3:04	30	0	0	0
		Side Channel	5	2:32	3:02	30	0	0	0
		Side Channel	6	2:33	3:03	30	0	0	0
		Side Channel	7	2:34	3:04	30	0	0	0
		Side Channel	8	2:35	3:05	30	0	0	0
		Side Channel	9	2:31	3:01	30	0	0	0
		Side Channel	10	2:32	3:02	30	0	0	0
		Side Channel	11	2:33	3:03	30	0	0	0
		Side Channel	12	2:34	3:04	30	0	0	0
13-Sep	Dun-02	Side Channel	1	15:46	16:00	14	0	0	0
		Side Channel	2	15:47	16:32	45	0	0	0
		Side Channel	3	15:47	16:00	13	0	0	0
		Side Channel	4	15:48	16:00	12	1	0	1
		Main Channel	5	15:51	16:16	25	0	0	0
		Main Channel	6	15:51	16:16	25	0	0	0
		Main Channel	7	15:53	16:17	24	0	0	0
		Main Channel	8	15:53	16:17	24	0	0	0
		Main Channel	9	15:54	16:18	24	0	0	0
		Main Channel	10	15:54	16:19	25	0	0	0
		Main Channel	11	15:56	16:21	25	0	0	0
		Main Channel	12	15:56	16:25	29	1	0	1
13-Sep	Dun-03	Main Channel	1	17:02	17:34	32	0	0	0
		Main Channel	2	17:03	17:35	32	0	0	0
		Main Channel	3	17:03	17:36	33	0	0	0
		Main Channel	4	17:04	17:37	33	0	0	0
		Main Channel	5	17:02	17:37	35	0	0	0
		Main Channel	6	17:02	17:38	36	14	0	14
		Main Channel	7	17:03	17:38	35	0	0	0
		Main Channel	8	17:03	17:38	35	0	0	0
		Main Channel	9	17:07	17:39	32	0	0	0
		Main Channel	10	17:07	17:40	33	0	0	0
		Main Channel	11	17:07	17:41	34	0	0	0
		Main Channel	12	17:08	17:46	38	0	0	0

Appendix A3 Continued

14-Sep	Dun-04	Main Channel	1	8:52	9:23	31	0	0	0
		Main Channel	2	8:52	9:24	32	0	0	0
		Main Channel	3	8:53	9:25	32	0	0	0
		Main Channel	4	8:53	9:25	32	0	0	0
		Main Channel	5	8:55	9:26	31	0	0	0
		Main Channel	6	8:55	9:26	31	0	0	0
		Main Channel	7	8:57	9:26	29	0	0	0
		Main Channel	8	8:57	9:27	30	0	0	0
		Main Channel	9	8:55	9:27	32	0	0	0
		Main Channel	10	8:55	9:27	32	0	0	0
		Main Channel	11	8:54	9:27	33	0	0	0
		Main Channel	12	8:53	9:27	34	4	3	7
13-Sep	Dun-05	Main Channel	1	9:58	10:32	34	0	0	0
		Main Channel	2	9:59	10:33	34	0	0	0
		Main Channel	3	10:01	10:34	33	0	0	0
		Main Channel	4	10:03	10:36	33	0	0	0
		Main Channel	5	10:05	10:37	32	0	0	0
		Main Channel	6	10:06	10:38	32	0	0	0
		Tributary	7	10:02	10:34	32	0	0	0
		Tributary	8	10:02	10:35	33	0	0	0
		Tributary	9	10:04	10:36	32	0	0	0
		Tributary	10	10:04	10:34	30	0	0	0
		Tributary	11	10:07	10:35	28	0	0	0
		Tributary	12	10:07	10:36	29	0	0	0
13-Sep	Dun-06	Side Channel	1	11:35	12:05	30	0	0	0
		Side Channel	2	11:35	12:05	30	0	0	0
		Side Channel	3	11:37	12:07	30	0	0	0
		Side Channel	4	11:39	12:09	30	0	0	0
		Side Channel	5	11:40	12:10	30	0	0	0
		Side Channel	6	11:34	12:04	30	0	0	0
		Side Channel	7	11:35	12:05	30	0	0	0
		Side Channel	8	11:36	12:06	30	1	0	1
		Side Channel	9	11:34	12:04	30	0	0	0
		Side Channel	10	11:35	12:05	30	0	0	0
		Side Channel	11	11:36	12:06	30	0	0	0
		Side Channel	12	11:37	12:07	30	0	0	0

Appendix A3 Continued

13-Sep	Dun-07	Main Channel	1	14:10	14:40	30	0	0	0
		Main Channel	2	14:11	14:41	30	0	0	0
		Main Channel	3	14:14	14:44	30	0	0	0
		Main Channel	4	14:16	14:46	30	0	0	0
		Main Channel	5	14:10	14:40	30	0	0	0
		Main Channel	6	14:10	14:40	30	0	0	0
		Main Channel	7	14:11	14:41	30	0	0	0
		Main Channel	8	14:14	14:41	27	0	0	0
		Main Channel	9	14:10	14:40	30	0	0	0
		Main Channel	10	14:11	14:41	30	0	0	0
		Main Channel	11	14:13	14:43	30	0	0	0
		Main Channel	12	14:13	14:43	30	0	0	0
14-Sep	Dun-08B	Side Channel	1	15:54	16:24	30	0	1	1
		Side Channel	2	15:54	16:24	30	0	0	0
		Side Channel	3	15:57	16:27	30	0	0	0
		Side Channel	4	15:57	16:27	30	0	0	0
		Side Channel	5	15:53	16:28	35	0	0	0
		Side Channel	6	15:54	16:24	30	0	0	0
		Side Channel	7	15:55	16:35	40	0	0	0
		Side Channel	8	15:56	16:26	30	0	0	0
		Side Channel	9	16:02	16:32	30	0	0	0
		Side Channel	10	16:02	16:32	30	0	0	0
		Side Channel	11	16:03	16:33	30	0	0	0
		Side Channel	12	16:03	16:33	30	0	0	0
Totals			96				21	4	25
Catch Composition (%)							84.0	16.0	
Minutes						2,906			
Hours						48.4			
Catch/Min (CPUE)							0.0072	0.0014	0.0086
Catch/Hr (CPUE)							0.4336	0.0826	0.5162

Appendix A4. Sample locations in the Seclusion and Dundas rivers during September, 2002. Local Global Positioning System (GPS) data maps are NAD27 Alaska.

River	Location	Latitude hddd° mm' ss.s"	Longitude hddd° mm' ss.s"	Elevation m
Seclusion	SEC-01	N58 31 56.6	W136 21 52.2	30.5
	SEC-02	N58 31 18.7	W136 22 16.7	27.4
	SEC-03	N58 30 54.5	W136 22 00.8	24.4
	Swiper Hole	N58 29 51.1	W136 21 27.1	22.9
	SEC-04	N58 29 31.5	W136 20 46.7	21.3
	SEC-05	N58 29 24.8	W136 20 15.2	15.2
	SEC-06	N58 28 22.4	W136 19 22.1	12.2
	SEC-07	N58 24 52.8	W136 19 09.2	9.1
	SEC-08A	N58 24 42.5	W136 19 15.7	6.1
Dundas	DUN-01	N58 28 50.7	W136 27 38.7	26.7
	DUN-02	N58 28 32.1	W136 27 24.7	22.4
	DUN-03	N58 28 16.1	W136 26 46.8	19.4
	DUN-04	N58 28 15.4	W136 26 13.9	18.2
	DUN-05	N58 28 09.1	W136 25 57.1	15.2
	DUN-06	N58 27 47.2	W136 25 08.5	12.2
	DUN-07	N58 27 20.2	W136 23 03.2	9.1
	DUN-08B	N58 26 09.4	W136 20 58.1	6.1
	Dundas Bay Camp	N58 23 02.2	W136 18 42.7	3

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