

Standard Operating Procedure #8: Quality Assurance/Quality Control

Version 1.0

In GLKN Amphibian Monitoring Protocol

Prepared by:

Gary S. Casper¹ and Joseph C. Mitchell²

¹ Great Lakes Ecological Services, LLC

P.O. Box 375

Slinger, Wisconsin 53086

² Mitchell Ecological Research Services, LLC

P.O Box 2520

High Springs, Florida 32655-2520

Suggested citation:

Casper, G. S., and J. C. Mitchell. 2018. Standard operating procedure #9: Quality assurance/Quality control (version 1.0). *In* G. S. Casper, E. Beever, U. Gafvert, and S. M. Nadeau. 2018. Amphibian monitoring protocol: Great Lakes Inventory and Monitoring Network (version 2.0). Natural Resource Report NPS/GLKN/NRR—2018/1761. National Park Service, Fort Collins, Colorado.

Contents

	Page
Revision History Log	v
Acknowledgements	v
8.0 Purpose	1
8.1 Applicability	1
8.2 Summary	2
8.3 Personnel Responsibilities	2
8.4 Quality Assurance	4
8.4.1 Site Selection	4
8.4.2 Training of Field Personnel	5
8.4.3 Field Training	6
8.4.4 Safety	7
8.4.5 Sampling Methods	7
8.4.6 Checking Song Meter Operation	8
8.4.7 Song Recognition	8
8.5 Quality Control	9
8.5.1 Song Recognition	9
8.5.2 Post-Field Event Review	9
8.5.3 Data Entry Accuracy	9
8.5.4 Database Review	10
8.5.5 Data Analysis	10
8.5.6 Protocol Revision	10
8.5.7 Reporting	10

Literature Cited	11
------------------------	----

Revision History Log

The following table lists all edits and amendments to this document since the original publication date. Information entered in the log must be complete and concise. Users of this standard operating procedure will promptly notify the program manager and/or the Great Lakes Network (GLKN) data manager about recommended and required changes. The program manager must review and incorporate all changes, complete the revision history log, and change the date and version number on the title page and in the header of the document file. For complete instructions, please refer to Revising the Protocol, SOP #10.

Previous Version #	Revision Date	Author (with title and affiliation)	Location in Document and Concise Description of Revision	Reason for Change	New Version #
Add rows as needed for each change or set of changes tied to an updated version number					

Acknowledgements

This document was prepared largely through the use of available National Park Service guidance and documents prepared for the Great Lakes Network Inventory and Monitoring program. The authors wish to acknowledge these sources and thank them for the valuable contribution they have made to this document. Some verbiage contained within this standard operating procedure (SOP) was first written in the protocol narrative and other SOPs, and we wish to thank the authors of those sections.

8.0 Purpose

This standard operating procedure (SOP) defines procedures for quality assurance and quality control to be used with the Great Lakes Network protocol for monitoring amphibians. Quality assurance is the planned and systematic pattern of all actions necessary to provide adequate confidence, or assurance, that a project outcome optimally fulfills expectations. Quality control is the systematic evaluation of the various aspects of a project to ensure, or control, that the standards of quality are being met. Quality control involves specific tasks undertaken to determine the reliability of field and electronic recording data. Together, quality assurance/quality control (QA/QC) is a substantial part of any monitoring program. The objective of QA/QC is to ensure that the data generated by a project are meaningful, representative, complete, precise, comparable, scientifically defensible, and reasonably free from bias (Irwin 2006).

8.1 Applicability

Procedures in this SOP will be implemented during all work pertaining to monitoring amphibians as described in the protocol narrative. This SOP is designed to assure that all data obtained will contribute quality information to an understanding of the ecological integrity of park units of the Great Lakes Network.

The rationale for dividing a sampling protocol into a protocol narrative with supporting SOPs is based on the following:

- The protocol narrative is a general overview of the protocol that gives the history and justification for doing the work and an overview of the sampling methods, but does not provide all methodological details. The protocol narrative will only be revised if major changes are made, such as changes in sampling design.
- The SOPs are specific step-by-step instructions for performing a given task. They are expected to be revised more frequently than the protocol narrative.
- Usually, when a SOP is revised, it is not necessary to revise the protocol narrative to reflect the specific changes made to the SOP. All versions of the protocol narrative and SOPs will be archived.

The steps for changing the protocol (either the protocol narrative or the SOPs) are outlined in Procedures for Revising the Protocol (SOP #10).

8.2 Summary

Amphibians are important and valuable resources at all nine of the parks of the Great Lakes Network: Apostle Islands National Lakeshore, Grand Portage National Monument, Indiana Dunes National Lakeshore, Isle Royale National Park, Mississippi National River and Recreation Area, Pictured Rocks National Lakeshore, St. Croix National Scenic Riverway, Sleeping Bear Dunes National Lakeshore, and Voyageurs National Park. Amphibians were ranked among the top vital signs across the parks of the GLKN (Route 2004). Reasons to monitor amphibians include (see protocol for references):

- Sensitivity: Amphibians generally are sensitive to changes in environmental factors, including temperature, precipitation, humidity, hydrology, land cover, nutrients, toxicants and exotic species, among others.
- Role as ecological integrators: Most species of amphibians require both terrestrial and aquatic habitats and their fitness is a function of environmental conditions across habitats.
- Conservation concern: Declines of populations of amphibians are among the most prominent global issues in conservation biology.
- Regional relevance: All four states in which the GLKN is located, as well as Federal agencies in the region, are currently monitoring amphibian populations; results of these efforts will provide the National Park Service with a broader context for data collected in parks of the GLKN.

The overall program goal is to design and implement a monitoring program that will track changes in the distribution (occupancy) of selected amphibian species over time, treating each park independently and allowing for flexibility in the sampling design to address specific park species and habitats. All personnel associated with this project must be trained to be competent on all tasks assigned as appropriate to his position and work with other personnel to ensure that of the details in the SOPs are followed precisely.

8.3 Personnel Responsibilities

Personnel will study this SOP prior to beginning work on the project and follow its procedures in order to conduct the project according to outlined QA/QC procedures. This will ensure consistency and comparability when changes in personnel occur. Roles of staff are explained in more depth in Section 5 of the amphibian protocol narrative, along with training and requirements. The final division of QA/QC responsibilities among Network staff, park staff and contractors will be determined during the pilot year.

The program manager is a pivotal person in the monitoring program and should be competent with all aspects of the program (set-up, equipment, safety, training, and details of all SOPs). He or she must be able to manage and work effectively with all personnel so that a team atmosphere is maintained at all times. An effective and well trained team will ensure that the monitoring project is successful. Personnel changes will occur over time and the program manager must maintain consistency in all aspects of the program by ensuring that all personnel are well trained and competent. The program manager is responsible for evaluating project data at specified intervals, and ensuring that data analysis and reporting objectives are met. The program manager serves as a liaison among other related monitoring projects conducted by partners (e.g., state monitoring programs), park staff, other Network staff (field personnel, data manager), and other GLKN monitoring program managers. The individual will coordinate with resource management staff at the parks to ensure parks are informed of monitoring activities. Specific responsibilities of the program manager include the following:

- Coordinate field schedules and availability of supplies with field personnel.
- Develop a training program for field personnel.
- Develop, document, and oversee the implementation of standard procedures for field data collection and data handling.
- Coordinate logistics with park staff.
- Develop quality assurance and quality control measures for the project, supervise staff training and conduct quality assurance checks of field sampling techniques at least once, mid-season, with each field crew.
- Supervise or perform data entry, verification, and validation.
- Together with a contractor, summarize and analyze data, prepare reports.
- Serve as the main point of contact concerning data content.

The program manager will also work closely with the data manager in the following capacities:

- Complete project documentation in the database (describing who, what, where, when, why and how of a project).
- Develop data verification and validation measures for quality assurance.
- Ensure staff are trained in the use of database software and quality assurance procedures.
- Coordinate changes to the field data forms and the user interface for the project database.
- Identify sensitive information that requires special consideration prior to distribution.

- Manage the archival process to ensure regular archival of project documentation, original field data, databases, reports and summaries, and other products from the project.
- Define how program data will be transformed from raw data into meaningful information and create data summary procedures to automate and standardize this process.
- Establish meaningful liaisons with state counterparts to promote sharing of data on a timely basis.

The program manager should also participate with the Network and parks in the selection and training of contractors and all field crew personnel. Skills of these individuals should be matched to tasks so that a team spirit is achieved.

Field personnel (network, park or contract) will be responsible for following protocols and SOPs during field activities and the handling of samples. Field personnel should be adequately experienced and/or trained in using field and monitoring equipment. This experience is best obtained through hands-on training, including pilot-testing equipment. Personnel should be familiar with the instruction manuals for all equipment, particularly with regard to calibration and maintenance procedures. See SOP #2, Training and Safety, for more details on training.

The field crew leader will be responsible for preparing supplies and equipment for the field season, making any necessary travel arrangements, maintaining sampling equipment and field vehicles, ensuring field personnel follow protocols, preparing field data forms for each site, and providing the program manager with field trip and check-in schedules.

8.4 Quality Assurance

A successful project is one that has been well thought out and all personnel are well trained to prepare and execute.

8.4.1 Site Selection

Since the sampling method has been determined, the target species will be those that are adequately sampled by the method, and can be adjusted post-hoc during analyses. The selection of the ten permanent sampling sites should therefore address the two coarse habitat parameters affecting amphibian communities: the breeding wetland hydro-period (for those species with aquatic stages), and the terrestrial habitat class. The wetland hydro-period classes are: a) temporary (seasonal) wetlands, b) semi-permanent wetlands (dry only in drought years), and c) permanent lake and stream habitats. The initial site selection should identify as many potential sampling sites of each class combination as possible, in order to, a) leave room for discarding sites that fail ground truthing or must be discarded for other reasons, and b) leave room for randomized selection of additional sites if the program expands. GLKN staff should assist parks in selecting sites within the area of inference for each park using wetland, vegetation and soil GIS layers, augmented with aerial imagery, park-

staff knowledge, and ground visits. Each park should choose sampling sites that best represent their habitats, target species and wetland types.

Final site selection will require ground truthing with habitat documentation taken (wetland hydro-period class, coarse habitat class), GPS coordinates taken, a site folder prepared with directions to and a map of each site made, and Song Meter and sensor placement and mounting options determined and documented (generally a shaded shoreline tree trunk preferred at 1 m above the high water mark, and avoid south facing exposure which could spike temperatures; see SOP 4, Automated Recording Systems, for details on developing site-specific Song Meter mounting methods and documentation during the pilot year).

Steps for Site Selection:

1. Assess and list habitats, target species and wetland types in the park.
2. Group target species by hydro-period and habitat requirements (see Tables 2 and 4 in protocol).
3. Determine the potential sampling area, considering any area of inference constraints, such as park-specific monitoring needs, limitations and objectives.
4. Use GIS and other habitat data to identify and stratify potential wetlands within the sampling area.
5. Select ten permanent sample sites from the potential wetlands identified following a generalized random-tessellation stratification design, representing the three possible wetland hydro-period classes as equally as possible.
6. Determine where in the wetland to place the Song Meter, with consideration for placement at a suitable habitat area and accounting for appropriate sensor deployment. For this step a site visit by an amphibian expert is recommended to ensure that suitable habitat is selected.
7. Ground truth selections, including documenting the exact placement and mounting method for each Song Meter and sensor, and replace sites as needed.

8.4.2 Training of Field Personnel

Training of field personnel by the program manager (or a contractor) has several components. Each must be mastered before the field work can commence. These include:

- Review of the protocol and SOPs to become familiar with the background of and procedures for amphibian monitoring using Automated Recording Systems (SOPs 1-10).
- Mastering the calibration and operation of the Song Meters and sensors, including being able to troubleshoot and repair problems in the field (SOP 4).

- Becoming competent with all aspects of the operation of GPS units (SOP 3).
- Becoming competent with identifying all local frog calls and adult amphibians.
- Passing the frog call quiz for species likely to be present in the sampling region:
<http://www.pwrc.usgs.gov/frogquiz/>.
- Being trained to endure and conquer unforeseen problems and challenges in the field under all weather conditions.
- Training in basic first aid (SOP 2).
- Ensuring that all protocols on procedures that follow the field event are adhered to precisely.
- Becoming competent with entering field data accurately (SOP 5).
- Ensuring that all field personnel maintain enthusiasm for and commitment to the project.

The most opportune time for field personnel to raise questions or concerns regarding methodology is prior to the field season.

8.4.3 Field Training

All members of the field crew must know and follow the details of the SOPs. Each must work well with other crew members so that a team approach is maintained. All members of the field crew must become proficient with the Automated Recording System (ARS) units, microphones, temperature sensors and handheld GPS units. Each field crew member must be able to perform the following instrument tasks:

1. Calibration
2. Deploying
3. Checking and re-setting
4. Retrieving (including data files)
5. Cleaning and storage

Manufacturer's instructions and SOP 4 detail all of the above steps for the ARS units, microphones and temperature sensors.

Each member of the field crew must be able to perform the following with handheld GPS units (SOP 6):

1. Navigation to a site.

2. Creating a new site/waypoint.
3. Creating a route.
4. Storing information.
5. Downloading information.

8.4.4 Safety

Safety of field personnel must be a primary concern when selecting field sites and performing all aspects of the field work. A number of potential hazards are associated with field work. Members of the field crew may be operating out of radio or cellular phone range, and can encounter potentially hazardous plants, animals and people. Field work requires an awareness of potential hazards and knowledge of basic safety procedures. Advanced planning can reduce or eliminate many safety hazards (SOPs 1 and 2). Basic safety preparations should be part of the pre- field work routine. At a minimum, safety preparations should include the following:

1. Designating a time and place to meet upon completion of field work.
2. Ensuring that each field crew member knows the location(s) that the other member(s) might be visiting.
3. Checking radios, including ensuring that each member has appropriate cellular phone numbers and radio call numbers.
4. Checking vehicles, including gas, tire pressure, and basic functionality (i.e., check to make sure that there is no noticeable damage such as leaking radiator fluid).
5. Making sure that maps and first aid kits are carried, as well as compasses and handheld GPS units.

8.4.5 Sampling Methods

The sampling design and replication using ARSs is detailed in the protocol and SOPs 4 and 7. Recordings of like species from like times can be bounded by first and last detections to determine the number of replicates during analysis, which will in most instances be quite large. For data recorded by field personnel, the personnel should become proficient with all aspects of identifying and ranking frog calls. Field personnel should review and be able to pass the frog call quiz for species likely to be present in the sampling region (<http://www.pwrc.usgs.gov/frogquiz/>), and be familiar with adult amphibian species likely to be encountered. Make sure that all possible problems and their solutions are reviewed. Ensure that any problems encountered in the field are resolved before the next survey event. Instill a mind-set that each protocol and field sampling technique must be replicated precisely to ensure consistency and comparability.

8.4.6 Checking Song Meter Operation

Ensure that the manual checking of the Song Meter during field visits follows the outline in section 4.1.7 in SOP 4. Errors in Song Meter operation should be logged and periodically reviewed for ways to reduce error. When errors do occur, data sets are absent or otherwise compromised for analysis.

8.4.7 Song Recognition

Additional studies will be needed to determine Type I and Type II error rates using ARS with Song Scope software for detecting calling amphibians. Hecnar and Casper (2009) provided detection rates for human call surveys. Human listeners can listen to recordings from ARS units following the standard call survey protocol if desired, and record call index values (which will not be provided by automated Song Scope data analyses). Differences between human and automated detection rates should also be quantified by further studies, by comparing results registered by ear in the field with those recorded by the Song Meter at the same time and place.

For ARS, Waddle et al. (2009) found variable error rates with lower frequencies more difficult to differentiate from ambient noise in Song Scope data analysis. The ARS portion of this protocol has two potential levels of error. First are the limits of the sampling area, which is a buffer around the ARS equal to the maximum distance at which the species can effectively be recorded. This distance varies by a range of factors including call amplitude, call frequency, the relative positions of the caller and receiver, habitat, background noise (including other frogs), and the auditory acuity of the receiver (Marten and Marler 1977, Parris 2002, Parris et al. 2009). However, since Song Meters are placed right at breeding sites, and far enough apart that no two Song Meters could record the same frog call, these errors are expected to be inconsequential. The calls that are recorded define the sample. Many of these parameters cannot be controlled for (i.e., the amplitude of a call, wind noise) and are part of the variation determining detection probabilities feeding into the percent area occupied statistic, so this variation need not be further quantified. The microphone and hardware specifications are provided by the manufacturer. Should these physical specifications change, they will need to be assessed to determine if detection rates will be affected and how comparing data between old and new microphones should be managed.

The second level of error is in detection rates for each species by the Song Scope recognition files. This error should be quantified by dedicated studies and understood in finalizing how data are analyzed and interpreted.

8.5 Quality Control

Quality control is the responsibility of each member of the project team. In general, each person must ensure that all tasks assigned are completed with competency and accuracy.

8.5.1 Song Recognition

The following studies should be completed during the first few years of program launch, and results discussed in detail in the first multi-year report.

1. Perform a validation study to compare differences between human and automated detection rates by comparing results registered by ear in the field with those recorded by a Song Meter at the same time and place. This will provide a better understanding of what differences might need to be accounted for when comparing Song Meter derived data with human call survey program data. The study can be accomplished by visiting the Song Meter location and conducting standard calling frog surveys (Weir and Mossman 2005) at the same times as the Song Meter is recording. After the season ends, have the same listener conduct standard calling frog surveys again by listening to the digital recordings made during the field surveys. A final study design should be developed by the program manager with sufficient replicates.
2. Perform a validation study to compare differences between species detected from the same recordings by a human listener vs. Song Scope software. This will improve our understanding of the limitations of Song Scope recognizer files. A final study design should be developed by the program manager with sufficient replicates and with attention to adjustments to settings in the recognizer files that may improve automated detection.
3. Perform a study to determine the distance various calls can be recorded with the ARS units. For this study, use a playback system holding climate variables, habitat, species and volume constant but varying distance, and determine the maximum recording distance for each species. The experiments should be conducted during the “off season” when no frog species are calling, and in a location where vegetation status (leaf density) is not a factor (such as in an open short grass field or on a golf course). A final study design should be developed by the program manager with sufficient replicates and controls.

8.5.2 Post-Field Event Review

The SOPs provide steps to follow once the fieldwork has been completed. Follow all of these protocols after each trip. Do not let the records for each field event accumulate. Perform all cleaning and maintenance as required to ensure that everything is ready for the next field event. Review the field event with the program manager and other personnel and discuss and resolve any issues or problems that arose during its execution. Maintain a log of each of these post-event reviews.

8.5.3 Data Entry Accuracy

Each person entering data from field records must do so accurately each time. Attention to detail is paramount. Mistakes will happen but they can be minimized by being rested and attentive when

entering data. On a regular schedule approved by the program manager and data manager, the crew leader gathers the data sheets and verifies the completeness, accuracy, and legibility of each form. Ensure that the data verification steps in SOP 5 are completed with a 100% check of hand-entered data.

8.5.4 Database Review

The data entered after each field trip should be reviewed periodically by comparing information accumulated in the field with the entry in the electronic file. Personnel executing this task must be able to recognize numbers and other alpha-numeric entries that lie outside the normal patterns established by the data. Become familiar with the flow of the data so that anything out of the ordinary is recognized. Follow procedures outlined in SOP 5. Prior to distributing the data for any type of use, the program manager validates the amphibian monitoring database content in the master amphibian data file according to procedures in SOP 5.

8.5.5 Data Analysis

Analyzing data obtained from the monitoring project can be straightforward if specific questions are established first. Follow the procedures in SOP 7 to ensure that general reporting requirements are met. Make sure that assumptions for each statistical test are met before using results to answer the specific question. The person assigned the task of analyzing the field data should master the program PRESENCE to answer questions about occupancy patterns.

8.5.6 Protocol Revision

Revisions of any of the protocols in the SOPs should follow an *a priori* set of steps to ensure that all changes are documented and archived. SOP 10 contains the steps that should be followed each time a revision occurs. Pay specific attention to archiving and historical documentation. Keep these requirements in mind when making any changes. Specifically, note the rationale and all reference points to provide a complete history of each change. In short, leave absolutely nothing out.

Related to this effort is the need to maintain all metadata associated with each step of the monitoring project. Ensure that all information related to a specific task, field event, project review, data analysis, etc. is maintained in a way that allows future retrieval.

8.5.7 Reporting

Several different types of documents will be derived from the monitoring program dataset, including annual reports summarizing the previous period's activities, technical reports that focus on specific questions asked, and published scientific papers. Follow the procedures outlined in SOP 5 to ensure consistency in format, layout and style for each type of report document needed. Scientific manuscripts must follow the format of the journal to which it is submitted.

Literature Cited

- Irwin, R. J. 2006. Draft Part B lite (Just the Basics) QA/QC review checklist for aquatic vital sign monitoring protocols and SOPs. National Park Service, Water Resources Division. Fort Collins, Colorado. Available at: <http://www.nature.nps.gov/water/vitalsigns/assets/docs/PartBLite.pdf> (accessed 20 may 2012).
- Marten, K., and P. Marler. 1977. Sound transmission and its significance for animal vocalization. I. Temperate habitats. *Behavioral Ecology and Sociobiology* 2:271–290.
- Parris, K. M. 2002. More bang for your buck: The effect of caller position, habitat and chorus noise on the efficiency of calling in the spring peeper. *Ecological Modeling* 156:213–224.
- Parris, K. M., M. Velik-Lord, and J. M. A. North. 2009. Frogs call at a higher pitch in traffic noise. *Ecology and Society* 14(1):25.
- Waddle, J. H., T. F. Thigpen, and B. M. Glorioso. 2009. Efficacy of automatic vocalization recognition software for anuran monitoring. *Herpetological Conservation and Biology* 4(3):384–388.
- Weir, L. A., and M. J. Mossman. 2005. North American Amphibian Monitoring Program (NAAMP). Pages 307–313 in M. J. Lannoo, editor. *Amphibian Declines: The Conservation of United States Species*. University of California Press, Berkeley, California.