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In This Issue

Dietary and Environmental Influences on Public Health

Diversity in diet has been shown to benefit human health by improving nutritional status and reducing risks of specific diseases. The biological diversity of forests and agricultural systems reasonably facilitates varied diets, and thereby positive health outcomes, in the populations that rely on them. However, the challenges of demonstrating this relationship limit its impact in concept, policy, and practice. Bélanger and Johns (2008) present a rationale for testing the dietary contribution of biological diversity to improved eye health based on a review of existing scientific knowledge. One obstacle they identify is that the majority of long-term epidemiological studies are focused on isolated micronutrients in Western populations, rather than whole foods and dietary patterns in developing regions. Their case study of eye health justifies and supports a strategy for reconstructing food systems in regions that typically harbor both the richest and most vulnerable biological diversity and the greatest disease burden.

Ciguatera Fish Poisoning (CFP) is an example of a specific foodborne disease problem with a complex set of interactions between ecological, socioeconomic, local governance, and community dynamics processes. Study of the whole picture of influences to coral reef ecosystem health, the human communities that depend on and are a part of them, and the factors associated with ciguatoxin biomagnification leading to this potentially fatal disease lends itself to an applied ecohealth approach based on both post-normal science and complex adaptive social-ecological systems research. Morrison et al. (2008) applied such an approach through their comparative study of CFP in three Cuban fishing communities. Their analysis identified that the level of organization of the local sports fishing community and the degree of degradation of the local nearshore marine ecosystem appear to be key factors influencing the diverging levels of CFP outbreaks recorded in the 1990s in the communities studied.

Pokras and Kneeland (2008) address a reemerging heavy metal that keeps affecting humans, wildlife, and ecosystems. Using transdisciplinary approaches to solve an ancient problem may be the only way to get rid of lead and other heavy metals and toxins from the environment. Educating people and policy makers may change our attitude towards a cleaner environment. Nationally, lead poisoning of waterfowl and bald eagles resulted in a 1991 federal ban on the use of lead shot in waterfowl hunting. By 1997, it was estimated that the ban on lead shot saved 1.4 million ducks. However, other lead sources remain, like lead sinkers, that are the primary cause of mortality in loons (*Gavia immer*). Policy changes recommended in this review article can help protect bird populations and improve the environment.

With increased understanding of the implications of environmental pollutants on the health of populations and the environment, the training of medical students as health advocates has gained increasing importance. Villela et al. (2008) report on their study to evaluate the effect on the attitudes of medical students achieved by delivering a single seminar on pesticide usage and human health. Their results show how open the students' attitudes are to community-specific environmental issues, and that incorporating education based on the ecosystem health model encourages future medical professionals to consider broadening their roles in community health promotion.

Marine Mammal Conservation, Environmental Pollution, and Infectious Disease

Most epidemiological models with GIS applications have been developed for terrestrial ecosystems, however, diseases and mortality in the oceans are increasing in prevalence, incidence, and geographic distribution. Norman (2008) overviewed the importance of GIS and spatial epidemiology in marine mammal conservation and health. It is evident that some emergent diseases in marine mammals are the result of pathogen pollution from terrestrial ecosystems. How can we measure the epidemiology of an outbreak in the oceans and to what scale? Many questions remain but this article fills some gaps and answers some questions on spatial epidemiology in marine mammals. As Norman states it, these differences will require the development of new models and control methods for emerging infectious diseases in marine ecosystems.

Bottlenose dolphins (*Tursiops truncatus*) have been recognized as marine mammal sentinels in aquatic and coastal environments. Dolphins residing in nearshore habitats are exposed to an increasing variety of persistent anthropogenic pollutants that degrade their habitat, limit their food resources, and increase their susceptibility to diseases. The following series of three articles describe research on populations of bottlenose dolphins in Sarasota Bay and the Indian River Lagoon (IRL), Florida. Read together, these articles cover several important aspects of the health impacts of anthropogenic pollutants on bottlenose dolphin populations.

Woshner et al. (2008) report on heavy metals in blood and skin of bottlenose dolphins from Sarasota Bay, Florida, relating these values to blood parameters. Heavy metal levels have often been measured from the blood of marine mammals, but the significance of the levels found has been poorly explained. There is evidence that, in Florida, mercury occurs at high levels in nature, however, dolphins evidently are subject to seasonal exacerbation of oxidative stress, which might render them more vulnerable to toxic effects of mercury. This article also expands on potential synergistic interactions and the consequences for blood values and, thereby, health. The bond of mercury with selenium makes these compounds relatively harmless. The toxicological significance of the selenium–mercury interaction is discussed.

Mazzoil et al. (2008) conducted a photo-identification survey within the IRL, Florida, between 2002 and 2005 to determine dolphin home ranges and site fidelity. Distributional analyses indicated that at least three different dolphin communities exist within the lagoon. Their results suggest that dolphins do not selectively avoid areas with relatively unfavorable water quality. Other factors may determine dolphin distribution patterns in the IRL and have important implications for the development of protection and management strategies. Further detailed study is required to elucidate dolphin population structure and habitat use on a smaller spatial scale, and to understand how dolphin behavior influences their exposure to anthropogenic pollutants.

Murdoch et al. (2008) describe the epidemiology of an outbreak of lobomycosis among bottlenose dolphins in the Indian River Lagoon. Lobomycosis is a rare chronic cutaneous infection caused by *Lacazia loboi,* previously called *Loboa loboi*. The disease manifests as severe verrucoid to nodular lesions, and may cause skin tumors in humans. Dolphins may represent a sentinel species for public health surveillance targeting this emerging infectious disease, as no other animals are naturally susceptible to this infection. Environmental correlates suggest that exposure to environmental stressors may have contributed to the high prevalence of this disease. Specific factors are not identified.

Stress and Change in Wildlife Populations

The next studies follow on from the theme of stressors and change in wildlife populations.

Recent studies have shown that, in ecosystems, parasites can outweigh top predators in both biomass and affects. What happens though when top predator numbers are reduced? In an effort to determine the effects of anthropogenic activity on parasite richness—in this case, fishing—Lafferty et al. (2008) compared the parasite communities at two tropical coral atolls in the Pacific. Not surprisingly, the site that experienced overfishing had lower parasite diversity and fewer parasites per host species than the un-fished site. The authors propose using the absence or presence of multi-host parasites as an indicator of ecosystem health.

Eeva et al. (2008), delves into the complicated interactions underlying plumage color changes in Great tit

(*Parus major*) nestlings in polluted environments. Carotenoids have roles in both the development of yellow feathers and also in physiological responses to oxidative stress as may be induced by environmental pollution. The authors manipulated dietary carotenoid levels in populations of nestlings along a pollution gradient surrounding a copper smelter and adjoining industries in the town of Harjavalta, Finland. Plumage color changes were induced but were similar in populations from polluted and unpolluted environments. These results show that the primary reason for a pale plumage in Great tit nestlings in a polluted environment is dietary lutein deficiency and not carotenoid-depletion or changes in deposition caused by environmental pollutants. This conclusion was further supported by changes identified in caterpillar abundance and the diet of nestlings along the pollution gradient.

Beldomenico et al. (2008) report on their longitudinal study of three populations of wild field voles (*Microtus agrestis*) to ascertain the factors associated with the occurrence of a type of white blood cells unique to voles, azurocytes. Their findings clarify the functional significance of these cells and their role in the natural history of rodent species. High counts were predominantly observed in pregnant females, especially after periods of high past vole densities when body condition was depressed due to lack of food. This implies a role for azurocytes in inducing spontaneous embryo resorption during unfavorable conditions. A perplexing question remains unanswered: If azurocytes are involved in gestation, why do males also have them at detectable levels? The authors suggest a role for these cells in response to infection.

Emerging Infectious Wildlife Diseases

West Nile virus emerged in North America in New York City during the summer 1999. By the fall of 2005, the disease was reported in all of the United States and declared endemic. West Nile virus is maintained in an enzootic cycle involving wild birds and ornithophilic mosquitoes. In North America, however, over 62 mosquito species and over 300 bird species have been found infected. Other modes of transmission have been observed including: transmission by non-mosquito invertebrates; vertical transmission in vector species, by ingestion of infected, fecal–oral transmission among vertebrate hosts; and human-to-human transmission in utero, breast milk, organ transplants, and blood transfusions. Nemeth et al. (2008) report naturally induced immune response of raptors, probably acquired through ingestion of prey.

Woodhams et al. (2008) report on their detection of Chytridiomycosis in frog populations east of the Panama Canal. This globally emerging infectious disease of amphibians is the leading cause of population declines and extirpations at species-diverse montane sites in Central America. Being the first report from this area, the authors suggest that Panama's diverse amphibian communities east of the Canal are at risk. Many important questions about the epidemiology of Chytridiomycosis remain unanswered. Findings from this report add to scientific understanding of how this disease is emerging and the contribution of changing environmental conditions to the complicated picture.

In a further example of disease emergence and population change, Sainsbury et al. (2008) present their findings from research into the spatial and temporal trends of squirrel poxvirus infection in red squirrels (*Sciurus vulgaris*) in the UK. As gray squirrels (*Sciurus carolinensis*), introduced into central and southern England from 1876, have encroached on red squirrel populations, the transmission of squirrel poxvirus and the ensuing disease in red squirrels has given the gray squirrel a competitive advantage over the red squirrel, allowing the former to increase its geographic range rapidly through England and Wales over the last 100 years. Several findings of importance for protection of remnant red squirrel populations include a threat of spread to Scottish red squirrel populations, a suggestion of direct rather than vector-borne transmission, and the first evidence of immunity to squirrel poxvirus in free-living red squirrels.

Nature-based tourism can garner much needed public interest and resources for wildlife conservation efforts. However, a natural consequence of expanding tourism at wildlife sanctuaries is increased human–wildlife contact. The threat to wildlife populations of anthropozoonotic (human-to-nonhuman animal) infectious disease is often overlooked by ecotourists. Muehlenbein et al. (2008) characterize the perceived vaccination status among a sample of ecotourists to the Sepilok Orangutan Rehabilitation Centre, Sabah, Malaysia. A large proportion of the visitors surveyed were not immunized against a number of vaccine-preventable infections. This included vaccination against seasonal influenza which is arguably the easiest to transmit to primates in sanctuaries such as Sepilok.

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