Effects of Competitive Dominance of an Exotic Crab, *Carcinus maenas,* Over the Native Crab, *Hemigrapsus oregonensis,* on Nutrient and Energy Acquisition by Harlequin Ducks

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INTRODUCTION

- The impact of prey availability during the winter and molting seasons on the population ecology and habitat requirements of the western North American population of harlequin ducks (*Histrionicus histrionicus*) has not been thoroughly investigated.
- Crabs, primarily the yellow shore crab (*Hemigrapsus oregonensis*), are significant food items to molting harlequins (Rodway & Cooke 2002).
- Significant declines in the populations of yellow shore crab have been attributed to the presence of the invasive exotic green crab, *Carcinus maenas,* which first established a presence in eastern Pacific coastal waters in the late 1980s (Grosholz et al. 2000). *C. maenas* has also been implicated in commercially important invertebrate population declines on the east coast of North America.
- If the presence of green crabs in western North American coastal waters is detrimental to harlequins in light of 1) displacement of important prey items, such as the yellow shore crab, and 2) a lack of nutritive benefit, then a higher importance may be placed on conservation and management of western harlequin populations.
- Alternatively, it is possible that the presence of green crabs poses no energetic challenge to harlequins.

GOALS & OBJECTIVES

- Use harlequins as a model species to determine the relative energy values of mobile prey, specifically the native yellow shore crab and invasive green exotic crab
  - Evaluate the relative energetic and nutrient value of the yellow shore crab – an established harlequin prey item – and the competing green crab.
  - Evaluate the assimilated energy of both crab species fed to harlequins.
  - Determine the functional response of harlequins to two densities of each species of crab.

Carcinus maenas

Hemigrapsus oregonensis

Histrionicus histrionicus in dive tank

METHODS

- Captive seaduck colony at USGS Patuxent Wildlife Research Center (Patuxent) includes 20 harlequins (14M:6F).
- Ducks maintained in open-air enclosures, each with a pool of water (circumference 5 m, depth 0.75 m)
- 2 large dive tanks equipped with cameras and other equipment for diving energetics studies with ducks (pictured).
- Live crabs (approximately 15-30 mm carapace width) obtained from Salem State College, Massachusetts; Portland State University, Oregon; and Friday Harbor Laboratories, Washington.
- Crabs maintained in a closed-system, temperature and salinity-regulated aquaculture facility at Patuxent.

Energy & Nutrient Composition and Digestibility

- 30 individuals of each crab species weighed and oven dried at 50°C.
- Crabs burned in a muffle furnace at 500°C to yield ash free dry mass.
- Bomb calorimetry conducted at Center of Excellence for Poultry Science (CEPS), University of Arkansas to determine energy content.
- 2 separate assimilation trials for each of 10 randomly selected ducks using known quantity of each crab species.
- Feces and excreta from ducks oven dried at 50°C to constant mass; homogenized subsamples analyzed by CEPS lab for energy, lipid, nitrogen, and ash content.

Functional Response: Intake Rates & Number of Dive Cycles

- 16 randomly selected ducks individually offered each crab species.
- 4 four separate dive trials per duck: each crab species presented in 2 separate densities (30 m^{-2} and 100 m^{-2}).
- Crabs distributed throughout a grid of four trays (1.0 m^2 total) filled with sand & gravel and lowered in dive tank.
- Trials recorded using underwater video camera; footage will be analyzed to determine time each duck spends searching for the food source.

IMPLICATIONS

- Results will provide insights into the habitat requirements and population ecology of western North American harlequins and provide a basis for future population-level comparisons.
- We hope to connect the results of this study to concerns regarding habitat, invasive species impacts, and trophic-level interactions specific to other seaducks feeding on mobile prey.

Histrionicus histrionicus at Patuxent Wildlife Research Center

One of two dive tanks (2.4 m x 1.8 m x 2.4 m) used for diving energetics studies with ducks at Patuxent Wildlife Research Center

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