Skagit River System Cooperative
11426 Moorage Way · P.O. Box 368 LaConner, WA 98257-0368
Phone: 360-466-7228 · Fax: 360-466-4047 · www.skagitcoop.org

To: Jenny Baker, Washington State Fish and Wildlife
From: Michael LeMoine, Eric Beamer and Greg Hood (SRSC)
Date: September 30, 2020
Subject: Technical summary of 2020 Milltown Island monitoring under contract WDFW #20-15118

This memorandum is a technical summary of the activities related to WDFW contract #20-15118. The specific tasks of the contract to be completed include: Task 1) survey channel cross sections and profiles, Task 2) mapping of beaver dams, lodges and channels, Task 3) GIS analysis of tidal channel dynamics, Task 4) GIS analysis of Milltown Island channel network comparability to reference marsh allometry, Task 5) monitoring of water levels in and around Milltown, Task 6) regular sampling for juvenile Chinook salmon over the entire outmigration period in 2020 and Task 7) intensive monitoring of the flood marsh area. As part of the technical summary, general methods and adaptations to methods are discussed, and salient results with limited recommendations are also presented in accordance with the stated contract deliverables. Raw data products either have been provided such as Tasks 1-2, 5-7 or will be provided as complete final datasets in the near future (Task 3 and 4).

Tasks 1 through 4 were intended to quantify current channel habitat conditions to inform future restoration need and design across all of Milltown Island including the northern lobe and southern lobe. GIS mapping and digitization work was completed by Spring of 2020. Channel cross-sections were completed by May 2020 along with mapping of beaver dams, lodges and channels. All survey work used an RTK-GPS with ~2cm accuracy. GIS analysis of current and historical (2007 to 2019) tidal channel dynamics along with all raw data were delivered to WDFW and their contractor Cardno by June 2020.

Water level monitoring in Task 5 was to increase the water level measures over the flooded marsh of the northern lobe of Milltown Island. Water level monitors (n=9) were borrowed from Washington State Department of Fish and Wildlife. The monitors were installed to measure water level difference across the flooded marsh with an upstream and downstream reference logger installed in well-connected channels (Figure 1). Upon presentation of preliminary data in early June, 2020 and discussion with WDFW and Cardno, the level monitoring network was adjusted where three level loggers were placed in the flooded marsh, two loggers remained in the reference channels and two loggers were placed in the South Fork Skagit approximately 1.5 km upstream and downstream of the flood marsh. All water level loggers were surveyed in with an RTK-GPS with ~2cm accuracy. Loggers were set to log water levels, temperature, and salinity every 15 minutes.

Fish monitoring at northern lobe of Milltown Island began the week of March 8, 2020 and ended the week of August 8, 2020 (Figure 2, Table 1). During this time two approaches were employed to evaluate fish use. One approach was to sample with a small beach seine and stick seines at regular two-week intervals within the known Chinook salmon out migratory period. For regular samples, sites were selected based on if the site was previously sampled to ensure consistency overtime and additional sites included new digitized habitat classification (Task 4). The objective is to provide a dataset to estimate abundance within the northern lobe of Milltown Island and understand changes in temporal use by fishes and specifically Chinook salmon fry across the newly identified habitat types. The second approach was to assess fish distributions intensively during a short duration over the northern lobe of Milltown Island. Thorough evaluation of fish distributions within the northern lobe of Milltown Island could then inform fish use of different habitats that include open channel, marsh, beaver pond and beaver channel or understand if fish are possible and able to use all available habitats (dispersal limited). The intensive monitoring approach was to survey fish use during the peak of the Chinook salmon outmigration utilizing a stick seine over the flood marsh with added sites from the regular sampling sites that were sampled within one week of the intensive sampling event. Given some uncertainty associated with when the peak might occur, SRSC and WDFW determined that three different periods of intensive sampling would occur. Sites were sampled over a two-day period. Then approximately 20 sites were selected at random for each channel type. All seines were fished in a round haul style and area was measured during each set. In addition, site characteristics such as water temperature, dissolved oxygen, salinity, and water velocity were measured.

During the sampling period some adjustments to the schedule and sites were needed. In April 2020, Covid-19 pandemic resulted in a stay at home order by the Governor of Washington State. In coordination with this order, SRSC implemented a two-week cessation of all field work to establish safe working procedures. The closure resulted in one week of missed sampling during the first part of April. In addition, the original proposal intended to use a Marsh Master to increase sampling effort during the intensive monitoring, however WDFW equipment operators and SRSC staff were not authorized to work together due to Covid-19 related constraints. Because of this, SRSC adapted the field effort so that surveys were conducted by foot. We were able to meet the target sampling but were only able to go out once rather than having repeated sampling over three different periods. Through out the year, tides and Skagit River water levels resulted in different draining rates which also effected the total number of sites sampled during fish monitoring. We added fish sampling sites after June 3, 2020 to have better coverage in the south and east portion of the northern lobe.

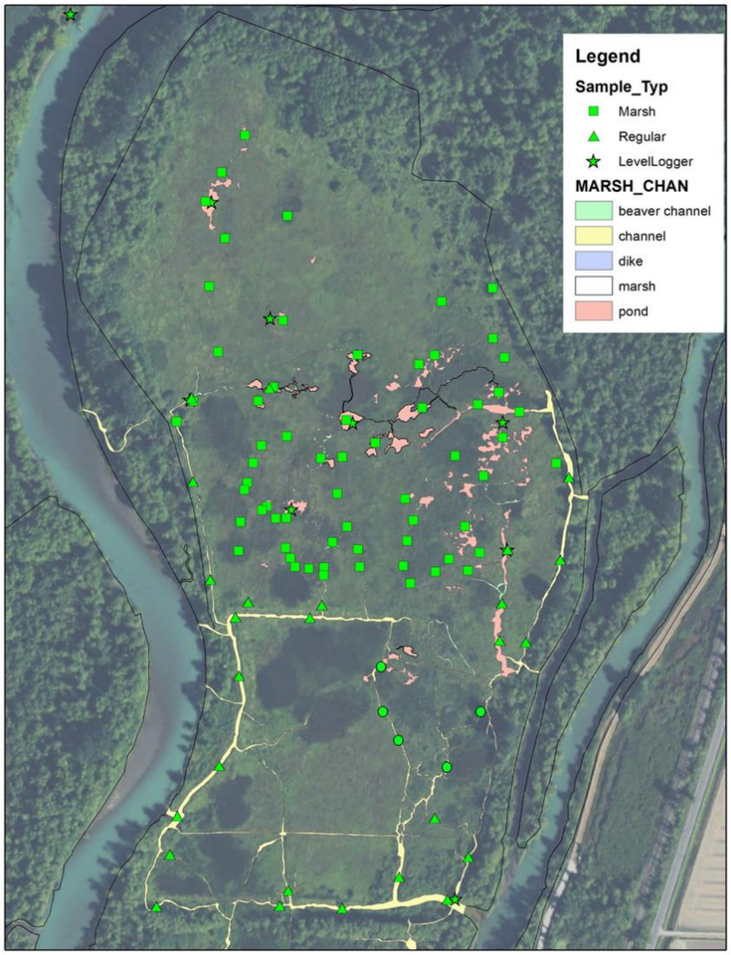

Figure 1. Marsh (intensive) and regular fish sampling sites and level logger locations. Green circles represent fish sampling sites added after June 15, 2020 to fill in monitoring locations.

Table 1. Number of sets for regular sampling and flooded marsh intensive sampling in Milltown Island northern lobe in 2020. Sets from regular sampling and intensive sampling were combined to evaluated fish habitat use and hydrologic distance influence on fish composition and salmonid abundance.

	Regular Sampling		Intensive Sampling	
Week	Small Beach Seine	Stick Seine	Small Beach Seine	Stick Seine
3/8/2020	13	7	0	0
3/22/2020	13	13	0	0
4/19/2020	13	9	0	0
4/26/2020	0	0	0	65
5/3/2020	13*	13*	13*	13*
5/17/2020	13	11	0	0
6/21/2020	12	4	0	0
7/5/2020	12	4	0	0
7/19/2020	12	5	0	0
8/2/2020	12	5	0	0

** sets that were used for both regular and intensive sampling*

Habitat Mapping (Tasks 1-4)

Monitoring objectives were met for Task 1 thru 4 (Figure 2). Channel cross-sections were measured at 37 locations with profiles taken in wadable channels during low tide. Habitat features were mapped in GIS and ground truth by SRSC staff. Elevations and locations were documented for beaver dams and lodges. In addition, two failing culverts along the eastern dike wall of the northern lobe of Milltown Island were discovered and documented. Overall, habitat mapping and survey work suggests restoration potential by removing the two culverts and providing addition breach points to allow more water exchange while considering current beaver activity that is creating aquatic habitat through dams and channel excavation. In addition, the depression of the flooded marsh could be improved by mounding land to promote (or plant) shrubs and trees to increase beaver activity within the center of the northern lobe of Milltown Island.

The complete analysis associated for Task 3 (GIS analysis of tidal channel dynamics from 2007 to 2019) and Task 4 (GIS analysis of Milltown Island channel network comparability to reference marsh allometry) will be completed by October 30, 2020 since that these activities are part of SRSC's in kind contribution to the project.

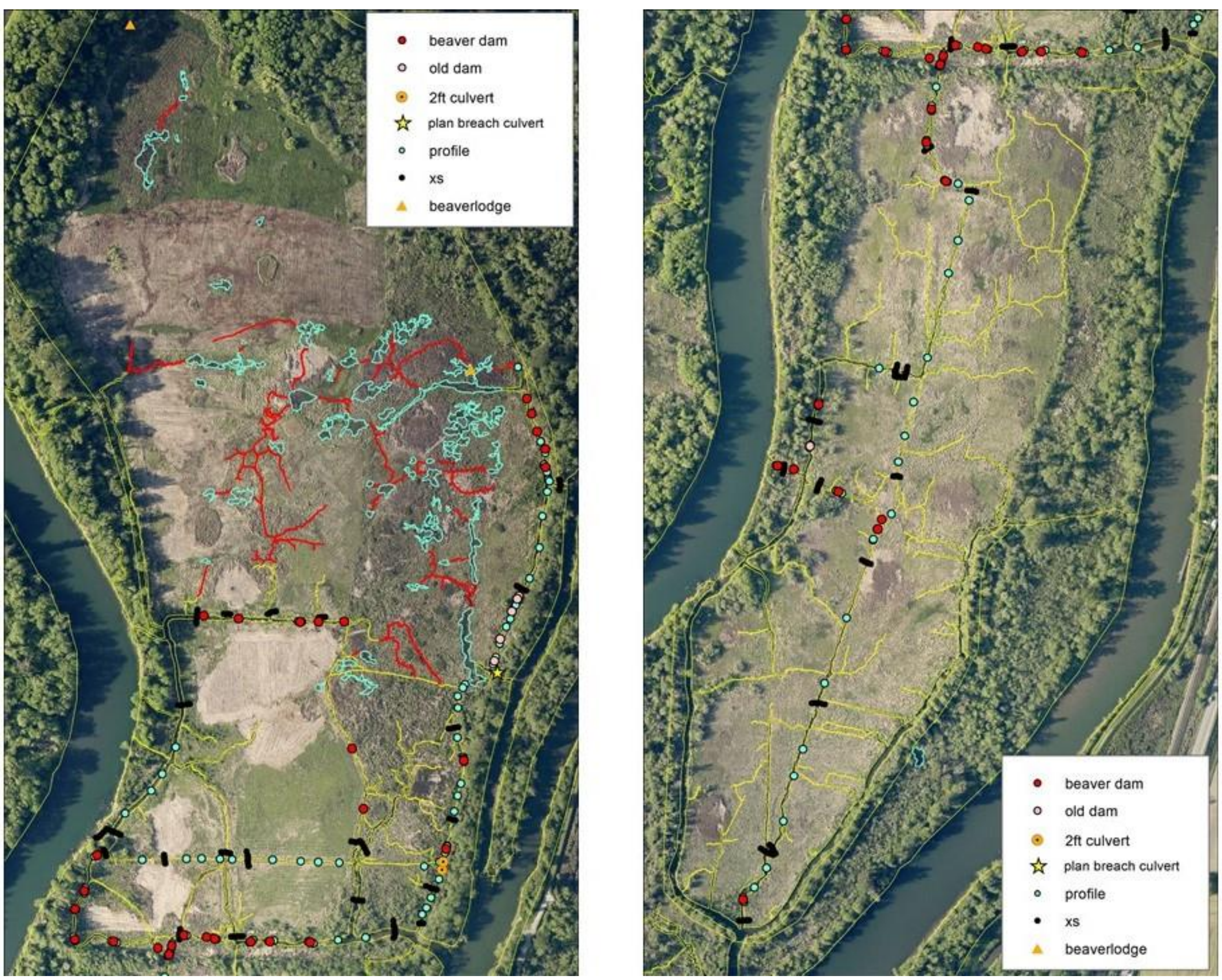

Figure 2. Locations of habitat monitoring (Task 1-4).

Water surface elevations (WSE) (Task 5)

WSE were measured across nine locations from March 17, 2020 to May 18, 2020. Then WSE were measured at six locations based on coordination with WDFW and Cardno from July 2, 2020 to August 24, 2020. All metadata and logger data will be delivered to WDFW as part of the final contract deliverables prior to the final submission of the technical summary.

Fish use of Milltown Island northern lobe (Task 6)

During the 2020 fish monitoring effort there were 7,323 individual fish across 14 species that were caught in the northern lobe of Milltown Island (Table 2). Included in the total fish observed were 142 Chinook salmon fry, 209 juvenile coho salmon and 11 chum salmon that were caught and identified. Chinook salmon fry were present throughout the monitoring period except for August sampling with the highest measured abundance occurring during the week May 3, 2020 (Figure 2). Additional sites were added after June 3, 2020 to fill sampling in areas missed previously, however no salmon were caught in this area. Then intent of the regular sampling is to inform total abundance of Chinook salmon fry but was not a direct deliverable of this contract. Chinook salmon fry overall abundance at the northern lobe of Milltown Island should be calculable with additional data from IMW reference sites and from the WDFW operated smolt trap at Burlington, WA.

Table 2. Overall mean catch converted to fish per hectare by week for regularly sampled sites with standard error represent within the parentheses.

Species	3/8/2020 20 sets	3/22/2020 26 sets	4/19/2020 22 sets	5/3/2020 26 sets	5/17/2020 25 sets	6/21/2020 16 sets	7/5/2020 16 sets	7/19/2020 17 sets	8/2/2020 17 sets	**Total 185 sets**
Chinook salmon, *O. tshawytscha*	318 (227)	287 (91)	358 (156)	659 (385)	70 (36)	239 (88)	92 (55)	53 (38)	0 (0)	**253 (65)**
Chum salmon, *O. keta*	16 (16)	24 (13)	6 (6)	20 (14)	4 (4)	0 (0)	7 (7)	0 (0)	0 (0)	**10 (3)**
Coho salmon, *O. kisutch*	0 (0)	0 (0)	318 (135)	581 (129)	1392 (486)	198 (66)	41 (41)	10 (10)	87 (40)	**337 (77)**
Cutthroat Trout, *O. clarkii*	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	33 (33)	10 (10)	**4 (3)**
Lamprey sp. Petromyzontiformes	0 (0)	6 (6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**0 (0)**
Mountain whitefish, *Prosopium williamsoni*	0 (0)	0 (0)	33 (24)	28 (15)	71 (42)	15 (15)	12 (12)	0 (0)	0 (0)	**20 (7)**
Peamouth, *Mylocheilus caurinus*	18 (18)	55 (32)	166 (123)	694 (397)	124 (75)	30 (24)	0 (0)	46 (39)	45 (27)	**155 (60)**
Pink salmon, *O. gorbuscha*	0 (0)	16 (16)	0 (0)	14 (14)	6 (6)	0 (0)	0 (0)	0 (0)	0 (0)	**5 (3)**
Prickly Sculpin, *Cottus asper*	11 (11)	0 (0)	0 (0)	116 (77)	201 (88)	68 (53)	96 (64)	87 (52)	184 (66)	**84 (19)**
Pumpkinseed, *Lepomis gibbosus*	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (6)	30 (30)	**3 (2)**
Starry flounder, *Platichthys stellatus*	0 (0)	0 (0)	0 (0)	4 (4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**0 (0)**
Sucker sp., Catostomidae	0 (0)	0 (0)	22 (22)	26 (16)	53 (33)	15 (15)	0 (0)	6 (6)	0 (0)	**15 (5)**
Threespine stickleback, *Gasterosteus aculeatus*	1234 (538)	3211 (1223)	32026 (16734)	10216 (3774)	16068 (3071)	4822 (1331)	13502 (3717)	13648 (4441)	29123 (6590)	**13515 (2333)**

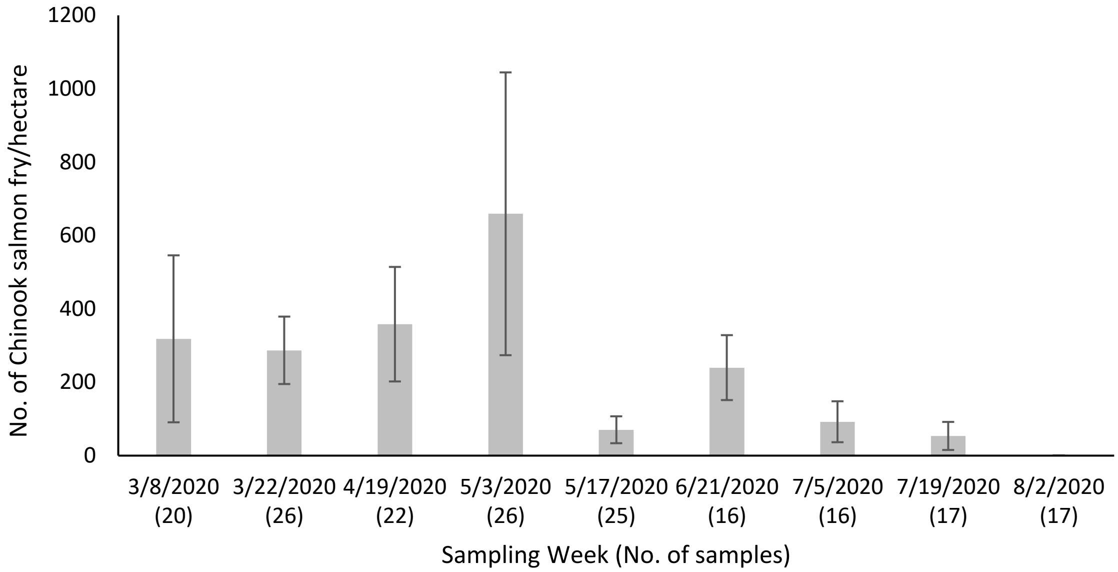

Figure 3. Mean number of Chinook salmon fry per hectare across regularly sampled sites by week with whiskers representing standard error. Number of samples taken are represented below the sampling week.

Fish use by habitat type and hydrologic distance (Task 7)

One objective of the 2020 monitoring was to determine if fish use and specifically Chinook salmon fry use differed by channel and flooded marsh habitats, and if beaver influenced fish use. Using the intensive monitoring data that included a total of 91 sites sampled over a 2-week period. The habitats and beaver influence were determined as part of the project (see Task 3 in Habitat mapping). Most of the fish use occurred within hydrologically formed or restored channels and was especially true for Chinook salmon fry and juvenile coho salmon (Figure 4). Beaver did not seem to influence salmon densities, however seining beaver influenced habitats are incredibly challenging due to water depth and steep channel walls. Capture efficiency is expected to be low in beaver influenced habitats. Only threespine sticklebacks were observed over the flood marsh.

Habitat use patterns maybe be associated to extent in which salmon disperse into the wetted channels and marsh. We observed significant ($p < 0.05$) associations with water depth and hydrologic distance and presence of salmon (*Onchorynchus* sp.). Salmon were more likely to be present closer to the South Fork Skagit River channels and in deeper water. Probability of a salmon species being present becomes 50% at 152 meters distance from the South Fork River channels and the probability of salmon species being present becomes 50% at a water depth of 0.98 meters (Figure 5). We could not differentiate between depth and distance because of cross correlation where deeper water depths were usually found near to the mouths of channels to the South Fork Skagit River. We also acknowledge that our sampling regime were only sufficient to describe the pattern of fish use and unable to describe the causal limitations of the pattern. We were limited to one intensively sampling event that limit our ability to compare internally and we had limited scope to use data collected from other areas of the Skagit delta to improve our inference to evaluate causes. Further, The WSE data (Task 5) could be used to update the existing hydrodynamic model for the island but we were unable to benefit from these results with our current fish analysis. Future work could include analysis of other data including Fischer Slough, Fir Island Farms and Wiley slough to evaluate how fish and especially Chinook salmon might be dispersal limited in tidal channels.

For the instance of the northern lobe of Milltown Island, fish and specifically Chinook fry salmon tended to be at the entrances of the main channels where the water was deeper in 2020. Further, SRSC field staff identified little surface water movement in the northwest portion of Milltown Island. In these areas water tended to be warm and have low morning dissolved oxygen concentrations (<8.0 mg/L). Fish could benefit with additional breaches in the western dike wall if it concurred with natural hydrologic processes through further hydrologic modeling.

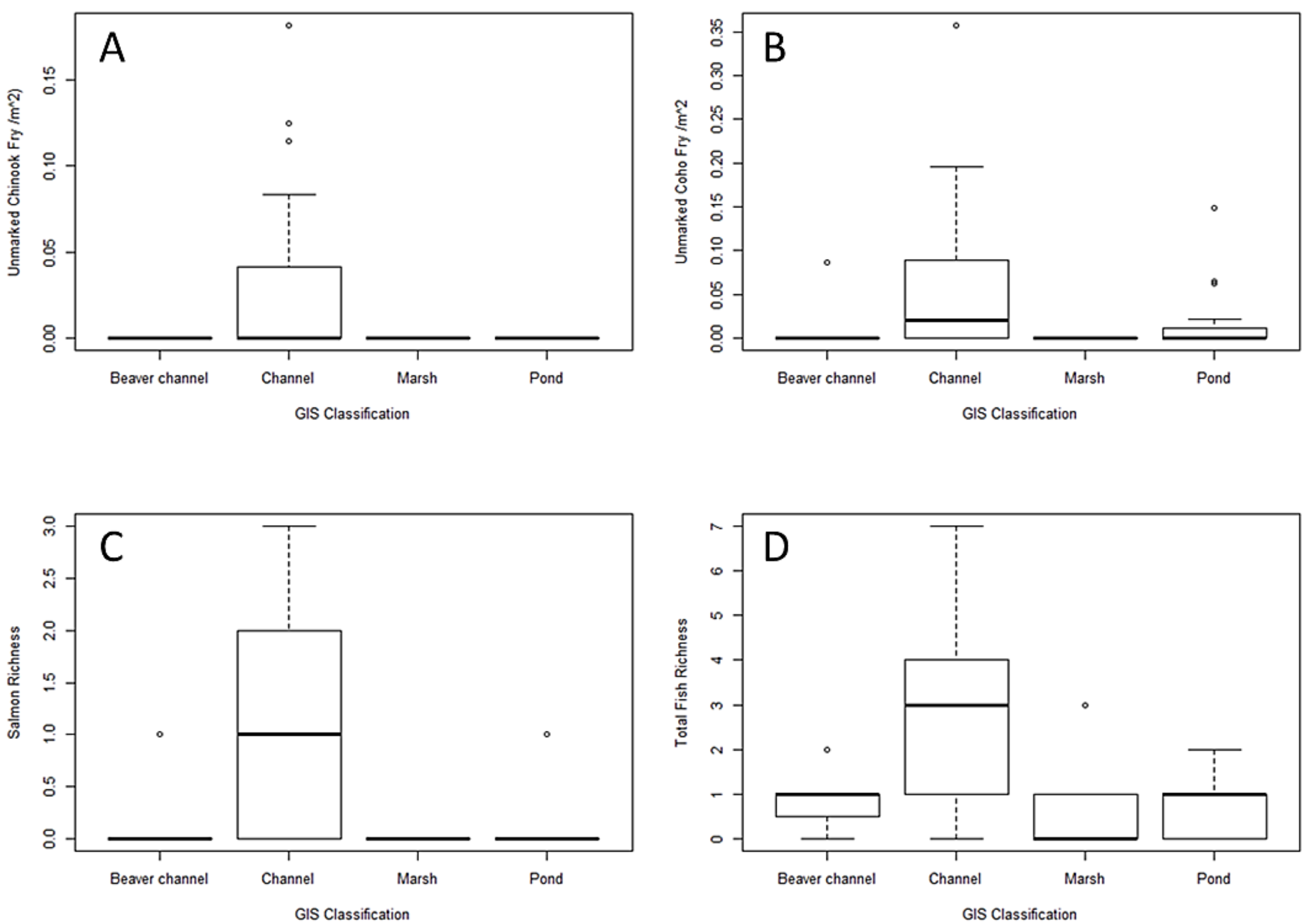

Figure 4. (A) Chinook salmon fry/m^2, (B) Coho salmon fry/m^2, (C) total salmon (*Onchorynchus* sp.) richness and (D) total fish richness by habitat classification from the intensive monitoring sites (n=91)

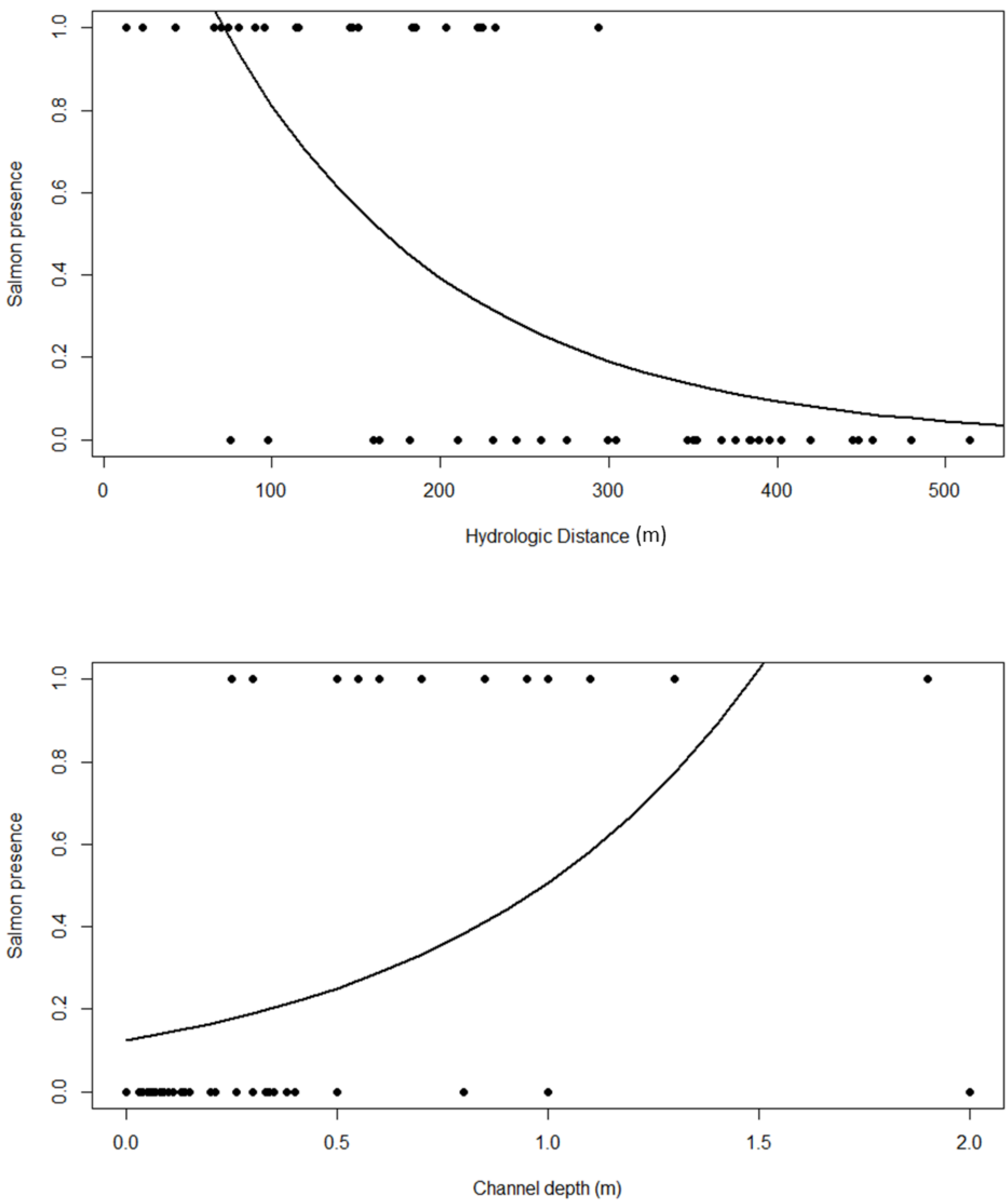

Figure 5. Salmon (*Onchornynchus* sp.) presence by hydrologic distance (m) (top) and channel depth (m) (bottom) that exhibited a significant relationship using a simple negative-binomial generalized linear model. The curve is the predicted relationship between presence and hydrologic distance and presence and channel depth.