One Health research at land-sea interfaces

Woutrina Smith, DVM, MPVM, PhD
One Health Institute & VME Department
School of Veterinary Medicine, UC Davis
Land – Sea Connections

Disease causing agents on land can affect the health of ocean inhabitants
Sea Otter Causes of Death

Slow it down! Boat strikes kill sea otters.

Sea otter on port side of boat
Pathogen pollution

Land to sea flow:
- Sewage plants
- Animals
- Rivers
- Ocean
- Shellfish

http://www.awag.org/Education
• *Cryptosporidium, Giardia,* and pathogenic bacteria in marine mussels and freshwater clams associated with recent rain events, exposure to rivers/streams, and/or human fecal sources (Miller et al., 2005, 2006a, 2006b).
Wetlands perform important functions to improve water quality and ecosystem health.
Collaborative Teams

- California Dept. of Fish and Wildlife
- UCD Wildlife Health Center
- Bodega Marine Laboratory
- United States Geological Survey
- Monterey Bay Aquarium
- The Marine Mammal Center
- UCSC Long Marine Laboratory
- Central Coast Water Quality Control Board
- United States Fish and Wildlife Service
Asia and Africa Water Quality Projects
Harmful Algal Blooms
Pinto Lake Watershed Approach: From Land to Sea

A. BACKGROUND INFORMATION & PROJECT RATIONALE

Sea Otter Deaths Linked to Microcystin
In 2007, a concerning problem was identified along the central California coast: During that year, at least 12 Southern sea otters, a state and federally-listed threatened species, were found dead along the shoreline with bright yellow gums and evidence of acute liver failure. Subsequent biochemical testing confirmed death due to acute microcystin poisoning. Microcystin is a highly toxic and environmentally stable byproduct of blooms by the cyanobacterium (blue-green alga) Microcystis. Super-blooms of Microcystis commonly occur in fresh and estuarine water bodies that are warm, shallow, stagnant and nutrient-enriched. However, this was the first time that these toxins had been linked to deaths of downstream-dwelling marine mammals. Since that time approximately 40 additional sea otters have tested positive for microcystin following postmortem examination.

Land-Sea Flow of Microcystin
A subsequent investigation confirmed that microcystin-contaminated fresh water was flowing into the Monterey Bay National Marine Sanctuary via impaired rivers, causing the sea otter deaths. The mussels, clams and crabs that sea otters rely on to survive were shown to concentrate and retain microcystin toxin in their tissues. Based on carcass stranding patterns and water testing, sea otter deaths due to microcystin poisoning were traced to specific rivers flowing into Monterey Bay. In one case a severe Microcystis bloom in Pinto Lake was linked with microcystin contamination of a downstream creek and river all the way to the ocean. The concentration of microcystin that was detected during this super-bloom at Pinto Lake was one of the highest ever measured in the United States and severe, recurrent Microcystis blooms have continued in Pinto Lake, resulting in the designation of this impaired water body as a state and national Cyanobacterial Harmful Algal Bloom (Cyanobacteria harmful algal bloom) “hotspot” (U.S. EPA, 2012).

Negative Impact of Microcystin on Human Health
There is significant potential for microcystin to cause human illness in California. Microcystin is extremely potent and environmentally stable. It can cause toxicity through ingestion, inhalation or dermal exposure. Microcystin contamination of drinking water has resulted in widespread gastrointestinal diseases in several areas of the United States (Falkiner, 2003). In extreme cases, acute microcystin poisoning has also caused mortality of humans and animals (Oelmann et al., 1998; Brind et al., 2003). Microcystin and related cyanobacterial compounds can also cause chronic poisoning at lower concentrations, can act as dermal and respiratory allergens, and have been linked with induction of liver cancer in humans. Another very concerning property of macrocystin is their ability to cycle repeatedly between the intestinal tract and liver, resulting in prolonged toxicity following a single ingested dose.
Welcome to Dr. Esteban Soto!
Fish microbiologist and pathologist extraordinaire!

wasmith@ucdavis.edu