ENVIRONMENTAL ASSESSMENT OF PROPOSED GEODUCK HARVEST ALONG THE NORTHEAST SHORELINE OF HOOD CANAL AT THE POINT JULIA GEODUCK TRACT (#20020)

Commercial geoduck harvest is jointly managed by the Washington Departments of Fish and Wildlife (WDFW) and Natural Resources (DNR) and is coordinated with treaty tribes through harvest management plans. Harvest is conducted by divers from subtidal beds between the -18 foot and -70 foot water depth contours (corrected to mean lower low water, hereafter MLLW). Harvest is rotated throughout Puget Sound in six geoduck management regions. The fishery, its management, and its environmental impacts are presented in the Puget Sound Commercial Geoduck Fishery Management Plan (DNR & WDFW, 2008) and the Final Supplemental Environmental Impact Statement (WDFW & DNR, 2001). The proposed continued harvest along the northeast shoreline of Hood Canal is described below.

Proposed Harvest Years: 2022-2023

Tract name: Point Julia geoduck tract (Tract #20020)

Description: (Figure 1, Tract vicinity map)

The Point Julia geoduck tract is a subtidal area of approximately 82 acres (Table 1) along the northeast shoreline of Hood Canal in the Hood Canal Geoduck Management Region.

The Point Julia tract is bounded by a line projected northerly from a point on the -25 foot (MLLW) water depth contour at 47°51.529’ N. latitude, 122°35.745 W. longitude (CP 1) to a point on the -70 foot (MLLW) water depth contour at 47°51.633’ N. latitude, 122°35.746’ W. longitude (CP 2); then northeast along the -70 foot (MLLW) water depth contour to a point at 47°51.877’ N. latitude, 122°35.128’ W. longitude (CP 3); then easterly to a point on the -25 foot (MLLW) water depth contour at 47°51.877’ N. latitude, 122°34.579’ W. longitude (CP 4); then southerly along the -25 foot (MLLW) water depth contour to a point at 47°51.355’ N. latitude, 122°34.649’ W. longitude (CP 5), then westerly to a point on the -25 foot (MLLW) water depth contour at 47°51.354’ N. latitude, 122°34.704’ W. longitude (CP 6), then along the -25 foot (MLLW) water depth contour to the point of origin (Figure 2). These latitude and longitude positons are in WGS84 datum.

This estimate of the tract boundary was made using bathymetry data from the National Oceanic and Atmospheric Administration (NOAA), WDFW geoduck surveys, and information provided by the Washington Department of Health (DOH). All contours are corrected to MLLW. Contour GIS layers from Dale Gombert (WDFW) were generated from NOAA soundings. Shoreline data was from DNR, digitized at 1:24000 scale in 1999. The -70 ft. (MLLW) water depth contour was used for the deep-water boundary, and the -25 ft. contour was used for the shallow boundary due to herring spawning habitat along the shoreline of this tract. The tract boundary latitude and longitude positions are reported in decimal minutes to the closest thousandths of a minute. Corner latitude and longitude positions were generated using GIS, and have not been field verified to determine consistency with area estimates, landmark alignments, or water depth contours.

The delineation of the tract boundary will be field verified by DNR prior to any geoduck harvest. Any variance to the stated boundary will be coordinated between WDFW and DNR prior to geoduck harvest.

Substrate:

Geoducks are found in a wide variety of sediments ranging from soft mud to gravel. The most common sediments where geoducks are harvested are sand with varying amounts of mud and/or gravel. The specific sediment type of a bed is primarily determined by water current velocity. Coarse sediments are generally found in areas of fast currents and finer (muddier) sediments in areas of weak currents. The major impact of harvest will be the creation of small holes where the geoducks are removed. The holes fill in within a few days to several weeks and have no long-term effects. The substrate holes refill in areas with strong water currents much faster than in areas with weak water currents. Water currents tend to be moderate in the vicinity of the Point Julia tract. In the upcoming year, currents will reach a predicted maximum flood velocity of 2.2 knots and maximum ebb velocity of 1.3 knots (Tides and Currents software; station #1576; Port Gamble Bay entrance).

Sub-surface substrates were observed to be predominantly sand (Table 2). The surface substrates within this tract are primarily sand, which was predominant on all 30 transects (Table 3).

Water Quality:

Water mixing at this tract is affected by the convergence of currents from the central basin of Puget Sound, Hood Canal, and Admiralty Inlet. This convergence prevents stratification (water layering) and brings deeper nutrient-rich waters to the surface. As a result, the marine waters in this area are well oxygenated and productive. The following data on water quality has been provided by the Washington Department of Ecology

(DOE) for Puget Sound for the Port Gamble station (PGA001) at 47.8400° N. latitude; 122.5800° W. longitude. The DOE latitude and longitude positions are recorded in decimal degrees. Between 1997 and 2001 (last year of data available at this location), at a water depth of 10 meters (33 ft.), the range of dissolved oxygen concentration was 5.6 mg/l to 12.0 mg/l. The range of salinity at this station and depth was 27.7 ppt. to 30.1 ppt. The range of water temperature at this station was 8.59° C to 14.38° C.

This geoduck tract is classified as “Approved” by DOH.

Biota:

Geoduck:

The Point Julia geoduck tract is approximately 82 acres. The abundance of geoducks on this tract is high, with a current estimated average density of 0.42 geoducks/sq.ft. This tract currently contains an estimated 2,721,022 pounds of geoducks (Table 1). Digging was noted as “moderately difficult” during the 2021 NRC pre-fishing survey.

The average density from the 2021 pre-fishing survey ranged from 0.05 geoducks/sq.ft. on transect #42 and 0.69 geoducks/sq.ft. on transect #13 (Table 3, Figure 3). The geoducks at the Point Julia tract are small, averaging 1.8 pounds (Table 4), while the average geoduck in Puget Sound is 2.1 pounds. The lowest average whole weight was 1.36 pounds per geoduck at dig station #4 and the highest average whole weight was 2.70 pounds per geoduck at dig station #2 (Table 4). Transect locations, and geoduck counts corrected with siphon “show factors”, are listed in Table 5.

The Point Julia geoduck tract was surveyed by Hart Crowser in 2014 as two separate tracts: Port Gamble Polluted and Point Julia. Ten supplemental transects and an eelgrass survey were conducted by WDFW in 2018 to establish information for this report. The tracts were combined as Point Julia and surveyed again in 2021 by NRC. The results of the 2018 and 2021 survey work were used in the preparation of this environmental assessment.

Geoducks are managed for long term sustainable harvest. No more than 2.7% of the fishable stocks are harvested (total fishing mortality) each year in each management region throughout Puget Sound. The fishable portion of the total Puget Sound population includes geoducks that are found in water deeper than -18 feet and shallower than -70 feet (corrected to mean lower low water (MLLW)). Other geoducks which are not harvestable are found inshore and offshore of the harvest areas. Observations in south Puget Sound show that major geoduck populations continue to depths of 360 feet.

Additional geoducks exist in polluted areas and are also unavailable for harvest, but continue to spawn and contribute to the total population.

The low rate of harvest is due to geoduck's low rate of natural recruitment. WDFW has studied the regeneration rate of geoducks on certain tracts throughout the Salish Sea. The estimated average time to regenerate a tract to its original density, after removal of 65 percent of the geoducks, is 55 years. The recovery time for the Point Julia tract is unknown. The research to empirically analyze tract recovery rates is continuing.

Fish:

Geoduck beds are generally devoid of rocky outcroppings and other relief features that attract and support many fish species, such as rockfish and lingcod. On geoduck tracts, the bathymetry is typically relatively flat and the substrate is typically composed of soft sediments, which provide few attachments for macroalgae associated with rockfish and lingcod. The fish observed during the 2018 supplemental survey at the Point Julia geoduck tract were various flatfish, sculpins, snake prickleback, tubesnout, white spotted greenling, and skate egg cases (Table 6).

WDFW marine fish managers were asked of their concerns of any possible impacts on groundfish and baitfish that geoduck fishing would have. Greg Bargmann of WDFW stated that geoduck fishing would have no long-term detrimental impacts and may have some short-term benefits to flatfish populations by increasing the availability of food. Dan Penttila of the WDFW Fish Management Program recommended that eelgrass beds within the harvest tract should be preserved for any spawning herring.

There are Pacific herring spawning grounds along the northeastern shoreline of Hood Canal in the vicinity of the Point Julia tract (1996 Washington State Baitfish Stock Status Report, Figure 4). Additionally, a pre-spawner holding area is located outside of Port Gamble Bay (Figure 4). The Port Gamble stock is considered the second largest spawning stock in Washington (1996 Washington State Baitfish Stock Status Report). Along the shorelines in the vicinity of the Point Julia tract, herring spawning timing is reported to occur between January 15 through April 15. During the herring spawning period, geoduck harvesting will occur between the -35 foot (MLLW) and -70 foot (MLLW) water depth contours. Based on a year-round nearshore tract boundary of -25 feet (MLLW), and a deeper nearshore tract boundary of -35 feet (MLLW) during the herring spawning season, geoduck fishing on the Point Julia tract should have no detrimental impacts on herring.

Surf smelt spawning habitat has been identified in the vicinity of the Point Julia geoduck tract (Figure 4). Surf smelt deposit adhesive, semi-transparent eggs on beaches that have a specific mixture of coarse sand and pea gravel. Inside Puget Sound, surf smelt spawning is thought to be associated with freshwater seepage, where the water keeps the spawning gravel moist. Eggs are deposited in water a few inches deep, around the time of the high water slack tide. There is substantial vertical separation between surf smelt spawning (slack high tide) and geoduck harvest activity (-25 feet to -70 feet, MLLW on the Point Julia tract).

Sand lance spawning has been documented in the vicinity of this tract. Sand lance populations are widespread within the Salish Sea. They are most commonly noted along shorelines of the eastern Strait of Juan de Fuca and Admiralty Inlet. However, WDFW plankton surveys and ongoing exploratory spawning habitat surveys suggest that there are very few, if any, bays and inlets in the Puget Sound basin that will not be found to support sand lance spawning activity. Spawning of sand lance occurs at tidal elevations ranging from +5 feet to about the mean higher high water line. After deposition, sand lance eggs may be scattered over a wider range of the intertidal zone by wave action. The incubation period is about four weeks. Sand lances are an important part of the trophic link between zooplankton and larger predators in the local marine food webs. Like all forage fish, sand lances are a significant component in the diet of many economically important resources in Washington. On average, 35 percent of juvenile salmon diets are comprised of sand lance. Sand lances are particularly important to juvenile Chinook salmon, where 60 percent of their diets are sand lance. Other economically important species, such as Pacific cod (*Gadus macrocephalus)*, Pacific hake (*Merluccius productus*) and dogfish (*Squalus acanthias*) feed heavily on juvenile and adult sand lance. There is substantial vertical separation between sand lance spawning (+5 feet to mean higher high water) and geoduck harvest activity (-25 feet to -70 feet, MLLW on the Point Julia tract). Geoduck harvesting on the Point Julia tract should have no detrimental impacts on sand lance spawning.

NOAA Fisheries Service announced on April 27, 2010 that it was listing canary and yelloweye rockfish as “threatened” and bocaccio as “endangered” under ESA (federal Endangered Species Act). The listings became effective on July 27, 2010. Historic high levels of fishing and water quality are cited as reasons that these rockfish populations are in peril and have been slow to recover. On January 23, 2017; canary rockfish were delisted based on newly obtained samples and genetic analysis (Federal Register 82 FR 7711). Geoduck fishery managers are tracking this process and will take actions necessary to reduce the risk of “take” of any listed rockfish species that could potentially result from geoduck harvest activity.

Two salmon populations, Puget Sound Chinook salmon and Hood Canal summer run chum salmon, were listed by the National Marine Fisheries Service on March 16, 1999 as threatened species under ESA. Critical habitat for summer run chum salmon populations includes all marine, estuarine, and river reaches accessible to the listed chum salmon between Dungeness Bay and Hood Canal and within Hood Canal. The timing for summer run chum spawning is early September to mid-October. Out-migration of juveniles has been observed in Hood Canal during February and March, though out-migration may be as late as mid-April. The Point Julia tract is outside of the critical habitat range for Hood Canal summer run chum salmon.

Critical habitat for Puget Sound Chinook salmon includes all marine, estuarine and river reaches accessible to listed Chinook salmon in Puget Sound. WDFW recognizes 27 distinct stocks of Chinook salmon; 8 spring-run, 4 summer-run, and 15 summer/fall and fall-run stocks. The existence of an additional five spring-run stocks is in dispute. The majority of Puget Sound Chinook salmon emigrate to the ocean as subyearlings.

Major tributaries in the general vicinity of the Point Julia geoduck tract, which support Chinook salmon runs, are the Duwamish Waterway/Green River basin and the Lake Washington basin (mouth at Shilshole Bay; with Cedar River, Issaquah Creek, and north Lake Washington tributaries and sub-basins). Three viable runs of Chinook salmon have been identified in the Duwamish Waterway/Green River basin. The status of the Spring run of Chinook salmon in the Duwamish Waterway/Green River basin is extinct. The status of the natural Summer/Fall run of Chinook salmon in the Duwamish Waterway/Green River basin is mixed native and non-native origin; a composite of wild, cultured, or unknown/unresolved production; and healthy with a 5-year geometric mean for total estimated escapement at 4,889 fish. The timing of the Duwamish River run is uncertain and has a 5-year geometric mean for total estimated escapement at 5,216 fish. The status of the Summer/Fall run in Newaukum Creek is mixed native and non-native origin; wild production; and healthy (NMFS, Appendix E, TM-35, Chinook Status Review).

The production of the Lake Washington Summer/Fall run of Chinook salmon is natural with a 5-year geometric mean for total estimated escapement at 557 fish. The status of the natural Cedar River Summer/Fall run of Chinook salmon is native origin; wild production; with a 5-year geometric mean for total estimated escapement at 377 fish. The status of the mixed Summer/Fall run of Chinook salmon in Issaquah Creek is non-native origin; a composite of wild, cultured, or unknown/unresolved production; and healthy. The status of the natural Summer/Fall run of Chinook salmon in the North Lake Washington tributaries is native origin; wild production; with a 5-year geometric mean for total estimated escapement at 145 fish (NMFS, Appendix E, TM-35, Chinook Status

Review).

The geographic separation (horizontal) of this tract from known spawning tributaries and vertical separation of geoduck harvest (deeper and seaward of the -18 ft. MLLW contour) from juvenile salmon rearing areas and migration corridors (upper few meters of the water column) reduces or eliminates potential impacts to salmon populations. Charles Simenstad of the University of Washington School of Fisheries stated that the exclusionary principle of not allowing leasing/harvesting in water shallower than -18 ft. MLLW, the 2+ ft. vertically from elevation of the lower eelgrass margin, and within any regions of documented herring or forage fish spawning should under most conditions remove the influences of harvest induced sediment plumes from migrating salmon. Geoduck harvest should have no impact on salmon populations.

On May 7, 2007, NOAA Fisheries Service announced listing of Puget Sound steelhead as “threatened” under ESA. This listing includes more than 50 stocks of summer- and winter-run steelhead. Steelhead share many of the same waters as Puget Sound Chinook salmon, which are already protected by ESA, and will benefit from shared conservation strategies. There are no identified streams or rivers in the vicinity of the southern shoreline of Bainbridge Island that support steelhead stocks. The horizontal separation between tributaries that support steelhead runs and the Point Julia tract will assure that geoduck harvest will likely have no impact on steelhead populations.

Green sturgeon have undergone ESA review in recent years, due to depressed populations. NOAA Fisheries Service produced an updated status review on February 22, 2005, and reaffirmed that the northern green sturgeon Distinct Population Segment (DPS) warranted listing as a Species of Concern, however proposed that the Southern DPS should be listed as Threatened under the ESA. NMFS published a final rule on April 7, 2006, listing the Southern DPS as threatened (71 FR 17757), which took effect June 6, 2006. The green sturgeon critical habitat proposed for designation includes the outer coast of Washington within 110 meters (m) depth (including Willapa Bay and Grays Harbor) to Cape Flattery and the Strait of Juan de Fuca to its United States boundary. Puget Sound proper has been excluded from this critical habitat designation. The Point Julia geoduck tract is outside of the critical habitat range of green sturgeon and geoduck harvest at this location will have no adverse effects on ESA recovery efforts for green sturgeon populations.

Invertebrates:

Marine invertebrates, which are frequently found on geoduck beds, were also observed on this tract. The most common and obvious of these include: [1] mollusks (geoducks, horse clams, and various nudibranchs); [2] echinoderms (false ochre stars and sunflower stars); [3] cnidarians (sea pens, sea whips, burrowing anemones, and plumed anemones); [4] arthropods (red rock crabs, decorator crabs, hermit crabs, graceful crabs, ghost shrimp, and unspecified shrimp) and [5] annelid worms (sabellid, and terebellid). Geoduck harvest has not been shown to have long-term adverse effects on these invertebrates. Geoduck harvest can depress some local populations of benthic invertebrates, however most of these populations recover within one year.

WDFW and DNR have studied the effects of geoduck harvest on the population of Dungeness crab at Thorndyke Bay in Hood Canal. The results of 4.6 years of study have shown no adverse effects on crab populations due to geoduck fishing. No Dungeness crab were observed during the 2018 supplemental survey

To determine the potential impacts to Dungeness crab, the percentage of substrate disturbed during fishing was calculated and compared to the entire crab habitat within the tract and shoreward of the tract to the +1 ft. level and seaward out to -360 ft. (MLLW) water depth contour (Figure 5, Potential crab habitat map). Dr. Dave Armstrong at the University of Washington has determined that Dungeness crab utilize Puget Sound bottoms from the +1 ft. level out to the -330 ft. level. The entire crab habitat along this tract is approximately 865 acres. There were about 1,514,297 harvestable geoducks in the entire 82 acre tract, from the 2021 pre-fishing survey estimate. With a harvest of 65 percent, the total number harvested would be 984,293 geoducks. Approximately 1.18 square feet of substrate is disturbed for every geoduck harvested, so 984,293 x 1.18 = 1,161,466 square feet of substrate. This equals about 27 acres. This is about 3.1 percent of the total available crab habitat in the vicinity of this tract. Based on there being no observations of Dungeness crab on this tract during the pre-fishing survey, the low amount of disturbance of potential crab habitat in the vicinity of the tract, plus the lack of effects observed at the Thorndyke Bay study, we conclude that any effects on Dungeness crab will be very minor, if they occur at all.

Aquatic Algae:

Large attached aquatic algae are not generally found in geoduck beds in large quantities. Light restriction often limits algal growth to areas shallower than where most geoduck harvest occurs. Aquatic algae observed during the 2018 supplemental geoduck survey Include diatoms, Laminarian algae, Ulva and small red algae (Table 7).

John Boettner and Tim Flint, from the WDFW Habitat Division, have stated that as long as geoduck fishing was restricted seaward of the eelgrass beds they have no concerns about the fishing. This was confirmed by WDFW Habitat Division who stated that the existing conditions in the fishery SEIS are sufficient to protect fish and wildlife habitat and natural resources. The shallow boundary of geoduck harvest will be set at least two vertical feet seaward of the deepest occurrence of eelgrass to protect all eelgrass along the tract from harvest activities.

WDFW’s 2018 eelgrass survey found eelgrass to a maximum depth of -16 ft. (MLLW), but due to the presence of herring spawning, the nearshore boundary shall be set deeper than -18 ft. (MLLW), along the -25 ft. (MLLW) water depth contour.

Marine Mammals:

Several species of marine mammals, including seals, sea lions, and river otters may be observed in the vicinity of this geoduck tract. The Southern Resident stock of killer whales resides mainly in the San Juan Islands throughout spring and summer, but incursions south into Puget Sound and occasionally, Hood Canal occur more frequently during winter months (Brent Norberg, NOAA, pers. comm. 5/15/06). The Southern Resident stock of killer whales was listed as “endangered” under ESA by the National Marine Fisheries Service on November 15, 2005. This is in addition to the designation of this stock in May 2003 as “depleted” under the Marine Mammal Protection Act. More information and a draft conservation plan for this stock can be found at the NOAA website (http://www.nwr.noaa.gov/Marine-Mammals/Whales-Dolphins-Porpoise/Killer-Whales/ESA-Act-Status/Listing-Final.cfm). Hand pick shellfish fisheries, like geoduck harvesting, are considered Category III under the Marine Mammal Authorization Program for Commercial Fisheries. This means that there is a “rare or remote” likelihood of marine mammal “take,” (Brent Norberg, NOAA, pers. comm. 5/15/06). Precautions should be taken by commercial divers, when marine mammals are in the area, to be aware of marine mammal movements and behavior to eliminate the remote risk of entanglement with diver hoses and lines.

Birds:

A variety of marine birds are common in Hood Canal and the general vicinity of this tract. The most significant of these are guillemots, murres, murrelets, grebes, loons, scoters, dabbing ducks, black brant, mergansers, buffleheads, cormorants, gulls, and terns. Blue heron, bald eagles, and osprey are also regularly observed. Geoduck harvest does not appear to have any significant effect on these birds or their use of the waters where harvest occurs. A study by DNR and the WDFW was conducted at northern Hood Canal to learn the effects of geoduck fishing on bald eagles (Watson et al., 1995). A significant conclusion of this study is that commercial geoduck clam harvest is unlikely to have any adverse impacts on bald eagle productivity.

Other uses:

Adjacent Upland Use:

The upland properties adjacent to the tract are primarily designated as “rural” and “natural” shoreline environmental designations.

To minimize possible disturbance to adjacent residents, harvest vessels are not allowed shoreward of the 200 yards seaward of the ordinary high tide line (OHT). Harvest is allowed only during daylight hours and no harvest is allowed on Saturday, Sunday, or state holidays.

The only visual effect of harvest is the presence of the harvest vessels on the tract. These boats (normally 35-40 feet long) are anchored during harvest and divers conduct all harvest out of sight. Noise from boats, compressors and pumps may not exceed 50 dB measured 200 yards from the noise source, which is 5 dBA below the state noise standard.

Fishing:

The waters around this tract are, at times, popular sport fishing areas. The WDFW Sport Fishing Rules pamphlet describes seasons, size limits, daily limits, specific closed areas, and additional rules for salmon and other marine fish species. The fishing which does occur should not create any problems for the geoduck harvesting effort in the area.

Geoduck fishing on this tract is managed in coordination with the Hood Canal Treaty Tribes through state/tribal geoduck harvest management plans. The non-Indian geoduck fishery should not be in conflict with any concurrent tribal fisheries.

Navigation:

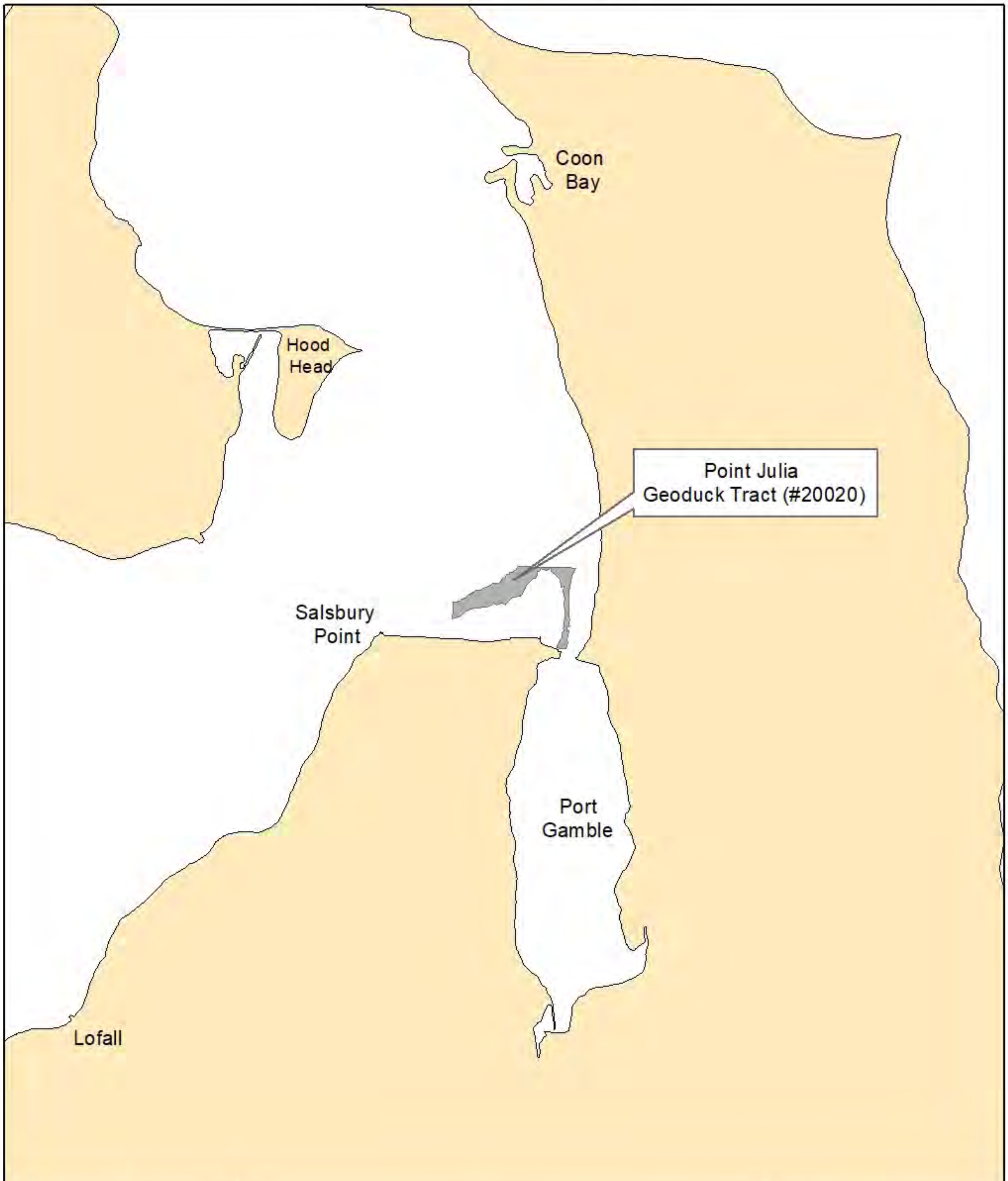
The Point Julia area is used by recreational and commercial vessels traveling in Northern Hood Canal. Geoduck harvesting at this site should not result in any significant navigational conflicts. The Washington Department of Natural Resources will notify the local boating community prior to any harvest.

Summary:

Commercial geoduck harvest is proposed for the Point Julia tract along the northeastern shoreline of Hood Canal. The tract was recently surveyed in 2021 by the NRC. The current geoduck biomass estimate for the 82 acre harvest area is 2,721,022 pounds. The commercial tract is presently classified by DOH as “Approved”. The shoreward boundary of the tract will be set along the -25 ft. MLLW water depth contour. The anticipated environmental impacts of this harvest are within the range of conditions discussed in the 2001 Final Supplemental Environmental Impact Statement. No significant impacts are expected from this harvest.

File: 220307_Point Julia_EA_20020.doc

Figure 1. Vicinity Map, Point Julia Commercial Geoduck Tract #20020



N
W E
S

1:70,000

1 inch = 1.1 miles

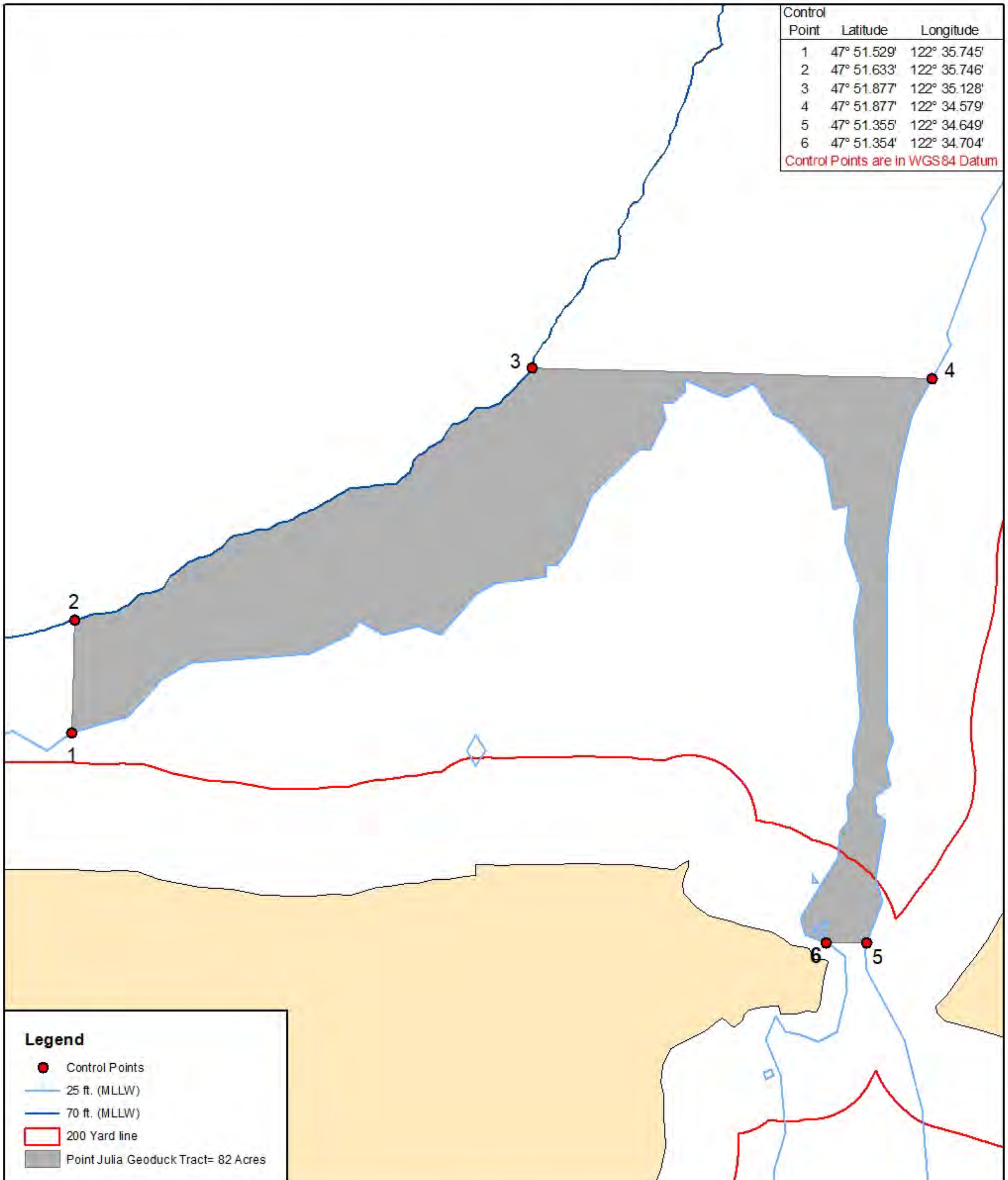
Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 0.375 0.75 1.5 2.25 Miles

Washington Department of FISH and WILDLIFE

Map Date: March 7, 2022
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 2. Control Points Map, Point Julia Commercial Geoduck Tract #20020



Control Point	Latitude	Longitude
1	47° 51.529'	122° 35.745'
2	47° 51.633'	122° 35.746'
3	47° 51.877'	122° 35.128'
4	47° 51.877'	122° 34.579'
5	47° 51.355'	122° 34.649'
6	47° 51.354'	122° 34.704'

Control Points are in WGS84 Datum

N W E S

1:10,000

1 inch = 0.16 miles

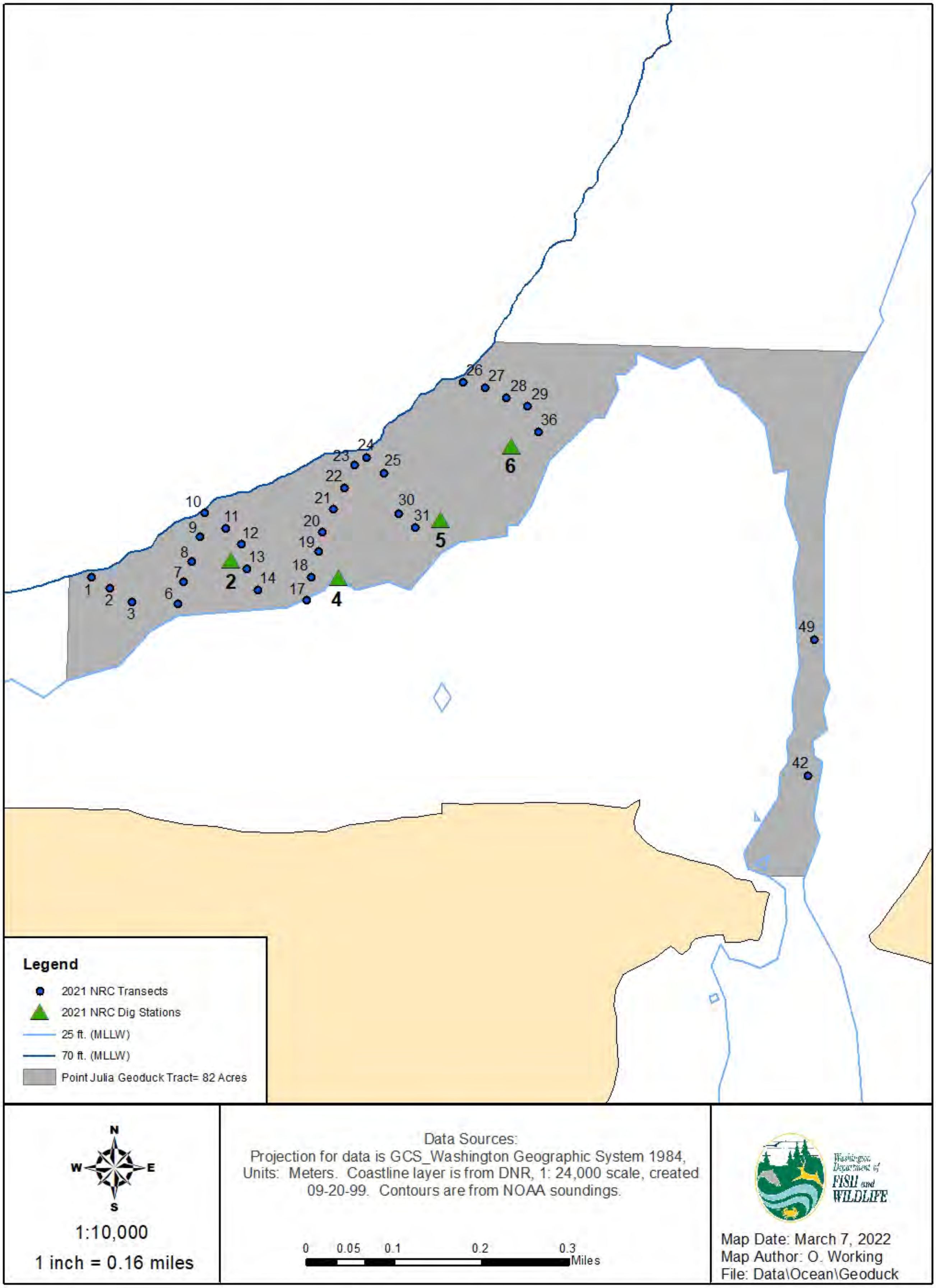
Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 0.05 0.1 0.2 0.3 Miles

Washington Department of FISH and WILDLIFE

Map Date: March 7, 2022
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 3. Transect and Dig Station Map, Point Julia Commercial Geoduck Tract #20020



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1 inch = 0.16 miles

Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

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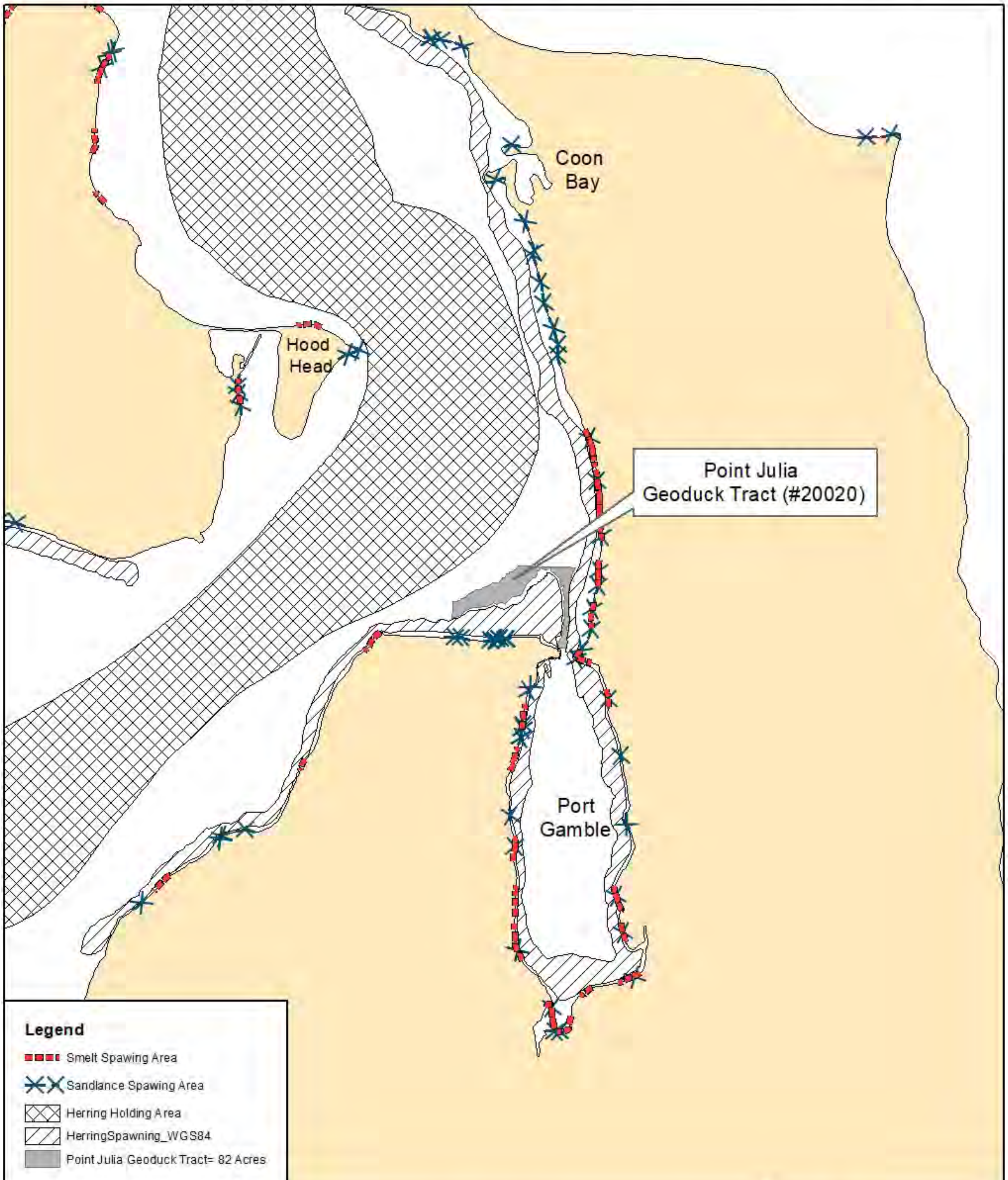
Map Date: March 7, 2022
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 4. Fish Spawning Areas Near the Point Julia Commercial Geoduck Tract #20020



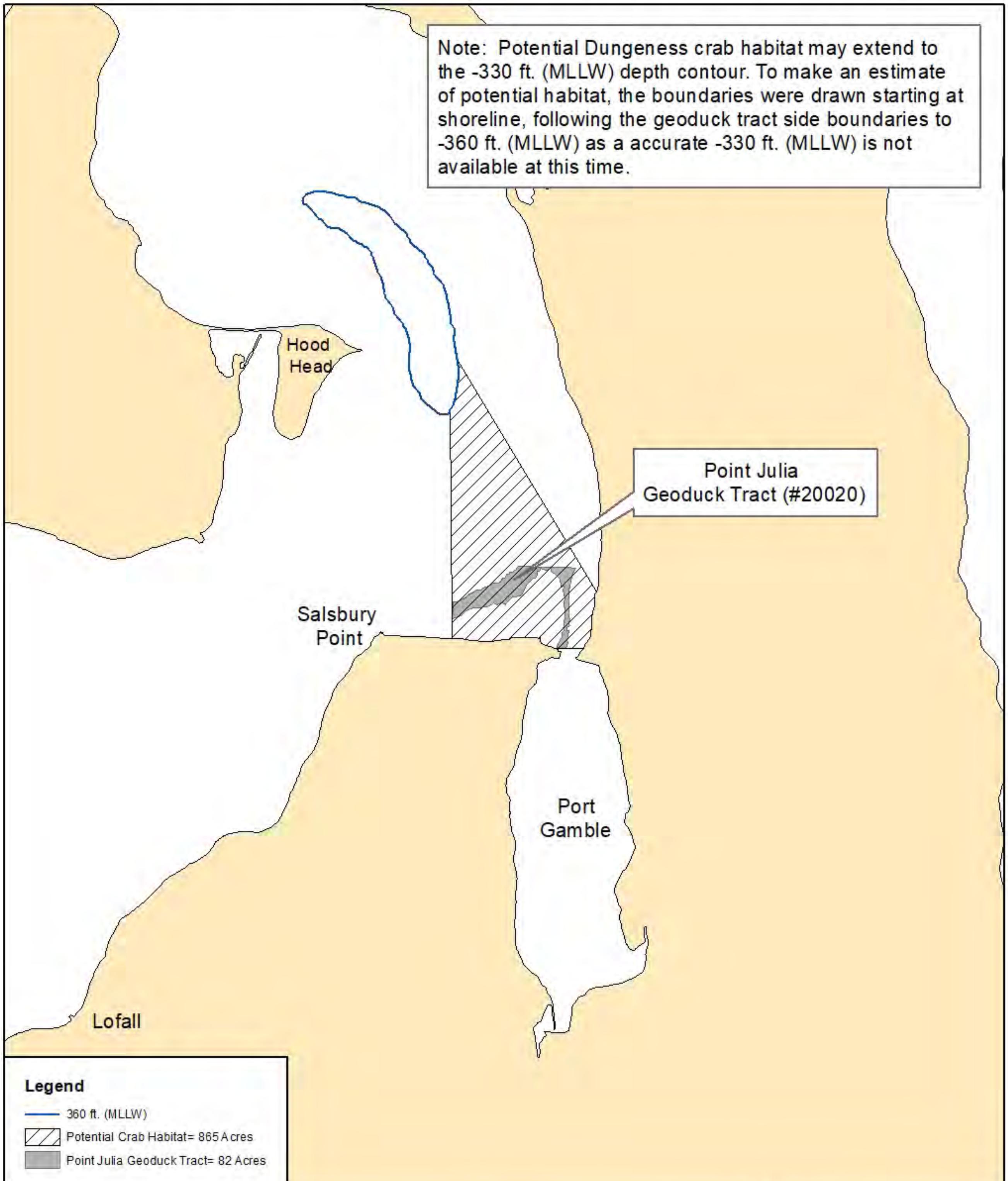
1:70,000
1 inch = 1.1 miles

Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 0.375 0.75 1.5 2.25 Miles

Map Date: March 7, 2022
Map Author: O. Working
File: Data\Ocean\Geoduck

Figure 5. Dungeness Crab Habitat Map, Point Julia Commercial Geoduck Tract #20020



N W E S

1:70,000

1 inch = 1.1 miles

Data Sources:
Projection for data is GCS_Washington Geographic System 1984, Units: Meters. Coastline layer is from DNR, 1: 24,000 scale, created 09-20-99. Contours are from NOAA soundings.

0 0.375 0.75 1.5 2.25 Miles

Washington Department of Fish and Wildlife

Map Date: March 7, 2022
Map Author: O. Working
File: Data\Ocean\Geoduck

EXPLANATION OF SURVEY DATA TABLES

The geoduck survey data for each tract is reported in seven computer-generated tables. These tables contain specific information gathered from transect and dig samples and diver observations. The following is an explanation of the headings and codes used in these tables.

Tract Summary

This table is a general summary of survey information for the geoduck tract including estimates of *Tract Size* in acres, average geoduck *Density* in animals per sq.ft., *Total Tract Biomass* in pounds with statistical confidence, and *Total Number of Geoducks*. Mass estimators are reported in average values for *Whole Weight* and *Siphon Weight* in pounds. Geoduck siphon weights are also reported in *Siphon Weight as a percentage of Whole Weight.* Biomass estimates are adjusted for any harvest that may occur subsequent to the pre-fishing survey.

Digging Difficulty

This table presents a station-by-station evaluation of the factors contributing to the difficulty of digging geoduck samples with a 5/8" inside nozzle diameter water jet. Codes for the overall subjective summary of the digging difficulty are given in the *Difficulty* column. An explanation of the codes for the dig difficulty follows:

Code	Degree of Difficulty	Description
0	Very Easy	Sediment conducive to quick harvest.
1	Easy	Significant barrier in substrate to inhibit digging.
2	Some difficulty	Substrate may be compact or contain gravel, shell or clay; most geoducks still easy to dig.
3	Difficult	Most geoducks were difficult to dig, but most attempts were successful.
4	Very Difficult	It was laborious to dig each geoduck. Unable to dig some geoducks.
5	Impossible	Divers could not remove geoducks from the substrate.

Abundance refers to the relative geoduck abundance; a zero (0) indicates that geoducks were very sparse, a one (1) indicates that they were moderately abundant and a two (2) indicates that they were very abundant. *Depth* refers to the depth that the geoducks were found in the substrate. A zero (0) indicates that they were shallow, a one (1) indicates that they were moderately deep and a two (2) indicates that they were very deep. The columns labeled *Compact*, *Gravel*, *Shell*, *Turbidity* and *Algae* refer to factors that contribute to digging difficulty by interfering with the digging process. A zero (0) in one of these columns indicates that the factor was not a problem, a one (1) indicates that the factor caused moderate difficulty and a two (2) indicates that the factor caused a significant amount of difficulty when digging. *Compact* refers to the compact or sticky nature of a muddy substrate. *Gravel* and *Shell* refer to the difficulty caused by these substrate types. *Turbidity* refers to the turbidity within the water near the dig hole caused by the digging activity. High turbidity makes it difficult to find the geoduck siphon shows. The difficulty of digging associated with turbidity varies with the amount of tidal current present. Therefore, the turbidity rating refers only to the conditions occurring when the sample was collected. *Algae* refers to algal cover, which also makes it difficult for the diver to find geoduck siphon shows. Because algal cover varies seasonally, this value only applies to the conditions when the sample was collected. The *Commercial* column gives a subjective assessment of whether or not it would be feasible to harvest geoducks on a commercial basis at the given station.

Transect Water Depths, Geoduck Densities and Substrate Observations

This table reports findings for each transect. *Start Depth* and *End Depth* (corrected to MLLW) are given for each transect. *Geoduck Density* is reported as the average number of geoducks per square foot for each 900 square foot transect. *Substrate Type* and *Substrate Rating* refer to evaluations of the substrate surface. A two (2) rating indicates that the substrate type is predominant. A one (1) rating indicates the substrate type was present.

Geoduck Weights and Proportion Over 2 Pounds

This table summarizes the size and quality of the geoducks at each of the stations where dig samples were collected. Weight values for any geoduck dig samples that were damaged during sampling to the extent that water loss occurred, are excluded from calculations. The *Number Dug* column lists the number of geoducks collected. The *Avg. Whole Weight (lbs.)* column gives the average sample weight of whole geoduck clams for each dig station. The *Avg. Siphon Weight (lbs.)* column gives the average weight of the siphons of the geoducks for each dig station. The percentage of geoducks greater than two pounds is given in the *% Greater than 2 lbs.* column.

Transect - Corrected Geoduck Count and Position Table

This table reports the diver *Corrected Count*, the geoduck siphon *Show Factor* used to correct the count, and the *Latitude/Longitude* position of the start point of each survey transect. Raw (observed) siphon counts are "corrected" by dividing diver observed counts for each transect with a siphon "show" factor (See WDFW Tech. Report FPT00-01 for explanation of show factor) to estimate the sample population density. Transect positions are reported in degrees and decimal minutes to the thousandth of a minute, datum WGS84.

Most Common and Obvious Animals Observed

This table summarizes the animals, other than geoducks, that were observed during the geoduck survey, and reports the total number of transects on which they were present (*# of Transects Where Observed)*. This is qualitative presence/absence data only, and only animals that can be readily seen by divers at or near the surface of the substrate are noted. The *Group* designation allows for the organization of similar species together in the table. Whenever possible, the scientific name of the animal is listed in *Taxonomer,* and a generally accepted *Common Name* is also listed. Many variables may make it difficult for divers to notice other animals on the tract, including but not limited to poor visibility, diver skill, animals fleeing the divers, animal size, or cryptic appearance or behavior (in crevasses or under rocks).

Most Common and Obvious Algae Observed

This table summarizes marine algae observed during the geoduck survey, and reports the total number of transects on which they were seen (*# of Transects Where Observed).* This is qualitative presence/absence data only, and only for macro algae, with the exception of diatoms. At high densities diatoms form a "layer" on or above the substrate surface that is readily visible and obvious to divers. Other types of phytoplankton are not sampled and are rarely noted. Whenever possible, the scientific name or a general taxonomic grouping of each plant is listed in *Taxonomer*.

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Table 1. GEODUCK TRACT SUMMARY

Tract Name	Point Julia
Tract Number	20020
Tract Size (acres) [a]	82
Density of geoducks/sq.ft. [b]	0.42
Total Tract Biomass (lbs.) [b]	2,721,022
Total Number of Geoducks on Tract [b]	1,514,297
Confidence Interval (%)	14.6%
Mean Geoduck Whole Weight (lbs.)	1.80
Mean Geoduck Siphon Weight (lbs.)	0.29
Siphon Weight as a % of Whole Weight	16%
Number of 900 sq.ft. Transect Stations	30
Number of Geoducks Weighed	47

[a.] Tract area is between the -25 ft. and -70 ft. (MLLW) water depth contours
[b.] Biomass is based on the 2021 NRC pre-fishing geoduck survey biomass.

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Table 2: DIGGING DIFFICULTY TABLE

Point Julia geoduck tract # 20020; 2021 NRC pre-fishing geoduck survey.

Dig Date	Dig Station	Difficulty (0-5)	Abundance (0-2)	Depth (0-2)	Compact (0-2)	Gravel (0-2)	Shell (0-2)	Turbidity (0-2)	Algae (0-2)	Commercial (Y/N)
8/16/2021	2	3								
8/17/2021	4	3								
8/17/2021	5	3	Remainder of dig station data not provided							
8/17/2021	6	3								

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Table 3: TRANSECT WATER DEPTHS, GEODUCK DENSITIES, AND SUBSTRATE OBSERVATIONS

Point Julia geoduck tract # 20020; 2021 NRC pre-fishing geoduck survey.

Date	Transect	Start depth (ft.) [a]	End depth (ft.) [a]	Geoduck Density (no. / sq. ft.) [b]	Substrate [c] sand	mud	gravel
6/8/2021	1	70	60	0.3586	2		
6/8/2021	2	60	43	0.3376	2		
6/8/2021	3	43	29	0.3358	2		
6/8/2021	6	29	38	0.2655	2	1	
6/8/2021	7	38	48	0.3885	2	1	
6/8/2021	8	49	58	0.5538	2		
6/8/2021	9	58	70	0.4466	2		
6/8/2021	10	70	59	0.5397	2		
6/8/2021	11	59	48	0.3252	2		
6/8/2021	12	46	36	0.6523	2		
6/8/2021	13	36	29	0.6857	2		
6/8/2021	14	29	25	0.5749	2		
6/8/2021	17	26	33	0.3024	2		
6/8/2021	18	33	37	0.4061	2		
6/8/2021	19	37	44	0.4764	2		
6/8/2021	20	44	48	0.4764	2		
6/8/2021	21	48	51	0.3833	2		
6/9/2021	22	51	62	0.3609	2	1	
6/9/2021	23	62	63	0.3368	2	1	
6/9/2021	24	63	54	0.4396	2	1	
6/9/2021	25	54	48	0.5643	2	1	
6/9/2021	26	69	58	0.4221	2	1	
6/9/2021	27	58	47	0.5140	2	1	
6/9/2021	28	47	37	0.5621	2	1	
6/9/2021	29	37	34	0.3653	2	1	
6/9/2021	30	41	36	0.4856	2		
6/9/2021	31	36	28	0.4134	2		
6/9/2021	36	31	27	0.3456	2		
6/16/2021	42	30	28	0.0497	2		1
6/16/2021	49	27	28	0.3388	2		

[a.] All depths are corrected to mean lower low water (MLLW)

[b.] Densities were calculated using a daily siphon show factor

[c.] Substrate ratings: 1 = present; 2 = predominant; blank = not observed

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Table 4: GEODUCK SIZE AND QUALITY

Point Julia geoduck tract # 20020; 2021 NRC pre-fishing geoduck survey.

Dig Date	Dig Station	Number Dug	Avg. Whole Weight (lbs.)	Avg. Siphon Weight (lbs.)	% of geoducks on station greater than 2 lbs.
8/16/2021	2	12	2.70	0.37	100%
8/17/2021	4	9	1.36	1.36	0%
8/17/2021	5	10	1.37	0.19	0%
8/17/2021	6	16	1.56	0.31	13%

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Table 5: TRANSECT CORRECTED GEODUCK COUNT AND POSITION TABLE

Point Julia geoduck tract # 20020; 2021 NRC pre-fishing geoduck survey.

Date	Transect	Corrected Count	Show Factor [a]	Latitude [b]	Longitude [b]
6/8/2021	1	323	0.632	47.86055	-122.59521
6/8/2021	2	304	0.632	47.86038	-122.59476
6/8/2021	3	302	0.632	47.86015	-122.59421
6/8/2021	6	239	0.632	47.86015	-122.59308
6/8/2021	7	350	0.632	47.86051	-122.59295
6/8/2021	8	498	0.632	47.86086	-122.59276
6/8/2021	9	402	0.632	47.86126	-122.59257
6/8/2021	10	486	0.632	47.86166	-122.59248
6/8/2021	11	293	0.632	47.86141	-122.59195
6/8/2021	12	587	0.632	47.86116	-122.59155
6/8/2021	13	617	0.632	47.86076	-122.59140
6/8/2021	14	517	0.632	47.86041	-122.59111
6/8/2021	17	272	0.632	47.86027	-122.58991
6/8/2021	18	366	0.632	47.86065	-122.58981
6/8/2021	19	429	0.632	47.86108	-122.58964
6/8/2021	20	429	0.632	47.86140	-122.58957
6/8/2021	21	345	0.632	47.86178	-122.58931
6/9/2021	22	325	0.508	47.86213	-122.58906
6/9/2021	23	303	0.508	47.86252	-122.58882
6/9/2021	24	396	0.508	47.86265	-122.58852
6/9/2021	25	508	0.508	47.86240	-122.58808
6/9/2021	26	380	0.508	47.86394	-122.58621
6/9/2021	27	463	0.508	47.86385	-122.58566
6/9/2021	28	506	0.508	47.86370	-122.58512
6/9/2021	29	329	0.508	47.86357	-122.58460
6/9/2021	30	437	0.508	47.86174	-122.58770
6/9/2021	31	372	0.508	47.86152	-122.58729
6/9/2021	36	311	0.508	47.86315	-122.58432
6/16/2021	42	45	0.492	47.85757	-122.57747
6/16/2021	49	305	0.492	47.85983	-122.57741

[a.] A siphon show factor was used to correct combined geoduck counts

[b.] Latitude and longitude are in decimal degrees (WGS84)

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Table 6: MOST COMMON AND OBVIOUS ANIMALS OBSERVED

Point Julia geoduck tract # 20020; 2018 WDFW Supplimental geoduck survey.

# of Transects where Observed	Group	Common Name	Taxonomer
2	ANEMONE	PLUMED ANEMONE	*Metridium spp.*
4	ANEMONE	STRIPED ANEMONE	*Urticina spp.*
10	BIVALVE	HORSE CLAM	*Tresus spp.*
10	CNIDARIA	SEA PEN	*Ptilosarcus gurneyi*
1	CNIDARIA	SEA WHIP	*Stylatula elongata*
1	CRAB	DECORATOR CRAB	*Oregonia gracilis*
1	CRAB	DECORATOR CRAB	*Pugettia spp.*
5	CRAB	GRACEFUL CRAB	*Cancer gracilis*
5	CRAB	HERMIT CRAB	Unspecified hermit crab
5	CRAB	RED ROCK CRAB	*Cancer productus*
1	FISH	BUFFALO SCULPIN	*Enophrys bison*
2	FISH	C-O SOLE	*Pleuronichthys coenosus*
2	FISH	PACIFIC SANDDAB	*Citharichthys sordidus*
7	FISH	SANDDAB	*Citharichthys spp.*
2	FISH	SCULPIN	Unspecified Cottidae
9	FISH	SNAKE PRICKLEBACK	*Lumpenus sagitta*
4	FISH	STARRY FLOUNDER	*Platichthys stellatus*
1	FISH	TUBESNOUT	*Aulorhynchus flavidus*
1	FISH	WHITE SPOTTED GREENLING	*Hexagrammos stelleri*
1	FISH EGGS	SKATE EGG CASE	*Raja spp* . egg case
10	NUDIBRANCH	ARMINA	*Armina californica*
1	SEA STAR	FALSE OCHRE STAR	*Evasterias troschelli*
3	SEA STAR	SUNFLOWER STAR	*Pycnopodia helianthoides*
8	SHRIMP	GHOST SHRIMP	Unspecified ghost shrimp
1	SHRIMP	SHRIMP	Unspecified shrimp
1	WORM	SABELLID TUBE WORM	*Sabellid spp.*
8	WORM	TEREBELLID TUBE WORM	*Terebellid spp.*

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Table 7: MOST COMMON AND OBVIOUS ALGAE OBSERVED

Point Julia geoduck tract # 20020; 2018 WDFW Supplemental geoduck survey.

# of Transects where observed	Taxonomer
4	Diatoms
10	*Laminaria spp.*
1	Ulva spp.
10	Unspecified small red algae

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