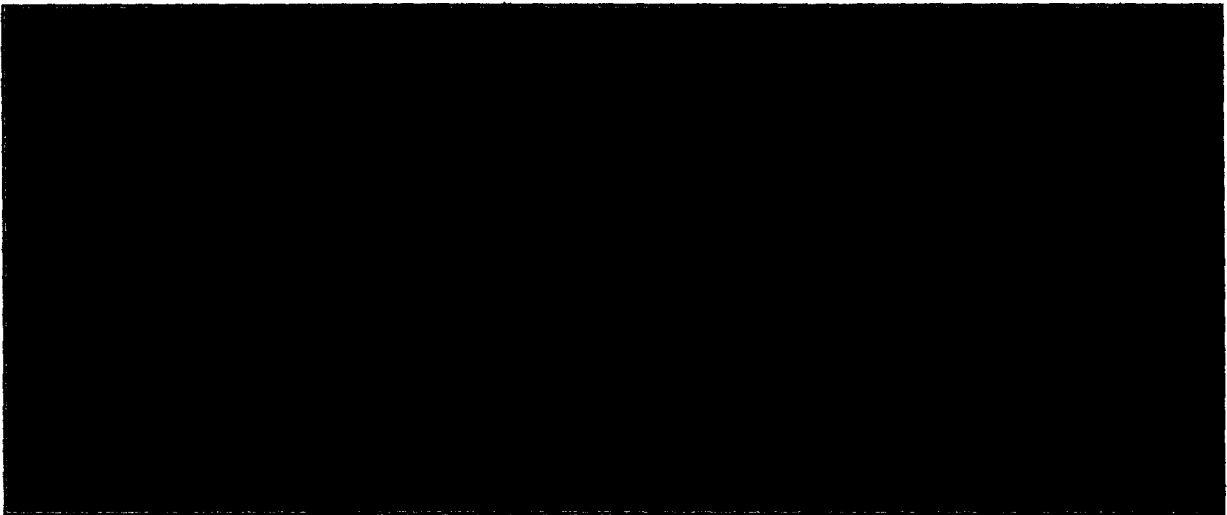
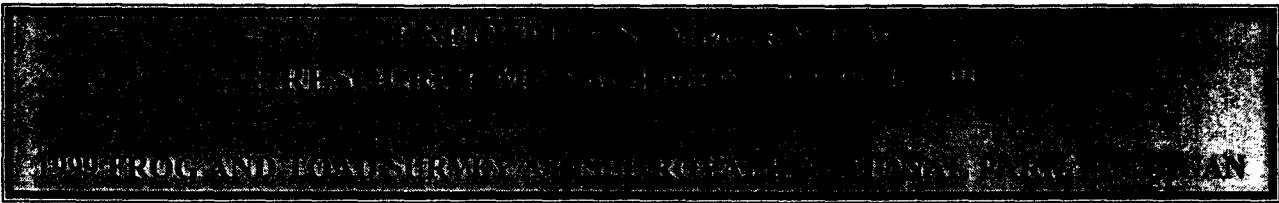


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During a survey of Michigan's herpetofauna in 1963 and 1964 it was discovered that Isle Royale National Park was home to six species of anurans. They were the American toad (*Bufo americanus*), spring peeper (*Pseudacris crucifer*), boreal chorus frog (*Pseudacris triseriata maculata*), green frog (*Rana clamitans melanota*), mink frog (*Rana septentrionalis*), and the wood frog (*Rana sylvatica*).

Since that time, there has been a growing concern for the apparent decline in several species of anurans (frogs and toads). There is not only concern for the individual species but for the role these populations serve as an indicator of environmental quality. Isle Royale National Park, Michigan, established a frog survey program to monitor and integrate island population data with the Michigan Department of Natural Resources Frog and Toad Survey program.

In 1996 two transects were created. The first transect followed the Mount Ojibway loop (MTOJ) the second was established along the trail between Three Mile and Lane Cove (TMLC). In 1997 a third transect was created between Moskey Basin and the north LeSage portage and was surveyed in 1998. A fourth survey was surveyed in 1999, on the Huginnin trail near Windigo. A call index was used to obtain a measurement of calling males for future comparison.

During the 1999 survey, five out of six of the previously known anurans were heard. The mink frog was not heard on the survey, but was heard by NPS employees during the summer. Comparison between the first four years has demonstrated a close correlation between the frog populations and the amount of rainfall during the summer. The apparent decline in numbers over the first three years of the survey reflected a decline in the amount of rainfall, which did not continue in 1999. The frog numbers also went up in 1999.

The new transect on the Huginnin Loop increased the amount of certain wetland types and added greatly to the number of species heard on the July run.

In 2000, the survey will continue on the existing four transects, and the numbers of American toads seen between survey points will also be recorded. If possible, more intensive surveys will be conducted in specific areas along the transect routes to more accurately record the "singing season" of Isle Royale's anurans.

ABSTRACT

The populations of anurans (frogs and toads) have been in apparent decline worldwide in recent years, and this has become a cause for concern. Frog and toad populations may serve as indicators of general environmental quality, so if a decline is taking place, it should indeed raise concerns, not only about the populations themselves but also about the environments in which they live. Isle Royale National Park (ISRO), Michigan, established a survey of frogs and toads in 1996 to monitor anuran populations on the island and to integrate these findings with those of the Frog and Toad Survey Program conducted by the Michigan Department of Natural Resources (DNR). Originally, two transects were established along park trails, then a third was added in 1997, and in 1999, a fourth was added.

In 1999, frog and toad surveys at ISRO were conducted in the early spring, late spring and summer on all four transects. Each transect has ten survey points, yielding a total of 40 points surveyed per run. The survey is based upon the calls given by the male frog and toads during their various mating seasons. Call indexes of 1, 2 or 3 were used to indicate the relative abundance of frogs and toads calling. These indexes were averaged and compared to those recorded in previous years. The intent of conducting three different runs throughout the spring and summer was to include the breeding seasons of all species surveyed.

A total of five out of the six anuran species usually found on Isle Royale were recorded on the four transects, but all six were heard at some point during the summer by park staff. The data collected is summarized and compared to that of the previous three years. Recommendations are made for improving the survey in 2000.

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INTRODUCTION

Concerns have been raised as to the low numbers of several of Michigan's frog species in the past several years (Michigan DNR 1996). Frogs and toads are especially vulnerable to human exploitation of their habitat, as they depend on wetlands, which are often destroyed by development. Fluctuations in frog and toad populations are therefore a possible indicator of the changing environmental quality of an area and the well being of its ecosystem. Thus, it is important to be aware of changes in abundance or distribution of anurans. By comparing data gathered on Isle Royale with that collected on the mainland, insights may be reached regarding the apparent decline in frog and toad numbers. With the assistance of the Michigan DNR, a frog and toad survey was established on Isle Royale in 1996 and has been continued and expanded over the ensuing four years.

The last known analysis of Isle Royale's frogs and toads was conducted in 1963-64 and revealed six species of anurans present on the island (Johnson 1965). The species found were the American toad (*Bufo americanus americanus*), spring peeper (*Pseudacris crucifer*), boreal chorus frog (*Pseudacris triseriata maculata*), green frog (*Rana clamitans melanota*), mink frog (*Rana septentrionalis*), and the wood frog (*Rana sylvatica*).

The survey of Isle Royale's frogs and toads has served as a comparison of recent population information with presence/absence data from 1963-64. These records will provide a means to determine current population figures and also to trace population trends over the years. This survey may also aid the Michigan DNR in determining the ranges and population sizes of many species.

STUDY AREA

Isle Royale National Park (Keweenaw Co., Michigan) is an archipelago of more than 200 islands in northwestern Lake Superior. It lies approximately 118 km (73 miles) from Michigan's Keweenaw Peninsula and at its closest point is approximately 24 km (15 miles) from Ontario's Sibley Peninsula. The Park encompasses about 544 km² (210 mi²) of land and water, of which 99% of the land base is federally designated wilderness.

The survey transects follow established park trails, and survey points are located in six different wetland types. As described by the Michigan DNR, these wetland types are as follows:

1. **Vernal Pond**—small body of standing water that forms in the spring from meltwater and is often dry by mid-summer. The area is usually dominated by annual vegetation.
2. **Wet Meadow**—looks similar to a fallow field, except that they are dominated by waterloving grasses and sedges. They contain nearly 100% vegetative cover with very little or no open water.

3. **Bog**—located on saturated, acidic peat soils. They support shrubs, herbs, and often tamarack (*Larix laricina*) or black spruce (*Picea mariana*). Some are totally overgrown and some consist of open water surrounded by floating vegetation.
4. **Marsh**—has standing water from less than an inch to up to 3 ft deep. They are dominated by soft-stemmed emergent plants. Vegetative cover is usually around 50%.
5. **Wooded Swamp**—soil is saturated throughout the growing season. On Isle Royale, trees found here include northern white-cedar (*Thuja occidentalis*) and balsam fir (*Abies balsamea*).
6. **Pond**—open body of water that is less than 20 acres in size and does not dry up in the summer months. There is little emergent vegetation present.

(Michigan DNR, 1996)

METHODS

Four standardized frog and toad survey routes were used in 1999. The survey runs were conducted in late April/early May, June, and July based upon temperature during these periods.

Selection of survey sites

Survey transects, all following park trails, are hiked prior to the first survey to assess the suitability of the route. Ten points in various wetland types are established along each of the four trails used as transects. A tree near each site is chosen and an aluminum tag is placed on the tree to mark the site for future reference. A file labeled "ISRO Frog Survey Transects" has been created and contains information on site locations, site wetland types, site numbers, maps of each transect, survey dates and field data sheets. This file is held in the Natural Resource Management files. The two transects created in 1996 follow the Mt. Ojibway loop (MTOJ) and the Three Mile to Lane Cove trail (TMLC). In 1997, a third transect was created from Moskey Basin to the area near the north Lake LeSage portage trail (MBLS). In 1999, a fourth transect on the Huginnin Cove loop (HUGI), at the west end of Isle Royale, was surveyed for the first time. This transect was added to the existing three transects, all of which are found on the east end of the island. All four transects were surveyed in 1999.

Census Techniques

Each transect is surveyed in the early spring, late spring and in the summer by one skilled observer and a data recorder. Upon arrival at a survey point, the observer and recorder remain silent for approximately one minute to ensure that their presence does not disturb calling frogs and toads. The observer then listens for five minutes, during which all species heard are recorded and indexed. If the observer is not able to identify a calling species within the five minutes, it is acceptable to extend the time by a few minutes until a positive ID can be made. Since the effectiveness of the five minute listening period varies greatly with weather and wind conditions and audibility of calls, it is more valuable to extend the listening period and obtain a positive ID on a species than to adhere strictly to the five minute time frame. Data is recorded on data sheets provided by

the Michigan DNR. A call index is used to estimate the numbers of calling males of a particular species (Michigan DNR 1996). The index is as follows:

1. Individuals can be counted; there is space between calls
2. Calls of individuals can be distinguished but there is some overlapping of calls
3. Full Chorus. Calls are constant, continuous and overlapping

The dates for the surveys are determined by a combination of frog and toad breeding dates and air temperature. Temperatures on Isle Royale tend to be significantly lower than on the mainland, so temperatures during surveys occasionally drop below those recommended by the DNR in their survey guidelines. Survey dates from 1996-1999 are given in Table 1. The census is begun at dusk on each sampling date and continues until the transect is complete. The survey is aborted if rainfall or wind interfere with the audibility of the calls.

Table 1. Survey dates by transect and survey period, 1996-1999.

	1996	1997	1998	1999
<u>Spring Run</u>				
TMLC	5/23	5/22	5/18	5/4
MTOJ	5/20	5/16	5/23	5/12
MBLS	*	5/21	5/23	5/5
HUGI	*	*	*	5/20
<u>June Run</u>				
TMLC	6/24	6/13	6/8	6/3
MTOJ	6/19	6/12	6/9	6/4
MBLS	*	6/11	6/8	6/2
HUGI	*	*	*	6/19
<u>July Run</u>				
TMLC	7/17	7/3	7/17	7/15
MTOJ	7/18	7/3	7/10	7/16
MBLS	*	7/3	7/8-9	7/16
HUGI	*	*	*	7/13

* No survey transects established at this time.

Data Analysis

After completing the 1999 survey runs, the mean call index was determined for each species surveyed and comparisons were made with the data from the previous three years. The species richness was also determined for each wetland type. June-July rainfall was calculated for 1996-1999 and compared to the mean call index for each species using Microsoft Excel® Standard Correlation.

ANALYSIS and RESULTS

Five out of six of previously recorded anuran species were heard in the 1999 survey. The mink frog, which was heard in the 1998 survey, was not heard in the 1999 survey. However, a chorus of mink frogs (call index 2) was heard by Natural Resource Management Intern Trevor Peterson on 8/1 (2:15 A.M.) in the drainage approximately 500 meters SW of survey point 8 on the TMLC transect.

The gray tree frog, which was reported several times in 1998 but never confirmed, was neither heard nor reported during the 1999 season. It is possible that the sound reported was an evening call of the winter wren (*Troglodytes troglodytes*), which sounds remarkably like the call of the gray tree frog.

The spring peeper dominated the spring run (found at 92.5% of sites surveyed) as well as the June run (found at 65.0% of sites surveyed), and the green frog was the most common species on the summer run (found at 37.5% of sites). See Table 2.

Significant numbers of American toads were observed during the 1999 July run. In the July run alone, 129 toads were observed on the three transects at the east end of the island. However, on these transects (TMLC, MBLs, and MTOJ), no toads were heard calling. The toads were seen on the trail while hiking between survey points.

The survey transects include six different wetland types, defined previously. Species abundance by wetland type varied from 3 to 5 species. Numbers from 1999 were identical to those from 1998 for the pond, wooded swamp and vernal pond, but differed for the other habitat types. The presence of the mink frog in 1998 yielded higher numbers for species richness in the bog and marsh. The addition of the Huginn transect in 1999 introduced a third wet meadow site into the survey system, which may have contributed to the higher values found in 1999 (see table 3).

FIGURE 1. SPECIES RICHNESS BY HABITAT TYPE*

*Due to an abundance of certain habitat types, distortion may occur (see table 3).

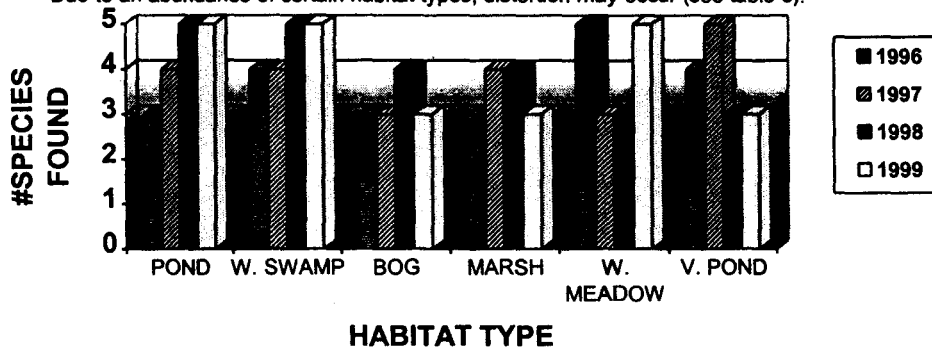


Table 2. Mean Call Indexes and Percent of Sites Occupied by Species (n=40), 1999.

		WOOD FROG	CHORUS FROG	SPRING PEEPER	AMERICAN TOAD	MINK FROG	GREEN FROG
	Mean	1.36	1.0	2.4	1.0	-----	-----
Spring Run	# Sites	11	2	37	2	0	0
	% Sites	27.5	5.00	92.5	5.00	0	0
	Mean	-----	-----	1.38	1.25	-----	1.0
June Run	# Sites	0	0	26	8	0	13
	% Sites	0	0	65.0	20.0	0	32.5
	Mean	-----	1.0	1.0	1.75	-----	1.4
July Run	# Sites	0	3	1	4*	0	15
	% Sites	0	7.5	2.50	10.0	0	37.5
1999 mean		1.36	1.00	1.96	1.36	0.00	1.21*

*All toads heard on the July run were on the Huginnin transect

Table 3. Number of Sites by Wetland Type

Wetland Type	# Sites-1998	# Sites-1999
Bog	1	1
Wooded Swamp	12	19
Wet Meadow	2	3
Vernal Pond	7	7
Pond	4	6
Marsh	4	4
Total	30	40

Mean indexes recorded in the 1999 survey were higher than those recorded in 1998 for four frog species (wood frog, spring peeper, chorus frog and green frog), and lower for the American toad and mink frog (see Figure 2).

Figure 2. MEAN OF INDEXES BY SPECIES

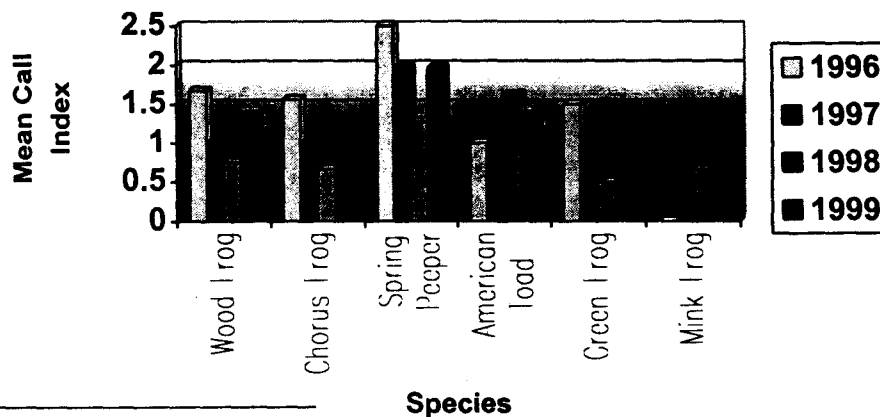
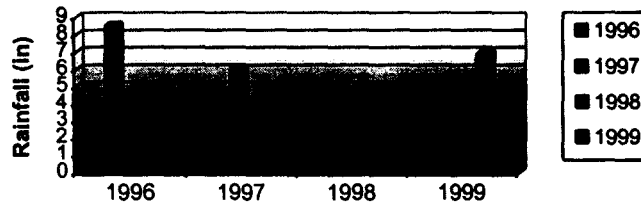


**Figure 3. COMBINED JUNE-JULY RAINFALL,
1996-1999**



The mean indexes for 1996 through 1999 seem to be closely correlated to the average June-July rainfall (depicted in Figure 3) for four out of six of the species surveyed (wood frog, chorus frog, spring peeper, and green frog). When the values for rainfall and mean call index from 1996 to 1999 are compared for these four species, the correlation values are quite high (see Figure 4 and Table 4). The mink frog can be viewed as an outlier in this comparison, as it was only recorded by the survey in 1998. The American toad is a terrestrial species (Harding 1997) and would thus be less dependent on a water source, so it can be expected that the mean call index for this species will not be as affected by the amount of rainfall during the summer. As shown in Table 4, the correlation values for rainfall and mean calling index of American toads and mink frogs are quite poor.

Figure 4. RAINFALL vs. MEAN CALL INDEX

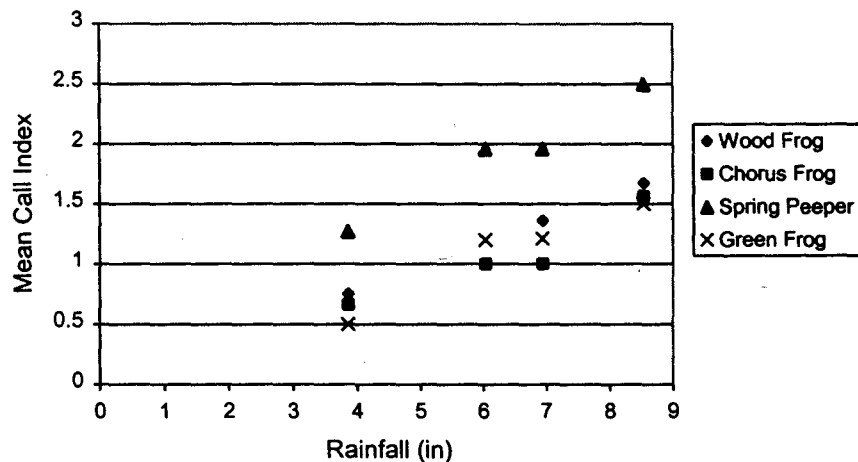


Table 4. CORRELATION VALUES OF RAINFALL vs. MEAN CALL INDEXES

Species	Correlation
Wood Frog	0.98
Chorus Frog	0.95
Spring Peeper	0.98
Green Frog	0.97
American Toad	-0.75
Mink Frog	-0.84

As data continues to be added to this survey, it will become more possible to form theories in regards to the factors that control anuran populations. At this point, several trends seem apparent, such as the relation of rainfall to frog population, but no solid conclusions can be made. The data gathered in 1999 seem to indicate that frog and toad populations are not in steady decline, as was feared previously. However, we lack a great deal of knowledge as to which environmental factors are most important to the well being of Isle Royale's frog and toad populations. Barring atmospheric pollutants, ISRO's anuran population could be viewed as a control group to compare with the mainland populations, as watershed pollution and habitat encroachment are at a minimum on Isle Royale.

RECOMMENDATIONS

Currently, the frog and toad survey includes only three runs per season, and this may not include the mating seasons of all species on Isle Royale. Also, the interval of time between surveys (approximately one month) leaves a large window of time during which peak calling of a given species may not be observed. If one site was chosen along each transect for a more intensive weekly survey (30 minutes or more at one location), the cycle of frog and toad singing may be observed more completely. These more regular surveys could focus on one area with high species richness, with the goal being to document the entire cycle of a species' calling. The "frog logger," an automated recording device, could also be used in this more intensive survey. This information could be added to that gathered in the regular survey. An August run could potentially be added to include the singing season of the mink frog as well.

In addition to more frequent surveys, the number of American toads seen on each transect should also be recorded. As the toads are easy to see on the trails and do not move quickly, it is easy to obtain an accurate count of toads per survey, and this number could serve as a secondary means to trace the toad population over the years (see Appendix 1). There is also a possibility that toads on Isle Royale are larger than those on the mainland (Johnson 1965). Samples of toads could be measured to determine whether or not this is in fact the case.

Finally, it may prove useful to expand the degree to which anuran populations depend on various weather factors such as rainfall, temperature and humidity. If trends can be observed, this information could be used to help determine the causes of observed fluctuations in anuran populations.

WORKS CITED

- Niemela, S., Oelfke, J. Egan, A. 1998. "1998 Frog and Toad Survey -Isle Royale National Park, Michigan." Resource Management Report 98-2, NPS. 9 pp.
- Harding, James H. 1997. Amphibians and Reptiles of the Great Lakes Region. University of Michigan Press, Ann Arbor, MI.
- Michigan DNR. 1996. "Natural History Information For Michigan Frog and Toad Survey." Michigan Department of Natural Resources Wildlife Division Report. 12 pp.
- Collins, Joseph T., Conant, Roger. 1991. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Peterson Field Guides. Houghton Mifflin Co., Boston, MA.
- Johnson, Wendel. 1965. A Zoogeographical Analysis of the Herpetofauna in Northern Michigan and adjacent Isle Royale. Michigan State University.

Appendix 1.

Toad Observation Form
Isle Royale National Park Frog and Toad Survey

Transect _____

Date _____

Record the number of toads seen on the trail between survey points.

	Run 1	Run 2	Run 3
	#Toads Seen	#Toads Seen	#Toads Seen
Survey Points			
1-2			
2-3			
3-4			
4-5			
5-6			
6-7			
7-8			
8-9			
9-10			
Total			

	Comments	
Run 1	Run 2	Run 3