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Whatcom County Clam Surveys 2004-2006

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for
Whatcom County Marine Resources Committee

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Abstract

The Marine Resources Committee (MRC) of Whatcom County is made up of a diverse group of citizens, who share conservation, recreation, economic, local governmental, and tribal interests in the marine habitat. The MRC identified a shellfish inventory of Whatcom County shorelines as a high priority project and embarked on planning and implementation of clam surveys. Beginning in 2004, the MRC, Whatcom County Staff, and local volunteers, have conducted three clam surveys each summer and have inventoried the majority of shorelines of Whatcom County. Baseline data of the types and number of clams in Whatcom County can be used to assess the health of clam populations, compare against historical records and future survey data, and identify potential clam enhancement areas. Other data collected on these surveys include substrate, vegetation, and notes on shoreline conditions. This information is also valuable in community outreach efforts focusing on the protection of shellfish resources.

This report describes the procedures used to implement the shellfish inventory project, survey sampling methods, discusses improvements and challenges posed by this project, and addresses logical next steps in regards to clam enhancement.

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Introduction

In order to protect and preserve our marine resources, we need to have adequate information about the current status of those resources. Shellfish - those both recreationally and commercially harvested - are a key marine resource for Whatcom County. The Whatcom County Marine Resources Committee (MRC) Data Management Subcommittee reviewed a data gap analysis done as part of the 2002 Action Grant. Based on this review, the subcommittee determined that gathering current data on shellfish in Whatcom County (at the species level) would be an appropriate next step for the Whatcom County MRC. In addition, the Whatcom County MRC has ranked the original Northwest Straits Commission benchmark for shellfish as a high local priority. Accurate shellfish survey data and comparison of these data to historical records will help the MRC evaluate locations and shellfish species to target for future reseeding and enhancement projects.

To address the data gaps in shellfish populations, the MRC, with the help of volunteers and Whatcom County staff, has been conducting clam surveys along the shorelines of Whatcom County for three years, as summarized below:

- 2004: Birch Bay, Semiahmoo Spit, and Mud Bay in Chuckanut Bay.
  Birch Bay is one of the largest recreational shellfish harvesting areas in Whatcom County. Birch Bay is currently on the Washington State Department of Health (DOH) shellfish area watch list as "threatened". A threatened status indicates that the DOH has noticed a downward trend in water quality at least one of their regular sampling sites in the bay.

  Drayton Harbor/ Semiahmoo Spit has historically provided tribal, commercial, and recreational shellfish harvesting opportunities. Portions of Drayton Harbor were closed to shellfish harvesting due to poor water quality in 1995. In 1999, the entire harbor was closed. Efforts to improve water quality have been underway for several years and levels of fecal coliform bacteria have been decreasing in many areas of the watershed and harbor. Due to these efforts and improvements in water quality, in 2004 a portion of Drayton Harbor was upgraded to a conditionally approved status.

  Areas of Chuckanut Bay were closed to shellfish harvest in 1994 after tests showed high counts of fecal coliform bacteria. Improvements have been made to protect water quality, such as surveying and upgrading septic systems, but there is still more work to be done to protect water quality and the shellfish resources.

- 2005: Marine Park in Bellingham, Birch Point, and Point Whitehorn/Cherry Point.
  Marine Park has historically been a popular clamming beach for Bellingham residents, however urban sources of pollution are a concern. With the recent restoration of the park's shoreline by the Port of Bellingham, a survey of the current clam population will provide information for comparison in future surveys.

  The Birch Point survey area helps fill the survey area gap between the Semiahmoo Spit/ Drayton Harbor and Birch Bay surveys conducted in 2004. While there are not many specific sites in this area known for clamming, there are pockets where the substrate may provide ideal habitat.

The Cherry Point area, while not particularly known for clamming, offers pockets with potential, but involves extra effort in accessing and digging its remote cobble beaches. A survey of the Cherry Point area shoreline will help provide a better understanding of the distribution of the shellfish resource. Collectively, the clam surveys help offer a comparison of clam populations among different locations and substrate types. Surveys also document the status of newcomers such as the rapidly spreading varnish clam.

- 2006: Marine Park in Blaine, Lummi Island, and Point Roberts.
  Marine Park in Blaine provides extensive tideflats adjacent to the Canadian border. Most of these tideflats are a mud/sand mixture which support fewer types of clams, however there are several pockets of gravelly substrate.

  A significant amount of Lummi Island's tidelands are in pblic ownership. However, there are relatively few areas with public access to the tideflats. There are several small beaches that have been noted as supporting manila and native littleneck clams, however few surveys have actually documented this.

  Point Roberts has several areas with extensive tideflats as well as several shorter beaches with gravelly substrate. This survey provided the MRC with an opportunity to work in this northwestern portion of Whatcom County which is separated from the rest of the county.

With the completion of the 2006 surveys, shellfish populations along the majority of feasible Whatcom County shorelines have been surveyed. Consequently, shellfish populations that were not previously documented now have baseline information to which future surveys can be compared. As proposed by the MRC Shellfish Subcommittee, the shorelines will be resurveyed every three to five years to continue learning about the health of shellfish populations. This project is also a success, in that it engages the community in marine resource issues and allows the public to take part in improving the health of the community and environment.

Methods and Materials

The methodology described in Procedures to determine intertidal populations of *Protothaca staminea*, *Tapes philippinaruym*, and *Crassostrea gigas* in Hood Canal and Puget Sound, Washington (WDFW 1996) was used as a model when designing the MRC clam surveys. While this methodology is designed to sample for only two species of hardshell clams, it provides guidance for the sites sampled through this survey.

Volunteers

Volunteers were utilized to implement clam surveys. All volunteers received training on the survey methods and were coordinated by Whatcom County Public Works-Stormwater Staff and Whatcom County MRC Clam Subcommittee members. Outreach to prospective volunteers was done prior to clam surveys by presenting to community groups, attending community events, posting flyers and sending notifications to e-mail lists. Volunteers were recruited, contacted, and assigned to the survey location(s) according to their interest. Volunteers worked in teams of two or three with distinct roles as surveyor or sampler. Surveyors were trained to follow protocols of the survey, including pacing along transects and setting flags consistently at each sample hole out to the waterline, digging sample holes, and recording data on the field sheet. The samplers were trained to identify, distinguish and sort clam species, and note substrate, vegetation and other important information on the field sheet. Samplers typically had previous experience with clams or keying out other species.

Field packets were compiled to assist the team conduct the survey correctly. Field packets included:

- Beach maps with overlain transect lines.
- Transect descriptions to help each team find their assigned transect(s.)
- Sample field sheet and protocol sheet.
- A clam identification card with 1.5 inch measurement line.
- A copy of the Scientific Collection Permit.
- An (FAQ) sheet listing frequently asked questions and answers.

Additionally, rovers that were experienced with clam identification and the survey techniques roamed the tideflats and were available during the surveys to help answer survey team questions.

Sampling Design

Clam surveys provide estimates of numbers and sizes of clam species on shorelines of Whatcom County. A systematic random design was utilized to obtain representative clam population data. At each location surveyed, the same density was sampled from boundary to boundary and from the top of the clam band to the water line. The approximate location of the clam band was found by noting changes in the substrate conditions and test holes. All surveys took place during a four-hour period centered on a low tide event of -1.0 ft or less MLLW.

Surveys were conducted along transects established prior to the survey using maps, Geographic Information System (GIS) software, and compass bearings. A “best fit” line, which runs parallel to the shoreline and represents the overall trend of the shoreline, was drawn on a GIS map. Transects were subsequently drawn perpendicular to the “best fit” line, and stretched from the top of the clam band to the waterline. For distinct changes in the shoreline direction (e.g. spits,

points, or bays) transects were placed parallel to the "best fit" line, creating a grid system. To ensure a systematic random collection, the starting point of each transect was assigned a random number of paces out from the top of the clam band and sample sites were staggered along transects throughout the beach. Transects are spaced 400 to 1320 feet (1/4 mile) apart and flags are laid every 40 or 100 feet along the transects to the waterline. Distance between transects and sample holes were determined prior to each survey based on area of shoreline surveyed and amount of volunteers participating in the clam survey.

Sampling Methods

Over the course of three years, adaptations were made to the basic protocol either to give better, more descriptive direction to volunteers or to better suit the particular sampling areas. Throughout the survey duration, the WDFW (1996) protocols were used as a template and should be referred to for further details.

The basic steps to surveys conducted in 2004 and 2005 are listed below:

- Survey staff placed surveys flags at the beginning of each transect prior to the surveys.
- The first survey sample site on the transect was determined using a random numbers table. The following sample sites were placed at regular intervals along the transect.
- A 12 inch circlular quadrat was used for each sample site. The survey hole was one foot deep.
- Shellfish were sorted by species and as larger or smaller that 1.5 inches (in accordance with harvesting sizes) in the field using a caliper. Numbers of species were recorded for each size category. Substrate and vegetation were also noted.
- All clam species and size categories were recorded on a field data sheet.
- The Whatcom Coutny MRC did not collect or remove clams for sample processing. Shellfish were replaced and the hole was refilled.

In 2004, the transect starting points were recorded sing a GPS unit. In 2005 and 2006, all sample sites were recorded using a GPS unit. The following additional adjustments to the 2004 and 2005 survey protocols were made in 2006 to accommodate surveys with extensive tideflats and provide more flexibility logistically.

- Survey staff placed surveys flags at the first sample site of each transect prior to the surveys. This assisted with reducing confusion about the placement of the first sample site based on the random numbers table.
- Volunteers paced out the first interval, set a flag (marked with the sample site number) at the left foot and continued in this manner to the waterline setting all survey flags prior to digging and inventorying clams.
- Once the water line is reached, the teams returned along the transect sampling clams at each flagged location until the starting point is reached. This allowed two sample teams to cover the longest transects.
- Clams werere measured with a 1.5 inch measurement line on their clam identification card.

At the sample site, a 1-foot circular quadrat or hoop was set with the flag in the center. The team counted the number of horse clam holes, substrate, water, and vegetation characteristics and

recorded the information on the data sheet. The hole was excavated one foot deep and to the size of the quadrat. The excavated substrate was placed on a tarp and sorted for clams. Clams were categorized on the tarp by species, measured, and the information was recorded on the data sheet. Clams were returned to the sample hole and the hole refilled with the substrate. The flag was returned to the refilled hole so a Global Positioning System (GPS) data point could be collected. Teams continued these steps as they surveyed the entire transect, then moved to the next assigned transect or turned in materials and data sheets if the survey was complete.

Survey materials included:

- The appropriate number of surveyor's flags labeled with the sample site number.
- Clipboard with field packets and field data sheets.
- Compass.
- Quadrat hoop 1 foot diameter.
- Shovels and tarp.

Recording Data

Volunteers were provided instruction on filling out the field data sheets completely and accurately in the training session. The header on the field data sheet includes information such as location, sampler and surveyor, foot pace, date, low tide time and height, compass bearing, transect number, completion time and comments to note weather and shoreline conditions. Most of the header information is completed prior to conducting the survey to ensure accuracy. Each of the following are noted on the field data sheet: substrate type, presence or absence of vegetation, presence or absence of 1 foot or more of water, clam species and size classification, and comments. Clam species are recorded on the data sheet as greater or less than 1.5 inches. Clam species included on the field data sheet are horse (indicated by presence of horse clam holes), varnish, manila, native littleneck, macoma, cockle, butter, and Eastern softshell. Emphasis is placed on noting the presence or absence of clams at each sample hole, as a zero provides more information than a blank entry. Field data sheets are briefly reviewed when teams are finished to reduce errors and ask questions while the information is fresh.

Whatcom County staff took GPS coordinates during the surveys. The 2006 adaptation to survey protocols, allowing teams to first lay out flags and sample on the way back towards the shoreline, provided a larger window of opportunity for staff to collect GPS data points.

Field data sheets and GPS data points were entered into Excel spreadsheets shortly after the survey day for data efficient processing. GPS coordinates were added to maps using GIS software and display each sample hole at a survey location. GPS coordinates were used to map the clam data and can be used in future follow up surveys to relocate survey areas.

Results

Clam surveys were conducted at nine locations during consecutive summers between 2004 and 2006. Descriptions of survey findings are provided below.

Birch Bay

The Birch Bay clam surveys were conducted on June 6, 2004. Twenty-five people assisted with the survey covering twelve transects. Transects began near Birch Bay State Park and were sited every ¼ mile around the Birch Bay shoreline to just east of the Birch Bay Village Marina. This survey area covered primarily the portion of tideflats with sand substrate in Birch Bay.

Transects ran from the upper part of the beach where clams were first found to the water line at low tide. Transects ranged in length from about 500 to 4,800 feet (or 0.1 to 0.9 miles) with 6 to 49 sample holes.

Table 1. Birch Bay 2004 Clam Survey- Number of Clams by Transect and Type

Transect	Varnish	Manila	Native Littleneck	Macoma	Cockle	Butter	Eastern Softshell	Horse	Total Clams
1a	1	0	1	6	1	0	0	0	9
2	4	0	2	20	1	2	0	2	31
3	4	2	4	9	1	0	0	3	23
4	102	0	0	23	1	3	1	1	131
5	11	0	1	36	1	0	0	1	50
6	106	0	0	15	0	0	0	0	121
7	120	1	2	37	2	11	11	2	186
8	226	4	0	40	0	0	0	0	270
9	156	0	2	11	0	0	0	0	169
10	35	2	2	13	1	0	1	1	55
11	0	0	1	2	1	1	0	3	8
12	0	0	0	0	2	0	0	0	2
Totals	765	9	15	212	11	17	13	13	**1055**

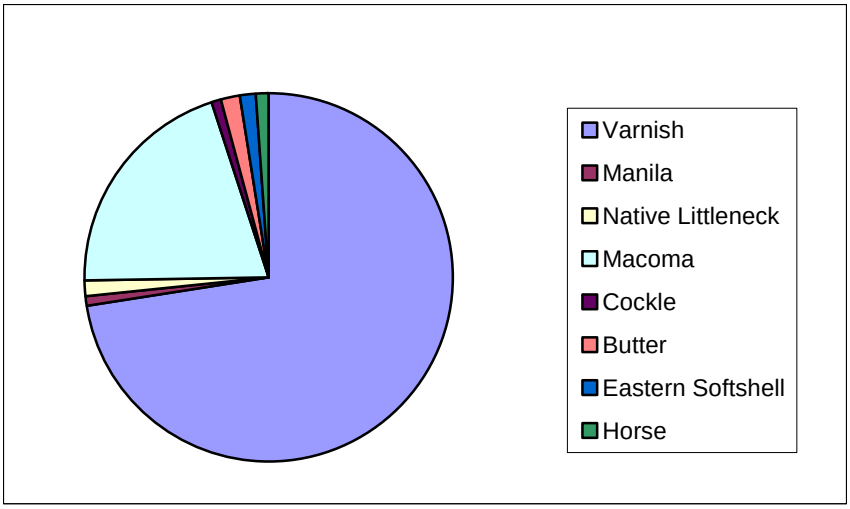


Figure 1. Birch Bay 2004 Clam Survey- By Species. The majority of clam species found at Birch Bay were varnish and macoma clams. Small amounts of native littleneck, manila, cockle, butter, Eastern softshell, and horse clams were also found at this location.

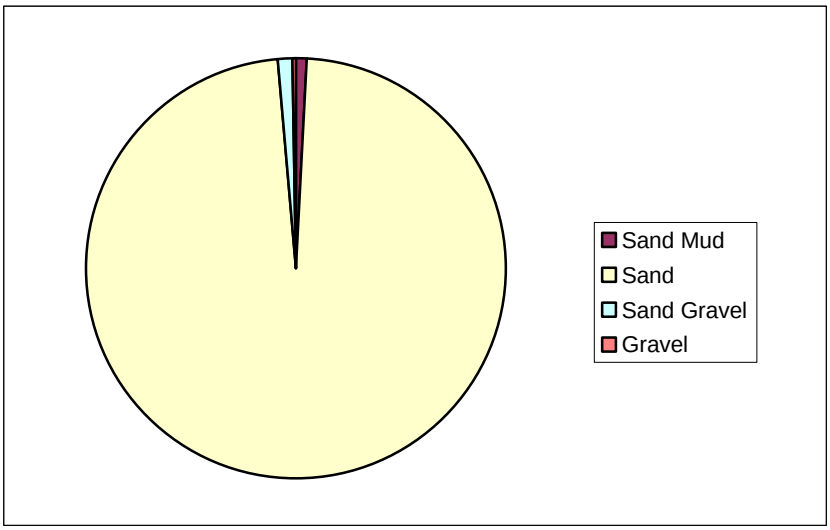


Figure 2. Substrate Types at Birch Bay Survey Area. The dominant substrate recorded at Birch Bay was sand. Very little mixed sand and mud, mixed sand and gravel, and gravel were also recorded at this location.

Semiahmoo Spit

The Semiahmoo Spit clam surveys were conducted on July 16 & 17, 2004. Twenty-four people assisted with the survey covering fourteen transects. Transects began near the Semiahmoo Spit County Park (on the outside of the spit) and were sited every 1/8 mile around the spit to a site across from the County park on the inside of the spit.

Transects ran from the upper part of the beach where clams were first found to the water line at low tide. Transects ranged in length from about 40 to 1,680 feet (or 0.01 to 0.3 miles) with 2 to 43 sample holes.

Table 2. Semiahmoo Spit 2004 Clam Survey- Number of Clams by Transect and Type

Transect	Varnish	Manila	Native Littleneck	Macoma	Cockle	Butter	Eastern Softshell	Horse	Total Clams
1	0	0	5	0	0	8	2	1	16
2	0	1	8	2	1	0	0	1	13
3	1	2	0	4	0	2	0	1	10
4	0	26	21	35	3	1	13	8	107
6	14	13	46	0	2	35	0	0	110
8	0	1	59	20	3	35	12	8	138
9	0	0	3	2	1	0	21	3	30
11	41	61	69	1	2	42	13	0	229
12	0	0	1	5	1	5	2	0	14
13	0	0	6	0	0	0	1	0	7
14	7	0	0	12	0	2	2	0	23
15	31	0	0	0	0	0	0	0	31
16	15	0	0	0	0	0	0	0	15
Totals	109	104	218	81	13	130	66	22	**743**

Surveys were not conducted at transects 5, 7, and 10.

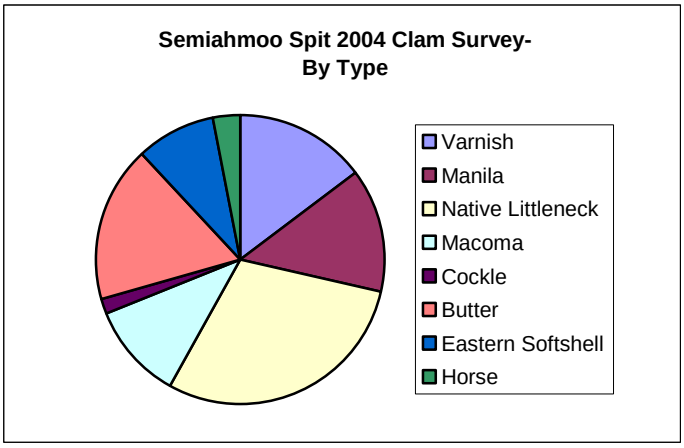


Figure 3. Semiahmoo Spit Clam Survey – By Species.
A wide variety of clam species were found at Semiahmoo Spit. The majority of clam species found at this location were native littleneck, followed closely by butter, manila, and varnish clams. Small amounts of macomas and Eastern softshell and few horse and cockle clams were also found at this location.

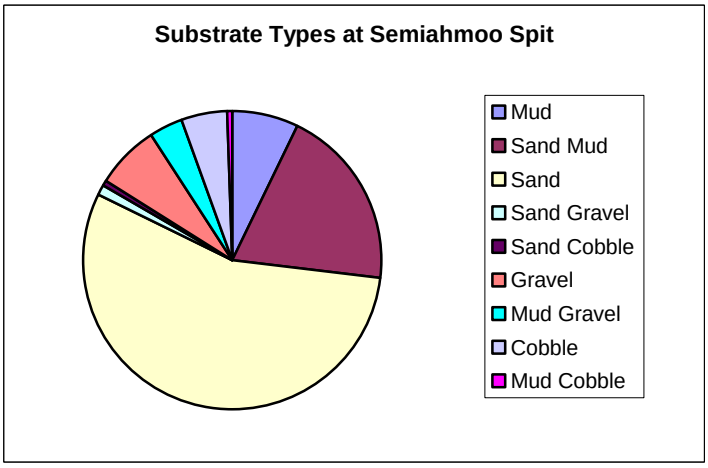


Figure 4. Semiahmoo Spit Survey Area Substrate Types.
A wide variety of substrate types were recorded at Semiahmoo Spit. The dominant substrates were sand and mixed sand and mud. Smaller amounts of mud, gravel, cobble, and mixed mud and gravel were recorded at this location. Very little mixed sand and gravel, mixed sand and cobble, and mixed mud and cobble were also recorded at this location.

Mud Bay in Chuckanut Bay

The Mud Bay (northern section of Chuckanut Bay) clam surveys were conducted on August 24, 2004. Nine people assisted with the survey covering six transects. Transects began near the railroad trestle on the west side of the bay and were sited every 1/8 mile around the shoreline to about the public access point.

Transects ran from the upper part of the beach where clams were first found to the water line at low tide. Sample holes were located every 40 feet along each transect. Transects ranged in length from about 400 to 1,160 feet with 11 to 30 sample holes.

Table 3. Mud Bay in Chuckanut Bay 2004 Clam Survey- Number of Clams by Transect and Type

Transect	Varnish	Manila	Native Littleneck	Macoma	Cockle	Butter	Eastern Softshell	Horse	Total Clams
1	5	27	3	3	0	0	1	0	39
2	0	0	82	4	0	20	4	0	110
3	0	16	70	55	0	18	1	1	161
4	4	104	19	56	0	6	11	0	200
5	0	69	9	71	0	0	26	1	176
6	3	8	1	33	0	0	1	1	47
Totals	12	224	184	222	0	44	44	3	**733**

Figure 5. Mud Bay Clam Types.
The majority of clam species found at Mud Bay were manila, macoma, and native littleneck clams. Small amounts of Eastern softshell and butter clams and very few varnish and horse clams were also found at this location.

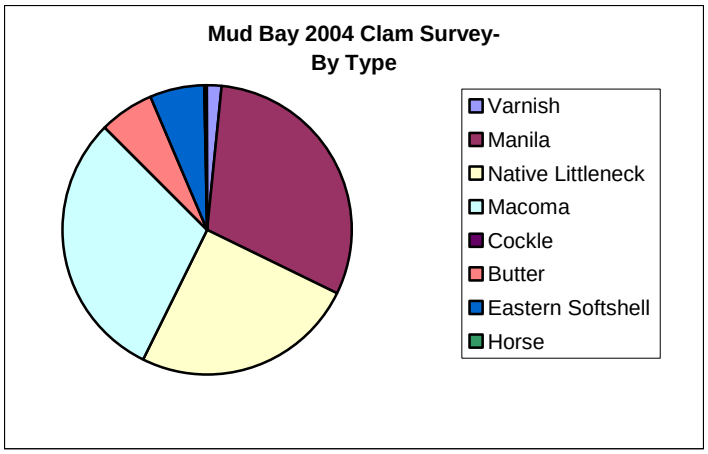
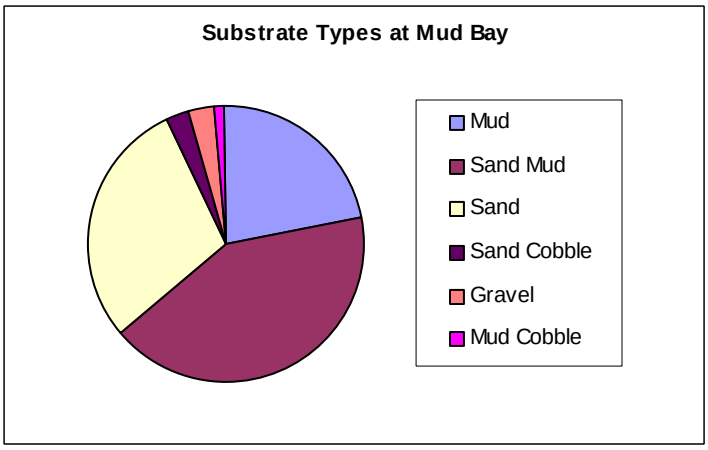


Figure 6. Substrate Types at Mud Bay.
The dominant substrates recorded at Mud Bay were mixed sand and mud, sand, and mud, respectively. Small amounts of gravel, mixed sand and cobble, and mixed mud and cobble were also recorded at this location.



<u>Marine Park in Bellingham</u>

The Marine Park clam surveys were conducted on May 26, 2005. Thirteen people assisted with the survey covering thirteen transects. Transects began at the north end of Marine Park and continued south along the shoreline at 200 feet increments.

Transects ran from the upper part of the beach where clams were first found to the water line at low tide. In comparison to other sites surveyed, transect for this survey were relatively short. Transects ranged in length from about 80 to 240 feet with 2 to 8 sample holes.

Table 4. Marine Park Bellingham- 2005 Clam Survey- Number of Clams by Transect and Type

Transect	Varnish	Manila	Native Littleneck	Macoma	Cockle	Butter	Eastern Softshell	Horse	Total Clams
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	3	0	1	4
3	0	0	2	1	1	6	0	2	12
4	1	5	10	4	4	21	0	1	46
5	0	0	9	0	2	15	2	9	37
6	0	0	2	2	1	5	5	0	15
7	0	2	55	3	1	9	0	3	73
8	1	0	14	0	1	1	0	0	17
9	0	0	5	0	1	1	0	0	7
10	0	0	1	1	0	1	0	0	3
11	0	0	6	0	0	1	1	0	8
12	0	0	12	0	0	3	0	0	15
13	0	0	2	0	0	1	0	0	3
Totals	2	7	118	11	11	67	8	16	**240**

Figure 7. Clam Types at Marine Park Bellingham. The majority of clam species found at Marine Park Bellingham were native littleneck. Butter clams were the next most abundant and manila, macoma, cockle, horse and Eastern softshell clams were found in small quantities. Very few varnish clams were found at this location.

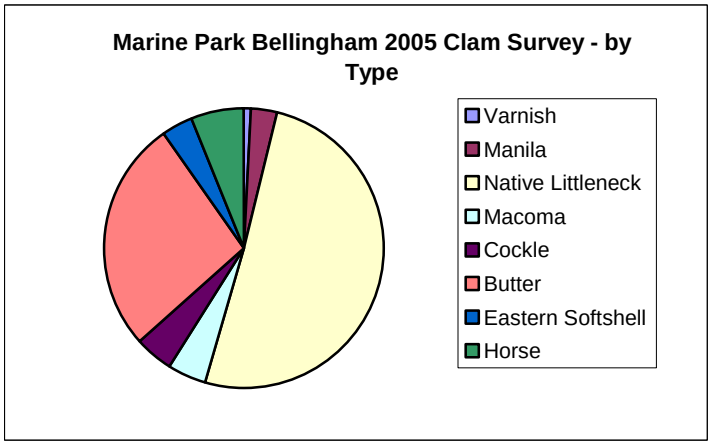
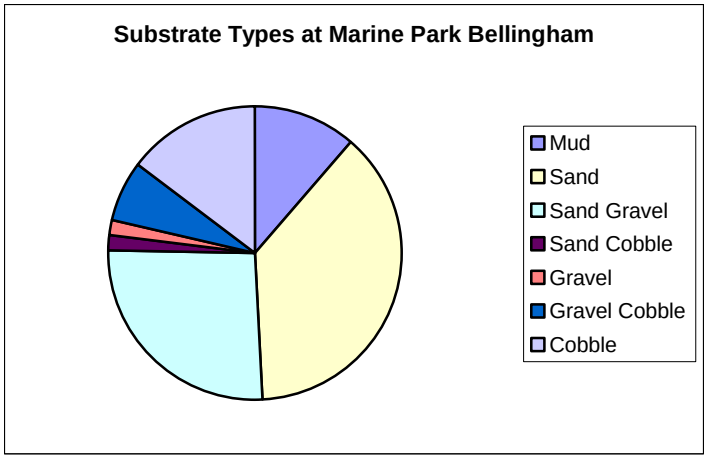


Figure 8. Substrate Types at Marine park Bellingham. The dominant substrate recorded at Marine Park Bellingham was sand, followed by mixed sand and gravel. Small amounts of mud and cobble and very little mixed gravel and cobble and mixed sand and cobble were recorded at this location.



Birch Point

The Birch Point clam surveys were conducted on June 23, 2005. Seventeen people assisted with the survey covering ten transects. Transects began near the marina at Birch Bay Village and were sited every ¼ mile along the shoreline to the south end of the Semiahmoo County Park.

Transects ran from the upper part of the beach where clams were first found to the water line at low tide. Transects ranged in length from about 120 to 1320 feet (0.02 to 0.25 miles) with 3 to 33 sample holes.

Table 5. Birch Point 2005 Clam Survey – Number of Clams by Transect and Type

Transect	Varnish	Manila	Native Littleneck	Macoma	Cockle	Butter	Eastern Softshell	Horse	Total Clams
2	0	0	14	0	2	7	1	1	25
3	0	0	0	10	0	0	0	1	11
4	0	0	4	29	3	0	0	4	40
5	0	0	0	14	0	0	0	3	17
6	3	3	12	15	3	3	1	10	50
7	2	0	25	9	0	1	0	9	46
8	1	3	61	3	3	11	0	0	82
12	0	1	10	5	0	1	0	0	17
14	0	0	12	10	0	8	0	0	30
20	0	0	36	0	0	38	1	2	77
Totals	6	7	174	95	11	69	3	30	**395**

Figure 9. Clam Types at Birch Point.

The majority of clam species found at Birch Point were native littleneck. The next most abundant clam species found were macoma, butter, and horse clams, respectively. Small amounts of cockle, manila, varnish, and Eastern softshell clams were also found at this location.

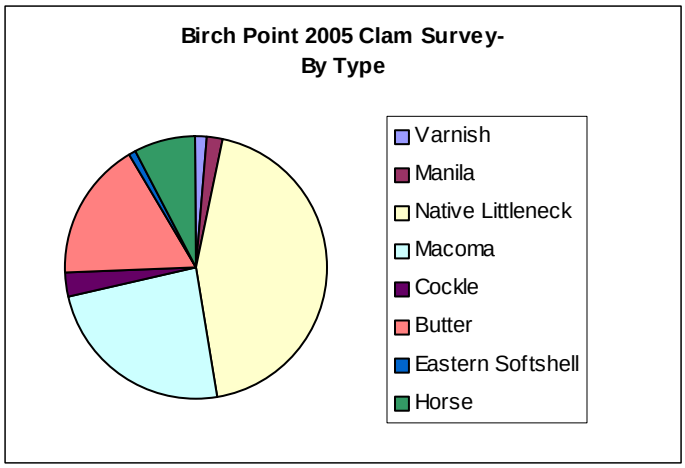
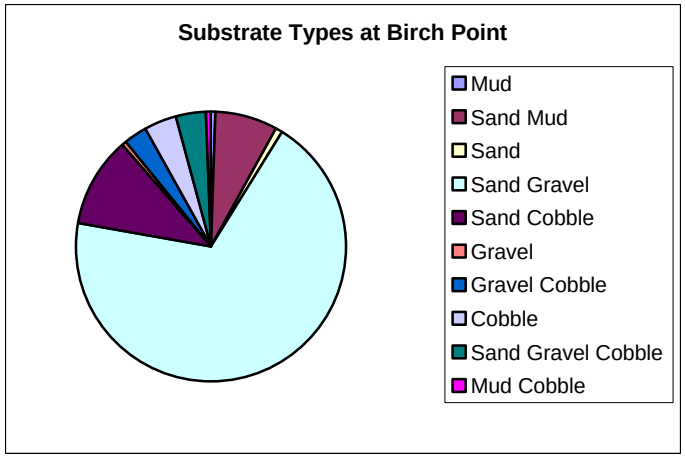


Figure 10. Substrate Types at Birch Point.

A variety of substrates are represented on this shoreline. The dominant substrate recorded at Birch Point was mixed sand and gravel, followed by mixed sand and cobble and mixed sand and mud. Small amounts of cobble, mixed gravel and cobble, and mixed sand, gravel, and cobble were recorded.



Point Whitehorn/Cherry Point

The Point Whitehorn/Cherry Point clam surveys were conducted on July 23, 2005. Twenty-eight people assisted with the survey covering fourteen transects. Transects began near the tip of Point Whitehorn and were sited each ¼ mile along the shoreline to south of the BP pier. One transect was also located near the Gulf Road.

Transects ran from the upper part of the beach where clams were first found to the water line at low tide. In comparison to other sites surveyed, transect for this survey were relatively short. Transects ranged in length from about 80 to 440 feet with 2 to 11 sample holes.

Table 6. Point Whitehorn/Cherry Point 2005 Survey – Number of Clams by Transect and Type

Transect	Varnish	Manila	Native Littleneck	Macoma	Cockle	Butter	Eastern Softshell	Horse	Total Clams
1	7	1	46	0	0	13	0	1	68
2	2	4	4	8	0	5	0	6	29
3	3	0	17	1	0	0	1	2	24
4	0	0	1	3	0	1	0	2	7
5	0	0	0	3	0	0	0	0	3
6	0	0	6	19	0	0	6	0	31
7	0	0	3	3	0	1	0	1	8
8	0	0	3	2	0	0	0	1	6
9	0	0	3	12	0	0	0	0	15
10	6	1	12	30	0	15	0	2	66
11	0	2	2	9	1	7	0	3	24
12	0	0	0	0	0	0	0	0	0
13	0	0	11	15	0	2	1	1	30
14	8	1	12	10	0	10	1	0	42
Totals	26	9	120	115	1	54	9	19	**353**

Figure 11. Point Whitehorn/ Cherry Point Clam Types

The majority of clam species found at Point Whitehorn/Cherry Point were native littleneck and macoma clams. The next most abundant clam species found were butter and varnish clams. Few horse, Eastern softshell, manila, and cockle clams were found and this location.

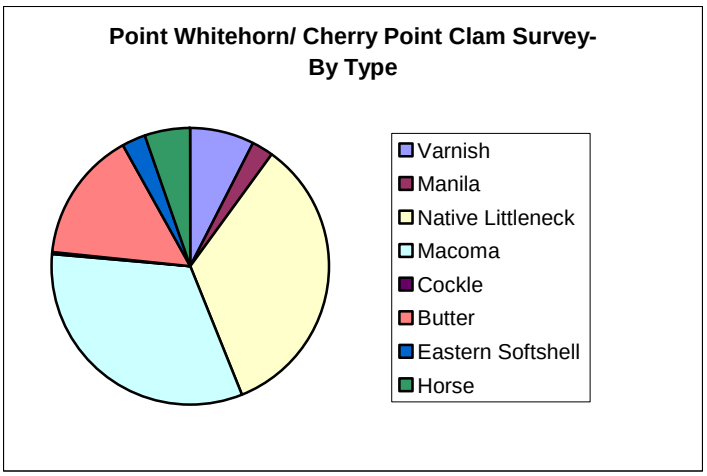
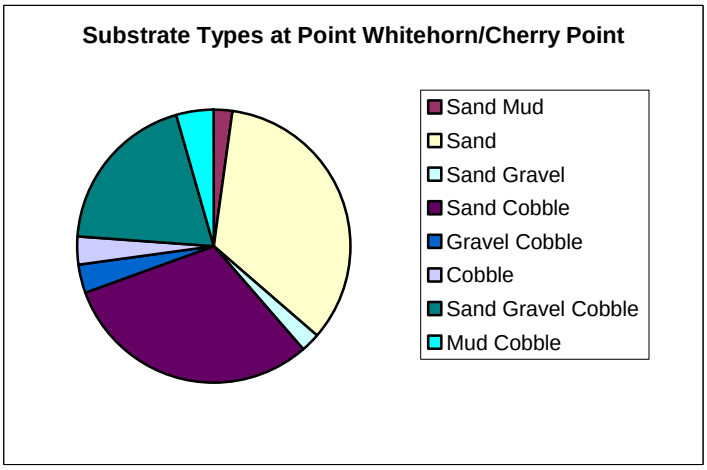


Figure 12. Point Whitehorn/ Cherry Point Substrate Types
The dominant substrate recorded at Point Whitehorn/Cherry Point was sand and mixed sand and cobble. Small amounts of mixed sand, gravel, and cobble were also recorded. Very little mixed mud and cobble, mixed gravel and cobble, cobble, mixed sand and mud, and mixed sand and gravel were recorded at this location.



Marine Park in Blaine
The Marine Park, Blaine surveys were conducted on June 24th, 2006. Fourteen people assisted with the survey covering 6 transects. Transects started on the beach just north of Marine Drive at the Blaine Marina and curved along the shoreline to the international border.

Transects ran from the upper part of the beach, where clams were first found, to the waterline at low tide. Clams were sampled every 100 feet along each transect. Transects ranged in length from about 800 to 3,800 feet with 8 to 38 sample holes.

Table 7. Marine Park, Blaine 2006 Clam Survey – Number of Clams by Transect and Type

Transect	Horse	Varnish	Manila	Native Littleneck	Macoma	Cockle	Butter	Eastern Softshell	Total Clams
2	1	67	20	0	23	0	0	4	115
4	5	43	16	1	54	0	0	4	123
6	1	20	1	0	52	0	1	7	82
8	5	2	1	3	37	2	7	6	63
10	0	3	10	0	3	0	0	0	16
12	0	14	17	0	3	0	0	1	35
Totals	12	149	65	4	172	2	8	22	**434**

Figure 13. Clam Types at Marine Park Blaine.
The majority of clam species found at Marine Park Blaine were macoma and varnish clams. The next most abundant clam species recorded were Manila. Small amounts of Eastern softshell, horse, butter, cockle, and native littleneck were also recorded at this location.

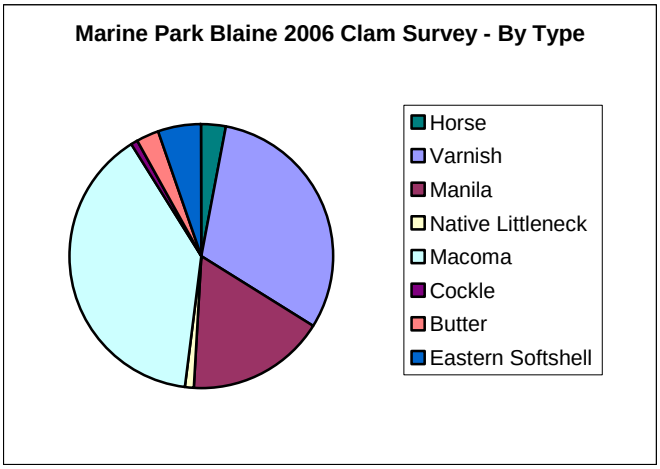
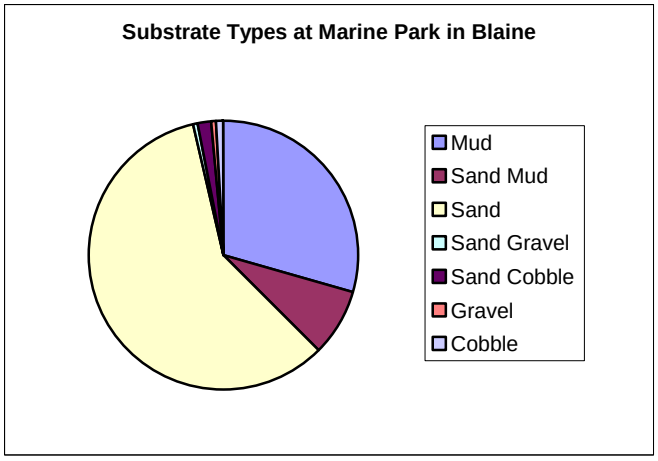


Figure 14. Substrate Types at Marine Park Blaine.
The dominant substrate recorded at Marine Park Blaine was sand and mud. Small amounts of mixed sand and mud, mixed sand and cobble, mixed sand and gravel, gravel, and cobble were also recorded.



Lummi Island

The Lummi Island surveys were conducted on July 10, 2006. Fourteen people assisted with the survey covering nine transects. Transects started on the east side of Lummi Island (Hale Passage) and were sited every 1/8 of a mile south of Lane Spit to north of Sunrise Cove. Transects ran from the upper part of the beach, where clams were first found, to the waterline at low tide. Clams were sampled every 40 feet along a transect. Transects ranged in length from about 160 to 760 feet with 4 to 19 sample holes.

Table 8. Lummi Island 2006 Clam Survey – Number of Clams by Transect and Type

Transect	Horse	Varnish	Manila	Native Littleneck	Macoma	Cockle	Butter	Eastern Softshell	Total Clams
1	0	1	0	6	0	3	15	0	25
5	0	1	0	2	6	7	1	0	17
6	2	0	0	25	22	0	0	0	49
12	0	0	0	3	30	0	0	0	33
13	0	0	1	3	12	0	0	0	16
14	0	3	2	3	8	0	6	3	25
15	0	0	1	2	22	6	1	0	32
16	0	3	0	8	61	1	2	1	76
19	1	0	0	0	0	0	3	1	5
Totals	3	8	4	52	161	17	28	5	**278**

Figure 15. Lummi Island Clam Types.
The majority of clam species found at the east side of Lummi Island were macoma followed by native littleneck. Smaller amounts of butter, cockle, varnish, Eastern softshell, manila, and horse clams were also found at this location.

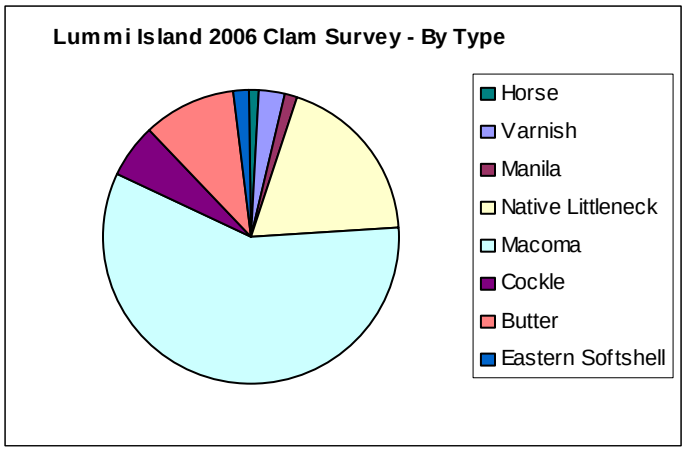
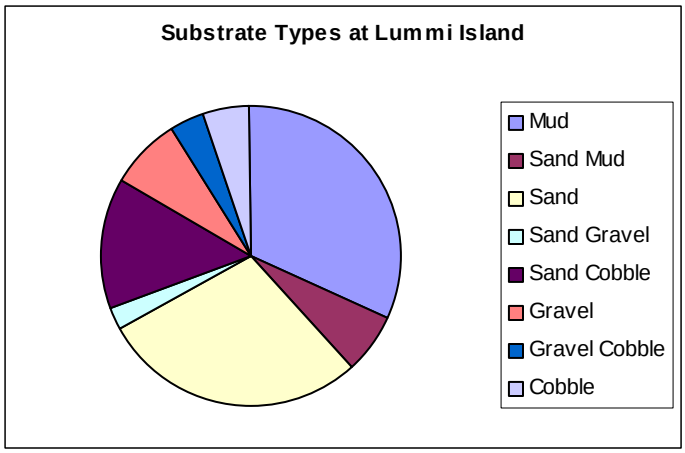


Figure 16. Lummi Island Substrate Types
The dominant substrate recorded at Lummi Island was mud, followed by sand. Small amounts of mixed sand and cobble, mixed sand and mud, gravel, cobble, mixed gravel and cobble, and mixed sand and gravel were also recorded at this location.



Point Roberts
Two distinct areas were surveyed at Point Roberts, Maple Beach and the area around Lighthouse Marine Park.

Table 9. Maple Beach 2006 Clam Survey – Number of Clams by Transect and Type

Transect	Horse	Varnish	Manila	Native Littleneck	Macoma	Cockle	Butter	Eastern Softshell	Total Clams
2	0	402	0	0	0	0	0	0	402
4	0	215	6	0	3	3	0	0	227
6	0	83	1	0	3	2	0	3	92
Totals	0	700	7	0	6	5	0	3	**721**

Figure 17. Maple Beach Clam Types.
The majority of clam species found at Point Roberts Maple Beach was overwhelmingly varnish clams. Few manila, macoma, cockle, and Eastern softshell were also found at this location.

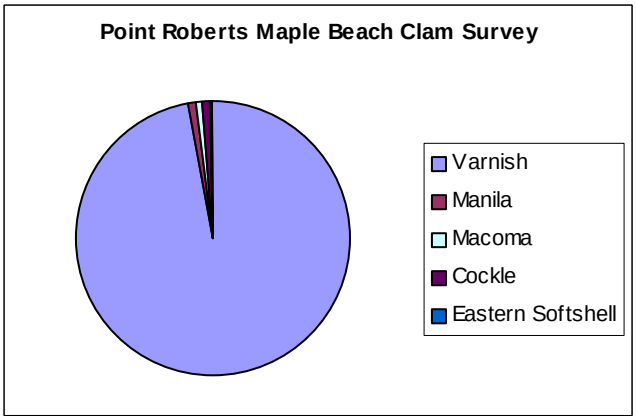


Figure 18. Maple Beach Substrate Types.
The dominant substrate recorded at Point Roberts Maple Beach was sand. Small amounts of mud and mixed sand and mud were recorded. Very little gravel, cobble, and mixed mud and gravel were recorded at this location.

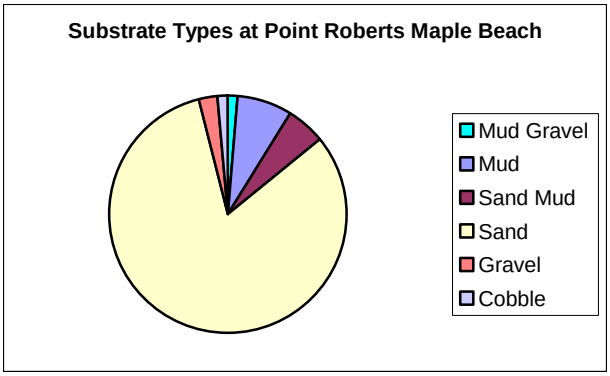


Table 10. Lighthouse Marine Park 2006 Clam Survey -- Number of Clams by Transect and Type

Transect	Horse	Varnish	Manila	Native Littleneck	Macoma	Cockle	Butter	Eastern Softshell	Total Clams
7	0	1	0	1	0	0	6	0	8
8	1	0	0	2	0	0	1	0	4
9	0	0	0	0	0	0	0	0	0
10	0	1	0	2	0	0	10	0	13
Totals	1	2	0	5	0	0	17	0	**25**

No clams were found at transects 11-16 on the west side of Lighthouse Marine Park. Due to the low numbers of clams found at this location, charts were not created for this area.

Figure 19 Lighthouse Marine Park Clam Types

The majority of clam species found at Point Roberts Lighthouse Marine Park was butter clams. Small amounts of native littleneck, varnish, and horse clams were also found at this location. The amount of clams found at this survey was not significant.

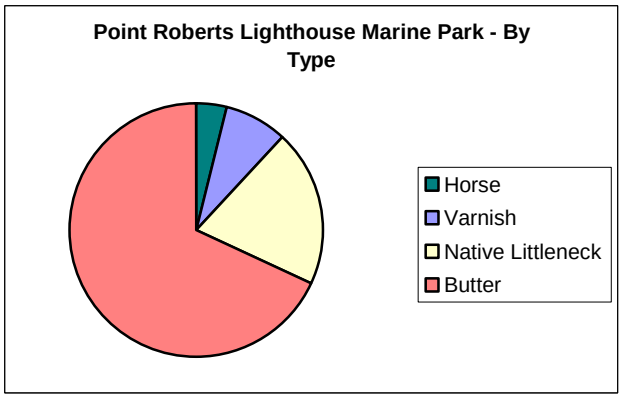
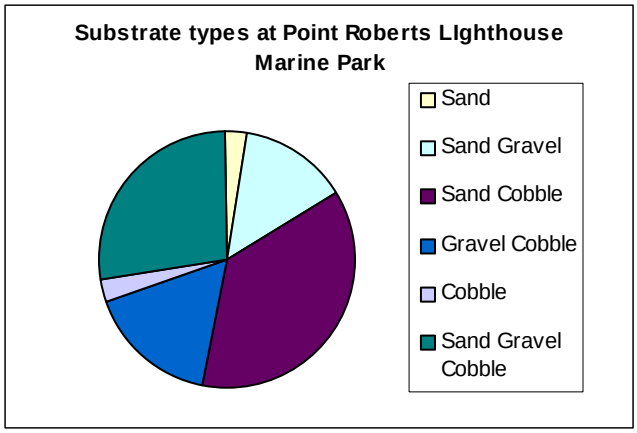


Figure 20 Lighthouse Marine Park Substrate Types

The dominant substrates recorded at Point Roberts Lighthouse Marine Park were mixed sand and cobble and mixed sand, gravel, and cobble. Followed by mixed gravel and cobble and mixed sand and gravel. Small amounts of cobble and sand were also recorded at this location.



Discussion

Substrate Pie Charts

Substrate Pie Charts were created to give a general representation of substrate types found at each location surveyed. Survey teams recorded substrate data on field sheets based on the types of substrate found and noted the surface substrate in order of dominance. For the purpose of these surveys and mapping, Whatcom County staff condensed these results to show major classifications. Future surveys will provide more specific guidance to the survey teams for describing substrate within the sample hole if it differs from the substrate found at the surface.

Challenges to Conducting Surveys

Several challenges arose while planning and conducting clam surveys that should be taken into consideration for future surveys. The primary challenges centered around access, volunteer schedules, and data accuracy.

Private property issues created obstacles in planning some clam surveys. Access through properties was necessary in some instances to conduct surveys (when transects were in front of properties) and accessing the transects through private property required permission. Private tidelands ownership was another obstacle, not only in surveying a transect, but also traversing the shoreline to adjacent transect locations. Vacation homes in private ownership were difficult to access because landowners were not available to ask permission and in some instances could not be located. This situation occurred at Lummi Island and Point Roberts. Additionally, some landowners were not open to having people on their property to conduct the surveys. Some indicated a fear that the clam survey would reveal a vital clamming area or take property away from the landowner through future regulations.

As with any volunteer project, we occasionally ran into difficulties recruiting volunteers for specific days and relying on volunteers' commitment to participate. This has been an enjoyable project and typically our recruitment rates have been high. However, the sizes of our survey areas are dependent on the number of volunteers we're able to commit to a particular day. Occasionally volunteers are not able to confirm their involvement until just days before the event. Additionally, we have had some volunteers commit to participate, receive information, and not show for survey without any prior indication to the survey. This creates a last minute scramble to survey planned transects with fewer people.

Some problems were noted when reviewing and entering data from the field data sheets and while mapping the data. There were a couple of instances where the transects were surveyed on an incorrect compass bearing or swayed off the original compass bearing. Survey teams did not always fully complete the field data sheets, leaving blanks that either had to be interpreted or could not be mapped. Additionally, volunteers struggled with surveying areas with water pools and boulders or other obstacles. Several adjustments in the training sessions and field packets were made to encourage using landmarks in combination with compasses, provide answers to frequently asked questions, and emphasize the need to fully complete data sheets.

Improvements
The summer of 2006 marked the third year of clam surveys along Whatcom County Shorelines. Building on knowledge from the previous two years of clam surveys, certain aspects of the protocols were modified to increase efficiency while conducting surveys.

For instance, the shoreline along Marine Park in Blaine has extensive tideflats. In order to meet our goals for this area with a limited number of volunteers, the following adjustments were made and subsequently used in future surveys.

- Setting flags to water line and sampling clams on the way back to the beach.
  - Helped volunteers reach the end of the transect before the tide turned.
  - Allowed two teams to survey a long transect.
  - Provided more time for staff to collect GPS Points.
- Adaptation to protocol is more flexible and allows for two teams to sample a long transect.
  - One team lays out flags to the water line and works their way back, following protocol.
  - A second team can start sampling from the first flags laid and the two teams can meet in the middle.

These types of adaptations will continue to be made to provide clarity for the volunteers and increase the reliability of data collected. The Shellfish Subcommittee met after the third and final clam survey of 2006 to debrief on that year's clam surveys successes. They developed further suggestions to improve the accuracy of the surveys including:
- Training scheduled on day prior to survey day
- Include more extensive vegetation survey (e.g. native eelgrass, Japanese eelgrass).

The Shellfish Subcommittee plans to begin resurveying these areas in 2008. As we begin resurveying areas, a large focus will be placed on surveying areas or transects we were unable to cover in the initial surveys. This will likely require further communication with landowners and larger pools of volunteers.

References

Procedures to determine intertidal populations of *Protothaca staminea*, *Tapes philippinaruym*, and *Crassostrea gigas* in Hood Canal and Puget Sound, Washington (WDFW 1996)