Symposium Abstracts: Dangerous Creatures? Arthropods Affecting Human Health–Fact and Fiction

Entomological Society of British Columbia Annual General Meeting, Simon Fraser University, Burnaby, B.C., October 25, 2014

Note: There was a total of seven papers presented in this symposium. We were able to obtain abstracts from six of the authors.

Bloodfeeding in Anophelines: context, context, context

B. Roitberg, Department of Biological Sciences, Simon Fraser University, Burnaby, B.C.

I argue that bloodfeeding by Anopheline mosquitoes is best understood from a contextual perspective. Here, the contexts are: body size; body mass; and, energy state. First, I review state-dependent theory as tool for explicating context, and then I describe three sets of experiments that explore my contention. These experiments consider three different points in the bloodfeeding sequence: attempting to access a host that is protected by a bednet; feeding at a host that attempts to defend itself; and, post-feeding dynamics after feeding on healthy and plasmodium-infected hosts. In all three cases, the complex response by female Anophelines is best understood by applying multi-factorial models that include interaction terms. In other words, size effects cannot be understood by evaluating energy state, etc. This is context. I conclude by showing that these contextual responses by female mosquitoes can impact mosquito-vectored diseases such as malaria. My final point is that simplistic approaches that treat mosquitoes as if they were flying syringes are problematic and will have short shelf life.

West Nile virus in British Columbia

A. Furnell, British Columbia Centre for Disease Control, Vancouver, B.C.

The British Columbia Centre for Disease Control is involved with West Nile virus because it is a reportable communicable disease. Our surveillance includes the mosquito component of the enzootic cycle. We use miniature Centre for Disease Control-issued light traps, baited with carbon dioxide, for field surveillance. Four Culex species exist in British Columbia (B.C.); we collected three in our surveillance. Culex pipiens is widely distributed across the province and is especially abundant in urban centres, which have well-developed storm-sewer catch-basin systems, where C. pipiens young develop. This species was implicated as the primary vector in the initial North American outbreak. Culex tarsalis can be found in northern B.C., but they are mostly found in the south, along the Canadian border, where specimens infected with West Nile virus were detected in the Okanagan Valley. Culex territans is commonly found in ponds or artificial containers that hold water, but are seldom collected in our light trap surveillance. They feed on amphibians, so are not considered part of the West Nile virus enzootic cycle. There is a new record of Culex restuans being identified on Vancouver Island. This common vector is associated with virus amplification in birds in the prairie provinces and in eastern Canada, but it is rare for B.C.

Innate immune responses of vectors to pathogens: What defines vector-pathogen specificity?

C. Lowenberger, Department of Biological Sciences, Simon Fraser University, Burnaby, B.C.

Certain vectors transmit specific pathogens that may cause disease in humans or other animals. Why do vectors transmit a limited number or type of pathogen/parasite and kill others? The innate immune system of insects, including vectors, evolved to recognize and eliminate microbial pathogens. The pathogens in turn have evolved to avoid, evade, or inactivate components of the immune system for their own benefit. Plasmodium, the causal agent of human malaria, develops in an area of the midgut that has almost no expression of

anti-parasite peptides. The parasite Trypanosoma cruzi, which causes human Chagas disease, never leaves the gastrointestinal (GI) tract of its kissing bug vector, but is transmitted through fecal transmission as it feeds on blood. If this parasite leaves the GI tract to enter the body cavity, it is killed by immune molecules. Human dengue virus, transmitted by Aedes aegypti, is often killed by components of the apoptotic pathway: the virus enters cells and is recognized, and the cells initiate apoptosis. However, the virus induces the expression of inhibitors of apoptosis (IAPs0) that delay apoptosis until the virus has replicated. The interplay between the innate immune system and specific parasites and pathogens determines which vectors transmit which pathogens to humans.

Ticks: The perspective of a physiologist

R. Kaufman, Professor Emeritus, University of Alberta, Salt Spring Island, B.C.

Whenever I have occasion to mention that my research area at the University was the physiology of ticks (and still is here on Salt Spring Island), 99.99% of the time the response is something like, "Oh, do you work on Lyme Disease?" Actually, I don't, but the response obviously reflects the general view that the only reason to do research on a nasty creature like a tick is to find out ways to eliminate them and the diseases they transmit! Fair enough, but I like to emphasize that even invertebrates, including ticks, can teach us a lot about physiological mechanisms in general. In this presentation I'll tell you that female ticks of the family Ixodidae regulate their body fluid composition while feeding on the host by secreting an enormous volume of saliva back into the host's circulation; this is how pathogens from infected ticks enter the host. I outline the control mechanisms of salivation: Basically, an interaction exists among several neural pathways that involve the neurotransmitters acetylcholine, dopamine, and γ-aminobutyric acid (GABA), and a pathway in which some ergot alkaloids are mimics. In most ixodid ticks, copulation must occur on the host, after both sexes have fed at least partially. After engorgement, the salivary glands degenerate by an autolytic process that is triggered by an ecdysteroid hormone and modified by a so-called "male factor". This male factor serves more importantly as an "engorgement factor" because, without it, virgin females feed to only about one-tenth the normal engorged weight. The engorgement factor consists of two proteins (α- and β-voraxin). When we immunized a rabbit against the two proteins, 75% of the normal mated females that fed on it failed to feed beyond the small size characteristic of virgins. This has implications for developing a biological control mechanism against ticks and the pathogens they transmit.

Natural products to control bed bugs

Y. Akhtar and M. B. Isman, Faculty of Land and Food Systems, University of British Columbia, Vancouver, B.C.

In recent years, infestations by bed bugs, Cimex lectularius L., (Hemiptera: Cimicidae), have increased dramatically in many parts of the world, including Canada and U.S.A. This has led to renewed interest in the development of products of dubious composition and efficacy to control the infestations. The exact cause of the resurgence of bed bugs is unclear, but may be a consequence of the development of resistance in the insects to commonly used synthetic insecticides, including pyrethroids, along with other factors. Although there is no evidence that bed bugs transmit disease between human hosts, they cause a range of emotional problems and have an especially negative impact on the hospitality industry. Urgent need exists to develop pest management tools that are effective in suppressing bed bug populations and do not themselves have undue negative impacts on human health. We discuss semiochemicals and diatomaceous earth (DE) as part of a bed bug pest management system. Approximately 150 compounds (provided by SemiosBio Technologies Inc.), including both natural and synthetic semiochemical analogs, were screened, using glass arenas, for repellent effects. Some of the compounds demonstrated sufficient bioactivity against bed bugs to be considered for continued repellent formulation development. Similarly, different samples of DE, provided by DE Labs Inc., were screened for toxic effects against C. lectularius. Based on LC50 values, DE Labs Inc. and Mother Earth DE-dusts were significantly more toxic than other DE-dusts. The use of these products

may represent a new, low-impact standard for public health pest control.

The truth about spider bites: "Aggressive" spiders and the threat to public health

Catherine Scott, Department of Biological Sciences, Simon Fraser University, Burnaby, B.C.

Current sensational media coverage indicates widespread ignorance about the basic biology of spiders and other arthropods. I argue that spiders should not generally be considered dangerous, but that misconceptions and misdiagnoses pose a greater threat to public health. There are only two genera of medically significant spiders in North America: Latrodectus (black widows) and Loxosceles (recluse spiders). Only the former is found in Canada. Spiders are generally unaggressive and bite only defensively. In places where widow and recluse spiders are common, bites are very rare. Physicians seem quick to blame unexplained bites or lesions on spiders in the absence of any evidence. Many other arthropods depend on blood meals from human or other vertebrate hosts and are thus more likely culprits for mysterious bites. Bacterial infections and a host of other conditions are commonly misdiagnosed as 'necrotic arachnidism', and lack of proper treatment can lead to complications and even death. Most spider bites are benign and do not require medical intervention. Spiders are far more useful than harmful as voracious predators of household and agricultural pests. I am optimistic that, through education and outreach, we can inspire people to respect and learn from these beautiful and amazing arthropods.

Tick distribution and tick-borne diseases in British Columbia

Muhammad Morshed, BC Centre for Disease Control

No abstract submitted