

# Survey of Anuran Populations within Minnesota

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**Chris Thorman**  
Biology Department  
Bemidji State University

Anurans (frogs and toads) are highly sensitive to environmental degradation and considered important indicators of environmental quality. Amphibians function as a monitor of local conditions. Minnesota has 14 species of frog and toad. The presence or absence of any of these species provides further information on the conditions of Minnesota's wetland habitats. The purpose of this study was to survey anuran species present within 3 regions of MN, measuring intensities, individual turnover rates of anurans, and breeding rate success. Three counties in Minnesota, Aitkin, Dakota and Marshall, were included. The methods of the Minnesota Frog and Toad Calling survey were used to do nighttime "listening surveys" during the early, middle and late breeding seasons during the years 1996-2003. These surveys include my two study sites surveyed the summer of 2003, and data from the Minnesota Department of Natural Resources Frog and Toad database (1996-2003). The data indicates that the routes surveyed show a high local turnover in populations, indicating the utility of a metapopulation model for these species. Over a longer period of time, these surveys can be used to detect large-scale population trends. The short duration and uneven coverage of the surveys so far make identification of trends difficult at this time.

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## INTRODUCTION

Anurans (frogs and toads) are an integral part in an ecosystem. These creatures consume large quantities of insects and other invertebrates making them vital components of community food webs. Amphibians have permeable skin and lay shell-less eggs that can readily absorb foreign substances (Blaustein and Johnson, 2003). Populations of some anurans have declined precipitously in recent years because of the high incidence of developmental defects (Blaustein and Johnson, 2003) in some areas has greatly increased interest in anuran responses to environmental conditions. Anurans are highly sensitive to environmental degradation from a variety of causes, and anurans are increasingly considered important indicators of environmental quality (Minnesota Department of Natural Resources, 2003).

The main contributing factors in the decline of anuran populations are wetland size, vegetation type, presence of competitors and predators, hydrologic characteristics, hydro period functions, loss of habitat, land use and their sensitivity to environmental conditions (Mitsch and Gosselink, 2000).

Minnesota has 14 species of frogs and toads. The presence or absence of a species on a local level provides further information on the conditions of Minnesota's wetland habitats (Blaustein and Johnson, 2003). Anuran populations at a particular route also fluctuate depending on changes in water quality, temperature, precipitation, ultraviolet radiation and adjacent land uses. The loss of these populations in certain areas is a signal that healthy ecosystems may be imperiled (Minnesota Department of Natural Resources, 2003).



The presence or absence of a species also indicates local colonization and extinction, indicating that amphibians are well described by metapopulation models (Marsh and Trenham, 2000). Metapopulations are populations that are spatially structured into local breeding populations linked by migration (Hanski and Gilpin, 1997). Local populations are established and die out frequently, while the overall regional population can persist. Anurans fit this pattern, in that they may be present at a wetland in one year but vacant the next because of local extinction and relocation at another site nearby. Local turnover can cause sampling error, making anuran populations hard to monitor.

The data obtained from the Minnesota Toad and Frog Calling Surveys, between 1996 and 2003, show no overall decline in amphibians (Johnson, 2002). These surveys show that the patterns indicate population turnover within these routes surveyed instead. Turnover occurs when subpopulations of long-lived species skip a breeding season or when climatic conditions are unfavorable. Also regular movement of groups of adults from one habitat to the next will cause a turnover within a species. These surveys provide a database for the assessment of local population trends, regardless of whether or not all species surveyed actually exhibit metapopulation dynamics. Therefore, to have effective conservation, metapopulations and local extinction and migration rates need to be examined to have a complete understanding of anuran occurrences (Hanski and Gilpin, 1997).

Anuran populations within Minnesota were analyzed in three counties, each county representing a distinct landscape for the different species of anurans in Minnesota. For this study, mean anuran intensities, turnover rates and breeding rate success among Minnesota's anurans was examined.

## **METHODS**

The North American Amphibian Monitoring Program (NAAMP) has developed a set of standard procedures to help monitor amphibian populations, including the frog and toad calling surveys. The Minnesota Frog and Toad Calling Survey (MFTCS) adapted these procedures to obtain more information on the species richness and distribution of the 14 anuran species in Minnesota and to monitor population changes in the state (Hamline University, 2000). The (MFTCS) is mainly designed to detect trends within the state over time, provide information

on where species are located throughout the state and how their populations change in abundance and distribution (Anderson and Baker, 2002).

The methods of the Minnesota Frog and Toad Survey involve nighttime "listening surveys" (Hamline University Calls of Frogs and Toads, 2000). Surveys are organized into "routes." Each route consists of ten wetland sites, which are visited three times annually (early spring, late spring, and summer) to represent the range of different species breeding seasons (Hamline University, 2000). Routes are established where wetlands have potential for amphibians to breed. A variety of wetland types are included in a given survey to represent the range of breeding sites for different species in an area, including ponds, lakes, roadside ditches, streams or even temporary wetlands (MFTCS, 2000). The timing of the survey with the phenology of frog calling is essential. During a survey period, a minimum water temperature is needed to be able to receive accurate results. For the survey period for early spring (April 15-30) minimum water temperature should be 50 degrees Fahrenheit, late spring (May 50 June 5) 60 degrees Fahrenheit and summer (June 25-July 10) 70 degrees Fahrenheit (Minnesota Frog Calling Survey, 2004). Surveys are done after dark; ideally on warm, cloudy evenings with wind speed less than 8 mph and high humidity. If conditions are unfavorable then the survey should be stopped and completed within a few days. For each site on a route, the observer should choose a fixed location which disturbs the frogs as little as possible. In each wetland the observer identifies the species present on the basis of their breeding season calls and then estimates the abundance of each species using call index values of 1, 2, or 3. Index value one indicates an individual that can be counted with space between calls, index value two indicates calls of individuals that can be distinguished but there is overlapping of calls, and index value 3 indicates a full chorus with is continuous and overlapping calls. At each site a minimum of 5 minutes of listening is required after the frogs or toads start calling (Minnesota Herpetological Society). In addition any other observations and occurrences should be recorded.

Minnesota Department of Natural Resources Nongame Wildlife Program has a database that includes all 116 MFTCS routes that have been run in Minnesota. These routes vary by how many years each have collected between the years of 1996-2003. Volunteers largely carry out the Minnesota Frog and Toad Calling



surveys; therefore some breeding periods and/or years are missed.

During my study I followed the Minnesota Frog and Toad Calling Survey protocols. I conducted surveys at Soberg Waterfowl Production Area in Dakota County located in southern MN and Rice Lake NWR in Aitkin County in north central MN. The U.S. Fish and Wildlife Service own both areas which contain wetlands that vary in vegetation coverage, wetland habitat hydrology and water chemistry. Soberg WPA consists of rolling grassland and prairie potholes. Soberg Wetland Production areas contain both seasonal and permanent wetlands, which are mostly fed by rain and runoff from the surrounding land. All wetlands at Soberg WPA are less than 1 acre. Most all these wetlands have also been restored. Data was collected during the summers of 2000 and 2003. Data in 2000 was collected during the early, middle, and late breeding season and then only collected during the middle and late breeding season during 2003. Rice Lake NWR is dominated by Tamarack bogs and shallow lakes with marshy shorelines. Wetlands at Rice Lake NWR were all permanent bodies of water, which are groundwater fed. These wetlands ranged from 0.393 to 3679 acres, containing small roadside wetlands, swallow marshes and Rice Lake. Vegetation at Rice Lake NWR was more diverse than that of Soberg WPA. The data was collected in 2003 and between the years of 1997 and 1999 during the early, middle and late breeding seasons at Rice Lake NWR.

In addition to my studies, information from the Minnesota Frog and Toad Database was obtained, which includes the following: Marshall County Route Data (southwestern MN) for 1994-2002, Aitkin County Route Data (north-central MN) for 1996-2002 and Dakota County Route Data (south metro area) for 1996-2002. Each county represents a distinctive region in Minnesota; collectively, the three counties include all Minnesota anuran species. The data were used to find mean anuran intensities, local turnover rates and anuran breeding success within these Minnesota counties.

The mean anuran species intensities were obtained from the Minnesota Frog and Toad Database. Only the routes for a given year that included all breeding seasons were analyzed. Turnover rates for a given species were calculated using the following formula: the number of changes of observations in a species from one consecutive year to another divided by

the total numbers of stops multiplied by the intervals of observation. The number of changed observations between consecutive years occurred when species either exhibited local extinction or colonization. The total number of stops included all stops in a given route that exhibited species that were present during their breeding season.

Successful breeding rates among species were also calculated for any given species. A success rate were measured by taking all stops on a route in a given year that were available for an individual species observed divided by all stops on a route that species were ever found breeding.

## RESULTS

There are a total of 14 species of frog and toad species in MN. The Northern Cricket Frog is on the endangered list. Aitkin County has (10) species, Marshall County (9) species and Dakota County (8) species. Species varied depending on breeding seasons among the counties. Table 1. Species only found in Marshall County are Canadian Toads and Great Plains Toad. Mink and Pickerel frogs were only found in Aitkin County. Dakota County only had species that were found in the other two counties.

**Table 1. Avg. Intensities of Anurans during a given breeding season**

Average of Intensity			
Amphibian ID	Early	Mid	Late
American Toad	2.22	1.54	1.22
Canadian Toad		1.55	2.00
Cope's Gray Treefrog	1.00	1.69	1.32
G. Plains Toad			1.75
Gray Treefrog	1.00	2.08	1.60
Green Frog		1.00	1.33
Mink Frog			1.00
Leopard Frog	1.20	1.28	1.22
Pickerel Frog	1.00		
Spring Peeper	2.19	2.04	1.00
Chorus Frog	1.94	1.83	2.00
Wood Frog	2.01	2.33	1.29

The mean anuran intensities range on a scale from 1-3 from 1.00 to 2.13 within the three counties. (Table 2.) Spring Peepers and Wood frogs have the highest intensities and Mink and Pickerel frogs show lower intensities.



**Table 2. Mean Anuran Intensities in MN**

Amphibian ID	Aitkin	Dakota	Marshall	MN
Mink Frog	1.00			1.00
Pickereel Frog	1.00			1.00
Leopard Frog	1.39	1.18	1.19	1.24
Green Frog	1.00	1.43		1.29
American Toad	1.32	1.70	1.59	1.58
Cope's Gray Treefrog	1.17	1.73	1.45	1.59
Canadian Toad			1.66	1.66
G. Plains Toad			1.75	1.75
Gray Treefrog	1.73	1.74	2.07	1.91
Chorus Frog	1.85	1.83	1.96	1.91
Wood Frog	1.58	1.79	2.30	2.01
Spring Peeper	2.23	2.90	1.43	2.13

Turnover rates among American Toads, Mink Frogs and Leopard Frogs are higher than the Chorus Frogs, Wood Frogs and Gray Treefrogs that have low turnover rates within the three counties in Minnesota analyzed. Table 3.

Chorus Frogs, Wood Frogs, and Spring Peepers obtained high successful breeding rates Minnesota and Green Frogs, Mink Frogs and Great Plains Toad had low successful breeding rates. Table 4.

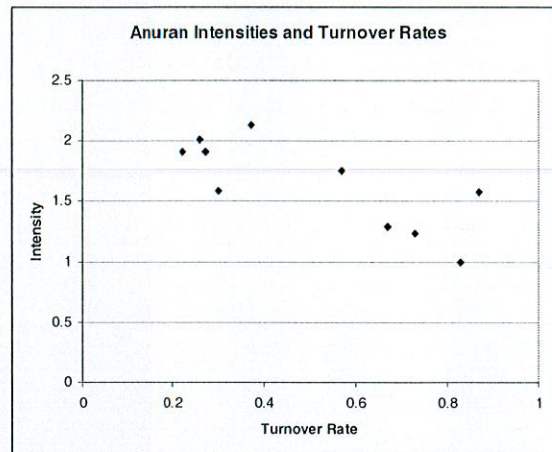
**Table 3. Turnover Rates of an Anuran in Minnesota**

MN Turnover Rate	County
Anuran	MN
Gray Treefrog	0.22
Wood Frog	0.26
Cope's Gray Treefrog	0.3
Spring Peeper	0.37
Western Chorus Frog	0.27
G.P Toad	0.57
Green Frog	0.67
Leopard Frog	0.73
Mink Frog	0.83
American Toad	0.87

**Table 4. Successful Breeding Rates among Counties and throughout MN**

Successful Breeding Rate	County			
Anuran	Aitkin	Dakota	Marshall	MN
G.P Toad	0.00	0.00	0.10	0.10
Green Frog	0.12	0.13	0.00	0.13
Mink Frog	0.13	0.00	0.00	0.13
Cope's Gray Treefrog	0.20	0.00	0.13	0.16
Leopard Frog	0.19	0.27		0.22
Gray Treefrog American	0.62	0.10	0.07	0.30
Toad	0.40	0.43	0.37	0.40
Spring Peeper	0.97	0.13	0.34	0.55
Wood Frog	0.68	0.10	0.82	0.63
Chorus Frog	0.85	0.57	0.97	0.81

**Table 5. Correlation between Anuran Intensities and Turnover Rates**



**DISCUSSION**

Anuran intensities within the three counties and turnover rates of Minnesota anurans are inversely related. Table 5. Species of higher intensities, such as, Spring Peepers (2.13), Wood Frogs (2.01), Western Chorus Frogs (1.91), and Gray Treefrogs (1.91) tend to show lower turnover rates compared to the other species of anurans. These species with higher intensities also have higher successful breeding rate. For example, the Western Chorus Frogs (.81), Wood Frogs (.63) and Spring Peepers (.55) all have higher successful breeding rates. Although the Gray treefrog with higher intensities shows more of a moderate successful breeding rate, (.3) compared to the other species. This may be due



to the fact that often times Gray treefrogs can easily be mistaken as a Cope's Gray Treefrog because of their similar calls.

An individual species' turnover rate is inversely related to its breeding success. Species of anurans with high turnover rates, such as, American Toads (.87), Mink Frogs (.83), Leopard Frogs (.73), Green Frogs (.67) and Great Plains Toad (.57) tend to show lower successful breeding rates.

The results obtained demonstrate metapopulations within anurans in Minnesota. Routes with higher intensities of anurans have low turnover rates compared to species with low intensities with higher turnover rates. Furthermore, species with high turnover show lower successful breeding rates.

Therefore, to have effective results and understanding of metapopulations of local extinction and migration rates needs to be examined to have a complete understanding of anurans occurrences. Also, sampling error can cause apparent local turnover when surveys are missed during a season or year. Ideally, for conducting anuran surveys in future studies more accurate data collections should be obtained.

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