2024 Portage Bay Clam Survey & Harvest Limit Report
with updates for Lummi Bay, Semiahmoo and Birch Bay

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Executive Summary

Clam Survey

Lummi Natural Resources conducted a stock assessment survey of harvestable Manila clams at Portage Bay between June 5th – August 21st, 2024. The survey took 24 days and covered a total of 190 acres. The average clam density ranged from 0.04 – 0.16 lbs/ft^2 and the total harvestable biomass was 828,092 lbs.

The total harvestable biomass for Lummi Bay and Semiahmoo was surveyed in 2023 resulting in 2,005,825 lbs and 70,826 lbs respectively. The detailed 2023 clam stock assessment survey is covered in a separate technical report.

Harvest Limit

Sustainable harvest recommendations for the 2024 – 2025 clam fishery season is recommended at 25% - 30% of the surveyed harvestable biomass.

Table: Summary of Manila clam stock assessment survey results conducted biennially

General area	Management area	Acres	Weighted mean density (lbs / ft^2)	Mean biomass estimate (lbs)	± 95 CI	TAC	Year surveyed	Next Survey
Birch Bay	20A - 200060			104,840		17,687	2023	2025
Semiahmoo	20A - 200104	34	0.0474	70,826	± 14,122	21,686	2023	2025
Lummi Bay	20A - S1B	222	0.0476	460,837	± 75,062	92,167	2023	2025
	20A - S1C (Senior)	226	0.0328	323,009	± 88,115	64,602	2023	2025
	20A - S1D&E	653	0.0430	1,221,979	± 170,653	244,396	2023	2025
	Total	**1,101**		**2,005,825**	**± 333,830**	**401,165**		
Portage Bay	21A - S4	40	0.1648	287,124	± 36,268	71,781	2024	2026
	21A - S5	31	0.1331	179,147	± 26,114	44,787	2024	2026
	21A - S6	-	-	-	-	-	not surveyed	2026
	21A - S7D	57	0.0993	246,625	± 46,093	61,656	2024	2026
	21A - S7E	62	0.0428	115,196	± 19,740	28,799	2024	2026
	Total	**190**		**828,092**	**± 128,216**	**181,123**		
	SUM Beaches			**2,904,743**		**621,661**		

Relevant Supplementary Reports:

1. 2023 Clam Survey Report (SharePoint > Natural Resources > Public > __Harvest Management > Tech Reports > Survey).
2. 2024-2025 Harvest Recommendations Report (SharePoint > Natural Resources > Public > __Harvest Management > Tech Reports > Harvest).

Survey Objectives

The 2024 Manila clam survey provides critical data for the management of the commercial Manila clam fishery. This work estimates the harvestable biomass of Manila clams on beaches within Lummi Nations Usual and Accustom area (U & A). Beaches are surveyed biennially, Portage Bay this past summer, 2024. Semiahmoo or Drayton Harbor and Lummi Bay were surveyed between May – August 2023 and will be surveyed again in 2025. Therefore, the current report focuses on Portage Bay.

Methods

Field Protocol

Beaches were surveyed following the Lummi Survey Protocol (Dolphin 2013), a modification of the standard Washington State adopted protocol (Campbell 1996), consistent with past survey methods. Surveys were carried out using a systematic random design with a series of parallel transects to determine the legal pounds per square foot of Manila clams. The sample clam densities are spatially weighted and the weighted average for each management area is then multiplied by the total surveyed area to estimate the total biomass of legal-size Manila clams.

Table 1. Beach specific survey design

Survey Area	Steps between Transect Lines	Steps between Quadrats	Quadrat Area
Portage Bay – S4 & S5	30	15	2.25 ft^2
Portage Bay – S7D & S7E	50	15	2.25 ft^2
Portage Bay – S7D (Brant Pt. Bay)	30	10	2.25 ft^2

The 2024 Portage Bay clam survey was conducted between June 5th – August 21st, 2024, during daytime low tides. The surveys took a total of 24 days to complete. A total of 2,154 quadrats were sampled covering 190 acres.

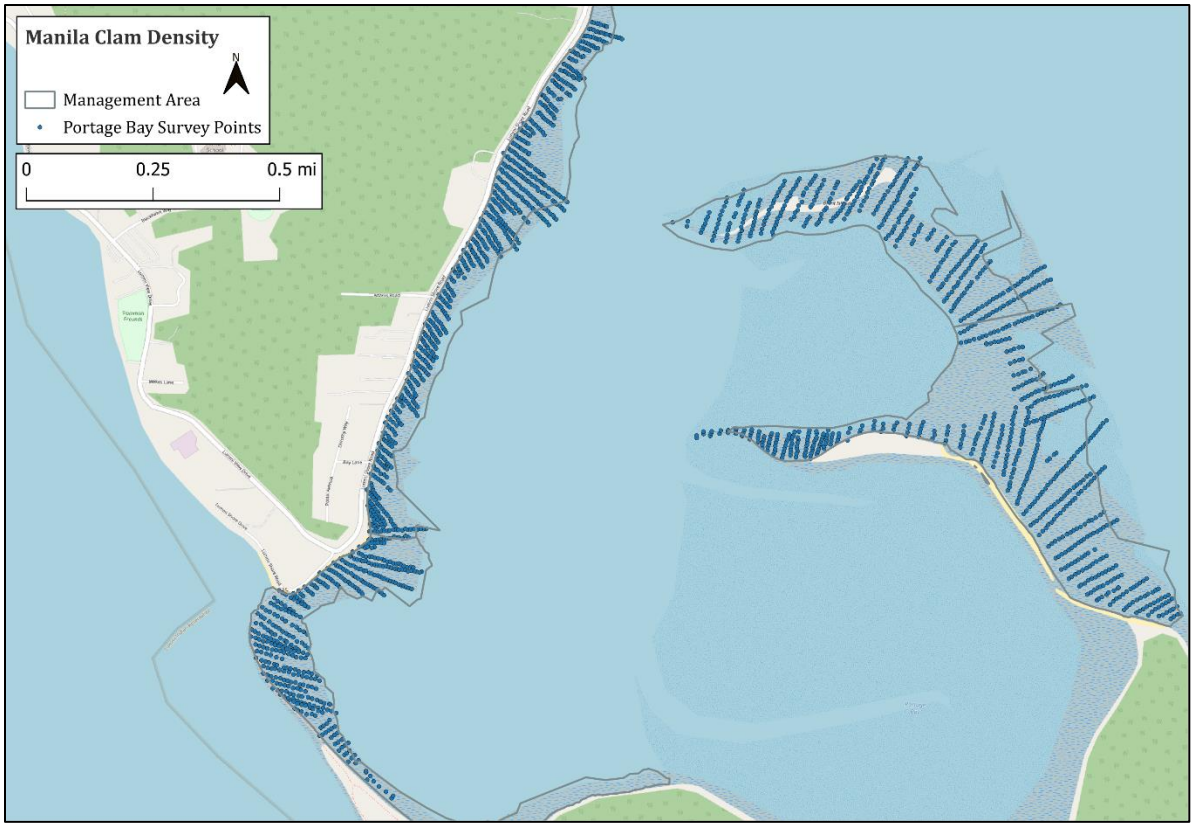

Figure 1. Clam stock assessment sample collection points (blue dot) in Portage Bay against management area (grey line)

Data Processing

Portage Bay survey data including GPS coordinates, quadrat size, and individual shell widths were entered into the LNR WebApp Clam Database built by Craig Dolphin. GPS coordinates are spatially verified and manually amended when necessary.

Beach-specific shell-width-weight relationships for Manila clams were used to estimate individual clam weights based on the shell-width data that is collected in the field (unpublished data, Dolphin 2005), which is automatically calculated by the WebApp Clam Database.

The legal-size threshold shell width was estimated to be 20mm for Portage Bay (or 1.5 in or 38.1 mm length). All threshold weights are counted as half.

Data Analysis

Clam density can vary between and within management areas. Therefore, Thiessen or Voronoi polygons (Dolphin, 2004a) are used to analyze the survey data to remove potential spatial bias using ArcGIS or QGIS. The current analysis was conducted in QGIS. The survey points are uploaded into QGIS, using NAD83/Washinton North (ftUS) + NAV88 height (EPSG:8790), then a 25ft buffer is applied to each of the survey points. In order to delimit the total surveyed area, a polygon layer is created and an outline of the survey area is traced. The Voronoi polygon is then created using Geoprocessing tools and clipped to the survey polygon. The square footage and legal biomass of individual sample polygons is calculated using the Field calculator under the Attribute table.

Calculate total biomass and accuracy

From the Voronoi polygon output data, the total area surveyed, the spatially weighted average clam density, precision of the density estimate, total clam biomass estimates for the management area, and 95% confidence intervals for the biomass estimate are calculated. The estimations of error around the spatially weighted mean need to be calculated based on a weighted variance. All of these calculations were performed in R programming, software for statistical computing. The Hmisc package was used to calculate the weighted mean and variance.

These calculated values are used to estimate the total biomass of harvestable clams for each beach management area. The spatially weighted mean clam density (lb/ft^2) is multiplied by the total area surveyed to determine the mean biomass estimate. To calculate the lower and upper biomass estimate the weighted mean clam +/- 95% Confidence Interval is then multiplied by the total area.

For full method description, see Hintz (2018).

Results

Portage Bay

The average density of Manila clams within discrete management areas ranged from 0.04 – 0.16 lbs/ft^2 (Table 2). The highest density was recorded for 21A-S4 (Senior bed) while the lowest density was recorded for 21A-S7E (Table 2). A distinct clam band can be identified in 21A-S4, S5, and S7-D validating the clam habitat was thoroughly covered during the survey (Figures 2 – 4). The lack of clam band in S7-E is likely due to low biomass (Figure 5). Clam densities are presented in the same scale for all management areas.

The 95% confidence interval (CI) indicates that there is a high level of variability around the weighted mean density. Therefore, the lower and upper biomass estimates range significantly between ~40,000 lbs to ~90,000 lbs within discrete management areas (Table 2). Across the four surveyed management areas, the total harvestable biomass of Manila clams ranges from 699,876 lbs to 956,307 lbs (Table 2).

Table 2. Summary of the estimated Manila clam biomass determined from the 2024 clam survey at Portage Bay

MGMT area	Acres	Weighted mean density (lbs / ft^2)	Standard error	95 CI	Precision	Biomass estimate		
						Lower	**Mean**	Upper
21A-S4	40	0.16	0.011	0.02	12.63	250,856	**287,124**	323,392
21A-S5	30.89	0.13	0.010	0.02	14.58	153,033	**179,147**	205,261
21A-S7D	57.03	0.1	0.009	0.02	18.69	200,532	**246,625**	292,718
21A-S7E	61.79	0.04	0.004	0.01	17.14	95,456	**115,196**	134,936
Total						699,876	**828,092**	956,307

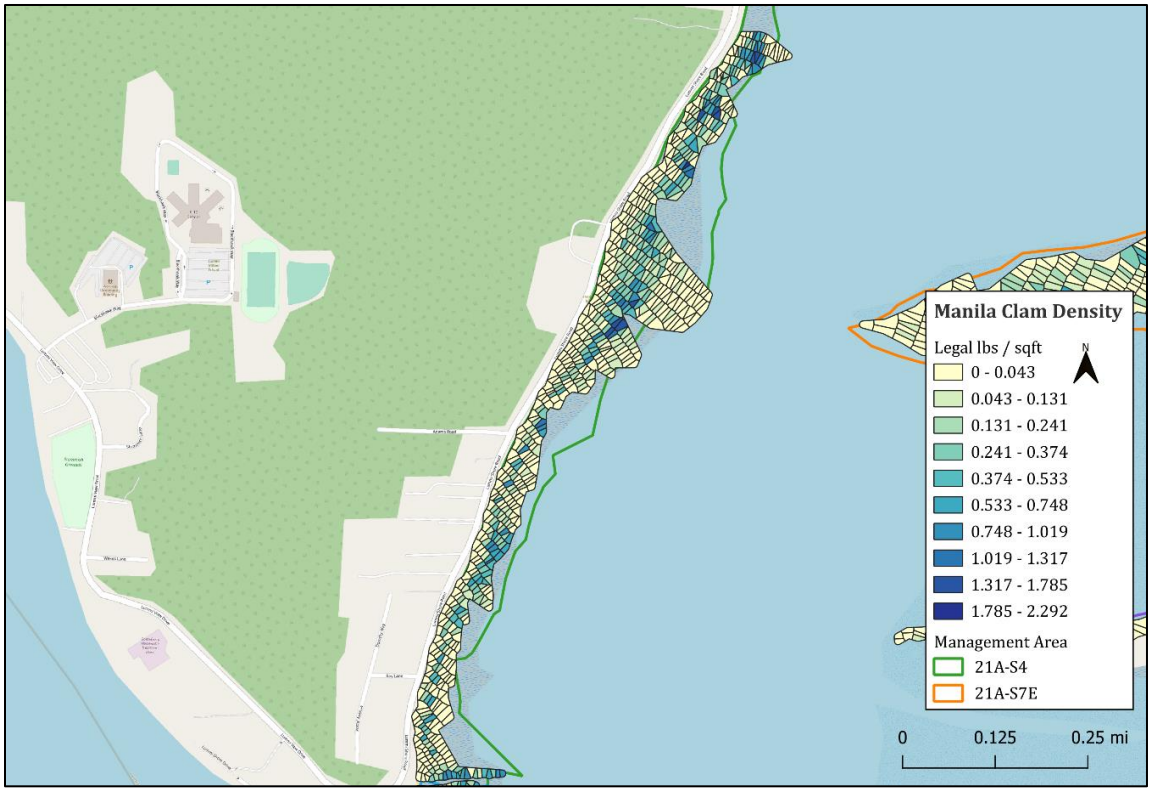

Figure 2. Legal Manila clam densities within Portage Bay, 21A-S4 based on the 2024 clam survey represented within Thiessen polygons.

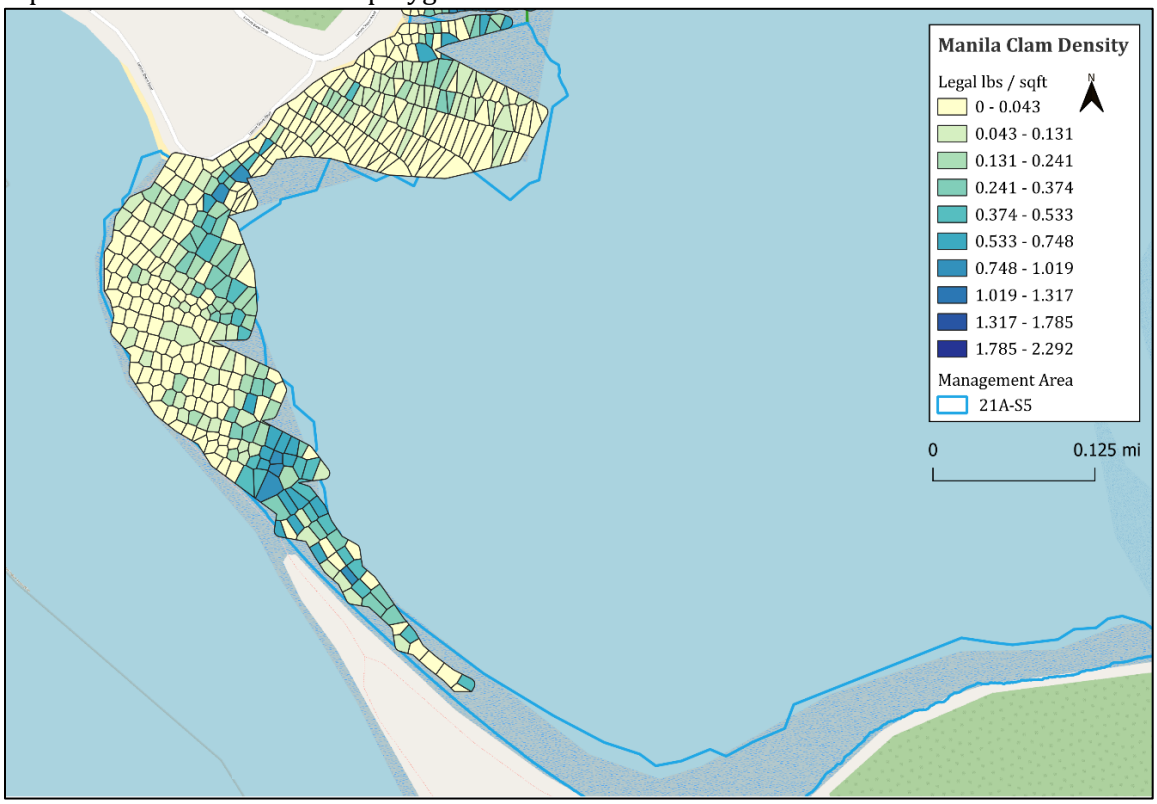

Figure 3. Legal Manila clam densities within Portage Bay, 21A-S5 based on the 2024 clam survey represented within Thiessen polygons.

Figure 4. Legal Manila clam densities within Portage Bay, 21A-S7-D based on the 2024 clam survey represented within Thiessen polygons.

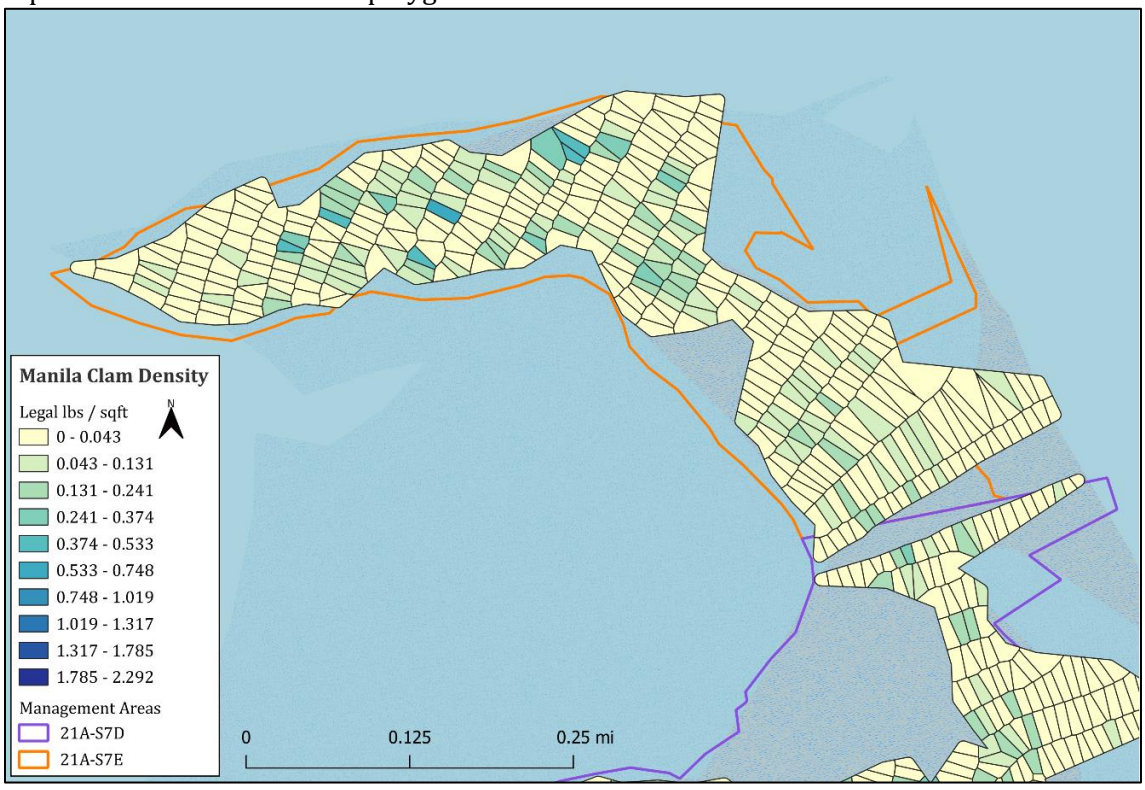

Figure 5. Legal Manila clam densities within Portage Bay, 21A-S7-E based on the 2024 clam survey represented within Thiessen polygons.

Discussion

During the 2024 Portage Bay clams survey, a total of 2,154 quadrats were samples. Despite the large number of quadrats sampled and area covered, not all management areas were covered. Management area 21A-S5 was not completed and 21A-S6 was not surveyed largely due to limited capacity and the time intensive nature of clam surveys. Management areas 21A-S4, S5, S7D and S7E are popular places to harvest clams for subsistence, ceremonial and commercial purposes.

Comparison with previous surveys at Portage Bay

Clam survey results have been documented at Portage Bay since 2006. The average density of harvestable Manila clams has ranged from 0.02 – 0.12 over the last 18 years of surveys (Figure 6).

A closer look at the last three years of surveys at Portage Bay illustrates that the average density of harvestable Manila clams has been increasing. There is a notable increase in average density from 2018 to 2021 for 21A-S4, S5 and S7D which has remained fairly consistent for 2024 (Table 3). The density in 21A-S7E reveals a slight increase between 2018 and 2021 which remained constant in 2024 (Table 3). Notably, the acreage surveyed varied within each management area between the 2018, 2021, and 2024 clam surveys at Portage Bay (Table 3). Some degree of variation is expected, however, a particularly wide range in survey area is present for S7D. This may be largely attributed to capacity and available low tides for completing survey work. Overall, the total surveyed acreage is comparable across years (Table 3). The most astonishing result was the tripling of the average density of harvestable Manila clams across Portage Bay between the 2018 and 2021 surveys which has remained consistent in the 2024 survey (Figure 6).

Comparison between commercial harvest beaches

Lummi Natural Resources conducts clam surveys Portage Bay, Lummi Bay and Semiahmoo on a biennial basis. The 2024 clam survey revealed that Portage Bay has the highest average density of harvestable Manila clams (0.11 lbs/ft^2) compared with Lummi Bay (0.04 lbs/ft^2) and Semiahmoo (0.05 lbs/ft^2). Portage Bay has more variability in Manila clam density compared with Lummi Bay (Table 4). In addition, the total acreage varies between beaches, where Lummi Bay has the largest harvestable area and Semiahmoo is the smallest (Table 4). The highest harvestable biomass is currently present at Lummi Bay followed by Portage Bay and Semiahmoo (Table 4).

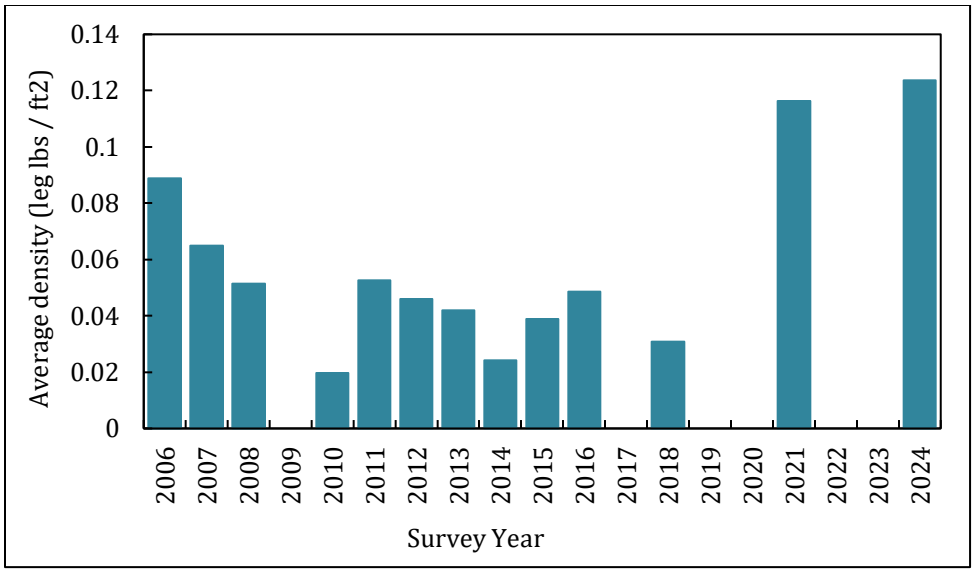

Figure 6. Average density of harvestable Manila clams surveyed at Portage Bay between 2006 – 2024.

Table 3. Comparison of weighted mean density, acreage surveyed, and mean biomass estimate +/- 95% CI from clam stock assessment surveys conducted at Portage Bay in 2018, 2021, and 2024.

Management Area	Weighted mean density (lbs/ft²)			Acres surveyed			Mean biomass estimate +/- 95% CI		
	2018	2021	2024	2018	2021	2024	2018	2021	2024
21A-S4	0.04	0.13	0.16	46	30	40	72,224	166,250	287,124
21A-S5	0.01	0.09	0.13	49	30	31	30,552	113,662	179,147
21A-S6		0.13			7			40,386	
21A-S7D	0.03	0.15	0.10	72	31	57	82,744	204,974	246,625
21A-S7E	0.02	0.04	0.04	50	70	62	41,275	114,148	115,196
Total	**-**	**-**	**-**	**216**	**168**	**190**	**226,795**	**639,419**	**828,092**

Harvest Limits

Clam biomass surveys have been conducted across on-reservation beaches, Lummi and Portage Bays, since 1989, however survey data between 1989 – 2000 was not properly documented and is difficult to determine if method and area are comparable (Dolphin 2002). Documented clam surveys have taken place annually since 2002, however, due largely to capacity the surveys have been conducted biennially following the 2018 survey. There is a gap in Lummi and Portage Bay clam survey data in 2019 (reason?), 2020 due to COVID-19 work restrictions, and again in 2022 due to Intertidal Shellfish Biologist staffing change over. A Lummi Bay clam survey was conducted in 2020; however, the methods were changed to accommodate COVID-19 work restrictions and has not been processed. Despite a survey taking place in 2021, there is no report to accompany this data.

The commercial clam harvest season runs from October through August, however most harvest occurs from October through May. The commercial TAC is generated for legal size Manila clams (for Portage Bay ≥20mm width) during the biennial clam survey for on- and off-reservation beaches. The TAC has historically been set based on expected production and the trends in the population (i.e. if the population is declining lower harvest rates were set and if the population was growing higher harvest rates were set). The long-term clam survey data allow clam biomass trends to be evaluated over time since the early 2000s. A sustainable TAC should also consider environmental and anthropogenic impacts.

Lummi Bay, Semiahmoo & Birch Bay Summary

The Lummi Bay, Semiahmoo and Birch Bay TACs were set for 2024 and 2025 based on the 2023 clam survey results (Table 4). Lummi Bay's harvestable biomass increased from previous years. The TAC was set at 20% of the total harvestable biomass, 401,075 lbs (Table 4). Semiahmoo's harvestable biomass decreased from previous years, however, as a co-managed beach the TAC is set at 33% unless a conservation issue is raised. Birch Bay is surveyed by WDFW and the TAC is also set at 33% of the harvestable biomass (Table 4).

Table 4.

General area	Management area	Acres	Weighted mean density (lbs / ft²)	Mean biomass estimate (lbs)	± 95 CI	TAC	Year surveyed	Next Survey
Birch Bay	20A - 200060			104,840		17,687	2023	2025
Semiahmoo	20A - 200104	34	0.0474	70,826	± 14,122	21,686	2023	2025
Lummi Bay	20A - S1B	222	0.0476	460,837	± 75,062	92,167	2023	2025
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	Total	**190**		**828,092**	**± 128,216**	**181,123**		
	SUM Beaches			**2,904,743**		**621,661**		

Notable Event

On August 1st, 2024, LNR staff observed a large quantity of dead bivalves along the Lummi Sea pond wall. The dead bivalves consisted primarily of Manila clams with varnish clams, Macoma spp., eastern soft-shell and oysters mixed in.

LNR staff attempted to quantify the number of pounds of Manila clams that perished on the Lummi Bay tidelands in late July, however, LNR does not currently have a rapid response survey methodology developed. On August 6th, 2024, LNR staff conducted a small opportunistic survey in the area where the dead clams had washed up. Staff laid a transect along the length of the tideland where the dead clams were concentrated. Quadrats (2.25 ft^2) were placed at random numbers along the transect. Manila clams were counted and identified as juvenile or adult. All remaining bivalves were counted. Within 7,650 ft^2 there were an estimated 2,742 pounds of dead Manila clams (Figure 7). In order to quantify the loss across Lummi Bay, a more comprehensive survey would be required. The upcoming 2025 Lummi Bay clam survey will help reveal the scale of Manila clam loss due during the summer of 2024.

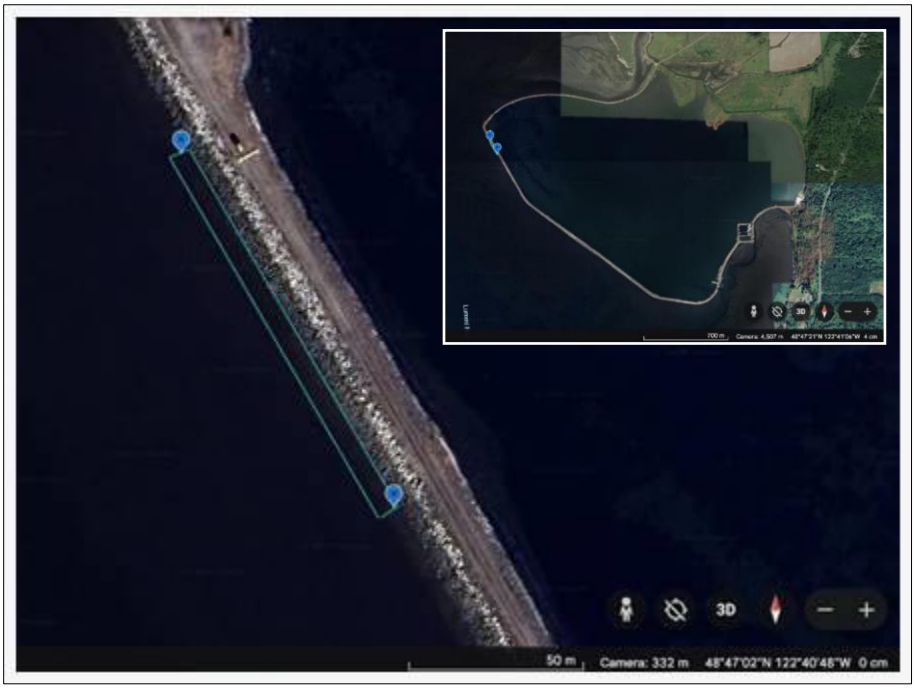

Figure 7. Outline of area covered during Manila clam mortality survey.

Portage Bay

Manila clam harvest

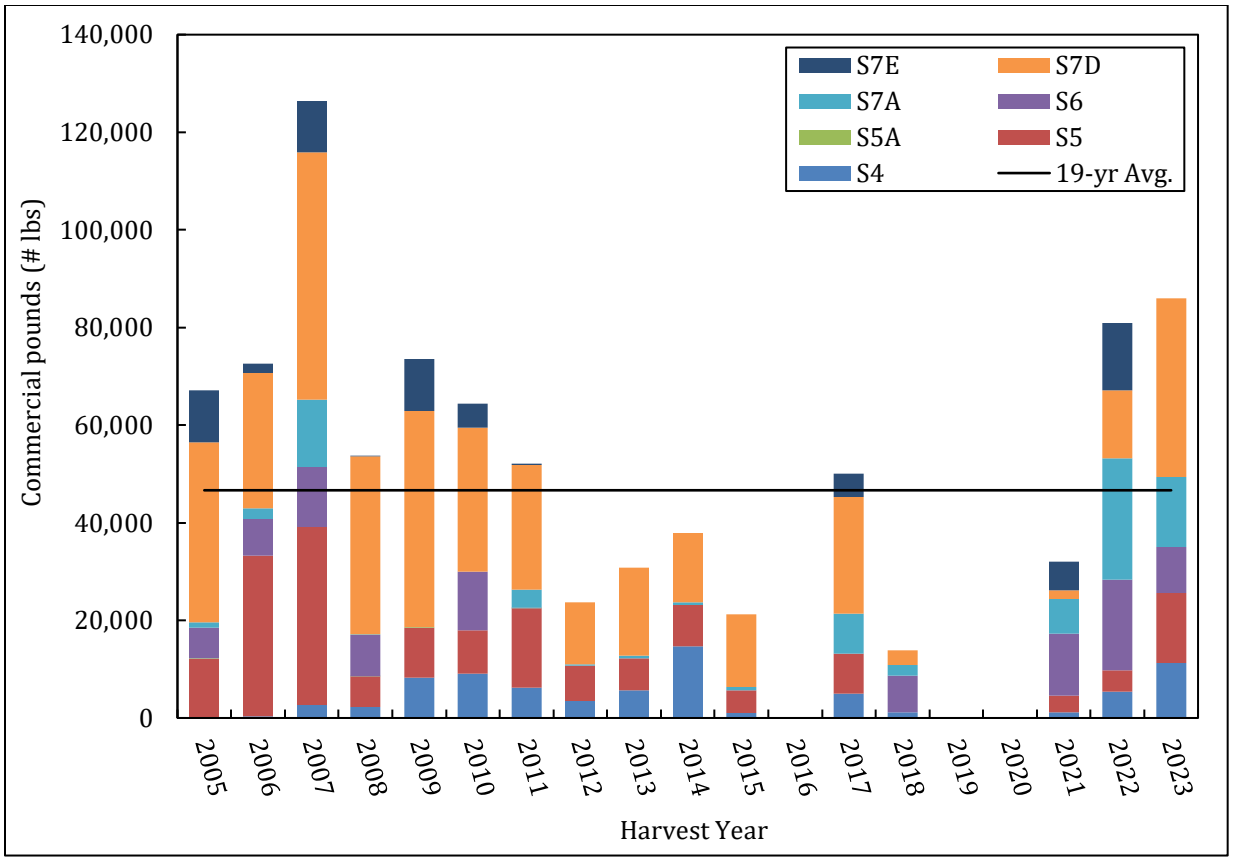

Figure 8. Total commercial harvest from Portage Bay between harvest years 2005 – 2023 plotted alongside 19-year average. Harvest year runs from Oct – August.

Total commercial landings from Portage Bay averaged ~55,000 lbs between 2005 – 2023. The highest annual commercial harvest was ~126,000 lbs in 2007 which was more than twice the 19-year average (Figure 8). The highest proportion of commercial harvest has consistently been out of S7-D (Figure 8).

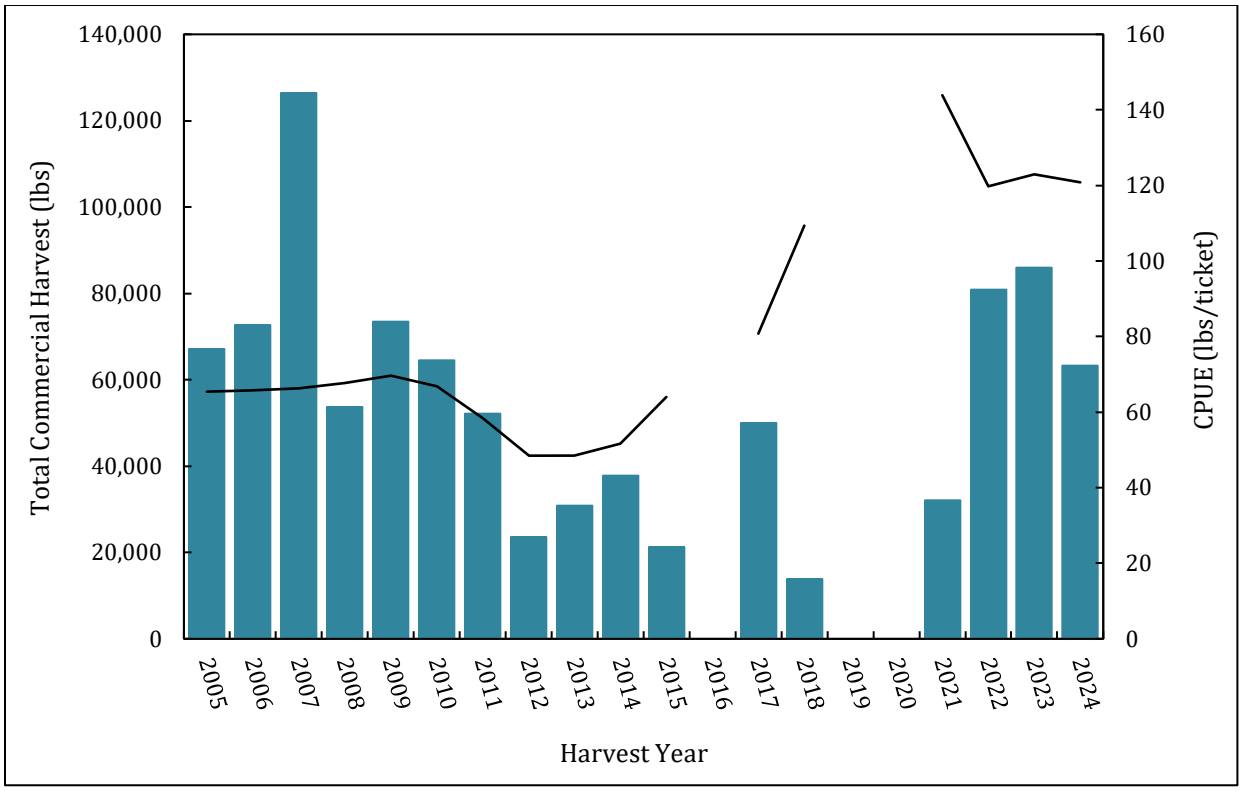

Figure 9. Catch per unit effort (CPUE). Included 2024 to date.

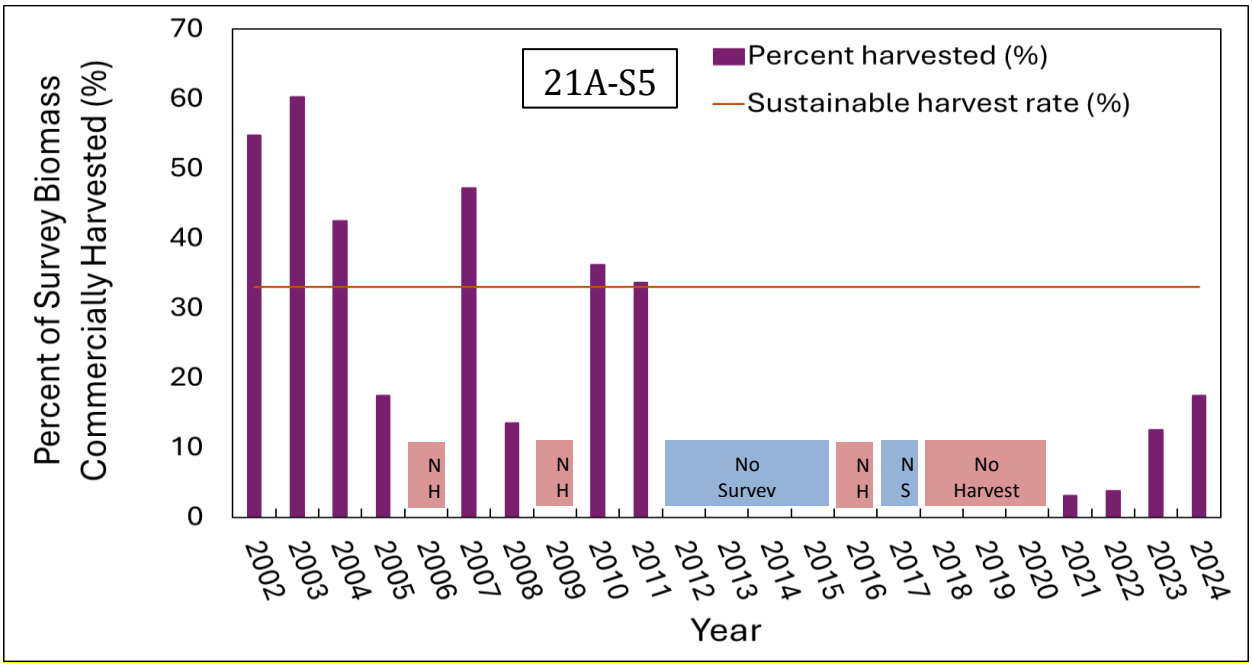

Figure 10. Percent of survey biomass commercially harvested from years with overlapping clam survey and commercial harvest information for 21A-S5

!!!Proposed Commercial harvest limit

The biomass at Portage Bay appears to be recovering from an extended period of low biomass (Figure 6). There are several factors which may account for the decline in biomass in the early to mid-2000s. Intertidal bivalve mortality associated with extreme temperature events was recorded for winter kills in 2006, 2008 and 2017 (Hintz 2018a) and due to extreme heat in 2021 (Raymon 2021 *et al*.). Further, it is likely that the overharvest in some discrete management areas in the early 2000s was a contributing, if not compounding factor (Figure 10).

Since 2014 the CPUE has been increasing as biomass levels have also increased, however the CPUE appears to be stagnating between harvest years 2023 and 2024 (Figure 6 & 9). This mirrors the consistent density and therefore biomass which was recorded during the 2021 and 2024 surveys. Despite an average density in harvestable biomass which tripled between the 2018 and 2021 surveys, the density remained consistent between the 2021 and 2024 surveys (Figure 6).

As a result of the 2024 clam stock assessment survey and an evaluation of previous years surveys and harvest, a 25% - 30% TAC is recommended for Portage Bay for the 2025-27 harvest years. On the more conservative end, a 25% TAC will allow room for the population to continue growing in the wake of an extended period where low biomass was present across Portage Bay. It will also allow some room if the freezing temperatures experienced in February 2025 alongside large minus tides impacted the population. On the less conservative side, a TAC of 30% is more likely to maintain current abundance or lead to a slight dip resulting in a lower CPUE over time.

The LFNR Commission approved a 25% TAC for the Portage Bay harvest years 2025 – 27 on March 18th, 2025.

On-Reservation Subsistence harvest

Some subsistence harvest takes place in Lummi and Portage Bays, however, there is currently no routine method to quantify subsistence harvest on-reservation beaches. Previous reports suggest subsistence harvest accounts for an estimated 14,906 lbs annually (Mueller and Starkhouse 2018) and more recently that subsistence harvest is around 12% of the harvestable biomass at Lummi Bay and 17% of the harvestable biomass at Portage Bay (Hintz 2018b). Furthermore, these estimates of subsistence harvest do not include harvest for ceremonial purposes and illegal poaching so the actual harvest of Manila clams from on-reservation beaches will likely be higher. Therefore, the proposed TAC provides a buffer to account for Manila clam harvest from subsistence, ceremonial, and illegal poaching.

References

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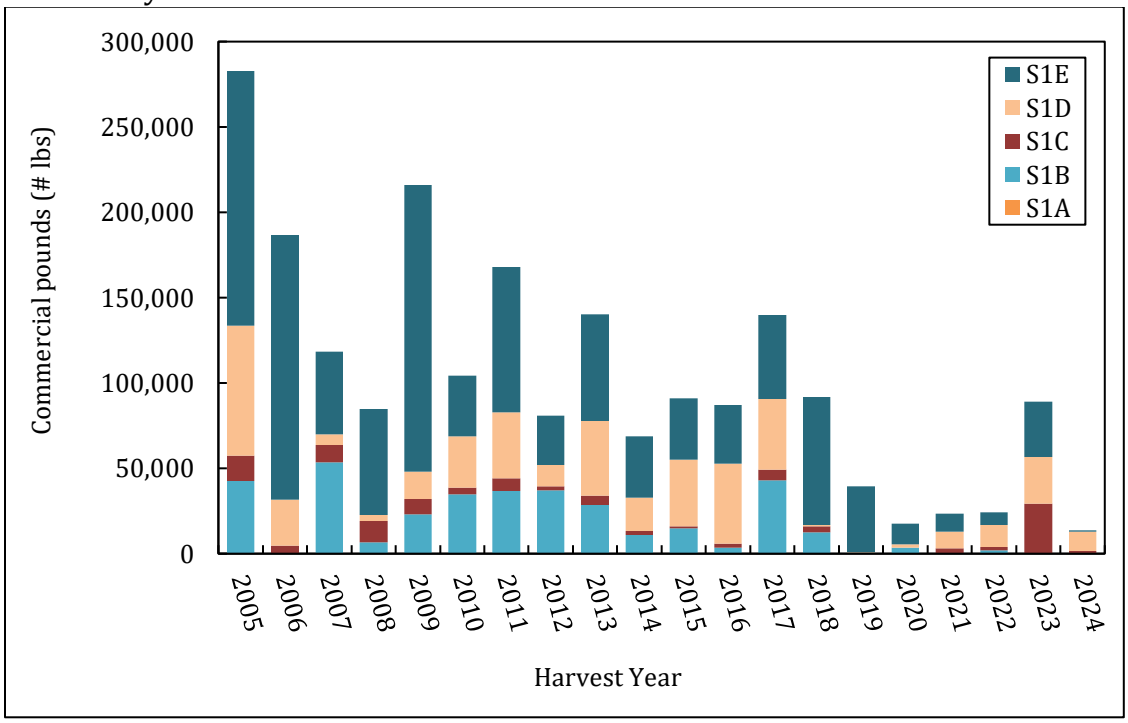
OTHER

Table 6 Comparison of Manila clam commercial harvest landings from past management years to the proposed TAC level for the 2018-2019 management year.

Area	Beach	Management year				Proposed TAC
		2019-20	2020-21	2021-22	2022-23	
Lummi Bay	S1B	-	3,504	-	1,760	92,077
	S1C	49	-	4,225	4,838	64,602
	S1D&E	19,722	9,340	29,626	24,104	244,396
		19,771	**12,844**	**33,851**	**30,702**	**401,075**
Portage Bay	21A-S4	-	-	719	5729	~75,000
	21A-S5	-	-	243	7625	
	21A-S6	-	-	3830	27424	
	21A-S7A	-	-	501	31516	
	21A-S7D	-	-	1359	14196	
	21A-S7E	-	-	3905	15871	
		-	**-**	**10,557**	**102,361**	**~75,000**
Total Pounds		**19,771**	**12,844**	**44,408**	**133,063**	**476,075**

Lummi Bay



Semiahmoo & Birch Bay

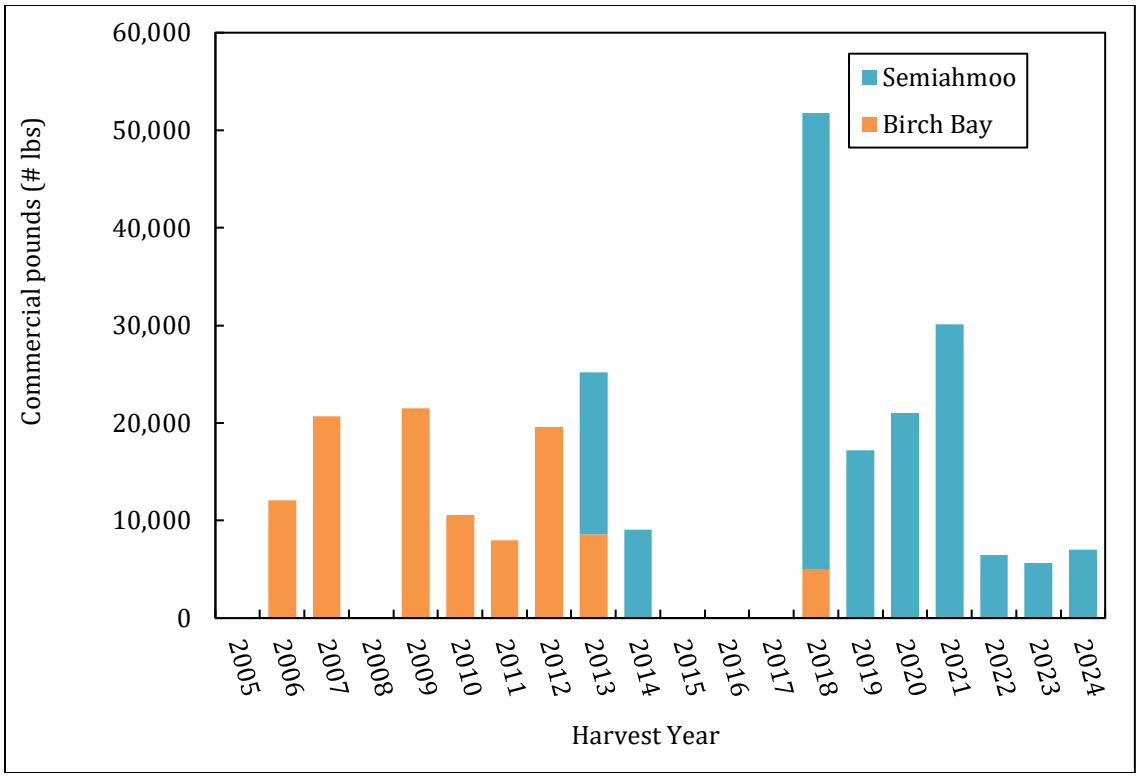


Figure 2. Total pounds of commercial harvest (columns) and harvest rate (line) between the 2010-11 through 2022-23 harvest years.