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Technical Memorandum

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Subject: Initial fish results from Leque Island restoration.

This technical memo gives the results of the fish species captured in 2019 and 2021 at Leque island restoration area and neighboring reference locations and includes a summary of the salmonid species captured. 2019 is considered pre-restoration because the interior channels were mostly inaccessible to fish, however some resident Threespine Sticklebacks were present and a short-term leak in the levee allowed some fish to access the site until April 2019. Conditions in 2021 are considered post-restoration and included a period of unprecedented high temperatures that were associated with daytime low tides (heat dome effect). These factors complicate direct comparisons and the results described in this document could change with additional data. SRSC and WDFW plan to continue sampling in 2022 and if funds are available have additional sampling in 2023.

Leque Island fish monitoring was conducted between February and August in the restoration area that comprises three tidal channels opening toward the southern end of the island and the Davis Slough tidegate that opens to the east into Davis Slough (Figure 1). Since we need to account for change over time and abundance can change year to year, eight reference site locations are also monitored during the same period. Fish were caught using stick seines (25 ft by 6 ft), beach seine (80 ft by 6 ft) and fyke nets (40 ft by 10 ft) all with 1/8 in mesh. Nets were deployed during ebb tides when water is contained in the wetted channels leaving the marsh surface dewatered (see Henrichs et al. 2020 for details).

Over the two years of fishing monitoring so far, we handled a total of 126,661 fish across 15 different species (Table 1). The majority of these fish were Threespine Sticklebacks common to Puget Sound estuaries. In 2019, before completion of the Leque Island restoration project 11 species were observed in the project channels and 13 species were observed in reference locations. We suspect that Starry Flounder, Surf Smelt, Sandlance, and Shiner Perch accessed the restoration site during the levee leak suggesting that total species within the restoration site would be lower than measured during pre-restoration monitoring if the levee was functioning. After restoration, we encountered more species at Leque Island than the reference sites in 2021. This suggests that more species can now

access and use the site, providing prey for predatory fishes, birds (e.g., blue heron) and mammals (e.g., river otters).

Figure 1. Location of the Leque Island fish sampling sites within the restoration area (left panel) and within the restoration locations (right panel). Beach seine sites are shown as circles, stick seines are shown as squares and fyke traps are represent by triangles (from Henrichs et al. 2020).

Table 1. Number of fish caught before and after restoration within the restoration sites and within the reference sites.

	2019 Pre-Restoration		2021 Post-Restoration	
	Reference	Restoration	Reference	Restoration
American Shad	1	0	0	0
Anchovy	0	0	0	1
Arrow Goby	17	40	204	496
Bull Trout	0	0	1	1
Chinook salmon	48	0	56	22
Chum Salmon	168	16	121	51
Coho Salmon	4	0	1	1
English sole	0	0	0	1
Pacific Herring	6	56	0	1
Peamouth	351	1	290	88
Prickly Sculpin	11	22	5	1
Sandlance	0	1	0	0
Shiner Perch	4701	52	866	1926
Staghorn Sculpin	430	390	72	343
Starry Flounder	722	92	136	70
Surf Smelt	169	556	76	281
Threespine Stickleback	666	107728	926	4376
Total fish Caught	7294	108954	2754	7659
Number of Species	13	11	12	15

One of the goals of the Leque restoration project is increase rearing capacity for juvenile Chinook salmon and Chum salmon by removing levees and returning tidal inundation to the site. Chinook salmon fry rear extensively in estuarine habitats and loss of tidal wetlands have been identified as limiting to recovery of this species (Puget Sound Chinook Recovery Plan). Chum salmon also rear in estuarine habitats but to a lesser degree than Chinook salmon. Other species such as Coho salmon juveniles and adult anadromous Bull trout are known to feed in estuaries but are considered more transient.

Densities of target species Chinook salmon and chum salmon increased in the Leque Island area after restoration. Densities of salmon in estuaries are strongly tied to annual out migration from rivers. To account for this, we can compare densities between restoration and reference locations. We observed a 338% increase in Chinook salmon density within the three channels of Leque Island and a 100% increase in the Davis Slough restored channel when compared to reference sites. Chum salmon densities increased by 19% in Leque Island and 790% in the Davis Slough restored channel. Coho parr and adult Bull trout were detected in Leque Island and encountered more often than before restoration. We do note that observed increases will likely change with more data especially considering the anomalous year 2021 was with the "Heat Dome".

Table 2. Annual mean densities of Chinook salmon fry, chum salmon fry and coho salmon parr between restoration and reference locations. Bull trout encounters were rare, so presence is reported. Davis Slough is separated in this table because of its distance from the southern Leque Island channels and the reference sites located by Stanwood, WA.

	Chinook Fry (# of fish per set)		Chum Fry (# of fish per set)		Coho Parr (# of fish per set)		Bull trout Presence	
Location	Before Restoration	After Restoration	Before Restoration	After Restoration	Before Restoration	After Restoration	Before Restoration	After Restoration
Leque Island								
Restoration	0.00	0.14	0.18	0.06	0.00	0.00	No	Yes
Reference	0.38	0.16	1.53	0.42	0.05	0.02	Yes	Yes
Davis Slough								
Restoration	0.00	0.19	0.00	1.25	0.00	0.03	No	No
Reference	0.53	1.03	1.27	2.00	0.00	0.03	No	No

References

Henrichs, B., M. LeMoine, G. Hood and L. Brokaw. 2020. Leque Island Estuary Restoration Monitoring and Adaptive Management Plan. Skagit River System Cooperative, La Conner, WA. pp. 31

National Marine Fisheries Service. 2007. Puget Sound Recovery Plan. https://repository.library.noaa.gov/view/noaa/16005.