SEPARC
Information Sheet #11

Southeastern PARC Partners in Amphibian and Reptile Conservation

RANAVIRUS IN CHELONIANS

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Pathogen Emergence and Die-offs:

Ranavirus, a genus in the Family Iridoviridae, is a highly infectious pathogen of fish, amphibians and reptiles (1, 5, 6, 16). Ranaviruses are probably best known for amphibian mortality events and are one of the deadliest pathogens of amphibians in the Southeastern United States (8). Ranaviruses also can be highly fatal in turtles (2, 10, 22) and have been most often associated with box turtle (*Terrapene carolina*) mortality events (1, 3, 15). In addition to box turtles, ranaviruses have been isolated from or detected in other chelonians, including gopher tortoises (*Gopherus polyphemus*, 15, 22), leopard tortoise (*Stigmochelys pardalis*, 4), Hermann's tortoise (*Testudo hermanni*, 17), Burmese star tortoises (*Geochelone platynota*, 15), soft-shelled turtles (*Trionyx sinensis*, 10; *Apalone ferox*, 18), red-eared sliders (*Trachemys scripta elegans*, 18, and experimentally by 9, 14) and yellow-bellied sliders (*T. s. scripta*, 18).

There have been multiple turtle mortality events reported (15, 21). Johnson et al (15) reported a multiple year die-off of box turtles in Venango County, Pennsylvania within a 200-ha wildlife sanctuary. Between 1999 and 2003, one box turtle death within the sanctuary was attributed to ranavirus; however, between 2003 and 2006, 24 turtle deaths were attributed to ranavirus. Johnson et al (15) also reported a ranavirus-associated morbidity and mortality event involving 30 eastern box turtles in Murray County, Georgia, and Ruder et al (21) reported a similar event of 8 eastern box turtles in Kentucky. In addition to the reports of mass morbidity or mortality, Allender et al (1, 2) documented ranavirus positive turtles presented to rehabilitation centers. It remains unclear if ranavirus played a role in the health status of the turtles presented to the rehab centers.

Pathogen Characteristics:

Ranaviruses are large, double-stranded, DNA viruses that may be infective with or without their envelope (5). Ranaviruses are unique in that they are capable of infecting multiple classes (5, 15). Indeed, Johnson et al. (15) found that ranaviruses isolated from a mortality event of Burmese star tortoises (*Geochelone platynota*) and from nearby southern leopard frogs (Rana sphenocephala) were similar. Furthermore, Jancovich (12) uncovered molecular evidence of recent host shifts and suggests that the ancestral ranavirus originated in fish.

Factors Contributing to Emergence:

Diagnostic methods have only recently made it possible for researchers to survey for ranavirus in free-ranging populations. Along with molecular characterization, it has been shown that human movement of wildlife is a factor that has contributed to the distribution of ranaviruses and other pathogens, such as *Bd* (11, 19). Ranaviruses are particularly concerning because they can be transmitted across classes and there is evidence supporting the likelihood of reservoir species (e.g., see 20).

Diagnostics and Signs of Disease:

Amphibian diseases caused by ranaviruses are reportable to the World Organization for Animal Health (Aquatic Animal Health Code 8.2). Clinical signs include nasal and ocular discharge, oral plaques (tongue, esophagus, palate), lethargy, and conjunctivitis (1, 2, 15, 21, see link below to photos of box turtle lesions). More advanced stages may also have poor body condition and emaciation (1). Abnormal behavior (e.g., circling) has also been reported (15). Swelling and erythema have been documented in water turtles (9, Fig. 1). Ranavirus is most commonly isolated from tissue, such as kidney and spleen (14), and lesions (18). Amplification of the major capsid protein by polymerase chain reaction (PCR) on mouth swabs, nasal flushes and blood have also yielded Ranavirus positive individuals (2, 14, 21). Positive PCR is often followed up by DNA sequencing (1). On blood smears, Allender (1) reported visible intracytoplasmic inclusions within circulating leukocytes, which is characteristic of ranaviruses. However, this should not be relied upon for diagnosis as this result has been inconsistent in experimental trials (13) and nonviral inclusions can look similar. Unfortunately, an effective therapeutic protocol has not been established (1).

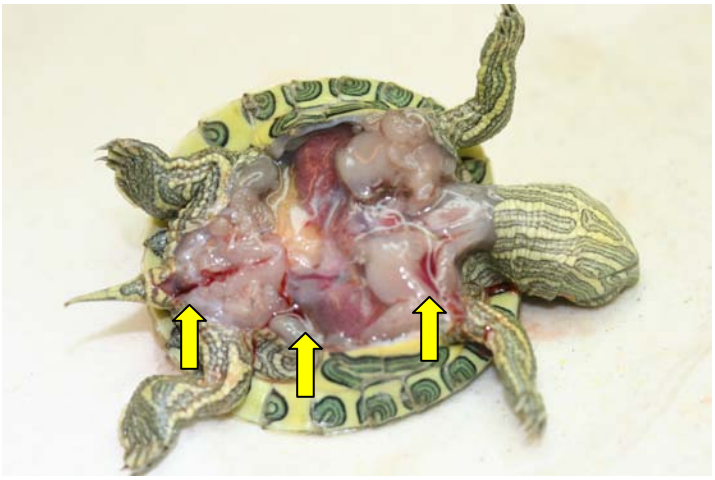

Figure 1. Swelling of the head and neck (from soft tissue fluid accumulation, i.e., edema) and internal hemorrhages (arrows) in a red-eared slider hatchling experimentally challenged through ingestion of a ranavirus infected tadpole.

Conservation Strategies:

Chelonian declines have been attributed to factors such as habitat loss, over collection and nest mortality. It has been only recently that disease (including ranaviruses) has been listed as a

factor for declines (1, 2, 6, 15). Unfortunately, mortality of chelonians is often undetermined, therefore vigilance of populations is important. Baseline population surveys can be useful to detect mortality events when they occur, and can help detect other chelonian health issues, including environmental or anthropogenic stressors. Property surveys also provide the opportunity to find empty shells, which help estimate mortality (7). Possibly the most worrisome fact is that turtles can shed the virus without clinical signs (13). The possibility of non-clinical carriers emphasizes the importance of considering disease in any translocation plans.

Resources:

Eastern Box Turtle Mortality Event: Photos
http://www.vet.uga.edu/vpp/activities/sevpac/archive/sevpac2009/78-%20Ruder%20Box%20turtle.pdf accessed August 2010.

Aquatic Animal Health Code: World Organization for Animal Health
http://www.oie.int/fileadmin/Home/eng/Health_standards/aahc/2010/en_chapitre_1.8.2.htm

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