



Ranavirus confirmed in a population of Long-Toed Salamanders (*Ambystoma macrodactylum*) in Lassen Volcanic National Park

Recently, the USGS National Wildlife Health Center confirmed that specimens of Long-Toed Salamanders (Figure 1) found dead during fall 2008 lake sampling died of an infection by Ranavirus. This is the first confirmed case of Ranavirus in this species of salamander!

The infected salamanders were encountered at Cliff Lake, in the central portion of Lassen Volcanic National Park, as part of a pilot project testing the Integrated Water Quality and Aquatic Communities protocols for the Klamath Inventory and Monitoring Network. Although this is the first confirmed case, observations of die-offs in previous years (2000, 2004) suggest that Ranavirus has been active within the park for at least the past nine years. In the reports, observers have estimated the number of dead in the dozens to hundreds of individuals in each case.

What is known about Ranavirus?

Ranavirus is a virus in the viral family Iridoviridae and is implicated as being among the causes of global amphibian declines. Individuals transitioning from larval to adult stages are the most susceptible; hence, die-offs will be apparent in recent metamorphs. Pronounced, external symptoms include petechiae (red blotches due to hemorrhaging) and subcutaneous edema (swelling). Both of these symptoms are visible in Figure 2. Other symptoms require necropsy to confirm consistency with Ranavirus diagnoses.

How Ranavirus is transmitted is still a field of active research. It is known that certain strains of Ranavirus are transmitted through shared habitat (water bodies) and also through cannibalism and scavenging of infected corpses. Importantly, some strains of Ranavirus have been shown to infect other species, including fish and reptiles. Molecular genetics is being done to determine if the strain found in Lassen Volcanic National Park is species-specific, or if it poses a further risk to other amphibians, fish, and reptiles. There is no evidence that Ranavirus is infectious to humans.

What is the source?

Evidence from Ranavirus discoveries in Tiger Salamanders (*Ambystoma tigrinum*) suggests that the virus has recently spread to new localities. This spread has been hypothesized to be due to human actions, such as trade and transport of lab animals, pets, food items, or accidental/intentional introductions. Conflicting with this is evidence that populations can recover in 1-2 years post-infection, suggesting that viruses and salamanders have co-evolved. How this relates to infection in Long-Toed Salamanders is unknown, but possibilities include: 1) It is a novel infection, spread by human activity; and 2) It is an endemic infection, but with increased host range, infection rate, and lethality.

Factors increasing the susceptibility of amphibian populations to Ranavirus are similar to that of Chytrid fungus, mainly sub-lethal stress. This stress may be from the role of exotic species, reduced habitat quality, and environmental change.

What can be done?

Follow-up surveys at Lassen Volcanic National Park will determine if the Ranavirus is merely a cyclical infection, with populations rebounding, or if populations appear to be permanently extirpated. Preventative measures for park managers include requiring field crews to disinfect collecting gear in between sampling different water bodies. Gear can be disinfected using household bleach or specialized agents such as Sparquat-128, but the general effectiveness against Ranavirus has yet to be determined. These procedures will also help prevent spread of other diseases and aquatic nuisance species (e.g., New Zealand Mudsnail, Whirling Disease, *Didymosphenia*, Quagga Mussel, etc.).

Parks with reports of Long-Toed Salamander populations (Table 1) should be on the lookout for die-offs. If die-offs are found, resource specialists should contact the USGS National Wildlife Health Center (<http://www.nwhc.usgs.gov/>) and the NPS Wildlife Health Program (<http://www.nature.nps.gov/biology/wildlifehealth/>).

Questions? Contact: Dr. Eric Dinger, Klamath Network Aquatic Ecologist, Eric_Dinger@nps.gov



Figure 1. Adult Long-Toed Salamander (from Stephen Corn, USGS).



Figure 2. Dead Long-Toed Salamander from Cliff Lake. Note red petechiae on ventral underside, and swelling in the buccal (chin) region. Gloves are recommended for handling of all sick or dead wildlife, including amphibians!

Table 1. Park Units with Long-Toed Salamanders (from NPSpecies)

- ✧ Big Hole National Battlefield (BIHO)
- ✧ Crater Lake National Park (CRLA)
- ✧ Craters of the Moon National Monument (CRMO)
- ✧ Ebey's Landing National Historic Reserve (EBLA)
- ✧ Glacier National Park (GLAC)
- ✧ Grant-Kohrs Ranch National Historic Site (GRKO)
- ✧ Hagerman Fossil Beds National Monument (HAFO)
- ✧ John Day Fossil Beds National Monument (JODA)
- ✧ Lake Roosevelt National Recreation Area (LARO)
- ✧ Lassen Volcanic National Park (LAVO)
- ✧ Mount Rainier National Park (MORA)
- ✧ Nez Perce National Historical Park (NEPE)
- ✧ North Cascades National Park (NOCA)
- ✧ Olympic National Park (OLYM)
- ✧ Whiskeytown National Recreation Area (WHIS)
- ✧ Whitman Mission National Historic Site (WHMI)