

2000

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Recommended Citation

Sargent, Lori G. (2000) "Frog and Toad Population Monitoring in Michigan," *Journal of the Iowa Academy of Science: JIAS*, 107(3-4), 195-199.

Available at: <https://scholarworks.uni.edu/jias/vol107/iss3/25>

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Frog and Toad Population Monitoring in Michigan

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A volunteer-based monitoring project for frog and toad populations in Michigan was initiated in 1996. The survey protocols developed by the North American Amphibian Monitoring Program (NAAMP) were used and modified to suit the needs of the Michigan project and because of the highly variable Michigan spring weather. The modifications include route establishment, recommended dates during which surveys are conducted, and a more specific definition of population indices. Development of the project included training workshops for volunteers.

INDEX DESCRIPTORS: amphibian monitoring, volunteer-based surveys, Michigan.

Michigan is home to 13 native species of anurans. In recent years, many scientists and observers have been concerned with the apparent rarity, decline, and/or population die-offs of several of these species (Blaustein and Wake 1990, Phillips 1990, Pechmann and Wilbur 1994). This concern was not only for the species themselves, but also for the ecosystems on which they depend. Frogs and toads, like many other aquatic organisms are sensitive to changes in water quality and adjacent land use practices that impact water quality. Their populations undoubtedly serve as an index to environmental quality. As a result, a survey was initiated in 1988 by the Michigan Natural Features Inventory (MNFI) on a limited basis to increase our knowledge of anuran abundance and distribution, and to monitor populations over the long term. The survey was not continued on a regular basis because of the lack of dedicated personnel.

The annual volunteer-based Michigan Frog and Toad Survey was initiated in 1996 by the Michigan Department of Natural Resources (DNR) Natural Heritage Program. Funding for the program comes from the Nongame Wildlife Fund through private contributions. The goals of the survey are four-fold: (1) to determine distribution of frog species in the state; (2) to identify areas for more intensive research on frog populations; (3) to educate Michigan citizens about frogs and aquatic ecosystems and; (4) to promote a positive relationship between citizens and the DNR through a volunteer program.

Procedures for conducting the calling surveys were taken from the successful Wisconsin survey (Mossman and Hine 1984) and advice from R. Hay (pers. comm.). Having a volunteer-based survey was the only way in which a significant amount of data could be collected. It was believed that volunteers could be trained to perform accurate surveys on the minimal number of species found in the state.

The Protocols and Strategies for Monitoring North American Amphibians developed by the North American Amphibian Monitoring Program (NAAMP) (Bishop et al. 1994) were adopted late in the 1996 survey season. The protocols were modified to clarify sampling concepts because of misperceptions by volunteers. Volunteer training and modifications to the protocols are discussed.

METHODS

Modifications to NAAMP Protocols

Michigan spring weather is extremely variable from year to year. Michigan experienced a very long, cold winter in 1996. Snow cover

and cold temperatures remained until June in the most northern areas and into May in some of the southern areas of the state. Many volunteers expressed frustration with cold temperatures and the few, if any, opportunities to conduct their surveys. Volunteers were often confused as to when surveys should be conducted. Even though air temperature was emphasized in training workshops as one of the most important factors in conducting surveys, volunteers became focused on running surveys during recommended dates rather than waiting for appropriate temperatures. Knowing that frogs take their cues to begin calling from air and water temperatures, we dispensed with the required dates and requested that volunteers wait until the suggested temperatures occurred in their area and to run surveys at least two weeks after a previous one. General dates were suggested with wide ranges to account for the variance across zones.

According to the NAAMP instructions, abundance indices are used to estimate frog species population abundance. The Michigan survey also used these indices, but it became apparent that there was significant variation among volunteers in their interpretation of them. Even though they were not instructed to do so, some volunteers included actual counts of the numbers of frogs they heard along with the abundance index for that species. It was deemed necessary, then, to define each index as a range of estimated number of individuals. A tape of frog calls also contains groupings of calls that demonstrate examples for each index.

Restrictions of survey route establishment described in the NAAMP protocols had to be relaxed to accommodate the extreme interest and high participation rates of Michigan citizens. The demand for survey routes far exceeded the number of "random" routes supplied by the NAAMP program. Where NAAMP routes were not indicated, volunteers were instructed how to randomize a route in their chosen area. For example, routes should be mapped on paper prior to driving them and routes should be established when frogs are not calling (i.e. before they emerge in the spring). Volunteers were instructed to not change or omit a site except if conditions did not permit surveying (i.e. loud noises prevented observer from hearing frog calls). The large number of volume of data submitted each year will help to alleviate much of the bias created by volunteers who do not follow the instructions to the letter.

Volunteer Training and Participation

A total of 26 training workshops held throughout the state in February and March 1996 attracted approximately 1000 participants.

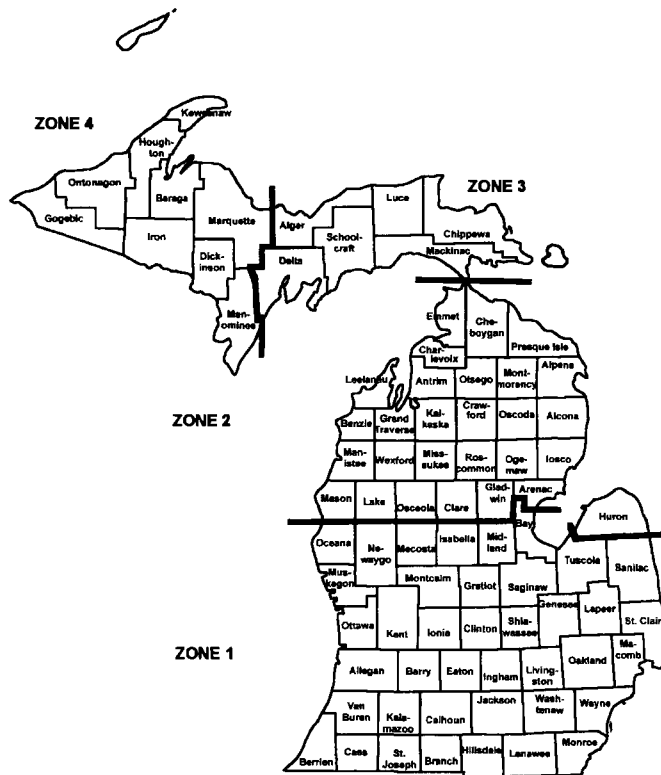


Fig. 1 Michigan Frog and Toad Survey Zones

Co-sponsors included the Parks and Recreation Division of the DNR, the Kalamazoo Nature Center, and the Kellogg Bird Sanctuary of Michigan State University. Even with minimal advertising, interest in the workshops and the survey was overwhelming. It seemed to be a favorite topic for the media. Workshops were approximately 2 h long and included information on general frog biology, distinguishing species by sight and sound, general habitat requirements, rules for setting up a route, and survey methods (Appendix I). "Random" routes developed and printed by the USGS Biological Resources Division were explained and offered to interested participants. Acceptable routes were not limited to these random routes because there were many more volunteers than routes. Explanations of route establishment included emphasis on randomization of site location. Instruction packages were also mailed to interested parties who did not attend a workshop.

Instruction packages distributed at each workshop included instructions on establishing a route and conducting the survey, a route description form and a list of wetland categories. Volunteers were instructed to submit a completed route description form and a map of their route. Route descriptions were recorded on county maps and in a database. If a route description was received that duplicated an existing site, the latter volunteer was asked to move the site location. Route descriptions include town, range, section, wetland type and a brief description of each site's orientation. Volunteers were instructed to describe each site by using one or more of the following wetland categories: vernal pond, wet meadow, bog or fen, marsh, wooded swamp, or pond (Appendix II). After route descriptions were registered each volunteer was given a number and then sent a package of materials including a cassette tape of frog calls, information on the biology of frogs and information on each species found in Michigan, a frog identification poster, and data sheets. The idea of with-

holding the tape and other materials until routes were registered was a recommendation from the coordinators of the Wisconsin Frog Survey.

There were 454 survey routes submitted as of October 1, 1996, attributing to a 49% participation rate among those attending workshops. A significant number of those were located in the southern third of the state, but there was good distribution throughout other portions, including three islands in the Great Lakes. Two areas that were lacking routes included the middle of the lower peninsula and the "thumb" area. Data sheets were submitted for 64% of the registered routes in 1996. The inclement weather significantly influenced participation in the first year. In 1997 there were 226 returning volunteers, of which 62% submitted data. Upon submission of data sheets, volunteers were sent a survey update, a data summary, and a "Frog Survey Participant" patch.

There is usually about a 1–2 week warm-up delay from south to north each spring in Michigan. The state was divided into four zones according to assumed climate differences. Comparisons between zones of calling peaks for each species will be done to determine if there is actual differences between the zones. Zone boundaries may be adjusted according to calling times as necessary. Analyses were performed by zone for each year (Tables 1, 2).

Regional coordinators were named for each of the four zones established for the survey. Regional coordinators provide local assistance for volunteers and provide the coordinator with information on developing conditions and onset of frog calling.

APPENDIX I

Instructions for Conducting Frog and Toad Calling Surveys

Establishing a New Route

1. *Determine a route consisting of 10 wetland sites.* All sites must be easily accessible at night, preferably along roadsides. Avoid sites that require trespass on private lands. The route should extend no more than approximately 35 miles, and may be quite short (for example, your route may be contained within a particular State Game Area or city). Stops should be a minimum of 1/4 mile apart. You should not be able to hear the same individual frogs or toads from 2 different sites. Stay within county boundaries, if convenient.

It is best to draw a tentative route on a map first, then drive the route and stop where wetlands can be seen from the road. Make those wetlands your sites. Sites should not be decided upon on the basis of the frog population status at that wetland. Sites should be determined by wetland suitability to provide frog habitat, not if frogs are present or absent. Consider large vs. small, open vs. shrubby vs. wooded, stagnant vs. flowing, permanent vs. temporary, natural vs. artificial, and remote vs. agricultural vs. urban sites. See the **Wetland Types sheet included with these instructions for definitions.** Do not avoid ponds that dry up during the year, for they are often productive during spring. Do avoid swift streams, and deep or denuded shores of lakes. Also, avoid areas with heavy background noise, such as busy streets or highways, certain industrial sites, and farms with barking dogs.

Volunteers sometimes find that one or more of the sites originally chosen turn out to be unsuitable breeding habitat or are poor sites because of unforeseen background noise, access problems, etc. In these cases, it is usually necessary to replace the problem site with a new site sometime after the first survey run, thus voiding the first year's monitoring data. To avoid this, it is recommended that you begin with 11 or 12 sites for the first year and choose only the 10 most reliable sites for the permanent route. At the end of the first year, report results *only for the 10 permanent sites.* However, wetland breeding sites for amphibians come and go. It is expected that some

Table 1. Summary of 1996 Frog and Toad Survey data. Data are given for the four zones (1–4) of Michigan, with the number of sites in parentheses. Columns for each zone are the mean of indices where species were found (I), the number of sites within the species' native range in that zone (n), and the percentage of sites where the species was located (%).

Species	1 (1851)			2 (710)			3 (70)			4 (270)		
	I	n	%	I	n	%	I	n	%	I	n	%
Blanchard's Cricket Frog (<i>Acris crepitans blanchardi</i>)	1.6	42	2.9									
American Toad (<i>Bufo americanus</i>)	1.6	755	40.8	1.6	255	35.9	1.8	33	47.1	1.7	121	44.8
Fowler's Toad (<i>B. woodhousii fowleri</i>)	1.6	33	4.0	1.1	8	2.5						
Eastern Gray Treefrog (<i>Hyla versicolor</i>)	2.0	1322	71.4	1.9	349	49.2	1.3	33	47.1	1.7	137	50.7
Cope's Gray Treefrog (<i>H. chrysoscelis</i>)	1.5	199	10.8	1.3	76	10.7	1.0	1	1.4	1.1	16	5.9
Northern Spring Peeper (<i>Pseudacris crucifer</i>)	2.3	1532	82.8	2.4	643	90.6	2.3	66	94.3	2.5	255	94.4
Western Chorus Frog (<i>P. t. triseriata</i>)	1.6	872	47.1	1.7	291	41.0	1.3	13	18.6	1.3	56	20.7
Bullfrog (<i>Rana catesbeiana</i>)	1.2	255	13.8	1.2	31	4.4	1.0	1	1.4	1.3	3	1.1
Green Frog (<i>R. clamitans</i>)	1.3	1025	55.4	1.4	402	56.6	1.3	44	62.8	1.3	150	55.6
Pickerel Frog (<i>R. palustris</i>)	1.2	35	1.9	1.1	9	1.3		0	0	1.0	1	0.4
Northern Leopard Frog (<i>R. pipiens</i>)	1.3	295	15.9	1.3	116	16.3	1.0	2	2.8	1.2	27	10.0
Mink Frog (<i>R. septentrionalis</i>)							2.0	1	1.4	1.4	9	3.3
Wood Frog (<i>R. sylvatica</i>)	1.6	586	31.6	1.6	250	35.2	1.8	41	58.6	1.6	139	51.5

Table 2. Summary of 1997 Frog and Toad Survey data. Data are given for the four zones (1–4) of Michigan, with the number of sites in parentheses. Columns for each zone are the mean of indices where species were found (I), the number of sites within the species' native range in that zone (n), and the percentage of sites where the species was located (%).

Species	1 (1739)			2 (649)			3 (60)			4 (270)		
	I	n	%	I	n	%	I	n	%	I	n	%
Blanchard's Cricket Frog (<i>Acris crepitans blanchardi</i>)	1.7	43	2.8									
American Toad (<i>Bufo americanus</i>)	1.6	687	39.5	1.8	270	41.6	1.8	38	63.3	1.7	113	41.8
Fowler's Toad (<i>B. woodhousii fowleri</i>)	1.5	35	3.8	1.0	3	0.9						
Cope's Gray Treefrog (<i>Hyla chrysoscelis</i>)	1.4	144	8.3	1.5	37	5.7		0	0	1.4	10	3.7
Eastern Gray Treefrog (<i>H. versicolor</i>)	2.0	1199	68.9	1.8	310	47.8	1.9	27	45.0	1.5	133	49.3
Northern Spring Peeper (<i>Pseudacris crucifer</i>)	2.2	1423	81.8	2.3	565	87.1	2.4	57	95.0	2.4	249	92.2
Western Chorus Frog (<i>P. t. triseriata</i>)	1.6	983	56.5	1.6	237	36.5	1.4	10	16.7	1.1	32	11.8
Bullfrog (<i>Rana catesbeiana</i>)	1.2	236	13.6	1.22	30	4.6		0	0	1.3	5	1.8
Green Frog (<i>R. clamitans</i>)	1.3	1016	58.4	1.44	370	57.0	1.5	35	58.3	1.3	138	51.1
Pickerel Frog (<i>R. palustris</i>)	1.2	23	1.3	1.0	11	1.7		0	0	1.0	6	2.2
Northern Leopard Frog (<i>R. pipiens</i>)	1.2	230		1.3	106	16.3	2.0	11	18.3	1.0	27	10.0
Mink Frog (<i>R. septentrionalis</i>)			13.2				2.2	11	18.3	1.2	9	3.3
Wood Frog (<i>R. sylvatica</i>)	1.7	417	24.0	1.7	201	31.0	1.5	31	51.7	1.7	123	45.6

sites will be better over time (i.e., beavers put in a new pond), and others will disappear (i.e., construction of a new mini-mall). These are to be expected and the stops should not be changed to incorporate new sites or eliminate sites that are no longer available.

If you want to run more than one route, please feel free to do so. However, if you cannot complete all three surveys on each route, select one route on which to make all three surveys and cover the other routes if you have time. Information from the additional sites will be useful as incidental information.

2. *Describe your route.* Prior to, or early the first year the route is run, send us the locations of your sites clearly marked on a map. If you do not have access to a county map or other suitable map that can be photocopied, contact the Wildlife Division. Carefully mark the precise locations of your 10 sites on the maps, being sure that the marks you make are not so large as to make the location of the site unclear. Describe each listening point and wetland on the Survey Route Description Form. Describe the wetlands using the terms defined on the Wetland Types sheet enclosed with these instructions. Sites should be numbered in a convenient route sequence. Return the map route description before conducting your surveys, to make sure your route is not overlapping someone else's. A route number will be assigned to your route.

3. *Enlist one or more additional observers* who will become familiar with the route and survey procedures, and who can run the route in the event that you are temporarily or permanently unable to do so.

Surveying a New or Established Route

1. *Review the instructional material and data forms.* You will receive a packet of materials that includes a cover letter, instructions, survey route description form, field data sheet, miscellaneous observations form, natural history information, a poster of all the native species of frogs and toads, and a tape of frog and toad calls.

2. *Know the calls, phenology, and general ranges of Michigan anurans.* All volunteers are required to have a cassette tape or other recording that includes the calls of all Michigan's anurans. The first cassette sent to an observer will be at no charge but there will be a nominal fee for subsequent tapes.

New and experienced observers will find it both helpful to review the tape periodically and to take it along during surveys to help identify uncertain calls. New observers can learn the calls gradually by starting with those species that may be calling during the early spring survey period (wood frog, spring peeper, leopard frog, chorus frog, and pickerel frog), followed by those that begin calling in late spring (American toad, Fowler's toad, cricket frog, and both tree frogs), and finally those species that begin calling during the summer (mink frog, green frog, and bullfrog). It is highly recommended that new observers practice distinguishing calls in the field with the help of a more experienced observer.

Your instructional materials also include a natural history packet that summarizes the geographic range, status, calls, biology, and morphology of each species in Michigan. Use this information to help determine which species are likely to occur in a given region, habitat, and season. Although it is entirely possible that, for example, you may find an unusually early or late singer, or a breeding population outside a species' previously documented range, you should be aware that these unusual occurrences may require special scrutiny or verification.

3. *Run the route three times, once during each designated period.* The timing of the survey with the phenology of frog calling is essential. In most areas, failing to make one of the three survey runs or failing to survey all ten sites will severely limit or invalidate the entire year's data for monitoring purposes. Consider minimum air temperatures, especially

for the early spring survey period, before running your route. When deciding whether or not to conduct a survey, consider the air temperature first. If air temperature is not approaching the minimum suggested temperature, wait until it does. Allow two weeks between survey periods. The recommended dates below serve as a guideline. The earliest time of the date range will be the most appropriate for the most southern parts of the state, and vice versa. For example, if you live in the Upper Peninsula you may have to wait until May for appropriate temperatures to start your survey. But, keep in mind, weather conditions determine good surveying time better than dates.

Survey Period	Range of Dates	Minimum Air Temperature
1. Early Spring	April–May	45°F
2. Late Spring	May–June	55°F
3. Summer	June–July	65°F

4. *Run surveys after dark, under favorable conditions.* Choose an evening when air temperatures are above the minimums stated above and when wind is less than 8 mph. Warm, cloudy evenings with little or no wind and high humidity (even drizzle) are ideal. Humidity and cloud cover are not critical, but temperature is. A sudden drop in air temperature will cause most anurans to cease calling. If part way through a survey run you find that conditions deteriorate significantly (e.g., rain begins, temperature drops, or wind increases), stop the survey and complete it at the next possible opportunity, within 2–3 days if possible.

5. *Listen for calls at each site.* Approach a listening point so as to cause minimal disturbance. The arrival of a car or a person may cause frogs to stop calling for a short time. Listen for a minimum of 3–5 minutes after the frogs start calling again, up to 10 minutes if necessary, to be certain of all calls. Listen to all calls audible from your listening point, not just those emanating from a particular pond, one side of the road, etc. Some calls may be drowned out by others, especially by the full chorus of spring peepers or chorus frogs. Where you suspect this to be the case, and after carefully listening and recording your initial data, you may try to silence the chorus by make a loud noise with horn, car door, or voice. Then listen for the less conspicuous species as the calling gradually resumes.

A tape recorder will enable you to record questionable situations that can be listened to and confirmed at a later time or date. Prescription hearing aids are helpful for listeners who have volume or frequency impairment.

6. *Record your observations on the field data sheet.* Include county, date, route number, observers names and addresses, weather conditions, time and additional comments on noise levels, attempts to silence loud choruses, changes in habitat since previous visits, etc. At each site, record the call index value for each species heard, according to the following:

Call Index Value	Criteria
1	Individuals can be counted. There is space between calls (1–5 individuals).
2	Calls of individuals can be distinguished but there is some overlapping of calls (6–12 individuals).
3	Full chorus. Calls are constant, continuous, and overlapping, unable to count.

7. *Verify records of rare species and those that are outside their documented range.* We encourage you to verify records for the cricket frog if you have any doubts about your identification. For species outside their range (not including the occasional undocumented county within the

heart of the range), verification is also encouraged. Verification can be accomplished by: a) making a tape recording of the frog(s) in question, b) obtaining verification from 2 additional experienced observers, or c) making a good quality photograph(s) of the animal such that identifying characteristics are visible. Submit tapes and photographs with your data sheets at the end of the summer.

Taking a specimen should be considered a last resort and is not encouraged, especially for the cricket frog.

8. *Return all materials by August 15*, but keep a copy of the field data sheet for your records.

9. *Important! Maintain one or more alternate observers* whom you feel will be able to produce results comparable to yours, should you not be able to run the survey temporarily or permanently. The alternate(s) should accompany you on the survey periodically and be familiar with the calls, route, and procedure.

Contributing Miscellaneous Observations

Other sight or sound observations of anurans or other reptiles and amphibians should be submitted on the Miscellaneous Observations Form. If you wish to run non-permanent survey routes of several wetlands in an area, you may submit the data on a separate copy of the Field Data Sheet, along with a clear description of the locality of each site.

APPENDIX II

Wetland Type Descriptors

Vernal Pond

Vernal ponds are small bodies of standing water that form in the spring from meltwater and are often dry by mid-summer or may even be dry before the end of the spring growing season. Many vernal ponds occur in depressions in agricultural areas, but may also be found in woodlots. Wetland vegetation may become established but are usually dominated by annuals.

Wet Meadow

Wet meadows usually look much like a fallow field except that they are dominated by water-loving grasses and sedges. They will contain nearly 100% vegetative cover with very little or no open water. Any surface water present is temporary or seasonal and only during the growing season in the spring. Wet meadows often form a transition zone between aquatic communities and uplands with soils that are often saturated and mucky.

Bog or Fen

Bogs are found on saturated, acid peat soils that are low in nutrients. They support low shrubs, herbs and a few tree species on a mat of sphagnum moss. Some bogs are totally overgrown and some consist of open water surrounded by floating vegetation. Acid-tolerant plants found in and around bogs include woody plants such as labrador tea, poison sumac, tamarack, and black spruce. Many species

of orchids prefer bog habitats, as do insect-eating sundews and pitcher plants. Bogs are usually only found in the northern part of Michigan.

Fens are similar to bogs except that the soils are more alkaline because they result from water passing through calcareous deposits. Fens have a higher plant diversity than bogs due to higher nutrient levels. Fens can be found in the southern part of Michigan.

Marsh

Marshes have standing water from less than an inch up to 3 feet deep. The amount of water can fluctuate seasonally or from year to year. They are dominated by soft-stemmed emergent plants such as cattails and rushes. Vegetative cover is usually around 50%. In Michigan, marshes can be found at the edge of some rivers and lakes, in lowlands and depressions, and in swales between sand dunes.

Wooded Swamp

Wooded swamps are aptly named because they are dominated by woody plants such as shrubs and/or trees. The soil is saturated throughout the growing season. Some may become dry during the summer months. In Michigan, trees and shrubs found in wooded swamps include red and silver maple, cedar, balsam, willow, alder, black ash, elm and dogwood. They often occur along streams or on floodplains, in flat uplands or shallow lake basins.

Pond

Ponds are open bodies of water that are less than 20 acres in size and that do not dry up during summer months. There is little emergent vegetation but some floating vegetation may occur around the edges.

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