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Discovery Bay Olympia Oyster Research Project 2010 Field Season Summary Report

For the Jefferson County Marine Resources Committee
Prepared by Karen Lull
September 2010



One-year old Olympia Oysters in Lagoon Drainage Channel. V. Brooks

Introduction:

The 2010 field season commenced January 10th with the continued examination of the Discovery Bay native oyster (*Ostreola chonchaphila*) resource. The first completed task involved the re-tagging of the Growth Rate oysters. The oysters required re-tagging due to the degradation of the labels (fading) and glue failure noted at the end of the 2009 field season. Weekly site visits commenced March 3rd and involved tasks to investigate factors affecting native oyster bed sustainability such as growth rate, mortality, spat settlement, and habitat condition.

The field work and observations associated with these factors are summarized below. Attached to this report are data sheets of pH and salinity measurements and environmental observations; mortality counts; and spatfall observations. Appendix I contains photo-documentation of the 2010 field season. Appendix II contains analysis of the growth rate data and additional 2009 spatfall data. Appendix II is contributed by Sharon Schlentner. These databases have been provided to Dr. Joth Davis (Taylor Resources / Univ. of WA) for further statistical analysis and archiving.

Task 1: Growth-rate Monitoring

On January 10th -12th the Growth Rate oysters were removed from the native oyster bed, placed in a cooler and transported to Taylor Shellfish Laboratory in Quilcene, WA. The oysters were kept overnight in a flow-through water table at ambient bay conditions. The following morning a work station was set up in the laboratory where the oysters were cleaned of epifauna, air dried and labeled with a small “bee tag”. The tags were attached with cyanoacrylate glue. When the glue had set, the oysters were weighed (0.1gram). Height, width, and thickness were measured to the nearest 1mm using vernier calipers. All attached 2009 spat were counted and measured (height only) to the nearest 1mm. When not being handled, the oysters were retained in the water table. On January 12th, all of the oysters were returned to the native oyster bed. The condition of the new tags were assessed on February 4th and found to be in good condition.

A total of 344 oysters were processed (172 Pond oysters were relabeled plus 1 dead; 164 Lagoon oysters were relabeled plus 7 dead). This equates to a fourth quarter September – December 2009) survival rate of 98% (172/175) for the Pond and 96% (171/164) for the Lagoon.

In order to maintain continuity with previous seasonal observations, the Growth Rate oysters were re-examined March 30th (Lagoon) and March 31st (Pond), weights and measurements were recorded as stated above. Attached 2009 spat were also quantified. After all of the measurements were completed, the oysters were placed in shell trays and returned to the pond and drainage lagoon.

A total of 331 oysters were processed (Pond = 137 live; 30 dead; 5 missing. Lagoon = 157 live; 7 dead). This equates to a first quarter January – March) survival rate of 80% (137/172) for the Pond and 96% (157/164) for the Lagoon.

Following the March measurements, the tagged oysters were checked on a weekly basis for mortality and cleaned of silt. Dead oysters were removed from the tray; the shells were measured and examined for any signs that could determine the cause of death

(predation, thinness, etc.). Any dead oysters whose shells had attached 2009 spat were returned to the native oyster bed.

During the second calendar quarter April – June, a total of thirty-two oysters had died (5/lagoon = 4% mortality; 27/pond = 20%). Unlike 2009, very few of the dead oysters showed obvious signs of stress (i.e. thin, weak, and eroding shells). The 37% (175/110) mortality rate sustained in the tagged Pond oysters since September 2009 may be attributable to one or more of these factors: the stress incurred during the re-tagging process in January, aging population, or possible exposure to toxic substances released during the removal of wood waste during 2009 site restoration.

The weight and measurement procedures were repeated September 6th and 7th, near the end of the growing season. Mortality of the tagged oysters was also calculated for the third calendar quarter July – September, and found to be 0% for the pond (N=110) and 2.6% (4/151), for the lagoon (N = 147).

The growth rate data has been entered into a database and delivered to Dr. Joth Davis where he will determine growth rate per age class. Growth increments will be scored and changes in size/age categories will enable the calculation of growth and survivorship and possibly recruitment parameters for this population.

Task 2: Mortality

Mortality observations of selected oysters were conducted on a quarterly basis during the field season. Three shell trays, (pond, NW drainage channel, lagoon tidepool) containing 100 oysters each were placed at the site. The oysters in this study were left to the vagaries of nature and were not “maintained”. After each quarterly count, the number of oysters in each tray is restored to 100.

The 2010 winter and spring mortalities were less than the previous year (see Table 1). The reduced mortality is likely attributable to milder winter – early spring weather. Evidence of thin, weak and eroded shells (such as a hole at the adductor muscle attachment) was still present but not as abundant as the previous year. Mortality associated with winter and early spring stress (freezing temperatures fluctuating with rapid warming) appears most prevalent in March, April, and May. Thin shells and stress due to rapidly warming water appear to be the main factors in the pond mortalities, whereas thin shells and siltation due to migrating drainage channels are the major causes of mortality in the lagoon.

Reduced salinity and pH values were recorded throughout the field season (see attached data sheet) with minimal apparent negative effect on the mature oysters and 2009 spat, though it is possible that these sub-optimal conditions could be a factor in the ability of oyster veligers to form shell and set on cultch.

In 2008 – 2009 several physical changes occurred at the research site such as the removal of the old mill buildings, removal of vegetation from the causeway and partial excavation of contaminated soil. The site restoration work appears to have had very little negative effect beyond some initial increased siltation.

Table 1: Seasonal Mortality

	Date Observed	Pond	Lagoon DC	Lagoon Tidepool
Winter	3/3/10	4%	4%	4%
Spring	6/01/10	6%	7%*	5%
Summer	9/3/10	0%	4%	2%

* Spring mortality in the Lagoon based on 6 dead/86 living with 8 oysters missing.

Task 3: Larval Set Monitoring

In 2009 sampling for the assessment of larval recruitment was changed from using vertical shell strings to the use of cultch trays with great success. The samplers consist of clean labeled Pacific oyster shells contained in plastic trays that are strategically located within the native oyster bed in both the sub tidal pond and the drainage lagoon. These samplers were again used for the 2010 field season.

The timing of deployment was based on oyster spawn condition, water and air temperatures, and knowledge gained through previous field seasons. Initial deployment was May 12th. The trays were installed at locations containing the highest density of native oysters. Five trays were located in the NW drainage channel of the lagoon at tide heights ranging from approximately +1.0' to +3.5'; one tray was located at the base of the large seep just above the seasonal tidepool (approx. +1.5') in the lagoon. The lagoon trays each contained 15 cultch shells for a total of 90 shells. Three trays were installed in the sub tidal pond (one large tray with 45 shells on the east side and two smaller trays (containing 23 and 22 shells each) near the tide gate, for a total of 90 cultch shells. In order to standardize the area available for spatfall between the tray locations, cultch shells were selected to be of similar size and weight and each batch of 15 shells had a dry weight in the range of 500 – 600 grams. In the drainage lagoon the trays were installed slightly below grade to ensure, at a minimum, the underside of the cultch would remain wet through much of the low tide cycle.

The cultch shells were left in place during the spawning season and a small sample of oysters was examined on a weekly basis to determine spawn condition. Sampling events involved selectively gathering up to six of the larger individual oysters from each area (pond and lagoon) and shucking them in the field. Oysters were observed under magnification (field loupe a/o field microscope) for signs of ripeness, visible eggs, sperm balls, or brooding. Once brooding and spent oysters were observed, the cultch shells were thoroughly examined for the presence of spat. The examined oysters appeared healthy and spawning proceeded as expected. Unfortunately, no spatfall was observed this season. Additionally, there was a significant lack of other young epifauna on the cultch (such as barnacles, mussels, clams). A few young limpets were observed, but those sustained high mortality.

Chronology of 2010 Spawning Condition and Spatfall

- 5/12 – oysters in active stage (gonad plump and bright)
- 5/19 – white sick (eggs observed in mantle) both pond and lagoon
- 5/26 – white sick; black sick (late stage brooding) and spent oysters observed
- 5/31 – begin weekly examination of cultch shells 6/4 – 6/23 all plankton samples contain oyster larvae (all less than 5 days old)
- 6/3 – 7/28: no spat observed

Reduced salinity and pH values were recorded throughout the field season (see attached data sheet) with particularly low measurements (pH 7.28/sal 30ppt pond; 7.34\ 30ppt pond; 7.41\24ppt nw drainage; 7.61\21ppt lagoon tidepool) occurring on May 26th, the day late stage brooding and spent oysters were observed. It is possible that these sub-optimal conditions could be a factor in the ability of oyster veligers to form shell and set on cultch (per Dr. Joth Davis, personal communication, 6/02/2010). Comprehensive knowledge of all the physical and environmental conditions required for successful larval recruitment continues to be elusive.

2009 Spatfall: Continued observations

In late winter (3/4/10) all of the 2009 spat were counted and measured. A few cultch shells from each location were selected and retained in the shell trays through the growing season. All of the remaining cultch with attached spat was placed in the native oyster bed. Measurements of the retained spat were repeated in late summer (8/25/10). Table 2 summarizes the growth and survival of the selected spat.

Table 2: 2009 Spat growth and Survival (selected cultch only).

Location	# of cultch shells	# of Live Olympia oysters		Shell Height (mm)		
		3/4/2010	8/25/2010		3/4/2010	8/25/2010
Lagoon	14	100	96	Min.	2	6
				Max.	32	47
				Avg.	16	28
				Med	16	29
Pond	12	49	45	Min.	5	21
				Max.	35	47
				Avg.	20	37
				Med	18	33

		Shell Height	
		Δ (mm)	% Increase
Lagoon	Min.	4	200%
	Max.	15	47%
	Avg.	12	75%
	Med	13	81%
Pond	Min.	16	320%
	Max.	12	34%
	Avg.	17	85%
	Med	15	83%

The solitary 2008 spat captured on cultch increased 20% in height this season (35mm to 42mm). Many of the larger spat are beginning to develop the characteristic cup shape of the Olympia oyster. Looking at the limited data set, it appears that spat gain the majority of their shell height during the first year of life (in this case 7/2009 through 8/2010), then the rate of height gain slows and the overall shell thickens.

Task 4: Habitat Condition

Temperature

The two continuous recording thermographs that were installed in the native oyster bed on 1/13/06 continue to collect tideland temperature data in the drainage lagoon and the sub tidal temperature of the mill pond. The thermographs were checked on a weekly basis through the field season and the data periodically downloaded by Dr. Joth Davis. The data is archived at Taylor Shellfish Laboratory in Quilcene, WA, and will be used by Dr. Davis to correlate water temperature to oyster population condition and behavior.

Salinity

Salinity was measured on a weekly basis March through early September using a refractometer. The measurements were taken directly above the oysters contained in the shell trays located in the NW drainage channel of the lagoon; the seasonal tidepool in the lagoon; the east side of the mill pond and the tide gate area of the mill pond. The salinities range from 9–34 ppt, with an average of 28 ppt (see attached data sheet). The seasonal tidepool receives large amounts of freshwater during spring runoff (March – early June) and would occasionally have low salinity (10-15ppt) sustained during low tide cycles. This same location regularly has suppressed salinity (20-25ppt), due to a lens of fresh water (from Snow / Salmon Creek) brought in on flooding tides. The concentration of fresh water in the tidepool is a function of the tide flat topography and is quickly ameliorated when the marine water breeches the tidepool. Reduced salinity (13-25ppt) was frequently observed in the NW drainage channel of the lagoon and can be attributed to a fresh water lens that drains from the surface of the mill pond as the tide falls. The fresh water accumulates in the pond from rainfall and seeps (originating from an adjacent pond). This fresh water drainage may be the cause of shell etching and erosion observed in the drainage channel. Salinity was also measured just outside the drainage lagoon in Discovery Bay and consistently found to be 30-35ppt.

On March 4th several seeps that flow at the head of the sub-tidal mill pond were measured for salinity to determine if freshwater was being released from the large freshwater pond south of the research site (see aerial photo in Appendix I). The salinity of these seeps was found to consistently be 15-17ppt. Seeps in the area of the old tide gate measured 22-25ppt, indicating freshwater input. Seeps draining into the lagoon along the former railroad causeway measured 30ppt, indicating a minimal amount of freshwater input.

This data is of interest because reduced salinity can have a negative impact on the health of the native oyster population. The North Olympic Salmon Coalition (NOSC) has discussed the possibility of re-contouring a portion of the railroad causeway which would allow the pond to drain and restore the freshwater input to a free flowing creek. This habitat improvement would be beneficial to salmon and very likely increase salinities for the benefit of the oyster population.

pH

pH was measured on a weekly basis March through early September using a portable field meter. The meter is accurate to 0.05 pH with a resolution of 0.01 pH. It automatically compensates for temperature. Measurements were taken directly above the oysters contained in the shell trays located in the NW drainage channel of the lagoon; the seasonal tidepool in the lagoon; the east side of the mill pond and the tide gate area of the mill pond. Measurements were taken on both neap and spring tides; ebb and flood tides. Three values were read for each sample site and then averaged. The probe was rinsed with a small amount of the sample prior to recording the value.

Water that is impounded in the pond through the low tide cycle, as well as water flowing over the oysters in the drainage lagoon consistently measure pH below that of Discovery Bay (Avg. = 8.12 measured at the old railroad trestle just prior to entering the lagoon). The Average pH for all sample sites was 7.71. The Minimum pH value of 7.28 was recorded near the old tide gate of the mill pond. The Maximum pH value of 8.08 was recorded in the Lagoon tidepool and occurred on a day with particularly high fresh water input from a seasonal creek (4/05/10). See attached data sheet for additional environmental conditions.

The persistent sub-optimal pH values at this site are a concern and the cause has not been ascertained. The cause may be from buried wood waste, changing marine conditions, biological actions (bio-films, bacteria, etc.) or other unknown factors. It is possible that the sub-optimal pH values could be a factor in the ability of oyster veligers to form shell and set on cultch, thus limiting the sustainability of the population. The situation warrants further investigation.

Physical Changes to the Research Site

A large tide pool has formed at the mouth of the drainage lagoon and extends to the east of the railroad bridge (bayside). The tide pool formed as sediment transported by Snow Creek built a shoal partially across the mouth of the drainage lagoon. This pool is retained even on minus tides and may provide additional oyster habitat if the substrate were enhanced with gravel and / or shell hash. See Appendix I for photos.

Additional restoration to the site has been proposed by The North Olympic Salmon Coalition (NOSC) including recontouring a portion of the railroad causeway, planting native vegetation, and removing the old tide gate. The benefits of recontouring the causeway is discussed above (see Salinity). The removal of the tide gate will improve the oyster habitat by widening the drainage channel from the sub-tidal pond into the drainage lagoon, allowing more gravel to be washed of sediment during tide changes. A greater area of washed gravel will provide additional suitable substrate for spat settlement, a limiting factor for this population.

Miscellaneous Activities

On June 2nd a native oyster survey and population estimate at the Discovery Bay research site was conducted by biologists Joth Davis (Taylor Resources) and Brian Allen (Puget Sound Restoration Fund) and assisted by myself. Results are reported under separate cover. See Appendix I for photos.

On June 15th at Seal Beach State Park training was provided to several Marine Resource Committee volunteers from around the Salish Sea on the methodology and equipment usage for conducting Olympia oyster Presence/ Absence surveys. The training was lead by Brady Blake of Washington Department of Fish and Wildlife and Betsy Peabody of Puget Sound Restoration Fund and assisted by myself and Sharon Schlentner. The training was comprehensive and included:

- Identification
- GPS
- Tide Height measurements
- Population survey (density, spatial distribution, spat)
- Habitat description
- Haphazard sampling methods

Appendix I
Discovery Bay Olympia Oyster Research Project
2010 Field Season Photo-documentation



Photo 1: Research Site



Photo 2: Re-tagging growth rate oysters in January. S. Schlentner



Photo 3: Karen checking spawn condition. S. Schlentner



Photo 4: Early stage brooding (white sick). S. Schlentner



Photo 5: Late stage brooding (black sick). S. Schlentner



Photo 6: High mortality in tagged pond oysters (March - May). S. Schlentner



Photo 7: NW Drainage channel; note channel migration, tray with pvc stake is now partially out of the water due to silt buildup. S. Schlentner



Photo 8: Channel migration filled tidepool with silt.

S. Schlentner (both)

Photo 9: Tray placement in the sub-tidal pond, note water clarity.





Photo 10: Tray placement in the Lagoon (NW drainage at left; seep and tide pool to right; tide gate at bottom). S. Schlentner



Photo 11: 2009 spat on cultch (March 2010) S. Schlentner



Photo 12: 2009 spat on gravel (July 2010). S. Schlentner



Photo 13: 2009 spat on tagged Olympia oyster (July 2010). S. Schlentner

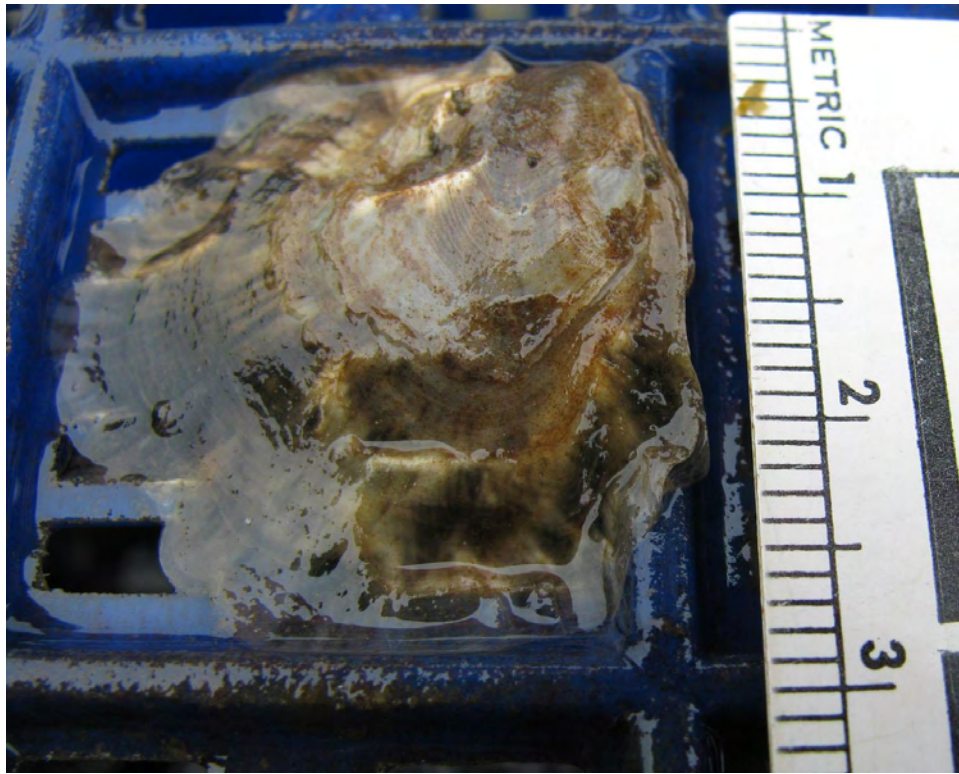


Photo 14: 2009 spat on bottom of cultch tray (July 2010). S. Schlentner



Photo 15: Sharon measuring pH at tidepool. K. Lull



Photo 16: Large tide pool beneath railroad trestle that may provide additional suitable Olympia oyster habitat (-1.8' tide). S. Schlentner



Photo 17: June 2010 Population Survey (Brian Allen snorkeling, Joth Davis looking on). K. Lull



Photos 18 & 19: June Population Survey, yellow flags are place to delineate extent of population in pond (top) and drainage Lagoon (bottom) K. Lull





Photo 19: June Population Survey. Joth Davis collects a sample using the haphazard method. K. Lull



Photo 20: B. Blake (WDFW) explains how to conduct native oyster surveys to volunteers at Seal Beach State Park. S. Schlentner



Photo 21: Measuring tide heights at Seal Beach training event. S. Schlentner



Photo 22: Volunteers practicing sampling methods, assisted by Betsy Peabody of PSRF (lower right). S. Schlentner