

Geoduck Clam Mariculture Site Survey Cruise Report

August 20 - 25, 2003



**by
Marc Pritchett**

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AUTHOR

Marc Pritchett is the herring and dive fisheries project leader for the Alaska Department of Fish and Game, Division of Commercial Fisheries, Region 1, 802 3rd St., Douglas, Alaska 99824.

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INTRODUCTION

On June 20, 2002, Governor Knowles signed House Bill (HB) 208² requiring the Alaska Department of Natural Resources (DNR) to identify, and offer for lease at auction, 90 sites suitable for aquatic farming, divided as follows: 60 sites for oysters and other suspended culture species; 20 sites for clams and other intertidal culture species; and 10 sites for geoduck and other subtidal culture species. HB 208 became law on June 21, 2002 under Chapter No. 81, SLA 2002.

DNR solicited nominations for suitable areas and together with the Alaska Department of Fish and Game (ADF&G), was charged with the evaluation of the physical and biological characteristics and public trust obligations of over 200 sites. DNR public noticed the preliminary best interest findings on July 1, 2003 for those sites requiring Alaska Coastal Management Program and public review.

To meet the subtidal culture requirement of 10 sites, ADF&G contracted to have the boundaries of non-commercially viable populations of geoduck clam beds with suitable habitat to support geoduck clam farms identified. In August 2003, department staff conducted surveys at eleven locations the contractor identified as suitable. Staff also conducted surveys on four additional sites applied for under the 2003 aquatic farm program opening. After ADF&G completed the surveys, public meetings were held and public comments considered, with final findings issued October 31, 2003. Beginning December 2004, 164 aquatic farm sites will be offered at a public auction. Sites not taken at the auction will be available on a first-come, first-serve basis in an over-the-counter offering. This report summarizes the August 2003 dive surveys.

SCHEDULE

The *R/V Kestrel* departed Petersburg at 0800 hours on Wednesday, August 20, 2003 and traveled to Ketchikan. Site surveys began August 21 and continued through August 25, 2003.

METHODS

Density estimates were made by scuba divers along two-meter-wide strip transects; these transects serve as the primary sampling unit. Transects run perpendicular to shore and extend to a minimum target depth of 17 m (55 fsw) below mean lower low water (mllw). Dives to the target

² The only difference between the process under HB 208 and the current Aquatic Farm Program, is that the applicable authorizations will be available almost immediately after the sites are awarded at auction. Leases entered into under the HB 208 process are subject to the same Aquatic Farm Program requirements under AS 38.05.083 and Title 11 of the Alaska Administrative Code Chapter 63 (11 AAC 63). Operation permits are subject to the same Aquatic Farm Requirements under AS 16.40.100 and Title 5 of the Alaska Administrative Code Chapter 41 (5 AAC 41).

depth include the majority of habitat in which commercial divers normally operate. Dives are limited to a maximum depth of 21 m (70 fsw) because deeper dives severely limit total bottom time for scuba divers and pose safety risks when conducted repetitively over several days. Transect length varies depending on the slope of the bottom. To complete the transects, two divers swam as a team along each transect, with one diver holding a two-meter rod (a 2.1-cm diameter white PVC tube) in a horizontal position, perpendicular to the census path. Transect direction was maintained by reference to a compass mounted on the rod. The diver carrying the rod counted the number of geoduck clams passing under one side of the rod (usually the left) while the second diver counted geoducks on the other side (usually the right). Alternatively, each diver may carry a one-meter rod, but under no circumstances would a diver count an area wider than one meter. A 200 m transect interval is the standard spacing for geoduck surveys but due to this survey's relatively small shoreline sections, a 50 m spacing was used as the standard transect interval. A tape measure was used to estimate geoduck bed width: beginning the dive in shallow water (at or near zero fsw or at the edge of bedrock), divers swam until they encountered geoducks where the depth was then noted. The tape measure was deployed at this depth and the distance to either the end of the transect (target depth) or the obvious end of the bed (e.g. bedrock) was noted. A tape measure is not used for standard geoduck surveys but was used here to estimate the number of geoducks per square meter for each transect (in addition to the standard method of number of geoducks per meter of shoreline).

In addition to recording the geoduck count for each transect, divers also recorded data for start and stop depths, substrate type, percent vegetative cover, vegetative type, and the presence of other species of interest including sea urchins, sea cucumbers, abalone, and *Sargassum muticum*. Vegetative type was recorded for the two most common types on each transect. Substrates were coded using a key that groups various algae and intertidal plant species into categories (Appendix A). Similarly, substrate type was recorded as "percent cover" for up to two types and was coded (Appendix B).

The beginning and ending time for each transect was recorded by a dive tender to allow for standardization to the mean lower low water (mllw) tide stage. Preferably, transects were paired (sides A and B) so that a dive team would census one strip while descending, and then a second strip when returning to shore. The second transect in each pair is approximately 10–15 meters to the left (when facing shore) of the first transect. This is the preferred method but may not be practical when a gentle slope requires extended bottom times, with multiple dives often necessary to complete one transect. It was left to the divers discretion as to whether a paired transect is appropriate for a particular transect site. The appendices list whether a transect was paired or not.

Density estimates were calculated as the average number of geoducks per meter of shoreline length:

$$D_l = \sum_{i=1}^n \frac{L_i}{kL_t} c_i \quad (1)$$

where:

D_1 = estimated number of geoducks per meter of shoreline,
 i = transect index,
 c_i = count of geoduck clams on each transect i ,
 L_i = shoreline segment length associated with each transect i ,
 L_t = total shoreline length,
 k = either 2 or 4.

The variable k in Equation 1 is equal to 2 when only side A is counted on a type 1 transect, or equals 4 when both sides A and B are counted, and corrects for the 2-meter width of each transect side.

Where a reasonable estimate of area could be made, the density per square meter of seabed was estimated:

$$D_2 = \frac{1}{Tn_D} \sum_{i=1}^n c_i, \quad (2)$$

where:

D_2 = estimated number of geoducks per square meter,
 c_i = count of geoduck clams on each transect i from 1 to n ,
 n_D = number of transects,
 T = transect length.

Uncertainty in the density estimate is expressed as the percent precision. The index is equal to the lower bound of the one-sided 90% confidence interval expressed as a percent of the average density and calculated as:

$$P_D = 100 \left(1 - t_\alpha \frac{s}{D\sqrt{n}} \right), \quad (3)$$

where:

P_D = percent precision of the density estimate,
 t_α = t-value from Student's distribution for a one-sided interval with significance, level $\alpha = 10\%$,
 s = standard deviation of the mean,
 D = estimated density of geoducks (D_1 or D_2).

In a perfectly precise estimate, P_D would equal 100%; decreasing numbers indicate increasing uncertainty.

Geoduck Weight Estimates

Geoduck weight estimates were made using data collected from previous commercial fisheries and assessment surveys. All data available (i.e. both commercial and survey samples) were combined and applied to the biomass estimates. In new areas where no data have been collected, all data collected and available from Southeast Alaska were averaged and used to estimate the biomass.

Mean weight per geoduck within a given area is estimated as:

$$W = \frac{\sum w_i}{n_w} \quad (4)$$

where:

W = estimated mean weight per whole geoduck,
 w_i = weight of the i^{th} geoduck from the available data,
 n_w = sample n for weight.

A total of 7,416 geoducks have been weighed from 1978 through the 2002-03 commercial season with a mean weight of 1,144 g (2.52 lb).

Geoduck Biomass Estimates

The estimate of total geoduck biomass in an area was calculated as:

$$B_{\text{bed}} = (D_1)(W)(S) \quad \text{or} \quad (5)$$

$$B_{\text{bed}} = (D_2)(W)(A), \quad (6)$$

where:

B_{bed} = estimated total geoduck biomass per defined area,
 D_1 = estimated density of geoducks per linear meter of shoreline,
 D_2 = estimated density of geoducks (number per square meter),
 S = total estimated shoreline length (in meters),
 A = total estimated bed area (in square meters).

Confidence limits for the biomass estimates are based on an estimate of the variance of the biomass. A variance-of-products formula (Goodman 1960) was used to calculate a variance estimate for the product of mean density and mean weight per geoduck. Assuming that there is no correlation between density and weight, then the variance of the biomass is:

$$\delta_B^2 = D^2 \frac{\delta_w^2}{n_w} + W^2 \frac{\delta_D^2}{n_D} - \frac{\delta_D^2 \delta_W^2}{n_D n_w}, \quad (7)$$

where:

δ_B^2 = variance of biomass, B,
 δ_D^2 = variance of mean density,
 δ_W^2 = variance of mean weight.

Uncertainty in the biomass estimate is expressed as the percent of precision. The index is equal to the lower bound of the one-sided 90% confidence interval expressed as a percent of the biomass. This index, similar to P_D (Equation 3), was calculated as:

$$P_B = 100 \left(1 - t_\alpha \frac{s}{B_{bed} \sqrt{n_D}} \right), \quad (8)$$

where:

P_B = percent precision of the density estimate,
 s = standard deviation of the mean biomass estimate (δ_B , from Equation 7).

The potential guideline harvest levels for biomass estimates were calculated using a precision adjusted biomass.

$$B_{adj} = P_B * B_{bed} \quad (9)$$

where:

B_{adj} = precision adjusted biomass estimate (used to calculate GHL),
 P_B = from Equation 8,
 B_{bed} = from Equation 5 or 6.

SHOW FACTOR SURVEYS

Geoduck clams can be difficult to count when they are hidden below the substrate. For this reason, the true clam density may be underestimated. The method described below, used to estimate the true density of geoducks from visual counts, is patterned after that used by the Washington Department of Fish and Wildlife (Bradbury et al. 2000). This method was originally introduced by Goodwin (1977), who coined the term “show factor.” A “show” is either a siphon visible above the substrate or a depression in the substrate that can be identified as having been made by a clam siphon (see ADF&G RIR 1J01-25 for a complete description for department show plot methodology).

The show factor, F , is the ratio of geoduck clam shows visible during a single observation of any defined area and the true abundance of harvestable geoducks within that area:

$$F = n / N, \quad (10)$$

where:

n = the number of visible shows within a defined area (show plot),
 N = the absolute number of harvestable geoducks within the area.

A show factor of 0.80 has been established for Southeast Alaska.

SURVEY RESULTS AND DISCUSSION

A total of 86 transects were plotted along 4,237 meters of shoreline. Site maps and transects are charted in Figures 1-4; suggested site coordinates from the reconnaissance survey are listed in Table 1; department transect coordinates are listed in Table 2; and site associated shoreline and number of transects are listed in Table 3. Density estimates for completed transects are summarized in Table 4.

Portions of this survey occurred during relatively increased seas (2-3 ft seas). These less than ideal conditions may have affected the actual show factor, potentially reducing transect counts. For example, all divers observed and remarked on the large amount of geoduck pseudofeces compared to the relatively small number of shows, suggesting a reduced show factor. There was no show plot in the area to validate the number of shows and resources were not available to establish a show factor site specific to this area and time. Consequently, the currently established show factor for Southeast Alaska of 0.80 was used to adjust transect counts.

Surveys are described below and identified as provided in the reconnaissance data and four 2003 mariculture site applications. Transect raw data can be reviewed in Appendix C. The small areas and therefore small number of transects often resulted in a large variance and range of shoreline estimate densities within individual areas (Table 4).

Lacroix and Zaugg Slate Island Sites

Ten transects were plotted and surveyed along 499 meters of shoreline associated with Lacroix and Zaugg sites on Slate Island. These surveys were conducted August 21, 2003. Sea state was approximately 2 foot. Seas had been 2-3 ft for the previous several days and may have affected the show factor. Good to excellent geoduck habitat was observed throughout the survey area. The estimated number of geoducks in this area was 41,978 with an estimated biomass of 105,778 pounds. Average density of geoducks for transect sections measured at this site's associated shoreline was 0.62 geoducks per square meter.

Morin Coho Cove Site

Four transects were plotted and surveyed along 216 m of shoreline associated with the Morin site near Coho Cove. These surveys were conducted August 21, 2003. Sea state was approximately 2 foot. Seas had been 2-3 ft for the previous several days and may have affected the show factor. Good to excellent geoduck habitat was observed throughout the survey area. The estimated number of geoducks in this area was 1,485 with an estimated biomass of 3,742 pounds. Average density of geoducks for transect sections measured at this site's associated shoreline was 0.14 geoducks per square meter.

Lacroix Point Alava Site

Four transects were plotted and surveyed along 180 m of shoreline associated with the Lacroix site near Point Alava. These surveys were conducted August 24, 2003 with sea state at less than one foot. Seas had been 2-3 ft for the previous several days and this may have affected the show factor. The estimated number of geoducks in this area was 6,497 with an estimated biomass of 16,371 pounds. Average density of geoducks for transect sections measured at this site's associated shoreline was 0.64 geoducks per square meter.

Sites 1-5

A total of 35 transects were plotted and surveyed along 1,746 m of shoreline associated with geoduck mariculture reconnaissance sites one through five. These surveys were conducted August 22 and 23, 2003 with sea state at approximately 2-3 feet. Seas had been 2-3 ft for the previous several days and this may have affected the show factor. Good to excellent geoduck habitat was observed throughout the survey area. The estimated number of geoducks in this area was 69,902 with an estimated biomass of 176,142 pounds. Average density of geoducks for transect sections

measured for the shoreline associated with sites 1 and 2 was 0.23 geoducks per square meter, for site 3 was 0.27 /m², site 4 was 0.40 / m², and site 5 was 0.40 / m².

Site 6

A total of six transects were plotted and five were surveyed along 284 m of shoreline associated with geoduck mariculture reconnaissance site six. These surveys began late afternoon August 23 and were completed August 24, 2003 with sea state less than one foot on August 24. Seas had been 2-3 ft for the previous several days and this may have affected the show factor. Reconnaissance data indicated a small bed of geoducks was located on Site 6 "...at the base of the reef...and inward toward the island." Using this information and provided reconnaissance site coordinates, three divers began surveying transect #35 (along the eastern side of the reef) to look for geoducks and confirm the reconnaissance. We observed no geoducks on transect #35 from 10 fsw to 34 fsw (4-28 mllw). After swimming to approximately 34 fsw (distance not measured, substrate was bedrock then gravel/sand) we turned approximately 90° to search for geoducks at these relatively shallow depths (zigzagged between 30-35 fsw, substrate remained gravel/sand). We observed no geoducks, then turned back to our original bearing before finding geoducks at 33 fsw. We deployed the tape and counted geoducks for 50 m to estimate density. Because we had deviated from the original transect we elected not to continue after the first 50 m and terminated the dive at 49 fsw. Estimated density over the 50 m was approximately 1.4 geoducks/m² (show factor corrected). As no geoducks were observed next to the reef, as indicated by reconnaissance site coordinates, in relatively shallow waters, transect #35 was not repeated and surveyed and assumed to be zero along the entire transect. Transect #35 was included in the final calculations as it is included in provided site coordinates. The estimated number of geoducks in this area was 7,041 with an estimated biomass of 17,742 pounds. Average density of geoducks for transect sections measured for the shoreline associated with site 6 was 0.24 geoducks / m².

Site 7

A total of eight transects were plotted along 400 m of shoreline associated with geoduck mariculture reconnaissance site seven. Sea state was approximately 2-3 feet. Seas had been 2-3 ft for the previous several days and this may have affected the show factor. Provided reconnaissance data indicated "...site seven has no clams." To confirm original reconnaissance, on August 23, 2003 two divers surveyed parallel to shore beginning at 55.1417° N. Lat., 131.0799° W. Lon. and ending 55.1453° N. Lat., 131.089° W. Lon. The divers zigzagged south to north from 25 to 38 mllw covering approximately 25 m at 1 m contour intervals. Mostly rock habitat (not geoduck habitat) was observed to 32 mllw with sand and silt deeper and 5-25% large bladed kelp (mostly *Laminaria spp.*). Three geoducks (widely separated) were observed during the 31 minute dive. No other clams were observed. This confirmed the supplied reconnaissance data and no survey transects were completed associated with site seven with savings of approximately one-half day of transect diving and associated vessel costs. Site seven shoreline was removed from the overall density and biomass calculations.

Site 8

Three transects were plotted along 145 m of shoreline associated with Site 8 (south of Fox Point). Provided reconnaissance data indicated this was a small area with "...only clams in the very shallow areas from 25 to 18 feet." Time constraints and costs associated with travel to this relatively isolated area precluded the use of limited resources to survey this site. Site 8 shoreline was not used in overall biomass calculations.

Sites 9 and 10

Thirteen transects were plotted along 641 m of shoreline associated with Sites 9 and 10 (west of Point Alava). These surveys were conducted August 24, 2003 with sea state less than one foot. Seas had been 2-3 ft for the previous several days and this may have affected the show factor. The estimated number of geoducks in this area was 11,372 with an estimated biomass of 28,654 pounds. Average density of geoducks for transect sections measured for shoreline associated with sites 9 and 10 was 0.20 geoducks / m².

Site 11

Three transects were plotted along 126 m of shoreline associated with Site 11 (north of Lucky Cove). These transects were conducted August 24, 2003 with sea state less than one foot. Seas had been 2-3 ft for the previous several days and this may have affected the show factor. The estimated number of geoducks in this area was 1,470 with an estimated biomass of 3,704 pounds. Average density of geoducks for transect sections measured for shoreline associated with site 11 was 0.20 geoducks / m².

Combined Surveyed Areas

A total of 75 transects were surveyed along 3,692 meters of shoreline from August 21 through 25, 2003. The estimated number of geoducks within this combined area is 139,250 with an estimated biomass of 350,885 pounds. Most current commercial fishing areas in Southeast Alaska are harvested every-other-year at 4% of the estimated biomass (e.g. 2% annual harvest rate). If the surveyed areas were open to commercial harvest, the Guideline Harvest Level (GHL), using the above harvest rate would be 14,509 pounds. Overall average transect density for transect sections measured was 0.33 geoducks per square meter. Excluding those sections where only one geoduck was seen (i.e. tape was deployed when the first geoduck was observed but no other geoducks were seen on that 50 m section), the average density was 0.36 /m².

Table 1. Suggested mariculture sites from 2003 NSIV/HB208 geoduck reconnaissance (sites 1-11 as identified in reconnaissance) and from 2003 site applications located within or near the reconnaissance area. Sites were used to plot survey shoreline and transects.

Suggested Sites from Reconnaissance							
Site	Corner	Latitude	Longitude	Site	Corner	Latitude	Longitude
1	NE	55.10610	-131.04213	7	NE	55.14517	-131.08067
1	NW	55.10610	-131.04873	7	NW	55.14478	-131.08410
1	SW	55.10490	-131.03823	7	SW	55.14172	-131.08305
1	SE	55.10490	-131.04213	7	SE	55.14172	-131.08000
2	NE	55.10648	-131.03638	8	NE	55.25253	-131.08158
2	NW	55.10648	-131.04075	8	NW	55.25293	-131.08302
2	SW	55.10562	-131.04068	8	SW	55.25205	-131.08373
2	SE	55.10487	-131.03560	8	SE	55.25197	-131.08183
3	NE	55.10452	-131.03443	9	NE	55.19548	-131.21922
3	NW	55.10447	-131.03618	9	NW	55.19627	-131.22435
3	SW	55.10123	-131.03508	9	SW	55.19608	-131.22820
3	SE	55.10137	-131.03305	9	SE	55.19433	-131.22147
4	NE	55.09848	-131.03118	10	NE	55.19388	-131.22278
4	NW	55.09787	-131.03450	10	NW	55.19567	-131.22668
4	SW	55.09602	-131.03302	10	SW	55.19480	-131.22958
4	SE	55.09682	-131.03097	10	SE	55.19298	-131.22527
5	NE	55.09560	-131.02927	11	NE	55.22200	-131.26977
5	NW	55.09560	-131.03223	11	NW	55.22190	-131.27162
5	SW	55.09333	-131.03072	11	SW	55.22148	-131.27167
5	SE	55.09408	-131.02862	11	SE	55.22155	-131.26980
6	NE	55.13770	-131.08223	Lacroix Slate*	NE	55.10045	-131.04922
6	NW	55.13773	-131.08607	Lacroix Alava*	NE	55.19538	-131.21902
6	SW	55.13462	-131.08385	Morin Coho*	NE	55.26215	-131.39050
6	SE	55.13642	-131.08082	Zaugg Slate*	NE	55.10045	-131.04922

* Data from 2003 site applications

Table 2. Geoduck survey transect coordinates.

Transect	Latitude	Longitude	Transect	Latitude	Longitude
1	55.19429	-131.21762	44	55.14318	-131.07986
2	55.19461	-131.21796	45	55.14362	-131.07998
3	55.19498	-131.21835	46	55.14406	-131.08009
4	55.19534	-131.21872	47	55.14452	-131.08021
5	55.26237	-131.39062	48	55.14496	-131.08034
6	55.26251	-131.39141	49	55.09434	-131.02823
7	55.26279	-131.39217	50	55.09478	-131.02847
8	55.26283	-131.39307	51	55.09522	-131.02869
9	55.09846	-131.04921	52	55.09566	-131.02891
10	55.09871	-131.04983	53	55.09662	-131.03080
11	55.09897	-131.05048	54	55.09709	-131.03073
12	55.09924	-131.05108	55	55.09753	-131.03064
13	55.09934	-131.05191	56	55.09798	-131.03078
14	55.09940	-131.05273	57	55.09843	-131.03092
15	55.09960	-131.05342	58	55.10163	-131.03250
16	55.09978	-131.05414	59	55.10206	-131.03271
17	55.09998	-131.05486	60	55.10250	-131.03292
18	55.10018	-131.05556	61	55.10293	-131.03314
19	55.19592	-131.22008	62	55.10334	-131.03348
20	55.19594	-131.22084	63	55.10379	-131.03370
21	55.19617	-131.22159	64	55.10426	-131.03377
22	55.19625	-131.22235	65	55.10531	-131.03480
23	55.19653	-131.22310	66	55.10581	-131.03515
24	55.19659	-131.22385	67	55.10627	-131.03555
25	55.19657	-131.22466	68	55.10663	-131.03627
26	55.19646	-131.22544	69	55.10677	-131.03715
27	55.19651	-131.22618	70	55.10669	-131.03827
28	55.19650	-131.22698	71	55.10678	-131.03906
29	55.19649	-131.22777	72	55.10682	-131.03984
30	55.19619	-131.22853	73	55.10677	-131.04063
31	55.19622	-131.22929	74	55.10670	-131.04141
32	55.22208	-131.26979	75	55.10661	-131.04222
33	55.22203	-131.27057	76	55.10636	-131.04301
34	55.22204	-131.27129	77	55.10633	-131.04379
35	55.13458	-131.08355	78	55.10630	-131.04461
36	55.13485	-131.08297	79	55.10648	-131.04539
37	55.13511	-131.08239	80	55.10656	-131.04612
38	55.13537	-131.08179	81	55.10686	-131.04691
39	55.13562	-131.08122	82	55.10691	-131.04769
40	55.13588	-131.08063	83	55.10696	-131.04846
41	55.14187	-131.07951	84	55.25300	-131.08195
42	55.14229	-131.07962	85	55.25307	-131.08277
43	55.14274	-131.07975	86	55.25260	-131.08340

Table 3. Designated priority and lower priority areas for 2003 geoduck surveys.

Priority Areas	Shoreline Trans Transect (m) / Area Numbers		
Pt. Alava, Lacroix	180	4	1-4
Coho Cove, Morin	216	4	5-8
Slate I. (Lacroix & Zaugg)	499	10	9-18
Total	895	18	
North of Quadra Pt.	1,746	35	49-83
Lower Priority Areas			
West of Pt Alava	641	13	19-31
Site 11, Nth of Lucky Cove	126	3	32-34
Site 6, Black I.	284	6	35-40
Site 7, Black I.	400	8	41-48
South of Fox Point	145	3	84-86
Totals			
Priority	2,641	53	
Low Priority	1,596	33	
Totals	4,237	86	

Table 4. Shoreline density and biomass estimates of geoduck clams from potential mariculture sites surveyed August 2003.

	All Surveyed Areas Combined	Alava, Lacroix	Coho Cove, Morin	Slate I. (Lacroix & Zaugg)	North of Quadra Pt. Sites 1-5	West of Pt. Alava Sites 9 & 10	North of Lucky Cove Site 11	Black Island Site 6
Number of Transects	75	4	4	10	35	13	3	6
Average per Linear Meter	37.7	36.1	6.9	84.1	40.0	17.7	11.7	24.8
Variance of Counts	1,908,525	1,523,014	24,219	5,207,309	1,209,879	753,225	111,068	1,111,979
Std. Variance of Mean	25.447	380.754	6.055	520.731	34.568	57.940	37.023	185.330
Shoreline (m)	3,692	180	216	499	1,746	641	126	284
Total Number of Geoducks	139,250	6,497	1,485	41,978	69,902	11,372	1,470	7,041
Variance of Total Number	346,864,606	12,336,416	282,488	129,662,516	105,381,032	23,806,608	587,770	14,947,965
Precision of Estimate	82.7%	11.5%	41.4%	62.5%	80.8%	41.8%	1.7%	19.0%
90% Coefficient of Variation	22.3%	127.2%	84.2%	49.7%	24.8%	76.5%	152.3%	110.7%
90% two-tail Precision	77.7%	-27.2%	15.8%	50.3%	75.2%	23.5%	-52.3%	-10.7%
Lower Bounds	108,227	-1,769	234	21,105	52,544	2,675	-769	-750
Upper Bounds	170,273	14,763	2,736	62,852	87,261	20,068	3,709	14,832
Average Weight (lb)	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52
Variance of Average Weight	0.00007933	0.00007933	0.00007933	0.00007933	0.00007933	0.00007933	0.00007933	0.00007933
Biomass Estimate	350,885	16,371	3,742	105,778	176,142	28,654	3,704	17,742
Variance of Biomass Est.	2,203,931,785	78,332,591	1,793,810	823,423,205	669,497,414	151,168,713	3,732,179	94,915,031
Precision of Estimate	82.7%	11.5%	41.4%	62.5%	80.8%	41.8%	1.7%	19.0%
90% Coefficient of Variation	22.3%	127.2%	84.2%	49.7%	24.8%	76.5%	152.3%	110.7%
90% two-tail Precision	77.7%	-27.2%	15.8%	50.3%	75.2%	23.5%	-52.3%	-10.7%
Lower Bounds Biomass Est.	272,687	-4,458	590	53,176	132,390	6,741	-1,937	-1,890
Upper Bounds Biomass Est.	429,084	37,200	6,894	158,380	219,894	50,568	9,345	37,373
Potential Precision Adjusted Quota ³	14,509	94	77	3,305	7,116	599	3	168

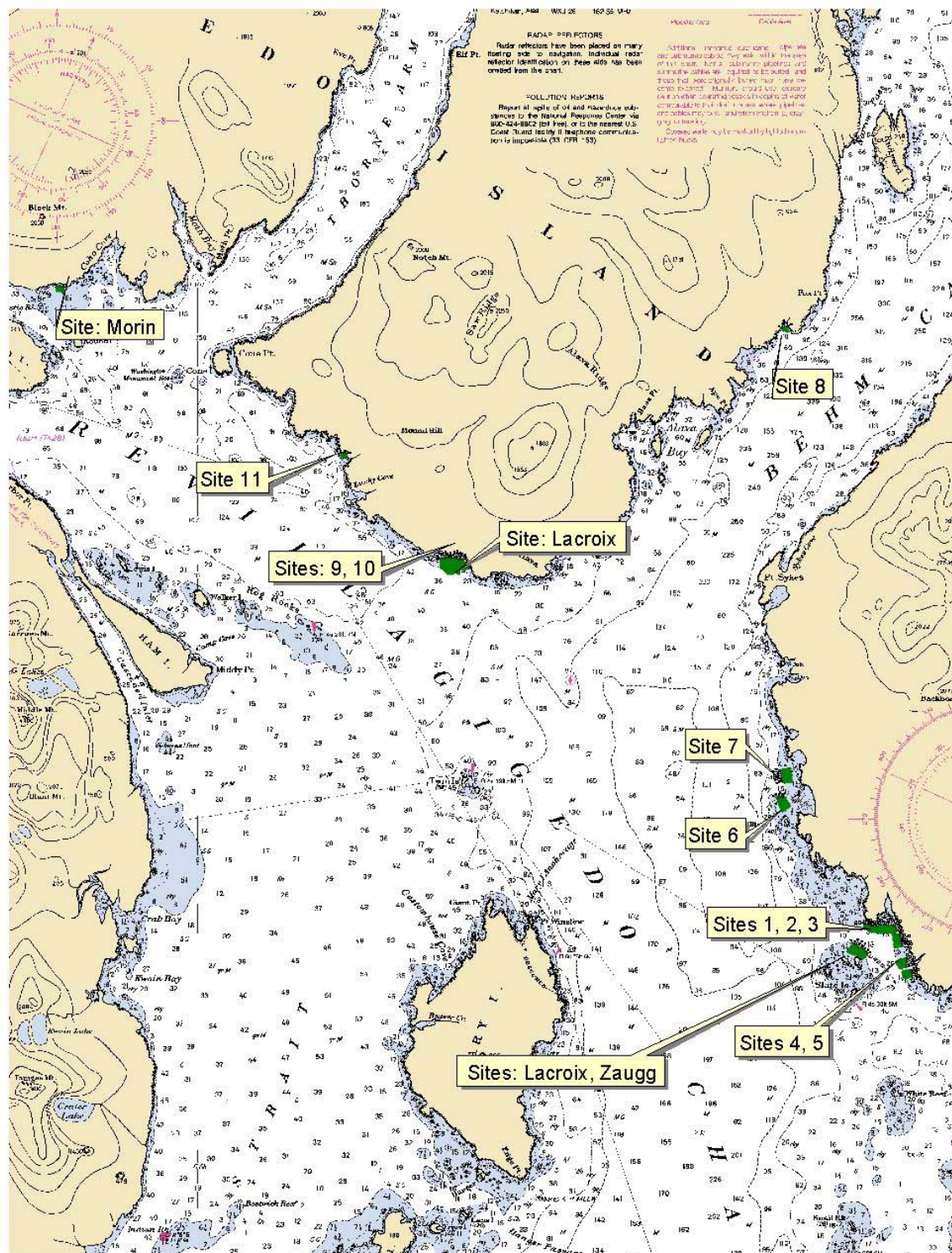
³ Includes a 0.80 show factor adjustment and assumes a target harvest rate of 4%.

Table 5. Transect geoduck density (geoducks per square meter), 2003 potential mariculture site survey.

Transect	Site									
	Coho Cove, Morin	Lacroix Alava	Site 11	Site 3	Site 4	Site 5	Site 6	Sites 1 & 2	Sites 9 & 10	Slate I., Lacroix Zaugg
1		0.46								
2		0.27								
3		1.59								
4		0.24								
5	0.05									
6	0.10									
7	0.16									
8	0.24									
9										0.30
10										0.86
11										0.89
12										0.10
13										0.04
14										0.25
15										0.67
16										0.87
17										1.12
18										0.71
19									0.11	
20									0.47	
21									0.44	
22									0.53	
23									0.01	
24									0.02	
25									0.03	
27									0.11	
28									0.04	
29									0.02	
30									0.02	
32			0.12							
33			0.38							
34			0.08							
36							0.30			
37							0.02			
38							0.48			
39							0.09			

Table 5. (Continued) Transect geoduck density (geoducks per square meter), 2003 potential mariculture site survey.

Transect	Site									
	Coho Cove, Morin	Lacroix Alava	Site 11	Site 3	Site 4	Site 5	Site 6	Sites 1 & 2	Sites 9 & 10	Slate I., Lacroix Zaugg
40							0.06			
49						0.28				
50						0.55				
51						0.10				
52						0.35				
53					0.96					
54					0.47					
55					0.42					
56					0.28					
57					0.15					
58				0.18						
59				0.13						
60				0.31						
61				0.20						
62				0.41						
63				0.65						
64				0.26						
65								0.07		
66								0.08		
67								0.12		
68								0.01		
69								0.09		
70								0.19		
71								0.06		
72								0.06		
73								0.26		
74								0.28		
75								0.11		
76								0.21		
77								0.40		
78								0.28		
79								0.28		
80								0.26		
81								0.62		
82								0.45		
83								0.17		
Grand Avg. I	0.14	0.64	0.20	0.27	0.40	0.40	0.24	0.23	0.20	0.62



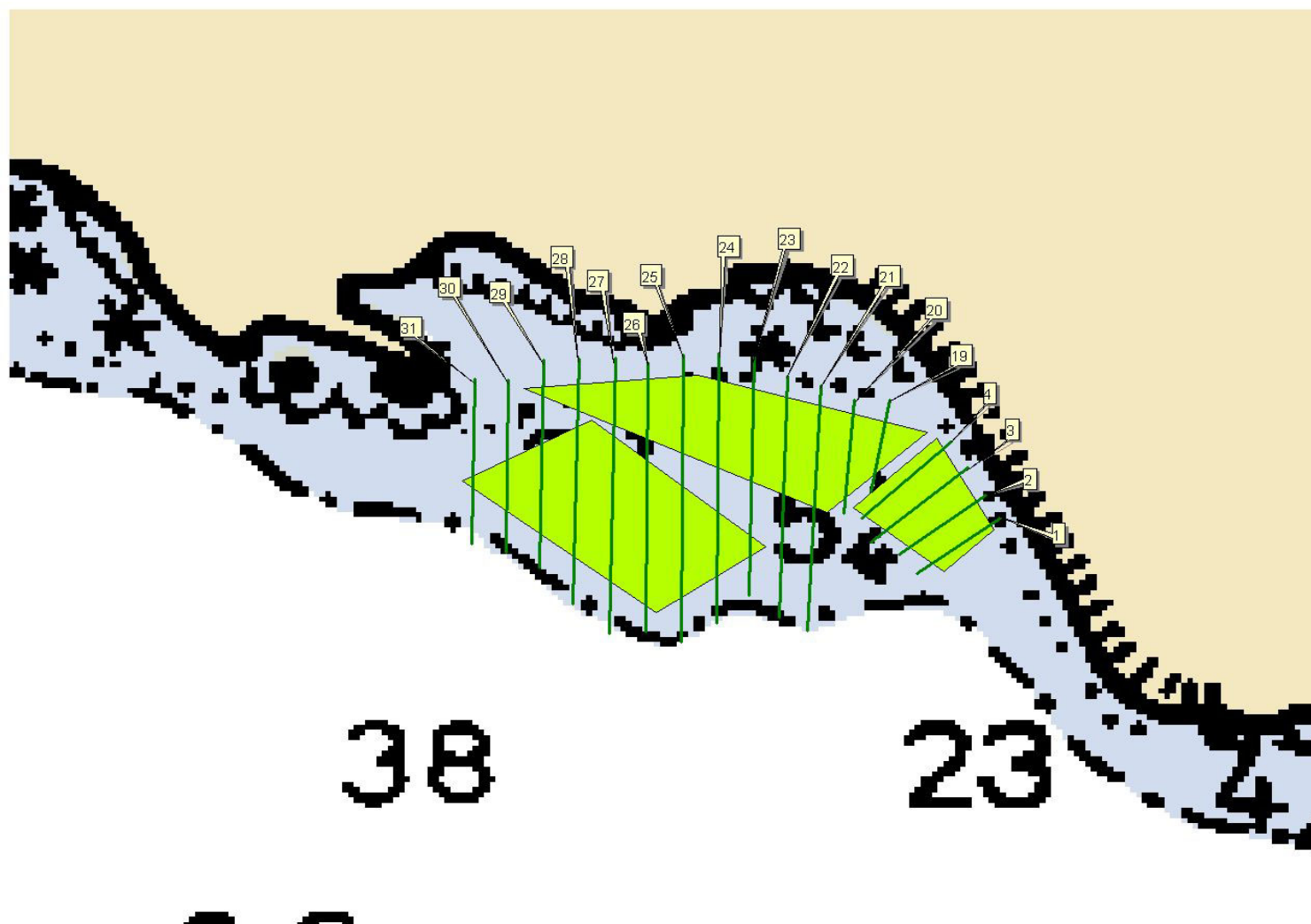


Figure 2. Suggested site locations and transects near Point Alava. Transects 1-4 are associated with Lacroix Pt. Alava application. Transects 19-31 are associated with reconnaissance sites 9 and 10.

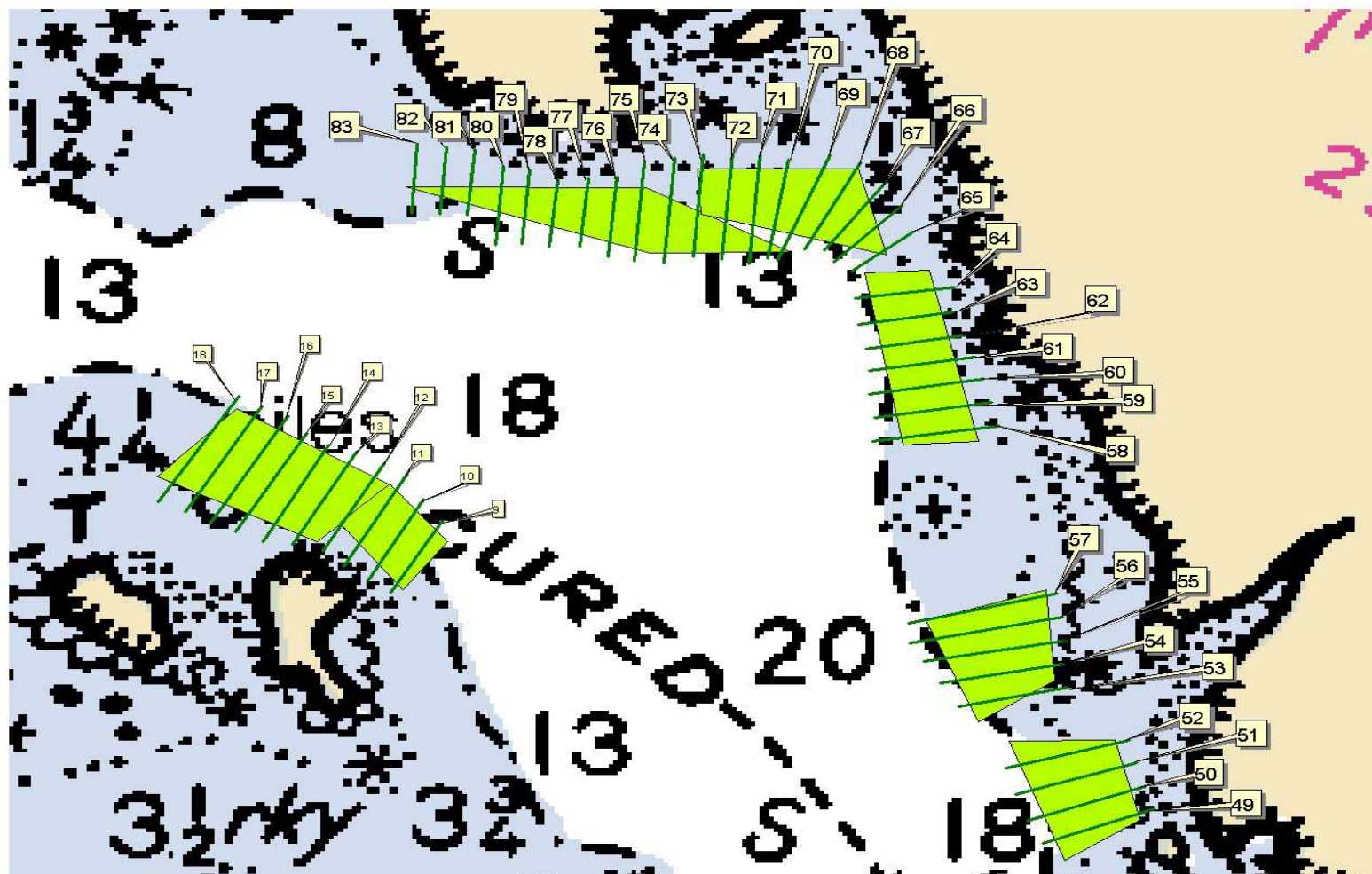


Figure 3. Suggested site locations and plotted transects near Slate Island. Transects 9-11 are associated with Zaugg's application, transects 12-18 are associated with Lacroix's application, transects 49-52 (site 5), 53-57 (site 4), 58-64 (site 3), and transects 65-83 (sites 1 and 2).

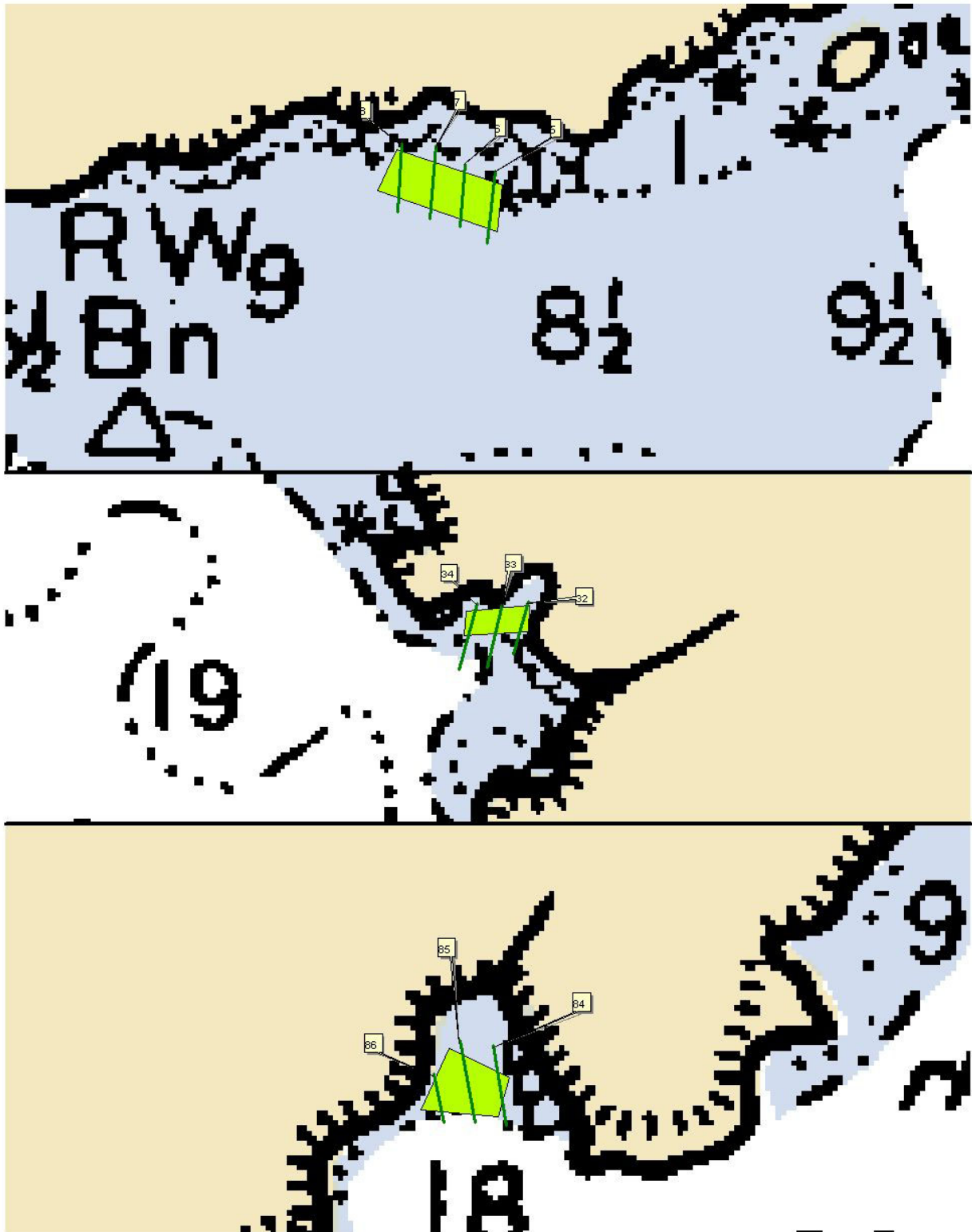


Figure 4. Suggested site locations and plotted transects: Coho Cove (top, reconnaissance site 8), north of Lucky Cove (middle, site 11), south of Fox Point (bottom, site 8).

APPENDICES

Appendix A. Key to vegetative substrate types used for geoduck clam surveys.

Code	Expanded Code	Species Included	Latin Names
AGM	Agarum	Sieve kelp	<i>Agarum clathratum</i>
ALA	Alaria	Ribbon kelps	<i>Alaria marginata</i> , <i>A. nana</i> , <i>A. fistulosa</i>
ELG	Eel grass	Eel grass, surf grasses	<i>Zostera marina</i> , <i>Phyllospadix serrulatus</i> , <i>P. scouleri</i>
FIL	Filamentous red algae	Sea brush, poly, black tassel	<i>Polysiphonia pacifica</i> , <i>P. hendryi</i> , <i>Pterosiphonia bipinnata</i>
FIR	Fir kelp	Black pine, Oregon pine (red algae)	<i>Neorhodomela larix</i> , <i>N. oregona</i>
FUC	Fucus	Rockweed or popweed	<i>Fucus gardneri</i>
HIR	Hair kelp	Witch's hair, stringy acid kelp	<i>Desmarestia aculeata</i> , <i>D. viridis</i>
LAM	Laminaria	split kelp, sugar kelp, suction-cup kelp	<i>Laminaria bongardiana</i> , <i>L. saccharina</i> , <i>L. yezoensis</i> (when isolated and identifiable)
LBK	Large Brown Kelps	Five-ribbed kelp, three-ribbed kelp, split kelp, sugar kelp, sea spatula, sieve kelp, ribbon kelp	<i>Costaria costata</i> , <i>Cymathere triplicata</i> , <i>Laminaria</i> spp., <i>Pleurophycus gardneri</i> , <i>Agarum</i> , <i>Alaria</i> spp.
MAC	Macrocystis	macrocystis	<i>Macrocystis integrifolia</i>
NER	Nereocystis	Bull kelp	<i>Nereocystis leutkeana</i>
RED	Red algae	All red leafy algae (red ribbons, red blades, red sea cabbage, Turkish washcloth)	<i>Palmaria mollis</i> , <i>P. hecatensis</i> , <i>P. callophyloides</i> , <i>Dilsea californica</i> , <i>Neodilsea borealis</i> , <i>Mastocarpus papillatus</i> , <i>Turnerella mertensiana</i>
ULV	Ulva	Sea lettuce	<i>Ulva fenestrata</i> , <i>Ulvaria obscura</i>
COR	Coralline algae	Coral seaweeds (red algae)	<i>Bossiella</i> , <i>Corallina</i> , <i>Serraticardia</i>

Appendix B. Key to bottom types used for geoduck clam surveys.

Code	Expanded code	Definition
RCK	Bedrock	Various rocky substrates > 1 meter in diameter
BLD	Boulder	Substrate between 25 cm and 1 meter
CBL	Cobble	Substrate between 6 cm and 25 cm
GVL	Gravel	Substrate between 0.4 cm and 6 cm
SND	Sand	Clearly separate grains of < 0.4 cm
MUD	Mud	Soft, paste-like material
SIL	Silt	Fine organic dusting
BAR	Barnacle	Area primarily covered with barnacles
SHL	Shell	Area primarily covered with whole or crushed shells
MUS	Mussels	Area primarily covered with mussels
WDY	Woody debris	Any submerged bark, logs, branches or root systems

Appendix C. HB-208 geoduck mariculture site assessment survey raw data, 2003.

Date	Transect Num.	Time In	Time Out	Diver #1	Diver #2	MLLW Start	MLLW End	Length Interval	Num. Geoducks	Bottom Type #1	Bottom Type #2	Percent Veg Cover	Veg Type #1	Veg Type #2	Comments
8/21/2003	5	9:00	9:13	DG	BL	-9	31		0						Rock from 45-60 fsw
8/21/2003	5	9:00	9:13	DG	BL	31	55	28	3 rck	snd		0			
8/21/2003	6	9:16	9:31	MP	ZH	16	27		0						bolder < 25fsw
8/21/2003	6	9:16	9:31	MP	ZH	27	55	30	6 snd			0			gd not showing, gd @36-45 fsw,wdebris@ 50 fsw
8/21/2003	7	9:26	9:42	WB	DG	1	18		rck						
8/21/2003	7	9:26	9:42	WB	DG	18	55	48	15 snd	mud					gd end @ approx 50 fsw. Substrait soft gd may not be showing well
8/21/2003	8	9:44	9:56	MP	JR	10	17		0 bld				elg		
8/21/2003	8	9:44	9:56	MP	JR	17	55	42	20 snd						gd stop @ apro 45 fsw, wdy@ 55-60+
8/21/2003	9	12:23	12:37	JR	ZH	13	43		0						
8/21/2003	9	12:23	12:37	JR	ZH	43	55	15	9 snd	shl		5 lbk			more gd to north of transect
8/21/2003	10	12:49	13:11	MP	ZH	-7	15		0 snd				elg		
8/21/2003	10	12:49	13:11	MP	ZH	15	38	50	134 snd			25 lbk			
8/21/2003	10	12:49	13:11	MP	ZH	38	56	12	9						lots of horse clams shallow
8/21/2003	11	13:25	13:45	Zh	Mp	-6	15		0 snd				elg		lots of horse clams
8/21/2003	11	13:25	13:45	Zh	Mp	15	30	28	64 snd			0			
8/21/2003	11	13:25	13:45	Zh	Mp	30	55	19	24						
8/21/2003	12	13:58	14:21	JR	Jm	-6	20		0						
8/21/2003	12	13:58	14:21	JR	Jm	20	44	50	10 snd	mud		5 lbk	elg		
8/21/2003	12	13:58	14:21	JR	Jm	44	55	28	0						
8/21/2003	13	14:33	14:57	MP	ZH	-7	14		0						
8/21/2003	13	14:33	14:57	MP	ZH	14	20	50	2 cbl	gvl		5 lbk			
8/21/2003	13	14:33	14:57	MP	ZH	20	41	50	8						
8/21/2003	13	14:33	14:57	MP	ZH	41	55	38	1						
8/21/2003	14	15:24	15:52	JR	MP	5	16		0 snd			50 elg			
8/21/2003	14	15:24	15:52	JR	MP	16	22	50	12 snd	gvl		50 lam			
8/21/2003	14	15:24	15:52	JR	MP	22	40	50	56 snd			5 lam			
8/21/2003	14	15:24	15:52	JR	MP	40	55	34	4 snd	gvl		5 lam		wdy	
8/21/2003	15	15:03	15:43	BL	WB	11	14		0 gvl	snd					
8/21/2003	15	15:03	15:43	BL	WB	14	18	50	9 gvl	snd		5 lam			
8/21/2003	15	15:03	15:43	BL	WB	18	26	50	74						
8/21/2003	15	15:03	15:43	BL	WB	26	50	50	119						
8/21/2003	15	15:03	15:43	BL	WB	50	55	13	0						more detritus below 50 fsw
8/21/2003	16	14:17	14:46	WB	DG	13	14		0						
8/21/2003	16	14:17	14:46	WB	DG	14	18	50	45 snd	cbl		25 lbk			
8/21/2003	16	14:17	14:46	WB	DG	18	27	50	40 snd	gvl		25 lbk			
8/21/2003	16	14:17	14:46	WB	DG	27	47	50	177 snd			5 lbk			
8/21/2003	16	14:17	14:46	WB	DG	47	55	14	0 snd	shl		5 lbk			a few h clams
8/21/2003	17	13:23	13:59	BL	DG	-6	16		0						
8/21/2003	17	13:23	13:59	BL	DG	16	19	50	37 snd			25 lbk			
8/21/2003	17	13:23	13:59	BL	DG	19	25	50	34						
8/21/2003	17	13:23	13:59	BL	DG	25	55	50	264						extensive bed 35-44 fsw elg @ 17fsw
8/21/2003	18	12:20	13:07	BL	WB	7	17		0 cbl			lbk			
8/21/2003	18	12:20	13:07	BL	WB	17	21	50	36 snd	gvl		5 lam			
8/21/2003	18	12:20	13:07	BL	WB	21	31	50	103 snd						
8/21/2003	18	12:20	13:07	BL	WB	31	55	50	75						very few greater than 50 fsw, densest @ 30-45 fsw mostly dimples.
8/22/2003	49	8:01	8:13	BL	WB	-8	27		0 rck			0			
8/22/2003	49	8:01	8:13	BL	WB	27	52	50	28						

Date	Transect Num.	Time In	Time Out	Diver #1	Diver #2	MLLW Start	MLLW End	Length Interval	Num. Geoducks	Bottom Type #1	Bottom Type #2	Percent Veg Cover	Veg Type #1	Veg Type #2	Comments
8/22/2003	49	8:01	8:13	BL	WB	52	55	3	0						fair number of urchins, no ducks exposed above seafloor
8/22/2003	50	8:01	8:46	MP	ZH	-8	18		0	snd		0			
8/22/2003	50	8:01	8:46	MP	ZH	18	23	50	29						
8/22/2003	50	8:01	8:46	MP	ZH	23	24	50	21						
8/22/2003	50	8:01	8:46	MP	ZH	24	26	50	8						
8/22/2003	50	8:01	8:46	MP	ZH	26	29	50	58						
8/22/2003	50	8:01	8:46	MP	ZH	29	37	50	113						
8/22/2003	50	8:01	8:46	MP	ZH	37	40	8	16						compass setting off, use for area estimate only
8/22/2003	51	8:27	8:41	BL	DG	-8	24		0	snd		5			
8/22/2003	51	8:27	8:41	BL	DG	24	39	50	14						
8/22/2003	51	8:27	8:41	BL	DG	39	55	19	2						
8/22/2003	53	8:50	9:16	WB	DG	-9	24		0	snd	sil	0			
8/22/2003	53	8:50	9:16	WB	DG	24	34	50	126						no necks exposed
8/22/2003	53	8:50	9:16	WB	DG	34	53	49	65						geoducks all below surface
8/22/2003	54	9:07	9:25	JR	JM	-9	27		0	snd		0			
8/22/2003	54	9:07	9:25	JR	JM	27	36	50	74						
8/22/2003	54	9:07	9:25	JR	JM	36	55	41	17						
8/22/2003	55	9:26	9:46	BL	WB	1	27		0	bld					
8/22/2003	55	9:26	9:46	BL	WB	27	39	50	73	snd					
8/22/2003	55	9:26	9:46	BL	WB	39	55	44	10	snd					No ducks extended above sea floor
8/22/2003	55	9:26	9:46	BL	WB										
8/22/2003	56	9:37	9:57	MP	ZH	-9	29		0	rck	snd				
8/22/2003	56	9:37	9:57	MP	ZH	29	41	50	68	snd					
8/22/2003	56	9:37	9:57	MP	ZH	41	54	50	10	snd					
8/22/2003	56	9:37	9:57	MP	ZH	54	55	8	1	snd					
8/22/2003	57	9:57	10:25	BL	DG	-9	23			rck					
8/22/2003	57	9:57	10:25	BL	DG	23	31	50	22	snd		5	lbk		
8/22/2003	57	9:57	10:25	BL	DG	36	36	50	30	snd					
8/22/2003	57	9:57	10:25	BL	DG	36	49	50	5	rck	snd				Rock first 38 m
8/22/2003	57	9:57	10:25	BL	DG	49	55	50	1	snd					
8/22/2003	58	10:14	10:41	ZH	MP	-9	26			rck					
8/22/2003	58	10:14	10:41	ZH	MP	26	32	50	22	gvl	snd	5	lbk		
8/22/2003	58	10:14	10:41	ZH	MP	32	36	50	25	snd					
8/22/2003	58	10:14	10:41	ZH	MP	36	55	34	5						
8/22/2003	59	10:53	11:18	JR	JM	-9	21								
8/22/2003	59	10:53	11:18	JR	JM	21	26	50	3	snd	sil	5	fir		
8/22/2003	59	10:53	11:18	JR	JM	26	29	50	3						
8/22/2003	59	10:53	11:18	JR	JM	29	35	50	28						
8/22/2003	59	10:53	11:18	JR	JM	35	55	28	10						
8/22/2003	60	14:31	15:02	wb	dg	-7	20			snd					
8/22/2003	60	14:31	15:02	wb	dg	20	24	50	6						
8/22/2003	60	14:31	15:02	wb	dg	24	27	50	18						
8/22/2003	60	14:31	15:02	wb	dg	27	47	50	81						
8/22/2003	60	14:31	15:02	wb	dg	47	55	5	2						Perfect habitat, possible low show factor
8/22/2003	61	14:30	14:59	ZH	MP	-6	18								
8/22/2003	61	14:30	14:59	ZH	MP	18	24	50	8	snd		0			
8/22/2003	61	14:30	14:59	ZH	MP	24	27	50	20						
8/22/2003	61	14:30	14:59	ZH	MP	27	40	50	38						
8/22/2003	61	14:30	14:59	ZH	MP	40	56	11	3						
8/22/2003	62	15:12	15:29	WB	DG	-7	22								

Date	Transect Num.	Time In	Time Out	Diver #1	Diver #2	MLLW Start	MLLW End	Length Interval	Num. Geoducks	Bottom Type #1	Bottom Type #2	Percent Veg Cover	Veg Type #1	Veg Type #2	Comments
8/22/2003	62	15:12	15:29	WB	DG	22	27	50	33 snd			5 red			
8/22/2003	62	15:12	15:29	WB	DG	27	55	41	40						
8/22/2003	63	15:11	15:33	JR	MP	-7	22		snd			25 lam			
8/22/2003	63	15:11	15:33	JR	MP	22	30	50	49 snd			5 lam			
8/22/2003	63	15:11	15:33	JR	MP	30	55	30	49 snd			0			
8/22/2003	64	15:38	15:58	DG	BL	-7	17								
8/22/2003	64	15:38	15:58	DG	BL	17	23	50	13 snd			10 red			
8/22/2003	64	15:38	15:58	DG	BL	23	50	50	38						
8/22/2003	64	15:38	15:58	DG	BL	50	55	4	0						
8/22/2003	65	15:44	16:06	ZH	JR	-7	17								
8/22/2003	65	15:44	16:06	ZH	JR	17	16	21	3 snd						
8/22/2003	65	15:44	16:06	ZH	JR	16	22	100	rck						Length approx. swam over rock
8/22/2003	65	15:44	16:06	ZH	JR	22	54	14	0 snd						
8/22/2003	66	16:10	16:29	WB	DG	-7	14		snd						
8/22/2003	66	16:10	16:29	WB	DG	14	18	44	6 gvl	snd		25 lbk			
8/22/2003	66	16:10	16:29	WB	DG	18	32	50	0 rck						
8/22/2003	66	16:10	16:29	WB	DG	32	55	35	7 snd						
8/22/2003	67	16:17	16:38	MP	ZH	-7	18		bld	snd		5 lam			
8/22/2003	67	16:17	16:38	MP	ZH	18	25	50	4 snd			5 lam			
8/22/2003	67	16:17	16:38	MP	ZH	25	51	50	14 snd			0			
8/22/2003	67	16:17	16:38	MP	ZH	51	55	6	2 snd						
8/23/2003	36	16:05	16:42	JR	MP	22	24		0 snd	gvl		75 red			
8/23/2003	36	16:05	16:42	JR	MP	24	25	50	12 snd	gvl		50 hir	lam		
8/23/2003	36	16:05	16:42	JR	MP	25	30	50	14 gvl	snd		25 lam			
8/23/2003	36	16:05	16:42	JR	MP	30	37	50	38 snd	gvl		5 lam			
8/23/2003	36	16:05	16:42	JR	MP	37	49	50	54 snd	shl		5 lam			
8/23/2003	36	16:05	16:42	JR	MP	49	55	15	0 snd	gvl		5 lam			
8/23/2003	52	8:09	8:36	JM	MP	4	10		0 snd			5 elg			
8/23/2003	52	8:09	8:36	JM	MP	10	19	50	10 snd						
8/23/2003	52	8:09	8:36	JM	MP	19	28	50	14 snd						
8/23/2003	52	8:09	8:36	JM	MP	28	36	50	70 snd			1 red			
8/23/2003	52	8:09	8:36	JM	MP	36	55	40	37 snd			1 red			
8/23/2003	79	11:25	11:45	WB	ZH	10	18		0 snd			1 elg			
8/23/2003	79	11:25	11:45	WB	ZH	18	30	50	48						
8/23/2003	79	11:25	11:45	WB	ZH	30	55	50	7						
8/23/2003	80	11:55	12:16	BL	WB	-10	17		0 snd			5 red			
8/23/2003	80	11:55	12:16	BL	WB	17	28	50	24						
8/23/2003	80	11:55	12:16	BL	WB	28	29	16	10 snd						
8/23/2003	80	11:55	12:16	BL	WB	29	39	30	0 rck						
8/23/2003	80	11:55	12:16	BL	WB	39	55	35	15 snd						
8/23/2003	83	14:26	15:02	ZH	BL	15	27		0 gvl	snd		5 lbk	red		
8/23/2003	83	14:26	15:02	ZH	BL	27	38	50	25						
8/23/2003	83	14:26	15:02	ZH	BL	38	48	50	22						
8/23/2003	83	14:26	15:02	ZH	BL	48	53	50	12						
8/23/2003	83	14:26	15:02	ZH	BL	53	53	50	8						
8/23/2003	83	14:26	15:02	ZH	BL	53	55	13	0						
8/23/2003	68	8:02	8:21	WB	ZH	-6	18		0 gvl	snd		0			
8/23/2003	68	8:02	8:21	WB	ZH	18	24	50	1						
8/23/2003	68	8:02	8:21	WB	ZH	24	35	50	0						
8/23/2003	68	8:02	8:21	WB	ZH	35	54	26	0						
8/23/2003	69	8:34	8:44	BL	WB	16	23		0 snd			0			
8/23/2003	69	8:34	8:44	BL	WB	23	38	50	9						

Date	Transect Num.	Time In	Time Out	Diver #1	Diver #2	MLLW Start	MLLW End	Length Interval	Num. Geoducks	Bottom Type #1	Bottom Type #2	Percent Veg Cover	Veg Type #1	Veg Type #2	Comments
8/23/2003	69	8:34	8:44	BL	WB	38	55	12	0						
8/23/2003	70	8:58	9:14	DG	JR	10	29		0 snd	gvl					
8/23/2003	70	8:58	9:14	DG	JR	29	55	34	13						a few horse clams
8/23/2003	71	9:00	9:17	ZH	BL	-6	25		0 snd			0			
8/23/2003	71	9:00	9:17	ZH	BL	25	36	50	7						
8/23/2003	71	9:00	9:17	ZH	BL	36	56	21	2						Compass heading 162 degrees
8/23/2003	72	9:26	9:42	MP	DG	13	20		0 snd			0			
8/23/2003	72	9:26	9:42	MP	DG	20	27	50	4						
8/23/2003	72	9:26	9:42	MP	DG	27	55	46	7						
8/23/2003	73	9:26	9:47	WB	ZH	14	22		0 snd			0			
8/23/2003	73	9:26	9:47	WB	ZH	22	31	50	10 snd	sil					
8/23/2003	73	9:26	9:47	WB	ZH	31	55	34	28						
8/23/2003	74	9:55	10:20	MP	JR	14	21		0 bld	snd		75 lam			
8/23/2003	74	9:55	10:20	MP	JR	21	23		0 snd			5 lam			
8/23/2003	74	9:55	10:20	MP	JR	23	30	50	14 snd	gvl		10 lam			
8/23/2003	74	9:55	10:20	MP	JR	30	50	50	41 snd	shl		50 red	lam		
8/23/2003	74	9:55	10:20	MP	JR	50	55	6	0 snd	shl		0			
8/23/2003	75	9:58	10:18	BL	WB	-10	14		0 snd			5 red	lam		
8/23/2003	75	9:58	10:18	BL	WB	14	23	50	1						
8/23/2003	75	9:58	10:18	BL	WB	23	34	48	20			50 red			Rock 48 m into interval
8/23/2003	75	9:58	10:18	BL	WB	34	55	25	0						
8/23/2003	76	10:31	10:49	DG	JR	15	18		0 snd			5 lbk			
8/23/2003	76	10:31	10:49	DG	JR	18	29	50	28 snd						
8/23/2003	76	10:31	10:49	DG	JR	29	54	28	8 snd						
8/23/2003	77	10:59	11:16	MP	DG	12	18		0 snd			10 lam			
8/23/2003	77	10:59	11:16	MP	DG	18	31	50	63 snd			5 lam			
8/23/2003	77	10:59	11:16	MP	DG	31	55	32	11 snd	shl		1 lam			
8/23/2003	78	11:03	11:18	ZH	BL	16	20		0 snd			5 lbk			
8/23/2003	78	11:03	11:18	ZH	BL	20	42	50	54						
8/23/2003	78	11:03	11:18	ZH	BL	42	55	19	1						
8/23/2003	81	13:39	14:10	MP	JR	11	20		0 rck	bld		5 lam			
8/23/2003	81	13:39	14:10	MP	JR	20	36	50	111 snd			75 red	lam		
8/23/2003	81	13:39	14:10	MP	JR	36	50	50	12 snd	shl		10 lam	red		
8/23/2003	81	13:39	14:10	MP	JR	50	55	25	0						
8/23/2003	82	14:20	14:52	DG	JR	10	20		0 rck						
8/23/2003	82	14:20	14:52	DG	JR	20	31	50	149 snd			10 lam			
8/23/2003	82	14:20	14:52	DG	JR	31	43	50	19 snd			30 elg			
8/23/2003	82	14:20	14:52	DG	JR	43	50	33	5 rck	snd					
8/23/2003	82	14:20	14:52	DG	JR	50	55	8	1 snd	shl					
8/24/2003	37	7:52	8:27	DG	JM	19	21		0 rck	cbl					
8/24/2003	37	7:52	8:27	DG	JM	21	22	50	2 snd	gvl		15 lbk			
8/24/2003	37	7:52	8:27	DG	JM	22	23	50	2 snd	gvl		5 lbk			
8/24/2003	37	7:52	8:27	DG	JM	23	22	50	0 snd	gvl		5 lbk			
8/24/2003	37	7:52	8:27	DG	JM	22	23	50	0						
8/24/2003	37	7:52	8:27	DG	JM	23	40	50	0 cbl			5 lbk			
8/24/2003	37	7:52	8:27	DG	JM	40	48	27	0 cbl	shl		0			did not reach target depth-low on air, no ducks seen @ 53 fsw or deeper
8/24/2003	39	8:43	9:01	JR	DG	23	23		0 snd						
8/24/2003	39	8:43	9:01	JR	DG	23	37	50	17 snd			0			
8/24/2003	39	8:43	9:01	JR	DG	37	55	50	1 snd			0			
8/23/2003	35	15:23	15:48	MP	DG	4	22		0 rck						

Date	Transect Num.	Time In	Time Out	Diver #1	Diver #2	MLLW Start	MLLW End	Length Interval	Num. Geoducks	Bottom Type #1	Bottom Type #2	Percent Veg Cover	Veg Type #1	Veg Type #2	Comments
8/23/2003	35	15:23	15:48	MP	DG	22	28		0 gvl	snd		50 agm			deviated from transect at approx. 33 fsw. See hard copy for our 'recon' notes
8/24/2003	1	9:36	9:50	JR	JM	13	25		0 rck	snd		50 lbk			
8/24/2003	1	9:36	9:50	JR	JM	25	53	50	46 snd			0			
8/24/2003	1	9:36	9:50	JR	JM	53	55	2	0						
8/24/2003	2	9:37	9:47	BL	WB	26	11		0 rck						rck to 20 fsw
8/24/2003	2	9:37	9:47	BL	WB	11	55		0 rck						
8/24/2003	2	9:37	9:47	BL	WB	13	25		0 rck	bld					
8/24/2003	2	9:37	9:47	BL	WB	25	26	22	12 snd						
8/24/2003	3	9:55	10:07	ZH	BL	-10	27		0 rck						
8/24/2003	3	9:55	10:07	ZH	BL	27	55	47	149 snd			0			most gd barely showing
8/24/2003	4	9:58	10:10	JM	JR	-10	1		0 rck			0			
8/24/2003	4	9:58	10:10	JM	JR	1	26		0 rck			0			
8/24/2003	4	9:58	10:10	JM	JR	26	32		0 cbl			0			
8/24/2003	4	9:58	10:10	JM	JR	32	55	50	24 snd			5 lbk			
8/24/2003	19	10:16	10:38	WB	ZH	12	23		0						
8/24/2003	19	10:16	10:38	WB	ZH	23	31	50	7 gvl	snd		25 lbk	red		approx 20 horseclams over entire transect (compass 180)
8/24/2003	19	10:16	10:38	WB	ZH	31	47	50	17						
8/24/2003	19	10:16	10:38	WB	ZH	47	55	11	2						
8/24/2003	20	10:18	10:39	JR	DG	9	27		0 bld			90 lam			
8/24/2003	20	10:18	10:39	JR	DG	27	36	50	52 snd			0			
8/24/2003	20	10:18	10:39	JR	DG	36	55	38	32						
8/24/2003	21	10:45	11:07	BL	WB	18	27		0 rck	snd					
8/24/2003	21	10:45	11:07	BL	WB	27	34	50	42						horseclams in similar numbers to 'ducks'
8/24/2003	21	10:45	11:07	BL	WB	34	55	46	42						
8/24/2003	22	10:47	11:15	JM	JR	15	33		0 snd	shl					
8/24/2003	22	10:47	11:15	JM	JR	33	40	50	100 snd			0			
8/24/2003	22	10:47	11:15	JM	JR	40	50	50	34 snd	shl		0			
8/24/2003	22	10:47	11:15	JM	JR	50	55	2	1 snd	shl		0			
8/24/2003	23	11:15	11:37	ZH	BL	-11	27		0 rck						
8/24/2003	23	11:15	11:37	ZH	BL	27	39		0						
8/24/2003	23	11:15	11:37	ZH	BL	39	48	50	1 snd			0			
8/24/2003	23	11:15	11:37	ZH	BL	48	55	16	0						good geoduck habitat
8/24/2003	24	11:24	11:47	DG	JM	27	35		0 snd			0			
8/24/2003	24	11:24	11:47	DG	JM	35	41	50	2 snd			0			
8/24/2003	24	11:24	11:47	DG	JM	41	55	29	0 snd	rck					52 66 fsw: 5 m snd, 15 m rck, 9 m snd
8/24/2003	38	9:51	8:27	ZH	BL	-5	20		0						
8/24/2003	38	9:51	8:27	ZH	BL	20	24	50	2 gvl	snd					not geoduck habitat
8/24/2003	38	9:51	8:27	ZH	BL	24	26	50	0 gvl	snd		50 lam	agm		not geoduck habitat
8/24/2003	38	9:51	8:27	ZH	BL	26	28	50	0 gvl	snd		50 lam	agm		not geoduck habitat
8/24/2003	38	9:51	8:27	ZH	BL	28	31	50	2 snd			41			
8/24/2003	38	9:51	8:27	ZH	BL	31	55	33	93 snd						
8/24/2003	40	8:47	8:02	WB	ZH	16	48		0						
8/24/2003	40	8:47	8:02	WB	ZH	48	55	9	1 snd			0			
8/24/2003	25	13:25	14:00	WB	ZH	23	28		0						
8/24/2003	25	13:25	14:00	WB	ZH	28	33	50	1 snd	shl		5 red			
8/24/2003	25	13:25	14:00	WB	ZH	33	39	50	1						
8/24/2003	25	13:25	14:00	WB	ZH	39	44	50	8						
8/24/2003	25	13:25	14:00	WB	ZH	44	47	25	0						
8/24/2003	25	13:25	14:00	WB	ZH	47	55		0 rck						
8/24/2003	28	14:09	14:26	BL	WB	19	24	30	0 snd						

Date	Transect Num.	Time In	Time Out	Diver #1	Diver #2	MLLW Start	MLLW End	Length Interval	Num. Geoducks	Bottom Type #1	Bottom Type #2	Percent Veg Cover	Veg Type #1	Veg Type #2	Comments
8/24/2003	28	14:09	14:26	BL	WB	24	15	50	0 rck						
8/24/2003	28	14:09	14:26	BL	WB	15	42	75	0 rck						
8/24/2003	28	14:09	14:26	BL	WB	42	55	12	1 snd						
8/24/2003	29	14:41	15:01	ZH	BL	15	17		0 rck						
8/24/2003	29	14:41	15:01	ZH	BL	17	25	50	1 snd			5 lbk	red		
8/24/2003	29	14:41	15:01	ZH	BL	25	43		0 rck						
8/24/2003	29	14:41	15:01	ZH	BL	43	55	28	2 snd						
8/24/2003	32	15:38	15:49	BL	WB	13	16		0 rck	snd					
8/24/2003	32	15:38	15:49	BL	WB	16	55	45	11 snd	sil					wdy debris, small band of good habitat 23-45 fsw. A few horse clams
8/24/2003	33	15:19	15:32	WB	ZH	5	25		0 rck						
8/24/2003	33	15:19	15:32	WB	ZH	25	54	50	38 snd	sil		0			
8/24/2003	33	15:19	15:32	WB	ZH	54	55	3	0 snd	sil		0			
8/24/2003	26	13:32	13:53	JR	DG	16	35		0 snd	sil		0			
8/24/2003	26	13:32	13:53	JR	DG	35	55		0 rck						
8/24/2003	27	14:02	14:29	JM	JR	17	20		0 snd			0			
8/24/2003	27	14:02	14:29	JM	JR	20	24	50	3 snd						
8/24/2003	27	14:02	14:29	JM	JR	24	26	23	0 snd						
8/24/2003	27	14:02	14:29	JM	JR	26	27	4	0 rck						
8/24/2003	27	14:02	14:29	JM	JR	27	35	50	0 snd						
8/24/2003	27	14:02	14:29	JM	JR	35	55	50	19						
8/24/2003	30	14:41	14:58	DG	JM	18	44		0 snd	rck					
8/24/2003	30	14:41	14:58	DG	JM	44	55	32	1 snd	cbl					
8/24/2003	31	15:06	15:21	DG	JR	-8	37		0 cbl	snd					
8/24/2003	31	15:06	15:21	DG	JR	37	55		0 cbl	shl					
8/24/2003	34	15:40	15:53	JM	JR	6	26		0 rck	snd		50 agm			
8/24/2003	34	15:40	15:53	JM	JR	26	39	42	7 rck	snd					
8/24/2003	34	15:40	15:53	JM	JR	39	55		0 rck						no geoduck habitat for most of transect

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