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Natural Resource Stewardship and Science

Developing a Freshwater Contaminants Monitoring Protocol for the Southeast Alaska Network

Summary of 2013 Fish and Habitat Sampling in Klondike Gold Rush and Sitka National Historical Parks

Natural Resource Data Series NPS/SEAN/NRDS—2014/679

ON THE COVER
Taiya River valley and surrounding landscape
Photograph by: Andrew Cyr, University of Alaska Fairbanks

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Summary of 2013 Fish and Habitat Sampling in Klondike Gold Rush and Sitka National Historical Parks

Natural Resource Data Series NPS/SEAN/NRDS—2014/679

Andrew Cyr[1], Christopher J. Sergeant[2], Juan A. Lopez[3,4], Todd M. O'Hara[1]

[1]University of Alaska Fairbanks
Wildlife Toxicology Lab
Department of Biology and Wildlife – Institute of Arctic Biology
Fairbanks, Alaska 99775

[2]National Park Service
Southeast Alaska Network
3100 National Park Road
Juneau, Alaska 99801

[3]University of Alaska Fairbanks
School of Fisheries and Ocean Sciences
Fisheries Division
Fairbanks, Alaska 99775

[4]University of Alaska Fairbanks Museum of the North
Fishes and Marine Invertebrates
Fairbanks, Alaska 99775

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Abstract

The National Park Service (NPS) Southeast Alaska Network (SEAN) is developing a long-term freshwater contaminants monitoring protocol for Glacier Bay National Park and Preserve (GLBA), Klondike Gold Rush National Historical Park (KLGO), and Sitka National Historical Park (SITK) in cooperation with partners at the University of Alaska Fairbanks (UAF) and University of Alaska Southeast (UAS). This report summarizes the results of fish and habitat sampling completed in summer 2013. The goal of this field effort was to collect fish in KLGO and SITK to compare the relative levels of a suite of contaminants among fish species and among freshwater locations with four different characteristics: 1) glacial influence with anadromous fish present; 2) glacial influence without anadromous fish present; 3) non-glacial influence with anadromous fish present; and 4) non-glacial influence without anadromous fish present.

Minnow traps, beach seines, and hook and line capture techniques were employed in suitable habitats in four different rivers (Taiya River, Nourse River, West Creek, and the Indian River) over the span of 13 fishing days for a total of 3,747 trap-hours. Throughout this capture effort, Dolly Varden (*Salvelinus malma*), Coastrange sculpin (*Cottus aleuticus*), juvenile coho salmon (*Oncorhynchus kisutch*), rainbow trout (*Oncorhynchus mykiss*), and spawning pink salmon (*Oncorhynchus gorbuscha*) were captured. A subset of captured individuals were euthanized and retained for contaminant analysis. We determined the location of apparent anadromous barriers on the Taiya River, West Creek, and the Indian River by observing the presence or absence of spawning salmon and noting potential elevation/velocity barriers along each river channel. Dolly Varden was the only species caught in each location (freshwater locations with the four different river characteristics), except above the apparent anadromous barrier on the Taiya River, thereby enabling a consistent comparison of fish age, growth, and contaminant concentrations across sites and rivers. Coho and coastrange sculpin were caught in the Taiya and Indian rivers below the apparent anadromous barriers. Pink salmon were observed and caught from the Taiya and Indian rivers.

Length data were recorded in the lab and otoliths were extracted from each fish for future age determination. Fish contaminant concentrations will be analyzed by fall 2014. The contaminant data, together with the ecological and length-at-age data generated from this field effort will be compiled and summarized into peer-reviewed manuscripts and support the development of a SEAN long-term contaminants monitoring protocol. In addition, this work will be used to enable a graduate student to complete their thesis for the completion of their Master of Science degree at the UAF.

Acknowledgments

In addition to field staff mentioned in the main document narrative, we thank staff at Klondike Gold Rush and Sitka National Historical Parks that were instrumental in providing project support. We are particularly grateful for the contributions made by Theresa Thibault, Carin Farley, Tahzay Jones, and Jessica Wilbarger.

Introduction and methods

The National Park Service (NPS) Southeast Alaska Network (SEAN) is developing a long-term freshwater contaminant monitoring protocol for Glacier Bay National Park (GLBA), Klondike Gold Rush National Park (KLGO), and Sitka National Historical Park (SITK) in cooperation with partners at the University of Alaska Fairbanks (UAF) and University of Alaska Southeast (UAS). This report summarizes the results of fish and habitat sampling completed in 2013. The goal of this effort was to collect fish in KLGO and SITK to compare the relative levels of a suite of contaminants among fish species and among freshwater sites with four different characteristics 1) glacial influence with anadromous fish; 2) glacial influence without anadromous fish; 3) non-glacial influence with anadromous fish; and 4) non-glacial influence without anadromous fish.

With respect to many criteria, fish are an ideal biological medium (sentinel) to detect and monitor contaminant presence in the freshwater environment. Species with high lipid contents can incorporate lipophilic contaminants on a time scale ranging from months to years, and thus act as spatial and temporal integrators of bioavailable contaminants in a system (Ewald et al., 1998; Letcher et al., 2010; Zhang et al., 2001). Bioaccumulation and biomagnification processes increase the concentrations of many contaminants, making many easily detectable in tissues of fish and enabling consistent detection across the various analytical chemistry methods and classes of chemicals (Jewett & Duffy, 2007; Zhang et al., 2001). Collection and laboratory analysis of widely distributed and abundant fish species can be cost effective and efficient. Additionally, when comparing contaminant concentrations to fish consumption advisory levels for humans and wildlife (Eagle-Smith et al., 2014), many of the studied fish species offer a relevant and direct comparison as important food items.

Contaminants analyses are underway and will be completed by the fall 2014. The results of this work will be used to support the development of standardized methodology and analysis techniques for comprehensive and efficient long-term freshwater contaminants monitoring within SEAN.

River description and selection

River selection for each park unit was based on locality specific criteria, which will be described in detail below. For more extensive descriptions of each river and watershed, see Sergeant and Johnson (2014).

Klondike Gold Rush National Historical Park

Three rivers or streams were sampled in or adjacent to KLGO: the Taiya River; the Nourse River; and West Creek. All three are glacially influenced, with documented annual salmon migrations. No sampling activities took place in the Skagway River, the only other major river present within KLGO, because it drains a different watershed from the Taiya River, does not currently host any long-term monitoring activities, and only the uppermost headwaters of the river are contained within the park (Figure 2).

Taiya River

The Taiya River (Figures 2 and 3) is approximately 25.7 km long, with a watershed of approximately 170 km^2 (Hood et al, 2006). It is currently the only river in the park with long-term monitoring activities (streamflow and water quality). The river flows south and it is almost entirely contained within park boundaries. The historic Chilkoot trail runs parallel to the Taiya River, providing ample opportunity for fish and habitat sampling. All Taiya River sites in our field sampling were accessed via the Chilkoot Trail. The proximity of the trail to the river ranges from mere centimeters to almost a kilometer. The Chilkoot trail, road access, and a few structures along the last mile of the river are the full extent of human development along the Taiya River.

Nourse River

The Nourse River (Figure 2) originates from a large proglacial lake west of the park and flows south. It drains into the Taiya River approximately 14.5 km upstream from the mouth. The Nourse River is approximately 11 km long and drains a watershed of approximately 205 km^2 (Hood et al., 2006). Although the river traverses large portions of KLGO, it is not easily accessed. Fish and habitat sampling opportunities were limited. We accessed the Nourse River via the historic Chilkoot Trail, where we crossed the Taiya River on the suspension bridge at Canyon City, then hiked off-trail to reach the river.

West Creek

West Creek, which flows east and drains into the Taiya River approximately 5 km upstream from the mouth, is adjacent to the park. West Creek is approximately 13 km long, and drains a watershed of 115 km^2 (Hood et al., 2006). West Creek was accessed by walking from the West Creek road. This road turns west off the main Dyea Road and proceeds uphill, paralleling the creek. We were able to drive to within 300 m of each sampling site on the creek. Except for the road that parallels the creek, there is no other human development along the creek.

Sitka National Historical Park

Indian River

The Indian River is a 10-km-long mature river with a watershed encompassing approximately 32 km^2 (Moynahan et al 2008). It is the only river flowing through SITK. Long-term streamflow and water quality monitoring occur just upstream of park boundaries (Sergeant and Johnson 2014). The Indian River is not glacially influenced. It includes spawning and rearing habitat for anadromous salmon populations. The Indian River watershed has no lakes contained within its drainage boundaries (Moynahan et al., 2008). We accessed the river via the Indian River Trail. There are varying degrees of urban development on all sides of the park, including city streets, residential development, water treatment facilities, an abandoned asphalt plant, a fish hatchery, and both personal and commercial boat use in nearby marine waters.

Fish species selection

Target species were selected by reviewing the existing literature on the fish fauna of the region and target drainages. The literature search included NPS surveys and reports, observations reported in peer-reviewed articles, and the NPS Certified Species List. Local residents, anglers, and NPS staff were also consulted. Based on the literature review and consultation, eight species were identified as

potential study targets: Dolly Varden (*Salvelinus malma*), coho salmon (*Oncorhynchus kisutch*), pink salmon (*Oncorhynchus gorbuscha*), sockeye salmon (*Oncorhynchus nerka*), threespine stickleback (*Gasterosteus aculeatus*), ninespine stickleback (*Pungitius pungitius*), coastrange sculpin (*Cottus aleuticus*), and slimy sculpin (*Cottus cognatus*).

Permits, animal care and use authorizations

The project was permitted to collect eight different species of freshwater fish, varying in life stage, and quantity (e.g. 10 adult pink salmon from each river, 50 juvenile or adult Dolly Varden from each river, etc.; Alaska Department of Fish and Game permit SF2013-227, and NPS permits KLGO-2013-SCI-003 and SITK-2013-SCI-003). Collection, handling and euthanasia practices were approved by UAF IACUC permit 449319-3.

Sample site selection

Prior to the start of field work, a set of potential sampling sites were selected using the following criteria: 1) whether a site was above or below a known or hypothesized barrier to anadromous migration, and 2) the proximity of the site to the access road or trail. Long-term monitoring sites must have reasonable access for field crews to conduct work in an efficient and safe manner. The suitability of these potential sites for long-term monitoring was further assessed on-site by considering habitat conditions such as terrestrial or aquatic vegetation, substrate, water depth, and streamflow.

Sample sites on the Taiya River and West Creek were upstream of some human development such as a campground and a short trail system, but the watershed is largely free of development. The lower portion of the Indian River is influenced by some human development, such as roads and bridges, residential areas, and a water diversion structure. Sampling sites on the lower, anadromous section of the Indian River spanned a range of urban development. Four sites were in the park and downstream of development, while two sites were approximately 300 meters upstream from any of the residential homes, streets, or other direct anthropogenic influences. Sites in the upper watershed were above an apparent anadromous barrier and absent of adult pink salmon during peak migration and spawning time periods.

Trapping and fish handling

Fish were trapped using Gees G-40 minnow traps (22.8 cm x 44.5 cm with 2.5 cm opening) baited with salmon eggs from sockeye salmon or pink salmon. Bait was placed in securely tied small cloth bags. Baited traps were deployed in water depths ranging from 0.3-2.0 m, and tied off to bank vegetation or rocks. Traps were labeled with a plastic tag listing the project, personnel involved, contact information, trap number, and all the applicable permit numbers. Stream characteristics (eddy, backwater, main channel, side channel, slough, lake, pond), habitat (vegetation, woody debris, etc.) and water information (color, odor, substrate type and color) were recorded. Pictures of each trap and the site were taken, along with site coordinates as determined by a handheld GPS device. Traps were left in the water for variable lengths of time based on access logistics. The contents of each trap were emptied into a 2-ga plastic bucket partially filled with river water. All of the fish in a trap were counted, identified to species (species identification was conducted on-site by qualified NPS personnel or a UAF fisheries biologist), then either euthanized and retained for analysis, or

released unharmed. Fish lengths and mass were recorded post-thaw in a laboratory setting at the University of Alaska Fairbanks.

Fish that were retained for contaminant analysis were handled using Nitrile gloves, euthanized by blunt force trauma to the head (following reviewed and approved animal care protocol, UAF IACUC protocol #449319-3), immediately triple-wrapped in Ultra-Clean Supremium Aluminum Foil (VWR International; see Figure 1) and then placed inside Ziplock Freezer bags and placed in a -20°C freezer within 8 hours.

Figure 1. Photos demonstrating sample collection techniques using ultra-clean foil and nitrile gloves.

Results

Dolly Varden, coho salmon, coastrange sculpin, pink salmon, rainbow trout (*Oncorhynchus mykiss*), Pacific staghorn sculpin (*Leptocottus armatus*), and starry flounder (*Platichthys stellatus*) were caught during sampling efforts. Dolly Varden were caught in each river within each park unit.

Klondike Gold Rush National Historical Park

Taiya River

From July 25 to August 2, 2013, we placed 85 traps at 19 different sites, for a total sampling effort of 1,500 trap-hours across all sites (Table 1a). Trapping effort at the thirteen sampling sites located downstream of an apparent anadromous barrier was 805 trap-hours. Trapping effort at the remaining six sites upstream of this apparent barrier was 691 trap-hours (Figures 2 and 3). We caught fish at 11 (85%) of the lower sites (Figure 3, downstream of the apparent barrier) and 0% of the higher sites (Figure 2, upstream of the apparent barrier). Dolly Varden were the most numerous (n=256), followed by coastrange sculpin (n=19), then by juvenile coho salmon (n=7). Some of these fish were retained for contaminant analysis: 14 Dolly Varden (mean weight [range] = 7.9 g [1.0-24.4 g], mean length = 87.5 mm [49.0-132.0 mm]); 19 coastrange sculpin (mean weight = 7.7 g [3.8-14.3 g], mean length = 84.8 mm [69.0-105.0 mm]); 7 juvenile coho (mean weight = 5.2 g [3.5-7.6 g], mean length = 76.9 mm [65.0-88.0 mm]).

During the sampling period, thousands of adult pink salmon were observed in the lower reaches of the river. We observed adult pink salmon as far upstream as Pleasant camp, at approximately mile 7 of the Chilkoot Trail. Ten adult pink salmon were caught by hook and line in the lower reaches of the river on August 5 (mean weight = 1244 g [804-1700 g], mean length = 507 mm [465-560 mm]) and retained for contaminant analysis. Beach seines were also employed for 12 different sets at four sites on the lower Taiya River and the intertidal flats on August 2. Catch was minimal, consisting of six Dolly Varden, four coastrange sculpin, two Pacific staghorn sculpin, and one starry flounder, none of which were retained for contaminant analysis. No catch efforts are reported for the beach seine sampling effort. Habitat and general site information for each of the sites is located in Table 2a.

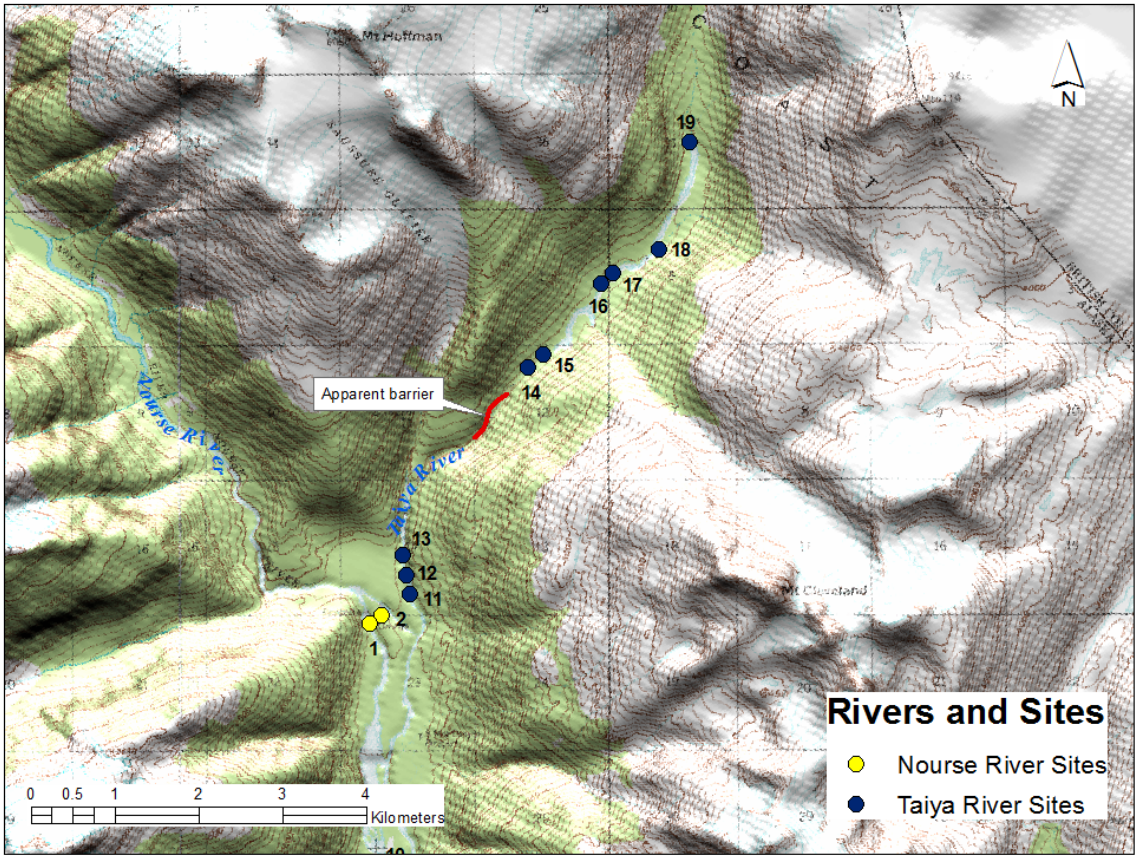

Figure 2. Upper watershed sampling sites in KLGO, including Taiya (blue dots) and Nourse (yellow dots) Rivers.

Nourse River

From July 31 to August 1, we placed 13 traps at two different sites, for a total sampling effort of 246 trap-hours, (Table 1b). We caught one Dolly Varden, which was not retained for analysis and no other fish. One site was located directly on the main channel of the river, which contained very few eddies in which to place traps, had very high velocity water, and did not appear likely to sustain juvenile salmonids. The second site was located in a shallow side channel that appeared to be suitable habitat for juvenile salmonids. However, due to strong diurnal changes in flows, the water dropped 20-30 cm overnight, and we did not catch any fish at that site. During the period of sampling, no adult salmon of any species were observed in the river. Habitat and general site information for each of the sites is located in Table 2b.

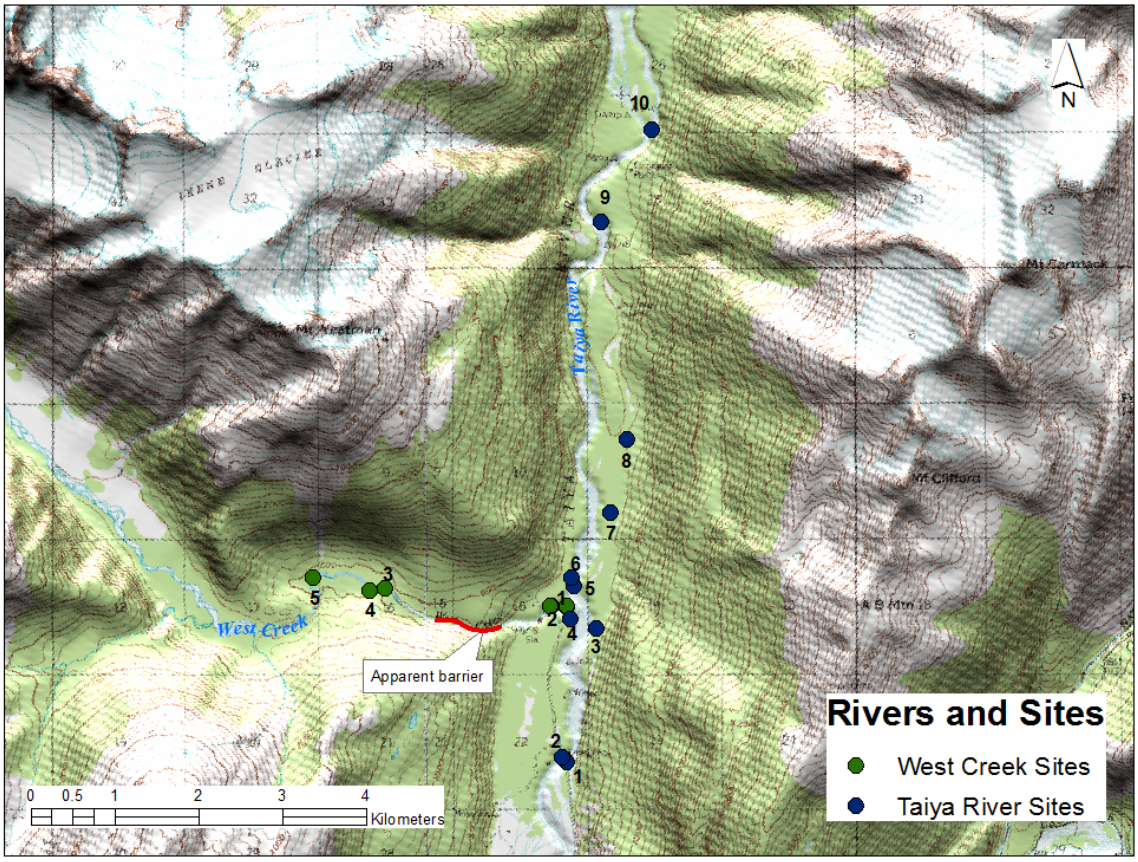

Figure 3. Lower watershed sampling sites in KLGO, including Taiya River (blue dots) and West Creek (green dots).

West Creek

From July 25 to July 28, we placed 24 traps at five different sites, for a total sampling effort of 532 trap-hours, (Table 1c). We caught fish at every site. Trapping effort at the three sites upstream of the apparent barrier was 420 trap-hours. Trapping effort at the two sites downstream of the apparent barrier was 112 trap-hours. Dolly Varden were present at every site and were the only species caught in West Creek (n=64). 36 Dolly Varden were retained for contaminant analysis (12 from downstream of the apparent barrier: mean weight = 5.8 g [1.9-11.7g], mean length = 80.2 mm [60-104 mm]. 24 from upstream of the apparent barrier: 23.7 g [9.5-44.8g], mean length = 131.8 mm [97-162 mm]). During the period of sampling several adult pink salmon were observed in the lower reaches of the river, above and below the road crossing. Habitat and general site information for each of the sites is located in Table 2c.

Figure 4. Representative photos of riverine habitat in KLGO (West Creek: *left picture*-above apparent barrier; *right picture*-below apparent barrier). Note the proximity of the glaciers to the study site, the density of the riparian vegetation, and the glacial silt color of the water.

KLGO sampling summary

Sampling period

July 25 to August 2, 2013

Field participants

Andrew Cyr (field project lead, UAF graduate student), Chris Sergeant (SEAN ecologist), Andres Lopez (UAF assistant professor), Jessica Wilbarger (NPS physical science technician)

Sampling gear

Minnow traps, beach seine, hook and line

Access methods

Vehicle and foot

Sampling sites

20 sites sampled in Taiya River: 19 with minnow traps, 1 with beach seines and hook and line

4 sites sampled along the tidal flats of the Taiya River with beach seines

2 sites sampled with minnow traps in Nourse River

5 sites sampled with minnow traps in West Creek

Table 1a. Trapping effort, fish counts, and catch per unit effort (CPUE) at sample sites on the Taiya River in KLGO (July 25 to August 2, 2013).

				Dolly Varden		Coho		Coastrange Sculpin			
Site	Trap hr	# traps	Total trap hr	Count	CPUE[1]	Count	CPUE[1]	Count	CPUE[1]	Total count	Total CPUE
1	18.9	4	75.7	28	0.4	0	0.0	14	0.2	42	0.6
2	18.9	2	37.8	73	1.9	2	0.1	0	0.0	75	2.0
3	21.8	2	43.7	16	0.4	3	0.1	0	0.0	19	0.4
4	18.4	3	55.1	18	0.3	0	0.0	1	0.0	19	0.3
5	18.2	3	54.5	19	0.3	1	0.0	1	0.0	21	0.4
6	18.1	3	54.3	33	0.6	0	0.0	0	0.0	33	0.6
7	23.3	3	70.0	22	0.3	1	0.0	0	0.0	23	0.3
8	21.4	4	86.3	0	0.0	0	0.0	0	0.0	0	0.0
9	21.6	3	64.7	19	0.3	0	0.0	3	0.0	22	0.3
10	0.6	4	2.3	0	0.0	0	0.0	0	0.0	0	0.0
11	19.9	5	99.4	10	0.1	0	0.0	0	0.0	10	0.1
12	20.1	5	100.5	5	0.0	0	0.0	0	0.0	5	0.0
13	20.2	3	60.6	8	0.1	0	0.0	0	0.0	8	0.1
14	19.2	7	134.2	0	0.0	0	0.0	0	0.0	0	0.0
14 (2)	18.0	5	90.0	0	0.0	0	0.0	0	0.0	0	0.0
15	17.2	5	85.8	0	0.0	0	0.0	0	0.0	0	0.0
15 (2)	18.9	5	94.6	0	0.0	0	0.0	0	0.0	0	0.0
16	15.4	5	77.1	0	0.0	0	0.0	0	0.0	0	0.0
17	16.1	5	80.5	0	0.0	0	0.0	0	0.0	0	0.0
18	14.9	5	74.4	0	0.0	0	0.0	0	0.0	0	0.0
19	13.6	4	54.4	0	0.0	0	0.0	0	0.0	0	0.0

trapping effort: mean=71.2 hr/site; SD=27.4 hr; range=2.3 hr-134.2 hr

[1] CPUE = # fish per trap-hour fished

Table 1b. Trapping effort, fish counts, and catch per unit effort (CPUE) at sample sites on the Nourse River in KLGO (July 31 to August 1, 2013).

				Dolly Varden		Coho		Coastrange Sculpin			
Site	Trap hr	# traps	Total trap hr	Count	CPUE[1]	Count	CPUE[1]	Count	CPUE[1]	Total count	Total CPUE
1	19.60	3	58.8	1	0.0	0	0.0	0	0.0	1	0.0
2	18.70	10	187.3	0	0.0	0	0.0	0	0.0	0	0.0

[1] CPUE = # fish per trap-hour fished

Table 1c. Trapping effort, fish counts, and catch per unit effort (CPUE) at sample sites on West Creek in KLGO (July 25 to July 28, 2013).

				Dolly Varden		Coho		Coastrange Sculpin			
Site	Trap hr	# traps	Total trap hr	Count	CPUE[1]	Count	CPUE[1]	Count	CPUE[1]	Total count	Total CPUE
1	18.5	3	55.6	8	0.1	0	0.0	0	0.0	8	0.1
2	18.8	3	56.3	24	0.4	0	0.0	0	0.0	24	0.4
3	19.3	6	115.5	16	0.1	0	0.0	0	0.0	16	0.1
4	19.8	6	118.6	10	0.1	0	0.0	0	0.0	10	0.1
5	31.0	6	186.0	6	0.0	0	0.0	0	0.0	6	0.0

trapping effort: mean=106.4 hr/site; SD=54.0 hr; range=55.6 hr-186.0 hr

[1] CPUE = # fish per trap-hour fished

Table 2a. Site coordinates (WGS84) and descriptions for the Taiya River in KLGO.

Site	Latitude	Longitude	Barrier	Description
1	59° 30'42.7"	135° 20'48.5"	Below	Main channel of the Taiya River, at the road bridge, river left. Muddy and silty water with sand and boulder substrate (rip rap side banks).
2	59° 30'44.5"	135° 20'50.8"	Below	Main channel of the Taiya River, at the road bridge, river right. Muddy and silty water with sand and mucky substrate.
3	59° 31'30.0"	135° 20'27.3"	Below	Small back water channel of the Taiya River, with muddy and silty water, and some overhanging vegetation.
4	59° 31'37.3"	135° 20'45.6"	Below	Eddy in the main channel of the Taiya River, ~300 m downstream from confluence with West Creek. Muddy and silty water, with sand and gravel substrate. Both small and large woody debris, with overhanging bank vegetation.
5	59° 31'51.1"	135° 20'42.4"	Below	Main channel of the Taiya River, ~300 m upstream from confluence with West Creek. Muddy and silty water, with muck and sand substrate.
6	59° 31'51.7"	135° 20'42.8"	Below	Eddy in a side channel of the Taiya River, ~350 m upstream from the confluence with West Creek. Muddy and silty water, with muck and sand substrate. Large woody debris and overhanging vegetation.
7	59 32'18.7"	135 20'15.3"	Below	Small side channel of the Taiya River, muddy and silty water with overhanging vegetation.
8	59° 32'52.9	135° 19'59.9"	Below	Beaver pond complex, brown/red water, mucky substrate, large and small woody debris.
9	59° 34'08.9"	135° 20'14.6"	Below	Small, swift moving tributary to the Taiya River, silty water, sand and cobble substrate with overhanging vegetation.
10	59° 34'49.2"	135° 19'38.5"	Below	Small, slow side channel of Taiya River, at trail bridge crossing, mucky and leaf litter substrate, large woody debris and overhanging vegetation.
11	59° 36'38.4"	135° 19'40.0"	Below	Small eddies on the main channel of the Taiya River at the Canyon City bridge, muddy and silty water with cobble and boulder substrate, overhanging vegetation.
12	59° 36'46.1"	135° 19'44.8"	Below	Shallow water and small eddies on the main channel of the Taiya River ~0.5 km above Canyon City at base of the steps, sand and cobble substrate with overhanging vegetation.
13	59° 36'56.7"	135° 19'43.0"	Below	Small eddies on the main channel of the Taiya River ~1 km above Canyon City, ~50 m downhill, muddy and silty water with sand and cobble substrate, large woody debris and overhanging vegetation.
14	59° 38'08.8"	135° 17'56.6"	Above	Eddy in the main channel of the Taiya, 3.2 km above Canyon City. Silty water with cobble and boulder substrate, and overhanging vegetation.
15	59° 38'12.8"	135° 17'48.8"	Above	Log jam on a side channel of the Taiya River at Pleasant Camp. Silty water with mud and mucky substrate. Large and small woody debris.
16	59° 38'39.4"	135° 16'59.9"	Above	~Mile 12 of the trail (km 19.3), on a side channel of the Taiya River, at a log jam, muddy and silty water with sand and mucky substrate, large woody debris and overhanging vegetation.
17	59° 38'34.2"	135° 17'14.8"	Above	Main channel of the Taiya River, between mile 11 and 12 of the trail (km 17.7-19.3), muddy and silty water, large woody debris and overhanging vegetation.
18	59° 38'48.0"	135° 16'33.3"	Above	Small backwater eddy of the Taiya River, muddy and silty water, with overhanging vegetation.
19	59° 39'24.3"	135° 16'03.9"	Above	Small eddies on the main channel of the Taiya River directly in front of Sheep Camp ranger's station, muddy and silty water, cobble and boulder substrate.

Table 2b. Site coordinates (WGS84) and descriptions for the Nourse River in KLGO.

Site	Latitude	Longitude	Barrier	Description
1	59° 36'25.6"	135° 20'11.7"	Below	Small eddies on the main channel of the Nourse River, high velocity muddy and silty water with minimal overhanging vegetation.
2	59° 36'28.7"	135° 19'56.4"	Below	Small side channel of the Nourse River, muddy and silty water, sand and mucky substrate, overhanging vegetation. Strong diurnal flow rates. Channel was conveying 75% less water the following morning.

Table 2c. Site coordinates (WGS84) and descriptions for West Creek in KLGO.

Site	Latitude	Longitude	Barrier	Description
1	59° 31'42.7"	135° 20'52.6"	Below	Large eddy in the main channel of West Creek, ~100 m from the confluence with the Taiya River, muddy and silty water, sand and cobble substrate.
2	59° 31'43.7"	135° 20'56.7"	Below	Small eddies on main channel of West Creek, river left, ~50 m upstream of road bridge, muddy and silty water, sand and boulder substrate with overhanging vegetation.
3	59° 31'52.2"	135° 23'26.2"	Above	Small backwater eddy of the main channel of West Creek, muddy and silty water, sand and mucky substrate with overhanging vegetation.
4	59° 31'49.7"	135° 23'05.9"	Above	At West Creek foot bridge, main channel, muddy and silty water, cobble and boulder substrate with overhanging vegetation.
5	59° 31'53.1"	135° 24'01.2"	Above	Near the end of the road along West Creek, muddy and silty water, sand, cobble and mucky substrate with small woody debris and minimal overhanging vegetation.

Sitka National Historical Park

During the mid-August sampling period, pink salmon were observed migrating and spawning in the river. They were observed in great numbers in each pool and riffle for the length of the first 3-4 miles of the river. The water levels were low during the sampling period, which further concentrated the salmon. The river was accessible along the Indian River Trail, leading up to a waterfall near the headwaters, which marked the three most upstream sampling sites (7-9) of the project. We were able to follow the distribution of the adult pink salmon along the length of the river, and did not observe any at the most upstream sampling sites (7-9). Immediately below Site 7, we found an apparent barrier (a 2-3 m high natural log jam with water trickling through the debris but not over the top). Site 9 was above a large waterfall and definite migration barrier approximately 20 m high.

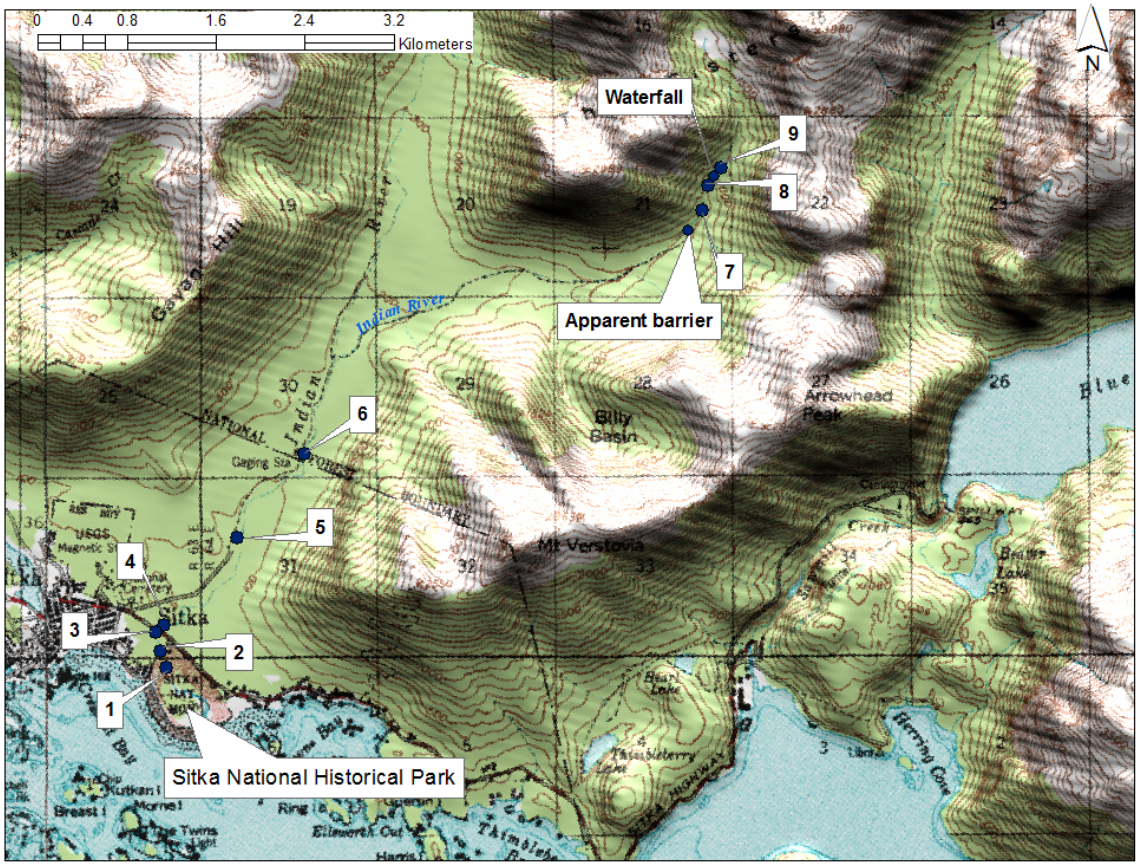

Figure 5. Sampling site locations in Indian River (SITK).

From August 14 to August 17, we placed 76 traps in 9 different sites, for a total sampling effort of 1,469 trap-hours (Table 3). One trap was vandalized during its deployment period. It was pulled from the water, causing mortality of several fish that had previously been captured. These mortalities were retained for contaminants analysis. We caught fish at all sites except Site 9, the most upstream sampling site and the only one upstream of a large waterfall. Dolly Varden were abundant at all sites that yielded fish (n=714). Coho salmon were present at the six lower sites (n=202), rainbow trout/cutthroat trout were present in four of the lowest six sites (n=83), and coastrange sculpin were present in low numbers in the lowest four sites (n=15). Some of the fish caught were retained for contaminant analysis: 54 Dolly Varden (mean weight = 17.9 g [0.8-52.8 g], mean length = 112.1 mm [46-174 mm]); 40 coho salmon (mean weight = 3.6 g [0.7-10.9 g], mean length = 65 mm [43-93 mm]); 4 rainbow trout (mean weight = 14.9 g [7.3-35.0 g], mean length = 104.3 mm [87-150 mm]); 15 coastrange sculpin (mean weight = 5.3 g [1.1-12.0 g], mean length = 76.9 mm [48-114 mm]); and 1 unknown salmonid (13.9 g; 110 mm). Ten adult pink salmon were caught with hook and line at Site 5 on August 14 (mean weight = 1260 g [849-1542 g]; mean length = 490 mm [420-530 mm]). Habitat and general site information for each of the sites is presented in Table 4.

Figure 6. Representative photo of riverine habitat in SITK (left) and fish captured in minnow trap (right).

SITK sampling summary

Sampling period

August 14 to August 17, 2013

Field participants

Andrew Cyr (field project lead, UAF graduate student), Chris Sergeant (SEAN ecologist), Emily Noyd (University of Washington intern at SITK), Steve Bryan (NPS volunteer)

Sampling gear

Minnow traps, hook and line

Access methods

Vehicle and foot

Sampling sites

Nine sites sampled with minnow traps on Indian River, one of the nine sites also sampled with hook and line

Table 3. Trapping effort, species counts, and catch per unit effort (CPUE) at sample sites on the Indian River in SITK (August 14 to August 17, 2013).

				Dolly Varden		Coho		Rainbow trout		Coastrange Sculpin			
Site	Trap hr	# traps	Total trap hr	Count	CPUE[1]	Count	CPUE[1]	Count	CPUE[1]	Count	CPUE[1]	Total count	Total CPUE
1	24.3	5	121.3	27	0.2	52	0.4	22	0.2	1	0.0	**102**	**0.8**
2	22.8	4	91.2	5	0.1	3	0.0	0	0.0	4	0.0	**12**	**0.1**
3	22.2	4	88.7	74	0.8	2	0.0	30	0.3	1	0.0	**107**	**1.2**
4	10.0	10	100.0	121	1.2	12	0.1	12	0.1	9	0.1	**153** [2]	**1.6**
5	22.2	15	333.5	147	0.4	129	0.4	10	0.0	0	0.0	**286**	**0.9**
6	18.0	10	180.0	85	0.5	4	0.0	9	0.1	0	0.0	**97**	**0.5**
7	19.8	8	158.3	56	0.4	0	0.0	0	0.0	0	0.0	**56**	**0.4**
8	20.1	15	300.8	199	0.7	0	0.0	0	0.0	0	0.0	**199**	**0.7**
9	19.1	5	95.3	0	0.0	0	0.0	0	0.0	0	0.0	**0**	**0.0**

trapping effort: mean=163.2 hr/site; SD=93.1 hr; range=88.7 hr-333.5 hr

[1] CPUE = # fish per trap-hour fished

[2] 1 unknown fish caught at Site 5, possibly a cutthroat trout

Table 4. Site coordinates (WGS84) and descriptions for the Indian River in SITK.

Site	Latitude	Longitude	Barrier	Description
1	57° 02'59.7"	135° 19'03.6"	Below	~300 meters downstream of road bridge, within SITK park boundaries. Site was dominated by cobble and gravel with some small boulders, and large woody debris.
2	57° 03'02.6"	135° 19'04.2"	Below	~100 meters downstream of road bridge, within SITK park boundaries. Site was dominated by cobble and gravel with some small boulders.
3	57° 03'07.7"	135° 19'07.7"	Below	Just below road bridge, within SITK park boundaries. Site was dominated by cobble and gravel with some small boulders.
4	57° 03'10.0"	135° 19'03.0"	Below	Site of downstream water quality meter and stream gauge, 50 meters above road bridge. Site was dominated by cobble and gravel with some small boulders, large woody debris, and overhanging vegetation.
5	57° 03'34.9"	135° 18'24.1"	Below	200 meters above "urban influence", above location of the stream diversion and the end of city streets. Site was dominated by cobble and gravel with some small boulders, and large woody debris.
6	57° 04'03.0"	135° 17'44.1"	Below	At location of upstream stream gauge, ~2.4 km upstream from bridge. Site was dominated by cobble and gravel with some small and large boulders, numerous pieces of large woody debris, and overhanging vegetation.
7	57° 05'15.0"	135° 14'11.5"	Above	~300 meters below waterfall, no pink salmon observed here. The river was small here, with many small pools, and overhanging vegetation. The site was dominated by cobble and gravel with abundant small boulders and both large and small woody debris.
8	57° 05'17.1"	135° 14'12.8"	Above	At, and below waterfall, above a clear anadromous barrier, no pink salmon observed here. The river was very small here, with little water conveyance, many small pools, and overhanging vegetation. The site was dominated by cobble and gravel with abundant small boulders and both large and small woody debris.
9	57° 05'21.5"	135° 14'09.4"	Above	10-15 meters above the waterfall, no potential for pink salmon to migrate here. The river was very small, dominated by tangled woody debris with a bare rock and gravel substrate.

Discussion

The field work conducted during the summer of 2013 contributed to knowledge of the presence and distribution of fish species across the rivers studied and was an important step to advance the development of the SEAN freshwater contaminants monitoring program. The primary objective of identifying suitable sampling sites and determining the presence and abundance of appropriate species was accomplished during this field session. Across both parks, one fish species, Dolly Varden, was collected from all rivers, including at locations above and below apparent anadromous barriers in two of the rivers. Several additional species were also caught and retained for contaminants analysis to provide additional qualitative information regarding detectable contaminants in these systems. In summary, we collected specimens from each of the four locations within the research question framework: glacial river, above anadromous barrier; glacial river, below anadromous barrier; non-glacial river, above anadromous barrier; non-glacial river, below anadromous barrier.

Additional objectives including exploring site access, study site selection, and validation of field collection methods as proof of principle were also met. Species presence and distribution data will be paired with future contaminant analyses to examine whether salmon and glacial melt influence contaminant concentrations within these freshwater biota.

Next steps

Lab work has been ongoing since completion of field work. At the time of preparation of this report, all fish have been processed through the preliminary stages of laboratory analysis. Each specimen has been photographed to validate species identification, and basic morphometric measurements have been taken and recorded (length and mass). Individual fish with uncertain species identification had fin clip samples removed for further genetic-based species identification. Due to anticipated inconsistencies in the content of and quality of sample preservation between individuals, all organs of the viscera were removed. Otoliths were extracted from all pink salmon, coho salmon, Dolly Varden and rainbow trout specimens, but not from the sculpins.

Dolly Varden lengths and masses varied greatly, suggesting the presence of more than one age cohort. This could directly affect the contaminants concentrations among individuals, with larger, older fish feeding at higher trophic levels and potentially having higher contaminants concentrations than smaller, younger fish. Age estimation and classification could provide a method of standardization for contaminant concentrations assessment for a species. The possibility of completing carbon and nitrogen stable isotope analysis on muscle for a subsample of the fish will also be considered. This analysis could provide valuable insight into potential differences in trophic levels and feeding dynamics within species, between the different fish species, sample sites, and rivers.

Specimens will either be homogenized individually for larger fish or in pools of individuals for smaller fish. The homogenates will then be prepared for detection and quantification of a suite of inorganic (mercury, lead, arsenic, nickel, cadmium, copper, zinc) and organic contaminants (several

PCBs, PBDEs, current-use and legacy pesticides, etc.) using Atomic Absorption spectroscopy (AA), a Direct Mercury Analyzer (DMA80), and Gas Chromatography - Mass Spectrometry (GC/MS).

Approximately 45 Dolly Varden samples were collected from three watersheds in GLBA in 2012 and will also be analyzed in the near future. These analyses may provide sufficient information to move forward with protocol development for Glacier Bay without additional sample collection.

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