Paratenic and Accidental Hosts

Standards addressed:

Language Arts – Common Core Math

- Reading Informational

Learning objectives:

- Students will be able to recognize what organisms can be paramedic hosts for the rat lungworm parasite that could be consumed and can be a source of disease transmission.
- Students will understand the term accidental host.
- Students will learn how to prevent disease.

Reading for comprehension:

Paratenic hosts

Rats and slugs and snails are the primary hosts of *Angiostrongylus cantonensis* but they are not the only hosts. There are other organisms that can carry this parasitic nematode and if we eat one of them that is infected with the L3 larvae, the infectious stage of the rat lungworm, we can get sick. These other organisms are called paramedic hosts, and we should be aware of them. One of these, which we collect when we find in the garden or around our house and put in the slug jug, is the invasive, predacious, **New Guinea flatworm *Platydemous manokwari***. This **planarian**, or flatworm, preys on land snails and will invert its stomach onto the captured prey and digest it. It is one of the 100 worst invasive species and was introduced throughout the Pacific Islands in an attempt to control the giant African snail, *Achatina fulica*, and the rosy wolf snail *Euglandina rosea.* Because this flatworm eats slugs and snails, it picks up the rat lungworm parasite and can be a source of disease transmission. Flatworms easily break into segments when disturbed or handled, and a small piece of an infected flatworm can harbor many

rat lungworm larvae. These flatworms also quickly decompose after they die and do not resemble their living form; they can look more like muddy water. There are other flatworms that live in Hawai'i, many of which have a shovel or hammerhead shaped head. We do not know if these flatworms harbor the rat lungworm larvae. Little is known about the biology and lifecycles of many of the flatworms found in Hawai'i. The New Guinea flatworm poses a great threat to many of Hawai'i's endangered native snails and may be partially responsible for the extinction of some of them.

(Above) *Platydemous manokwari* the New Guinea flatworm. A known carrier of the rat lungworm parasite. (Below) *Bipalium kewense* another flatworm species found in Hawaii.

Hammer-headed flatworm (above) (species unknown)

Other paramedic hosts include the **crustaceans**, freshwater shrimp, prawns, and crabs. In Hawai'i, we have native fresh water shrimp, *Atyoida bisulcata* ‘opae kala‘ole or ‘opae kuahiwi, and *Macrobrachium grandimanus* “opae ‘oeh‘a. There are also invasive fresh

water prawns in our rivers, *Macrobrnchium lar* the Tahitian prawn (photo on the left). How these crustaceans become infected is not well studied or understood, however they can harbor the early stages of the rat lungworm parasite, including the infective third stage larvae. People can become infected with rat lungworm disease by eating raw or undercooked, freshwater shrimp, prawns, or crabs. In Thailand, the consumption of a dish called "dancing shrimp" has caused infection by the rat lungworm parasite. This dish is made with raw shrimp and lemon juice, an acid, which "cooks" the shrimp but does not harm the rat lungworm parasite and may actually excite it.

We do not know if the a'ama crabs are carriers of the rat lungworm larvae but it is possible they may be. Besides crustaceans, frogs, which are **amphibians**, have been identified as paramedic hosts of the rat lungworm parasite. At this time, we do not know if our non-native/invasive frogs and toads, such as the coqui frog and cane toad, are paramedic hosts (Hawai'i has no native amphibians).

In Asia, water monitor lizards, which are **amphibious reptiles**, can also be paramedic hosts. The only reptile native to Hawai'i, the copper striped blue-tailed skink (*Emoia impar*) is extinct. All other land-dwelling reptiles found in Hawai'i, which includes lizards and geckos, are introduced. It is unknown if any of these are paramedic hosts.

To prevent rat lungworm disease transmission from a paramedic host, thorough cooking is recommended. Remember, cooking will kill the parasite, so cook those prawns you capture from Hawaiian streams.

Accidental hosts

Mammals that become infected with L3 rat lungworm larvae may become sick with rat lungworm disease and are called accidental hosts. The parasite cannot mature and reproduce in an accidental host, and so accidental hosts are sometimes referred to as "dead-end hosts." Accidental hosts can include humans, dogs, horses, apes and monkeys, some bird species, and a range of other animals. When infected, the larvae act as they do once back inside the rat host; they burrow through the intestine, enter the bloodstream, migrate through organs, and eventually some may make it to the brain, resulting in eosinophilic meningitis and a classic case of rat lungworm disease. Veterinarians on Hawai'i Island have reported cases of rat lungworm disease in dogs, especially puppies, and horses. Veterinarians from zoos in Hawai'i have reported the disease in monkeys and a lemur. Near Miami Florida, an orangutan died of rat lungworm disease, alerting health authorities to the presence of the parasite in Florida. Some animals have been euthanized due to the severity of the disease, including dogs and horses. It is important that we protect not just ourselves, by using safe practices for handling slugs and snails and in our food preparation, we must also protect our pets and animals. Slugs, especially the semi-slug *Parmarion martensi* seem to have a preference for dog and cat food and may climb into pet food dish for a meal if the bowl is left unattended. It is important to bring pet food dishes in at night so as not to attract slugs, snails and rats. Also, check water bowls and buckets (horses and livestock) for any drowned slugs or snails. When these intermediate hosts drown they can shed infective stage rat lungworm parasites and it is possible an animal may become infected in this way.

Student Activities:

Critical thinking:

- Why do you think *Angiostrongylus cantonensis* the rat lungworm, can live inside of these other paramedic hosts?

- What to humans, which can be accidental hosts, have in common with other animals that can be accidental hosts and become very sick with rat lungworm disease, such as dogs, horses, monkeys and apes?

Learn more about invasive species in Hawai'i.

- What other invasive species can you think of that are problems for Hawai'i?
- How do invasive species affect other species and Hawai'i's ecosystems?
- What can we do to prevent the introduction of invasive species?
- What can we do to control invasive species?

This material is written by Kathleen Howe and produced by the Hawaii Island Rat Lungworm Working Group with funding from the Hawaii Invasive Species Council and support from the Daniel K. Inouye College of Pharmacy. Photo credits: Jarvi Lab.