Expanding Research to Keep Pace with Extensive Restoration in the Nisqually Delta

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Introduction

The return of tidal inundation to over 750 acres of the Nisqually National Wildlife Refuge (Nisqually NWR) in fall of 2009 was the crowning moment in the effort to protect and restore the Nisqually Delta (South Puget Sound, Washington). The Nisqually NWR restoration project combined with three earlier projects completed on Nisqually Tribe property amounts to over 900 acres of estuary restored, representing one of the most significant advances to date towards the recovery of Puget Sound.

The first Nisqually Delta restoration project in 1996 covered only 9 acres and monitoring consisted of a few basic metrics to assess site specific habitat development. Since this modest beginning the restoration projects have grown in size, cost, complexity, and their predicted impact on estuarine and nearshore habitats. In order to stay on pace with the increased spatial, financial, and technical scale of the projects the Nisqually Tribe, Nisqually NWR, U. S. Geological Survey (USGS), and others have expanded their research and monitoring activities.

The USGS and the Nisqually Tribe are conducting research at multiple scales in order to examine the impact of the restoration on the linkages between physical processes, habitat structure changes, and the functional response of fish and birds. The research and monitoring effort is focused on:
1) sediment delivery to the delta via the Nisqually River;
2) hydrodynamics affecting sediment transport and estuarine mixing;
3) geomorphic change;
4) vegetation community colonization and succession;
5) terrestrial (insect), benthic, and neustonic invertebrate community response;
6) bird response to process and structure changes as expressed by their distribution and relative abundance; and
7) Chinook salmon response to process and structure changes as expressed by their distribution and relative abundance, feeding ecology, estuarine residence time and growth, and life history diversity.

Methods

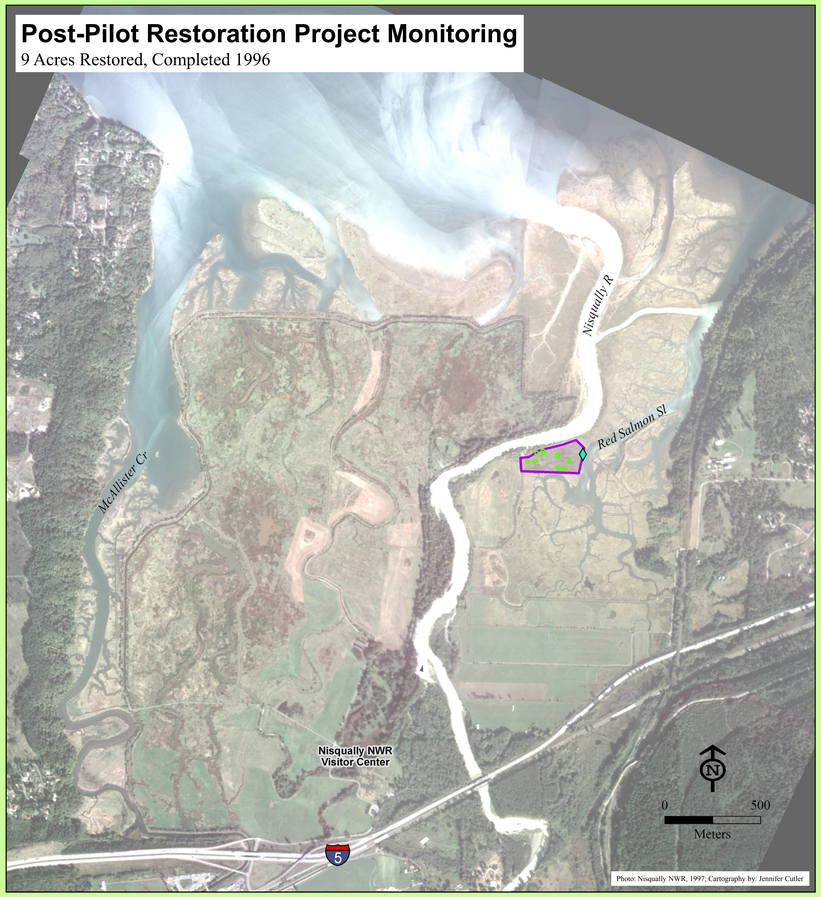
The following maps track the implementation of the Nisqually Delta restoration projects and corresponding significant monitoring components.

Heather Minnella conducting monthly bird survey.

Emiliano Perez beach seining for fish.

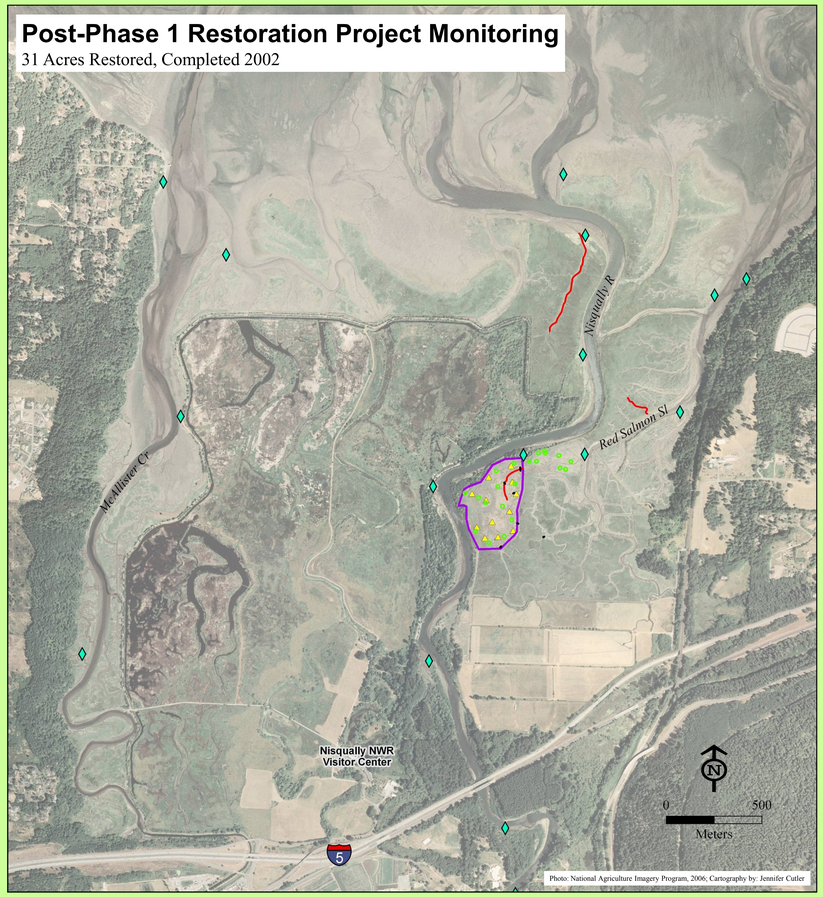
Glenn Guntenspergen and Kelley Turner using Surface Elevation Table to measure elevation changes.

Matthew Holt conducting bathymetric survey.



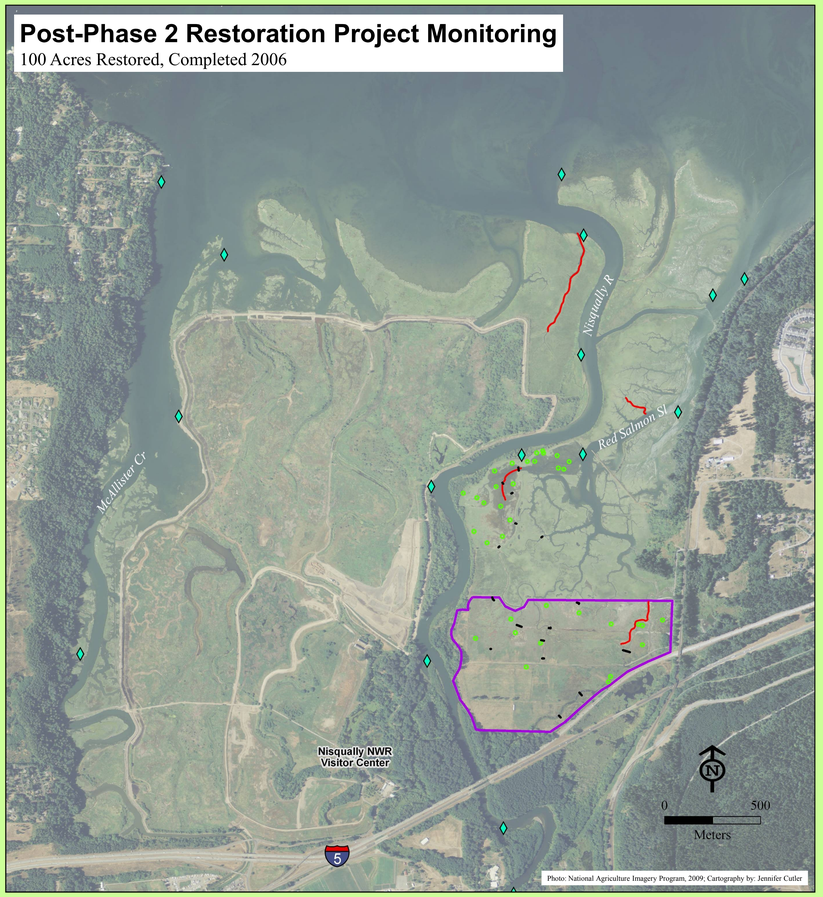
- Nisqually Delta Restoration Project Phase
- 9m Vegetation Plots (percent species cover; annually)
- Seine Site (salmon presence; periodically in spring)

Pilot project area looking north.



- Nisqually Delta Restoration Project Phase
- Fish Diet Study Intensive Monitoring Sites (fish fyke trap, fallout terrestrial and benthic invertebrates-6 replicates each, neuston-aggregate; monthly Mar.-Aug.)
- 9m Vegetation Plots (percent species cover; annually)
- Seine Sites (broad scale fish distribution and abundance patterns; Chinook collected for otolith analysis; bimonthy Feb.-Oct.)
- Sand Tags (sediment deposition and erosion; annually)
- Cross Sections (elevation and geomorphology; biannually)

Fallout trap collecting terrestrial invertebrates.



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Fyke net set to trap fish.

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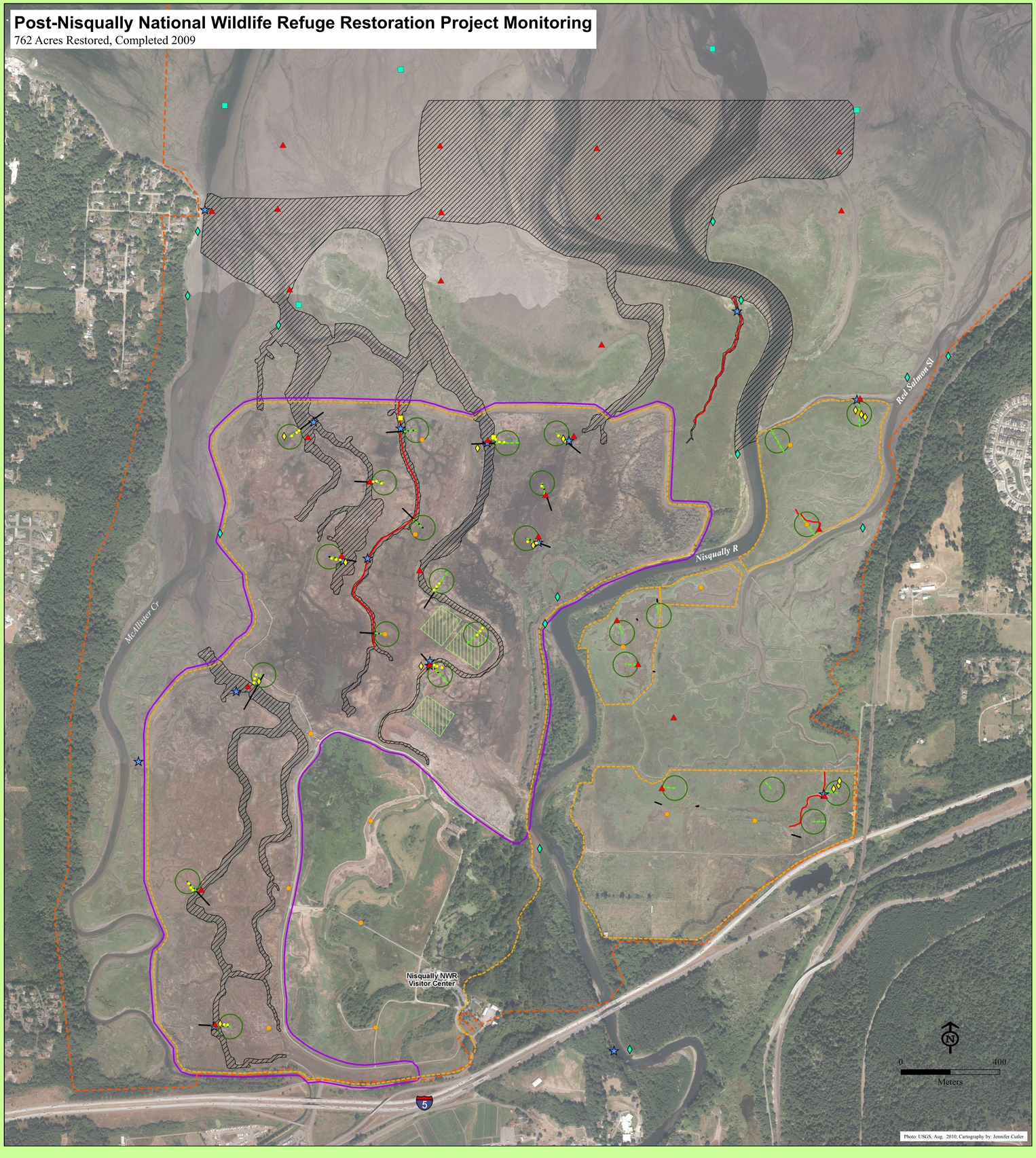
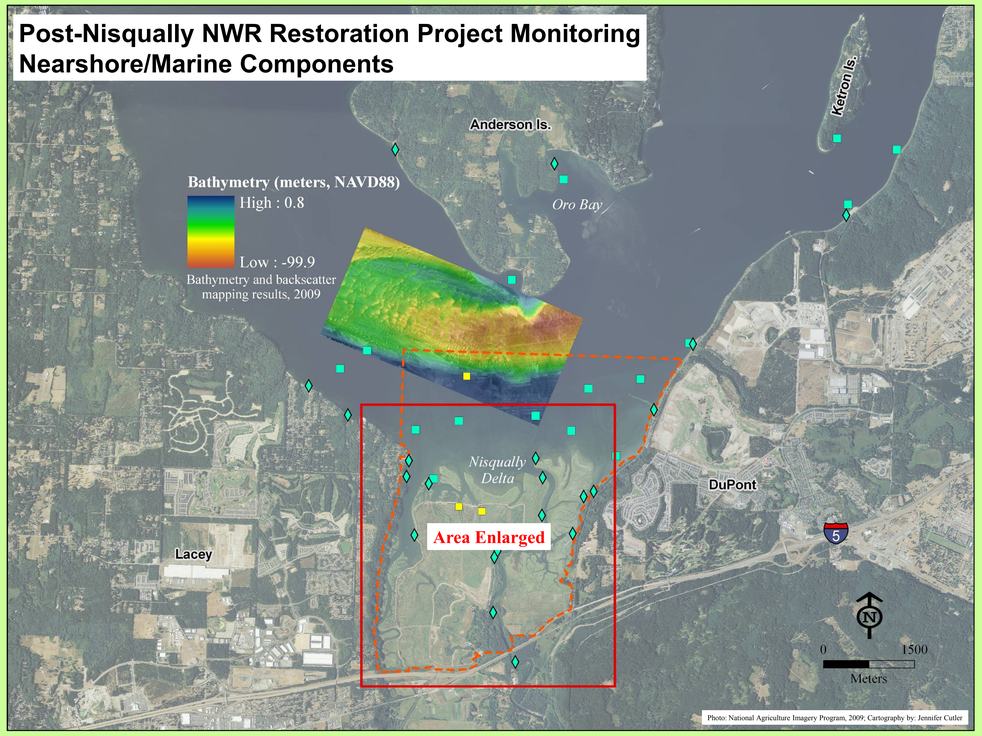
Post-Nisqually National Wildlife Refuge Restoration Project Monitoring

762 Acres Restored, Completed 2009



Post-Nisqually NWR Restoration Project Monitoring Nearshore/Marine Components



- Nisqually Delta Restoration Project Phase
- Benthic Invertebrate Samples (10x10cm core, 3 replicates; annually)
- Fish Diet Study Intensive Monitoring Sites (fish fyke trap, fallout terrestrial and benthic invertebrates-6 replicates each, neuston-aggregate; monthly Mar.-Aug.)
- Variable Circular Plot Songbird Surveys (monthly April-June)
- Area Bird Surveys (monthly during high tide)
- Delta Bird Survey (annually during high tide)
- Permanent Vegetation Transects (50m, point intercept and quadrat; annually)
- Vegetation Colonization Study (vegetation quadrat, sediment pin and feldspar marker horizon; annually)
- 50m Vegetation Plots (percent habitat cover; annually)
- Seine Sites (broad scale fish distribution and abundance patterns; Chinook collected for otolith analysis; bimonthy Feb.-Oct.)
- Lampara Net Sites (nearshore and delta flats fish distribution and abundance patterns; Chinook collected for otolith analysis; monthly Apr.-Sept.)
- Water Level and Water Quality Loggers (level, temperature, conductivity; continuous)
- Hydrodynamic Monitoring (current velocities, discharge, net sediment transport, geomorphic change; continuous)
- Surface Elevation Table and Feldspar Marker Horizon (elevation, sediment deposition; biannually)
- Sediment Pins (sediment deposition and erosion; quarterly)
- Cross Sections (elevation and geomorphology; annually)
- Bathymetric Survey Locations (elevation and geomorphology; 2010)

Results/Discussion

Estuary restoration in the Nisqually Delta has progressed from small localized projects to a suite of projects that directly impact nearly a thousand acres with the potential to change physical and biological processes across the entire system. The size and scope of the restoration effort makes its potential contribution to restoration science unprecedented in Puget Sound. Additionally, there is a need to develop adaptive management indicators to help the Nisqually Tribe and the Nisqually NWR manage a dynamic landscape vulnerable to impacts from sea-level rise, altered hydrology, and other anthropogenic and natural changes. In order to take advantage of this research opportunity and to provide important adaptive management tools the Nisqually Tribe, USGS, and others have initiated a research approach linking physical process changes with biological response.

The key outcomes of Nisqually Delta research include:

- A fluvial sediment input budget for climate change, sea-level, and land-use scenario testing and for site-specific applications related to restoration planning and adaptive management.
- A hydrodynamic model to develop adaptive management indicators by exploring a range of possible future conditions, including variations in river discharge, river channel migration or breaching, and climate change induced sea level rise.
- Short term restoration performance assessment based on process (sediment and hydrodynamics)-structure (vegetation and invertebrate composition)-function (juvenile Chinook distribution and feeding ecology as well as avian distribution) linkages.
- Quantitative indicators (growth, residency, and life history diversity) of Chinook salmon response to estuary restoration compared to the pre-restoration baseline dataset.
- A quantitative inventory of aerial, neuston, and benthic invertebrate availability across the restoring and reference sites.
- A suite of physical and biological indicators whose status over the long-term can be used by the Nisqually Tribe and the Nisqually NWR to adaptively manage the Nisqually Delta and as guidance for other restoration projects.

Partners and Funding Sources

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