Digging up trends in Coos Bay clam abundance: A comparison of historical and recent survey methods and data

Amy M. Hutmacher, Anthony D'Andrea, Stacy N. Galleher, Kelsey L. Adkisson, Natalie A. Amoroso, Jennifer C. Boyer Oregon Department of Fish & Wildlife, Marine Resources Program

Introduction

In 2008 and 2009 the Oregon Department of Fish and Wildlife's Shellfish and Estuarine Assessment of Coastal Oregon (SEACOR) program conducted the first comprehensive clam abundance and habitat survey in Coos Bay since the 1970s (Hancock et al 1979). Multiple methods were developed for the 2008-2009 study to yield an unbiased estimate of clam abundance and distribution throughout the estuary, and to replicate the methods used in the 1970s. Comparisons of historical to contemporary Coos Bay data proved challenging because the sampling technique employed in the 1970s was intended to identify areas with harvest potential. This method comparison highlights the limitations inherent in comparing data from studies with different designs and intents and the need for unbiased methods for determining accurate clam abundances throughout Oregon estuaries.

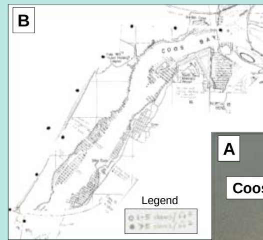
Methods

Three sampling methods were utilized to assess clam abundance in Coos Bay (Figure 1A) and to make comparisons with data from the 1970s surveys: a rapid assessment method (RAM), 2009 MAX, and 2009 FOOT. Gaper (*Tresus capax*) and butter clam (*Saxidomus gigantea*) burrow holes were counted to quantify the abundance of each species. 2009 MAX and 2009 FOOT were conducted on the Clam Island and Pigeon Point tide flats (Figure 1A).

- RAM was used in 2009 at 1 m^2 waypoints along a 50 x 200 m grid throughout the estuary.
- 2009 MAX was conducted by navigating to a waypoint in a known bivalve bed and circumambulating ~30 m around the waypoint to locate the area of maximum clam density.
- 2009 FOOT involved counting burrow holes in the densest 1 ft^2 within the 30 m area around the point. 2009 FOOT best replicated the 1970s methods and yielded a clam density value in the same units (clams/ft^2).

The percent cover of eelgrass was also recorded and was binned similar to the 1970s survey using categories of sparse, moderate, and dense. The 1970s clam data was recorded as density categories (0, 1-5, >5 clams/ft^2), so for comparison 2009 FOOT data was placed into the same categories. To calculate low estimates of abundance, sites with 1-5 and >5 clams were assumed to have 1 and 6 clams, respectively. For high estimates, 5 and 6 clams were assumed.

The 1970s sample locations and data represented on hand drawn maps (Figures 1B and 1C) were digitized and ArcGIS was used to create maps to visually compare the historical data to the 2009 results. Both abundance calculations were graphed for comparison.



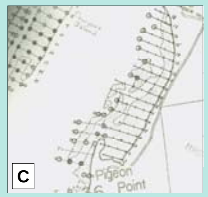
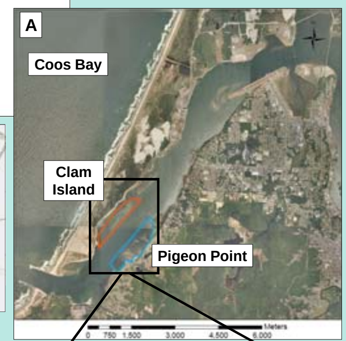


Figure 1. (A) Clam Island and Pigeon Point tide flats were resampled in 2009 for comparison with 1970s data. (B and C) Hand drawn maps indicating sample locations and densities of target species were used to compile data from 1970s surveys.



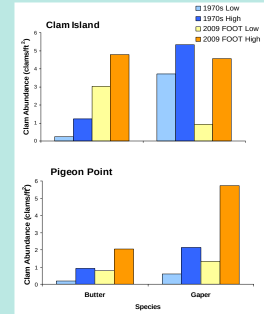


Figure 4. Butter clam abundance seems to have increased at both flats since the 1970s and gaper clam abundance has increased at Pigeon Point while decreasing at Clam Island. These patterns are consistent whether low or high estimates are used.

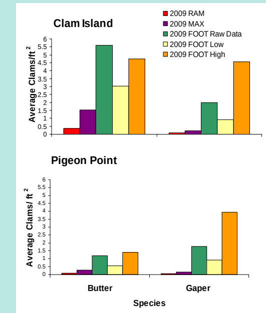


Figure 5. The 2009 FOOT method overestimates clam abundance when compared to RAM. This was expected as the 1970s and 2009 FOOT surveys targeted areas with high clam abundance. The degree of overestimation is based on the species, tide flat, and whether the data is converted to a low or high estimate of the values within each bin (0, 1-5, >5).

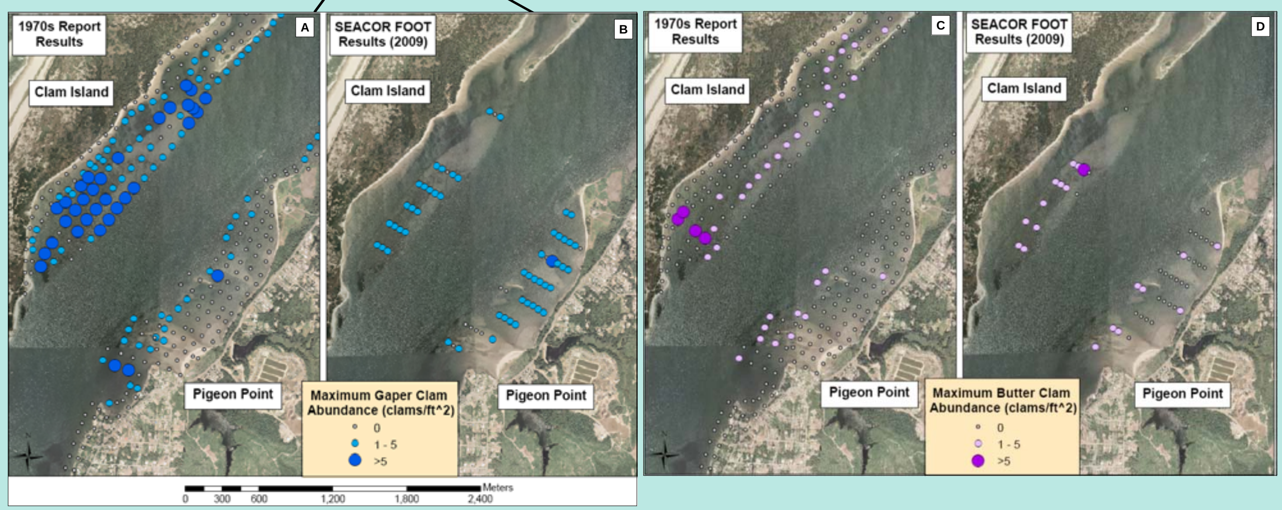


Figure 2. In the 1970s (A and C) and 2009 surveys (B and D), clam abundance was recorded as density ranges. With the results from the 1970s alongside those from 2009, it can be seen that in some areas gaper (A and B) and butter clam (C and D) densities have increased whereas in other areas they have decreased. Fewer sites with high gaper densities (>5/ft²) were sampled in 2009. Note that more locations were sampled in the 1970s than in 2009.

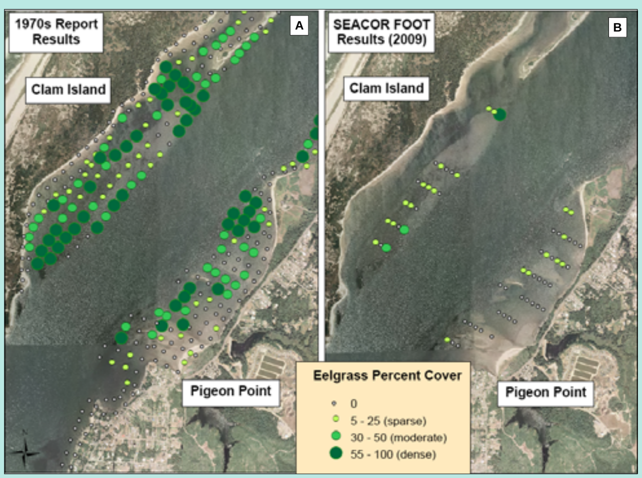


Figure 3. In the 1970s survey eelgrass cover (A) was categorized as sparse, moderate, dense, or not present. Eelgrass percent cover values from 2009 (B) were converted to these cover categories. It appears that areas with dense eelgrass cover have declined over time; however, it should be noted that many more locations were sampled in the 1970s than in 2009.

Discussion

Differences were observed in gaper and butter clam abundance over time and based on methodology. It was expected that the 1970s and 2009 FOOT methods overestimated clam abundance compared to estimates derived from RAM; the 1970s and 2009 FOOT methods were intended to estimate maximum clam abundances per square foot on a tide flat, while RAM did not specifically target areas with high clam density. Whether low or high estimates are used, trends in clam abundance are the same; however, the magnitude of overestimation differs. For example, 2009 FOOT low estimates of butter clam abundance are 8.3 and 5.6 times greater for Clam Island and Pigeon Point, respectively. 2009 FOOT high estimates of gaper clam abundance are 44 and 57.1 times greater for Clam Island and Pigeon Point, respectively.

Because the historical data was only available in a binned format, the calculation of low and high clam abundance estimates required assigning discreet values to each bin; thus, abundance estimates, particularly those based on the historical data, should be used conservatively. However, comparing locations with high densities of clams with habitat data could be useful in determining habitat characteristics correlated with clams. For example, ODFW studies in Tillamook Bay have found that eelgrass is positively correlated with clams. Mapping estimates of algae cover and sediment type from the 1970s and 2009 surveys might be useful, but the qualitative nature of the 1970s data will limit the extent of the comparisons that can be made.

The results of this project emphasize the value of retaining raw data instead of binned data and the limitations of comparing data from projects with different sampling designs and intents.

Acknowledgements

Fieldwork that formed the basis of this project was conducted by ODFW crews in the 1970s, as well as the Coos Bay SEACOR team and volunteers. 1970s data was entered into ArcGIS by Steven Highland. This project was funded by recreational shellfish licenses.