

Amphibian Monitoring in the Great Lakes Inventory and Monitoring Network: 2014 Annual Report

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The National Park Service Great Lakes Inventory and Monitoring Network (Network) is implementing an amphibian monitoring protocol at national park units across the Great Lakes region based on automated acoustic monitoring (Casper and Beever 2013). Implementation began in 2013 with three parks participating by selecting 10 sites and deploying an Automated Recording System (ARS) at each site per the approved protocol (*op. cit.*). ARSs were Song Meters manufactured by Wildlife Acoustics, Inc. (970 Sudbury Road, Concord, MA 01742-4939). In 2014 two additional parks participated with 10 sites each. This report provides annual summary results for the program.

1. Methods

1.1 Site Selection and Equipment Deployment

ARSs and pre-programmed SD cards were provided by the Network to Apostle Islands National Lakeshore (APIS), Indiana Dunes National Park (INDU), Mississippi National River and Recreation Area (MISS), Pictured Rocks National Lakeshore (PIRO), and Sleeping Bear Dunes National Lakeshore (SLBE) in early 2014. The three Parks set up in 2013 (INDU, PIRO, SLBE) repeated the study at the pre-selected permanent sampling sites. For the two new Parks (APIS, MISS), we selected permanent sites using the same process. Up to 30 sites were pre-selected by the Network in a stratified random design per the Protocol (Casper and Beever 2013) and associated Standard Operating Procedures. ARSs were tested for quality control by the Network or the participating park before field deployment, and each site was ground truthed by the principle investigator (GC) for qualifying as suitable habitat and to assign its wetland category (temporary, semi-permanent, permanent). Ten ARSs were then deployed with a goal of three in each of three qualifying wetland ranks and the tenth unit placed at a final qualifying site at each park's discretion. At APIS site selection had to consider logistical concerns, and on the islands most amphibian breeding habitat consists of either lagoons (with water levels determined by

lake levels which seep through porous sand) or beaver ponds on impounded streams. At MISS, site selection had to consider noise levels and high water events that could drown units. Most amphibian breeding habitat in this narrow, linear, urban riverway consists of floodplain wetlands, with very few wetlands that are not subject to flooding from high water events. In all parks, Song Meters were field checked mid-season to confirm continuing operation by park staff, and removed after the calling season. Upon return of ARSs to the office, SD cards were removed, backed up, and sent to the Network for archiving and analyses. Each park will inspect and test ARS equipment again prior to redeployment in 2015, with repairs and replacements as needed. Forms detailing ARS deployment and retrieval, as well as subsequent equipment checks and retrieval, are on file with each park and the Network office.

1.2 Recognizer Development

We continued developing recognizers utilizing species recordings obtained from ARSs deployed on this and other western Great Lakes area projects. This process is described in the Song Scope software manual. Currently we have four species recognizers sufficiently developed for automated sampling of recordings: Spring Peeper (*Pseudacris crucifer*), Treefrog (*Hyla chrysoscelis* and *H. versicolor* combined), American Toad (*Anaxyrus americanus*), and Green Frog (*Lithobates clamitans*), and others under development (see 2.2). Recognizer specifications are provided in Table 1.

1.3 Data Analysis

Digital audio recordings are site, time and date stamped in file names. For each site we received varying numbers of samples (a sample is a 5-minute digital audio recording), along with a TXT file containing date and time stamped temperature logger data. These data are summarized in Table 2 and Appendix D. The logger data included data from both internal and external temperature sensors per the Protocol.

1.3.1 Analyzing Species With Recognizers

For each site we performed a stepwise process to reduce raw data to subsets of samples for analysis. This procedure applies a sampling protocol that maximizes detection probabilities, and defines the sample size, as follows.

1. Examine file names and size to discover equipment failures. This Step discovers "empty" or blank samples (considered invalid) and begins the process of assigning bounding dates. Empty samples are those that are silent and do not contain any background noise at all, indicating equipment failure or that the ARS started recording before microphones were attached and it was deployed in the field. These are not valid samples and are eliminated from analyses. The equipment failures discovered in this Step are those that result in either no recording made at all (typically due to battery failure, water damage, or physical damage from animals or tree fall), or an empty recording resulting from microphone detachment or failure. It will not discover failures that made "garbage" recordings (e.g., from damaged but still functioning microphones or motherboards). See Step 5 to screen for "garbage" recordings.
 - a. For each Site, eliminate any files where file size = 0. Record the file name, date, and time

- of the first and last remaining samples (each file name is date and time stamped).
- b. Examine the remaining files for gaps in date/time stamps, indicating the unit stopped recording but then re-started (such as when batteries failed but were then replaced on a mid-season check). Record the gap dates, which will be used to determine sample size.
 - c. Compare the date/time of the first file with the deployment date/time recorded on the deployment forms. Eliminate any files that occurred prior to deployment. Open files in Song Scope as needed to find and verify the first valid sample. Record the file name, date, and time of the first valid sample.
2. Subset the remaining files further by time of day. We selected 3-5 samples per evening with the first sample being the first pre-sunset. We chose this time because calling activity gradually declines after sunset as temperatures drop, and there is less bird call interference after dark, which reduces the number of false positives in the results. Under the current protocol, sampling occurs hourly from noon till midnight, so the total number of samples in an evening will vary depending on the time when sunset occurs. In future, we recommend starting with the first file post-sunset to further reduce bird song interference (but see discussion in Section 3).
- a. *Adjusting File Selections for Sunset and Daylight Savings Time:* Obtain sunset times from (http://aa.usno.navy.mil/data/docs/RS_OneYear.php). The 2014 tables are provided in Appendix C. ARS's do not automatically adjust for daylight savings time, but because this shift occurs in early March and early November (<http://www.day-finder.com/daylight-savings.php>), ARS's are calibrated to log in local Daylight Time throughout the sampling period (so file time stamps are in local time). Sunset tables in Appendix C, however, are in Standard Time, so when determining sunset time one hour must be added to the time to account for Daylight Time. Examples of proper sample selection based on these tables are provided below.

Park	Place	Date	Sunset	Sample to Use
AINL	Bayfield, WI	5/28/2014	1946 CDT	2100h
ISRO	Grand Marais, MN	5/28/2014	1948 CDT	2100h
MISS	St. Paul, MN	5/28/2014	1948 CDT	2100h
PIRO	Munising, MI	5/28/2014	2048 EDT	2200h
INDU	Porter, IN	5/28/2014	1913 CDT	2100h
SLBE	Traverse City, MI	5/28/2014	2018 EDT	2200h

3. Run the file subset from Step 2 through the available species recognizers.
4. Examine the recognizer output to determine the species-specific sample bounding dates. For each species and site, verify the first and last calling dates by manually scanning the first and last recognizer detections using Song Scope (see below for manual scanning procedure) until first and last detections are confirmed visually and by audio playback. This identifies any possible false presences in first and last detections. Eliminate any samples outside these bounding dates. The reduced recognizer output now lists all samples that contained one or more putative detections between the bounding dates and within the time of day

constraints.

- a. Note: For output from the American Toad recognizer, manually scan for the first and last detection that is 5 or more seconds in duration. Then, in Excel, eliminate all results less than 5 seconds in duration. It is currently not possible to automate this step within Song Scope, and it improves results by eliminating many false presences. If all of the detections are less than 5 seconds in duration, then manually scan for the first and last accurate detection, and use these as the bounding dates.
5. Scan the recognizer output results from Step 4 for detection gaps, where samples consistently had no detections for any species. Manually examine these files for potential "garbage" recordings indicating malfunctioning equipment. These typically have consistent white noise with no variation (if they recorded nothing at all they should have been eliminated in Step 1). If a "garbage" recording is found, then check Channel 2. If good data is present on Channel 2, then the sample can either be manually scanned or re-run through the recognizer (with Channel 2 selected on the Mixer Tab). If neither of the channels contain valid data, then document the suspect samples and dates, and eliminate these as invalid samples in the calculations for Step 6.
 - a. Note: No detections may also result from actual absence of frogs calling, sometimes resulting from cold temperatures or strong storms. If birds, wind, thunder, or other animal or anthropogenic sounds are recorded, the sample is good. If unsure, examine available temperature logs for the date/time, and if the air temperature is below 4.4C (40F) eliminate as an invalid sample.
6. Calculate the sample size as the number of samples (5-minute recordings) remaining in this reduced output. This can be accomplished within Excel through manipulation of files to eliminate duplicates with the same date/time stamp in the file name. Note that the resultant *number of samples* will be fewer than the *number of detections*, as there are often many detections within a single sample (see Table 3). Also, the time of day constraints (Step 2) may be adjusted in the future if it is determined that daytime samples are better for detecting some species (e.g., Wood Frog, Chorus Frog). Record the bounding dates, number of detections, number of samples, and number of dates the species was detected.

1.3.2 Determining False Presence Rates

Anticipating data needed for occupancy modeling after 5 years, we provide two more analyses that can be used in new models developed by Miller et al. (2011, 2013; Pillay et al. 2014) that account for both false presences and false absences. In these models, false presence rates are determined by comparing samples from the same locations and dates (with all other covariates presumably the same) by two different methods, one of which has more "certainty" than the other. For example, one suggestion is to use call index values and assume that high index values are more "certain" detections than low index values. Such techniques will require more assumptions and more complexity in the modeling and interpretation of results.

We determined false presence rates by choosing a random sample of up to 10 detections per site (some sites had <10 detections) and confirming each detection by manual scanning (see

procedure below, results in Table 9). The random samples were selected from the reduced data set resulting from Section 1.3.1, where same-date duplicates were removed. The number of automated detections evaluated ranged from 20 to 161 across all sites for a given species. This returned a false presence rate that can be applied in occupancy modeling. It also quantifies the efficacy of the recognizers in this regard. This same data set of verified samples could also be treated as a second kind of survey or sampling technique (manual scanning of auditory files in Song Scope), which has higher "certainty" than the automated recognizer detection technique (false presence rates should be zero with manual scanning). In this second treatment we can let Miller's models determine the likelihood of false presences by inputting data from both sampling techniques. Which treatment proves more efficacious and returns data closer to reality remains to be seen. We fully expect that by the time we analyze data for occupancy at the 5-year mark, these models will be revised again.

1.3.3 Analyzing Species Without Recognizers

We determined presence or absence for species we have not developed recognizers for by manually scanning 30 samples from each site. This sample size was chosen to exceed the 20 samples per cell recommended by Simmons et al. (2011). The species evaluated by this method are currently (in phenological calling order): Wood Frog, Chorus Frogs (both species are treated together), Leopard Frog, Pickerel Frog, Fowler's Toad, Cope's Gray Treefrog, Mink Frog, and American Bullfrog. If and when recognizer files are developed for any of these species they can be evaluated per the automated process. Note that manual scanning is only necessary for species that are otherwise known to occur in each park (Table 4) and do not have recognizers developed. For species with recognizers the automated system is preferred. Table 4 is based on all available data, and revisions based on our latest status assessment are explained in footnotes. We encourage additional field work to document presence or absence of questionable species in each park.

1.3.3.4 Manual Scanning Procedure

1. Open the folder of samples from a site and open the first file (*.WAV) to be scanned in Song Scope software (File → Open). Adjust settings as follows for Song Scope version 3.4 (Note that these are the default settings except for the Background Filter on the Spectrogram Tab):
 - a. Display tab: all sliders on 0 except Saturation on 255 and Luminosity on 128.
 - b. Mixer tab: Sample Rate to 8000, Playback Speed Normal, Max Sample Delay 64, all other sliders at 0. [NOTE: If the default Channel 1 appears blank, try Channel 2 and note this problem in comments.]
 - c. Spectrogram Tab: FFT Size 256, FFT Overlap 1/2, Frequency Range 128, Background Filter 1s, all other sliders at 0.
 - d. Detector tab: Max Syllable and Max Syllable Gap at 50, Max Song at 30, Dynamic Range at 20, Algorithm at 2.0.
 - e. Recognizers tab: leave alone, as this does not change the view of the sonogram.
2. Review the example sonograms in Appendix A to aid in visual scanning. Refer to these

examples each time you evaluate a new species.

3. Grabbing the slider with the mouse pointer, scroll slowly to the right until a sound wave is observed. Release the slider and click the Play button (triangle) to listen to confirm the species calling (headphones are recommended). Click the Pause button and record the species(s) heard in the Manual Scan Data Sheet (Appendix B). Then grab the slider again with your mouse pointer and continue scrolling to the right until you see another (different) sound pattern. Play again to confirm, then Pause and record the data. Continue to the end of the file. After a little experience you should be able to visually recognize species call patterns almost instantly, but always confirm the first instance by audio verification.
 - a. Tip: After adjusting settings, always keep one file open in a Song Scope window, opening a new file from it using File → Open (it will open in a new window). This will save your settings. If you close all open Song Scope file windows, the settings will return to default when you again open a new file.

1.3.3.5 Manual Scanning Sample Selection and Study Design

1. Prepare the Site file set to scan. Select a Site and begin with the file subset from Step 2 of the automated scan process (Section 1.3.1). If needed, further reduce this subset by eliminating any "garbage" files identified in Step 5 (Section 1.3.1). Reduce this subset further by selecting only one sample per day, this being the first sample at least 30-minutes post-sunset, which should have the highest sound level if frogs are calling. Be sure to follow instructions for adjusting for Daylight Savings Time in file selections.
2. Determine general bounding dates for the Site sample set. This Step determines valid start and end dates for manual scanning. For a Start Date, if the automated process detected Spring Peeper at the Site, use the first detection as the start date (see automated results). If Spring Peeper was not detected, use the first file. For an End Date, if the automated process detected Green Frog at the Site, use the last detection as the end date. If Green Frog was not detected, use the last file but not later than July 31.
3. Select 30 samples based on equal spacing of file selections between bounding dates (typically, every other or every third day). Record the file names of these samples on the Manual Scan Data Sheet (Appendix B). Fill in the *Evaluator Name* and *Site* columns on the datasheet. Note: there are utilities for copying file names from Explorer window to an Excel spreadsheet, so typing file names should not be necessary.
4. Run a manual survey on the 30 files recording each species present.
 - a. Using the reduced sample set from Step 3 above, begin scanning for the species to be evaluated per the How to Manually Scan instructions above. Species for evaluation are those listed in Table 5 as present in the park and without developed recognizers. Enter a 1 in the species column for each species confirmed both visually and audibly. If there is only a visual or audible confirmation for a species, but not both (i.e., the call is visually lost within background noise but can still be heard), then make a note in the comments column regarding the call's location in the sample, but don't mark a 1 for the species. Any questionable calls should also be noted in the comments and then independently verified by a second observer. Repeat with the next file until all of the appropriate

species have been confirmed present, or until all of the files in the folder are scanned.

- i. Tip: For noisy samples, visually scan for calls first, and verify them second. You don't need to 'listen through the noise' to find potential calls because both a visual and audible confirmation are required to assure presence.
 - ii. Note: If "garbage" samples are found (see Section 1.3.1 Step 5 above) indicating additional equipment malfunction that was not previously eliminated, scan forwards and backwards until these malfunction bounding dates are determined and eliminate those days from all sampling, re-adjusting sample selection as needed (e.g., re-select the 30 samples if necessary, or see Section 1.3.3.6 below for substituting samples). Note any such discoveries on the data sheet and notify the automated scanning personnel to make appropriate changes in their analysis results.
- b. Have a qualified second observer verify every first and questionable detection for each species at each site.

1.3.3.6 Protocol For Substituting Noisy Files

Occasionally during the manual scanning or other proofing processes samples may be found where the recordings are so noisy that they should be considered invalid samples. Both anthropogenic (traffic, airplanes, etc.) and natural (wind and waves from storms) noise can violate protocol, which requires that the species be detectable during the survey. If such samples are encountered, follow this protocol to substitute noisy samples for new samples. Exceptionally noisy ARS sites may have to be relocated.

1. First examine the samples immediately before and after. If both are still noisy then Step 2.
2. Examine all later samples for that night. If still too noisy, then Step 3.
3. Follow the same process for the night before and the night after, until a suitable sample is found.
4. Explain substitution in comments field.

2. Results

2.1 Site Selection, Equipment Deployment and Retrieval, Data Collection

These data forms are archived at each park and the Network office, pending database development and data entry. In 2014, initial site selection from the remote sensing randomized site list went fairly smoothly (weather issues aside), but there was difficulty in distinguishing between ephemeral and semi-permanent wetland classifications based on only one site visit. These rankings should be periodically re-evaluated based on hydroperiod data. Equipment deployment was performed as best as possible in this pilot year, and improvements in materials and fastening of posts, cords and sensors may be realized as the program progresses.

Equipment and data retrieval were handled by park and Network staff. Data contained on SD cards from each ARS unit were delivered to the investigators and examined for completeness,

including scanning of files to determine "empty" files indicating equipment failures. Results are presented in Table 2.

Data collection success is presented in Table 6 with sampling success rates. Since deployment dates vary each year with phenology and staff logistics, sampling start dates are not static. Once deployed the pilot protocol assumed 13 samples recorded each day (1200h to 0000h), at the top of each hour, until units are retrieved. The protocol intent is to continue sampling through July 31 to allow for analyses of late calling species (e.g., American Bullfrog). Therefore, the expected number of samples is calculated from the actual deployment date of each unit through July 31. See Table 2 for actual sampling dates. In 2014, APIS, INDU, MISS and SLBE Song Meters were recording 13 samples per day (1200h to 0000h), while PIRO Song Meters were recording 16 samples per day (1200h to 0300h).

2.2 Recognizer File Development

Our current recognizers are sufficient for automated sampling for four species provided both false presences and false absences are accounted for in subsequent analyses. Our Spring Peeper recognizer works very well overall, but will return some false presences identifying some birds and Chorus Frogs as Spring Peepers, and it does not identify full Spring Peeper choruses. In selecting samples for analysis, filtering the recognizer output by time of day and time of year can help reduce false presences, such as utilizing later samples (after midnight) to eliminate confounding bird calls and full choruses. Reducing false presences of Spring Peepers from misidentified Chorus Frog calls may be difficult but we continue to evaluate this. The American Toad recognizer works well once calls less than 5 seconds are filtered out post-processing. We do not yet have training files for Fowler's Toad so have not examined how well this recognizer can differentiate between these two species, although a frequency filter may achieve this as Fowler's Toad calls are a higher frequency (and this species is currently known only from INDU, and possible in SLBE). The Gray Treefrog recognizer works well and additional development will be assessed as more data and Cope's Gray Treefrog recordings are evaluated. The Green Frog recognizer returns few false absences, but incorrectly detects a lot of background noise as false presences. We continue to evaluate additional filtering to reduce false presences in this recognizer.

The status of recognizer development for the remaining species in the Network is variable. For Wood Frog, Northern Leopard Frog, Western Chorus Frog, and American Bullfrog, we are incorporating additional training samples and will test a recognizer on 2015 data. The calls of these species are fairly distinct, so we anticipate being able to develop quality recognizers, possibly improved by selecting daytime samples for those species that also call during the day. For Boreal Chorus Frog, we have not yet incorporated enough training samples, and the samples currently in hand show a difference in frequency range from the Western Chorus Frog. We may be able to develop a quality recognizer if we can obtain more training data from ISRO or other sources. For Mink Frog, the call is very weak and not well differentiated from Green Frog calls and background noises. Its visual signature in a sonogram, however, is distinct

enough for a human to pick it out visually, giving us confidence that our manual scanning protocol will allow for analyzing this species if automation fails. Current recognizers do well at detecting Mink Frogs (low false absences), but have a high false positive rate in our informal testing. We continue to work on recognizer development for this species. We have a preliminary recognizer developed for Blanchard's Cricket Frog and will further improve it with training data from 2015 from southwestern Wisconsin. Our treefrog recognizer currently does not distinguish between Cope's and Gray Treefrogs, and these species may need to be analyzed as a species pair. Where distinguishing Cope's status is important, manual scanning can be used. This species is currently known from only three participating parks (INDU, MISS, and possibly APIS). For the remaining species (Fowler's Toad and Pickerel Frog) we have no training samples and the prospects for recognizer development remain unknown. However, as mentioned above, we expect to be able to develop a Fowler's Toad recognizer by restricting our American Toad recognizer to only higher frequencies. The same technique may succeed to differentiate Pickerel and Northern Leopard frog calls. Where desired, species for which adequate recognizers cannot be developed can be sampled by the manual scanning protocol.

2.3 Data Analysis

Species detected at each site by each method are detailed in Table 7, along with the proportion of the total number of species known to occur in a Park (from Table 4) that were detected at each site (detection rate). Note that the "detection rate" is not a detection probability (each species is not assumed present at each sampling site). For example, at APIS01, 4 of the 9 possible species in the Park were detected, and over time the non-detection of Wood Frog, Northern Leopard Frog, and Mink Frog might be examined more closely at this site to see if they were detected in some years and 2014 should be treated as a false absence, or if they are never detected over time (truly absent), perhaps because the wetland is unsuitable for them. In future, detection probabilities can be evaluated for each sampling site and compared by wetland type.

2.3.1 Species With Recognizers

Appendix D provides raw recognizer outputs with results of filtering steps.

2.3.2 False Presence Rates

False presence rates for the automated recognizer detections are presented in Tables 8-10. These values can be used to apply false presence rates for modeling. Note that these detections were from the reduced data set as described in Section 1.3.1. False presences would be higher if data were not reduced to ensure the highest detection probabilities (best sampling protocol). The confirmed data set (from the manual scanning procedure) can also be used as a second high "certainty" survey sample set with false presences assumed to be zero. Used in this manner a false presence constant need not be used and the model can determine occupancy probability adjusted for false presence likelihood (Miller et al. 2013).

2.3.3 False Absences in Occupancy With Recognizers

By manually scanning 30 samples for each site, we were able to compare occupancy

determinations with our recognizer results and calculate false absence rates for species with recognizers developed. This assumes there are no false presences in the manual scans, of which we are confident as all first and questionable detections for these species were verified by an independent observer. Note that the 30 samples scanned manually are a subset of the (usually) much larger number of samples scanned by the recognizer. The summaries following are derived from Table 7.

Spring Peeper: This species was detected at 39 sites by both methods combined. All but one of these sites had detections by both manual and automated scanning. At SLBE01, only manual scanning detected Spring Peeper, where the call was very faint and distant, hence possibly not present at the subject wetland. Assuming SLBE01 is a valid occupancy (that distant calls are counted), the occupancy false absence rate for this recognizer was 0.025.

American Toad: This species was detected at 29 sites by both methods combined. One site had only recognizer detection (SLBE02), and one site had only manual detection (MISS09). At SLBE02 in manually scanned samples with automated detections toads could not be confirmed and strong Spring Peeper choruses may have obscured them, as the automated detections that were verified were faint. At MISS09 the manual detection was verified but very loud background noise may have defeated the automated recognition in this file (MISS09 is so noisy it probably violates protocol and should be relocated). If we drop SLBE02 as a presumed false presence (since it could not be manually confirmed), we are left with 28 sites confirmed as occupied, 27 of which were detected by the recognizer, for a false absence rate of 0.036.

Gray Treefrog: Gray Treefrogs were detected at 31 sites by both methods combined. At 3 sites detections were only by manual scanning (PIRO01, PIRO02, PIRO08). At all other sites Gray Treefrogs were detected by both methods. The recognizer was able to detect faint individual calls at some APIS sites when the quality and score filters were reduced, indicating that the calls at APIS were likely too faint to be detected using the regular parameters. The Gray Treefrog recognizer is not able to detect full choruses, and it is likely that at PIRO there was not a single call within the chorus that was strong enough to be detectable over the chorus. Assuming all 31 sites were valid occupancies, the occupancy false absence rate for this recognizer was 0.10.

Green Frog: This species was detected at 35 sites by both methods combined. At 5 sites detections were made only by manual scanning (INDU02, INDU03, MISS08, MISS09, PIRO06). Manual detections were independently verified at all sites, but the MISS sites have very loud anthropogenic noise and probably violate protocol and should be relocated. PIRO06 Green Frog calls were either very few and abbreviated, or very faint and distant. Both extraneous noise and unusually faint or brief calls may be problematic for automated recognition. Assuming all 35 sites were valid occupancies, the occupancy false absence rate for this recognizer was 0.14.

In sum, very few occupancy changes resulted from manual scanning, and recognizer false absence rates are well below the maximum 0.3 level recommended for modeling (Mackenzie

and Royle 2005).

2.3.4 Species Without Recognizers

Manual scanning is feasible as a technique for monitoring species where automated detection is not developed. The results of our manual scanning are provided in Table 7 and Appendix B. Manual scanning involves visual recognition of call patterns with auditory verification, and 5-minute samples can be processed in roughly 2 minutes by experienced personnel using Song Scope software and quality headphones. The technique should return no false presences, as every first or questionable detection is verified by a second observer. Initial false presences in 2014 manual scanning were limited to Cope's Gray Treefrog (from difficulty in distinguishing calls from Gray Treefrog), and Chorus Frog sp. (some Spring Peeper trill calls were mistaken for Chorus Frogs), all of which were eliminated by second observer verification. We have found that these two particular false presences are also common in state frog calling program data. As manual scanning personnel become more experienced, these initial false presences should be reduced or even eliminated.

We prepared species-area curves and statistics for each site where 30 samples were manually scanned (summarized in Table 11, complete data in Appendix E). MISS08 was excluded as only 9 samples were available. Combining all sites from all parks, new species were detected as late as sample 30. However, this varied by park. For the two northern parks where late calling American Bullfrog and Northern Cricket Frog are absent, maximum species richness was achieved by samples 19 (APIS) and 20 (PIRO). For INDU, MISS and SLBE maximum detection was achieved by samples 30, 27, and 29, respectively. At INDU, late detections resulted from single Green Frog detections at samples 30 for INDO02 and sample 26 for INDO03, and American Bullfrog detections at samples 30 for INDO06, and sample 26 at INDU09. At MISS, late detections resulted from the single site (MISS04) where Blanchard's Cricket Frog was detected at sample 27. At SLBE03, a late Green Frog detection in sample 29 on June 28 is a result of July data missing due to premature equipment failure and consequently the 30 samples were shifted earlier in phenology to span the actual recording period of 16 April to 29 June, so this late detection is anomalous and SLBE actually clusters with the northern parks in this analysis (excluding SLBE03 places the maximum detection achieved at sample 18). Remaining sites at INDU and MISS had complete detection by samples closer to the average for each park.

A manual Blanchard's Cricket Frog detection was made at MISS04 and independently confirmed in two samples (MISS04_20140616_230000.wav, MISS04_20140618_230000.wav). This site is approximately 12 river miles downstream of known occupied sites near the mouth of the Minnesota River (MN DNR). Given that the species is State Endangered, a visual confirmation is desired, but has not yet been obtained. The site was not re-sampled in 2015.

3. Discussion

Data collection issues in 2014 included equipment and logistical problems. Song Meters at

some parks are deployed too late for capturing Wood Frogs, but this is expected and Wood Frogs may be monitored at these parks by egg surveys, if desired. At MISS, flooding damaged some Song Meters. SLBE02 files are all time stamped 2013, which we suspect was a programming or date setting error. We assume the day, month and time are correct as these match the day and month on the deployment form, but no remark is made on the form regarding the incorrect year.

Blank files (which recorded a file the same size as good recordings but without sound) were found in no discernible pattern. We suspect these are due to microphone failure, and are investigating ways to screen for discovering such files. Currently, when discovered these files are eliminated from analyses, after first checking if Channel 2 recorded properly (all analyses are initially limited to Channel 1, with Channel 2 as a backup if the microphone on Channel 1 fails). We recommend tracking microphones and make recording the microphone number part of the deployment form. This would allow tracking recording failures against individual microphone failures. Corresponding labels could be added to the Song Meter housing at the microphone ports to make it easy to match the correct microphone to port when deploying.

The species-area curves and statistics presented must be evaluated in the context of phenology, where not all species are present throughout the entire sampling period. To determine if 30 samples is enough to avoid missing species present, it is not as simple as selecting samples randomly, or evenly distributed (as we did), at any site. The graphs that bump up towards the end are those sites where either late callers (Blanchard's Cricket, Green, American Bullfrog) began calling towards the end of the sampling period, or the recording period was truncated (SLBE03). The actual sample size for surveying these species would need to be counted from the date it started calling (which cannot be known unless we scan every day - for most sites every second or third evening was scanned). By the same reasoning, the early caller sample size is unknown. Therefore, we do not recommend placing much emphasis on this analysis. Rather, from an occupancy modeling standpoint, consider that 30 samples is 10 times more than the calling programs we are emulating achieve, and a program using 30 samples can be modeled for false absences and false presences, for occupancy analyses just as the automated results are (but with much higher sample sizes).

Song Scope version 4 has been released and has a new capability termed "Sound Scape". This is described in the manual as follows.

"A Song Scape can be described as a spectrogram on a large time scale. Instead of looking at individual vocalizations as they appear in small time scales measured in seconds, a Song Scape lets you view the frequency spectrum over a large time scale measured in days, months, and even years at time. This powerful visualization makes it possible to observe phenological events, such as what time of year specific frog species begin to vocalize, and what time of night they are most active. A Song Scape can also help locate interesting acoustic events, such as a change in the composition of the dawn chorus, by looking at thousands of recordings simultaneously. You can then zoom in on an individual recording and observe the specific vocalizations that contributed to the change. Song Scapes are embodied by a Song Scape Summary (.sss) file

and are organized into discrete time periods (e.g. hourly). For each time period, the summary file contains spectral information such as minimum, maximum, average, and the standard deviation of power levels for each of several frequency bands."

We suspect that USGS is planning to utilize a Song Scope analysis in some capacity at SACN and VOYA. However, how it will be used for monitoring (what parameters are monitored and how) remains unclear. Nevertheless, if new Song Scope licenses are purchased, this capability will become available and may yield additional insights worth pursuing.

At PIRO, ARSs were programmed to collect a greater number of samples than other parks (ending at 3 a.m. instead of midnight. We now recommend this programming for all parks to allow for selecting samples later in the night for analyses. This allows for samples with less bird song interfering. If desired, sampling could alternatively be shifted to start later each day (3 p.m. instead of noon) if the amount of data collected or battery drain is an issue.

We also recommend the Network re-evaluate programming and sampling design taking into account that, a) the highest detection probabilities for frogs will likely be at 30, 60 and 90 minutes post-sunset (less bird song interference, warmest part of the night), b) such sampling can be programmed utilizing the ATSUNSET command, c) continuing to take hourly samples from noon to 0300h is feasible even with these added post-sunset times given the space available on the SD cards, and d) any such change should re-visit the idea of making data collection consistent with the USGS program recording on the top of each hour. There are also data management efficiencies to consider, as the file selection process could be more efficient if only the 3 post-sunset times were selected each night for analysis without need for sunset table referencing and corrections. The ATSUNSET command is dependent upon the ARS clock being properly set and accounting for Daylight Savings Time (see manual).

Excessive noise is an issue on some sites in INDU and MISS (mainly from planes and trains). Noise can confound automated and manual detections, returning higher error rates. To address this, we will be suggesting alternative locations for some MISS units later this year, as their ongoing herp inventory identifies more suitable sites. At INDU we suggest investigating whether or not the programming can be adjusted to avoid train noise by examining train schedules, or if alternative sites (preferably on the same wetland) can be found for INDU03, INDU04, INDU07, INDU08, and INDU09.

To allow for a better understanding of site conditions, change over time and within seasons, and differences among sites that might influence amphibian occupancy, we also recommend that a botanical description of each permanent sampling site be completed (at minimum describing dominant plant species and communities), some water chemistry metrics be monitored, and photo documentation be implemented, every 5-10 years. A wetland monitoring SOP has been completed under the Amphibian Monitoring Protocol to address this recommendation.

A new version of the Song Meter (SM3) has also been released which we now have some experience with. These units have improved battery life and programming capabilities, and significant design improvements for durability and ease of mounting. They also have built in microphones with improved sensitivity which may require less frequent maintenance and replacement. Transitioning to the SM3 platform as replacement units are needed is feasible. Advantages would be improved durability and easier mounting options, improved battery life and possibly higher quality recordings. Disadvantages are larger size and greater weight (weight with 4 D-cell batteries is 7.05 lbs, width 8.25 in., height 12.25 in., depth 2.5 in.), which may be problematic where units are backpacked into remote locations. Also, programming buttons are readily accessible on the unit front such that the public could press buttons (a security box may be needed where this may be an issue). Using the SM3 platform would also require new programming files be developed (easily accomplished), and SOP revisions to address the SM3 platform specifics (particularly SOP 4 Automated Recording Systems).

For SM3 units, and SM2 units with backboards, mounting can be accomplished via straps to a post or tree, then locked if necessary with a cable lock. This eliminates the need for any power tools to drive screws or tighten bolts. SM3 units have flanges built into the housing for mounting and locking and do not need backboards.

Ongoing results continue to suggest ways to better analyze data, and the strengths and limitations of the automated and manual analyses. For example, anthropogenic noise is a problem for the toad recognizer, returning high false presence rates. However, the occupancy decision can still be made with confidence for each site by using the manual scanning procedure to verify the first and last automated detections. Occupancy false absence rates in the recognizers are well within statistical objectives.

4. Literature Cited

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5. Tables

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6. Appendices

- Appendix A: Example Sonograms (PDF)
- Appendix B: Manual Scan Data Sheets (MS Excel)
- Appendix C: Sunset Tables (PDF)
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- Appendix E: Species Area Curves and Table 11 (MS Excel)

Table 1: Recognizers

	PSCR2	HYVEa	ANAM3a	RACLa
Parameters	Spring Peeper	Gray Treefrog	Am. Toad	Green Frog
Sample Rate (Hz)	16000	16000	16000	8000
FFT Size	256	256	128	256
FFT Overlap	1/2	7/8	1/2	1/2
Frequency Minimum	40	11	12	9
Frequency Range	16	36	8	94
Background Filter	1s	1s	1s	1s
Maximum Syllable	336	600	1008	16
Maximum Gap	144	920	156	224
Maximum Song	400	2288	6844	832
Dynamic Range	25	20	15	20
Maximum Complexity	44	43	32	32
Maximum Resolution	27	9	6	6
Minimum Quality	20	20	20	30
Minimum Score	50	50	50	60
Cross Training	78.17 ± 9.37%	74.15 ± 4.38%	77.48 ± 5.03%	76.24 ± 6.42%
Total Training	83.58 ± 8.22%	74.06 ± 4.83%	77.39 ± 4.17%	75.88 ± 5.67%
Training Files	2 files from Ottawa National Forest (ONF); 30 annotations.	4 files from ONF; 38 annotations.	3 files from ONF; 17 annotations.	3 files from ONF; 63 annotations.
Training Notes	Annotated a single peep between 2000 & 4000 Hz; training files from evening samples (10 PM - 2 AM) only.	Annotated a 0.2 to 0.7 sec trill between 600 & 3000 Hz; training files from evening samples (10 PM - 2 AM) only.	Annotated a 5 - 9 sec trill between 1600 - 2250 Hz; call between 300 - 2000 Hz; training files from evening samples (10 PM - 2 AM) only. Requires additional post-processing filtering in Excel (limit call duration to > 5 sec).	Annotated a 1 - 1.4 sec between 300 - 2000 Hz; training files from evening samples (10 PM - 2 AM) only.

Table 2: Data Summary

File	Date range of files	Date range of valid samples	Invalid samples (i.e., empty)	Deployment date & time of first sample	Recovery date & time	Temp data present?	Deployment notes present?	Mid-season check notes present?	Recovery form notes present?	Logger notes	Notes regarding samples	Notes regarding songmeter	File Statistics
APIS01	5/28/14 - 6/11/14; 7/7/14 - 7/26/14	5/30/14 - 6/11/14; 7/7/14 - 7/26/14	Prior to 0530_1200; 610_1500, 611_1400, & 611_1700	5/30/2014, 12:00	9/12/14, 14:45	Y	Y	N	Y	logger found under water	APIS01_MeyersBeach		3.95 GB, 445 files
APIS02	5/28/14 - 6/9/14; 7/7/14 - 7/19/14	5/30/14 - 6/9/14; 7/7/14 - 7/19/14	Prior to 0530_1200; 602_0000 & 607_2200	5/30/2014, 12:00	9/12/14, 15:50	N	Y	N	Y	water too deep to retrieve logger	APIS02_LtISandBay		2.83 GB, 319 files
APIS03	5/28/14 - 8/24/14	5/28/14 - 9/4/14	Prior to 0528_1700	5/28/2014, 16:00		N	Y	N	N		APIS03_StocktonLagoon		11.5 GB, 1286 files
APIS04	5/28/14 - 9/4/14	5/28/14 - 9/4/14	Prior to 0528_1400; 609_1700	5/28/2014, 14:00		Y	Y	N	N		APIS04_StocktonWest		11.5 GB, 1285 files
APIS05	5/28/14 - 7/19/14	5/29/14 - 7/19/14	Prior to 0529_1400	5/29/2014, 14:00	10/10/14, 9:45	Y	Y	N	Y	water level low	APIS05_SandWestBay		6.14 GB, 685 files
APIS06	5/28/14 - 7/28/14	5/29/14 - 7/28/14	Prior to 0529_1600; 601_2300, 610_1900 & 728_2300	5/29/2014, 16:00	10/10/14, 10:00	Y	Y	N	Y	logger dry	APIS06_SandEastBay		7.19 GB, 805 files
APIS07	5/28/14 - 9/4/14	5/28/14 - 9/4/14	Prior to 528_1900	5/28/2014, 18:00	9/16/14, 10:30	N	Y	N	Y	logger missing	APIS07_Michigan		11.5 GB, 1288 files
APIS08	5/28/14 - 9/4/14	5/29/14 - 9/4/14	Prior to 529_1200	5/29/2014, 12:00	9/18/14, 14:00	Y	Y	N	Y	No issues	APIS08_Rocky		11.5 GB, 1287 files
APIS10	5/28/14 - 7/25/14	5/29/14 - 7/25/14	Prior to 529_1200	5/29/14 0:00	9/22/14, 10:15	N	Y	N	Y	logger missing; was present at mid-season check	APIS10_Basswood		6.8 GB, 759 files
APIS11	5/28/14 - 9/4/14	5/28/14 - 9/4/14	None	5/28/2014, 12:00	9/18/14, 10:45	Y	Y	N	Y	No issues	APIS11_Outer		11.5 GB, 1288 files
INDU01	4/11/14 - 7/7/14	4/24/14 - 7/7/14	Prior to 0424_1500	4/24/2014, 15:00	11/19/14; 14:45	Y	Y	Y	Y			Fail indicator light at recovery	10.2 GB, 1142 files
INDU02	4/11/14 - 7/19/14	4/25/14 - 7/19/14	Prior to 425_1200	4/25/2014, 12:00	12/11/2014, 12:45	N	Y	Y	Y	logger not recovered		Fail indicator light at recovery	11.4 GB, 1275 files
INDU03	4/11/14 - 6/16/14	4/22/14 - 6/16/14	Prior to 421_1500, 0616_2200; missing 422_2100	4/21/2014, 15:00	12/10/14, 14:45	Y	Y	Y	Y		All data on Channel 2, as Channel 1 mic was damaged. Meter apparently started on 4/11 but not deployed in field until 4/21.	Fail indicator light at recovery	7.69 GB, 862 files
INDU04	4/11/14 - 7/17/14	4/25/14 - 7/17/14	Prior to 425_1400, 714_2200	4/25/2014, 14:00	41962.54861	Y	Y	Y	Y		Mid-season fail light, batteries corrected fail, redeployed at 6/25/14 3 PM; No data gap observed	Fail indicator light at recovery and right mic broken	11.0 GB, 1234 files
INDU05	4/11/14 - 7/19/14	4/24/14 - 7/19/14	Prior to 0424_1800	4/24/2014, 18:00	12/11/14 at 14:25	Y	Y	Y	Y			Fail indicator light at recovery	11.4 GB, 1279 files
INDU06	4/11/14 - 6/15/14	4/25/14 - 6/15/14	Prior to 0425_1200	4/25/2014, 12:00	12/10/14 at 14:20	Y	Y	Y	Y			Fail indicator light at recovery	7.66 GB, 856 files
INDU07	4/11/14 - 7/19/14	4/23/14 - 7/19/14	Prior to 0423_1500	4/23/2014, 15:00	12/9/14 at 15:05	Y	Y	Y	Y			Fail indicator light at recovery	11.5 GB, 1288 files
INDU08	4/11/14 - 6/17/14	4/24/14 - 6/17/14	Prior to 0424_1300, 425_0000 & 617_2100	4/24/2014, 13:00	12/9/14 at 15:20	Y	Y	Y	Y			Fail indicator light at recovery	7.84 GB, 878 files

Table 2: Data Summary

File	Date range of files	Date range of valid samples	Invalid samples (i.e., empty)	Deployment date & time of first sample	Recovery date & time	Temp data present?	Deployment notes present?	Mid-season check notes present?	Recovery form notes present?	Logger notes	Notes regarding samples	Notes regarding songmeter	File Statistics
INDU09	4/11/14 - 7/19/14	4/24/14 - 7/19/14	Prior to 0424_1200	4/24/2014, 12:00	12/9/14 at 14:30	Y	Y	Y	Y			Fail indicator light at recovery and left mic broken; NEED new location for 2015 - too hard to access	11.5 GB, 1288 files
INDU10	4/11/14 - 7/19/14	4/23/14 - 7/19/14	Prior to 0423_1400	4/23/2014, 14:00	12/9/14 at 14:50	Y	Y	Y	Y			Fail indicator light at recovery	11.5 GB, 1288 files
MISS01	5/7/14 - 8/14/14	5/7/14 - 8/14/14	None	5/7/2014, 12:00	9/26/14 at 10:20	Y	Y	Y	Y		When deployed on 5/5 SM date was changed to 5/1, so all sample dates are adjusted to actual date (file date + 4 days).	Fail indicator light at recovery	11.5 GB, 1288 files
MISS02	5/6/14 - 8/13/14	5/6/14 - 8/13/14	None	5/7/2014, 12:00	9/26/14 at 10:50	Y	Y	Y	Y		When deployed on 5/5 SM date was changed to 5/1, so all sample dates are adjusted to actual date (file date + 4 days).		11.5 GB, 1288 files
MISS03	5/7/14 - 6/26/14	5/7/14 - 6/26/14	622_0000	5/7/2014, 12:00	7/21/2014 at 10:55	N	Y	Y	Y	logger not recovered	When deployed on 5/5 SM date was changed to 5/1, so all sample dates are adjusted to actual date (file date + 4 days).	unit found submerged on 7/21/14	5.82 GB, 651 files
MISS04	4/25/14 - 6/22/14	4/25/14 - 6/22/14	None	4/26/2014, 12:00	attempted 9/26/14	N	Y	Y	Y	logger not recovered		unit went missing sometime between Aug & Sept, later returned by citizen	6.82 GB, 782 files
MISS08	6/11/14 - 7/7/14	6/13/14 (=5/17); 6/15/14 - 6/21/14 (=5/24)	516_1200 to 517_0000 are blank, 5/18_1200 blank, possibly others (need a way to discover these).	6/11/14, 12:00	7/21/2014	N	Y	Y	N	logger dead	When deployed on 6/10 SM date was apparently programmed as 5/14, so all sample dates are adjusted to actual date.	Unit and logger found submerged on 7/21/14	3.03 GB, 340 files
MISS09	6/11/14 - 9/18/14	6/11/14 - 9/18/14	None	6/11/14, 12:00	9/26/2014 at 14:20	Y	Y	Y	Y		When deployed on 6/10 SM date was apparently programmed as 5/14, so all sample dates are adjusted to actual date.	Fail indicator light at recovery; site too noisy near Hwy 494, recommend changing site.	11.5 GB, 1288 files
PIRO01	5/10/2014 - 6/20/14	5/27/2014 - 6/20/14	Prior to 527_1200	5/21/2014, 16:00	7/30/14 at 13:50 (logger)	Y	Y	Y	Y			Fail indicator light at recovery on 9/5/14	5.90 GB, 660 files
PIRO02	5/9/14 - 7/01/14; 8/04/14 - 8/08/14	5/22/14 - 7/01/14; 8/04/14 - 8/08/14	Prior to 522_1300; missing eve samples on 5/23	5/22/2014, 12:00	9/2/14 at 13:37	Y	Y	Y	Y	Logger submerged and ok	dead batteries changed on 8/4/14 at 1300	Fail indicator light at recovery on 9/2/14	8.06 GB, 901 files
PIRO03	5/10/14 - 8/08/14	5/21/14 - 8/08/14	Prior to 521_1400	5/21/2014, 14:00	8/29/14 at 9:30	Y	Y	Y	Y			Fail indicator light at recovery	12.8 GB, 1438 files
PIRO04	5/10/14 - 8/8/14	5/22/14 - 8/8/14	Prior to 522_1200; 18 missing files afternoon of 5/22, 5/23, 5/24	5/21/14 0:00	8/04/14 at 11:55 (logger)	Y	Y	Y	Y			Fail indicator light at recovery; both mics off and damaged	12.7 GB, 1423 files
PIRO05	5/10/14 - 8/8/14	5/21/14 - 8/8/14	Prior to 0521_1200	5/21/2014, 12:00	9/4/14 at 13:30	Y	Y	Y	Y			Fail indicator light at recovery	12.8 GB, 1440 files

Table 2: Data Summary

File	Date range of files	Date range of valid samples	Invalid samples (i.e., empty)	Deployment date & time of first sample	Recovery date & time	Temp data present?	Deployment notes present?	Mid-season check notes present?	Recovery form notes present?	Logger notes	Notes regarding samples	Notes regarding songmeter	File Statistics
PIRO06	5/10/14 - 8/8/14	5/19/14 - 8/8/14	Prior to 519_1300	5/19/2014, 12:00	8/15/14 at 10:00	Y	Y	Y	Y	No water on 8/1/14		Fail indicator light at recovery	12.8 GB, 1440 files
PIRO07	5/10/14 - 7/31/14	5/22/14 - 7/31/14	Prior to 522_1600	5/22/2014, 16:00	7/31/2014 at 8:50	Y	Y	Y	Y	No water		Fail indicator light at recovery; both mics off and one destroyed	11.7 GB, 1312 files
PIRO08	5/10/14 - 8/4/14	5/21/14 - 5/25/14	Prior to 521_1200; after 525_2100	5/19/2014, 15:00	8/4/14 at 12:20	N	Y	Y	Y	logger not deployed - couldn't access open water	Empty files after unit deployed	One mic ripped off; other chewed	12.3 GB, 1378 files
PIRO09	5/10/14 - 5/19/14	None	ALL files invalid	5/23/14 0:00	8/29/2014 at 8:38	Y	Y	Y	Y	logger functioning	No samples before unit was deployed. Channel 1 is blank, Channel 2 has noise but appears identical in each file.	Unit is dead and removed on 8/1/14	1.29 GB, 147 files
PIRO10	5/10/14 - 8/8/14	5/21/14 - 8/8/14	Prior to 521_1600	5/27/2014, 12:00?	9/9/14 at 13:20	Y	Y	Y	Y	logger functioning	Form says deployed on 5/27 but first sample is from 5/21.	Unit removed on 8/1/14; mic destroyed by animal	12.0 GB, 1439 files
SLBE01	5/6/14 - 7/24/14	5/6/14 - 7/24/14	None	5/6/2014, 15:00	10/15/14 at 13:34	Y	Y	Y	Y			Fail indicator light at mid-season check and final recovery	9.18 GB, 1027 files
SLBE02	5/6/14 - 8/31/14	5/6/14 - 8/31/14	Prior to 506_1400; 512_2100, 513_2200, & 515_2300	5/6/2014, 14:00	10/15/14 at 14:26	Y	Y	Y	Y			Fail indicator light at recovery	14.6 GB, 1645 files
SLBE03	4/16/14 - 7/24/14	4/16/14 - 7/24/14	None	4/16/2014, 13:00	10/17/14 at 10:05	Y	Y	Y	Y			Fail indicator light at recovery	11.5 GB, 1289 files
SLBE04	4/24/14 - 7/24/14	4/24/14 - 7/24/14	None	4/24/2014, 12:00	10/20/14 at 12:52	Y	Y	Y	Y	logger in muck at recovery		Fail indicator light at mid-season check and final recovery; unit found on ground, mics on ground w one broken	10.6 GB, 1186 files
SLBE05	5/6/14 - 7/24/14	5/6/14 - 7/24/14	None	5/6/2014, 16:00	10/1/14 at 15:27	N	Y	Y	Y	logger file not provided		Fail indicator light at mid-season check and final recovery	9.17 GB, 1026 files
SLBE06	4/16/14 - 7/10/14	4/16/14 - 7/10/14	710_1200	4/16/2014, 15:00	10/20/14 at 14:37	Y	Y	Y	Y	logger functioning		Unit removed on 8/6/14	9.88 GB, 1104 files
SLBE07	5/8/14 - 7/24/14	5/8/14 - 7/24/14	None	5/8/2014, 15:00	10/1/14 at 14:12	Y	Y	Y	Y	logger functioning		Fail indicator light at mid-season check and final recovery	8.95 GB, 999 files
SLBE08	4/24/14 - 7/24/14	4/24/14 - 7/24/14	None	4/24/2014, 12:00	10/12/14 at 17:38	Y	Y	Y	Y	logger functioning		Fail indicator light at mid-season check and final recovery	10.6 GB, 1185 files
SLBE09	5/8/14 - 7/1/14	5/8/24 - 7/1/14	0508_1400, 701_1500	5/8/2014, 14:00	10/17/14 at 13:56	Y	Y	Y	Y	logger functioning		Fail indicator light at mid-season check and final recovery; replaced batteries 5/8/14 - functioning but no light	6.30 GB, 707 files
SLBE11	5/28/14 - 7/24/14	5/28/14 - 7/24/14	None	5/28/2014, 13:00	9/15/14 at 14:40	Y	Y	N	Y	logger functioning		Fail indicator light at recovery	6.60 GB, 739 files

Table 3: Summary of Recognizer Detections

Park Site	Recognizer	Initial No. Detections ¹	No. Samples with Any Detections ²	No. Days with Any Detections ³
APIS01	Spring Peeper	1406	48	13
APIS02	Spring Peeper	838	37	11
APIS03	Spring Peeper	6044	116	33
APIS04	Spring Peeper	1920	125	38
APIS05	Spring Peeper	2571	105	33
APIS06	Spring Peeper	178	42	16
APIS07	Spring Peeper	4198	118	34
APIS08	Spring Peeper	4385	107	30
APIS10	Spring Peeper	2023	107	35
APIS11	Spring Peeper	2779	100	29
APIS01	American Toad	30	2	1
APIS02	American Toad	190	15	7
APIS03	American Toad	398	59	31
APIS04	American Toad	0	0	0
APIS05	American Toad	111	16	12
APIS06	American Toad	61	1	1
APIS07	American Toad	70	13	9
APIS08	American Toad	182	16	6
APIS10	American Toad	33	7	6
APIS11	American Toad	167	33	16
APIS01	Tree Frog	1	0	0
APIS02	Tree Frog	0	0	0
APIS03	Tree Frog	5	0	0
APIS04	Tree Frog	1	0	0
APIS05	Tree Frog	51	11	7
APIS06	Tree Frog	27	7	5
APIS07	Tree Frog	121	21	11
APIS08	Tree Frog	0	0	0
APIS10	Tree Frog	0	0	0
APIS11	Tree Frog	0	0	0
APIS01	Green Frog	1193	65	20
APIS02	Green Frog	611	44	13
APIS03	Green Frog	1501	104	48
APIS04	Green Frog	150	35	19
APIS05	Green Frog	539	82	31
APIS06	Green Frog	2	0	0
APIS07	Green Frog	1078	89	39
APIS08	Green Frog	6	0	0
APIS10	Green Frog	1138	92	30
APIS11	Green Frog	1479	126	53
INDU01	Spring Peeper	1037	88	33
INDU02	Spring Peeper	9368	152	35
INDU04	Spring Peeper	3335	100	23
INDU05	Spring Peeper	3970	118	27

Table 3: Summary of Recognizer Detections

Park Site	Recognizer	Initial No. Detections ¹	No. Samples with Any Detections ²	No. Days with Any Detections ³
INDU06	Spring Peeper	5215	116	27
INDU07	Spring Peeper	4883	162	37
INDU08	Spring Peeper	7023	136	32
INDU09	Spring Peeper	4219	132	37
INDU10	Spring Peeper	7368	171	38
INDU01	American Toad	23	0	0
INDU02	American Toad	506	0	0
INDU04	American Toad	250	30	12
INDU05	American Toad	202	0	0
INDU06	American Toad	47	1	1
INDU07	American Toad	140	17	8
INDU08	American Toad	51	10	5
INDU09	American Toad	156	13	10
INDU10	American Toad	12	0	0
INDU01	Tree Frog	60	22	12
INDU02	Tree Frog	166	9	4
INDU04	Tree Frog	32	3	2
INDU05	Tree Frog	365	10	5
INDU06	Tree Frog	7	2	1
INDU07	Tree Frog	712	79	35
INDU08	Tree Frog	76	21	13
INDU09	Tree Frog	931	112	53
INDU10	Tree Frog	992	108	54
INDU01	Green Frog	74	0	0
INDU02	Green Frog	220	0	0
INDU04	Green Frog	356	2	2
INDU05	Green Frog	573	107	43
INDU06	Green Frog	521	43	17
INDU07	Green Frog	6463	241	67
INDU08	Green Frog	1502	80	27
INDU09	Green Frog	5782	245	70
INDU10	Green Frog	7375	240	73
MISS01	Spring Peeper	115	0	0
MISS02	Spring Peeper	83	0	0
MISS03	Spring Peeper	56	0	0
MISS04	Spring Peeper	477	0	0
MISS08	Spring Peeper	31	0	0
MISS09	Spring Peeper	37	0	0
MISS01	American Toad	699	82	32
MISS02	American Toad	957	73	25
MISS03	American Toad	888	52	21
MISS04	American Toad	972	68	26
MISS08	American Toad	1	1	1
MISS09	American Toad	0	0	0

Table 3: Summary of Recognizer Detections

Park Site	Recognizer	Initial No. Detections ¹	No. Samples with Any Detections ²	No. Days with Any Detections ³
MISS01	Tree Frog	1	0	0
MISS02	Tree Frog	0	0	0
MISS03	Tree Frog	1	0	0
MISS04	Tree Frog	204	32	18
MISS08	Tree Frog	0	0	0
MISS09	Tree Frog	0	0	0
MISS01	Green Frog	3574	190	74
MISS02	Green Frog	8749	240	73
MISS03	Green Frog	8	0	0
MISS04	Green Frog	18	0	0
MISS08	Green Frog	5	0	0
MISS09	Green Frog	68	0	0
PIRO01	Spring Peeper	4052	72	25
PIRO02	Spring Peeper	2961	116	41
PIRO03	Spring Peeper	3248	121	50
PIRO04	Spring Peeper	1795	110	46
PIRO05	Spring Peeper	4256	136	51
PIRO06	Spring Peeper	1435	62	28
PIRO07	Spring Peeper	1490	58	24
PIRO08	Spring Peeper	375	12	5
PIRO09	Spring Peeper	0	0	0
PIRO10	Spring Peeper	1941	116	44
PIRO01	American Toad	25	0	0
PIRO02	American Toad	98	15	9
PIRO03	American Toad	9	0	0
PIRO04	American Toad	2	0	0
PIRO05	American Toad	294	20	9
PIRO06	American Toad	33	0	0
PIRO07	American Toad	508	0	0
PIRO08	American Toad	93	9	5
PIRO09	American Toad	0	0	0
PIRO10	American Toad	332	25	14
PIRO01	Tree Frog	0	0	0
PIRO02	Tree Frog	0	0	0
PIRO03	Tree Frog	455	31	16
PIRO04	Tree Frog	695	32	20
PIRO05	Tree Frog	6	0	0
PIRO06	Tree Frog	3	0	0
PIRO07	Tree Frog	51	18	13
PIRO08	Tree Frog	0	0	0
PIRO09	Tree Frog	0	0	0
PIRO10	Tree Frog	0	0	0
PIRO01	Green Frog	38	7	6
PIRO02	Green Frog	191	21	14

Table 3: Summary of Recognizer Detections

Park Site	Recognizer	Initial No. Detections ¹	No. Samples with Any Detections ²	No. Days with Any Detections ³
PIRO03	Green Frog	718	72	40
PIRO04	Green Frog	567	71	35
PIRO05	Green Frog	1495	121	52
PIRO06	Green Frog	12	0	0
PIRO07	Green Frog	8	0	0
PIRO08	Green Frog	0	0	0
PIRO09	Green Frog	0	0	0
PIRO10	Green Frog	455	47	29
SLBE01	Spring Peeper	29	0	0
SLBE02	Spring Peeper	4189	162	57
SLBE03	Spring Peeper	5123	167	49
SLBE04	Spring Peeper	4239	142	43
SLBE05	Spring Peeper	2092	88	28
SLBE06	Spring Peeper	2847	167	49
SLBE07	Spring Peeper	3347	122	41
SLBE08	Spring Peeper	702	41	23
SLBE09	Spring Peeper	1807	105	37
SLBE11	Spring Peeper	346	60	31
SLBE01	American Toad	101	5	4
SLBE02	American Toad	98	18	11
SLBE03	American Toad	28	0	0
SLBE04	American Toad	810	48	21
SLBE05	American Toad	224	0	0
SLBE06	American Toad	31	2	2
SLBE07	American Toad	433	27	10
SLBE08	American Toad	99	15	12
SLBE09	American Toad	360	35	16
SLBE11	American Toad	618	29	16
SLBE01	Tree Frog	75	13	8
SLBE02	Tree Frog	1185	67	31
SLBE03	Tree Frog	2266	71	33
SLBE04	Tree Frog	4	2	2
SLBE05	Tree Frog	964	61	36
SLBE06	Tree Frog	496	62	32
SLBE07	Tree Frog	217	22	12
SLBE08	Tree Frog	5	2	2
SLBE09	Tree Frog	1	1	1
SLBE11	Tree Frog	3	0	0
SLBE01	Green Frog	27	0	0
SLBE02	Green Frog	36	5	5
SLBE03	Green Frog	39	4	2
SLBE04	Green Frog	642	84	34
SLBE05	Green Frog	957	77	33
SLBE06	Green Frog	1632	99	39

Table 3: Summary of Recognizer Detections

Park Site	Recognizer	Initial No. Detections ¹	No. Samples with Any Detections ²	No. Days with Any Detections ³
SLBE07	Green Frog	1494	149	60
SLBE08	Green Frog	269	56	38
SLBE09	Green Frog	2694	111	44
SLBE11	Green Frog	103	0	0

1 - after filtering by time of day. 2 - after filtering by first and last accurate detection, and removing duplicate detections per sample. 3 - after filtering by first and last accurate detection.

Table 4: Species Confirmed by Park

Species	Recognizer File Complete?	Recognizer in Progress?	Comments	APIS	GRPO	INDU	ISRO	MISS	PIRO	SACN	SLBE	VOYA
American Toad	Yes	NA	Additional duration filter applies	P	P	P	P	P	P	P	P	P
Fowler's Toad	No	No	Insufficient training data	A	A	P	A	A	A	A	A	A
Blanchard's Cricket Frog	No	Yes	In progress	A	A	P	A	A ¹	A	A	A	A
Cope's Gray Treefrog	No	Yes	Detected by Gray Treefrog recognizer	p ⁶	A	P	A	P	A	P	A	A
Gray Treefrog	Yes	Yes	Currently unable to separate the two treefrog species	P	P	P	P	P	P	P	P	P
Spring Peeper	Yes	NA	Complete	P	P	P	P	A ²	P	P	P	P
Western Chorus Frog	No	Yes	Currently unable to separate the two chorus frog species	A	A	P	A	A	A	A	P	A
Boreal Chorus Frog	No	Yes	Currently unable to separate the two chorus frog species	p ⁷	P	A	P	P	A ⁸	P	A	P
American Bullfrog	No	Yes	In progress	A ³	A	P	A	A ³	A ³	P	P	A
Green Frog	Yes	NA	Complete	P	P	P	P	P	P	P	P	P
Mink Frog	No	Yes	In progress	P	P	A	P	A	p ⁴	P	A	A
Pickerel Frog	No	No	Insufficient training data	A	A	A ⁵	A	A	A	P	P	A
Northern Leopard Frog	No	Yes	In progress	P	P	P	A	P	P	P	P	P
Wood Frog	No	Yes	In progress	P	P	P	P	P	P	P	P	P

P = Present, A = Absent. Changes from 2013:

- 1 - Species confirmed near park western border, possible detection within park in 2014. Treated as present in analyses.
- 2 - Species known outside of park, but apparently absent from within park due to lack of suitable habitat. Treated as absent in analyses.
- 3 - Records from park are questionable, without vouchers. Treated as absent in analyses.
- 4 - Records from park are without vouchers. Treated as present in analyses but needs confirmation.
- 5 - Records from park are historic and it is considered extirpated. Treated as absent in analyses.
- 6 - Records from park are without vouchers. Treated as present in analyses but needs confirmation. If present, likely found only on mainland and possibly Sand Island.
- 7 - Records from park are without vouchers. Treated as present in analyses but needs confirmation.
- 8 - Records from park are rejected, without vouchers. Treated as absent in analyses.

Table 5: Assumed Breeding Periods by Park

Species	APIS	GRPO	INDU	ISRO	MISS	PIRO	SACN	SLBE	VOYA
Wood Frog	3/25 - 5/ 10	4/1 - 5/10	3/1 - 4/15	4/1 - 5/10	3/20 - 5/10	3/25 - 5/15	3/20 - 5/10	4/1 - 5/15	4/1 - 5/10
W. Chorus Frog	absent	absent	3/1 - 5/25	absent	absent	absent	absent	3/20 - 5/15	absent
Boreal Chorus Frog	3/25 - 5/15	4/1 - 5/15	absent	4/1 - 5/15	3/20 - 5/15	absent	3/20 - 5/15	absent	4/1 - 5/15
Spring Peeper	automate analysis	automate analysis	automate analysis	automate analysis	automate analysis*	automate analysis	automate analysis	automate analysis	automate analysis
No. Leopard Frog	4/10 - 6/10	4/1 - 6/10	3/25 - 5/10	absent	3/20 - 5/31	4/10 - 6/5	4/1 - 5/25	4/1 - 5/25	4/1 - 6/10
Pickrel Frog	absent	absent	absent	absent	absent	absent	4/10 - 5/25	4/10 - 5/25	absent
Am. Toad	automate analysis	automate analysis	automate analysis	automate analysis	automate analysis	automate analysis	automate analysis	automate analysis	automate analysis
Fowler's Toad	absent	absent	4/15 - 6/1	absent	absent	absent	absent	absent	absent
Gray Treefrog	automate analysis	automated automate	automate analysis	automate analysis	automate analysis	automate analysis	automate analysis	automate analysis	automate analysis
Cope's Gray Treefrog	4/25 - 7/15	absent	4/15 - 7/1	absent	4/20 - 7/15	absent	4/20 - 7/15	absent	absent
Cricket Frog	absent	absent	5/15 - 8/10	absent	5/15 - 8/10*	absent	absent	absent	absent
Green Frog	automate analysis	automate analysis	automate analysis	automate analysis	automate analysis	automate analysis	automate analysis	automate analysis	automate analysis
Mink Frog	6/1 - 8/15	6/5 - 8/15	absent	6/5 - 8/15	absent	6/1 - 8/15	6/1 - 8/15	absent	absent
Am. Bullfrog	absent	absent	5/20 - 8/15	absent	5/25 - 8/15*	absent	5/25 - 8/15	5/25 - 8/15	absent

Note: These dates are based on Michigan, Minnesota and Wisconsin calling frog survey program phenology charts, and local knowledge. They will be revised as data are collected and analyzed. We did not analyze any files for Bullfrogs past July 31, as calling rates decline significantly after July. * These MISS species are apparently absent but could potentially colonize in future from nearby populations.

Table 6: Data Collection Results

Site	Date & Time of First Recorded Sample	Date & Time of First Valid Sample ¹	Date & Time of Last Recorded Sample	Number of invalid samples within sampling period ²	N Expected Sample Days ³	N Expected Samples ⁴	N Actual Sample Days ⁵	N Actual Samples ⁶	Success Rate Days ⁷	Success Rate Samples ⁸	Known Issues Affecting Success Rate
APIS01	5/28/2014 12:00	5/30/2014 12:00	7/26/2014 21:00	3	63	819	33	424	0.52	0.52	
APIS02	5/28/2014 12:00	5/30/2014 12:00	7/19/2014 21:00	2	63	819	24	308	0.38	0.38	
APIS03	5/28/2014 12:00	5/28/2014 17:00	9/4/2014 00:00	0	65	845	65	840	1.00	0.99	
APIS04	5/28/2014 12:00	5/28/2014 14:00	9/4/2014 00:00	1	65	845	65	842	1.00	1.00	
APIS05	5/28/2014 12:00	5/29/2014, 14:00	7/19/2014 20:00	0	64	832	52	671	0.81	0.81	
APIS06	5/28/2014 12:00	5/29/2014, 16:00	7/28/2014 23:00	3	64	832	61	786	0.95	0.94	
APIS07	5/28/2014 12:00	5/28/2014, 19:00	9/4/2014 00:00	0	63	819	63	812	1.00	0.99	
APIS08	5/28/2014 12:00	5/29/2014, 12:00	9/4/2014 00:00	0	64	832	64	832	1.00	1.00	
APIS10	5/28/2014 12:00	5/29/2014, 12:00	7/25/2014 20:00	0	64	832	58	751	0.91	0.90	
APIS11	5/28/2014 12:00	5/28/2014, 12:00	9/4/2014 00:00	0	63	819	63	819	1.00	1.00	
INDU01	4/11/2014 12:00	4/24/2014, 15:00	7/7/2014 21:00	0	99	1287	75	970	0.76	0.75	Fail Indicator Light at Recovery
INDU02	4/11/2014 12:00	4/25/2014, 12:00	7/19/2014 00:00	0	98	1274	86	1106	0.88	0.87	Fail Indicator Light at Recovery
INDU03	4/11/2014 12:00	4/21/2014 15:00	6/16/2014 22:00	1	102	1326	57	736	0.56	0.56	Fail Indicator Light at Recovery
INDU04	4/11/2014 12:00	4/25/2014, 14:00	7/14/2014 22:00	1	98	1274	81	1049	0.83	0.82	Fail Indicator Light at Recovery
INDU05	4/11/2014 12:00	4/24/2014, 18:00	7/19/2014 00:00	0	100	1300	87	1113	0.87	0.86	Fail Indicator Light at Recovery
INDU06	4/11/2014 12:00	4/25/2014, 12:00	6/15/2014 21:00	0	98	1274	52	674	0.53	0.53	Fail Indicator Light at Recovery
INDU07	4/11/2014 12:00	4/23/2014, 15:00	7/19/2014 00:00	0	100	1300	88	1129	0.88	0.87	Fail Indicator Light at Recovery
INDU08	4/11/2014 00:00	4/24/2014, 13:00	6/17/2014 21:00	2	99	1287	55	710	0.56	0.55	Fail Indicator Light at Recovery
INDU09	4/11/2014 00:00	4/24/2014, 12:00	7/19/2014 00:00	0	99	1287	87	1119	0.88	0.87	Fail Indicator Light at Recovery
INDU10	4/11/2014 00:00	4/23/2014, 14:00	7/19/2014 00:00	0	100	1300	88	1130	0.88	0.87	Fail Indicator Light at Recovery
MISS01	5/7/2014 12:00	5/7/2014 12:00	8/15/2014 00:00	0	86	1118	86	1118	1.00	1.00	Fail Indicator Light at Recovery
MISS02	5/6/2014 12:00	5/7/2014 12:00	8/9/2014 00:00	0	87	1131	87	1131	1.00	1.00	
MISS03	5/7/2014 12:00	5/7/2014 12:00	6/22/2014 00:00	1	86	1118	47	598	0.55	0.53	Songmeter was flooded
MISS04	4/25/2014 15:00	4/26/2014 12:00	6/22/2014 22:00	0	98	1274	59	763	0.60	0.60	
MISS08	6/11/2014 12:00	6/11/2014 12:00	6/21/2014 12:00	26	51	663	11	106	0.22	0.16	
MISS09	6/11/2014 12:00	6/11/2014 12:00	9/18/2014 00:00	0	51	663	51	663	1.00	1.00	Fail Indicator Light at Recovery
PIRO01	5/10/2014 14:00	5/21/2014, 16:00	6/20/2014 15:00	74	72	936	31	317	0.43	0.34	Fail Indicator Light at Recovery
PIRO02	5/9/2014 14:00	5/22/2014, 13:00	8/8/2014 03:00^	0	71	923	71	922	1.00	1.00	Fail Indicator Light at Recovery
PIRO03	5/10/2014 15:00	5/21/2014, 14:00	8/8/2014 03:00	0	72	936	72	934	1.00	1.00	Fail Indicator Light at Recovery
PIRO04	5/10/2014 14:00	5/22/2014 12:00	8/8/2014 03:00	18	72	936	72	918	1.00	0.98	Fail Indicator Light at Recovery
PIRO05	5/10/2014 15:00	5/21/2014, 12:00	8/8/2014 03:00	0	72	936	72	936	1.00	1.00	Fail Indicator Light at Recovery
PIRO06	5/10/2014 15:00	5/19/2014, 13:00	8/8/2014 03:00	0	74	962	74	961	1.00	1.00	Fail Indicator Light at Recovery
PIRO07	5/10/2014 15:00	5/22/2014, 16:00	7/31/2014 03:00	0	71	923	71	907	1.00	0.98	Fail Indicator Light at Recovery
PIRO08	5/10/2014 14:00	5/21/2014, 12:00	8/4/2014 12:00	0	74	962	74	962	1.00	1.00	Fail Indicator Light at Recovery
PIRO09	5/10/2014 14:00	5/23/2014 00:00	5/19/2014 13:00	ALL	70	910	0	0	0.00	0.00	Songmeter unit found dead
PIRO10	5/10/2014 15:00	5/21/2014, 16:00	8/8/2014 03:00	0	66	858	66	854	1.00	1.00	
SLBE01	5/6/2014 15:00	5/6/2014, 15:00	7/24/2014 00:00	0	87	1131	80	1025	0.92	0.91	Fail Indicator Light at Recovery
SLBE02	5/6/2014 14:00	5/6/2014, 14:00	8/31/2014 23:00	3	87	1131	87	1126	1.00	1.00	Fail Indicator Light at Recovery
SLBE03	4/16/2014 13:00	4/16/2014, 13:00	7/24/2014 00:00	0	107	1391	100	1287	0.93	0.93	Fail Indicator Light at Recovery
SLBE04	4/24/2014 12:00	4/24/2014, 12:00	7/24/2014 00:00	0	99	1287	92	1184	0.93	0.92	Fail Indicator Light at Mid-Season Check & Recovery

Table 6: Data Collection Results

Site	Date & Time of First Recorded Sample	Date & Time of First Valid Sample ¹	Date & Time of Last Recorded Sample	Number of invalid samples within sampling period ²	N Expected Sample Days ³	N Expected Samples ⁴	N Actual Sample Days ⁵	N Actual Samples ⁶	Success Rate Days ⁷	Success Rate Samples ⁸	Known Issues Affecting Success Rate
SLBE05	5/6/2014 16:00	5/6/2014, 16:00	7/24/2014 00:00	0	87	1131	80	1024	0.92	0.91	Fail Indicator Light at Mid-Season Check & Recovery
SLBE06	4/16/2014 15:00	4/16/2014, 15:00	7/10/2014 12:00	1	107	1391	86	1103	0.80	0.79	
SLBE07	5/8/2014 15:00	5/8/2014, 15:00	7/24/2014 14:00	0	85	1105	78	1002	0.92	0.91	Fail Indicator Light at Mid-Season Check & Recovery
SLBE08	4/24/2014 00:00	4/24/2014, 12:00	7/24/2014 00:00	0	99	1287	92	1184	0.93	0.92	Fail Indicator Light at Mid-Season Check & Recovery
SLBE09	5/8/2014 00:00	5/8/2014, 14:00	7/1/2014 15:00	2	85	1105	55	703	0.65	0.64	Fail Indicator Light at Mid-Season Check & Recovery
SLBE11	5/28/2014 13:00	5/28/2014, 13:00	7/24/2014 00:00	0	65	845	58	741	0.89	0.88	Fail Indicator Light at Recovery

¹This was typically the day following deployment day, but may have been later depending on when the program was scheduled to start.

²Sampling period is defined as the time between the first valid sample and July 31. Invalid samples did not contain data.

³Calculated as number of days from date of first valid sample to July 31

⁴Calculated as the number of expected sample days multiplied by 13 (number of samples collected per day).

⁵Calculated as number of days from date of first valid sample to date of last recorded sample within the sampling period.

⁶Calculated as the actual number of sample days X 13, minus any invalid samples, as well any samples not collected prior to the first valid sample or after the last recorded sample within the sampling period.

⁷Calculated as N Actual Days / N Expected Days

⁸Calculated as N Actual Samples / N Expected Samples

^APIRO collected 16 samples per day, but only 13 were considered for our analyses.

Table 7: 2014 Detection Results by Site

Site	N Days	N	WF	WCF	BCF	SP	NLF	PF	AT	FT	GT	CGT	BLCF	GF	MF	AB	N Sp. Possible	N Sp. Detected	Detection Rate
APIS01	33	424	-	A		RM		A	RM	A	RM		A	RM		A	9	4	0.44
APIS02	24	308	-	A		RM		A	RM	A			A	RM		A	9	3	0.33
APIS03	65	840	-	A		RM		A	RM	A	RM		A	RM		A	9	4	0.44
APIS04	65	842	-	A		RM		A		A			A	RM		A	9	2	0.22
APIS05	52	671	-	A		RM		A	RM	A	RM		A	RM		A	9	4	0.44
APIS06	61	786	-	A		RM		A		A	RM		A			A	9	2	0.22
APIS07	63	812	-	A		RM		A	RM	A	RM		A	RM		A	9	4	0.44
APIS08	64	832	-	A		RM		A	RM	A			A			A	9	2	0.22
APIS10	58	751	-	A		RM		A		A			A	RM		A	9	2	0.22
APIS11	63	819	-	A		RM		A	RM	A			A	RM		A	9	3	0.33
INDU01	75	970	-	M	A	RM		A			RM				A		11	3	0.27
INDU02	86	1106	-	M	A	RM		A			RM			M	A		11	4	0.36
INDU03	57	736			A	RM		A	RM		RM			M	A		11	4	0.36
INDU04	81	1049	-	M	A	RM		A	RM		RM			RM	A		11	5	0.45
INDU05	87	1113	-		A	RM		A			RM			RM	A		11	3	0.27
INDU06	52	674	-		A	RM		A			RM			RM	A	M	11	4	0.36
INDU07	88	1129	-	M	A	RM	M	A	RM		RM			RM	A		11	6	0.55
INDU08	55	710	-		A	RM	M	A	RM		RM			RM	A		11	5	0.45
INDU09	87	1119	-	M	A	RM	M	A	RM		RM			RM	A	M	11	7	0.64
INDU10	88	1130	-	M	A	RM	M	A			RM			RM	A		11	5	0.45
MISS01	86	1118		A		A	M	A	RM	A				RM	A	A	8	3	0.38
MISS02	87	1131		A		A		A	RM	A				RM	A	A	8	2	0.25
MISS03	47	598		A	M	A	M	A	RM	A					A	A	8	3	0.38
MISS04	59	763		A	M	A	M	A	RM	A	RM		M		A	A	8	5	0.63
MISS08	11	106	-	A	-	A	-	A	RM	A		M		M	A	A	8	3	0.38
MISS09	51	663	-	A	-	A	-	A	M	A		M		M	A	A	8	3	0.38
PIRO01	31	317	-	A	A	RM		A		A	M	A	A	RM		A	7	3	0.43
PIRO02	71	922	-	A	A	RM		A	RM	A	M	A	A	RM		A	7	4	0.57
PIRO03	72	934	M	A	A	RM		A		A	RM	A	A	RM		A	7	4	0.57
PIRO04	72	918	-	A	A	RM		A		A	RM	A	A	RM		A	7	3	0.43
PIRO05	72	936	-	A	A	RM		A	RM	A		A	A	RM		A	7	3	0.43
PIRO06	74	961	M	A	A	RM		A		A		A	A	M		A	7	3	0.43
PIRO07	71	907	-	A	A	RM		A		A	RM	A	A			A	7	2	0.29
PIRO08	74	962	-	A	A	RM		A	RM	A	M	A	A			A	7	3	0.43
PIRO09	unit malfunctioned, no valid samples obtained																		
PIRO10	66	854		A	A	RM		A	RM	A		A	A	RM		A	7	3	0.43
SLBE01	80	1025	M		A	M			RM	A	RM	A	A		A		9	4	0.44
SLBE02	87	1126	M		A	RM			R	A	RM	A	A		A		9	4	0.44
SLBE03	100	1287	M		A	RM				A	RM	A	A	RM	A		9	4	0.44
SLBE04	92	1184	M		A	RM	M		RM	A	RM	A	A	RM	A		9	6	0.67
SLBE05	80	1024			A	RM				A	RM	A	A	RM	A		9	3	0.33
SLBE06	86	1103	M		A	RM				A	RM	A	A	RM	A		9	4	0.44
SLBE07	78	1002			A	RM			RM	A	RM	A	A	RM	A		9	4	0.44
SLBE08	92	1184			A	RM			RM	A	RM	A	A	RM	A		9	4	0.44
SLBE09	55	703			A	RM			RM	A	RM	A	A	RM	A		9	4	0.44
SLBE11	58	741	-	-	A	RM	-	-	RM	A		A	A		A		9	2	0.22

Table 7: 2014 Detection Results by Site

WF = Wood Frog, WCF = Western Chorus Frog, BCF = Boreal Chorus Frog, SP = Spring Peeper, NLF = Northern Leopard Frog, PF = Pickerel Frog, AT = American Toad, FT = Fowler's Toad, GT = Gray Treefrog, CGT = Cope's Gray Treefrog, BLCF = Blanchard's Cricket Frog, GF = Green Frog, MF = Mink Frog, AB = American Bullfrog. Blank cells mean that no detections were obtained by any method. R = Detected by recognizers, M = Detected by manual scan, RM = Detected by both recognizer and manual scan, (-) = No valid samples were obtained during species breeding season, A = Considered absent from park and not detected by any method, N Days = Total number of valid days sampled, N = Total number of valid samples for site (no later than July 31). Note that N Species Possible does not account for wetland type and assumes all species known from a park could be present in any wetland. Species were not counted in the N Species Possible column if there were not any samples collected within the known breeding period.

Table 8: 2013 False Presence Rates (APIS and MISS added; bolded values are 0.10 or greater)

Park	Species	N Sites With Detections	N Random Detections Evaluated	N Correct	False Presence Rate
APIS	Am. Toad	4	37	37	0.00
MISS	Am. Toad	3	30	27	0.10
PIRO	Am. Toad	7	57	55	0.04
SLBE	Am. Toad	2	13	11	0.15
APIS	Gray Treefrog	3	21	20	0.05
PIRO	Gray Treefrog	5	20	19	0.05
SLBE	Gray Treefrog	2	6	6	0.00
APIS	Green Frog	1	10	8	0.20
MISS	Green Frog	1	10	9	0.10
PIRO	Green Frog	5	50	49	0.02
SLBE	Green Frog	3	15	15	0.00
APIS	Spring Peeper	5	50	50	0.00
INDU	Spring Peeper	7	64	62	0.03
MISS	Spring Peeper	0	NA	NA	NA
PIRO	Spring Peeper	10	100	98	0.02
SLBE	Spring Peeper	3	29	27	0.07
Combined	Am. Toad	16	137	130	0.05
Combined	Gray Treefrog	10	47	45	0.04
Combined	Green Frog	10	85	81	0.05
Combined	Spring Peeper	25	243	237	0.02

Table 9: 2014 False Presence Rates (bolded values are 0.10 or greater)

Park	Species	N Sites With Detections	N Random Detections Evaluated	N Correct	False Presence Rate	Possible reasons
APIS	Am. Toad	8	161	145	0.10	Loud waves/wind
INDU	Am. Toad	6	51	22	0.57	Loud train noise
MISS	Am. Toad	5	41	41	0.00	
PIRO	Am. Toad	4	69	67	0.03	
SLBE	Am. Toad	8	67	55	0.18	Spring peeper or tree frog choruses
APIS	Gray Treefrog	3	27	26	0.04	
INDU	Gray Treefrog	10	78	77	0.01	
MISS	Gray Treefrog	1	32	31	0.03	
PIRO	Gray Treefrog	3	30	29	0.03	
SLBE	Gray Treefrog	9	65	65	0.00	
APIS	Green Frog	8	80	77	0.04	
INDU	Green Frog	7	62	60	0.10	Loud train noise
MISS	Green Frog	2	20	19	0.05	
PIRO	Green Frog	6	57	56	0.02	
SLBE	Green Frog	8	69	65	0.06	
APIS	Spring Peeper	9	91	90	0.01	
INDU	Spring Peeper	10	100	95	0.05	
MISS	Spring Peeper	0	NA	NA	NA	
PIRO	Spring Peeper	9	90	84	0.07	
SLBE	Spring Peeper	9	91	80	0.12	Loud background (flowing/splashing water, birds)
Combined	Am. Toad	31	389	330	0.15	Loud background/ start and stop in calling
Combined	Gray Treefrog	26	232	228	0.02	
Combined	Green Frog	31	288	277	0.04	
Combined	Spring Peeper	37	372	349	0.06	

Table 10: Combined 2013-14 False Presence Rates (bolded values are 0.10 or greater)

Park	Species	N Random Detections Evaluated	N Correct	False Presence Rate
Combined	Am. Toad	526	460	0.13
Combined	Gray Treefrog	279	273	0.02
Combined	Green Frog	373	358	0.04
Combined	Spring Peeper	615	586	0.05

Table 11: Manual Scanning Species Detection by Park

Park	N Sites	N Species Detected	Minimum N Samples to Complete Detection	Maximum N Samples to Complete Detection	Average N Samples to Complete Detection at Any Site
APIS	10	4	4	19	10.8
INDU	10	7	6	30	16.2
MISS	5	7	5	27	11.5
PIRO	9	5	2	20	12.3
SLBE	10	6	1	29*	13.1
All	44	7	1	30	12.9

* - 18 if anomalous SLBE03 data are excluded