INFLUENCE OF HARMFUL ALGAL BLOOMS ON THE FORAGING BEHAVIOR OF SHOREBIRDS IN CENTRAL CALIFORNIA

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Approach

Shorebirds and seasonally toxic prey in California

Our general approach was to document and correlate changes in the foraging behavior of free-ranging avian predators with seasonal changes (spatial and temporal) in harmful algal bloom (HAB) related toxicity of their invertebrate prey in two different habitat and community types. Habitats included: 1) Rocky shores where Black Oystercatchers (Haematopus bachmani) forage primarily on sea mussels (Mytilus californianus), and, 2) Exposed sandy beaches where a diversity of shorebirds forage on extremely abundant mole crabs (Emerita analoga). Each of these prey species are known to accumulate PSPT during HAB events. These two systems provided ideal study sites for determining the ecological role of phytoplankton in benthic communities. Pairing each sandy site with a rocky site separated by only a few hundred meters not only minimized field effort, but enabled comparisons of prey toxicity and predator behavior in different habitat types exposed to very similar bloom conditions. Although shellfish at the proposed study sites generally exceed the state quarantined level for PSPT toxicity every year (8µg STX/100g - STX is saxitoxin, the most potent compound in the PSPT toxin profile), it is also true that more intense toxic phytoplankton blooms occur at random locations along the California coast nearly every year. These sites (north to south): Limantour Beach, Pescadero Beach, Pebble Beach, Pfeiffer State Beach have historically exhibited a latitudinal gradation in toxicity from the north to the south. Therefore, Limantour and Pescadero beaches were considered “toxic” sites, while Pebble Beach and Pfeiffer were considered control areas.

Hypothesis 1 results- Birds switch to alternate prey at high prey toxicity

Abstract

We tested the general hypothesis that the foraging behavior and distribution of shorebirds under natural conditions are mediated by benthic prey toxicity due to harmful algal blooms (HAB’s). In California, observed changes in shorebird (mainly Oystercatchers, Whimbrels, Godwits and Kittiwakes) foraging behavior was correlated with seasonal changes in paralytic shellfish poisoning toxins in their primary prey, sea mussels (Mytilus californianus) and mole crabs (Emerita analoga). In rocky habitats where mussel toxicity exceeded 150µg/STX/100g, Oystercatchers significantly increased their consumption of limpets as well as their discard rate of mussel tissue. In sandy beach habitats, where Emerita toxicity exceeded 150µg/STX/100g, shorebird abundance decreased significantly, while their rejection rate of Emerita prey increased significantly.

Hypotheses

How does the seasonal increase in prey toxicity due to PSPT producing HAB’s influence the foraging behavior of avian predators?

H1: Avian predators switch to alternate prey at a predictable toxicity threshold.

H2: Avian predators reject prey containing concentrations of toxins above a threshold level.

Methods

Field Data

Observations of foraging birds were made every two weeks during the lowest tides of the month at pre-selected rocky and sandy beach sites from April through October. Foraging data was collected using a “continuous focal sample” method. Time and duration of the bird’s activities were recorded to the nearest second, as well as habitat used, and weather and surf conditions. Major activity categories included: searching, prey handling, inactive periods of foraging due to wave interruption, resting, interacting with other birds (especially kleptoparasitism), and out-of-view. All prey captured during a focal sample was identified and recorded. Rejection and partial consumption of prey was also noted.

Toxin analysis

Representative samples of prey (sea mussels and mole crabs), were collected during each sampling period for PSPT analysis. These samples were handled and processed according to California State Department of Health Services (CDHS) shellfish monitoring protocols, and analyzed for PSPT by CDHS using the standard mouse bioassay.

Hypothesis 3 results- Birds discard a significantly greater percentage of captured prey at higher toxicity

Conclusions

Shorebirds reduce their exposure to PSPT toxins during HAB events by:

• changing their diet
• discarding toxic prey
• avoiding affected areas

These behavioral responses may account for the rarity of shorebird mortality due to HAB’s.

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