Research Proposal

Sitka National Historical Park (SITK)

Sitka, Alaska

Pink and Chum Salmon

Estimation of Stray Rates of Pink and Chum Salmon into the Indian River, Sitka National Historical Park

NATIONAL PARK SERVICE (NPS)

Liv Magni, Biologist, Sitka National Historical Park, 105 Monastery Street, Sitka, Alaska 99835

Abstract

Sitka National Historical Park is implementing a study with the intent of better understanding the rate of straying of pink and chum salmon from the Sheldon Jackson hatchery (SJH) into the Indian River. In 2012 the percentage of fish thermally marked as originating in the SJH that spawned in the Indian River varied between 3% and 8%, and in 2019 varied between 0% and 97% depending upon sampling period. The goal of this study is to supplement existing sampling by SJH and evaluate if the timing of sampling changes the inference of rates of straying and compare fish origin (hatchery vs natural spawners) to prespawn mortality.

Beginning June 1, SITK biologist will walk the Indian River recording the number of live and senescent dead pink and chum salmon. Presence of senescent dead salmon commences biological sampling which includes species, sex, length, otoliths and prespawn mortality. Biological sampling will occur once a week at six locations along the Indian River: three above and below the pedestrian footbridge. A crew of Student Conservation Interns (3) will assist the Park's Biologist in biological sampling of senescent dead salmon throughout the duration of the run. GPS established transects for sampling locations provide an estimate of spatial variability, such as occupancy of fish above and below the pedestrian footbridge, can be attributed to each pair of collected otoliths. Trays of otoliths prepared on site will be packed into a cooler and shipped back to Juneau to the MARK lab. The Alaska Dept Fish and Game will also be provided with the metadata indicating the location of each otolith collection.

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Overview

Statement of Issue

The National Park Service is charged with maintaining natural populations of fish and wildlife. The SITK General Management Plan lists the following goals: insure that "ecological processess and conditions associated with the Indian River…are protected." Maintain "…a healthy viable river and riparian system that sustains wildlife populations". Maintain "water quality and minimum streamflows needed to sustain the dependent biota of the Indian River, particularly native fish populations" and the Park will "…develop a monitoring program for anadromous fish and monitor the proportion of hatchery fish present in the river at different times of the year…" (NPS, 2012)

Salmon constitute an important resource linkage between the ocean and freshwater and terrestrial ecosystems by delivering vital marine derived nutrients. Pink and Chum salmon in SITK use the Indian River for migration, spawning and incubation of eggs, and rearing of young (NPS 2009). Straying of hatchery salmon may be disruptive to wild populations for a variety of reasons; a few generations of artificial breeding and rearing of salmon in a protected environment can lead to domestication, altered gene frequencies, and phenotypic changes that reduce the adaptive fitness of wild populations (Fleming and Gross 1993; Berejikian et al. 2001; Myers et al. 2004; Mobrand et al. 2005; Araki et al. 2007; Naish et al 2007; Araki et al. 2008; Grant 2012)

Prior to the establishment of Sheldon Jackson Hatchery, located adjacent to SITK, peak escapement of pink salmon in the Indian River was stable from year to year at about 500 fish. In 1977, two years after the establishment of the hatchery, pink salmon escapement jumped to 17,500, coincidental with the first return of hatchery-raised fish. Since then, escapement has been variable from year to year, peaking above 400,000 in years of high abundance but much less in other years. Increases in chum, coho and king salmon also occurred. Today, evidence suggest that the defunct Sheldon Jackson Hatchery (now Sitka Sound Science Center) contributes to the high abundance of salmon in the Indian River. First, the exponential increase in pink salmon coincide with hatchery operations. Second, Sheldon Jackson Hatchery has raised and released over 3,000,000 pink salmon fry for four decades. Three, Sheldon Jackson Hatchery took salmon from Indian River for broodstock. Four, Sheldon Jackson Hatchery diverts water from the Indian River to use for hatchery operations. Five, pink salmon have the highest observed stray rate, and the Sheldon Jackson hatchery and Indian River are adjacent.

Literature Summary

Inter-Fluve Inc (2019) Sitka Sound Science Center (SSSC) in partnership with the U.S. Fish and Wildlife Service (USFWS) contracted Inter-Fluve to conduct a geomorphic assessment of the Indian River in the vicinity of the boulder dam diverting flow to the SSC fish hatchery, identify alternatives for improved sediment transport and fish passage through the Sheldon Jackson Hatchery diversion reach of Indian River.

Paustin et al. (2018) brought stakeholders together to develop a feasible watershed management strategy and develop a prioritized list of action items to improve watershed stewardship and accomplish restoration objectives.

Haven (2019) collected otoliths from pink and chum salmon to better understand straying from Sheldon Jackson Hatchery into the Indian River, Sitka National Historical Park

Sergeant et al. (2017) using field observation and modeling, investigated the relationship between density of salmon and flow flows, and these variables contributing to hypoxic events in the Indian River, Sitka National Historical Park

Gende (2015) collected otoliths from pink and chum salmon to better understand straying from Sheldon Jackson Hatchery into the Indian River, Sitka National Historical Park

NPS (2011) described streamflow characteristics of the Indian River and historical diversion by the Seldon Jackson Hatchery. Estimations of diversions from the Indian River by Sitka Sound Science Center as well analysis of the diversions, particularly if reported values of water use matched field observations.

Eckert et al. (2006) summarized and analyzed data obtained on fish and macroinvertebrates from the Neal et al. (2004) report.

Brewer (2001) fish trapping efforts in the Indian River near the Sheldon Jackson dam found juvenile coho salmon, rainbow trout, and Dolly Varden. The diversion trapping efforts found juvenile coho salmon, chinook salmon, Dolly Varden, and rainbow trout. Length frequencies of Coho and Dolly Varden juvenile fish were also determined.

Paustian and Hardy (1995) measured channel morphology, described streambed characteristics, and evaluated fish habitat using a hierarchical stream habitat classification.

Nadeau and Lyon (1987) Identified in-stream flow requirements of salmon, assessed potential impacts of dewatering events, and investigated alternatives to mitigate adverse impacts to fishery resources caused by the withdrawal of water.

Scope of the Study

Indigenous people and salmon in the lands now called Alaska have been intertwined for at least 12,000 years. Salmon continue to be a central way of life for the Alaska Natives, contributing to the physical, social, cultural, spiritual, and physiological well-being. Expeditions to the Pacific Northwest in the first half of the nineteenth century explained with great excitement the abundance by of fish. In the 1970s, salmon catches were among the lowest since 1900. In 1972, Article 8, section 15 of Alaska's Constitution was amended to bolster hatcheries to recover the state's fish economy. Statewide annual harvest averaged 20 million salmon in the 1970s. Today, statewide annual harvest average 180 million salmon. Straying of hatchery salmon may be disruptive to wild populations for a variety of reasons; a few generations of artificial breeding and rearing of salmon in a protected environment can lead to domestication, altered gene frequencies, and phenotypic changes that reduce the adaptive fitness of wild populations (Fleming and Gross 1993; Berejikian et al. 2001; Myers et al. 2004; Mobrand et al. 2005; Araki et al. 2007; Naish et al 2007; Araki et al. 2008; Grant 2012)

Intended Use of Results

Results of this study will be used to inform SITK of anadromous fish populations in the Indian River to improve park managers ability to effectively manage fish populations. Relevant stakeholders of the Indian River, including but not limited to: Sitka Tribe of Alaska, Sitka Sound Science Center, Alaska Department of Fish and Game, City and Borough of Sitka, Sitka Ranger District and the Alaska Raptor Center will be notified of the results of this study.

Objectives/Hypotheses to be Tested

1. Characterize the proportion of pink and chum salmon of wild and hatchery origin returning to the Indian River, using the presence of hatchery created thermal otolith marks (assuming that thermal marks are visible) to identify fish stocks

2. Characterize any spatial and temporal variability in the proportion of returning wild and hatchery pink and chum salmon between:
   a. Upstream and downstream
   b. Early and late season

3. Characterize any spatial and temporal variability in the proportion of returning wild and hatchery pink and chum salmon that experience prespawn mortality

Methods

Description of the Study Area

Six 1600-m^2 river transects, equally spaced and randomly selected, are surveyed for anadromous pacific salmon carcasses within Indian River in Sitka National Historical Park. Transects upstream of the pedestrian footbridge are accessible by the River View Trail while downstream, transects are accessible by the Russian Memorial Loop.

GPS Locations of Transects						
Transect	1	2	3	4	5	6
Point 1	57.052160, -135.318331	57.051092, -135.317989	57.050005, -135.317310	57.049113, -135.316640	57.048029, 135.315652	57.046966, -135.314314
Point 2	57.051991, -135.318314	57.050916, -135.317982	57.049829, -135.317313	57.048936, -135.316647	57.047862, 135.315641	57.046785, -135.314331
Point 3	57.051992, -135.318639	57.050905, -135.318299	57.049916, -135.317473	57.048940, -135.316960	57.047861, 135.315966	57.046783, -135.314637
Point 4	57.052160, -135.318635	57.051079, -135.318294	57.050013, -135.317643	57.049109, -135.316969	57.048037, 135.315963	57.046959, -135.314638
Center	57.052073, -135.318488	57.051000, -135.318147	57.050005, -135.317310	57.049113, -135.316640	57.047951, 135.315814	57.046874, -135.314481
Footbridge	Upstream			Downstream		

Procedures

Field

Pink and Chum salmon carcasses will be surveyed for biological data in Sitka National Historical Park in the Indian River. Six transects, three above and below the pedestrian footbridge, will be sampled for biological data including sex, length, prespawn mortality and otoliths. Otoliths will be extracted each week from 60 pink and chum salmon for a total of 120 sampled fish. Adipose fin clip will be sampled by noting the full/partial absence of adipose fin due to hatchery origin. Length of salmon will be determined by placing snout of fish to the end of length board and measuring the post hypural length to the nearest millimeter; length will be measured in this way due to caudal fin fray as due to spawn. Prespawn mortality will be recorded by the presence or absence of eggs. Estimates of egg retentions in carcasses will not recorded. For example, “50% of eggs were spawned”. The surveyor will only record the presence or absence of prespawn mortality. In this study, presence of prespawn mortality is defined as the remainder of all or mostly all the eggs (75% >).

Laboratory

Salmon otoliths are extracted, cleaned, and stored with ethanol in a vial with a unique sample ID. Otoliths will be stored in a cool, dry place until shipped to ADG&G Mark & Tag lab where samples will be destroyed during processing. Hatchery or natural origin salmon will be determined by the presence or absence of a thermal mark on the fish’s otolith or inner ear bone. Thermal otolith marking is done by alternating warmer and colder incubation water over about a three-to-six-day period, usually during the egg stage. This procedure will lay down alternately dark and light rings on the fish’s ear bone (called the otolith), similar to rings on a tree. Naturally spawned salmon will have less distinct marks that lack regularly spaced intervals. Fish can be marked with different patterns of thermal marks, allowing for stock separation among hatcheries or even release locations.

Collections

Salmon otoliths are extracted, cleaned, and stored with ethanol in a vial with a unique sample ID. Otoliths will be stored in a cool, dry place until shipped to ADG&G Mark & Tag lab where samples will be destroyed during processing.

Analysis

Hatchery or natural origin salmon will be determined by the presence or absence of a thermal mark on the fish’s otolith or inner ear bone. Thermal otolith marking is done by alternating warmer and colder incubation water over about a three-to-six-day period, usually during the egg stage. This procedure will lay down alternately dark and light rings on the fish’s ear bone (called the otolith), similar to rings on a tree. Naturally spawned salmon will have less distinct marks that lack regularly spaced intervals. Fish can be marked with different patterns of thermal marks, allowing for stock separation among hatcheries or even release locations. Otoliths will provide estimate of the 1) proportion of pink and chum salmon of hatchery and natural origin returning to the Indian River 2) temporal or spatial trends associated with hatchery and natural origin pink and chum salmon and the 3) proportion of hatchery to natural origin pink and chum salmon that experience prespawn mortality. In the past, SJH has had some difficulty producing consistent and easily identifiable marks. However, in 2011 a new marking procedure was adopted, resulting in a more dependable otolith mark.

Schedule

Fieldwork will start prior and end after salmon spawn to ensure the entirety of the run is sampled. Fieldwork is anticipated to begin early June and end late November.

Budget

Budget of project varies depending on available funding for otoliths to be processed by ADF&G. Below is an inventory of gear associated with the project.

Project Inventory & Budget Considerations	
Line-Item	Quantity
Transect flags	10
Garmin 76scx	1
50-meter tape measure	2
ADFG otolith well plate	20
Filet Knives	4
Otolith tweezers	4
Length board (mm)	4
Line (fish collection)	4
Waders	4
Wader boots	4
Hi-Vis Vest	4
Knee pads	4
Waterproof gloves	8
Rite-in-the-Rain Paper for data sheets	100
Waterproof tablet case	2
Personal Flotation Device	4
Bear Spray	4
ADFG Otolith processing	1200

Products

Publications and Reports

An annual report will be generated and accompany a NPS Investigator's Annual Report form.

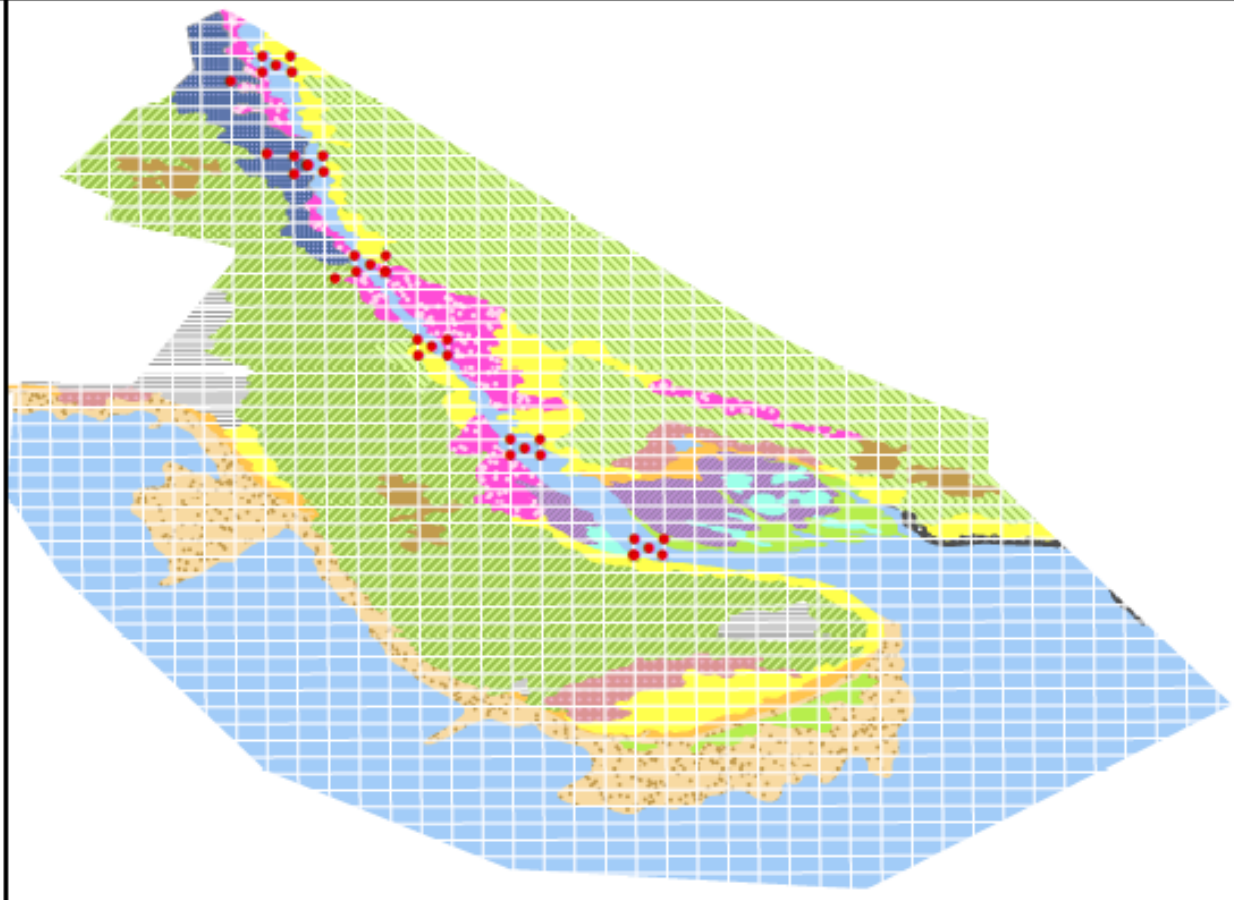
Collections

No collections will produce, as samples will be destroyed during processing.

Sitka National Historical Park

Transect Locations of Pacific Salmon Carcass Surveys

Alaska Region
National Park Service
U.S. Department of the Interior



Legend

- Transect Locations - Fishnet Grid
- Developed
- Cobble Beach
- Rockweed Intertidal
- Nootka Alkaligrass Tidal Flat
- Lyngbye's Sedge Tidal Marsh
- Tufted Hairgrass - Pacific Silverweed Halophytic Wet Meadow
- American Dunegrass - Large Umbel Coastal Meadow
- Red Alder / Salmonberry Riparian Forest
- Red Alder / Sitka Spruce / Salmonberry Forest
- Sitka Spruce - Western Hemlock / Red Alder / Salmonberry Forest
- Sitka Spruce - Western Hemlock / Devil's Club Forest
- Western Hemlock - Sitka Spruce / Blueberry Species Forest
- Western Hemlock - (Sitka Spruce) / Depauperate Forest
- Western Hemlock / Blueberry Species Forest
- Water

0 87.5 175 350 Meters

Description of the Study Area

Transect 1

Transect 1 is located downstream of the Sawmill Creek Road Bridge, and upstream of the footbridge. The right bank riparian zone is composed of Red Alder / Salmonberry Forest while the left bank contains Red Alder / Sitka Spruce / Salmonberry forest. Deep pools and large cobble / boulders occur in this section. A gravel bar is present on the left bank.

Transect 1 Coordinates:

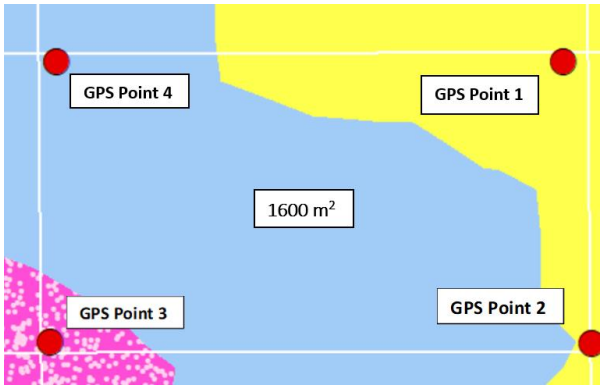
Point 1: 57.052160, -135.318331

Point 2: 57.051991, -135.318314

Point 3: 57.051992, -135.318639

Point 4:57.052160, -135.318635

Center: 57.052073, -135.318488



Transect 2

Transect 2 is located downstream of the Sawmill Creek Road Bridge, and upstream of the footbridge. Transect coordinates are as follows; point 1, point 2, point 3, point 4 and center. The right bank riparian zone is composed of Red Alder / Salmonberry Forest while the left bank contains Red Alder / Sitka Spruce / Salmonberry forest. Downed trees and slouched banks occur in this reach due to erosion. A 20-meter stretch of mostly dewatered cobble / boulder occurs in this reach.

Transect 2 Coordinates:

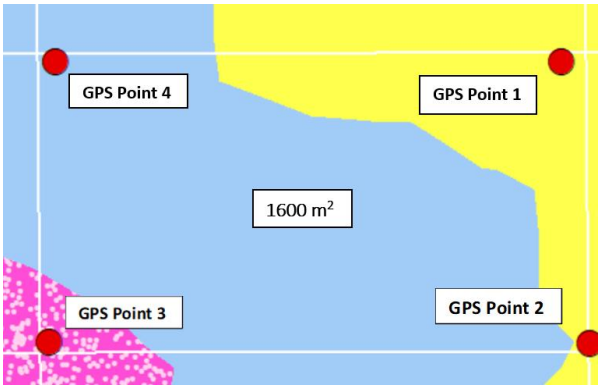
Point 1: 57.051092, -135.317989

Point 2: 57.050916, -135.317982

Point 3: 57.050905, -135.318299

Point 4: 57.051079, -135.318294

Center: 57.051000, -135.318147



Transect 3

Transect 3 is located downstream of the Sawmill Creek Road Bridge, and upstream of the footbridge. The right and left bank riparian zone is composed of Red Alder / Salmonberry Forest. Downed wood in this reach resulted in erosion occurring upstream on the east bank of the river. A deep pool occurs on the right bank alongside downed wood.

Transect 3 Coordinates:

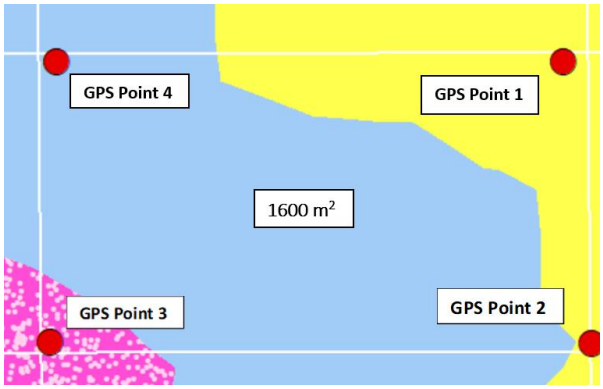
Point 1:57.050005, -135.317310

Point 2: 57.049829, -135.317313

Point 3: 57.049916, -135.317473

Point 4: 57.050013, -135.317643

Center: 57.050005, -135.317310



Transect 4

Transect 4 is located downstream of the footbridge. The right bank riparian zone is composed of Red Alder / Sitka Spruce Forest while the left bank contains Red Alder / Salmonberry Forest. A large gravel bar, resulting from a root wad, has formed in the middle of the river's channel. A deep pool has scoured in front of the rootwad where salmon find cold water refugee compared to most of the river which has a uniformly shallow depth during summer months. Transect 4 water can be brackish.

Transect 4 Coordinates:

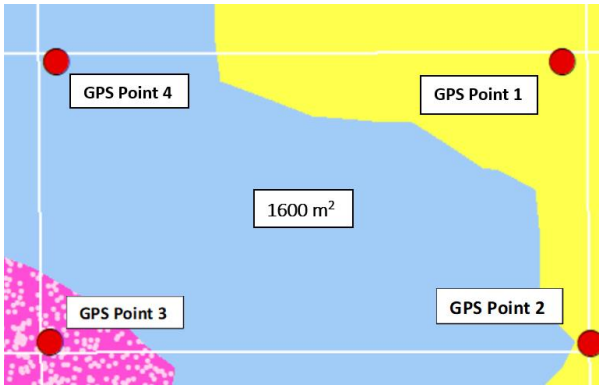
Point 1: 57.049113, -135.316640

Point 2: 57.048936, -135.316647

Point 3: 57.048940, -135.316960

Point 4: 57.049109, -135.316969

Center: 57.049113, -135.316640



Transect 5

Transect 5 is located downstream of the footbridge. The right bank riparian zone is composed of Red Alder / Salmonberry forest while the left bank contains Red Alder / Sitka Spruce forest. Gravel bars occur on either bank. River channel is slightly deeper than other sections of the river due to the funneling of water. Downed trees occur in this river reach due to erosion which resulted from a deconstructed Navy bridge that remains in the river. Transect 5 is within the estuary.

Transect 5 Coordinates:

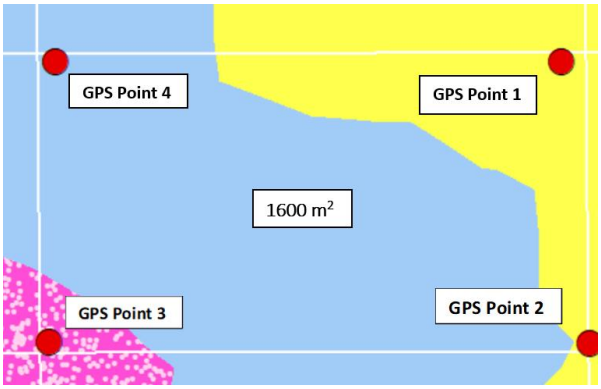
Point 1: 57.048029, -135.315652

Point 2: 57.047862, -135.315641

Point 3: 57.047861, -135.315966

Point 4: 57.048037, -135.315963

Center: 57.047951, 135.315814



Transect 6

Transect 6 is located downstream of the footbridge. Transect coordinates are as follows; point 1, point 2, point 3, point 4 and center. The right bank riparian zone is composed of Red Alder / Sitka Spruce Forest while the left bank contains Nootka Alkali grass tidal flat. Transect 6 is within the estuary. A gravel bar occurs on the left bank.

Transect 6 Coordinates:

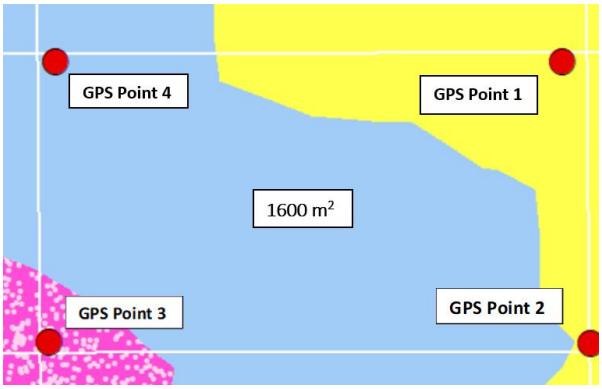
Point 1: 57.046966, -135.314314

Point 2: 57.046785, -135.314331

Point 3: 57.046783, -135.314637

Point 4: 57.046959, -135.314638

Center: 57.046874, -135.314481



Supporting Documentation and Special Concerns

Safety

Prior to field activities, surveyors must

1. Review "*Pacific Salmon Spawner Survey"* Job Hazard Analysis
2. Complete 'Bear Awareness' and bear spray training

Access to Study

Sites are easily accessible from Sitka National Historical Park trails. Surveyors will navigate to transects using a Garmin 76SXC or by using a georeferenced map produced on the Tab Active 2

Use of mechanized and other equipment

Field flags will be deployed temporarily to detail transects. Researchers will collect biological data on dead salmon along the riverbank using knives and tweezers.

Chemical use

Bear spray will accompany each surveyor. Ethanol will be used to clean, and store otoliths.

Ground disturbance

This project will not involve ground disturbance.

Animal Welfare

Research does not involve data collection from any live animals. Carcasses of salmon will be sampled for data, and returned to the river, as to minimize human disturbance of natural ecosystem.

NPS assistance

Research will be accomplished by SITK biologist, and Student Conservation Association Interns.

References

Gende, S.M. and B. Carter. 2017. Straying rates of pink salmon into the Indian River, Sitka National Historical Park: National Park Service, Glacier Bay Field Station, Juneau AK.

Medley, N. 2012. Quantification of Hatchery-Spawned Salmon Straying in Indian River: National Park Service, Water Resources Division, Fort Collins CO.

Neal, E.G. et al. 2004. Water Quality and Streamflow of the Indian River, Sitka National Historical Park, 2001-2002: U.S. Geological Survey Scientific Investigation Report 04-5023.

Neal, E.G. and E.H. Moran. 2007. Water Quality Monitoring Strategies for the Indian River, Sitka, Alaska: Administrative Report, U.S. Geological Survey, Juneau AK.

Paustian, S.J. and Hardy, T. 1995. Aquatic Resource Survey: Indian River, Sitka National Historical Park: U.S.D.A. Forest Service, Sitka AK, Prepared for National Park Service, Anchorage AK.

Sergeant, C.J. and Johnson W.F. 2014. Southeast Alaska Network Freshwater Water Quality Monitoring Program, 2013 Annual Report: Natural Resource Technical Report NPS/SEAN/NTR—2014/840, National Park Service, Juneau, AK.

Stopha, M. 2015. An Evaluation of the Sheldon Jackson Salmon Hatchery for Consistency with Statewide Policies and Prescribed Management Practices: Alaska Dept. of Fish and Game, Div. of Commercial
Fisheries, Regional Information Report 5J15-07, Anchorage AK.

Summit Consulting Services. 2004. Indian River Corridor and Watershed Master Plan: Prepared for City and Borough of Sitka, AK.

Tetra Tech, 2013. City and Borough of Sitka, Stormwater Management Plan: Prepared for City and Borough of Sitka, AK.

Thornton, T. F., & Hope, F. (1998). Traditional Tlingit Use of Sitka National Historical Park. US National Park Service.