County: Clallam
Grant No: SEANWS-2018-ClCoCD-00007

PROJECT TITLE: Final Olympia Oyster Restoration Report

DELIVERABLES FOR TASK NO: 5.2

PROGRESS REPORT: [ ] FINAL REPORT [X]

PERIOD COVERED: October 1, 2018 – September 30, 2019

DATE SUBMITTED: September 30, 2019

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistant agreement CE-01J31901-0 to the Puget Sound Partnership. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Olympia Oyster Restoration

Introduction

The Clallam County Marine Resources Committee (Clallam MRC), Jamestown S'Klallam Tribe (JST) and Puget Sound Restoration Fund are working together to restore Olympia oysters in Clallam County with a focus on Sequim Bay. The effort is part of a larger goal underway to restore 100 acres of Olympia oyster habitat in the Puget Sound area by 2020.

In 2012 one acre of JST tidelands in Sequim Bay near Blyn was dedicated to Olympia oysters. Grow-out bags with approximately 6,200 Olympia oyster seed were planted on the tidelands and the following year seeded cultch bags with approximately 500,000 oysters were spread onto the tidelands. In 2014 seeded cultch bags with approximately 250,000 seed were spread on to an additional half acre of tidelands making the total restoration site 1.5 acres.

The successful restoration effort on Jamestown's tidelands prompted Clallam MRC and their partners to search for other potential restoration sites in Sequim Bay. Several potential sites in Sequim and Dungeness Bay were investigated unsuccessfully. In May 2018 the JST proposed using a parcel of tidelands that they lease from WA Department of Natural Resources at the head of Sequim Bay. The site is approximately 700 ft. east of the current restoration site and covers an area of 0.3 acre. In July and August 2019 more than 100 bags of Olympia oyster seed were moved from the area they have overwintered to the new restoration site at the head of Sequim Bay and spread at the site.

The newly restored Dawley Road property was another potential restoration site near the head of Sequim Bay. In September 2017 Clallam MRC submitted a Special Use Permit to the US Fish and Wildlife Service asking for permission to establish two test plots at their Dawley Road property in Sequim Bay. After receiving the permit in September 2018 the test plots were installed in October, 2018.

Olympia Oyster Restoration Efforts Summer 2019

The 2019 restoration season was busy. The following five major tasks were accomplished:

1) Purchasing, transporting and spreading 67 cubic yards of blank shells at the 1.5 acre Jamestown Tidelands Restoration Site. The effort was done by JST with help from the 2019 summer intern hired by Clallam MRC.
2) Purchasing, transporting and spreading 850 bags of blank shells at the 0.3 acre Blyn DNR Restoration Site (new site). The effort was done JST with help from the 2019 summer intern and Clallam MRC members. The effort was funded by the MRC Opportunity Fund through NWSF.
3) Population survey at the Jamestown Tidelands Restoration Site conducted by Liz Tobin, JST shellfish biologist, assisted by Clallam MRC members and summer intern.

4) Population survey at the Blyn DNR Restoration Site conducted by Liz Tobin, JST shellfish biologist, assisted by Clallam MRC members.
5) Assessment of the two test plots at Dawley Road established in fall 2018. The assessment was done by Liz Tobin with the help of Chris Burns, JST senior technician, and Helle Andersen, Clallam MRC Project Coordinator.

The purpose of the survey at the 1.5-acre restoration site was to estimate the abundance and size distribution of the Olympia oyster population. Because of the placement of blank shells a bed edge delineation could not be made and a density estimate specific to the bed area could not be determined. The purpose of the survey at the 0.3-acre restoration site was to estimate total Olympia oyster abundance and density; identify the population size distribution and delineate the perimeter of the Olympia oyster bed associated with the restoration site. The following sections summarizing the results of the two population surveys and the assessment of the test plots at Dawley Road were submitted by Elizabeth Tobin to the Clallam MRC.

Figure 1. Summer intern Alisandra Baccus and Neil Harrington, JST biologist, assisting in on of the population survey.

The Peninsula Daily News published a large article about the 2019 Olympia oyster restoration efforts in Sequim Bay https://www.peninsuladailynews.com/news/jamestown-sklallam-tribe-aids-olympia-oysters-in-sequim-bay/

Maps and report prepared by:
JST Shellfish Biologist - Liz Tobin
9/25/2019

2019 Olympia Oyster Population Survey
Jamestown Tidelands Restoration Site

An Olympia oyster population survey was completed at the Blyn restoration site by two members of the Clallam MRC (Lyn Muench and Ed Bowlby), CMRC intern Alisandra Baccus and three members of Jamestown's Natural Resources Department on July 16, 2019. The purpose of this survey was to estimate the abundance and size distribution of the Olympia oyster population associated with the 1.5-acre Olympia oyster restoration site located on Jamestown's tribal tidelands (Fig. 1).

Survey Methods:
The population survey was carried out using a systematic random design to eliminate any bias in the sampling scheme. The Olympia oyster survey was conducted during a -1.6 ft. MLLW tide so that the entire oyster bed was exposed to allow for complete sampling. Seven transects, spaced 30 feet apart, were laid out along a 4° compass heading running from the southern to the northern boundary of the restoration site (Fig. 2). Along each transect, Olympia oysters were sampled using a 0.25 m^2 quadrat ("sample plot"). The starting position of the first transect from the Southwest corner and the starting position of the first 0.25 m^2 sample plot for each transect were randomized using a random number generator. After placement of the first 0.25 m^2 quadrat, subsequent sample plots were spaced approximately every 30 feet along each transect. A total of 70 sample plots (equal to an area of 17.5 m^2) were examined for Olympia oysters within the bounds of the restoration site. This sampling protocol allowed for non-biased, yet consistent stratified sampling throughout the site. All substrate, down to approximately 2 inches, within a sample plot was examined to determine the number of live and dead Olympia oysters. Shell length (measurement from the hinge to the longest edge of the shell) was measured for up to 10 individuals in every sample plot when present. All field data was compiled and analyzed by Jamestown's Shellfish Biologist and reported to the Clallam MRC.

Population Survey Results:
For consistency with population surveys from previous years, the 2019 survey was conducted within the bounds of the 1.5-acre restoration site which resulted in a population estimate of 24,585 viable oysters and an average oyster density of 4 oysters per m^2 (Table 1). Assessment of Olympia oyster survivorship indicated that 65% of the total number of oysters identified and counted were viable. Olympia oysters at this site exhibit a high-level patchiness, resulting in the relatively low oyster density due to the large number "zero" observations (Fig. 6). To moderate the number of zero observations in past surveys, a mean oyster density was also calculated within the boundary of the oyster bed (Table 1; Fig. 3). Because a bed edge delineation could not be made prior to the 2019 population survey due to the placement of 67 cubic yards of blank shell for substrate enhancement (Fig. 4), a density estimate specific to the bed area could not be determined (Table 1). However, it does not appear that the Olympia oyster bed boundary has expanded within the restoration site since the 2018 bed delineation (Fig. 6).

The size range of the subsampled live adult oysters was 17-64 mm (Fig. 5). While natural recruitment to the restoration site has been observed in previous years, none of the randomly measured oysters in the 2019 survey were identified as new recruits (e.g., < 1 year old) based on size. Since Olympia oyster recruitment has been observed throughout the Jamestown tribal tidelands, we attribute the lack of

identified recruits during this survey to the relatively low sample size (n=33) of randomly measured oysters.

Summary:

The 2019 population survey results continue to support that joint CMRC-Jamestown restoration efforts on the Blyn tidelands have generally been successful. Olympia oysters are surviving, growing, reproducing and expanding their population area well beyond the bounds of the restoration site. While not captured in this survey, a notable increase in Olympia oysters has been observed by Jamestown's Natural Resources staff throughout the head of Sequim Bay. Due to past observations identifying suitable substrate as being a limiting factor for Olympia oyster settlement, and likely accounting for the relatively low oyster densities, efforts to enhance shell substrate occurred in May and June 2019 to help promote long-term sustainability of the population at this site (Fig. 4).

A health assessment of Olympia oysters on Jamestown's tribal tidelands was completely by AquaTechnics on October 4, 2018 to evaluate their suitability for Puget Sound Restoration Fund's brood stock program. The results found no known or certifiable infectious diseases and identified the Blyn oysters to be "well fed" and reproductively healthy (a copy of this report can be provided upon request). This health assessment provides further support that the joint CMRC-Jamestown restoration efforts have been successful in establishing a healthy and viable Olympia oyster population in Sequim Bay.

Maps and report prepared by:
JST Shellfish Biologist - Liz Tobin
9/25/2019

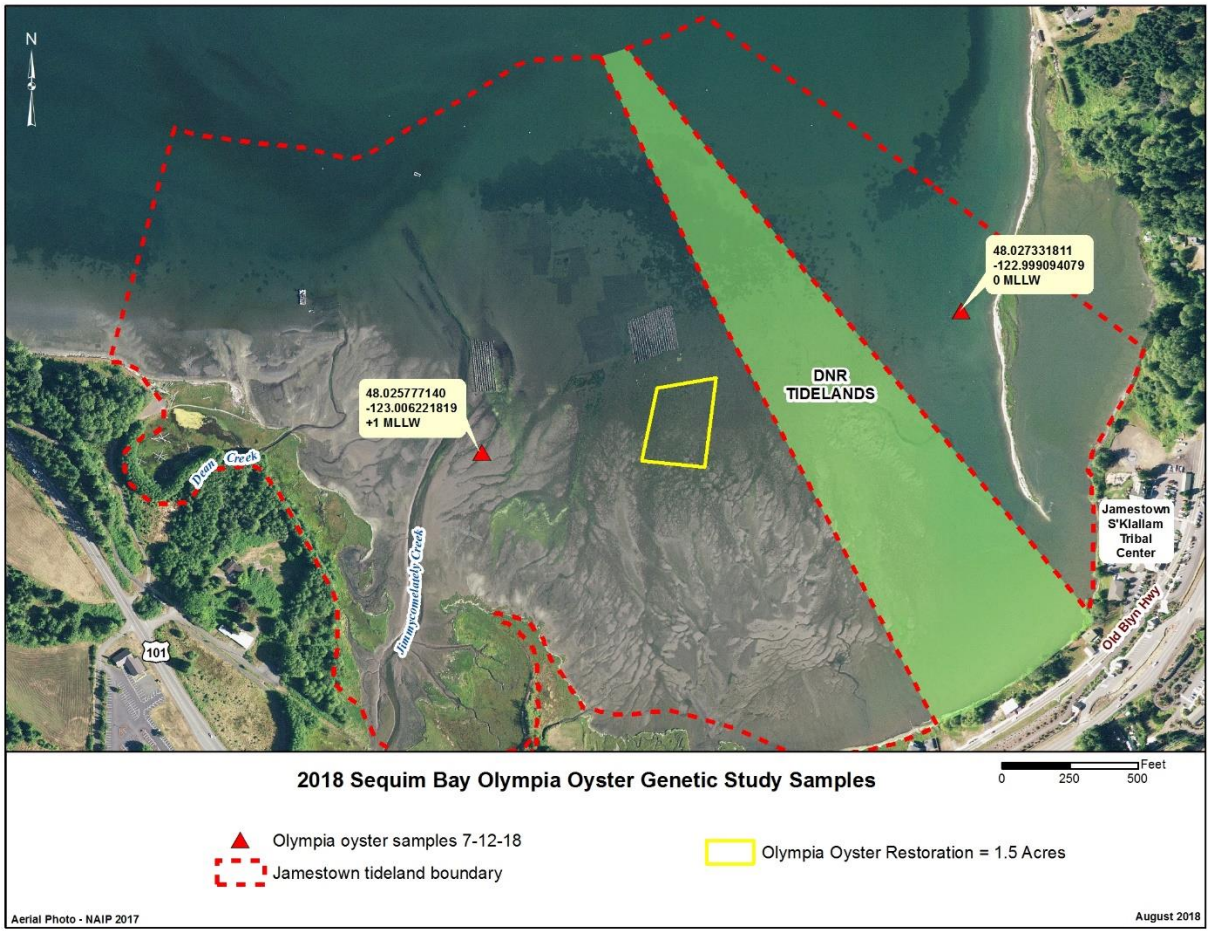

Figure 1: Maps of Jamestown tribal tidelands showing the location of the 1.5 acre Blyn restoration site (yellow polygon) and locations were Olympia oysters were collected for brood stock health assessment (red triangles).

Maps and report prepared by:
JST Shellfish Biologist - Liz Tobin
9/25/2019

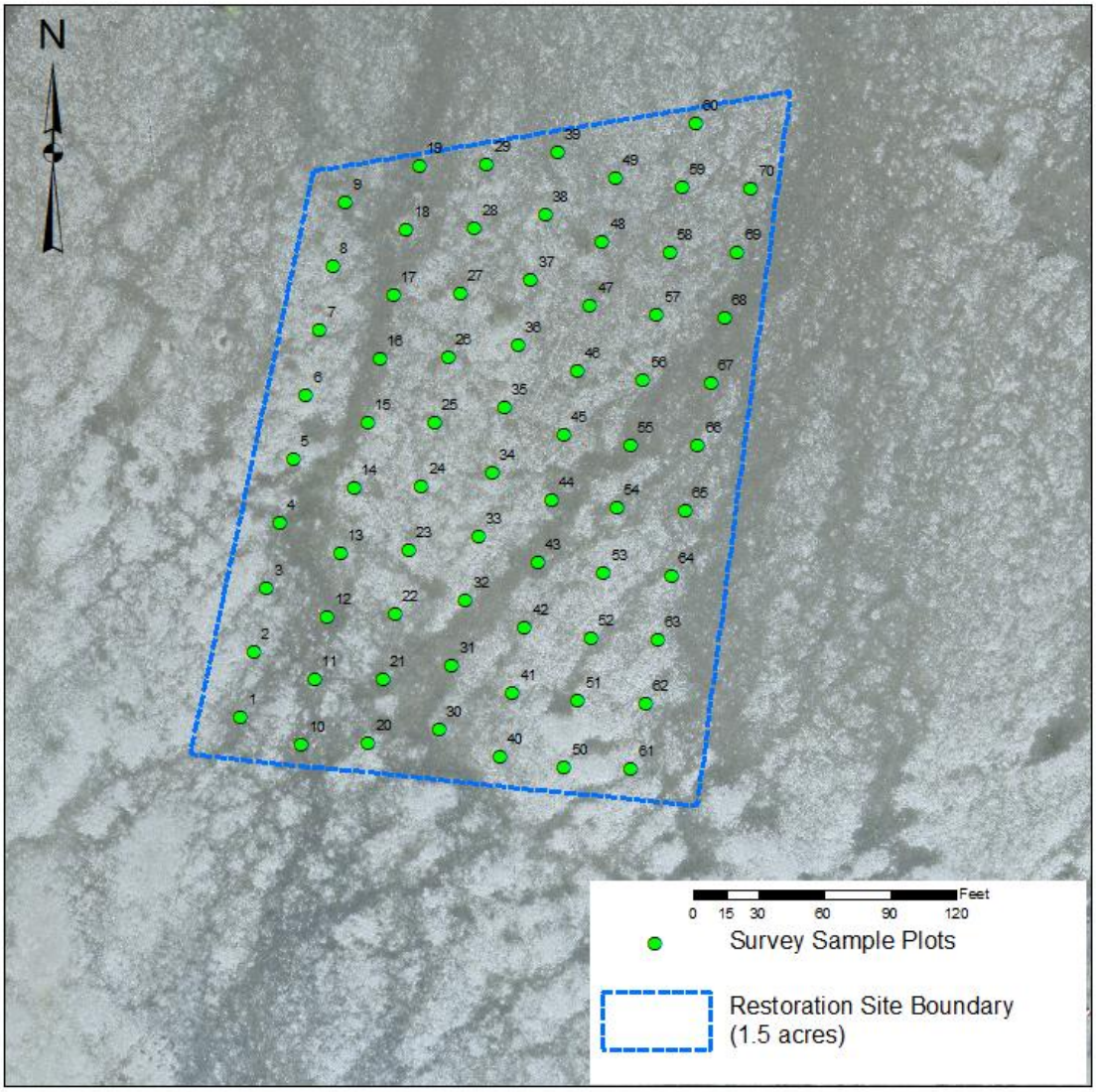

Figure 2: 2019 Jamestown tidelands Olympia oyster restoration site population survey design.

Maps and report prepared by:
JST Shellfish Biologist - Liz Tobin
9/25/2019

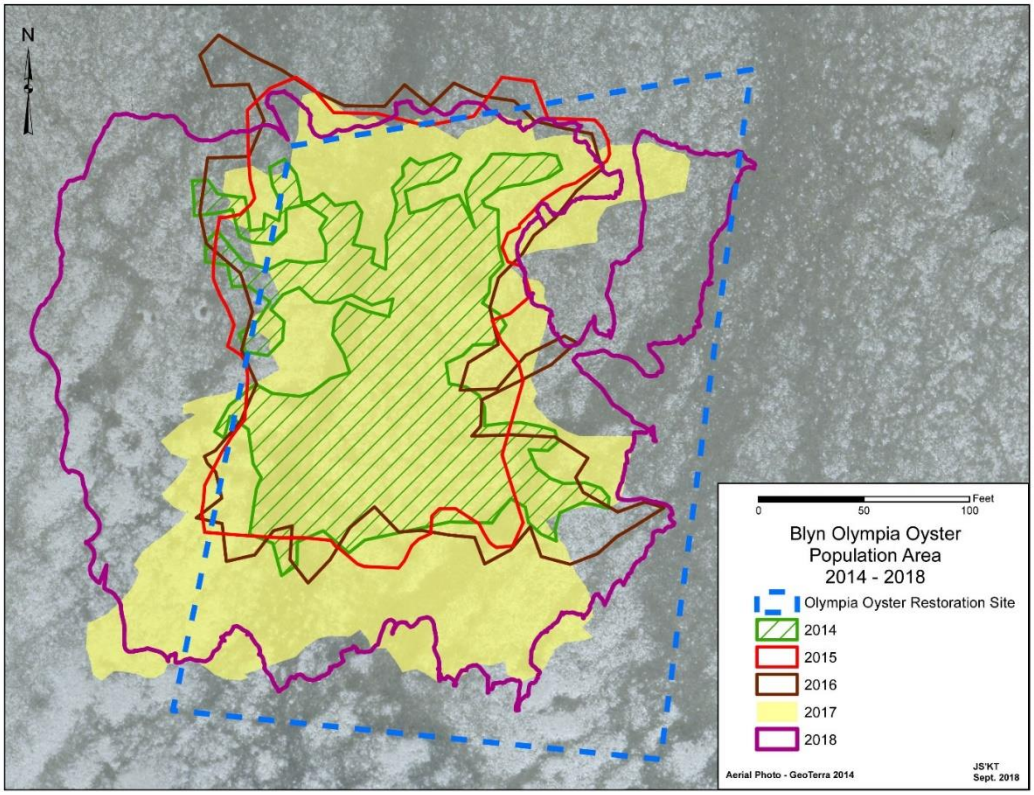

Figure 3. Olympia oyster bed boundaries from 2014 - 2018 are compared. A population boundary was not acquired in 2019 due to the coverage of blank shell distributed throughout the restoration masking the ability to clearly delineate the population boundary edge.

Figure 4. Photo showing blank oyster shell for substrate enhancement within the 1.5-acre restoration site.

Maps and report prepared by:
JST Shellfish Biologist - Liz Tobin
9/25/2019

Table 1: Oyster density data, population area and population size estimate for the Jamestown Olympia oyster restoration site from 2014 – 2019. The 2019 population estimate includes 95% confidence intervals.

Survey Year	Mean Restoration Site Density (# m^{-2})	Population Area (acres)	Mean Population Area Density (# m^{-2})	Population Estimate	Notes
2014	--	0.42	28	46,800	Survey only within oyster bed area; 39 subsamples
2015	18	0.64	24	46,620	Unseeded cultch added; Survey throughout 1.5 acre restoration site
2016	15	0.74	19	55,770	Survey throughout 1.5 acre restoration site: 51 subsamples
2017	5	1.05	8	33,978 (±15,783)	Restoration site shifted southward, Survey throughout 1.5 acre restoration site: 78 subsamples
2018	4	1.05	5	19,429 (±10,431)	Survey throughout 1.5 acre restoration site: 63 subsamples
2019*	4	--	--	24,584 (±20,453)	Survey throughout 1.5 acres restoration site: 70 subsamples

*67 cubic yards of blank oyster shell was spread throughout the 1.5-acre restoration site from May – June 2019 for substrate enhancement prior to the population survey being conducted on July 16, 2019 (Fig. 4).

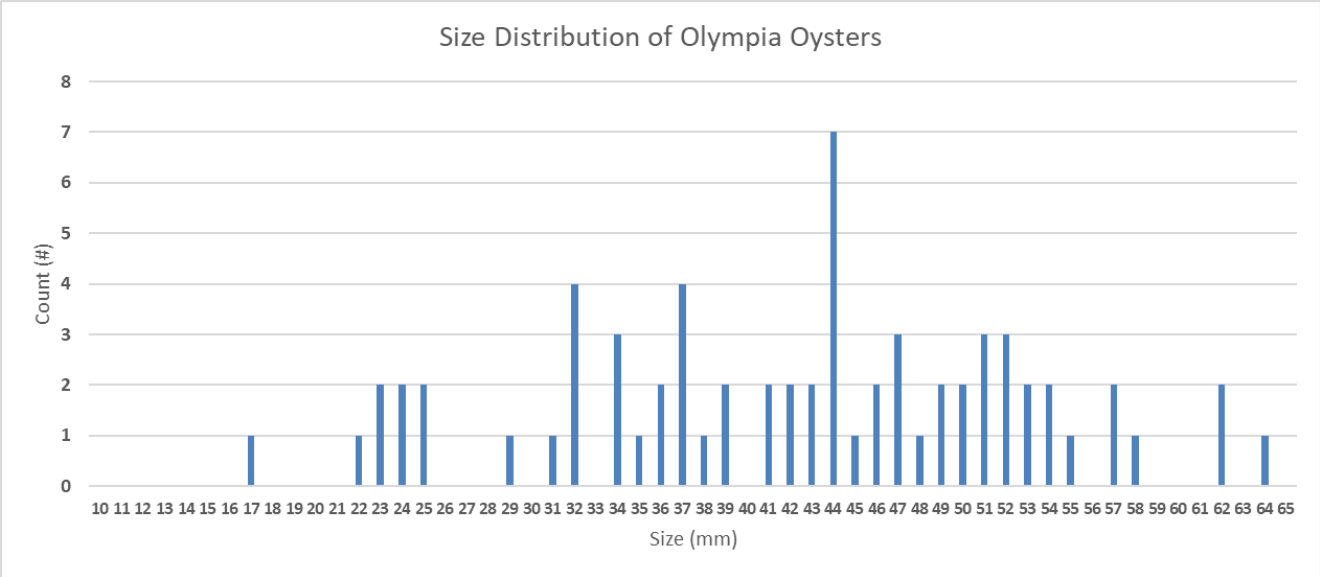

Figure 5. Size distribution of subsampled Olympia oyster from the 1.5-acre Jamestown restoration site during the 2019 population survey**.**

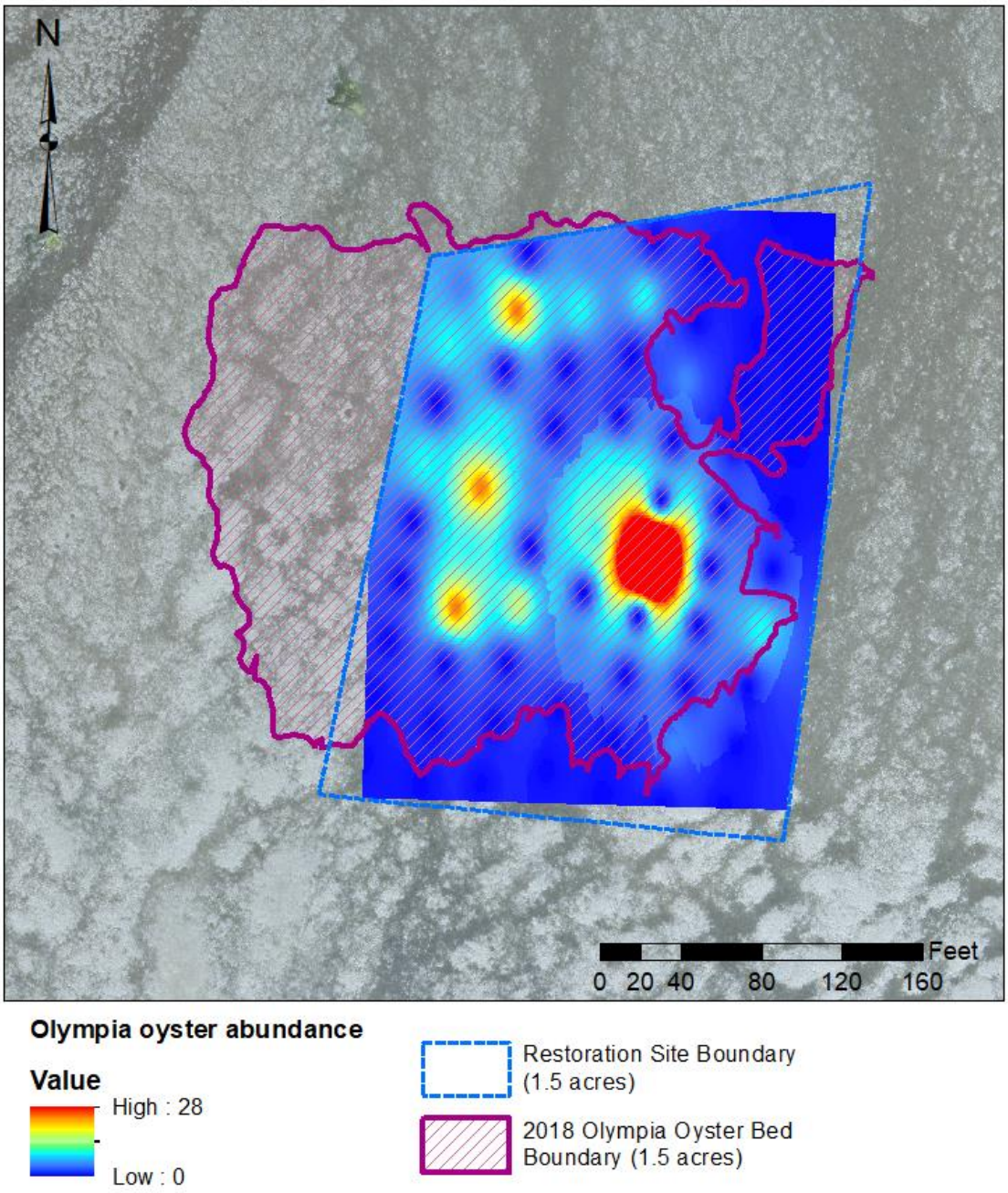

Figure 6. Heatmap of Olympia oyster abundance from the 2019 population survey at the Jamestown restoration site. Data are interpolated in ArcGIS 10.5.1 using inverse distance weighting. The analysis was masked by the restoration site boundary. Red designates the high abundance Olympia oyster patches within the restoration site. The 2018 Olympia oyster bed boundary is shown for comparison.

Maps and report prepared by:
JST Shellfish Biologist, Liz Tobin
8/5/2019

2019 Olympia Oyster Population Survey
Blyn DNR Restoration Site

An Olympia oyster (*Ostrea lurida*) population survey was completed on May 20, 2019 at the 0.3 acre Blyn restoration site on the DNR tideland parcel adjacent to Jamestown's tribal tidelands. Four Jamestown S'Klallam Tribe (JST) staff and two members of the Clallam County Marine Resources Committee (CMRC) participated in the population survey. The purpose of this survey was to estimate total Olympia oyster abundance and density (# per sq. meter); identify the population size distribution and delineate the perimeter of the Olympia oyster bed associated with the restoration site.

Survey Methods:
The population survey employed a systematic random design to allow for consistent sampling throughout the site and eliminate any bias in the sampling scheme. The survey was conducted on a -1.8 ft. MLLW tide so that the entire oyster bed was exposed to allow for complete sampling. Five transects, spaced 20 feet apart, were laid out running from the southern to the northern boundary of the restoration site (Fig. 1). Olympia oysters were sampled (counted and measured) within a 0.25 m^2 quadrat ("sample plot"). The starting position of the first transect from the Southwest corner and the starting position of the first 0.25 m^2 sample plot for each transect were randomized using a random number generator. After placement of the first 0.25 m^2 quadrat, subsequent sample plots were spaced every 20 feet along the transect (Fig. 1). A total of 36 sample plot (equal to a total sampled area of 9 m^2) were examined for Olympia oysters within the restoration site boundary. All substrate, down to approximately 2 inches, within the sample plot was examined to determine the total number of live and dead Olympia oysters. The population estimate is based on live counts of Olympia oysters. The shell length (measurement from the hinge to the longest edge of the shell) of up to 10 randomly selected live Olympia oysters was measured for each sample plot when oysters were present. A survey grade GPS unit was used to collect coordinates for each sample plot location within the restoration site. All field data was compiled and analyzed by Jamestown's Shellfish Biologist, Liz Tobin, and reported to the Clallam MRC.

Survey Results:
Assessment of Olympia oyster survivorship found that 33% of the total oysters counted were viable, suggesting mortality of up to two thirds of the population (i.e., seeded cultch) may have occurred within the first year between August 13, 2018 and May 20, 2019. The seeded cultch was acquired from Puget Sound Restoration Fund in June 2017 and were 'beach hardened' on the Blyn tidelands approximately 1 year prior to being distributed ("outplanted") on the DNR restoration site. The size range of the 99 subsampled live oysters was 12 – 57 mm. The upper end of the oyster size distribution indicates that mature Olympia oysters were likely present at the site prior to outplanting of the seeded cultch. The lower end of the oyster size distribution suggests some natural recruitment may have also occurred. An average density of 27 oysters per m^2 was calculated for the 0.3 acre restoration site. The 2019 population size estimate for the Blyn DNR restoration site is 31,296 (±33,419) oysters. The large amount of uncertainty (i.e., wide confidence intervals) around the population estimate is due to the high variability of the count data.

Maps and report prepared by:
JST Shellfish Biologist, Liz Tobin
8/5/2019

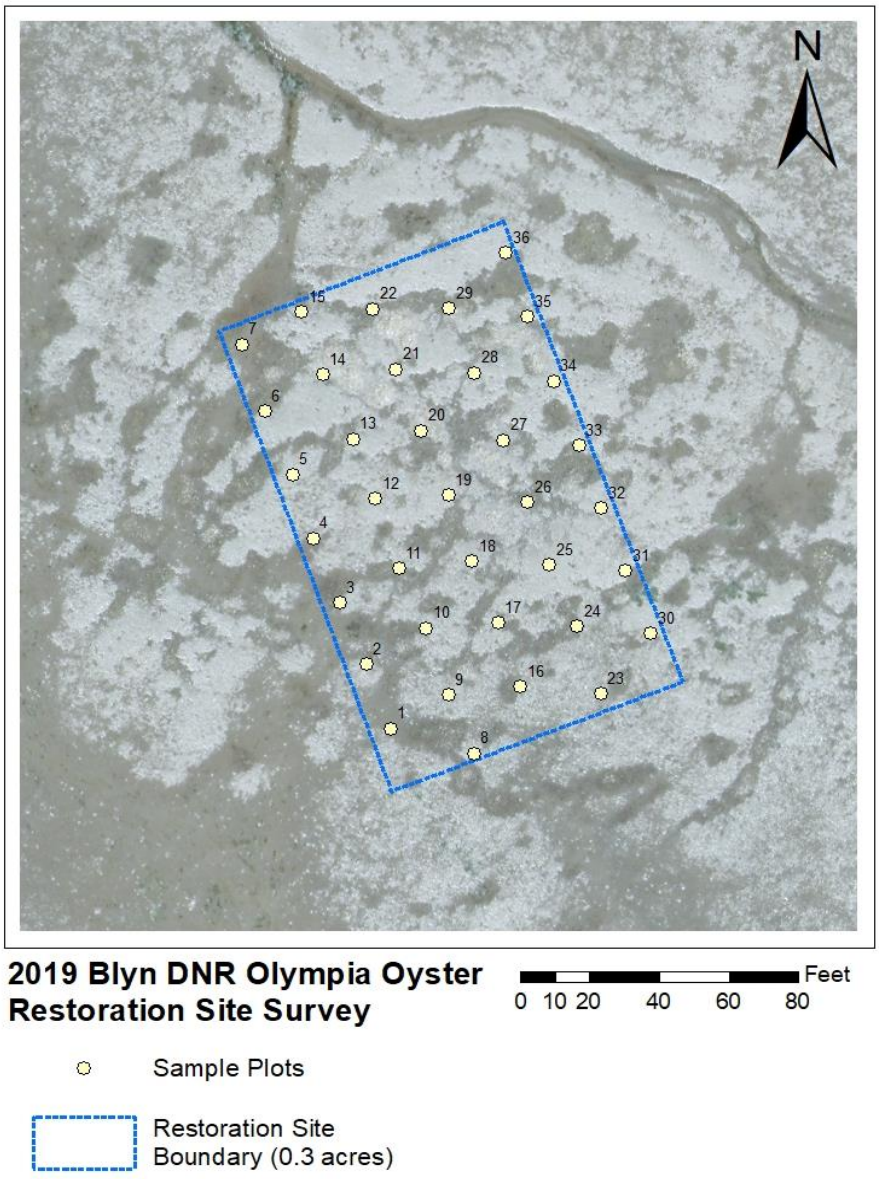

Figure 1: 2019 Blyn DNR site Olympia oyster population survey design

Maps and report prepared by:
JST Shellfish Biologist, Liz Tobin
8/5/2019

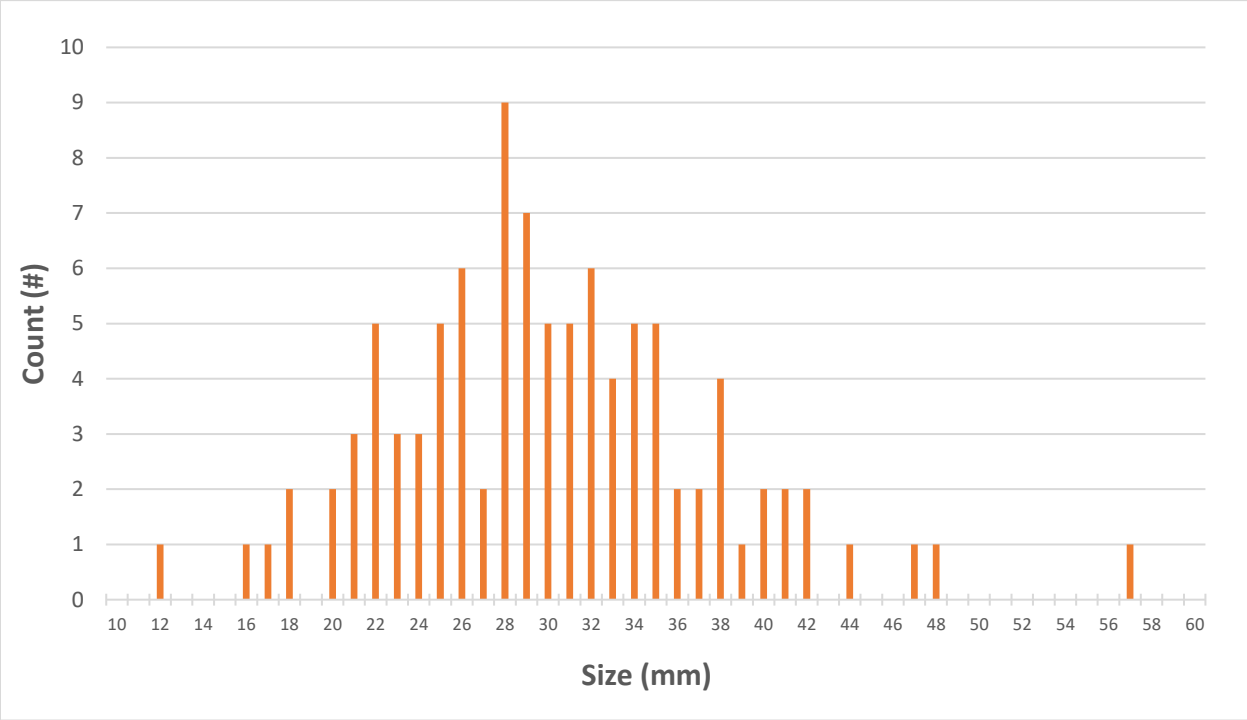

Figure 2. 2019 Olympia oyster size distribution at the Blyn DNR restoration site.

Maps and report prepared by:
JST Shellfish Biologist, Liz Tobin
8/5/2019

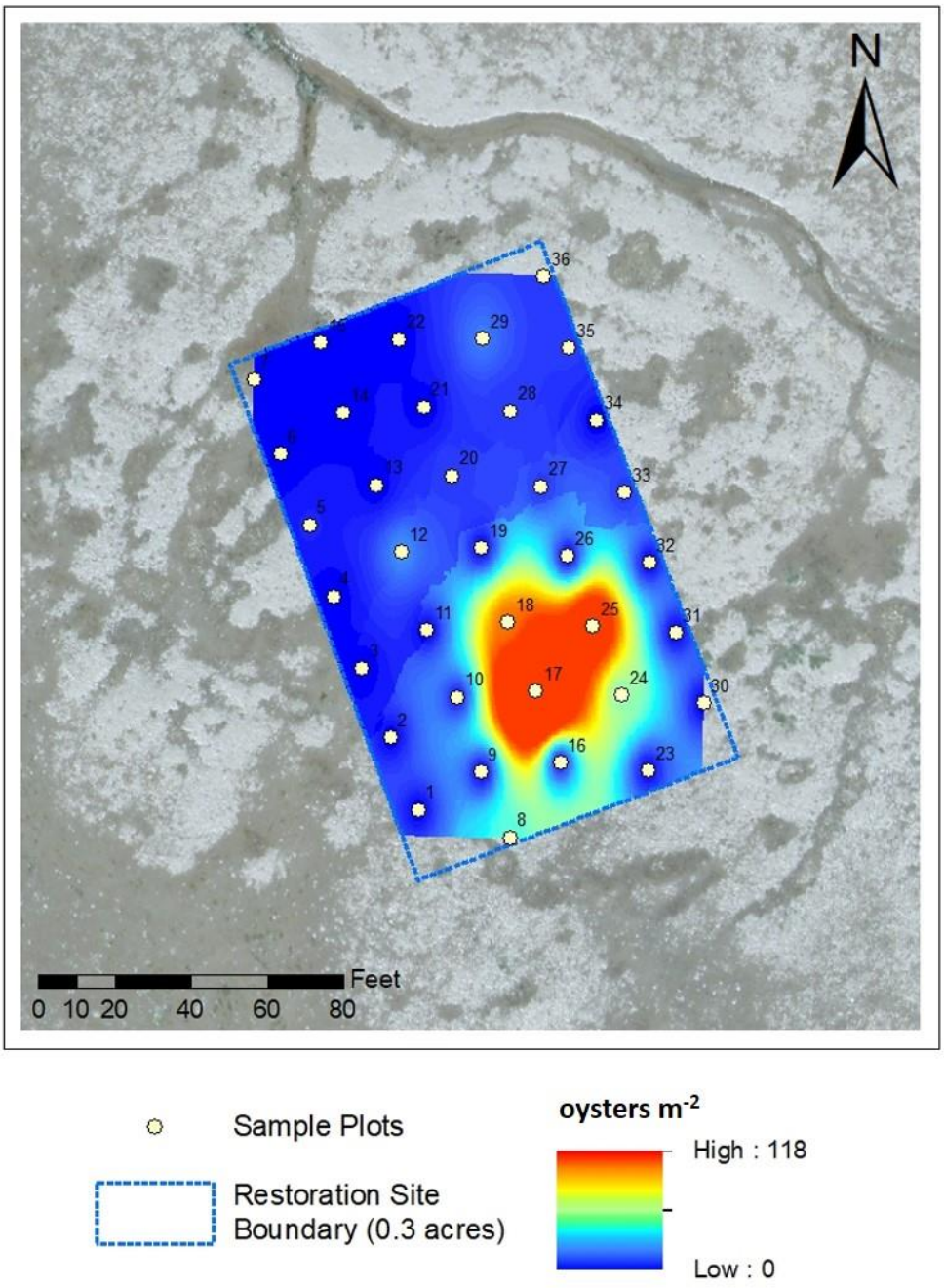

Figure 3. 2019 Olympia oyster density (#/m^2) at the Blyn DNR restoration site in Sequim Bay. Data are interpolated in ArcGIS 10.5.1 using inverse distance weighting. The analysis was masked by the restoration site boundary. Red designates high densities of Olympia oysters within the surveyed area

Olympia Oyster Restoration Test Site Report
USFWS Dawley Property

On October 15, 2018 Jamestown S'Klallam Tribe's Shellfish Biologist and three members of the Clallam MRC (Helle Anderson, Jeff Ward and Ed Bowlby) set up a test plots to assess the suitability of USFWS, Dungeness National Wildlife Refuge, Dawley Unit Tidelands in Sequim Bay, WA for Olympia oyster restoration. The test plots (described below) were checked after approximately 1 year on August 28, 2019 by Jamestown Natural Resources staff (Liz Tobin and Chris Burns) and CMRC Project Coordinator (Helle Anderson) to measure survival and growth of the oysters and provide an assessment that would be used to determine if the restoration effort should move forward on at the Dawley Unit property.

Test Plot Set-up

Two bags of Olympia oyster seeded cultch was transferred from the Jamestown tribal tidelands at the head of Sequim Bay to the Dawley Unit tidelands located approximately 1 km NW of the Jamestown tidelands. The seeded cultch was acquired from the Puget Sound Restoration Fund in summer 2017 overwintered (i.e., "beach hardened") on the Jamestown tribal tidelands until ready for use on the Dawley property. Two types of test plots were established using the two bags of seeded cultch. Bag #1 was cut open and the shell was dispersed within 1 meter of a reference stake at an approximate tidal elevation of 0.0 MLLW. Bag #2 was left in tact and staked to the beach a few meters away at the same tidal elevation. For each test plot, 10 individual shells were randomly sampled from each bag to determine the proportion of dead vs. live oysters and 30 individual oysters were measured to determine baselines for assessment of survival and growth (Table 1: Initial Set-up).

Year 1 Results

After 1 year, Jamestown Natural Resources staff and the CMRC program coordinator returned to the Dawley Unit site to assess Olympia oyster survivorship and growth for each test plot. An estimated 1/3 of the spread cultch (Bag #1) was retained on site and the other 2/3 had "blown out", presumably due to wind and/or wave action. Of the cultch that remained, oyster survivorship was poor with only 15% being alive after 1 year. While survival was initially lower for Bag #1 cultch (44%), the Year 1 assessment still indicates a 52% decline in survival. Oyster survival in Bag #2 (bagged cultch) also decreased substantially from an initial 80% live oyster count down to 23% at the Year 1 assessment (Table 1). The average oyster density also declined from 0.4 to 0.12 oysters per shells for Bag #1 (spread cultch) and from 2 to 1.3 oysters per shell for Bag #2 (bagged cultch). Average oyster shell length measurements marginally increased by a few mm (1-4 mm) over the year for each test plot (Table 1). The spread cultch that was retained (Bag #1) had slightly more growth compared to the bagged cultch (Figure 1).

Table 1: Table of survival and size measurements made for the two plots at time of set-up and at the Year 1 assessment.

		Initial Set-up (10/5/18)				Year 1 Assessment (8/28/19)			
Test Plots	**GPS Coordinates**	**Live (%)**	**Dead (%)**	**Size Range (mm)**	**Average Size (mm)**	**Live (%)**	**Dead (%)**	**Size Range (mm)**	**Average Size (mm)**
Bag #1 (spread)	48.15001, -123.15817	44	56	16-48	29	15	85	21-48	33
Bag #2 (closed)	48.15008, -123.15821	80	20	15-48	32	23	77	17-49	33

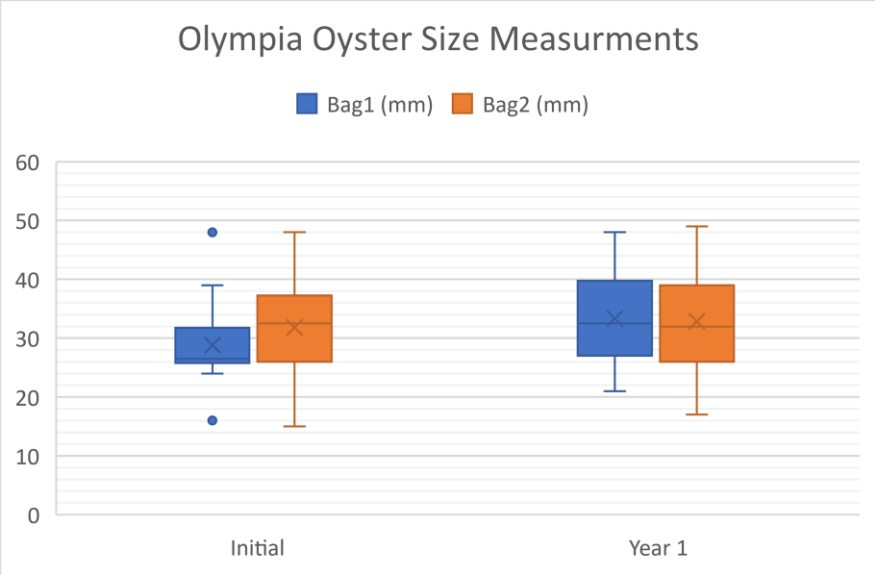

Figure 1. Olympia oyster size measurement upon plot set-up and at the Year 1 assessment.

Summary

The survival and shell length data indicate that Olympia oyster survival and growth were marginal to poor for the two test plots set up at the Dawley property site. It is unclear what environmental conditions contributed to the limited growth and poor survival given then Dawley property is in proximity (~ 1 km) to the Jamestown tidelands where Olympia oyster restoration has been largely successful. Possible contributing factors may include: 1) angle of exposure resulting in more wind/wave energy, 2) a slightly steeper beach slope of >2% and 3) a lack of moist habitats from tidal channels/pools and/or freshwater drainage that Olympia oyster often prefer and is found throughout the Jamestown tidelands. Fine beach sediments also resulted in partial smothering of the bagged cultch which may have enhanced the oyster mortality of that test plot. An additional issue of concern is that extensive eelgrass was observed up to the 0.0 MLLW which may limit the extent of restoration activities and possibly constrain restoration efforts to to occur higher up on the beach than would be ideal.

JST Recommendation

Based on the data acquired from the test plots and from observation made by Jamestown Natural Resources staff, it is our recommendation to Clallam MRC not to go forward with the restoration efforts on the USFWS Dawley Property tidelands.