



U.S. Fish & Wildlife Service

Amphibian Abnormalities on National Wildlife Refuges

Overview

Concern about amphibian abnormalities became widespread in 1995, when middle school students discovered frogs with misshapen, extra or missing limbs at a Minnesota wetland. Since then, scientists have continued to report frogs and toads with severe abnormalities, and have documented global amphibian population declines, disease outbreaks and an increased rate of species extinctions.

In 2000, the U.S. Congress asked agencies within the Department of the Interior, including the U.S. Fish and Wildlife Service (Service) and the U.S. Geological Survey, to address growing concerns about the health of amphibians in the U.S. The Service's Environmental Contaminants Program then began the National Abnormal Amphibian Program to determine the distribution and severity of amphibian abnormalities on national wildlife refuges. The National Abnormal Amphibian Program has developed one of the world's largest databases on amphibian abnormalities, and has released findings from 10 years of sampling (2000–2009) in PLOS ONE, the peer-reviewed, online journal of The Public Library of Science (<http://www.plosone.org/>).

The major findings of the study are that abnormality frequencies across large areas of the country were within expected background levels, and the severe, extra-legged frogs and toads (that raised concern in the mid-1990s) were extremely rare on refuges. Nonetheless, we also found areas where levels of abnormal frogs were higher than expected in California, the Mississippi River Valley, and Alaska. We found that locations with high numbers of abnormal frogs clus-



Northern leopard frog with a missing leg.
Photo by Steve Mierzykowski/USFWS

tered together (at scales of tens to hundreds of km across). Combining these findings of few abnormalities in general and discreet locations where abnormal frogs cluster together in space directs our research attention to these high abnormality “hotspot clusters” to figure out what is going on in these places. Such studies would aim to identify the causes of the abnormalities and recommend habitat improvements to refuge managers.

Amphibians—Early Signals of Environmental Stress

Since amphibians are sensitive to a variety of environmental stresses, they are considered by the scientific community to be early indicators of the health of their environment. Surveying amphibian abnormalities gives the American people a snapshot of this national issue and an increased awareness of possible risks to other wildlife or humans.

The National Wildlife Refuge System, with 561 refuges and 38 wetland management districts comprising more than 150 million acres, is the world's premier system of public lands managed for the conservation and, where appropriate, restoration of fish, wildlife, plants and their habitats. To ensure the health of these habitats, specialists in the Service's Environmental Contaminants Program monitor the effects of contamination on fish and wildlife found on refuges. This study used the national wildlife refuge system as a natural laboratory in which to examine patterns in amphibian abnormalities over space and time.

The Study

The objectives of this research were to 1) find the percentage of abnormal frogs and toads on the nation's national wildlife refuges and 2) determine how the percentages vary

geographically at a variety of scales, and over time.

At each wetland, the team captured and carefully examined frogs and toads, and recorded the results along with information about the site. About 95 percent of the animals were released unharmed back into the same wetland. The remainder were sent to laboratories for diagnostics to understand whether the abnormality was caused by injuries, parasites, or contaminants, three of the main causes of abnormalities in frogs.

Key Findings

- Over ten years, we examined 68,359 individual amphibians of 37 species at 152 national wildlife refuges. This is one of the world's largest databases on amphibian abnormalities.
- At a landscape level, abnormal frogs occurred infrequently or not at all on national wildlife refuges. A core dataset of 48,081 amphibians of 32 species from 132 national wildlife refuges showed that on average, only 2 percent had

skeletal or eye abnormalities (expected background level of such abnormalities is 0 to 2 percent).

- The most common abnormalities involved were partially missing or shortened toes or legs (Figure 1).
- The severe extra-limb abnormality type that garnered national media attention in the 1990s was exceedingly rare on refuges, and only 12 of the individuals in the core dataset had an extra limb (0.025%).
- Most of the variation in the abnormalities was accounted for by where the amphibian was collected, as opposed to the species or the year the animals were captured.
- Clusters of high-abnormality sites were found in the Mississippi River Valley throughout California, and in south-central and eastern Alaska (Figure 2).
- Our results strongly implicate local factors (e.g., parasites,

predation, contaminants, pollution or a combination of those factors), as the cause of the abnormalities.

The Future

The Service is collaborating with university partners on a detailed analysis to determine land uses that are correlated with the abnormalities. Results will aid in the conservation of amphibians and the ecosystems upon which we all depend.

Source: Reeves, Mari K., K.A. Medley, A.E. Pinkney, M. Holyoak, P.T.J. Johnson, and M.J. Lannoo. 2013. Localized Hotspots Drive Continental Geography of Abnormal Amphibians on U.S. Wildlife Refuges. Public Library of Science One. DOI 10.1371/journal.pone.0077467.

**U.S. Fish and Wildlife Service
Ecological Services Program
4401 North Fairfax Drive, Suite 820
Arlington, VA 22203
703-358-2171**

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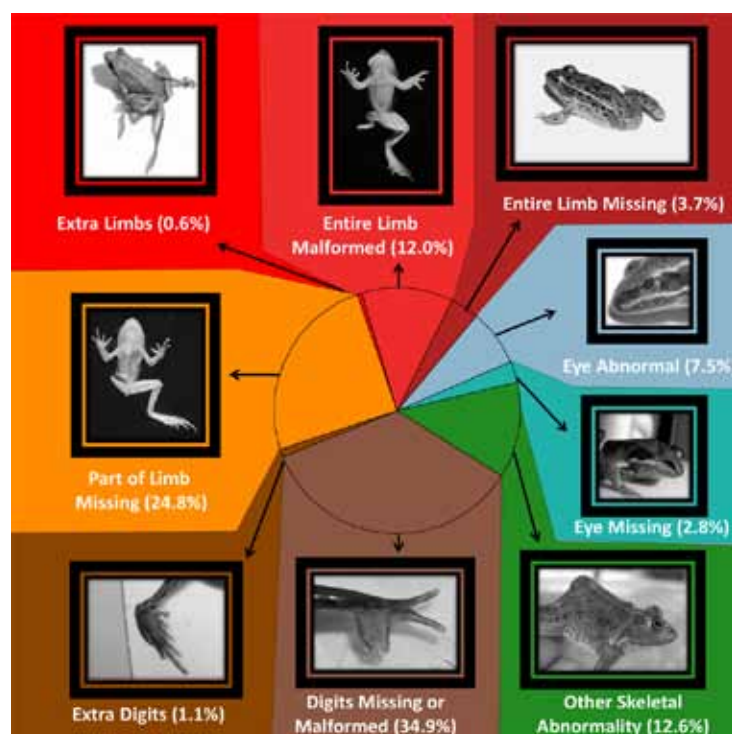


Figure 1: Percentages of abnormal frogs found in the field surveys. Percentages in photo figure are proportions of each abnormality out of total abnormalities.

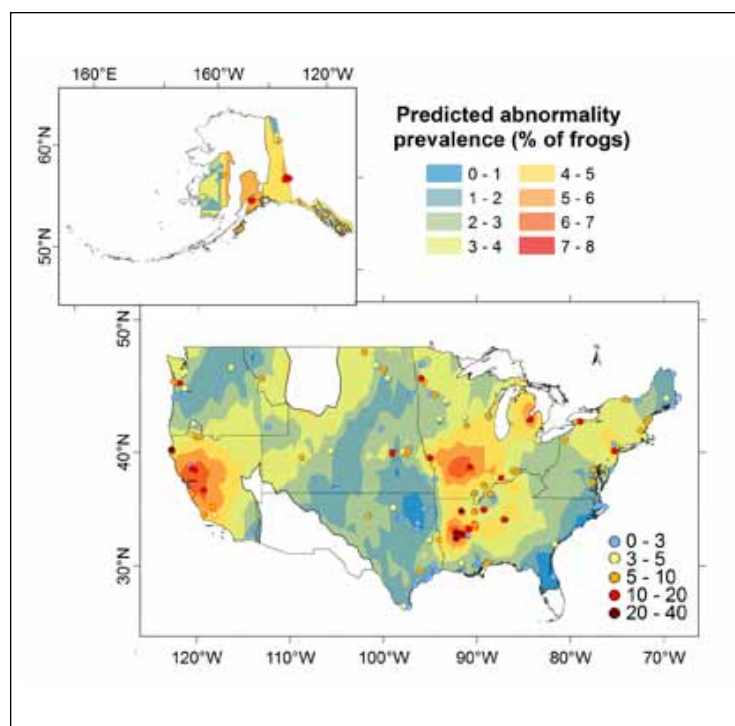


Figure 2: Geographic distribution of amphibian abnormalities with hotspot clusters. Warmer colors represent higher predicted abnormality prevalence (% of frogs abnormal).