



Trends in Amphibian Occupancy in the United States

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Abstract

Though a third of amphibian species worldwide are thought to be imperiled, existing assessments simply categorize extinction risk, providing little information on the rate of population losses. We conducted the first analysis of the rate of change in the probability that amphibians occupy ponds and other comparable habitat features across the United States. We found that overall occupancy by amphibians declined 3.7% annually from 2002 to 2011. Species that are Red-listed by the International Union for Conservation of Nature (IUCN) declined an average of 11.6% annually. All subsets of data examined had a declining trend including species in the IUCN Least Concern category. This analysis suggests that amphibian declines may be more widespread and severe than previously realized.

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Introduction

Amphibians have received increasing attention since a crisis of declining populations was first recognized in the late 1980s [1]–[3]. In 2004, a comprehensive global assessment of amphibian status suggested that 32.5% of the world's species and 31.7% of the United States' species were declining [4]. The current extinction rate for amphibians has been estimated to be 211 times the background rate [5]. These numbers indicate that many species have conservation problems but they do not reveal the rate of population loss. Here, we use data from the U.S. Geological Survey's Amphibian Research and Monitoring Initiative (ARMI) to estimate the rate of change in the probability that amphibians occupy ponds and other comparable habitat features across the United States.

Documenting the rate of change in population parameters requires intensive studies that separate true changes in populations from changes in the probability of capture or detection when amphibians are present [6]. Such studies are relatively rare and it is unusual to have sufficient trend data to assess patterns at a national scale. The occupancy estimates produced by ARMI are statistically unbiased because they use repeated surveys to account statistically for the probability of detecting a species that is present [7]. Hence, our trend estimates based on these data are not influenced by changes in detection, though they rely on data points that each have associated error. Each occupancy estimate that we analyze applies to a species at a study area and each study area has a range of inference spanning tens to hundreds of sites. For heuristic purposes, the probability of site occupancy can be thought of as the expected proportion of sites occupied within the study area [7]. These occupancy estimates span a broad range of habitats, geographic areas (Figure 1A), and species including International Union for Conservation of Nature (IUCN) categories ranging from Endangered to Least Concern (Figure 1B).

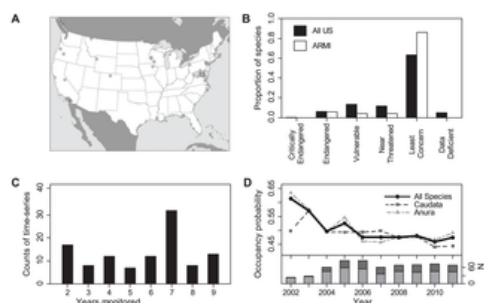


Figure 1. Characteristics of monitoring data.

(A) Location of monitoring areas. (B) Distribution of species among IUCN categories. (C) Number of years monitored in each time series. (D) Mean annual