A Tale of Two Crabbies: Temperature Effects on the Bioenergetics of Dungeness and Graceful crabs

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Average Global Sea Surface Temperature, 1880–2015

Photo: NOAA
Introduction

Photo: ECY

Legend:
- Red = higher than expected (> *IQR)
- Black = expected (= *IQR)
- Orange = higher than previous measurements
- Green = lower than expected (< *IQR)
- Gray = no data

*IQR = Interquartile Range (25th – 75th percentiles); n = 17
Dungeness crab numbers decline in south sound

Islander John Cushing has gone crabbing for the Pacific Northwest's famed Dungeness crab two times this year, and unlike in previous years when he quickly caught his limit, this year he has come away nearly empty handed — and concerned about the state of the fishery.
Dungeness crab

**Size:** to 20 cm  
**Economic importance:** high  
**Highest Densities:** North Puget Sound; deeper waters

Graceful crab

**Size:** to 9 cm  
**Economic importance:** low  
**Highest Densities:** South Puget Sound; shallow embayments
How does temperature affect performance of the two species?
Inputs:
- ambient temperature
- Start Weight
- End Weight

\[ R + W + G = C \]

\[ S.W. - E.W. = G \]

Start Day \rightarrow \text{Respiration} \rightarrow W \rightarrow \text{growth} \rightarrow \text{End Day}

R \quad W \quad G \quad C
Inputs:
• ambient temperature
• Start Weight
• End Weight

\[ C - R + W = G \]
Physiological Rate

Consumption
Respiration

Digestion Rate

Temp

Max. Lethal Temp

Thermal Stress
Crab consumption experiments

1) Consumption at different sizes
2) Consumption at different temps (5-24 deg C)

Starved 48 hrs → acclimated 6 hrs → 12 hour forage period → filtered food

Food before feeding

Food after drying

Laboratory aquaria
**Graceful crab**

**Consumption at diff sizes**

**Constant temperature**

\[ y = 0.2652x^{0.432} \]

\[ R^2 = 0.4441 \]

\[ y = 0.2652x^{-0.568} \]

\[ R^2 = 0.58006 \]
Graceful crab

Consumption at diff temps
Similar size class

Specific Consumption (WWg/WW g)

Temperature (Deg C)
Consumption at diff temps
Similar size class

Dungeness crab

Graceful crab
Some thoughts...

- Temperature-consumption curves differ for the two species.

- These differences in performance relative to temperature may contribute to differences in distribution.

- Additional work is needed to resolve other components of the bioenergetics model (e.g., egestion).
Predator-prey and habitat relationships

Introduction

Question

Approach

Findings

Summary
Shifting size at age
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