Ranaviruses: Cold-blooded Killers

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Abstract: Emerging infectious diseases have been linked to amphibian population declines. A group of viruses belonging to the genus *Ranavirus* (Family: Iridoviridae) is responsible for amphibian mass mortality events in the Americas, Europe, and Asia. However, it is frequently suggested that ranaviruses only affect common species, are incapable of causing population declines, and emergence is unlikely because they are a part of a natural host-pathogen system. Our objective was to synthesize results from field reports, experiments, and case studies collected by 13 collaborating scientists who are conducting research on ranaviruses in six countries and to assess the validity of these claims. To date, ranaviral disease has been diagnosed in >100 amphibian species from eight anuran and three urodelean families, with distributions encompassing all latitudes and elevations that amphibians inhabit. Mortality has been documented in abundant species with widespread distributions (e.g., *Lithobates sylvaticus*) as well as in rare species with limited global range (e.g., *Cynops ensicauda*). The pathogen also causes disease in reptilian and osteichthyan hosts. Population declines and local extinction are possible through annual reoccurring die-offs. Consequently, the persistence of populations experiencing ranavirus die-offs can depend on rescue effects from adjacent populations, which may not occur in fragmented populations or with rare species. Although ranaviruses may be endemic, there can be significant geographic variability among isolates, which can confer enhanced pathogenicity in disjunct populations. Further, ranaviruses isolated from aquaculture facilities and bait shops have greater virulence than wild isolates. Thus, ranavirus outbreaks may be facilitated by the commercial transport of ectothermic vertebrates or the movement of virions on fomites such as recreational or research gear. Anthropogenic stressors (e.g., pesticides, nitrogenous waste) also contribute to the emergence of ranaviral disease. Considering that ranaviral disease occurs in a diversity of ectothermic vertebrates and may be contributing to global amphibian declines, we recommend that researchers and natural resource practitioners incorporate ranavirus surveillance into existing disease monitoring programs. We recommend that these efforts focus on uncommon species and isolated populations. Field ecologists should adopt standard disinfecting procedures, and disinfecting stations should be provided for recreationists. Natural resource agencies should strongly consider regulations that require ranavirus-free certification for the movement of herpetofauna and fish across national and state borders. We recommend that future research efforts focus on mechanisms of ranavirus emergence with the intent of identifying conservation strategies. In summary, our synthesis demonstrates the need for reevaluation of the threat of ranaviruses in ectothermic vertebrate populations.

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