GEODUCK CLAM STOCK ASSESSMENT SURVEYS

AND FISHERY MANAGEMENT

FOR THE 1999-2000 SEASON

By

Marc Pritchett
Robert Larson
John Clark

Regional Information Report[1] No. 1J00-34

Alaska Department of Fish and Game
Division of Commercial Fisheries
Southeast Region
Juneau, Alaska

December 2000

[1] The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse and hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data, this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

ACKNOWLEDGMENTS

The authors wish to thank the scuba divers who collected the data: William Bergmann, Cathy Botelho, John Clark, Bill Davidson, Phil Doherty, Dave Gordon, Kyle Hebert, Tim Koeneman, Brian Lynch, Jan Rumble, Scott Walker, and Doug Woodby of the Alaska Department of Fish and Game. Thanks also to Denny Heimdahl and Bill Olson for their skillful and safe operation of the *R/V Sundance*, to Dave Gordon and Scott Walker for providing the fishery data and reviewing the management section, and to Cori Cashen for overall editing and formatting of the final report.

TABLE OF CONTENTS

Page

ACKNOWLEDGMENTS....2

LIST OF TABLES....4

LIST OF FIGURES....4

LIST OF APPENDICES....4

ABSTRACT....5

INTRODUCTION....6

METHODS....6

Geoduck Weight Estimates....8
Geoduck Biomass Estimates....8

SURVEY RESULTS AND DISCUSSION....11

FISHERY MANAGEMENT AND SEASON SUMMARY....12

LITERATURE CITED....15

APPENDIX....25

LIST OF TABLES

Page

Table 1. Biomass estimates of geoduck clams from five areas surveyed in Southeast Alaska in 1999. ... 16
Table 2. Southeast Alaska 1999-2000 season commercial geoduck clam harvest by area. 17

LIST OF FIGURES

Page

Figure 1. Geoduck clam survey and commercial harvest areas in Southeast Alaska..... 18
Figure 2. Nakat Bay (in Subdistrict 101-11) 1999 geoduck survey transect locations. 19
Figure 3. Foggy Bay 1999 geoduck survey transect locations..... 20
Figure 4. Sea Otter Sound (Turn Point and Cone Bay in Subdistrict 101-90-) 1999 geoduck survey transect locations. 21
Figure 5. Cone Island 1999 geoduck survey transect locations. 22
Figure 6. Goddard (Bed 113-31/41-001) 1999 geoduck survey transect locations..... 23

LIST OF APPENDICES

Page

Appendix A. Key to vegetative substrate types used for geoduck clam surveys..... 26
Appendix B. Key to bottom types used for geoduck clam surveys. 27
Appendix C. Nakat Bay (in Subdistrict 101-11) geoduck clam assessment survey, 1999. 28
Appendix D. Foggy Bay (Bed 101-23-001) geoduck clam assessment surveys, 1999. 33
Appendix E. Sea Otter Sound (Subdistrict 103-90) geoduck clam assessment surveys. 38
Appendix F. Cone Island (Subdistrict 104-40) geoduck clam assessment survey, 1999. This area survey is not complete. The listed data and calculations are presented for information purposes, only..... 45
Appendix G. Goddard (portions of Subdistricts 113 - 31/41) geoduck clam assessment survey. Transects 1 – 51 were surveyed in 1998; transects 52 – 72 were surveyed in 1999..... 48
Appendix H. Guideline harvest level calculations for Vallenar Bay for the 1999-2000 season. 64

ABSTRACT

Surveys were conducted in portions of commercial fishing Subdistricts 101-11, 101-23, 103-90, 104-40, and 113-31 to estimate geoduck clam biomass. The surveys were conducted by Alaska Department of Fish and Game (ADF&G) divers during June and August 1999 using the ADF&G *R/V Sundance*. Total geoduck clam biomass was estimated for areas surveyed at approximately 2,483,995 kg (5,476,180 lb). Not all areas surveyed in 1999 were scheduled to open during the 1999-2000 season. The fishery was opened in November 1999 with a Guideline Harvest Level of 92,943 kg (204,900 lb). One area, Sea Otter Sound in Subdistrict 103-90 with a GHL of 20,639 kg (45,500 lb), did not open as originally scheduled due to incomplete ADEC water quality testing, and was eventually rescheduled to open for the 2000/01 season. An estimated total of 91,745 kg (202,260 lb) of geoduck clams was harvested during the 1999/2000 fishery.

INTRODUCTION

Historically, geoduck clam assessment surveys have been limited in scope in Southeast Alaska. Stock assessment surveys were first attempted in Southeast Alaska in 1982 at Noyes Island and in 1988 and 1989 at Biorka Island, Kah Shakes, and Gravina Island. Although commercial fisheries have been ongoing since 1985, no additional surveys were conducted until 1997. Beginning in 1997 established commercial harvest areas are being resurveyed as are several new areas. The principal goals of this project were to: 1) conduct a biomass assessment survey prior to opening the commercial fishery in areas scheduled to open for the 1999/2000 season, and 2) continue improvement of assessment techniques for future surveys. Areas surveyed were Nakat Bay in Subdistrict 101-11, Foggy Bay in Subdistrict 101-23-001, Cone Island area in Subdistrict 104-40, Turn Point and Cone Bay in Subdistrict 103-90, and the Goddard area in portions of Subdistricts 113-31 and 113-41 (Figure 1).

METHODS

Density estimates were made by scuba divers along two-meter-wide strip transects. There are two types of transects that may be used depending on the area; these transects serve as the primary sampling unit. The first type runs perpendicular to shore and is used along straight shorelines (not coves or bays). Transects extend to a minimum target depth of 17 meters (55 fsw) depth below mean lower low water (MLLW). Dives to the target depth include the majority of habitat in which commercial divers normally operate. Dives were 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. Type-one transects were used for all areas surveyed in 1999[2].

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 buddy counts geoducks on the other side (usually the right).

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, and abalone. Vegetative type was recorded for the two most common types on each transect, with the most prevalent type listed first. 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).

[2] The second type of transect is used in coves and embayments where a reasonable estimate of sea bed area can be made. A buoyed anchor is dropped on a transect location where divers descended and survey a measured distance using a tape measure or a measured length of cord. Type-two transects would be used in areas such as Ulitka Bay or Little Steamboat Bay.

The beginning and ending time for each transect was recorded by a dive tender to allow for later standardization to the mean lower low water (MLLW) tide stage. Preferably, shoreline (type-one) 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 was approximately 15-20 meters to the left (when facing shore) of the first transect. This was the preferred method but may not be practical when a gentle slope required 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 was appropriate for a particular transect site. The appendices list whether a transect was paired or not.

Density estimates for type one areas were calculated as the average number of geoducks per meter of shoreline length:

$$D_1 = \sum_{i=1}^{n} \frac{L_i}{kL_t} c_i \quad , \qquad (1)$$

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,
n = number of transects,
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.

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:

$$P_D = 100\left(1 - t_\alpha \frac{s}{D\sqrt{n}}\right), \qquad (2)$$

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 α = 10%,
s = standard deviation of the mean, weighted for shoreline estimates (type 1),
D = estimated density of geoducks,
n = number of transects (Table 1).

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 fisheries and surveys. All data available from the surveyed area were combined and applied to the biomass estimates. In new areas where no data have been collected (e.g. Nakat Bay), all data collected and available from Southeast Alaska were used and the average used to estimate the biomass. After the fishery has occurred, data collected for that area from the commercial fishery will be averaged and used to recalculate the biomass estimate. If there are significant differences in an area's weight estimate, an adjustment will be made to the biomass estimate and thus to future GHLs for that area. This method of estimating geoduck weight for an area increases the efficiency of geoduck surveys. Previously, when samples were collected from each site during a survey, a limited number of samples were obtained that required a disproportionate amount of effort. Weight estimates from commercial samples allows a larger samples size without the concurrent effort but assumes that commercial sampling is representative sampling.

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

$$W = \frac{\sum w_i}{n_w}, \qquad (3)$$

where:

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

Geoduck Biomass Estimates

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

$$B_{bed} = (D_1)(W)(S) \quad \text{or,} \qquad (4)$$

$$B_{bed} = (D_2)(W)(A)$$

where:

B_{bed} = 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)
W = estimated mean weight per geoduck (in pounds),
S = total estimated shoreline length (in meters, using NOAA charts),
A = total estimated bed area (in square meters, using NOAA charts).

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:

$$\delta_B^2 = D^2 \frac{\delta_w^2}{n_w} + W^2 \frac{\delta_D^2}{n_D} - \frac{\delta_D^2 \delta_W^2}{n_D n_w} \tag{5}$$

where:

δ^2_B = variance of biomass, B,
D = mean density of geoducks,
W = mean weight (pounds per geoduck),
δ^2_D = variance of mean density,
δ^2_W = variance of mean weight,
n_D = number of transects,
n_W = number of geoducks weighed.

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 2), was calculated as:

$$\mathrm{P_B} = 100\left(1 - t_\alpha \frac{\mathrm{s}}{\mathrm{B}_{bed}\sqrt{\mathrm{n}}}\right), \tag{6}$$

where:

P_B = percent precision of the biomass estimate,
t_α = t-value from Student's distribution for a one-sided interval with significance level α = 10%,
s = standard deviation of the mean biomass estimate δ_B, from equation 5),
B_{bed} = total geoduck biomass per defined area,
n = number of transects.

The statistical objective for each area was for a precision level of 66.7% of the estimated biomass[3]. Guideline harvest levels whose biomass estimates did not achieve the precision objective were adjusted by the actual precision obtained.

$$\mathrm{GHL_{adj}} = \frac{\mathrm{P_B}}{66.7\%} * \mathrm{B_{bed}} \tag{7}$$

[3] The statistical objective is that we are at least 90% certain that the harvest rate does not exceed the target harvest rate by more than 50%. This means that a 2% harvest rate could be a maximum of 3% due to uncertainty in counts and weights. The 3% maximum harvest rate translates into a precision level of 66.7%.

where:

GHL_{adj} = precision adjusted guideline harvest level,
P_B = from equation 8, above,
B_{bed} = from equation 5 or 6, above.

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 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 which can be identified as having been made by a clam siphon.

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:

$$F = n / N \tag{8}$$

where:

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

Determination of show factors is very labor intensive and requires that divers be able to visit a site continuously for relatively lengthy periods (up to 5-7 days per site). The remoteness of most geoduck fisheries in Southeast Alaska prohibits establishing show factors specific for Southeast geoducks. Limited show factor work was accomplished in Southeast Alaska in 1998 (Pritchett et al. 1999). Values obtained were 0.73 at west Gravina Island and 0.81 in the Goddard area. In Puget Sound, the 1992 average annual geoduck show factor for all show plots was 0.77 and the average for all show plots from 1984 to 1993 was 0.62; Puget Sound geoduck biomass estimates are adjusted using a show factor of 0.75 (Bradbury et al. 2000). Since establishing show plots is extremely time consuming ADF&G decided to use a show factor of 0.75 to adjust the guideline harvest levels in Southeast Alaska for the 1999-2000 season. This value agrees with the 1998 Southeast Alaska data and with values and methods employed in Puget Sound. Using the standard show factor avoids the need of establishing separate show plots for each area being surveyed and 0.75 appears to be a conservative value that will not result in excessive harvest.

The guideline harvest levels for most Southeast areas open during the 1999-2000 season were adjusted for a show factor as:

$$GHL_F = \frac{GHL_{bed}}{F} \tag{9}$$

where:

GHL_F = show factor adjusted guideline harvest level (GHL) estimate,
GHL_{bed} = geoduck GHL estimate,
F = show factor, from equation 8.

A show factor was not applied to the Vallenar Bay GHL. The biomass for this area was recalculated from historic data which indicated that industry divers, which were present during the survey, felt confident that all geoducks were showing and that a show factor should not be applied.

SURVEY RESULTS AND DISCUSSION

A total of 92 transects were completed in 1999 in five areas of Southeast Alaska (Table 1, Figures 2-6). Biomass estimates were calculated using density estimates for linear shoreline (Type I transects). Total estimated geoduck biomass in the five areas is 2,455,553 kg (5,413,476 lb). Approximately 42% of the total biomass surveyed was in Foggy Bay followed by Nakat Bay (18%), Sea Otter Sound (16%), Goddard (14%), and Cone Bay (10%). Cone Bay is a new area where only a fraction of the potential beds have been surveyed; consequently, the biomass in this area will probably increase significantly. Approximately half of the transects in Foggy Bay have been completed. The Appendices list the raw data, survey biomass, and GHL estimates for each area.

On two occasions, adverse weather prevented the scheduled survey of Vallenar Bay in 1999. This area had not been surveyed since 1988 and recent surveys along the west Gravina Island shore (i.e. Middle Gravina in 1997 and Nehenta Bay in 1998) indicated a substantial decrease in GHL might be justified. Consequently, the original data was closely re-examined for this area and the original biomass estimate was adjusted. Appendix H describes the method and results of this re-examination.

Precision for biomass estimates ranged from 49.5% to 77.6% among the three areas where surveys were completed (Nakat Bay, Sea Otter Sound, and Goddard - Table 1). The remaining areas will be complete during future surveys, improving on the listed precision's.

FISHERY MANAGEMENT AND SEASON SUMMARY

Geoduck clams are long-lived with low and apparently sporadic recruitment Therefore, the objective of geoduck fishery management is to allow low exploitation rates on beds open to commercial harvest. Commercial harvest is also restricted to beds for which biomass estimates are available. The guideline harvest level (GHL) for each area is calculated as 2% of the estimated biomass per year (Larson and Minicucci 1997). Harvests are by permit only and historically have been allowed from October 1 through May 31 to avoid the summer spawning and recovery period and to minimize PSP toxin levels.

Open fishing areas were approved for harvesting geoduck clams for intrastate and interstate sale by ADEC. Geoducks were sold either fresh or frozen only after satisfactory testing for Paralytic Shellfish Poisoning (PSP) by ADEC prior to sale and distribution. A certificate and permit from ADEC was required to possess, harvest, process, and distribute geoduck clams for sale for human consumption or bait.

All miscellaneous shellfish dive fisheries in Southeast Alaska were under a limited entry moratorium during this fishery (moratorium from 1996 – 2000), with 169 divers eligible to participate. Each diver was required to have a current Interim Use Permit and to complete a Miscellaneous Shellfish Species registration/Permit Form during fishing operations. The ADF&G Ketchikan area office has responsibility for the management of Nakat Bay, Kah Shakes, Vallenar Bay, and Steamboat Bay geoduck fisheries while the Goddard area is managed through the Sitka area office. The Southeast Alaska Regional Dive Fisheries Association (SARDFA) Geoduck Committee requested the department start the 1999/2000 season as of 9:00 a.m. Sunday, November 28, 1999, for a Sunday through Thursday fishery. Due to high effort levels anticipated on some of the areas open for commercial geoduck harvest, shorter fishing periods were needed to stay within the guideline harvest levels (GHLs). A total of 61 divers participated in the Southeast Alaska geoduck fishery, landing an estimated 91,745 kg (202,260 lb) of clams (Table 2). In the Ketchikan management area, four companies purchased product: Silver Lining, E. C. Phillips, Craig Fish, and Evergreen Seafoods. Only product harvested from Kah Shakes went to the live market. In the Sitka management area, live product was handled by Sitka Sound Seafoods while processed product was shipped to Ketchikan processors.

Nakat Bay (Subdistrict 101-11) opened with a GHL of 17,917 kg (39,500 lb) of whole geoduck clams. This represents approximately 4% of the estimated harvestable biomass. At a harvest rate of 4%, this area is not scheduled to reopen to the commercial harvest of geoduck clams for two years (2001-02 season). The open commercial fishing area was only in those waters of Nakat Bay, Sitklan Passage, Lincoln Channel, and Tongass Passage east of the longitude of Tree Point light and south of a line extending from a point on the mainland shore at 54°48’18” N. latitude, 130°47’18” W. longitude to the northernmost tip of Slim Island, to a point approximately 0.25 nm north of High Point at 54°47’47" N. latitude, 130°44’17” W. longitude, and west of a line from Point Phipp at 54°46’36” N. latitude, 130°37’15” W. longitude to a point at the southwestern entrance of Fillmore Inlet at 54°47’36” N. latitude, 130°38’05” W. longitude, and north of the U.S. Canadian border. This area was open for a total of 11 days beginning 9:00 a.m. Sunday, November 28, 1999 with daily openings from 9:00 a.m. to 3:00 p.m., and closed for the season by

emergency order at 3:00 p.m., Tuesday, December 14, 1999. A total of 13 divers harvested 16,344 kg (36,032 lb) of geoducks in the 66 hours the fishery was open (Table 2).

The Kah Shakes area (Bed 101-23-002) opened with a GHL of 17,146 kg (37,800 lb) of whole geoduck clams. This represents approximately 4% of the estimated harvestable biomass. At a harvest rate of 4%, this area is not scheduled to reopen to the commercial harvest of geoducks for two years (2001-02 season). The open commercial fishing area was along the mainland shore, south of the latitude of Kah Shakes Point at 55°04'05" N. latitude and north of the latitude of Kirk Point at 55°00'00" N. latitude. This area was open for 5.5 days beginning 9:00 a.m. Sunday, November 28, 1999 from 9:00 a.m. to 3:00 p.m., and closed by emergency order for the season at 12:00 noon, Tuesday, December 7, 1999. A total of 12 divers harvested 16,727 kg (36,876 lb) of geoducks in the 33 hours during which the fishery was open (Table 2).

Vallenar Bay on the west coast of Gravina Island area (Bed 101-29-004) opened with a GHL of 24,766 kg (54,600 lb) of whole geoduck clams. This represents approximately 8% of the estimated harvestable biomass. At this harvest rate, this area is not scheduled to reopen to the commercial harvest of geoducks for eight years (2003-04 season). The open commercial fishing area was along the western shore of Gravina Island south of the latitude of the northernmost tip of Vallenar Point and north of South Vallenar Point at 55°22'50" N. latitude. This area was open for a total of 3.5 days beginning 9:00 a.m. Sunday, November 28, 1999. Openings occurred from 9:00 a.m. to 3:00 p.m. on November 28, December 5, and December 7, and from 9:00 a.m. to 1:00 p.m. December 9, 1999. This area was closed for the season by emergency order as of 1:00 p.m., Thursday, December 9, 1999. A total of 37 divers harvested 25,215 kg (55,588 lb) of geoducks in the 21 hours during which the fishery was open (Table 2).

Steamboat Bay (Big Steamboat Bay, Noyes Island, Bed 103-70-003) opened with a GHL of 24,177 kg (53,300 lb) of whole geoduck clams. This represents approximately 4% of the estimated harvestable biomass for this area. At this harvest rate, Steamboat Bay is not scheduled to open to the commercial harvest of geoduck clams for two years (2001-02 season). The open commercial fishing area was along the northern shore of Noyes Island south of a line from Point Incarnation at 55°33'19" N. latitude, 133°37'19" W. longitude, to Steamboat Point at 55°33'09" N. latitude, 133°38'54" W. longitude and north of 55°32'13" N. latitude. The southern closure line was approximately 2400 feet north of the head of Steamboat Bay. This area was open for a total of 13 days from 9:00 a.m. to 3:00 p.m., beginning 9:00 a.m., Sunday, November 28, 1999 through Wednesday, December 1; on Sunday, December 5 through Thursday, December 9, and from Sunday December 12 through Wednesday, December 15, 1999. This areas was closed for the season by emergency order as of 3:00 p.m., Wednesday, December 15, 1999. A total of 17 divers harvested 24,393 kg (53,777 lb) of geoduck clams in the 78 hours during which the fishery was open (Table 2).

Sea Otter Sound (in Subdistrict 103-90) was originally scheduled to open November 28, 1999 in conjunction with other Southeast geoduck fisheries but ADEC water quality testing was not completed. The GHL for this area during the 1999-2000 season was 20,639 kg (45,500 lb) which represents 4% of the estimated harvestable biomass. The open commercial fishing area was scheduled in those waters south and east of a line extending from Cape Lynch light to the southernmost tip of Whale Head Island, to the northernmost tip of Turn Point, and north and west of a line that extends from a point at 55°49'32" N. latitude, 133°19'44" W. longitude on Tuxekan Island located approximately 1.7 nm south of the

northernmost tip of Turn Point, then west to the northernmost tip of Garden Island at 55°49’24” N. latitude, 133°22’47” W. longitude, to a point on the eastern shore of Heceta Island at 55°48’20” N. latitude, 133°29’30” W. longitude. Water quality testing was completed by midsummer and discussion occurred between the department and industry concerning opening this area in August or September. After water quality testing was completed, prefishery testing for PSP occurred and failed. Since it was almost certain this product would enter the processed market, rather than the more lucrative live market, the SARDFA Geoduck Committee voted during its August 4, 2000 meeting not to open this area at this time. This area was then scheduled to open for the 2000/01 season in hopes of better results from PSP testing.

The Goddard area (in portions of Subdistricts 113-31 & 41) opened with a GHL of 8,936 kg (19,700 lb) of whole geoduck clams. This represents 2% of the estimated harvestable biomass. At this harvest rate, this area is scheduled to open to the commercial harvest of geoduck clams during the 2000/01 season. The open commercial fishing area was in those waters along the western coast of Baranof Island south and west of a line beginning at the southern entrance to Kanga Bay at 56°53'33" N. latitude, 135°22'47" W. longitude to the northwesternmost tip of Kanga Island located at 56°54'04" N. latitude, 135°22'02" W. longitude, then extending north and west to the southernmost tip of Ulinoi Island located at 56°55'51" N. latitude, 135°23'45" W. longitude, to the northwest tip of Ulinoi Island located at 56°55'59" N. latitude, 135°24'01" W. longitude, then southwest to the northernmost tip of the unnamed island within the Taigud Islands at 56°55'45" N. latitude, 135°24'51" W. longitude, then continues southwest to the northeasternmost tip of Hanus Island located at 56°51'56" N. latitude, 135°30'25" W. longitude, then north and east of a line extending from a point on the southeast shore of Biorka Island at 56o50'33" N. latitude, 135°30'58" W. longitude to a point at 56°45'00" N. latitude, 135°22'26" W. longitude; and north of 56°45'00" N. latitude and west of 135°20'00" W. longitude and all waters within Big Bay will be open, with the following exception: All waters of Kliuchevoi Bay will be closed east of a line from 56°50'24" N. latitude, 135°22'31" W. longitude to 56°50'12" N. latitude, 135°22'41" W. longitude, and those waters within the unnamed bay located southeast of Frosty Reef east of a line from 56°52'49" N. latitude, 135°22'56" W. longitude to 56°52'42" N. latitude, 135°22'59" W. longitude to 56°52'38" N. latitude, 135°22'59" W. longitude. This area was open from 9:00 a.m. to 3:00 p.m. daily, on Sunday through Thursday of each week, beginning 9:00 a.m. Sunday, November 28, 1999, and was closed by emergency order as of 3:00 p.m., Thursday, February 3, 2000. The total harvest was 9,066 kg (19,987 lb) of which approximately 60-65% went to the live market. All the harvest occurred from the east and northeast shore of Legma Island. A total of five divers made landings though most (>50%) product was landed by a single harvester.

LITERATURE CITED

Bradbury, A., B. Sizemore, D. Rothaus, and L. Timme. 2000. Stock Assessment of Subtital Geoduck Clams (*Panopea abrupta*) in Washington. Marine Resources Unit, Fish Management Division, Fish Program, Washington Department of Fish and Wildlife.

Goodman, L. A. 1960. On the exact variance of products. Am. Statistical Association Journal. 708-713.

Harbo, Rick M., 1997. Shells and shellfish of the Pacific Northwest. Harbour Publishing, Canada.

Larson, R. and T. Minicucci. 1997. Miscellaneous dive fisheries, 1995/96. In: Shellfish fisheries, Southeast Alaska-Yakutat region 1995/96, report to the board of fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report No. 1J96-31, Juneau.

Pritchett, M., R. Larson, and J. E. Clark. 1999. Geoduck clam stock assessment surveys and fishery management for the 1998/99 season. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 1J99-36, Juneau.

Table 1. Biomass estimates of geoduck clams from five areas surveyed in Southeast Alaska in 1999.

	Nakat Bay	Foggy Bay[a]	Sea Otter Sound[b]	Cone Island[c]	Goddard[d]
Subdistrict	101-11	101-23	103-90	104-40	113-31/41
No. Transects	36	18	26	11	70
Density – Avg. per linear meter	58.6	58.6	57.63	100.75	10.96
Shoreline Length (m)	7,200	17,112	7,156	2,200	22,166
Estimated Num. of Geoducks	422,200	1,003,429	412,433	221,650	242,899
Precision of Estimate	64.8%	52.6%	67.2%	27.6%	78.3%
Weight					
Number of Samples	2,780	420	32	2,780	64
Average Weight (g)	1,073	1,039	939	1,073	1,382
Average Weight (lb)	2.36	2.29	2.07	2.36	3.05
Data obtained from…	SE commercial avg.	Foggy Bay commercial avg.	1998 Port Alice survey	SE commercial avg.	1998 survey
Biomass (kg)	452,622	1,041,644	387,951	237,621	335,715
Biomass (lb)	997,843	2,296,393	855,271	523,856	740,113
Precision of Estimate	49.5%	42.0%	66.5%	20.2%	77.6%
90% of Being Within 66.7% Adjustment	74.3%	62.9%	99.7%	30.4%	N/A
Show Factor Adjustment	0.75	1.00	0.75	N/A	0.75
Harvest Rate	4%	4%	4%	N/A	2%
Quota (kg)	17,933	26,220	20,637		8,952
Quota (lb)	39,534	57,804	45,497	N/A	19,736
Announced GHL (lb)	39,500	Not Open This Season	45,500	N/A	19,700

[a] For Information Only: Approximately first half of survey begun. Scheduled completion in 2000. Includes expanded area to Foggy Point.
[b] Includes 18 transects from 1998 Port Alice survey, and 8 transects from the 1999 Turn Point and Cone Bay surveys.
[c] For Information Only: This is a new area and only limited survey completed. No schedule to complete this area, to date.
[d] Includes 19 'new' transects from 1999 survey combined with 51 transects from 1998 survey and recalculated.

Table 2. Southeast Alaska 1999-2000 season commercial geoduck clam harvest by area.

Area	Subdistrict-Bed	Number of Divers	Number of Boats	Guideline Harvest Level, kg (lb)	Hours Open	Kilograms (lb) Harvested[a]
Nakat Bay	101 - 11	13	7	17,917 (39,500)	66	16,344 (36,032)
Kah Shakes	101 - 23 - 815002	12	9	17,146 (37,800)	33	16,727 (36,876)
Vallenar Bay	101 - 29 - 815004	37	23	24,766 (54,600)	21	25,215 (55,588)
Steamboat Bay	103 - 70 - 815003	17	15	24,177 (53,300)	78	24,393 (53,777)
Sea Otter Sound	103 - 90	Not Opened – See Text		20,639 (45,500)		
Goddard	113 - 31/41 - 001	5	3	8,936 (19,700)	300	9,066 (19,987)
	Totals	61	40	113,581 (250,400)		91,745 (202,260)

[a] Harvest Estimates from IFDB October 2000.

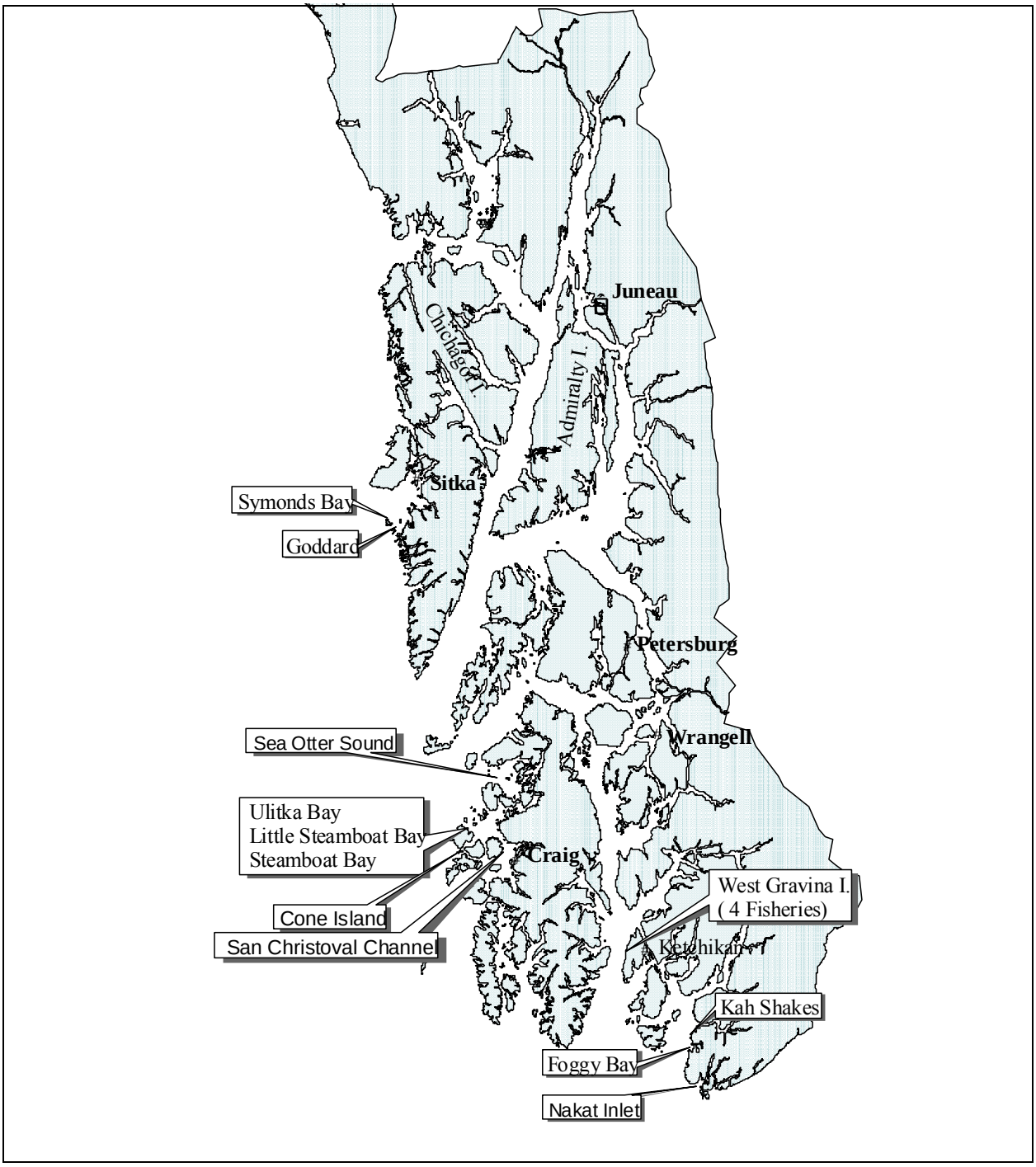

Figure 1. Geoduck clam survey and commercial harvest areas in Southeast Alaska

.

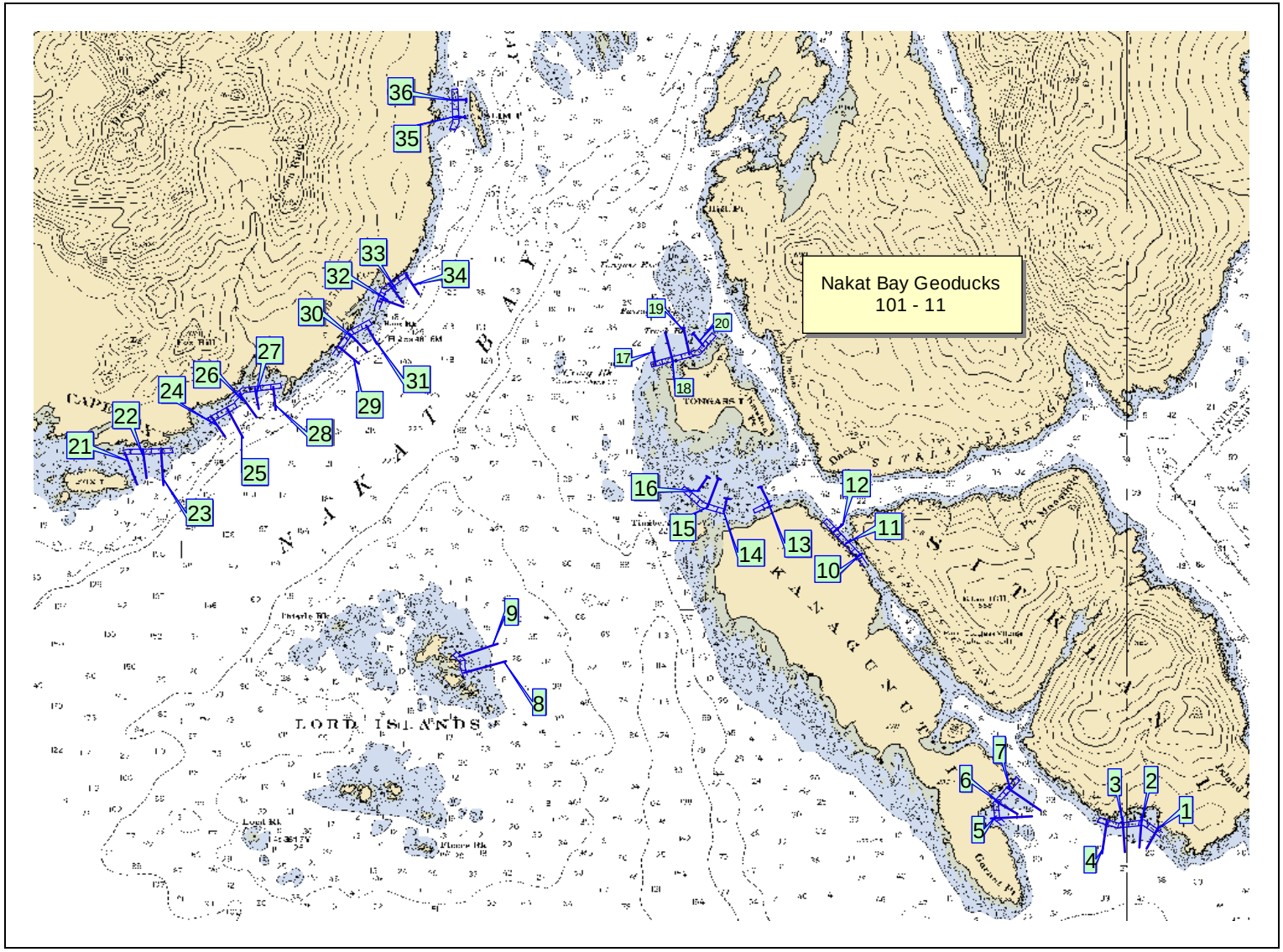

Figure 2. Nakat Bay (in Subdistrict 101-11) 1999 geoduck survey transect locations.

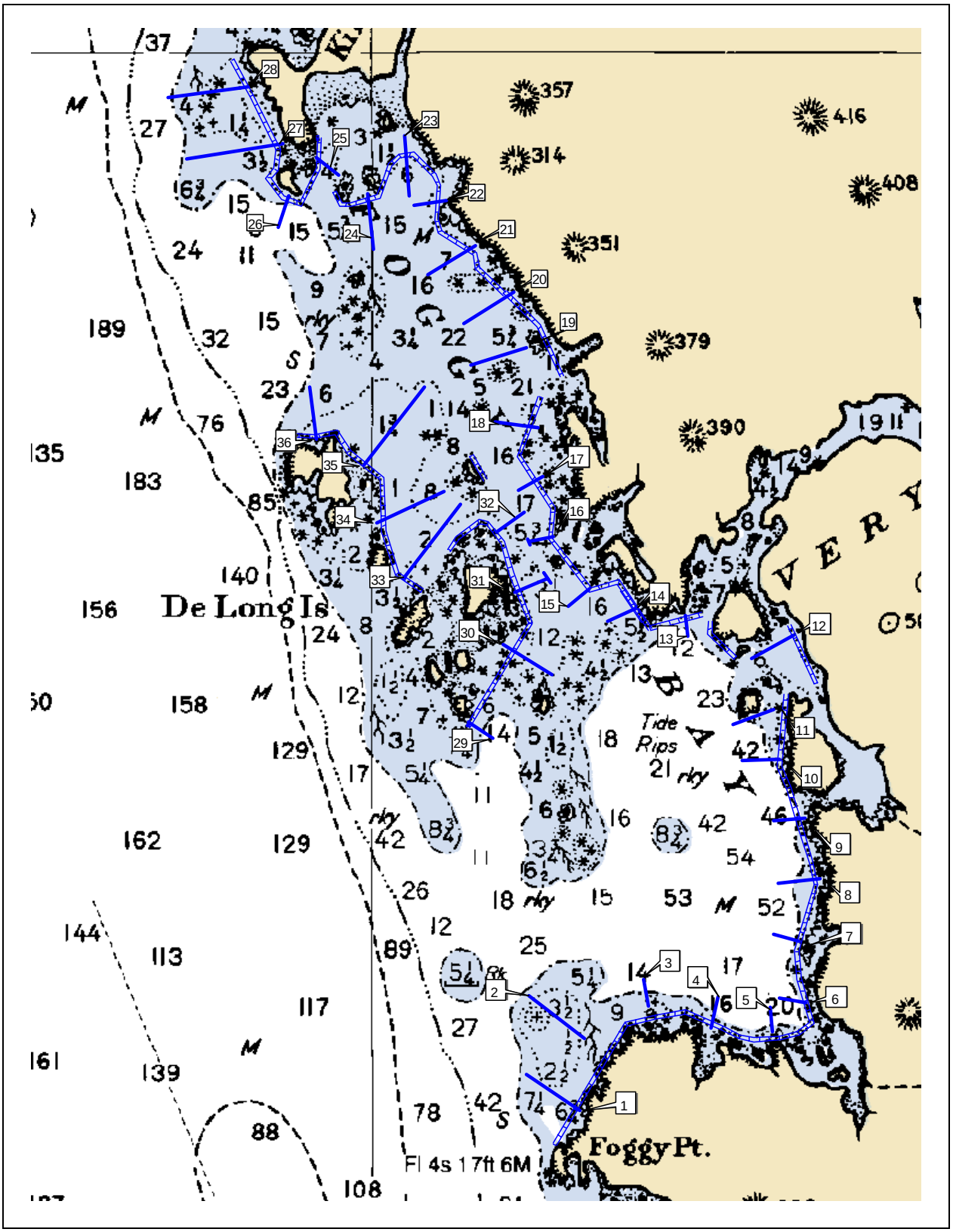

Figure 3. Foggy Bay 1999 geoduck survey transect locations.

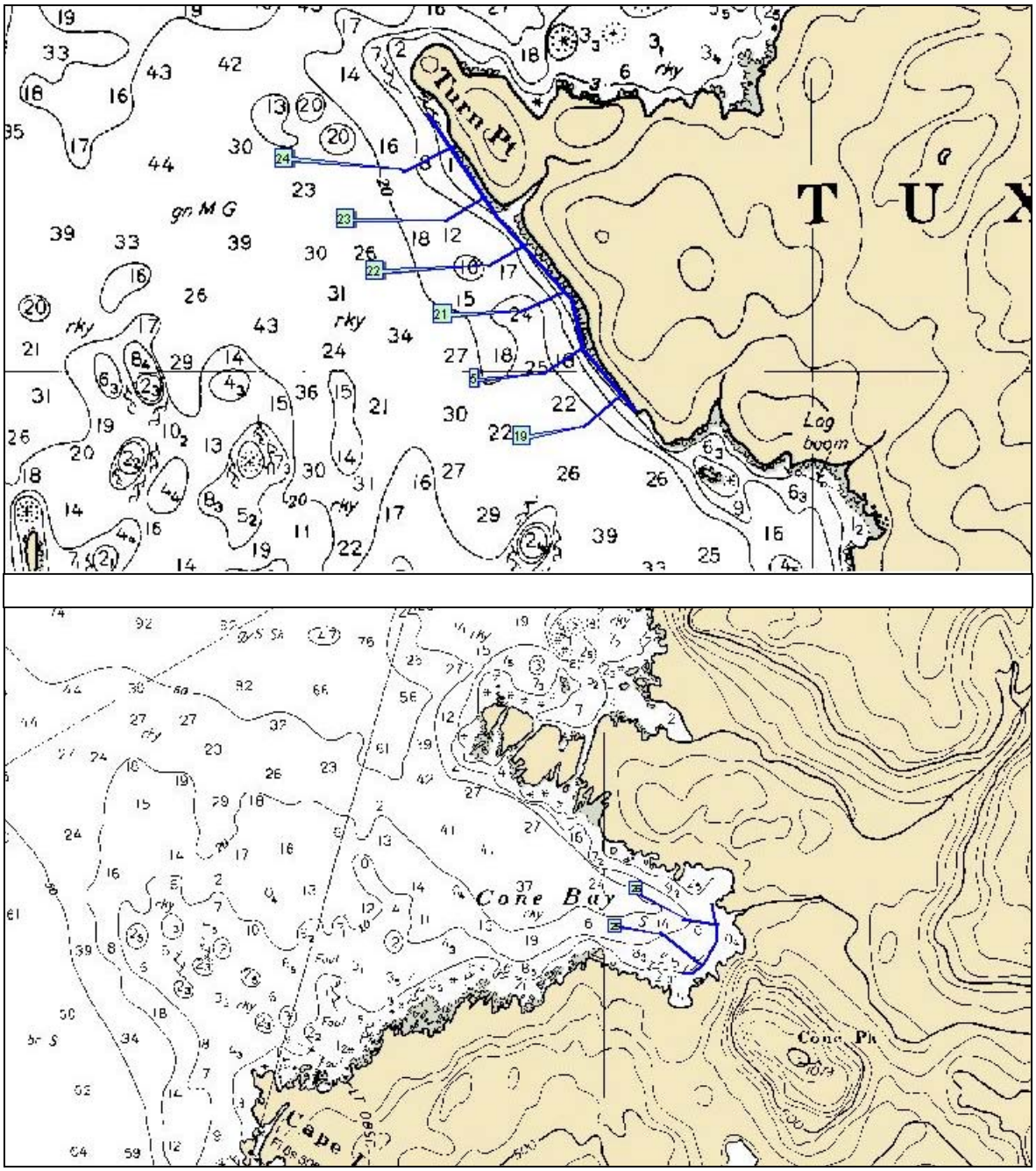

Figure 4. Sea Otter Sound (Turn Point and Cone Bay in Subdistrict 101-90-) 1999 geoduck survey transect locations.

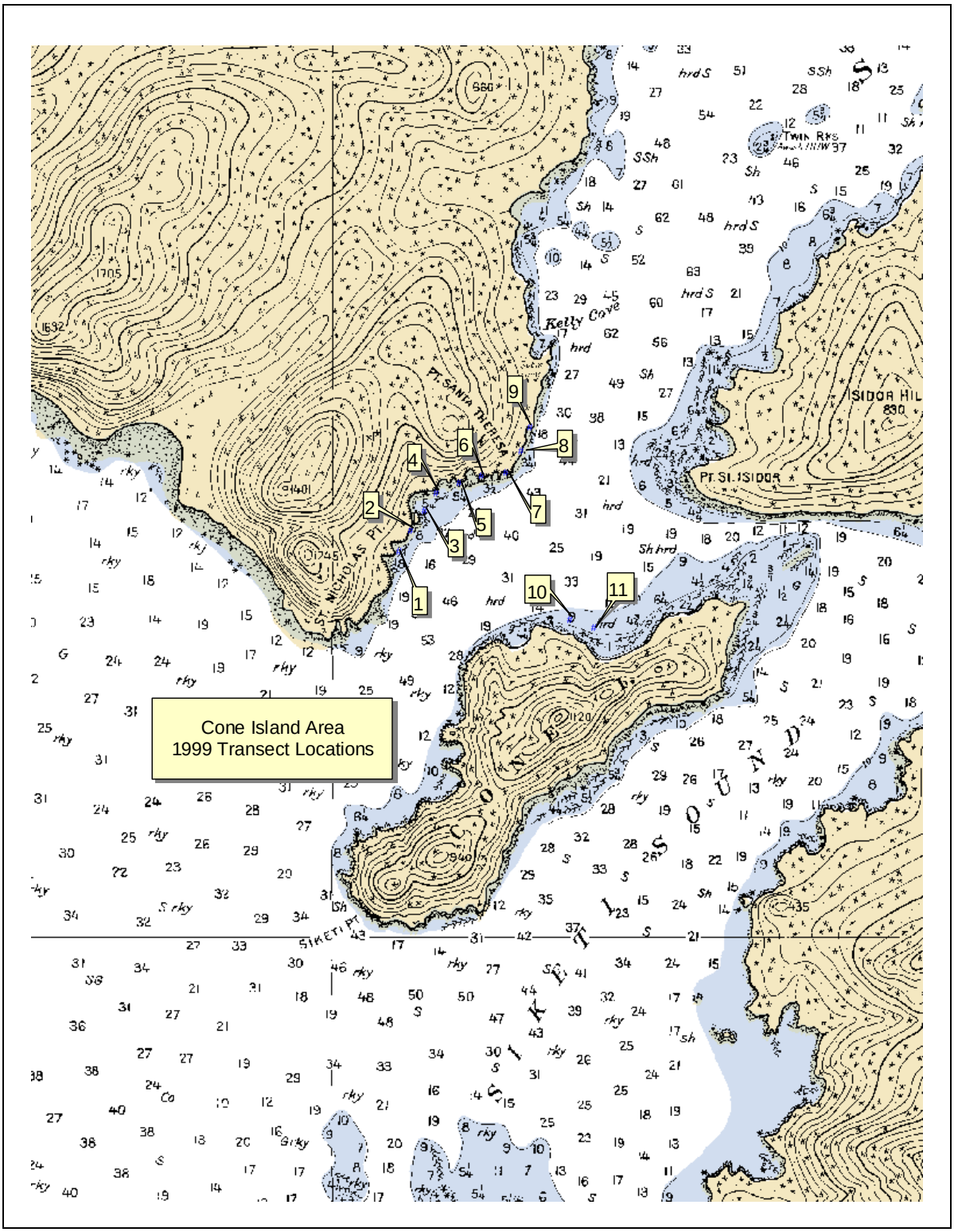

Figure 5. Cone Island 1999 geoduck survey transect locations.

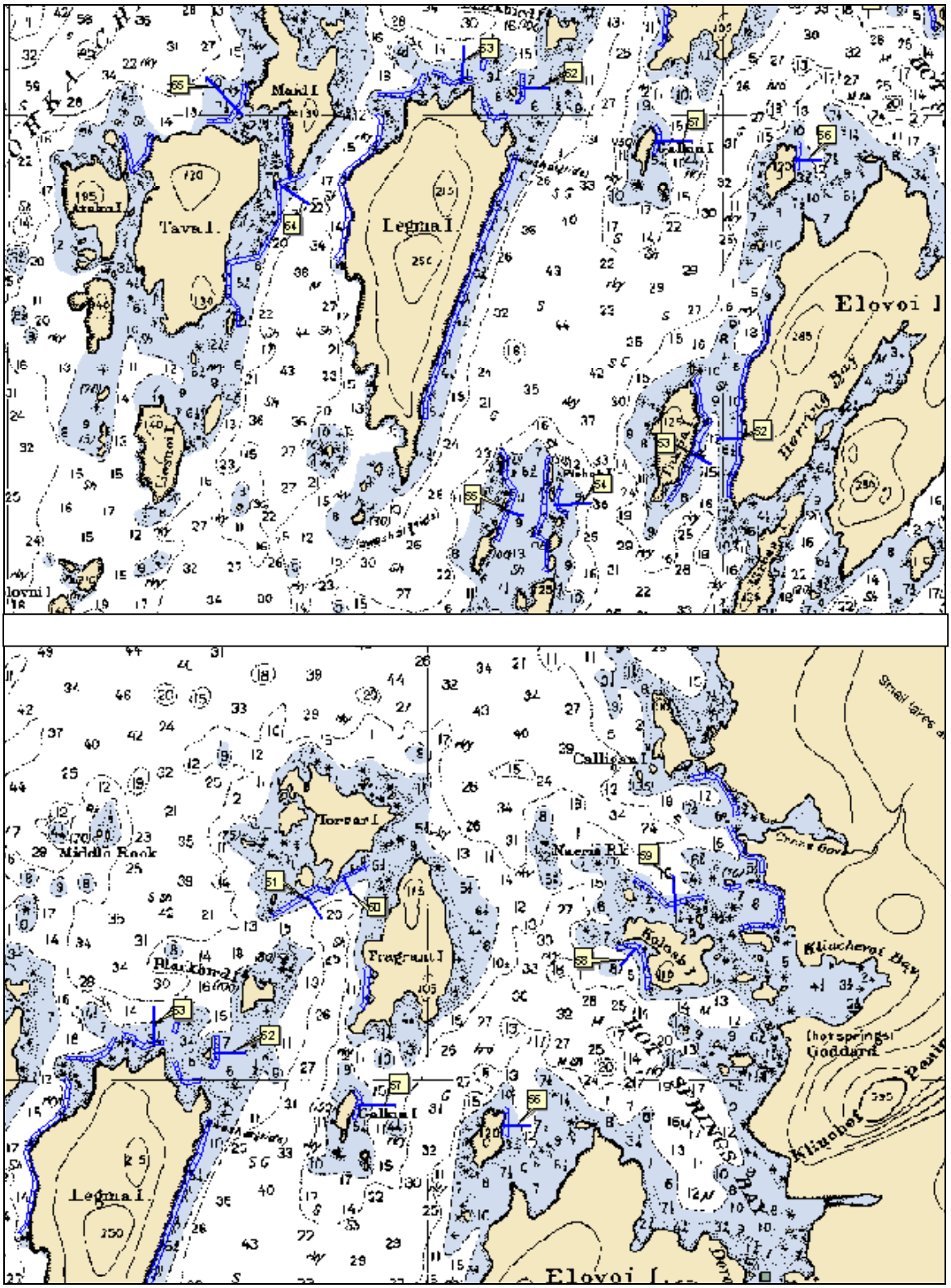

Figure 6. Goddard (Bed 113-31/41-001) 1999 geoduck survey transect locations.

-continued-

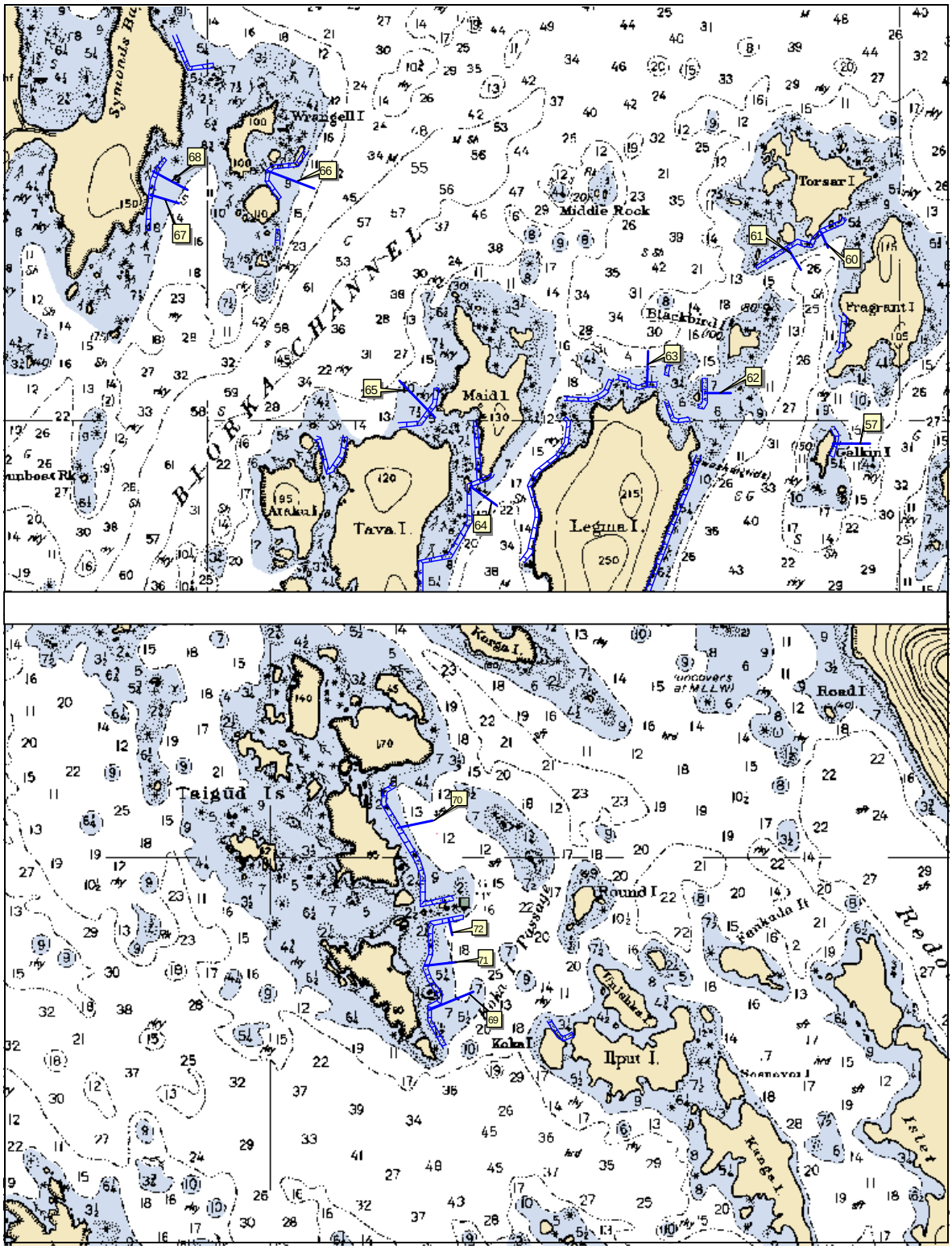

Figure 6. (page 2 of 2)

APPENDIX

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

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

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

Code	Expanded code	Definition
RCK	Rock	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 (very rarely used)
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. Nakat Bay (in Subdistrict 101-11) geoduck clam assessment survey, 1999.

GEODUCK ASSESSMENT TRANSECT DETAILS:

Survey Area: Nakat Bay

Cruise Dates: August 13 & 14, 1999

Divers: (DW) D. Woodby, (RL) R. Larson, (MP) M. Pritchett, (JR) J. Rumble, (SW) S. Walker, (CB) C. Botelho

Date	Transect #	Time In	Time Out	Total Time	Diver #1	Diver #2	Width	MLLW Start (fsw)	MLLW End (fsw)	No. of Geoducks	No. of Horseclams	Bottom Type #1	Bottom Type #2	% Vegetation Cover	Predominant Vegetation Type	Comments
13-Aug-99	1a	11:07	11:28	0:21	DW	RL	2	23	55	4	3					
13-Aug-99	2a	11:45	12:16	0:31	RL	CB	2	12	55	155	56	snd	gvl			many false geoducks, HC count only by one person (28*2=56)
13-Aug-99	3a	11:38	11:51	0:13	MP	JR	2	12	55	54	8					60 False GD for one count
13-Aug-99	4a	11:11	11:28	0:17	JR	SW	2	-6	55	84	24					many false GD
13-Aug-99	5a	14:50	15:08	0:18	SW	JR	2	-15	43	5	87					27 false GD
13-Aug-99	7a	14:16	14:38	0:22	SW	MP	2	-15	53	63	16	cbl	rck			47 false geoduck
13-Aug-99	6a	14:46	15:17	0:31	CB	DW	2	-16	55	12	2	snd	rck			16*1 count false geoducks
13-Aug-99	8a	15:53	16:33	0:40	RL	DW	2	-14	55	406	922	snd	gvl			HC 1 count * 2, 100% HC @ 45 fsw
13-Aug-99	9a	15:39	16:17	0:38	MP	JR	2	8	55	353		snd	shl			HC = TNTC
13-Aug-99	10a	10:42	10:49	0:07	SW	MP	2	-4	10	1	171	snd	gvl	50	lam	swam all way across
13-Aug-99	11a	10:11	10:21	0:10	MP	JR	2	-1	34	1	129	shl	mud	5	lam	
13-Aug-99	12a	10:09	10:26	0:17	CB	DW	2	-1	55	5	7	snd	cbl	5	lbk	
13-Aug-99	13a	9:18	9:41	0:23	CB	RL	2	2	55	69	80	snd	shl			HC 1 count*2, false GD present
13-Aug-99	14a	8:47	9:29	0:42	JR	SW	2	2	55	143	3					False GD 1 count=64
13-Aug-99	15a	8:08	8:29	0:21	MP	SW	2	23	55	7		cbl	snd	10	lam	false GD present
13-Aug-99	16a	8:12	8:47	0:35	RL	DW	2	3	29	0	0	cbl	gvl	35	lbk	1 abalone(3.75"), false GD present
14-Aug-99	17a	8:58	9:17	0:19	CB	RL	2	2	55	0	0					
14-Aug-99	18a	8:37	8:56	0:19	JR	MP	2	28	55	5		snd	cbl			1st GD @ 40-45
14-Aug-99	19a	7:58	8:30	0:32	RL	SW	2	26	56	286	38	cbl		5	lam	224 false GD
14-Aug-99	20a	7:58	8:19	0:21	MP	DW	2	21	55	61	2	shl	snd			rck above 35 fsw, False GD=41
14-Aug-99	21a	16:25	16:58	0:33	RL	SW	2	8	55	44	25	snd	shl	20	lam	
14-Aug-99	22a	15:55	16:37	0:42	DW	MP	2	4	55	988	94	snd	shl			false GD present but not counted
14-Aug-99	23a	15:45	16:07	0:22	SW	CB	2	-15	54	0		cbl	shl			GD off transect?
14-Aug-99	24a	15:18	15:37	0:19	DW	JR	2	25	55	317	0	snd	shl			68 false GD
14-Aug-99	25a	14:50	15:06	0:16	MP	JR	2	12	55	147		snd	shl			false GD = 61
14-Aug-99	26a	14:52	15:15	0:23	RL	CB	2	-15	55	181		gvl				gvl begins @ 40 fsw, 1st GD @ 41
14-Aug-99	27a	14:10	14:35	0:25	MP	DW	2	12	55	289	9	snd	rck			1 ab, 53 false GD
14-Aug-99	28a	14:13	14:36	0:23	SW	RL	2	-14	55	299		snd	gvl	0		71 false GD
14-Aug-99	29a	11:43	11:54	0:11	SW	CB	2	-4	55	27	4	cbl				4 false GD
14-Aug-99	30a	11:39	11:59	0:20	DW	JR	2	21	55	6	0	snd	shl			
14-Aug-99	31a	10:58	11:19	0:21	RL	CB	2	30	55	1	0					

-continued-

Appendix C. (page 2 of 5)

Date	Transect #	Time In	Time Out	Total Time	Diver #1	Diver #2	Width	MLLW Start (fsw)	MLLW End (fsw)	No. of Geoducks	No. of Horseclams	Bottom Type #1	Bottom Type #2	% Vegetation Cover	Predominant Vegetation Type	Comments
14-Aug-99	32a	11:00	11:16	0:16	MP	JR	2	11	55	13	8	snd	shl			7 false GD, 1 GD @ 32 fsw
14-Aug-99	33a	10:19	10:41	0:22	MP	DW	2	17	55	25	168	shl	snd			6 false GD, 1st GD @ 41 fsw
14-Aug-99	34a	10:21	10:37	0:16	RL	SW	2	0	55	48	14	gvl	snd			34 false GD, appeared to be edge of bed-better snd and more GD south
14-Aug-99	35a	9:42	10:02	0:20	SW	CB	2	2	55	50	50	cbl		10	lam	5 false GD, HC @ 13 fsw
14-Aug-99	36a	9:39	9:57	0:18	DW	JR	2	21	55	73	24	snd	shl			7 false GD, GD start @ 21 fsw

Appendix C. (page 3 of 5)

Nakat Bay Geoduck 1999 Transect Summary

Transect No.	Transect side a	Transect side b	Average per Meter	Est. Number per Transect's Shoreline
1	4		2	400
2	155		77.5	15,500
3	54		27	5,400
4	84		42	8,400
5	5		2.5	500
6	12		6	1,200
7	63		31.5	6,300
8	406		203	40,600
9	353		176.5	35,300
10	1		0.5	100
11	1		0.5	100
12	5		2.5	500
13	69		34.5	6,900
14	143		71.5	14,300
15	7		3.5	700
16	0		0	0
17	0		0	0
18	5		2.5	500
19	286		143	28,600
20	61		30.5	6,100
21	44		22	4,400
22	988		494	98,800
23	0		0	0
24	317		158.5	31,700
25	147		73.5	14,700
26	181		90.5	18,100
27	289		144.5	28,900
28	299		149.5	29,900
29	27		13.5	2,700
30	6		3	600
31	1		0.5	100
32	13		6.5	1,300
33	25		12.5	2,500
34	48		24	4,800
35	50		25	5,000
36	73		36.5	7,300

---------- No Side "b" counts made ----------

Appendix C. (page 4 of 5)

Nakat Bay 1999 geoduck survey biomass estimate and guideline harvest level.

Nakat Bay	
Number of Transects	36
Average per Linear Meter of Shoreline	58.64
Variance of Counts	9,006
Std. Variance of Mean	250
Shoreline (meters)	7,200
Total Number of Geoducks	422,200
Variance of Total Number	12,968,549,714
Precision of Estimate	64.8%
90% Coefficient of Variation	45.6%
90% Two-Tail Precision	54.4%
Average Weight (average of sample means) in Pounds	2.36
Variance of Average Weight	0.46039138
Biomass Estimate	997,843
Variance of Biomass Est.	148,535,580,003
Precision of Estimate	49.5%
90% Coefficient of Variation	65.3%
90% Two-Tail Precision	34.7%
Lower Bounds Biomass Est.	346,676
Upper Bounds Biomass Est.	1,649,009
90% of being within 66.7% Adjustment	74.3%
Show Factor Adjustment	0.75
Target Harvest Rate	4%
Quota WITHOUT Precision Adjustment	53,218
Quota WITH Precision Adjustment	39,534

Appendix C. (page 5 of 5)

Nakat Bay latitudes and longitudes for 1999 transects.

Transect No.	Latitude	Longitude
1	54.72676	-130.66103
2	54.72785	-130.66397
3	54.72766	-130.66724
4	54.72737	-130.67023
5	54.72766	-130.69058
6	54.72955	-130.68959
7	54.73096	-130.68765
8	54.74312	-130.78343
9	54.74478	-130.78436
10	54.75554	-130.71380
11	54.75686	-130.71608
12	54.75817	-130.71822
13	54.76105	-130.72954
14	54.76027	-130.73745
15	54.76068	-130.74052
16	54.76224	-130.74251
17	54.77581	-130.74974
18	54.77630	-130.74665
19	54.77680	-130.74363
20	54.77773	-130.74112
21	54.76648	-130.84319
22	54.76664	-130.84000
23	54.76670	-130.83687
24	54.77019	-130.82788
25	54.77102	-130.82508
26	54.77264	-130.82318
27	54.77322	-130.82033
28	54.77351	-130.81715
29	54.77755	-130.80542
30	54.77916	-130.80362
31	54.78001	-130.80088
32	54.78279	-130.79820
33	54.78421	-130.79644
34	54.78535	-130.79376
35	54.80208	-130.78498
36	54.80386	-130.78504

Appendix D. Foggy Bay (Bed 101-23-001) geoduck clam assessment surveys, 1999.

GEODUCK ASSESSMENT TRANSECT DETAILS:

Survey Area: Nakat Bay

Cruise Dates: July 16 and 17, 1999

Divers: (SW) S. Walker, (PD) P. Doherty, (KH) K. Hebert, (MP) M. Pritchett, (BD) B. Davidson, (RL) R. Larson, (DW) D. Woodby, (CB) C. Botelho

Date		Time in	Time out	Length Interval	Diver #1	Diver #2	Tide correction	Width	MLLW start	MLLW End	No geoducks	No horseclams	Bottom type #1	Bottom type #2	Percent veg cover	Predominant Vegetation type #1	Comments
09-Sep-98	1a	12:15	15:46		SW	KH	17	2	-4	41	0	0	rck	cbl	0		many urchins all sizes start at 22'
09-Sep-98	1a	12:15	15:46	30	SW	KH	17	2	41	42	6	0	snd		0		
09-Sep-98	1a	12:15	15:46	30	SW	KH	17	2	42	46	8	0	snd		0		
09-Sep-98	1a	12:15	15:46	30	SW	KH	17	2	46	46	0	0	cbl		0		
09-Sep-98	1a	12:15	15:46	30	SW	KH	17	2	46	49	0	0	snd		0		
09-Sep-98	3a	15:37	16:12		PD	MP	17	2	-1	28	0		bld		0		some cucs, few urchins
09-Sep-98	3a	15:37	16:12	9	PD	MP	17	2	49	53	15	0	snd	shl	0		
09-Sep-98	3a	15:37	16:12	50	PD	MP	17	2	28	32	26	3	snd		0		
09-Sep-98	3a	15:37	16:12	50	PD	MP	17	2	32	49	57	1	snd	shl	0		
09-Sep-98	5a	16:09	16:21		BD	KH	17	2	-8	39	0	0	rck		25	lbk	not geoduck habitat
09-Sep-98	5a	16:09	16:21		BD	KH	17	2	39	53	0	0	snd		0		
09-Sep-98	5b	16:09	16:21		BD	KH	17	2	-7	53	0	0	rck		10	lbk	
09-Sep-98	7a	16:27	16:43		PD	MP	16	2	9	43	0	0	bld	snd	0		
09-Sep-98	7a	16:27	16:43	8	PD	MP	16	2	43	54	1	0	shl	snd	0		
09-Sep-98	7b	16:27	16:43		PD	MP	16	2	29	54	0	0	cbl	bld	0		not good geoduck habitat, rck at 45'
09-Sep-98	9a	16:30	16:56		BD	KH	16	2	4	15	0	0	rck		20	lbk	
09-Sep-98	9a	16:30	16:56	6	BD	KH	16	2	41	54	4	0	snd		0		
09-Sep-98	9a	16:30	16:56	30	BD	KH	16	2	15	41	20	0	snd	cbl	0		
09-Sep-98	9b	16:30	16:56	30	BD	KH	16	2	19	24	96	8	snd		0		rck at 35'
09-Sep-98	9b	16:30	16:56	30	BD	KH	16	2	24	54	185	12	snd		0		
09-Sep-98	11a	16:55	17:27		PD	MP	15	2	1	23	0	0	bld	cbl	0		
09-Sep-98	11a	16:55	17:27	20	PD	MP	15	2	36	55	113	0	snd		0		
09-Sep-98	11a	16:55	17:27	50	PD	MP	15	2	23	36	223	0	snd		0		
10-Sep-98	13a	9:22	9:51		SW	KH	0	2	0	21	0	0	bld	snd	0		
10-Sep-98	13a	9:22	9:51	10	SW	KH	0	2	55	70	4	0	snd		0		urchins @ 70'
10-Sep-98	13a	9:22	9:51	30	SW	KH	0	2	21	36	269	0	snd		0		
10-Sep-98	13a	9:22	9:51	30	SW	KH	0	2	36	55	151	0	snd		0		
10-Sep-98	15a	10:10	10:31		KH	BD	0	2	0	24	0	0	snd	rck	0		
10-Sep-98	15a	10:10	10:31		KH	BD	0	2	24	35	0	0	snd		0		
10-Sep-98	15a	10:10	10:31		KH	BD	0	2	35	71	0	0	rck		0		

-continued-

Appendix D. (page 2 of 5)

Date		Time in	Time out	Length Interval	Diver #1	Diver #2	Tide correction	Width	MLLW start	MLLW End	No geoducks	No horseclams	Bottom type #1	Bottom type #2	Percent veg cover	Predominant Vegetation type #1	Comments
10-Sep-98	15b	10:10	10:31		KH	BD	0	2	44	17	0	0	snd	cbl	0		not geoduck habitat
10-Sep-98	15b	10:10	10:31		KH	BD	0	2	71	44	0	0	rck		0		
10-Sep-98	17a	11:41	11:54		KH	SW	3	2	-3	55	0	0	rck		0		rock to silty bottom
15-Aug-99	19a	9:44	9:58		JR	RL	-1	2	20	55	3	0	gvl	rck	5	lbk	
15-Aug-99	21a	10:19	10:41		SW	DW	0	2	19	55	159	2	snd	cbl	15	lam	1st GD @ 23 fsw
15-Aug-99	23a	10:14	10:41		MP	JR	0	2	11	55	154	7	snd	mud			1st GD @ 21 fsw
10-Sep-98	25a	9:39	9:54		RL	PD	0	2	9	21	0	0	cbl	snd	30	fir	max depth = 24 fsw
10-Sep-98	27a	9:00	9:19		MP	PD	2	2	18	45	0	0	bld	gvl	0		
10-Sep-98	27a	9:00	9:19		MP	PD	2	2	45	55	0	0	gvl	snd	5	lbk	not geoduck habitat
10-Sep-98	29a	8:45	9:00		BD	SW	2	2	-2	42	0	0	bld		0		urchins
10-Sep-98	29a	8:45	9:00		BD	SW	2	2	42	55	0	0	cbl		0		urchins
10-Sep-98	29b	8:45	9:00		BD	SW	2	2	-2	50	0	0	bld		0		urchins
10-Sep-98	29b	8:45	9:00		BD	SW	2	2	50	55	0	0	shl	cbl	0		urchins
10-Sep-98	31a	10:48	11:10		SW	BD	0	2	0	22	0	0	bld	cbl	0		cucs urchins
10-Sep-98	31a	10:48	11:10	0	SW	BD	0	2	27	55	0	0	rck	snd	0		
10-Sep-98	31a	10:48	11:10	6	SW	BD	0	2	26	27	24	0	snd		0		
10-Sep-98	31a	10:48	11:10	30	SW	BD	0	2	22	26	112	0	snd		0		
15-Aug-99	33a	8:11	9:23		RL	MP	2	2	15	26	621	10	snd	gvl	20	elg	
15-Aug-99	35a	8:33	9:59		DW	CB	1	2	3	49	13				65	elg	started to get shallower at end of dive

Appendix D. (page 3 of 5)

Foggy Bay Geoduck 1998 & 1999 Transect Summary

Transect No.	a	b	Average Per Meter	Est. Number per Transect's Shoreline
1	14		7	6,655
2				
3	98		49	46,583
4				
5	0	0	0	0
6				
7	1	0	0.25	238
8				
9	24	281	76.25	72,488
10				
11	336		168	159,712
12				
13	424		212	201,541
14				
15	0	0	0	0
16				
17	0		0	0
18				
19	3		1.5	1,426
20				
21	159		79.5	75,578
22				
23	154		77	73,201
24				
25	0		0	0
26				
27	0		0	0
28				
29	0	0	0	0
30				
31	136		68	64,645
32				
33	621		310.5	295,182
34				
35	13		6.5	6,179
36				

Foggy Bay geoduck survey biomass estimate and guideline harvest level.

Number of Transects	18
Average per Linear Meter	58.64
Variance of Counts	7,816
Std. Variance of Mean	434
Shoreline (meters)	17,112
Total Number of Geoducks	1,003,429
Variance of Total Number	127,144,190,028
Precision of Estimate	52.6%
90% Coefficient of Variation	61.8%
90% Two-Tail Precision	38.2%
Average Weight (average of sample means) in Lbs	2.288546
Variance of Average Weight	0.37827728
Biomass Estimate	2,296,393
Variance of Biomass Est.	998,690,364,502
Precision of Estimate	41.9739%
90% Coefficient of Variation	75.7%
90% Two-Tail Precision	24.3%
Lower Bounds Biomass Est.	557,926
Upper Bounds Biomass Est.	4,034,860
90% of being within 66.7% Adjustment	62.9%
Show Factor Adjustment	1.00
Target Harvest Rate	4%
Quota **WITHOUT** Precision Adjustment	91,856
Quota **WITH** Precision Adjustment	57,804

Appendix D. (page 5 of 5)

Foggy Bay latitudes and longitudes.

Transect No.	Latitude	Longitude
1	54.927550	-130.974950
3	54.934717	-130.966750
5	54.932967	-130.952117
7	54.939217	-130.948200
9	54.947633	-130.948083
11	54.955133	-130.951833
13	54.961667	-130.962417
15	54.963550	-130.973783
17	54.971133	-130.979617
19	54.980033	-130.981283
21	54.986967	-130.987583
23	54.994633	-130.995917
25	54.993117	-131.006583
27	54.993333	-131.013433
29	54.954217	-130.988250
31	54.963217	-130.982700
33	54.964050	-130.996050
35	54.971950	-131.000800

Appendix E. Sea Otter Sound (Subdistrict 103-90) geoduck clam assessment surveys.

GEODUCK ASSESSMENT TRANSECT DETAILS:

Survey Area: Sea Otter Sound

Cruise Dates: Turn Point & Cone Bay = June 24, 1999.
1998 Port Alice data is included for completeness.
1999 Divers: (RL) R. Larson, (MP) M. Pritchett, (SW) S. Walker, (DW) D. Woodby, (KH) K. Hebert, (JR) J. Rumble

Date	Area	Transect No.	Time In	Time Out	Total Time	Diver #1	Diver #2	Width	Length Interval	MLLW Start	MLLW End	No Geoducks	No Horseclams	Bottom Type #1	Bottom Type #2	Percent vegetative Cover	Predominate Vegetative Type #1	Comments
16-Sep-98	Port Alice	1a	12:02	12:32	0:30	PD	SW	2	50	27	42	49		snd	sil	75	lbk	first geoduck seen at 36 fsw
16-Sep-98	Port Alice	1a	12:02	12:32	0:30	PD	SW	2	50	42	55	6		snd	sil	50	lbk	
16-Sep-98	Port Alice	1a	12:02	12:32	0:30	PD	SW	2		55	61	3		snd	sil	0		
16-Sep-98	Port Alice	2a	16:21	16:59	0:38	PD	SW	2	50	-3	25	14		snd		40	lbk	first geoduck at 18 fsw
16-Sep-98	Port Alice	2a	16:21	16:59	0:38	PD	SW	2	50	25	35	23		snd		85	lbk	hard to see due to LBK
16-Sep-98	Port Alice	2a	16:21	16:59	0:38	PD	SW	2	50	35	51	7		snd		90	lbk	too much LBK to see
16-Sep-98	Port Alice	2a	16:21	16:59	0:38	PD	SW	2	10	51	55	0		snd		60	lbk	
16-Sep-98	Port Alice	2a	16:21	16:59	0:38	PD	SW	2		55	57	2		snd		10	lbk	
17-Sep-98	Port Alice	3a	8:38	9:08	0:30	PD	MP	2		10	13	0						
17-Sep-98	Port Alice	3a	8:38	9:08	0:30	PD	MP	2		13	55	14		snd	sil	100	lbk	
17-Sep-98	Port Alice	3a	8:38	9:08	0:30	PD	MP	2		55	65	0		snd	sil	75	lbk	deeper = same substrate w/fewer veg. (<5%)
16-Sep-98	Port Alice	4a	11:10	11:42	0:32	SW	KH	2		-8	26	1	10	snd	shl	40	lbk	
16-Sep-98	Port Alice	4a	11:10	11:42	0:32	SW	KH	2	50	26	45	65		snd	shl	20	lbk	
16-Sep-98	Port Alice	4a	11:10	11:42	0:32	SW	KH	2	15	45	55	22		snd		20	lbk	
16-Sep-98	Port Alice	4a	11:10	11:42	0:32	SW	KH	2	18	55	62	11		snd		20	lbk	
17-Sep-98	Port Alice	5a	9:24	10:05	0:41	PD	MP	2		13	23	19		snd		40	lbk	
17-Sep-98	Port Alice	5a	9:24	10:05	0:41	PD	MP	2		23	33	2		snd		100	lbk	
17-Sep-98	Port Alice	5a	9:24	10:05	0:41	PD	MP	2		33	55	149		snd		30	lbk	100 m bedrock, good geoduck last part
17-Sep-98	Port Alice	6a	10:22	10:57	0:35	PD	MP	2		27	55	287		snd	sil	25	lbk	
17-Sep-98	Port Alice	6a	10:22	10:57	0:35	PD	MP	2		55	61	0		snd				
17-Sep-98	Port Alice	7a	11:22	11:43	0:21	PD	MP	2		25	30	0		rck				
17-Sep-98	Port Alice	7a	11:22	11:43	0:21	PD	MP	2		30	55	467		snd		10	lbk	
17-Sep-98	Port Alice	7a	11:22	11:43	0:21	PD	MP	2		55	60	139		snd		10	lbk	
16-Sep-98	Port Alice	8a	16:38	17:08	0:30	BD	MP	2		27	29	0		snd		0		started at edge of macro bed, sea otters on site
16-Sep-98	Port Alice	8a	16:38	17:08	0:30	BD	MP	2	50	29	35	23		snd		0		
16-Sep-98	Port Alice	8a	16:38	17:08	0:30	BD	MP	2	6	35	55	3						
16-Sep-98	Port Alice	8a	16:38	17:08	0:30	BD	MP	2		55	60	0		bld		10	lbk	
16-Sep-98	Port Alice	8a	16:38	17:08	0:30	BD	MP	2		60	67	3		snd		0		sand waves start
16-Sep-98	Port Alice	9a	10:28	10:52	0:24	PD	KH	2		31	51	0		rck		10	lbk	terrible shows
16-Sep-98	Port Alice	9a	10:28	10:52	0:24	PD	KH	2		51	61	0		rck		0		rck stops at 70'

-continued-

Appendix E. (page 2 of 7)

Date	Area	Transect No.	Time In	Time Out	Total Time	Diver #1	Diver #2	Width	Length Interval	MLLW Start	MLLW End	No Geoducks	No Horseclams	Bottom Type #1	Bottom Type #2	Percent vegetative Cover	Predominate Vegetative Type #1	Comments
16-Sep-98	Port Alice	9a	10:28	10:52	0:24	PD	KH	2		61	66	13		snd		0		habitat looks good
16-Sep-98	Port Alice	9b	10:28	10:52	0:24	PD	KH	2		52	61	21		snd		0		rck begins at 61 fsw
16-Sep-98	Port Alice	10a	10:00	10:12	0:12	PD	SW	2		-8	29	0	0	rck		50	mac	
16-Sep-98	Port Alice	10a	10:00	10:12	0:12	PD	SW	2		29	44	0	0	cbl	snd	10	lbk	
16-Sep-98	Port Alice	10a	10:00	10:12	0:12	PD	SW	2	33	44	55	88				0		none showing
16-Sep-98	Port Alice	10a	10:00	10:12	0:12	PD	SW	2	10	55	62	6				0		
16-Sep-98	Port Alice	10b	10:00	10:12	0:12	PD	SW	2	18	35	38	82		snd		0		
16-Sep-98	Port Alice	10b	10:00	10:12	0:12	PD	SW	2	55	38	56	217		snd		0		
16-Sep-98	Port Alice	10b	10:00	10:12	0:12	PD	SW	2	10	56	62	117		snd		0		
16-Sep-98	Port Alice	11a	15:40	16:00	0:20	SW	KH	2		31	47	0	0	rck		20	lbk	
16-Sep-98	Port Alice	11a	15:40	16:00	0:20	SW	KH	2		47	55	0	0	cbl	snd	10	lbk	
16-Sep-98	Port Alice	11a	15:40	16:00	0:20	SW	KH	2		55	67	0	0	cbl		0		
16-Sep-98	Port Alice	12a	14:54	15:27	0:33	PD	KH	2	36	25	55	133		snd		75	lbk	shows are poor - mostly depressions
16-Sep-98	Port Alice	12a	14:54	15:27	0:33	PD	KH	2	8	55	65	21		snd		0		visibility 40'
16-Sep-98	Port Alice	13a	9:12	9:53	0:41	MP	BD	2		-8	16	0		rck	bld	75	lbk	
16-Sep-98	Port Alice	13a	9:12	9:53	0:41	MP	BD	2		16	19	0		snd		25	lbk	
16-Sep-98	Port Alice	13a	9:12	9:53	0:41	MP	BD	2	50	19	26	75		snd		0		
16-Sep-98	Port Alice	13a	9:12	9:53	0:41	MP	BD	2		26	28	0		sil	rck	0		
16-Sep-98	Port Alice	13a	9:12	9:53	0:41	MP	BD	2	35	28	31	47		snd		0		
16-Sep-98	Port Alice	13a	9:12	9:53	0:41	MP	BD	2		31	32	0						
16-Sep-98	Port Alice	13a	9:12	9:53	0:41	MP	BD	2	50	32	40	268		snd		0		
16-Sep-98	Port Alice	13a	9:12	9:53	0:41	MP	BD	2	27	40	45	63		snd		0		
16-Sep-98	Port Alice	13a	9:12	9:53	0:41	MP	BD	2		45	44	0		snd	gvl	0		BD lost weight pack and 'shot' to surface. 1-hr safety surface interval, did not repeat transect, at 52 fsw encountered rock and no further geoduck habitat
16-Sep-98	Port Alice	14a	15:42	16:20	0:38	MP	BD	2		15	19	0	0	snd		0		rock shallower, mounded sand
16-Sep-98	Port Alice	14a	15:42	16:20	0:38	MP	BD	2		19	31	0		rck		100	mac	depth range was 22-6-34 ->swam over reef
16-Sep-98	Port Alice	14a	15:42	16:20	0:38	MP	BD	2	10	31	32	46		snd		0		large (37 cm) lemon peel nudibranch
16-Sep-98	Port Alice	14a	15:42	16:20	0:38	MP	BD	2		32	36	0		rck				rock reef
16-Sep-98	Port Alice	14a	15:42	16:20	0:38	MP	BD	2	41	36	55	57		snd		0		more otter excavations at 42 fsw
16-Sep-98	Port Alice	14a	15:42	16:20	0:38	MP	BD	2	14	55	67	13		snd	sil	0		
16-Sep-98	Port Alice	15a	14:00	14:35	0:35	MP	BD	2		9	28	0	0	rck		40	mac	
16-Sep-98	Port Alice	15a	14:00	14:35	0:35	MP	BD	2		28	39	0		snd		0		
16-Sep-98	Port Alice	15a	14:00	14:35	0:35	MP	BD	2	50	39	42	11		snd		20	lbk	
16-Sep-98	Port Alice	15a	14:00	14:35	0:35	MP	BD	2	50	42	44	2		rck	snd	10	lbk	
16-Sep-98	Port Alice	15a	14:00	14:35	0:35	MP	BD	2	27	44	59	1		snd		10	lbk	

-continued-

Appendix E. (page 3 of 7)

Date	Area	Transect No.	Time In	Time Out	Total Time	Diver #1	Diver #2	Width	Length Interval	MLLW Start	MLLW End	No Geoducks	No Horseclams	Bottom Type #1	Bottom Type #2	Percent vegetative Cover	Predominate Vegetative Type #1	Comments
16-Sep-98	Port Alice	15a	14:00	14:35	0:35	MP	BD	2		59	68	4		snd		0		
16-Sep-98	Port Alice	16a	10:48	11:12	0:24	MP	BD	2		-9	14	0		cbl		100	mac	
16-Sep-98	Port Alice	16a	10:48	11:12	0:24	MP	BD	2		14	25	0		rck		50	mac	
16-Sep-98	Port Alice	16a	10:48	11:12	0:24	MP	BD	2	11	25	29	22		snd		0		
16-Sep-98	Port Alice	16a	10:48	11:12	0:24	MP	BD	2		29	44	0		rck				
16-Sep-98	Port Alice	16a	10:48	11:12	0:24	MP	BD	2	14	44	55	4		snd		0		
16-Sep-98	Port Alice	16a	10:48	11:12	0:24	MP	BD	2	4	55	61	1		snd		0		more (?) geoducks on either side of transect due to rock ledge
16-Sep-98	Port Alice	17a	12:44	13:04	0:20	MP	BD	2		-8	10	0		snd		40	mac	
16-Sep-98	Port Alice	17a	12:44	13:04	0:20	MP	BD	2		10	52	0		rck	snd	40	mac	
16-Sep-98	Port Alice	17a	12:44	13:04	0:20	MP	BD	2		52	55	0		snd		0		
16-Sep-98	Port Alice	17a	12:44	13:04	0:20	MP	BD	2		55	62	4		snd		0		many excavations at 70 fsw
16-Sep-98	Port Alice	18a	13:19	13:42	0:23	MP	BD	2		13	29	0		snd		0		sand mounds or 'waves'
16-Sep-98	Port Alice	18a	13:19	13:42	0:23	MP	BD	2		29	31	0		snd		0		sand flat
16-Sep-98	Port Alice	18a	13:19	13:42	0:23	MP	BD	2		31	48	0		rck		90	lbk	
16-Sep-98	Port Alice	18a	13:19	13:42	0:23	MP	BD	2		48	55	1		snd	cbl	0		old excavations 60-65 fsw
16-Sep-98	Port Alice	18a	13:19	13:42	0:23	MP	BD	2		55	63	0		snd		0		this transect was a sand strip between two rock 'reefs'
24-Jun-99	Turn Point	19a	12:04	12:28	0:24	RL	DW	2		22	55	58	0	gvl	shl			1st geoduck at 36 fsw
24-Jun-99	Turn Point	19a	12:04	12:28	0:24	RL	DW	2		55	63	13	0	gvl	shl			
24-Jun-99	Turn Point	19b	12:04	12:28	0:24	RL	DW	2		23	55	76	0	gvl	shl	50	lbk	
24-Jun-99	Turn Point	19b	12:04	12:28	0:24	RL	DW	2		55	63	24	0	gvl	shl			
24-Jun-99	Turn Point	20a	12:13	12:35	0:22	JR	KH	2		19	55	64	8	snd		10	lam	1st duck at 30 fsw, 90% lam above 25 fsw
24-Jun-99	Turn Point	20a	12:13	12:35	0:22	JR	KH	2		55	65	3	0	gvl	cbl			
24-Jun-99	Turn Point	20b	12:13	12:35	0:22	JR	KH	2		19	55	52	5	snd		10	lam	
24-Jun-99	Turn Point	20b	12:13	12:35	0:22	JR	KH	2		55	65	2	0					
24-Jun-99	Turn Point	21a	12:46	13:05	0:19	SW	KH	2		29	55	33	4					
24-Jun-99	Turn Point	21a	12:46	13:05	0:19	SW	KH	2		55	64	16	0					
24-Jun-99	Turn Point	21b	12:46	13:05	0:19	SW	KH	2		20	55	82	3					
24-Jun-99	Turn Point	21b	12:46	13:05	0:19	SW	KH	2		55	64	24	0					
24-Jun-99	Turn Point	22a	12:50	13:18	0:28	DW	MP	2		25	59	41	1	shl	snd	0		
24-Jun-99	Turn Point	22a	12:50	13:18	0:28	DW	MP	2		59	68	24	0					ducks continue deeper
24-Jun-99	Turn Point	22b	12:50	13:18	0:28	DW	MP	2		33	39	0	0					
24-Jun-99	Turn Point	22b	12:50	13:18	0:28	DW	MP	2		39	59	28	0					above 41 fsw gvl/shl, not diggable
24-Jun-99	Turn Point	22b	12:50	13:18	0:28	DW	MP	2		59	68	13	0					
24-Jun-99	Turn Point	23a	13:25	13:40	0:15	JR	SW	2		27	55	13	0	shl	gvl	50	lam	
24-Jun-99	Turn Point	23a	13:25	13:40	0:15	JR	SW	2		55	64	1	0					

-continued-

Appendix E. (page 4 of 7)

Date	Area	Transect No.	Time In	Time Out	Total Time	Diver #1	Diver #2	Width	Length Interval	MLLW Start	MLLW End	No Geoducks	No Horseclams	Bottom Type #1	Bottom Type #2	Percent vegetative Cover	Predominate Vegetative Type #1	Comments
24-Jun-99	Turn Point	23b	13:25	13:40	0:15	JR	SW	2		16	55	6	0	snd	gvl	30	lam	
24-Jun-99	Turn Point	23b	13:25	13:40	0:15	JR	SW	2		55	64	1	0					
24-Jun-99	Turn Point	24a	13:34	14:09	0:35	MP	RL	2		9	28	0	0	cbl	bld	100	lam	first duck at 34 fsw
24-Jun-99	Turn Point	24a	13:34	14:09	0:35	MP	RL	2		28	55	55	0	gvl	shl	10	lam	
24-Jun-99	Turn Point	24a	13:34	14:09	0:35	MP	RL	2		55	64	5	0	gvl				
24-Jun-99	Turn Point	24b	13:34	14:09	0:35	MP	RL	2		-6	25	0	0	cbl	gvl	10	lbk	
24-Jun-99	Turn Point	24b	13:34	14:09	0:35	MP	RL	2		25	55	37	0	gvl	shl	20	lam	
24-Jun-99	Turn Point	24b	13:34	14:09	0:35	MP	RL	2		55	64	1	0	gvl				
24-Jun-99	Cone Bay	25a	16:24	17:03	0:39	RL	MP	2		10	55	47	7	gvl	snd	5	lam	did not go to 70 fsw low on air
24-Jun-99	Cone Bay	25b	16:24	17:03	0:39	RL	MP	2		25	29	10	0					
24-Jun-99	Cone Bay	25b	16:24	17:03	0:39	RL	MP	2		29	55	119	2	snd	gvl			
24-Jun-99	Cone Bay	26a	16:23	17:07	0:44	SW	KH	2		14	50	137	2					
24-Jun-99	Cone Bay	26a	16:23	17:07	0:44	SW	KH	2		50	68	52						
24-Jun-99	Cone Bay	26b	16:23	17:07	0:44	SW	KH	2		17	36	59						
24-Jun-99	Cone Bay	26b	16:23	17:07	0:44	SW	KH	2		36	50	129						
24-Jun-99	Cone Bay	26b	16:23	17:07	0:44	SW	KH	2		50	67	61						

Appendix E. (page 5 of 7)

Sea Otter Sound transect summary.

Area & Survey Year	Transect No.	Side A	Side B	Total (Side A & B)	Average per meter	Density for Represented Shoreline
Port Alice 1998	1	58		58	29	7,982
Port Alice 1998	2	46		46	23	6,330
Port Alice 1998	3	14		14	7	1,927
Port Alice 1998	4	99		99	49.5	13,624
Port Alice 1998	5	170		170	85	23,395
Port Alice 1998	6	287		287	143.5	39,496
Port Alice 1998	7	606		606	303	83,395
Port Alice 1998	8	29		29	14.5	3,991
Port Alice 1998	9	13	21	34	8.5	2,339
Port Alice 1998	10	94	416	510	127.5	35,092
Port Alice 1998	11	0		0	0	0
Port Alice 1998	12	154		154	77	21,193
Port Alice 1998	13	453		453	226.5	62,340
Port Alice 1998	14	116		116	58	15,963
Port Alice 1998	15	18		18	9	2,477
Port Alice 1998	16	27		27	13.5	3,716
Port Alice 1998	17	4		4	2	550
Port Alice 1998	18	1		1	0.5	138
Turn Pt. 1999	19	71	100	171	42.75	11,766
Turn Pt. 1999	20	67	54	121	30.25	8,326
Turn Pt. 1999	21	49	106	155	38.75	10,665
Turn Pt. 1999	22	65	41	106	26.5	7,294
Turn Pt. 1999	23	14	7	21	5.25	1,445
Turn Pt. 1999	24	60	38	98	24.5	6,743
Cone Bay 1999	25	47	129	176	44	12,110
Cone Bay 1999	26	189	249	438	109.5	30,138

	Shoreline Length (m)	Percent Shoreline	Biomass	Percent Biomass
Port Alice	4,955	69%	671,774	79%
Turn Point	1,651	23%	95,886	11%
Cone Bay	550	8%	87,610	10%
Total	7,156		855,271	

Appendix E. (page 6 of 7)

Sea Otter Sound geoduck survey biomass estimate and guideline harvest level.

Number of Transects	26
Average per Linear Meter	57.63
Variance of Counts	5,361
Std. Variance of Mean	206
Shoreline (meters)	7,156
Total Number of Geoducks	412,433
Variance of Total Number	10,559,318,720
Precision of Estimate	67.2%
90% Coefficient of Variation	42.6%
90% Two-Tail Precision	57.4%
Average Weight (average of sample means) in Lbs	2.07
Variance of Average Weight	0.01184190
Biomass Estimate	855,271
Variance of Biomass Est.	47,297,659,213
Precision of Estimate	66.5277%
90% Coefficient of Variation	43.4%
90% Two-Tail Precision	56.6%
Lower Bounds Biomass Est.	483,784
Upper Bounds Biomass Est.	1,226,758
90% of being within 66.7% Adjustment	99.7%
Show Factor Adjustment	0.75
Target Harvest Rate	4%
Quota Without Precision Adjustment	45,614
Quota With Precision Adjustment	45,497

Appendix E. (page 7 of 7)

Sea Otter Sound transect latitude and longitude.

Area	Transect No.	Latitude	Longitude
Port Alice Geoduck	1	55.830967	-133.538583
Port Alice Geoduck	2	55.833800	-133.550833
Port Alice Geoduck	3	55.836467	-133.551833
Port Alice Geoduck	4	55.837200	-133.556133
Port Alice Geoduck	5	55.836883	-133.567083
Port Alice Geoduck	6	55.837533	-133.572283
Port Alice Geoduck	7	56.005000	-133.577000
Port Alice Geoduck	8	55.834700	-133.583500
Port Alice Geoduck	9	55.833333	-133.587367
Port Alice Geoduck	10	55.832117	-133.591417
Port Alice Geoduck	11	55.831050	-133.595133
Port Alice Geoduck	12	55.828217	-133.597450
Port Alice Geoduck	13	55.825883	-133.597167
Port Alice Geoduck	14	55.823467	-133.597033
Port Alice Geoduck	15	55.820967	-133.596133
Port Alice Geoduck	16	55.826867	-133.618617
Port Alice Geoduck	17	55.828883	-133.621200
Port Alice Geoduck	18	55.830333	-133.625800
Turn Point	19	55.832450	-133.346800
Turn Point	20	55.834230	-133.349580
Turn Point	21	55.836440	-133.350890
Turn Point	22	55.838370	-133.353590
Turn Point	23	55.840170	-133.356530
Turn Point	24	55.842230	-133.358690
Cone Bay	25	55.791500	-133.656890
Cone Bay	26	55.793750	-133.655380

Appendix F. Cone Island (Subdistrict 104-40) geoduck clam assessment survey, 1999. This area survey is not complete. The listed data and calculations are presented for information purposes, only.

GEODUCK ASSESSMENT TRANSECT DETAILS:
Survey Area: Cone Island
Cruise Dates: July 17, 1999
Divers: (KH) K. Hebert, (JR) J. Rumble, (RL) R. Larson, (JC) J. Clark, (DG) D. Gordon, (MP) M. Pritchett

Date	Area	Transect No.	Time In	Time Out	Total Time	Diver #1	Diver #2	Width	MLLW Start	MLLW End	No. Geoducks	No horseclams	Bottom Type #1	Bottom Type #2	Percent veg cover	Predominate Vegetative Type #1	Comments
17-Jul-99	104-40	1a	14:34	14:46	0:12	KH	JR	2	49	55	74	1	gvl	snd			rck ended at 55 fsw
17-Jul-99	104-40	10a	15:54	16:09	0:15	RL	JR	2	39	55	85	2	gvl	cbl	20	lbk	geoducks 3/m^2 @ 70 fsw
17-Jul-99	104-40	11a	15:40	16:13	0:33	MP	JC	2	22	55	279	79	gvl	snd	90	lam	sea cucumber present
17-Jul-99	104-40	2a	14:10	14:21	0:11	JR	RL	2	42	60	149	6	gvl	cbl	0		
17-Jul-99	104-40	3a	13:45	13:55	0:10	RL	KH	2	52	60	31	3	gvl				very strong current, 1st geoduck at 57 fsw
17-Jul-99	104-40	4a	12:51	13:30	0:39	JR	KH	2	33	55	2185	0	snd		10	lbk	geoduck start at 51 fsw
17-Jul-99	104-40	5a	12:48	13:16	0:28	JC	MP	2	25	55	1346		snd	gvl	0		geoducks begin at 41 fsw, 16/m^2 @ 45', 26/m^2 @ 57'
17-Jul-99	104-40	6a	13:42	14:00	0:18	JC	DG	2	-5	59	274	7	snd				geoducks begin @ 41 fsw
17-Jul-99	104-40	7a	14:15	14:20	0:05	MP	DG	2	34	55	0	0	cbl	gvl			"stiff" current
17-Jul-99	104-40	8a				MP	DG				0						not dove, stiff current, similar area/current to T#7 (indeed, current so strong on T#7 we probably touched on portions of T#8 !)
17-Jul-99	104-40	9a	14:34	14:46	0:12	MP	DG	2	15	55	52	8	gvl	snd	20	lam	strong current, most geoducks tended to be more shallow than deep

Cone Island Transect Summary

Transect No.	Side A	Side B	Grand Total	Average Sides A & B	Geoducks per Represented Shoreline
1	39	35	74	19	3,700
2	67	42	109	27	5,450
3	12	19	31	8	1,550
4	1,458	725	2183	546	109,150
5	497	849	1346	337	67,300
6	172	102	274	69	13,700
7	0	0	0	0	0
8	0	0	0	0	0
9	14	38	52	13	2,600
10	47	38	85	21	4,250
11	240	39	279	70	13,950

Appendix F. (page 2 of 3)

Cone Island geoduck survey biomass estimate. This area survey is not complete. The listed data and calculations are presented for information purposes, only.

Number of Transects	11
Average per Linear Meter	100.75
Variance of Counts	31,074
Std. Variance of Mean	2,825
Shoreline (meters)	2,200
Total Number of Geoducks	221,650
Variance of Total Number	13,672,642,500
Precision of Estimate	27.6%
90% Coefficient of Variation	95.6%
90% Two-Tail Precision	4.4%
Average Weight (average of sample means) in Lbs	2.363436
Variance of Average Weight	0.46039138
Biomass Estimate	523,856
Variance of Biomass Est.	92,696,734,365
Precision of Estimate	20.2496%
90% Coefficient of Variation	105.3%
90% Two-Tail Precision	-5.3%
Lower Bounds Biomass Est.	-27,969
Upper Bounds Biomass Est.	1,075,680
90% of being within 66.7% Adjustment	30.4%
Show Factor Adjustment	0.75
Target Harvest Rate	2%
Non-Precision Adjusted Quota	13,969
Precision Adjusted Quota	4,241

Appendix F. (page 3 of 3)

Cone Island transect latitude and longitude.

Transect No.	Latitude	Longitude
1	55.44441	-133.65800
2	55.44597	-133.65652
3	55.44743	-133.65474
4	55.44871	-133.65323
5	55.44947	-133.65036
6	55.44991	-133.64743
7	55.45022	-133.64434
8	55.45174	-133.64240
9	55.45351	-133.64118
10	55.43945	-133.63622
11	55.43887	-133.63314

Appendix G. Goddard (portions of Subdistricts 113 - 31/41) geoduck clam assessment survey. Transects 1 – 51 were surveyed in 1998; transects 52 – 72 were surveyed in 1999.

GEODUCK ASSESSMENT TRANSECT DETAILS:
Survey Area: Goddard
Cruise Dates: July 17-25,1998 and June 6, 1999
Divers: (RL) R. Larson, (JR) J. Rumble, (SM) S. Marshall, (JC) J. Clark, (MP) M. Pritchett, (DG) D. Gordon, (BL) B. Lynch, (BD) B. Davidson, (WB) W. Bergmann, (SW) S. Walker

Date	Transect no	Time in	Time out	Total time	Diver #1	Diver #2	Width	Length Interval	MLLW start	MLLW End	No. Geoducks	No. Horseclams	Bottom Type #1	Bottom Type #2	Percent Vegetative Cover	Predominate Vegetative Type #1	Comments
21-Jul-98	1a	10:11	10:41	0:30	RL	JR	2		-6	26	0	0	rck				rock cliff
21-Jul-98	1a	10:11	10:41	0:30	RL	JR	2	48	30	55	56	4	snd	shl	10	lbk	
21-Jul-98	1a	10:11	10:41	0:30	RL	JR	2	12	55	64	9	0	shl		0		
21-Jul-98	1b	10:11	10:41	0:30	RL	JR	2	59	55	28	34	2	snd	shl			
21-Jul-98	1b	10:11	10:41	0:30	RL	JR	2	16	64	55	3	0	snd	shl			otters in area, geoducks not showing well
21-Jul-98	2a	9:33	9:53	0:20	RL	SM	2		-4	28	0	0	rck		90	lbk	no abs or urchins
21-Jul-98	2a	9:33	9:53	0:20	RL	SM	2		28	36	0	0	shl	snd	0		
21-Jul-98	2a	9:33	9:53	0:20	RL	SM	2	19	36	55	2	1	snd	shl	0		1st geoduck at 41 feet
21-Jul-98	2a	9:33	9:53	0:20	RL	SM	2	10	55	66	0	0	shl	mud			not geoduck habitat
21-Jul-98	2b	9:33	9:53	0:20	RL	SM	2	30	55	24	4	0	snd	shl	0		edge of gvl/rck edge
21-Jul-98	2b	9:33	9:53	0:20	RL	SM	2	9	66	55	0	0	snd	mud	0		
21-Jul-98	3a	11:12	11:34	0:22	JR	SM	2		28	33	0	0	snd	shl	50	lbk	
21-Jul-98	3a	11:12	11:34	0:22	JR	SM	2		33	57	0	0	snd				
21-Jul-98	3a	11:12	11:34	0:22	JR	SM	2	7	57	63	1	0	snd				
21-Jul-98	3b	11:12	11:34	0:22	JR	SM	2		33	23	0	0	snd	rck			
21-Jul-98	3b	11:12	11:34	0:22	JR	SM	2		53	33	0	0	snd				
21-Jul-98	3b	11:12	11:34	0:22	JR	SM	2		63	53	0	0	snd				
20-Jul-98	4a	11:00	11:28	0:28	JC	MP	2		23	27	0	0	cbl	snd	30	mac	
20-Jul-98	4a	11:00	11:28	0:28	JC	MP	2	40	27	45	0	1	snd	shl	30	lbk	
20-Jul-98	4a	11:00	11:28	0:28	JC	MP	2	11	45	55	1	0	snd	shl	0		
20-Jul-98	4b	11:00	11:28	0:28	JC	MP	2	33	47	23	0	0	rck		100	lbk	swam laterally -> saw no geoducks
20-Jul-98	4b	11:00	11:28	0:28	JC	MP	2		55	47	0	1	snd	shl	0		
17-Jul-98	5a	9:25	10:10	0:45	SM	RL	2	37	30	60	0	0	shl		0		searched to 73 fsw, no geoducks
17-Jul-98	5b	9:25	10:10	0:45	SM	RL	2	28	38	60	8	0	snd	bld	0		
20-Jul-98	6a	10:12	10:40	0:28	RL	DG	2		35	48	0	0	bld	rck	10	lbk	
20-Jul-98	6a	10:12	10:40	0:28	RL	DG	2	8	48	55	2	0	snd		0		clean crushed shell
20-Jul-98	6a	10:12	10:40	0:28	RL	DG	2	7	55	64	0	0	snd		0		to 74', looked to 80' -> did not see any shows
20-Jul-98	6b	10:12	10:40	0:28	RL	DG	2	35	55	40	0	2	shl				
20-Jul-98	6b	10:12	10:40	0:28	RL	DG	2	13	65	55	0	1	snd	shl	0		
20-Jul-98	7a	10:02	10:35	0:33	JR	MP	2	32	34	56	5	7	snd	cbl	40	lbk	2 truncated clams
20-Jul-98	7b	10:02	10:35	0:33	JR	MP	2	22	35	17	0	1	cbl		40	lbk	
20-Jul-98	7b	10:02	10:35	0:33	JR	MP	2	50	56	35	2	3	snd				4 truncated clams

-continued-

Appendix G. (page 2 of 16)

Date	Transect no	Time in	Time out	Total time	Diver #1	Diver #2	Width	Length Interval	MLLW start	MLLW End	No. Geoducks	No. Horseclams	Bottom Type #1	Bottom Type #2	Percent Vegetative Cover	Predominate Vegetative Type #1	Comments
20-Jul-98	8a	11:11	11:21	0:10	SM	DG	2		28	55	0	0	shl	cbl	0		
20-Jul-98	8b	11:11	11:21	0:10	SM	DG	2		55	28	0	0	shl	cbl	0		
20-Jul-98	9a	11:51	12:13	0:22	JC	JR	2		17	53	0	0	rck	snd	40	lbk	
20-Jul-98	9a	11:51	12:13	0:22	JC	JR	2	1	53	55	1	3	snd	shl	0		geoducks seen 62-70 feet
20-Jul-98	9b	11:51	12:13	0:22	JC	JR	2		44	37	0	0	snd				
20-Jul-98	9b	11:51	12:13	0:22	JC	JR	2	24	55	44	1	1	snd	shl	0		
20-Jul-98	9b	11:51	12:13	0:22	JC	JR	2		61	55	3		snd				
20-Jul-98	10a	11:39	12:11	0:32	SM	DG	2	30	31	34	60	0	snd	shl	20	lbk	
20-Jul-98	10a	11:39	12:11	0:32	SM	DG	2	30	34	51	94	0	snd		0		
20-Jul-98	10a	11:39	12:11	0:32	SM	DG	2	13	51	56	40	0	snd		0		
20-Jul-98	10b	11:39	12:11	0:32	SM	DG	2		29	31	0	0	snd	shl	0		
20-Jul-98	10b	11:39	12:11	0:32	SM	DG	2	30	31	35	54	2	snd	shl	40	lam	
20-Jul-98	10b	11:39	12:11	0:32	SM	DG	2	30	35	48	82	4	snd		10	lbk	
20-Jul-98	10b	11:39	12:11	0:32	SM	DG	2	12	48	55	34	2	snd	shl	5	lbk	
21-Jul-98	11a	17:00	17:21	0:21	JC	MP	2		30	55	0	0	snd	shl	5	lbk	
21-Jul-98	11a	17:00	17:21	0:21	JC	MP	2		55	67	0	0	snd	shl	5	lbk	
21-Jul-98	11b	17:00	17:21	0:21	JC	MP	2		55	29	0	0	snd	shl	5	lbk	rock wall at 32'
21-Jul-98	11b	17:00	17:21	0:21	JC	MP	2		67	55	0	2	snd	shl	5	lbk	
21-Jul-98	12a	14:53	15:23	0:30	MP	JC	2		27	31	0	0	bld	rck	90	lbk	
21-Jul-98	12a	14:53	15:23	0:30	MP	JC	2	50	31	49	15	1	snd		0		
21-Jul-98	12a	14:53	15:23	0:30	MP	JC	2	35	51	41	7	2	snd		10	lbk	started back up slope without reaching target depth
21-Jul-98	12b	14:53	15:23	0:30	MP	JC	2	50	32	47	13	0	snd		0		at start rock wall to 30, bld to 36
21-Jul-98	12b	14:53	15:23	0:30	MP	JC	2	37	47	38	5	0	snd				
21-Jul-98	13a	15:40	16:02	0:22	DG	JC	2	50	21	50	6	0	snd	shl	40	lbk	silt at 40'
21-Jul-98	13b	15:40	16:02	0:22	DG	JC	2		-5	22	0	0	rck		100	lbk	1 abalone, approx. 20 red urchins
21-Jul-98	13b	15:40	16:02	0:22	DG	JC	2		22	28	0	0	snd		0		
21-Jul-98	13b	15:40	16:02	0:22	DG	JC	2	50	28	53	2	0	snd		40	lbk	slt present
21-Jul-98	14a	16:19	16:45	0:26	MP	DG	2		19	23	0	2	snd		100	lbk	
21-Jul-98	14a	16:19	16:45	0:26	MP	DG	2	39	23	55	20	12	snd		40	lbk	snd slt substrate
21-Jul-98	14a	16:19	16:45	0:26	MP	DG	2	10	55	63	0	0	mud		10	lbk	
21-Jul-98	14b	16:19	16:45	0:26	MP	DG	2		19	23	0	5	snd		20	lbk	
21-Jul-98	14b	16:19	16:45	0:26	MP	DG	2	39	23	55	16	13	snd		10	lbk	snd slt substrate
21-Jul-98	14b	16:19	16:45	0:26	MP	DG	2	10	55	63	6	0			20	lbk	slt substrate
21-Jul-98	14c	16:19	16:45	0:26	MP	DG	2	37	55	23	26	3	snd	mud	10	lbk	
21-Jul-98	14c	16:19	16:45	0:26	MP	DG	2	10	63	55	2	0	mud		10	lbk	
21-Jul-98	15a	9:08	9:48	0:40	MP	DG	2		26	33	0	0	rck	snd	90	lbk	

-continued-

Appendix G. (page 3 of 16)

Date	Transect no	Time in	Time out	Total time	Diver #1	Diver #2	Width	Length Interval	MLLW start	MLLW End	No. Geoducks	No. Horseclams	Bottom Type #1	Bottom Type #2	Percent Vegetative Cover	Predominate Vegetative Type #1	Comments
21-Jul-98	15a	9:08	9:48	0:40	MP	DG	2	23	33	55	11	1		cbl	50	lbk	slt cbl substrate
21-Jul-98	15a	9:08	9:48	0:40	MP	DG	2	12	55	66	18	0	snd		0		
21-Jul-98	15b	9:08	9:48	0:40	MP	DG	2	34	55	34	25	12	shl	snd	40	lbk	34' to 0 = rock/lbk
21-Jul-98	15b	9:08	9:48	0:40	MP	DG	2	13	66	55	16	1	snd		0		snd slt substrate
21-Jul-98	16a	10:06	10:24	0:18	MP	JC	2		-6	47	0	0	rck		100	lbk	
21-Jul-98	16a	10:06	10:24	0:18	MP	JC	2		47	55	0	0	snd	shl	0		
21-Jul-98	16a	10:06	10:24	0:18	MP	JC	2	6	55	64	4	2	snd		0		
21-Jul-98	16b	10:06	10:24	0:18	MP	JC	2		55	-6	0	0	rck	bld	90	lbk	
21-Jul-98	16b	10:06	10:24	0:18	MP	JC	2		64	55	0	2	snd		0		
20-Jul-98	17a	14:48	15:16	0:28	JR	MP	2	27	26	55	77	27	snd	shl	5	lbk	
20-Jul-98	17a	14:48	15:16	0:28	JR	MP	2	6	55	65	17	0	snd	shl	0		
20-Jul-98	17b	14:48	15:16	0:28	JR	MP	2	48	55	23	114	19	snd	shl	5	lbk	
20-Jul-98	17b	14:48	15:16	0:28	JR	MP	2	11	65	55	20	1	snd	shl	0		
20-Jul-98	18a	14:48	15:26	0:38	RL	SM	2		16	40	0	0	bld	cbl	80	lbk	
20-Jul-98	18a	14:48	15:26	0:38	RL	SM	2	18	40	55	24	6	cbl	shl	0		
20-Jul-98	18b	14:48	15:26	0:38	RL	SM	2	12	55	66	6	0	snd		0		
20-Jul-98	18b	14:48	15:26	0:38	RL	SM	2	30	56	32	22	7	snd		0		
20-Jul-98	18b	14:48	15:26	0:38	RL	SM	2	14	63	55	3	2	snd		0		
20-Jul-98	19a	15:35	16:10	0:35	MP	JC	2		20	30	0	0	bld	snd	100	lbk	
20-Jul-98	19a	15:35	16:10	0:35	MP	JC	2	33	30	55	18	17	snd	bld	80	lbk	
20-Jul-98	19a	15:35	16:10	0:35	MP	JC	2		55	67	12	6	snd		0		
20-Jul-98	19b	15:35	16:10	0:35	MP	JC	2	39	55	27	9	12	snd	cbl	50	lbk	
20-Jul-98	19b	15:35	16:10	0:35	MP	JC	2		67	55	12	2	snd		0		
20-Jul-98	20a	16:01	16:23	0:22	RL	DG	2	65	38	26	98	8	snd		40	lbk	
20-Jul-98	20b	16:01	16:23	0:22	RL	DG	2	65	38	27	116	20	snd		10	lbk	
21-Jul-98	21a	10:44	11:13	0:29	JC	DG	2		-7	46	0	0	rck		100	lbk	
21-Jul-98	21a	10:44	11:13	0:29	JC	DG	2		46	52	0	0	bld		100	lbk	
21-Jul-98	21a	10:44	11:13	0:29	JC	DG	2		52	55	0	0	snd	shl	10	lbk	
21-Jul-98	21a	10:44	11:13	0:29	JC	DG	2	28	55	65	7	0	snd		30		veg type = cuc grass
21-Jul-98	21b	10:44	11:13	0:29	JC	DG	2		52	-7	0	0	rck	bld	100	lbk	
21-Jul-98	21b	10:44	11:13	0:29	JC	DG	2	21	55	52	2	0	snd		10		veg type = cuc grass
21-Jul-98	21b	10:44	11:13	0:29	JC	DG	2	28	65	55	9	2	snd		30		veg type = cuc grass
22-Jul-98	22a	8:43	9:17	0:34	MP	JR	2		24	29	0	0	snd	shl	30	lbk	
22-Jul-98	22a	8:43	9:17	0:34	MP	JR	2		29	55	5	4	shl	cbl	30	lbk	counter for length interval broke
22-Jul-98	22a	8:43	9:17	0:34	MP	JR	2	11	55	67	8	1	snd	shl	0		more geoducks deeper
22-Jul-98	22b	8:43	9:17	0:34	MP	JR	2		55	32	59	9	snd		0		heavy kelp bed below 35 feet

-continued-

Appendix G. (page 4 of 16)

Date	Transect no	Time in	Time out	Total time	Diver #1	Diver #2	Width	Length Interval	MLLW start	MLLW End	No. Geoducks	No. Horseclams	Bottom Type #1	Bottom Type #2	Percent Vegetative Cover	Predominate Vegetative Type #1	Comments
22-Jul-98	22b	8:43	9:17	0:34	MP	JR	2	12	67	55	14	9	snd		0		
21-Jul-98	23a	11:30	12:05	0:35	DG	MP	2	41	16	55	0	4	shl		30	lbk	24' edge of kelp start of transect
21-Jul-98	23a	11:30	12:05	0:35	DG	MP	2		55	63	0	0	shl		5	lbk	
21-Jul-98	23b	11:30	12:05	0:35	DG	MP	2		32	-8	0	0	rck		90	lbk	
21-Jul-98	23b	11:30	12:05	0:35	DG	MP	2	24	55	33	11	1	snd		30	lbk	the only geoducks seen were deep
21-Jul-98	23b	11:30	12:05	0:35	DG	MP	2	14	64	55	14	0	snd		40		veg = cuc grass
22-Jul-98	24a	9:40	10:11	0:31	JR	MP	2		30	47	0	0	snd	shl	40	lbk	
22-Jul-98	24a	9:40	10:11	0:31	JR	MP	2	18	47	55	11	3	snd	shl	10	lbk	
22-Jul-98	24a	9:40	10:11	0:31	JR	MP	2	19	55	69	30	0	snd		0		geoducks deeper, swam laterally consistent geoducks along contour
22-Jul-98	24b	9:40	10:11	0:31	JR	MP	2		30	46	0	0	snd	cbl	40	lbk	
22-Jul-98	24b	9:40	10:11	0:31	JR	MP	2	18	46	55	26	0	snd	gvl	50	lbk	
22-Jul-98	24b	9:40	10:11	0:31	JR	MP	2	19	55	69	25	0	snd	shl	5	lbk	
22-Jul-98	25a	10:33	10:57	0:24	DG	MP	2		-4	39	0	0	rck	bld	100	lbk	
22-Jul-98	25a	10:33	10:57	0:24	DG	MP	2		39	56	0	0	bld	shl	40	lbk	
22-Jul-98	25a	10:33	10:57	0:24	DG	MP	2		56	63	0	0	shl		20	lbk	
22-Jul-98	25a	10:33	10:57	0:24	DG	MP	2	3	63	66	1	0	shl		20	lbk	
22-Jul-98	25b	10:33	10:57	0:24	DG	MP	2		55	39	0	0	rck	bld			swam 65-70 feet- no ducks, swam to 56 49.517 135 28.201
22-Jul-98	25b	10:33	10:57	0:24	DG	MP	2		66	55	0	0	shl				
21-Jul-98	26a	15:28	16:04	0:36	RL	SM	2		-4	30	0	0	rck		90	lbk	
21-Jul-98	26a	15:28	16:04	0:36	RL	SM	2	18	26	26	0	18	snd		90	lbk	no urchins, approx. 15 cucs
21-Jul-98	26a	15:28	16:04	0:36	RL	SM	2		30	30							
21-Jul-98	26a	15:28	16:04	0:36	RL	SM	2	69	30	26	36	12	snd		90	lbk	
21-Jul-98	26b	15:28	16:04	0:36	RL	SM	2		-4	28	0	0	cbl	shl	100	lbk	
21-Jul-98	26b	15:28	16:04	0:36	RL	SM	2	18	26	26	14	12	snd	shl	90	lbk	gravel @ 30' on south shore
21-Jul-98	26b	15:28	16:04	0:36	RL	SM	2	69	28	26	26	18	shl	snd	90	lbk	
21-Jul-98	27a	16:30	16:51	0:21	JR	RL	2		43	39	0	0	shl	gvl			bottom turned to whole shells and gvl
21-Jul-98	27a	16:30	16:51	0:21	JR	RL	2	34	43	43	7	0	snd	shl	5	red	went half way to other island
21-Jul-98	27b	16:30	16:51	0:21	JR	RL	2		43	39	0	0	gvl	shl	40	lbk	
21-Jul-98	27b	16:30	16:51	0:21	JR	RL	2	34	43	43	4	0	snd	shl	15	red	went half way to other island
22-Jul-98	28a	13:22	13:42	0:20	JR	DG	2		34	47	0	0	rck	bld			transect stopped at 56 50.667, 135 29.512
22-Jul-98	28a	13:22	13:42	0:20	JR	DG	2		47	58	0	0	bld	cbl	20	lbk	
22-Jul-98	28a	13:22	13:42	0:20	JR	DG	2		58	64	0	0	cbl		18	lbk	
22-Jul-98	28b	13:22	13:42	0:20	JR	DG	2		58	54	0	0	rck				one geoduck off transect
22-Jul-98	28b	13:22	13:42	0:20	JR	DG	2		64	58	0	0	shl				
22-Jul-98	29a	13:28	13:42	0:14	JC	BL	2		-8	55	0	0	rck	bld	40	lbk	

-continued-

Date	Transect no	Time in	Time out	Total time	Diver #1	Diver #2	Width	Length Interval	MLLW start	MLLW End	No. Geoducks	No. Horseclams	Bottom Type #1	Bottom Type #2	Percent Vegetative Cover	Predominate Vegetative Type #1	Comments
22-Jul-98	29a	13:28	13:42	0:14	JC	BL	2		55	62	0	0	rck	bld	40	lbk	
22-Jul-98	29b	13:28	13:42	0:14	JC	BL	2		55	-8	0	0	rck	snd	40	lbk	
22-Jul-98	29b	13:28	13:42	0:14	JC	BL	2		62	55	0	0	snd	rck	5	lbk	
22-Jul-98	30a	11:28	11:39	0:11	BL	SM	2		37	55	0	0	rck	snd	30	lbk	0-43 cbl-20% lbk
22-Jul-98	30a	11:28	11:39	0:11	BL	SM	2		55	64	0	0	snd				
22-Jul-98	30b	11:28	11:39	0:11	BL	SM	2		37	55	0	0	snd	rck	10	agm	
22-Jul-98	30b	11:28	11:39	0:11	BL	SM	2		55	64	0	0	snd	rck			snd to 82, no clams
22-Jul-98	31a	10:42	10:57	0:15	JC	BL	2		-4	55	0	1	snd	rck	5	lbk	
22-Jul-98	31a	10:42	10:57	0:15	JC	BL	2		55	66	0	35	snd		5	lbk	
22-Jul-98	31b	10:42	10:57	0:15	JC	BL	2		-4	42	0	0	rck	snd	5	agm	
22-Jul-98	31b	10:42	10:57	0:15	JC	BL	2		42	55	0	0	rck	snd	5	agm	
22-Jul-98	31b	10:42	10:57	0:15	JC	BL	2		55	66	4	28	snd		5	agm	
19-Jul-98	32a	15:20	15:36	0:16	BD	JC	2		15	-3	1	0	snd		100	lbk	
19-Jul-98	32a	15:20	15:36	0:16	BD	JC	2	5	19	15	0	1	snd				
19-Jul-98	32a	15:20	15:36	0:16	BD	JC	2	5	24	19	2	4	snd				
19-Jul-98	32a	15:20	15:36	0:16	BD	JC	2	5	29	24	2	1	snd				
19-Jul-98	32a	15:20	15:36	0:16	BD	JC	2	5	34	29	8		snd				
19-Jul-98	32a	15:20	15:36	0:16	BD	JC	2	5	38	34	12		snd				
19-Jul-98	32a	15:20	15:36	0:16	BD	JC	2	5	42	38	7		snd				
19-Jul-98	32a	15:20	15:36	0:16	BD	JC	2	5	46	42	4		snd				
19-Jul-98	32a	15:20	15:36	0:16	BD	JC	2	5	51	46	1		snd				
19-Jul-98	32a	15:20	15:36	0:16	BD	JC	2	5	57	51	0		snd				
19-Jul-98	32a	15:20	15:36	0:16	BD	JC	2	5	61	57	1		bld	snd	2	lbk	
19-Jul-98	32b	15:20	15:36	0:16	BD	JC	2	5	24	20	1		snd		2	lbk	
19-Jul-98	32b	15:20	15:36	0:16	BD	JC	2	5	32	24	3		snd		2	lbk	
19-Jul-98	32b	15:20	15:36	0:16	BD	JC	2	5	36	32	6		snd		2	lbk	
19-Jul-98	32b	15:20	15:36	0:16	BD	JC	2	5	40	36	11		snd		2	lbk	
19-Jul-98	32b	15:20	15:36	0:16	BD	JC	2	5	42	40	12		snd		2	lbk	
19-Jul-98	32b	15:20	15:36	0:16	BD	JC	2	5	47	42	9		snd		2	lbk	
19-Jul-98	32b	15:20	15:36	0:16	BD	JC	2	5	54	47	4		snd		2	lbk	
19-Jul-98	32b	15:20	15:36	0:16	BD	JC	2	5	58	54	0		snd		2	lbk	
19-Jul-98	32b	15:20	15:36	0:16	BD	JC	2	5	61	58	0		snd		2	lbk	
19-Jul-98	33a	14:34	15:13	0:39	SM	JR	2		28	39	0	0	snd	shl	0		
19-Jul-98	33a	14:34	15:13	0:39	SM	JR	2	30	40	42	4	7	snd	shl	0		
19-Jul-98	33a	14:34	15:13	0:39	SM	JR	2	30	42	51	3	1	snd	shl	0		
19-Jul-98	33a	14:34	15:13	0:39	SM	JR	2	10	51	55	0	0	snd	shl	0		

-continued-

Appendix G. (page 6 of 16)

Date	Transect no	Time in	Time out	Total time	Diver #1	Diver #2	Width	Length Interval	MLLW start	MLLW End	No. Geoducks	No. Horseclams	Bottom Type #1	Bottom Type #2	Percent Vegetative Cover	Predominate Vegetative Type #1	Comments
19-Jul-98	33b	14:34	15:13	0:39	SM	JR	2	30	47	39	3	0	snd	shl	0		
19-Jul-98	33b	14:34	15:13	0:39	SM	JR	2	30	55	47	3	0	snd	shl	0		
18-Jul-98	34a	13:26	13:54	0:28	SM	MP	2		10	30	0	0	snd		90	lbk	
18-Jul-98	34a	13:26	13:54	0:28	SM	MP	2		30	55	0	0	snd		0		some geoducks deeper (80+ fsw)
18-Jul-98	34b	13:26	13:54	0:28	SM	MP	2	22	55	31	2	0	snd		0		2 geoducks at beginning (deep end) of transect w/nothing shallower, at 36 fsw transect went back into 90-100% lbk, ended transect
19-Jul-98	35a	13:59	14:44	0:45	RL	JC	2	23	21	28	36	16	snd	shl	80	lbk	
19-Jul-98	35a	13:59	14:44	0:45	RL	JC	2	30	28	32	2	0	gvl	cbl	50	lbk	
19-Jul-98	35a	13:59	14:44	0:45	RL	JC	2	30	32	33	0	0	cbl	gvl	30	lbk	
19-Jul-98	35a	13:59	14:44	0:45	RL	JC	2	30	33	34	0	0	gvl	cbl	60	lbk	
19-Jul-98	35a	13:59	14:44	0:45	RL	JC	2	54	34	42	0	0	rck	cbl	60	lbk	
19-Jul-98	35a	13:59	14:44	0:45	RL	JC	2	50	42	57	0	0	snd				
19-Jul-98	35b	13:59	14:44	0:45	RL	JC	2	83	21	33	22	1	gvl	snd	80	lbk	
19-Jul-98	35b	13:59	14:44	0:45	RL	JC	2	134	33	57	0	1	gvl	snd	80	lbk	
19-Jul-98	36a	11:36	11:51	0:15	RL	BD	2		-7	51	0	0	snd	mud			
19-Jul-98	36b	11:36	11:51	0:15	RL	BD	2		-7	55	0	0	snd	mud			
23-Jul-98	37a	15:37	15:55	0:18	BL	DG	2		-7	28	0	0	cbl	snd	70	lbk	
23-Jul-98	37a	15:37	15:55	0:18	BL	DG	2		28	57	0	0	gvl	snd	30	agm	
23-Jul-98	37a	15:37	15:55	0:18	BL	DG	2	10	57	63	6	0	snd				
23-Jul-98	37b	15:37	15:55	0:18	BL	DG	2		-7	28	0	0	rck				
23-Jul-98	37b	15:37	15:55	0:18	BL	DG	2		28	55	0	0	cbl	snd	20	lbk	
23-Jul-98	37b	15:37	15:55	0:18	BL	DG	2	10	55	63	3	0	snd				more geoducks deeper, fair densities
23-Jul-98	38a	10:48	11:21	0:33	MP	SM	2		19	33	0	0	snd		100	lbk	
23-Jul-98	38a	10:48	11:21	0:33	MP	SM	2	28	33	55	34	3	snd	cbl	40	lbk	
23-Jul-98	38a	10:48	11:21	0:33	MP	SM	2	12	55	67	24	1	snd		0		
23-Jul-98	38b	10:48	11:21	0:33	MP	SM	2	12	40	30	3	1	snd	shl	100	lbk	
23-Jul-98	38b	10:48	11:21	0:33	MP	SM	2	18	55	40	43	3	snd		0		
23-Jul-98	38b	10:48	11:21	0:33	MP	SM	2	13	67	55	29	2	snd		0		
23-Jul-98	39a	9:11	9:45	0:34	SM	JR	2		25	29	0	0	snd	cbl	90	lbk	
23-Jul-98	39a	9:11	9:45	0:34	SM	JR	2	21	29	47	14	12	snd	cbl	40	lbk	
23-Jul-98	39a	9:11	9:45	0:34	SM	JR	2	7	47	55	21	4	snd		5	lbk	
23-Jul-98	39a	9:11	9:45	0:34	SM	JR	2	14	55	70	11	5	snd		5	lbk	truncated clams throughout transect
23-Jul-98	39b	9:11	9:45	0:34	SM	JR	2	12	37	29	2	1	rck	snd	70	lbk	truncated clams throughout transect, sea cucs present
23-Jul-98	39b	9:11	9:45	0:34	SM	JR	2	17	55	37	16	4	snd	rck	60	lbk	
23-Jul-98	39b	9:11	9:45	0:34	SM	JR	2	17	70	55	24	2	snd		5	lbk	
23-Jul-98	40a	8:12	8:43	0:31	JC	JR	2		30	32	0	0	snd		50	lbk	

-continued-

Date	Transect no	Time in	Time out	Total time	Diver #1	Diver #2	Width	Length Interval	MLLW start	MLLW End	No. Geoducks	No. Horseclams	Bottom Type #1	Bottom Type #2	Percent Vegetative Cover	Predominate Vegetative Type #1	Comments
23-Jul-98	40a	8:12	8:43	0:31	JC	JR	2	30	32	49	9	1	snd		70	lbk	
23-Jul-98	40a	8:12	8:43	0:31	JC	JR	2	13	49	55	8	3	snd		70	lbk	sea cucs present on transect
23-Jul-98	40a	8:12	8:43	0:31	JC	JR	2	19	55	72	14	2	snd		20	lbk	geoducks below 70, truncated clams present throughout transect
23-Jul-98	40b	8:12	8:43	0:31	JC	JR	2		29	41	2	3	snd		50	lbk	cuc grass present
23-Jul-98	40b	8:12	8:43	0:31	JC	JR	2	30	41	51	1	0	snd		90	lbk	cuc grass present
23-Jul-98	40b	8:12	8:43	0:31	JC	JR	2	14	51	57	4	0	snd		70	lbk	cuc grass present
23-Jul-98	40b	8:12	8:43	0:31	JC	JR	2	17	57	72	3	1	snd		10	lbk	geoducks below 70
23-Jul-98	41a	16:21	16:43	0:22	MP	SM	2		29	-7	0	0	rck	bld	70	lbk	
23-Jul-98	41a	16:21	16:43	0:22	MP	SM	2		35	29	0	0	snd	bld			
23-Jul-98	41a	16:21	16:43	0:22	MP	SM	2		55	35	0	0	gvl	bld	90	lbk	
23-Jul-98	41b	16:21	16:43	0:22	MP	SM	2		35	-7	0	0	rck	snd		lbk	
23-Jul-98	41b	16:21	16:43	0:22	MP	SM	2		55	35	0	0	gvl	bld	90	lbk	
23-Jul-98	42a	15:29	15:48	0:19	JR	MP	2		35	41	0	0	rck	snd	40	lbk	
23-Jul-98	42a	15:29	15:48	0:19	JR	MP	2		41	55	0	0	rck		10	lbk	
23-Jul-98	42a	15:29	15:48	0:19	JR	MP	2		55	62	0	0	rck		10	lbk	
23-Jul-98	42b	15:29	15:48	0:19	JR	MP	2		41	35	0	0	rck	snd	40	lbk	
23-Jul-98	42b	15:29	15:48	0:19	JR	MP	2		55	41	0	0	rck		10	lbk	
23-Jul-98	42b	15:29	15:48	0:19	JR	MP	2		62	55	0	0	rck		10	lbk	
23-Jul-98	43a	14:54	15:05	0:11	SM	MP	2		28	55	0	0	rck		70	lbk	
23-Jul-98	43a	14:54	15:05	0:11	SM	MP	2		55	62	0	0	rck		60	lbk	no geoducks seen deeper
23-Jul-98	43b	14:54	15:05	0:11	SM	MP	2		55	22	0	0	rck		70	lbk	no geoducks deeper, rock
23-Jul-98	43b	14:54	15:05	0:11	SM	MP	2		62	55	0	0	rck		60	lbk	
23-Jul-98	44a	14:17	14:36	0:19	JR	MP	2		25	50	0	0	rck	snd	20	lbk	
23-Jul-98	44a	14:17	14:36	0:19	JR	MP	2		50	61	0	0	snd	rck	5	lbk	
23-Jul-98	44b	14:17	14:36	0:19	JR	MP	2	16	55	37	0	0	snd	rck			
23-Jul-98	44b	14:17	14:36	0:19	JR	MP	2	6	61	55	16	1	snd				
24-Jul-98	45a	13:58	14:35	0:37	MP	DG	2		-8	25			rck		100	ner	
24-Jul-98	45a	13:58	14:35	0:37	MP	DG	2		25	26			snd	shl	50	lbk	
24-Jul-98	45a	13:58	14:35	0:37	MP	DG	2	50	26	37	4		snd	shl	60	lbk	lots of horseclams
24-Jul-98	45a	13:58	14:35	0:37	MP	DG	2	47	37	54	36		snd	shl	40	lbk	some horseclams
24-Jul-98	45a	13:58	14:35	0:37	MP	DG	2	12	54	62	14		snd		20	lbk	cuc grass
24-Jul-98	45b	13:58	14:35	0:37	MP	DG	2		25	27			rck		100	lbk	
24-Jul-98	45b	13:58	14:35	0:37	MP	DG	2	50	27	37	5	37	snd		95	lbk	
24-Jul-98	45b	13:58	14:35	0:37	MP	DG	2	47	37	55	10	3	snd		20	lbk	
24-Jul-98	45b	13:58	14:35	0:37	MP	DG	2	12	55	62	5	1	snd		10	lbk	geoducks deeper
24-Jul-98	46a	14:52	15:17	0:25	MP	BL	2		27	36	0	0	rck	snd	60	lbk	

-continued-

Date	Transect no	Time in	Time out	Total time	Diver #1	Diver #2	Width	Length Interval	MLLW start	MLLW End	No. Geoducks	No. Horseclams	Bottom Type #1	Bottom Type #2	Percent Vegetative Cover	Predominate Vegetative Type #1	Comments
24-Jul-98	46a	14:52	15:17	0:25	MP	BL	2	50	36	49	12	5	cbl	shl	25	lbk	swam 1/2 way for data and then to 75 recon, no geoducks
24-Jul-98	46b	14:52	15:17	0:25	MP	BL	2	31	49	41	2	2	shl	rck	25	lbk	
24-Jul-98	47a	14:10	14:37	0:27	JR	JC	2		26	37	0	0	rck	cbl	70	lbk	diving on a site that was sampled (dug), silt everywhere, and a few holes
24-Jul-98	47a	14:10	14:37	0:27	JR	JC	2		37	56	14	0	snd		10	lbk	
24-Jul-98	47a	14:10	14:37	0:27	JR	JC	2	6	56	61	3	0	snd		10	lbk	1 dug, included in number
24-Jul-98	47a	14:10	14:37	0:27	JR	JC	2	9	61	68	3	11	snd		10	lbk	
24-Jul-98	47b	14:10	14:37	0:27	JR	JC	2	8	38	34	1	0	rck	snd	40	lbk	
24-Jul-98	47b	14:10	14:37	0:27	JR	JC	2	30	61	38	16	2	snd		5	lbk	1 dug, included in number
24-Jul-98	47b	14:10	14:37	0:27	JR	JC	2	11	68	61	2	0	snd		5	lbk	
24-Jul-98	48a	11:51	12:12	0:21	SM	JC	2		28	52	0	0	snd	rck	80	lbk	
24-Jul-98	48a	11:51	12:12	0:21	SM	JC	2	9	52	58	3	0	snd		10	grs	cucumber grass
24-Jul-98	48a	11:51	12:12	0:21	SM	JC	2	7	58	67	6	0	snd		5	grs	cucumber grass
24-Jul-98	48b	11:51	12:12	0:21	SM	JC	2		-3	29			rck		90	lbk	
24-Jul-98	48b	11:51	12:12	0:21	SM	JC	2		29	52		4	cbl	shl	60	lbk	
24-Jul-98	48b	11:51	12:12	0:21	SM	JC	2	9	52	60	4	3	snd	cbl	20	lbk	
24-Jul-98	48b	11:51	12:12	0:21	SM	JC	2	7	60	67	5	0	snd				
25-Jul-98	49a	11:25	12:08	0:43	JR	JC	2		37	33	20	6	rck		30	lbk	
25-Jul-98	49a	11:25	12:08	0:43	JR	JC	2	20	48	37	6	0	snd		15	lbk	
25-Jul-98	49a	11:25	12:08	0:43	JR	JC	2	30	49	48	30	0	snd		15	lbk	went halfway across channel
25-Jul-98	49b	11:25	12:08	0:43	JR	JC	2		41	45	10	0	snd		30	lbk	
25-Jul-98	49b	11:25	12:08	0:43	JR	JC	2		45	33	10	0	snd		40	lbk	went halfway across channel, measuring device broke, pencil broke
25-Jul-98	49b	11:25	12:08	0:43	JR	JC	2	44	47	41	20	0	snd		30	lbk	cuc grass
25-Jul-98	50a	12:53	13:16	0:23	BL	MP	2		30	38	0	0	bld	snd	90	lbk	
25-Jul-98	50a	12:53	13:16	0:23	BL	MP	2		38	50	0	2	snd		0		
25-Jul-98	50a	12:53	13:16	0:23	BL	MP	2		50	53	2	2	shl		0		
25-Jul-98	50a	12:53	13:16	0:23	BL	MP	2		53	62	0	0	shl		0		
25-Jul-98	50b	12:53	13:16	0:23	BL	MP	2		-7	28			bld	snd	30	lbk	
25-Jul-98	50b	12:53	13:16	0:23	BL	MP	2		28	38	0	0	snd	cbl	20	lbk	
25-Jul-98	50b	12:53	13:16	0:23	BL	MP	2	10	48	53	0	0	shl				
25-Jul-98	50b	12:53	13:16	0:23	BL	MP	2		58	63	0	0	shl				extended from west shore to west shore to rock in center of channel
25-Jul-98	51a	12:44	13:14	0:30	SM	JR	2	30	46	44	4	0	shl	wdy	5	lbk	went halfway across channel
25-Jul-98	51a	12:44	13:14	0:30	SM	JR	2	30	51	46	36	0	snd	shl	5	lbk	
25-Jul-98	51a	12:44	13:14	0:30	SM	JR	2	30	51	51	40	0	snd		5	lbk	
25-Jul-98	51b	12:44	13:14	0:30	SM	JR	2		44	-7	0	0	rck				rck wall from 51 to 0
25-Jul-98	51b	12:44	13:14	0:30	SM	JR	2	7	45	44	0	0	snd	shl	5	lbk	

-continued-

Appendix G. (page 9 of 16)

Date	Transect no	Time in	Time out	Total time	Diver #1	Diver #2	Width	Length Interval	MLLW start	MLLW End	No. Geoducks	No. Horseclams	Bottom Type #1	Bottom Type #2	Percent Vegetative Cover	Predominate Vegetative Type #1	Comments
25-Jul-98	51b	12:44	13:14	0:30	SM	JR	2	30	47	45	4	2	snd	shl	5	lbk	
25-Jul-98	51b	12:44	13:14	0:30	SM	JR	2	30	47	51	22	0	snd	shl	5	lbk	
25-Jul-98	51b	12:44	13:14	0:30	SM	JR	2	30	51	51	10	0	snd	shl	5	lbk	
06-Jun-99	52a	8:41	9:06	0:25	MP	DG	2		18	31	0	0	snd	cbl		mac	
06-Jun-99	52a	8:41	9:06	0:25	MP	DG	2		31	55	8	2	snd				
06-Jun-99	52a	8:41	9:06	0:25	MP	DG	2		55	67	1	0	snd				
06-Jun-99	52b	8:41	9:06	0:25	MP	DG	2		21	31	0	1	bld	snd		lam	thick kelp, rck/bld shallower than 21-24 fsw
06-Jun-99	52b	8:41	9:06	0:25	MP	DG	2		31	55	12	4	snd				
06-Jun-99	52b	8:41	9:06	0:25	MP	DG	2		55	67	6	0	snd				
06-Jun-99	53a	9:18	9:48	0:30	WB	DG	2		29	44	0	0	snd	shl			
06-Jun-99	53a	9:18	9:48	0:30	WB	DG	2		44	55	8	0	snd				
06-Jun-99	53a	9:18	9:48	0:30	WB	DG	2		55	68	10	0	snd				
06-Jun-99	53b	9:18	9:48	0:30	WB	DG	2		28	38	0	0	snd	shl			
06-Jun-99	53b	9:18	9:48	0:30	WB	DG	2		38	55	8	0	snd				
06-Jun-99	53b	9:18	9:48	0:30	WB	DG	2		55	68	14	1	snd				
06-Jun-99	54a	10:08	10:33	0:25	WB	MP	2		34	43	0	0	bld				
06-Jun-99	54a	10:08	10:33	0:25	WB	MP	2		43	49	11	0	snd				
06-Jun-99	54a	10:08	10:33	0:25	WB	MP	2		49	55	4	0	snd				
06-Jun-99	54a	10:08	10:33	0:25	WB	MP	2		55	69	13	0	snd				
06-Jun-99	54b	10:08	10:33	0:25	WB	MP	2		35	43	0	0	bld				
06-Jun-99	54b	10:08	10:33	0:25	WB	MP	2		43	55	5	0	snd				
06-Jun-99	54b	10:08	10:33	0:25	WB	MP	2		55	69	6	0	snd				
06-Jun-99	56a	10:52	11:19	0:27	MP	DG	2		12	44	0	6	gvl	snd	100	lam	
06-Jun-99	56a	10:52	11:19	0:27	MP	DG	2		44	60	24	5	snd				
06-Jun-99	56a	10:52	11:19	0:27	MP	DG	2		60	70	4	0	snd				
06-Jun-99	56b	10:52	11:19	0:27	MP	DG	2		29	55	24	17	snd	gvl			gvl/snd <29fsw
06-Jun-99	56b	10:52	11:19	0:27	MP	DG	2		55	70	2	0	snd	shl			
06-Jun-99	57a	14:13	14:50	0:37	RL	JR	2		36	55	18	8	snd	cbl	10	lbk	
06-Jun-99	57a	14:13	14:50	0:37	RL	JR	2		55	67	0	0	snd	cbl			
06-Jun-99	57b	14:13	14:50	0:37	RL	JR	2		37	55	16	9					
06-Jun-99	57b	14:13	14:50	0:37	RL	JR	2		55	67	0	0					
06-Jun-99	58a	8:34	8:51	0:17	SW	JR	2		-3	55	0	0	snd				
06-Jun-99	58a	8:34	8:51	0:17	SW	JR	2		55	67	0	0	snd				
06-Jun-99	58b	8:34	8:51	0:17	SW	JR	2		30	55	4	0					
06-Jun-99	58b	8:34	8:51	0:17	SW	JR	2		55	67	0	0					
06-Jun-99	59a	9:40	10:04	0:24	RL	JR	2		39	55	25	0					false geoducks present

-continued-

Appendix G. (page 10 of 16)

Date	Transect no	Time in	Time out	Total time	Diver #1	Diver #2	Width	Length Interval	MLLW start	MLLW End	No. Geoducks	No. Horseclams	Bottom Type #1	Bottom Type #2	Percent Vegetative Cover	Predominate Vegetative Type #1	Comments
06-Jun-99	59a	9:40	10:04	0:24	RL	JR	2		55	70	1	0					
06-Jun-99	59b	9:40	10:04	0:24	RL	JR	2		30	55	10	0					
06-Jun-99	59b	9:40	10:04	0:24	RL	JR	2		55	70	9	0					4 false geoducks
06-Jun-99	60a	10:40	11:07	0:27	JR	SW	2		20	50	17	2	snd	cbl			
06-Jun-99	60a	10:40	11:07	0:27	JR	SW	2		50	70	9	0					3 false geoducks
06-Jun-99	60b	10:40	11:07	0:27	JR	SW	2		14	50	8	12	snd	cbl			3 false geoducks
06-Jun-99	60b	10:40	11:07	0:27	JR	SW	2		50	70	13	1					
06-Jun-99	61a	11:21	11:51	0:30	RL	SW	2		51	55	7	2	snd	shl	10	lbk	
06-Jun-99	61a	11:21	11:51	0:30	RL	SW	2		55	70	8	3					
06-Jun-99	61b	11:21	11:51	0:30	RL	SW	2		43	46	7	12	gvl	shl			
06-Jun-99	61b	11:21	11:51	0:30	RL	SW	2		46	55	12	5					
06-Jun-99	61b	11:21	11:51	0:30	RL	SW	2		55	70	14	8					
06-Jun-99	62a	13:58	14:28	0:30	DG	WB	2		12	42	0	0	rck	bld			
06-Jun-99	62a	13:58	14:28	0:30	DG	WB	2		42	51	0	0	cbl				
06-Jun-99	62a	13:58	14:28	0:30	DG	WB	2		51	55	0	0	cbl				went south 100m to start side-B->poor substrate between sides w/no geoducks, gvl/snd
06-Jun-99	62b	13:58	14:28	0:30	DG	WB	2		37	47	48	2	cbl				
06-Jun-99	62b	13:58	14:28	0:30	DG	WB	2		47	55	0	0					called up before going into cove, good #'s ducks when called up but was headed into an area covered by another transect due to large distance between sides a & b
06-Jun-99	64a	14:47	15:04	0:17	MP	WB	2		31	55	0	0	cbl	snd			started at edge of kelp
06-Jun-99	64a	14:47	15:04	0:17	MP	WB	2		55	65	0	0	snd	gvl			
06-Jun-99	64b	14:47	15:04	0:17	MP	WB	2		42	55	0	0	bld	snd	20	agm	
06-Jun-99	64b	14:47	15:04	0:17	MP	WB	2		55	65	0	0					
06-Jun-99	65a	16:20	16:50	0:30	MP	WB	2		42	55	51		snd	gvl			5 meters of light white snad and good ducks, didn't go past target depth-would have run out of air before finishing side B
06-Jun-99	65b	16:20	16:50	0:30	MP	WB	2		38	56	79		snd	gvl			5 m of light white snd w/ducks (e.g. ducks throughout but mostly in shallow 'white sand'
06-Jun-99	67a	15:32	15:57	0:25	SW	JR	2		20	55	0	0	bld	rck		mac	
06-Jun-99	67a	15:32	15:57	0:25	SW	JR	2		55	65	0	0	cbl	rck		lam	
06-Jun-99	67b	15:32	15:57	0:25	SW	JR	2		30	55	0	0	cbl	rck		lam	
06-Jun-99	67b	15:32	15:57	0:25	SW	JR	2		55	65	0	0	cbl	rck		lam	
06-Jun-99	68a	16:18	16:53	0:35	RL	SW	2		24	55	7	7	gvl	cbl	30	red	horse clams present
06-Jun-99	68a	16:18	16:53	0:35	RL	SW	2		55	64	7	0					changes to sand at 65'
06-Jun-99	68b	16:18	16:53	0:35	RL	SW	2		34	54	34	4	snd	shl			no veg.
06-Jun-99	68b	16:18	16:53	0:35	RL	SW	2		54	64	6	0					
06-Jun-99	69a	8:10	8:46	0:36	JR	WB	2		25	33	0	0	snd	cbl			
06-Jun-99	69a	8:10	8:46	0:36	JR	WB	2		33	37	0	0	gvl				

-continued-

Appendix G. (page 11 of 16)

Date	Transect no	Time in	Time out	Total time	Diver #1	Diver #2	Width	Length Interval	MLLW start	MLLW End	No. Geoducks	No. Horseclams	Bottom Type #1	Bottom Type #2	Percent Vegetative Cover	Predominate Vegetative Type #1	Comments
06-Jun-99	69a	8:10	8:46	0:36	JR	WB	2		37	57	22	0	snd				
06-Jun-99	69a	8:10	8:46	0:36	JR	WB	2		57	68	3	0	snd				
06-Jun-99	69b	8:10	8:46	0:36	JR	WB	2		28	38	1	0					
06-Jun-99	69b	8:10	8:46	0:36	JR	WB	2		38	57	15	0					
06-Jun-99	69b	8:10	8:46	0:36	JR	WB	2		57	68	0	0					
06-Jun-99	70a	8:13	8:39	0:26	RL	BD	2		11	34	0	0	snd		90	lbk	
06-Jun-99	70a	8:13	8:39	0:26	RL	BD	2		34	55	17	0	snd				
06-Jun-99	70a	8:13	8:39	0:26	RL	BD	2		55	66	4	0	snd	mud			
06-Jun-99	70b	8:13	8:39	0:26	RL	BD	2		11	31	0	0	rck		100	lam	
06-Jun-99	70b	8:13	8:39	0:26	RL	BD	2		31	55	10	0	gvl	shl	10	lam	
06-Jun-99	70b	8:13	8:39	0:26	RL	BD	2		55	66	3	0	snd	mud			
06-Jun-99	71a	9:10	9:40	0:30	JR	WB	2		19	33	0	0					
06-Jun-99	71a	9:10	9:40	0:30	JR	WB	2		33	55	11	0					
06-Jun-99	71a	9:10	9:40	0:30	JR	WB	2		55	68	3	0					
06-Jun-99	71b	9:10	9:40	0:30	JR	WB	2		26	55	5	4	snd	gvl			
06-Jun-99	71b	9:10	9:40	0:30	JR	WB	2		55	68	9	2					
06-Jun-99	72a	8:57	9:29	0:32	MP	BD	2		18	45	0	0	rck	bld	100	lam	at end of dive, went back to 40-45fsw and swam towards inside of bay to exam extent of 'bed', there was no extend, we had swam up (side B) over a patch, or the bed went to the outside (between sides a & b)
06-Jun-99	72a	8:57	9:29	0:32	MP	BD	2		45	60	4	0	snd	shl	0		
06-Jun-99	72a	8:57	9:29	0:32	MP	BD	2		60	68	8	0	snd	shl	0		
06-Jun-99	72b	8:57	9:29	0:32	MP	BD	2		32	46	25	0	snd				
06-Jun-99	72b	8:57	9:29	0:32	MP	BD	2		46	55	0	0	cbl	snd	50	lam	
06-Jun-99	72b	8:57	9:29	0:32	MP	BD	2		55	68	2	0	cbl	snd	50	lam	bottom was cbl, gvl, sand-->would be very hard to dig

Appendix G. (12 of 16)

Goddard Transect Summary

Transect No.	Total Count (sides A & B combined)	Meters (i.e. Side A & B, 2 m each)	Weight	Average per meter	Weighted Count (per m)	Weighted Variance	Shoreline per Transect (m)	Geoducks (per Weighted Shoreline Section)	Cumulative Count
1	102	4	1.0000	25.50	0.71	5.9161257	620	15,813	15,813
2	6	4	1.0000	1.50	0.04	2.5027362	620	930	16,744
3	1	4	1.0000	0.25	0.01	3.2079770	620	155	16,899
4	1	4	0.7500	0.25	0.01	2.4059827	465	116	17,015
5	8	4	0.7500	2.00	0.04	1.6838397	465	930	17,945
6	2	4	0.7500	0.50	0.01	2.2949509	465	233	18,178
7	7	4	0.5625	1.75	0.03	1.3343509	349	610	18,788
8	0	4	0.5625	-	-	1.8897280	349	-	18,788
9	5	4	0.5000	1.25	0.02	1.3183950	310	388	19,176
10	364	4	0.3750	91.00	0.95	67.2148232	233	21,162	40,338
11	0	4	0.2109	-	-	0.7086480	131	-	40,338
12	40	4	0.5625	10.00	0.16	0.0144483	349	3,488	43,826
13	8	4	1.0000	2.00	0.06	2.2451196	620	1,240	45,066
14	70	6	0.7500	11.67	0.24	0.0105323	465	5,426	50,493
15	70	4	0.5000	17.50	0.24	0.5986418	310	5,426	55,919
16	4	4	0.2344	1.00	0.01	0.6502362	145	145	56,064
17	228	4	0.4167	57.00	0.66	24.7111868	258	14,728	70,792
18	55	4	0.5000	13.75	0.19	0.1090296	310	4,263	75,056
19	51	4	0.5000	12.75	0.18	0.0449116	310	3,953	79,009
20	214	4	0.3750	53.50	0.56	18.9873029	233	12,441	91,451
21	18	4	0.4167	4.50	0.05	0.4861933	258	1,163	92,613
22	86	4	0.4167	21.50	0.25	1.2954475	258	5,555	98,169
23	25	4	0.7500	6.25	0.13	0.4651225	465	2,907	101,076
24	92	4	1.0000	23.00	0.64	4.0568049	620	14,263	115,339
25	1	4	0.7500	0.25	0.01	2.4059827	465	116	115,455
26	76	4	0.5625	19.00	0.30	1.0177265	349	6,628	122,083
27	11	4	0.7500	2.75	0.06	1.4136924	465	1,279	123,362
28	0	4	0.7500	-	-	2.5196373	465	-	123,362
29	0	4	0.7500	-	-	2.5196373	465	-	123,362
30	0	4	0.6667	-	-	2.2396776	413	-	123,362
31	4	4	0.6667	1.00	0.02	1.8495608	413	413	123,775
32	84	4	1.0000	21.00	0.59	2.8211405	620	13,023	136,798
33	13	4	0.6667	3.25	0.06	1.1081852	413	1,344	138,142
34	2	4	0.5000	0.50	0.01	1.5299673	310	155	138,297
35	60	4	0.7500	15.00	0.31	0.3427796	465	6,977	145,273
36	0	4	0.5000	-	-	1.6797582	310	-	145,273
37	9	4	0.3333	2.25	0.02	0.7071857	207	465	124,240
38	133	4	0.5000	33.25	0.47	6.9512184	310	10,310	134,550
39	88	4	0.5000	22.00	0.31	1.7054979	310	6,822	141,372
40	41	4	0.3750	10.25	0.11	0.0052616	233	2,384	143,755
41	0	4	0.5000	-	-	1.6797582	310	-	143,755
42	0	4	0.3333	-	-	1.1198388	207	-	143,755

-continued-

Appendix G. (page 13 of 16)

Transect No.	Total Count (sides A & B combined)	Meters (i.e. Side A & B, 2 m each)	Weight	Average per meter	Weighted Count (per m)	Weighted Variance	Shoreline per Transect (m)	Geoducks (per Weighted Shoreline Section)	Cumulative Count
43	0	4	0.5000	-	-	1.6797582	310	-	143,755
44	16	4	0.3333	4.00	0.04	0.4515127	207	827	144,582
45	74	4	0.2500	18.50	0.13	0.3978251	155	2,868	147,450
46	14	4	0.3750	3.50	0.04	0.5835753	233	814	148,264
47	39	4	0.5000	9.75	0.14	0.0204190	310	3,023	151,287
48	18	4	0.2813	4.50	0.04	0.3281805	174	785	152,072
49	96	4	0.5000	24.00	0.34	2.3792839	310	7,442	159,514
50	2	4	0.5000	0.50	0.01	1.5299673	310	155	159,669
51	116	4	0.5000	29.00	0.41	4.5533451	310	8,992	168,661
52	27	4	0.5000	6.75	0.09	0.2477186	310	2,093	170,754
53	40	4	0.5000	10.00	0.14	0.0128429	310	3,101	173,855
54	39	4	0.3750	9.75	0.10	0.0153142	233	2,267	176,122
55		4	Transect Not Surveyed						176,122
56	54	4	0.0313	13.50	0.01	0.0056486	19	262	176,384
57	34	4	0.2813	8.50	0.07	0.0475466	174	1,483	177,866
58	4	4	0.1953	1.00	0.01	0.5418635	121	121	177,987
59	45	4	0.2813	11.25	0.09	0.0006701	174	1,962	179,949
60	47	4	0.2292	11.75	0.08	0.0040198	142	1,670	181,619
61	48	4	0.1615	12.00	0.05	0.0049028	100	1,202	182,821
62	48	4	0.2500	12.00	0.08	0.0075915	155	1,860	184,681
63		4	Transect Not Surveyed						184,681
64	0	4	0.5000	-	-	1.6797582	310	-	184,681
65	130	4	0.4375	32.50	0.40	5.6799265	271	8,818	193,499
66	229	4	0.5000	57.25	0.80	29.9763255	310	17,751	211,250
67	0	4	0.3333	-	-	1.1198387	207	-	211,250
68	54	4	0.3333	13.50	0.13	0.0602515	207	2,791	214,041
69	41	4	0.3333	10.25	0.10	0.0046770	207	2,119	216,160
70	34	4	0.5000	8.50	0.12	0.0845274	310	2,636	218,795
71	28	4	0.3333	7.00	0.07	0.1461066	207	1,447	220,242
72	39	4	0.1917	9.75	0.05	0.0078273	119	1,159	221,401

Goddard geoduck survey biomass estimate and guideline harvest level.

Number of Transects	70
Average per Linear Meter	10.96
Variance of Counts	236
Std. Variance of Mean	3.37
Shoreline (meters)	22,166
Total Number of Geoducks	242,899
Variance of Total Number	1,656,076,335
Precision of Estimate	78.3%
90% Coefficient of Variation	27.9%
90% Two-Tail Precision	72.1%
Average Weight (lb)	3.05
Variance of Average Weight	0.01853951
Biomass Estimate	740,113
Variance of Biomass Est.	16,438,485,995
Precision of Estimate	77.5846%
90% Coefficient of Variation	28.9%
90% Two-Tail Precision	71.1%
Lower Bounds Biomass Est.	526,352
Upper Bounds Biomass Est.	953,874
90% of being within 66.7% Adjustment (for info only, adjustment not used)	116.3%
Show Factor Adjustment	0.75
Target Harvest Rate	2%
Quota Without Precision Adjustment	19,736

Appendix G. (page 15 of 16)

Goddard transect latitude and longitude.

Transect No.	Latitude	Longitude
1	56.766850	-135.354733
2	56.770900	-135.354500
3	56.783433	-135.386283
4	56.810267	-135.416200
5	56.817250	-135.414400
6	56.810833	-135.420783
7	56.814750	-135.419517
8	56.805417	-135.440017
9	56.810433	-135.437917
10	56.809733	-135.441483
11	56.839350	-135.392467
12	56.845200	-135.383733
13	56.845283	-135.379667
14	56.851383	-135.384583
15	56.838833	-135.424033
16	56.844950	-135.427300
17	56.817317	-135.448983
18	56.822367	-135.446850
19	56.827250	-135.443167
20	56.833450	-135.443533
21	56.836433	-135.449783
22	56.826500	-135.460683
23	56.831383	-135.457367
24	56.823700	-135.473133
25	56.827383	-135.468350
26	56.832050	-135.466933
26	56.832050	-135.466933
27	56.831200	-135.483650
28	56.845350	-135.492183
29	56.850383	-135.488833
30	56.847150	-135.506350
31	56.857683	-135.501667
32	56.906333	-135.382367
33	56.907100	-135.397017
34	56.911450	-135.400333
35	56.915133	-135.395217
36	56.921883	-135.403417
37	56.815783	-135.450883
38	56.819800	-135.448217
39	56.825033	-135.444517
40	56.829400	-135.440933

-continued-

Appendix G. (page 16 of 16)

Transect No.	Latitude	Longitude
41	56.834933	-135.444600
42	56.834100	-135.456233
43	56.829600	-135.460983
44	56.825667	-135.461417
45	56.844500	-135.432650
46	56.846183	-135.424017
47	56.851883	-135.387083
48	56.845000	-135.393033
49	56.808350	-135.442383
50	56.806667	-135.442350
51	56.807617	-135.440533
52	56.812817	-135.415350
53	56.811650	-135.420483
54	56.808267	-135.436617
56	56.830367	-135.408033
57	56.831617	-135.424400
58	56.841333	-135.393567
59	56.841333	-135.393567
60	56.845617	-135.426083
61	56.844500	-135.430050
62	56.834933	-135.440150
64	56.828767	-135.468367
65	56.833333	-135.472550
66	56.849583	-135.492620
67	56.848017	-135.506867
68	56.849633	-135.506750
69	56.907483	-135.398500
70	56.918917	-135.402000
71	56.910217	-135.398917
72	56.913117	-135.396183

Appendix H. Guideline harvest level calculations for Vallenar Bay for the 1999-2000 season.

On two occasions attempts to survey Vallenar Bay were aborted due to severe weather (safety concerns) and the lack of geoduck shows (again, probably due to weather). Recent surveys on west Gravina Island indicated original non-fished biomass may have been less than originally estimated. Consequently, the original data was re-examined prior to the fishery.

The original 1987 department survey data for Vallenar Bay (and all West Gravina Island geoduck fisheries) is available in the form of:

1) a memo to P. Larson from T. Koeneman dated September 24, 1987, and
2) two USGS Survey charts (Ketchikan A-6 and B6 Quadrangles).

Density Estimate

Original density estimate for Vallenar Bay (and all of W. Gravina Island) was 6.12 geoducks per square meter. This value is the average of four transects from the west side of Gravina of which only one transect was from Vallenar Bay (5.9 / m^2). Data from three additional transects within Vallenar Bay are on the USGS maps but no notes exist as to why these data were not used. All four density estimates that are associated with Vallenar Bay were used for the revised non-fished biomass estimate.

Weight

The original weight used for all of West Gravina Island was 2.5 lb. The average weight from Vallenar Bay samples in 1987 was 1.98 lb. Averaging all currently available data from Vallenar Bay, including the 1987 data and that weight data collected during the commercial fishery, equals 2.02 lb per geoduck clam.

Shoreline (Bed) Length

Original shoreline used was 1.5 statute miles (sm). From the original map, I could only measure 1.0 sm from the "main bed." An additional 0.2 sm representing three very small beds occurs near the head of the bay, but according to recent conversations with industry divers, no one fishes there. These three small beds are not included in the recalculation.

Bed Width and Area

Each density estimate transect (above) included a bed width estimate. The shoreline length (above) was proportioned according to these four width estimates to estimate area.

Non-fished Biomass Estimate

Using the above conditions:

1 statute mile = 1.6093 km

1,609 meters / 4 transects = 402 m per transect

402 m * 51 m transect width = 20,502 m^2 * 4.14 avg density = 84,878 geoducks
402 m * 29 m transect width = 11,658 m^2 * 1.28 avg density = 14,922 geoducks
402 m * 51 m transect width = 20,502 m^2 * 5.84 avg density = 119,732 geoducks
402 m * 50 m transect width = 20,100 m^2 * 5.90 avg density = 118,590 geoducks

Total geoducks = 338,122 * 2.02 lb = **683,006 lb non-fished biomass** * 0.08 harvest rate = 54,640 lb GHL.

Announced GHL was 54,640 pounds. No show factor was included in the GHL due to the already uncertain nature of the biomass estimate. Also, in the memo mentioned above, industry divers present during the 1987 survey thought that all the geoducks were showing and no show factor should be used.

During the 2000 survey season, 14 transects were completed in Vallenar Bay. Though additional transects remain to be completed, this preliminary data indicates a current (June 2000) standing stock of 252,796 pounds of geoducks (details of this survey will be presented in a subsequent RIR). Vallenar Bay has been open for the 1987-88, 1991-92, 1995-96, and 1999-2000 seasons for a combined harvest of 423,069 pounds. Combining the June 2000 survey estimate with the known, previously harvested poundage, yields a non-fished biomass estimate of 675,865 pounds. This agrees favorably with the estimate above, used to calculate the 1999-2000 season's GHL.

The Alaska Department of Fish and Game administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility, or if you desire further information please write to ADF&G, P.O. Box 25526, Juneau, AK 99802-5526; U.S. Fish and Wildlife Service, 4040 N. Fairfield Drive, Suite 300, Arlington, VA 22203; or O.E.O., U.S. Department of the Interior, Washington DC 20240.

For information on alternative formats for this and other department publications, please contact the department ADA Coordinator at (voice) 907-465-4120, (TDD) 907-465-3646, or (FAX) 907-465-2440.