



Estimating Effort in Tidally Influenced Shellfish Fisheries of Oregon Estuaries

Justin Ainsworth and Mitch Vance

Oregon Department of Fish and Wildlife, Marine Resources Program
Newport, OR 97365



Introduction

In Oregon estuaries, recreational crabbing and clamming are popular activities for local residents as well as visitors. Participation in both of these fisheries is influenced by the tides, and the Oregon Department of Fish and Wildlife's Shellfish Program has developed empirical models to estimate total seasonal or annual participation. These models exploit the relationship between instantaneous fishery effort counts and total daily effort. These effort estimates are part of a larger survey to estimate total recreational shellfish harvest in Tillamook, Netarts, Yaquina, Alsea, Winchester, and Coos bays.



Fisheries

Crab Fishery: Bay crabbing effort for Dungeness and red rock crabs peaks during the time just before and after a high or low tide when tidal currents are slower. Crabbers typically deploy gear an hour or two before slack current and fish their gear for an hour or two after. Gear can include pots, rings, and snares.

Clam Fishery: Bay clamming is generally conducted when the tide level is between -2.0 ft (below Mean Lower Low Water) and +2.0 ft. Commonly targeted bay clams include gaper clams, cockles, butter clams, native littleneck clams, purple varnish clams, and softshell clams.



Effort Count Methods

Instantaneous effort counts are scheduled to coincide with the tides.

Crab survey: All buoys within a bay are counted near the time of slack tide (either high or low) and categorized by day type (weekend or weekday).

Clam survey: All diggers within a bay are counted at low tide. Stratified by day type (weekend or weekday) and by tide magnitude (moderate (0.0 to -1.0 feet) or extreme (≤ -1.0 feet)).

Model Development

Crab Survey: Instantaneous buoy counts were conducted every 30 minutes during daylight hours to generate a series of daily effort curves. The integrated area under each curve yields the whole day effort (WDE). The effort unit is pot-hours; the number of pots fished multiplied by soak time. The relationship between a count (C) at time (t) creates a correction factor (CF) such that $CF_t = WDE/C_t$, with a 95% confidence interval, $CF_t = \pm t_{0.05,df} \times sd(CF_t) / \sqrt{n}$.

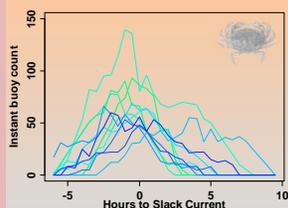


Figure 1. Total number of buoys counted in Yaquina Bay during the development of the Correction Factor model. Each line represents a sampling day where counts were conducted every 30 minutes during daylight hours.

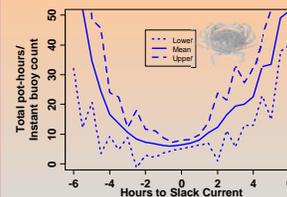


Figure 2. Model generated correction factors for estimating whole day effort (in pot-hours) by expanding instantaneous counts of buoys during crabbing effort surveys.

Clam Survey: Whole day effort observations were pooled together to create the Effort Distribution Ratio (EDR) model. Samplers arrived on the clam bed 3 hours before low tide and stayed until 3 hours after low tide, conducting instantaneous counts (C) every 30 minutes. Additionally, a census was conducted by recording the total effort (number of diggers, E) for the whole day. The ratio between the number of diggers present at time (t) and the total diggers is $EDR_t = C_t/E$, with a 95% confidence interval, $EDR_t = \pm t_{0.05,df} \times sd(EDR_t) / \sqrt{n}$.

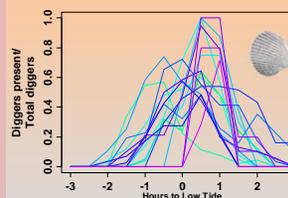


Figure 3. Multiple effort distribution ratio observations. Each line represents the ratio between the number of diggers present at each 30 minute count and the total diggers that visited the tideflat.

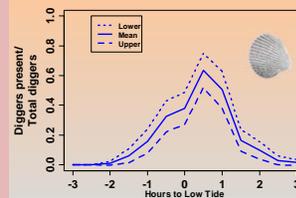


Figure 4. Model generated effort distribution ratios for estimating whole day effort (number of diggers) by expanding instantaneous counts of clam diggers during estuarine clamming effort surveys.



Acknowledgements:

We would like to thank all of the shellfish samplers who helped collect data: Carri Andersen, Jim Heinrich, Wendy Sletten, Nate Lewis, Laura Kushner, Stephanie Ichien, Aaron Bliesner, Kelly Corbett, Ashley Quintance, and David Phillips.

This work is funded by ODFW recreational shellfish license sales.

Contact Information:

Justin Ainsworth - 541-867-0300 ext. 288
Justin.C.Ainsworth@state.or.us

Mitch Vance - 541-867-0300 ext. 233
Mitch.Vance@state.or.us

ODFW Shellfish Program -
<http://www.dfw.state.or.us/MRP/shellfish/>

Model Application

Crab Survey: Since 2008, buoy counts have been conducted in Tillamook, Netarts, Yaquina, Alsea, Winchester, and Coos bays. Multiple effort counts per week were expanded using the CF model and averaged within strata. Estimates of total seasonal or annual effort are generated for each estuary. As an example, Figure 5 shows the weekend crabbing effort in Yaquina Bay is almost always greater than weekdays, and the most overall effort occurs in the late summer/early fall.

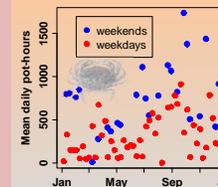


Figure 5. Bay crabbing effort per week in Yaquina Bay in 2009. Daily pot-hours is estimated by expanding bay-wide buoy counts using the Correction Factor model.

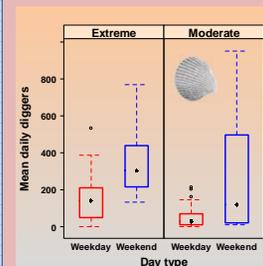


Figure 6. Clam digging effort in Netarts Bay, 2008-2010, on days with extreme low tides (≤ -1.0 feet) compared to moderate low tides (0 to -1 feet). The daily number of diggers is estimated by expanding bay-wide clam diggers counts using the Effort Distribution Ratio model.

Clam Survey: Clamming effort surveys have been conducted in Tillamook, Netarts, Yaquina, and Coos bays since 2008. Multiple effort counts during low tides were expanded using the EDR model and averaged within strata. Figure 6 exemplifies the effect that day type and tide magnitude have on the total number of daily diggers in Netarts Bay during the years 2008-2010. Weekend effort is higher than weekday effort, as well as on days with extreme low tides (0 to -1 feet).

The Rest of the Story

These effort estimation models continue to be employed as part of our recreational shellfish catch and effort surveys. Coupling the effort estimates with catch information obtained by on-site harvester interviews (creel surveys), allows us to estimate total recreational shellfish harvest. These estimates can be made for any specific species, bay, or time period.

While this presentation focuses on bay crabbing and clamming, we also have programs that estimate recreational effort and catch in the razor clam fishery and the Columbia River Dungeness crab fishery. Each of these fisheries employ slightly different methods while accomplishing the same goal. Estimates of overall effort and total take by recreational harvesters are very helpful for public education as well as for resource management decisions.