Spatial comparison of bay clam morphometrics and age structure in three Oregon estuaries

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Introduction

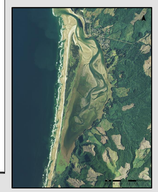
Management of Oregon's bay clam resources and habitats are the responsibility of the Oregon Department of Fish and Wildlife (ODFW) Shellfish Program. Bay clams, which are referred to and managed collectively, include: butter clams (*Saxidomus gigantea*), cockles (*Clinocardium nuttallii*), gaper clams (*Tresus capax*), and native littleneck clams (*Leukoma staminea*). This analysis examined bay clam morphometrics and age structures in three recreationally important Oregon estuaries: Netarts, Tillamook and Yaquina bays. Presented here are the results from gapers and cockles, which differ in several key life history traits. Age-size relationships are an informative component of bay clam management. These findings will guide future ageing studies.

Estuaries

Tillamook

Tillamook Bay is the second largest outer coast estuary in Oregon and is fed by five major rivers. It supports more than 70% of the state's commercial bay clam fishery and has one of the most popular recreational clamming areas in Oregon.

Netarts



Netarts Bay is a popular location for recreational clamming. Commercial harvest of cockles and oyster farming also occur within the bay. Unlike most of Oregon's estuaries, Netarts Bay is not fed by a major river. Instead, a number of small streams flow into it from the surrounding watershed. This results in relatively high salinity in the bay, enhancing the quality of shellfish habitat.

Yaquina

The lower Yaquina Bay estuary is a drowned river mouth system with salt marshes, sloughs, and several large mud flats. The bay supports a mosaic of commercial and recreational uses including many popular recreational clamming areas.

Bay Clams

Cockles

Clinocardium nuttallii

- Lengths up to 10 cm
- Found near surface in the mid to low intertidal
- Life span 15-19 years
- Summer reproduction around year 2
- Mobile: move with a highly developed foot

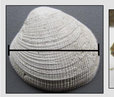
Gapers

Tresus capax

- Lengths up to 18 cm
- Found up to meter deep in the lower intertidal
- Life span 15 years
- Winter reproduction around age 3 or 4
- Sessile: adult gaper are unable to rebury once disturbed

Data Sets

This analysis utilized four existing data sets, each with unique characteristics.



Length measurement

Width measurement

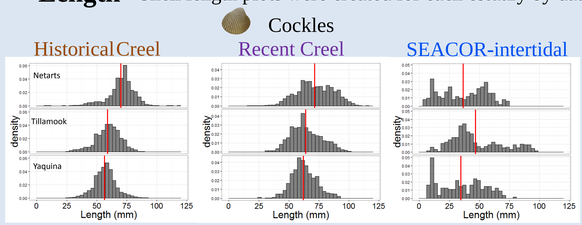
Cockle estimated age from growth checks

Data Set	Years Sampled	Data Type	Methods	Parameters
Historical Creel	1983-1991	fisheries dependent	recreational harvester interviews	length, age from growth checks
Recent Creel	2008-2014	fisheries dependent	recreational harvester interviews	length
SEACOR-full (subtidal and intertidal)	Netarts-2013-2014 Tillamook-2010-2012 Yaquina-2012	fisheries independent	stratified random sampling	length, weight, width, density
SEACOR-intertidal	Netarts-2013-2014 Tillamook-2010-2011 Yaquina-2012	fisheries independent	stratified random sampling	length, weight, width, density

Do bay clam morphometrics or age structures vary on a spatial scale?

Length

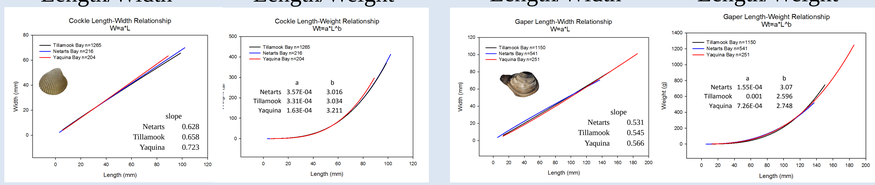
Shell length plots were created for each estuary by data set with mean length shown in red.



Morphometric Relationships

- SEACOR-full data were used to create regression relationships.
- The variation in slope between the estuaries were evaluated using ANCOVA (α=0.05).

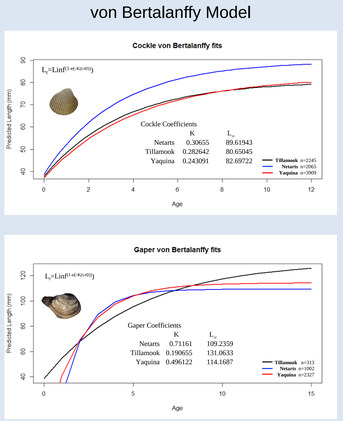
Morphometrics differ significantly between estuaries

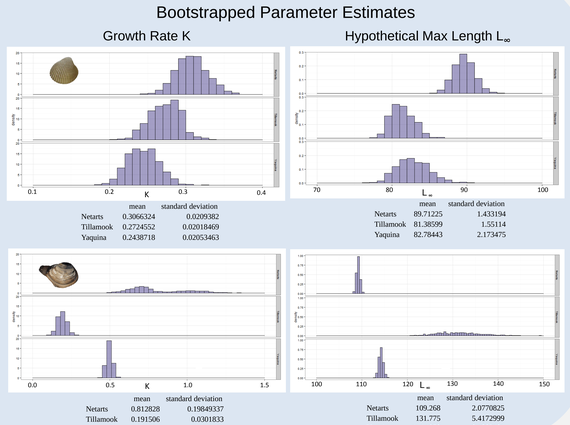


Growth Models

- The von Bertalanffy model parameters (l_∞, K, and t_0) were estimated for each estuary from the Historical Creel data.
- Differences in model predictions between estuaries were explored by bootstrapping parameter estimates 1000 times and using ANOVA with pairwise comparison using t tests with pooled standard deviation (α=0.05).

Growth models differ significantly between estuaries

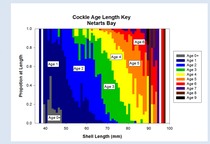




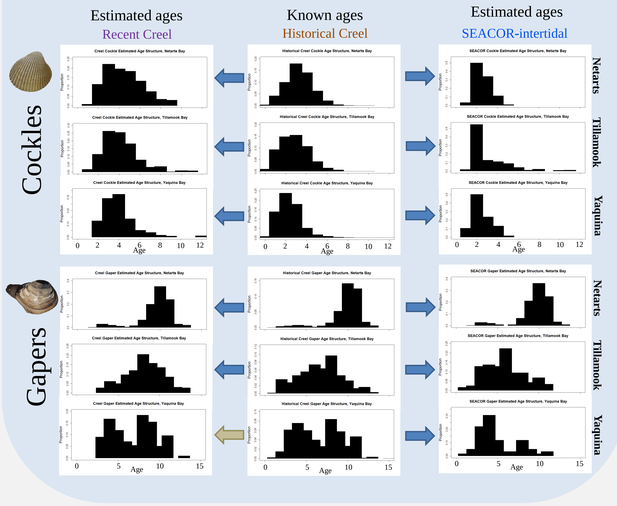
Age-Length Keys

- Age-length keys were created using the Historical Creel data.
- Keys were then applied to the Recent Creel and SEACOR data.
- The differences in mean age between data sets were evaluated using a KS-test (α=0.05). Each estuary with a blue arrow ⟸ has significant differences in their estimated age from the known age structure.

Example Age-Length Key



Most estimated age structures are significantly different between estuaries and between data sets



Findings

- **Spatial Variability**: Cockle and gaper morphometrics and age structure vary on a spatial scale. Similar results were found for butter and native littleneck clams.
- **Data Type:** The use of fisheries-dependent data with inherent biases of non random sampling and size selectivity may alter predicted relationships when applied to fisheries-independent data.
- **Ageing:** Reliability of growth checks for ageing varies by species.
- **Further studies:** Spatial variability, data type and ageing method should be taken into consideration both in further data collection efforts and in the building and application of growth models informing the effective scale for fisheries management.

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