

Standard Operating Procedure 3: Field Work

Version 1.0

In Protocol for Monitoring Mercury in Resident Lake Fish

Prepared by:

Mark Sandheinrich ¹, David D. VanderMeulen ², and Krista K. Bartz ^{3,4}

¹ University of Wisconsin – La Crosse
River Studies Center
1725 State Street
La Crosse, Wisconsin 54601

² National Park Service
Great Lakes Network
2800 Lake Shore Drive East
Ashland, Wisconsin 54806

³ National Park Service
Southwest Alaska Network
240 West 5th Avenue
Anchorage, Alaska 99501

⁴ Contact author: krista_bartz@nps.gov

September 2018

Suggested citation:

Sandheinrich, M., D. D. VanderMeulen, and K. K. Bartz. 2018. Standard operating procedure 3: Field work – Version 1.0. *In* K. K. Bartz, K. M. Junghans, and D. D. VanderMeulen. 2018. Protocol for monitoring mercury in resident lake fish – Version 1.0: Southwest Alaska Inventory and Monitoring Network. Natural Resource Report. NPS/SWAN/NRR—2018/1734. National Park Service, Fort Collins, Colorado.

Contents

	Page
Figures.....	iii
Tables.....	iii
Revision History Log.....	1
Acknowledgements.....	1
Introduction.....	2
Equipment and Supplies	3
Field and Post-Field Procedures	4
Overview of Procedures	4
Recording Information	4
Collecting Fish.....	5
Preventing Contamination	5
Processing Fish.....	6
Storing and Shipping Samples.....	8
Summary of Field QA/QC Procedures	8
Data and Records Management	9
Literature Cited	10
Appendix 3.1.....	11

Figures

	Page
Figure 1. Maps of potential lake trout sampling locations at two Tier 1 lakes.	2
Figure 2. Example photograph of a lake trout prior to processing.....	7
Figure 3.1.1. Field form for resident lake fish monitoring by the SWAN.....	11
Figure 3.1.2. Sample labels for resident lake fish monitoring by the SWAN.....	12
Figure 3.1.3. Collection information cards for resident lake fish monitoring.....	13

Tables

	Page
Table 1. Checklist of equipment and supplies required for collecting and processing fish.	3
Table 2. Summary of QA/QC documentation and sampling methods.	9

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 (SOP) will promptly notify the Southwest Alaska Network (SWAN) project manager and/or data manager about recommended and required changes. The project 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 SOP 8 (Protocol Revision).

Revision History Log:

Previous Version #	Revision Date	Revision Author	Revision Description and Location in SOP	Justification for Revision	New Version #
—	—	Bartz	Initial creation	—	1.0

Add rows as needed for each change or set of changes tied to an updated version number

Acknowledgements

This SOP was adapted from a similar SOP in the Great Lakes Network (GLKN) protocol for monitoring mercury in dragonflies and fish (VanderMeulen et al. 2018). The majority of the GLKN SOP was lifted verbatim from a draft SOP prepared by M. Sandheinrich. Note that all product and company names are trademarks™ or registered® trademarks of their respective holders. Use of them in this SOP and associated appendices does not imply any affiliation with or endorsement of them by the U.S. National Park Service.

Introduction

This Standard Operating Procedure (SOP) describes field methods for sampling resident lake fish once every five years from Tier 1 lakes in two Southwest Alaska Network (SWAN) parks. Within each Tier 1 lake, sampling locations will be selected on the basis of their logistical feasibility and conformance to the habitat preferences of our focal species (Figure 1). In particular, we will target locations where depth increases rapidly (e.g., lake shelf edges) and/or where salmon smolts are relatively concentrated (e.g., stream mouths). This spatial sampling design assumes that the focal species' population in each Tier 1 lake is panmictic, until proven otherwise.

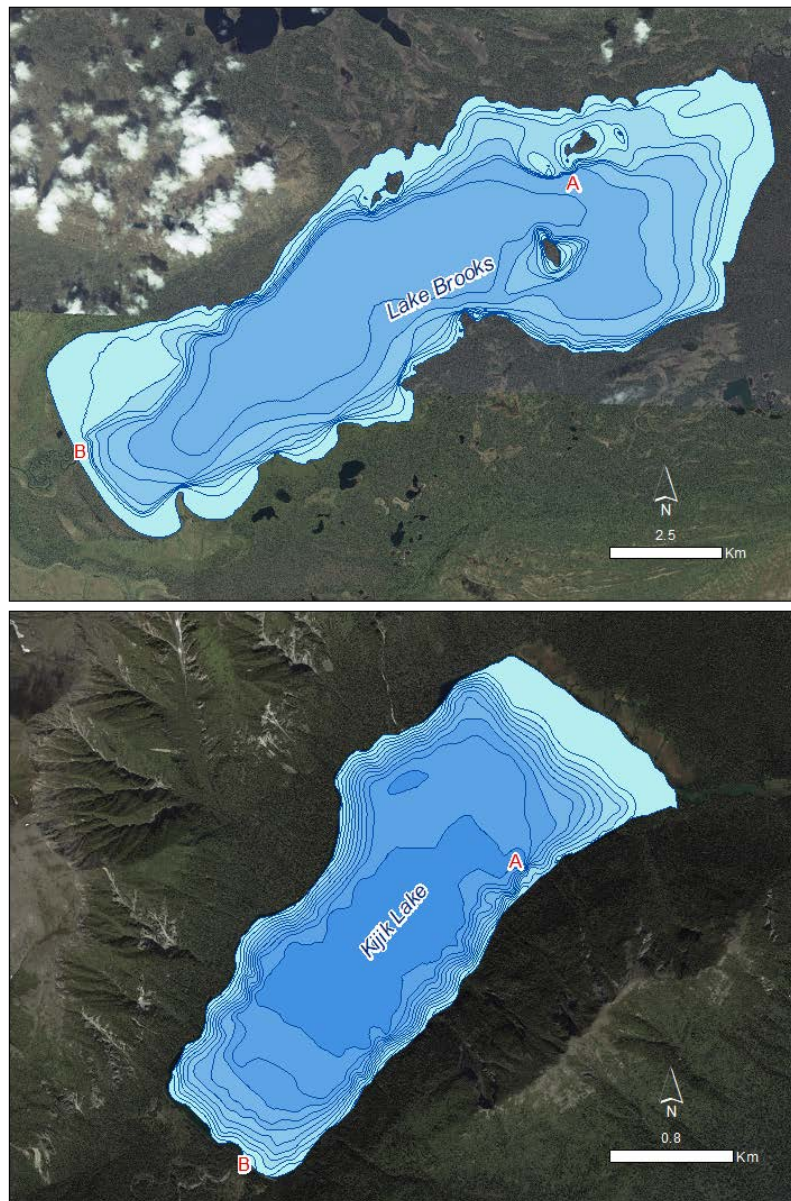


Figure 1. Maps of potential lake trout sampling locations at two Tier 1 lakes: Lake Brooks (upper panel) and Kijik Lake (lower panel). In each map, points “A” and “B” represent lake shelves and stream mouths, respectively. Contour lines are 10 m increments.

Fish will be collected in early summer, after ice out but before the arrival of adult sockeye salmon. This timing should minimize both temporal variability and sampling effort. The focal species will be lake trout (*Salvelinus namaycush*) and the sample size will be 20 fish per lake, as described in the protocol narrative. Ideally, samples will be divided evenly among genders, with a target size of ≥ 400 mm (total length). This SOP also covers post-field procedures, such as fish processing, storing, and shipping.

Equipment and Supplies

Refer to the checklist of sampling equipment and supplies needed for collecting fish from each lake (Table 1). All equipment and supplies will be provided by the SWAN or SWAN cooperators. Additional items for personal safety and wellbeing are listed in SOP 2. Keep on hand all necessary forms, permits, licenses, and manuals.

Table 1. Checklist of equipment and supplies required for collecting and processing fish.

✓	Equipment and Supplies
☐	Waders, boots, and personal flotation devices (PFDs)
☐	Field binder (with site maps and collection permits) and fishing licenses
☐	Two or more communication devices (i.e., park radio, satellite phone, cell phone, inReach®)
☐	Field notebooks, pencils, and pens (waterproof ink)
☐	Blank field forms on waterproof paper (Appendix 3.1)
☐	Sample labels and collection information cards, with pre-printed ID codes (Appendix 3.1)
☐	Angling equipment, gill net, and net pen (as appropriate for the site)
☐	Tool kit (with multi-tool included) and first aid kit
☐	Cooler with ice
☐	Powder free nitrile gloves (multiple sizes)
☐	GPS and digital camera with extra flash cards and batteries
☐	Fillet knives, cutting boards, and lab-grade detergent (e.g., Liquinox®)
☐	Fish weigh scale and measuring board
☐	Tweezers and small vials (for otolith extraction and storage)
☐	Unused food-grade plastic bags (e.g., Whirl-Pak®) or Ziploc®; at least 15 large and 90 small per lake
☐	Large plastic garbage bags (for transporting fish carcasses)

Field and Post-Field Procedures

Overview of Procedures

- Review field gear checklist and compile field kit.
- Create a new field data sheet for each sampling location, printed on waterproof paper.
- Inspect boat; ensure all safety gear is on board.
- Load boat with sampling gear, launch boat, and navigate to monitoring site.
- Collect fish via angling (hook and line) or gill nets.
- Hold fish in a net pen until departure.
- Euthanize fish, place them in labeled plastic bags, and store them on ice until dissection.
- Take site photos and collect one or more representative GPS points.
- Verify that the field form is filled out, minus the portions completed during processing.
- Return to field station and process fish as follows:
 - Photograph each fish, and record its weight, length, and gender on the field form.
 - Remove the sagittal otoliths from each fish.
 - Store the otoliths in labeled vials at room temperature.
 - Remove 3 tissue samples per fish, using “Clean Hands – Dirty Hands” methods.
 - Place tissue samples in a freezer and store until ready for shipment.
- Ship tissue samples on wet ice to Anchorage, and then on dry ice to the contract laboratory.
- As soon as possible, review field forms and laboratory results.
- At the end of the season, enter or import all field and laboratory data into NPSTORET.

Recording Information

Consistent methods are important to long-term data quality. In actuality, the ideal conditions are not always met in the field or in the lab and changes in staff occur. Therefore, documentation of procedures, site conditions, laboratory analysis, and reasons for deviations of any kind is important. Personnel are encouraged to write down more than they feel may be necessary in the moment, as the future interpretation of their data will depend on the written record, not the memory of an individual. Field forms should be printed in advance on waterproof paper (see Appendix 3.1). Information recorded on the field forms at the time of sampling should include:

- Park and lake name
- Date(s) when sampling occurred
- Times of arrival and departure
- Names and affiliations of field personnel
- GPS coordinates where fishing occurred
- Numbers and species of any fish caught unintentionally as bycatch

- General comments (e.g., which lures, times, depths worked best; what weather conditions were encountered)

The completed field forms will be maintained in chronological order by sampling site, copied into project binders and the originals maintained on file as hard and electronic copies indefinitely. Field forms will be reviewed annually by SWAN personnel. See SOP 4 (Data Entry and Management) for details.

Collecting Fish

Angling with hook and line or fishing with gill nets may be used to collect fish. The effectiveness of each method varies by location, time of day, and month of year, among other things. Therefore, past experience at the sampling location and understanding of the target species' habitat preference should be used as a guide in selecting the method of sampling.

Angling with artificial lures may be more effective than setting nets in lakes for non-schooling predatory species, such as lake trout. The selection of lures should be based on previous experience and information from other anglers. Try trolling with fry and smolt patterns or spoons in locations frequented by juvenile salmon, next to the cool, deep water preferred by adult lake trout.

Gill nets may be effective for collecting fish, especially when angling fails. A discussion of gill nets and other passive means of fish capture may be found in Hubert 1996. Steps for setting gill nets are outlined below:

- From a boat, set the gill net perpendicular to the shoreline in water that is deeper than the height of the net. It is easiest to set the windward end of the net first and then deploy the net as the boat is pushed downwind.
- The net should be kept taut as it is deployed. A line and buoy should be attached to one end of the lead line of the net to facilitate retrieval.
- Nets should be checked for fish frequently and at least every two hours to minimize mortality of non-target species.

Note that when fish are removed from the hook or net, they should not be laid down on the ground or the floor of the boat, or exposed to any water or residue in the boat. Rather, once caught, fish will be screened for external lesions or abnormalities, and then retained live in a net pen underwater until departure from the site (time permitting). Use of a net pen is recommended particularly on overnight trips, because fish carcasses could increase the risk of bear encounters. Prior to departure, fish will be euthanized with a sharp blow to the back of the head and placed into clean, food-grade plastic bags, individually. Bagged fish will be stored on wet ice in a cooler for transport. Also prior to departure, one or more site photos and GPS points should be collected. GPS points should represent the general locations where fishing occurred (e.g., the midpoint along a linear shoreline transect where samples were collected).

Preventing Contamination

It is easy to contaminate samples with Hg or other environmental contaminants, because they may surround us (i.e., in soil, leaves, hair, personal care products, etc.). Therefore, everything should be

kept ultra-clean during processing in order to avoid contamination of samples and biasing of laboratory results. The following procedure should be used when processing samples:

- Always wear powder-free nitrile gloves when dissecting fish.
- Never touch the inside of the inner bag (i.e., the first bag you put the tissue sample into).
- Clean all surfaces that contact the samples between fish (i.e., gloves, knives, cutting board).
- Work in pairs, using the “Clean Hands – Dirty Hands” method:
 - One person is in charge of the sample bags (“Dirty Hands”) and the other will pick up and place the samples in the bags (“Clean Hands”).
 - Clean Hands puts on gloves and then touches nothing but the sample and any pre-cleaned supplies. Dirty Hands does not need to wear gloves.
 - Clean Hands fillets a fish and removes three samples of skinless axial muscle tissue, weighing ~10 g each.
 - Dirty Hands holds three bags open while Clean Hands places a sample inside each bag. Clean Hands seals the bag.
 - Dirty Hands fills out a label for each bagged sample and slips it and the inner bag into an outer bag. Dirty Hands seals the outer bag.
 - Wash surfaces and change gloves between samples to ensure that there is no carryover from one sample to the next.
 - Go to the next individual and repeat. Place all of the small double bags into one or more of the larger zipper seal bags for storage and to keep them safe and together.

Processing Fish

- Photograph each fish (Figure 2), and record its gender, weight, and length on the field form:
 - Gender should be recorded as M, F, or U (male, female, or unknown).
 - Weight should be recorded (in grams) for three measurements, which are averaged.
 - Length should be recorded (in millimeters) as both total length and fork length. The total length is the maximum length of the fish, with the mouth closed and the tail fin pinched together. The fork length is shorter, from the tip of the jaw or snout (again with the mouth closed) to the center of the fork in the tail.



Figure 2. Example photograph of a lake trout prior to processing. Note the inclusion of the measuring tape and sample ID in the photograph.

- Remove otoliths from each fish and store them in a labeled vial at room temperature. For a review of techniques, see Secor et al. 1992.
- Collect tissue samples in triplicate from each fish, as described above (~10 g per sample).
- Once tissue samples have been collected, each is double bagged; placed first in an inner zipper bag, then placed in an outer bag along with a sample label facing outward (Appendix 3.1), and stored on wet ice.
- Each individual will be assigned a sample ID using the following convention: 4-letter park acronym_5-letter site code_2-digit sample number_1-letter triplicate ID_YYYYMMDD. Use the site codes previously assigned for SWAN water quality monitoring as shown in the SOPs (Shearer et al. 2015). For example, the first of three replicate samples from the eleventh lake trout collected from Lake Brooks in Katmai National Park and Preserve on July 15, 2018 would be labeled “KATM_lbroo_11_A_20180715.”
- Count all bagged samples and confirm that the number recorded on the datasheet matches the number of triplicate tissue samples.
- Record the park, lake, sampling date, species, and number of samples on the “collection information card” (Appendix 3.1) and place the card into the bag containing all of the individually bagged samples, making sure the card is legible through the bag.
- Time permitting, examine the stomach contents of each fish before disposal of the carcass. Record qualitative findings on the field form.
- Dispose of the carcasses as stipulated in the Alaska Department of Fish and Game permit.

Storing and Shipping Samples

- After processing, store fish tissue samples in a freezer until shipping. Do not allow samples to thaw and refreeze; keep them frozen once placed in the freezer.
- Tissues samples can be stored frozen until both lakes in a park have been visited; then they must be shipped in a cooler on wet ice to Anchorage.
- Once in Anchorage, tissue samples can be stored frozen until samples from both parks are in hand. Then, they must be shipped to the contract laboratory on dry ice.
- Include a copy of the field form in the shipment. Alternatively, the field forms can be scanned and emailed to the lab with the originals included in the shipment. When shipping, place the frozen tissue samples under the dry ice (the samples should not be crushed as long as they remain frozen) and fill any excess in the cooler with crumpled paper to ensure that they remain frozen during shipment.
- When shipping samples on dry ice, the “dry ice box” on the shipping label must be checked if using FedEx as a carrier. Also, the cooler must be marked as containing dry ice by using an additional “dry ice label.” Per FedEx regulations, coolers with dry ice must have a pinhole drilled in the lid. Use care when taping to assure that this small hole remains uncovered.
- Contact the laboratory coordinator when a shipment is ready to verify that someone will be available to accept the shipment. Shipments should be sent via FedEx Overnight before 2:00 pm from the FedEx branch office at the airport (6050 Rockwell Avenue in Anchorage) on Mondays or Tuesdays (and not during weeks with holidays).

Summary of Field QA/QC Procedures

Quality assurance/quality control (QA/QC) procedures are devised to help ensure that data collected are as representative of the natural environment as possible. QA procedures are required in all data collection efforts as part of this monitoring protocol. Many of the key elements of QA have been included in the SOPs where appropriate, as well as detailed in the Data Quality Standards (DQSs; Bartz et al. 2018). A summary of important QA/QC procedures follows. Table 2 lists additional requirements for QA/QC methods and documentation.

- Field staff must be trained by personnel experienced in the protocol. Details of the training are provided in SOP 2 (Training and Safety).
- All manually recorded field measurement data will be collected on field forms; data captured (e.g., GPS locations or photos) or reported (laboratory sample results) electronically and the equipment used will be documented. Hard and electronic copies will be made as soon as possible after surveys and kept at a separate location as backup.
- Complete records will be maintained for each sampling site and all supporting metadata will be recorded appropriately (field forms or electronically).

Table 2. Summary of QA/QC documentation and sampling methods.

Procedure	Description or Reason
Office binder	Containing: copies of safety-related SOPs and JHAs, copies of relevant SOPs, checklist of QA/QC reminders, sampling schedule, shipping instructions, and blank forms and labels.
Field binders	Containing: GPS coordinates for verification of correct sampling location, summary of previous field measurements to compare with new measurements, maps and photographs of field sites, and any required permits.
Field forms	Field forms are the only written record of field measurements, so copies are placed in field binders and originals must be kept on file indefinitely.
Field methods	Require consistent sampling methods.
Sample preservation	Environmental samples are maintained as close to sampling conditions as possible, or are transported and shipped according to protocol requirements.
Chain-of-custody	A chain-of-custody includes not only the form, but all references to the sample in any form, document or log book which allow tracing the sample back to its collection, and documents the possession of the samples from the time they were collected until the analytical results are received.
Laboratory methods	Require consistent analytical methods and detection limits.

The project manager, in consultation with experienced professionals, will be responsible for taking corrective responsive action in the case in which QA/QC is not followed or in the case of an unexpected event. Responsive action is often needed in the event of missing data, errors on field sheets, changes due to field conditions, problematic analyses and other events that do not fall within the standard operating procedures. A “Memo-to-file” will be used to document any decisions or corrections that are made. This memo will include the date, name of author, site or sample referred to, a description of the problem or error, and a statement describing the decision made or action taken. The memo will be archived with the appropriate site data and files.

Data and Records Management

- Hand-written field sheets should be reviewed for completeness no later than the end of each field day. Make photocopies and scan as soon possible and file them appropriately.
- Ensure that field forms, field notebooks, and other hardcopy records are secure, organized, and available for viewing, reproduction, or transfer upon request and/or at the end of each field season.
- Schedule and perform regular data transfer and backup. Data will be protected from loss or damage by daily backup, when possible, or on a feasible schedule approved by the project leader and the data manager. Ideally, raw data are backed up off-site as soon as a sampling trip is completed. Electronic data will be backed up to the SWAN T Drive following each sample round.

- Record and verify observed or measured data values. Complete paper forms and enter or import data into NPSTORET and/or other electronic databases.
- Data validation, the process by which data are approved or rejected as being accurate, involves the review of the results of all measurements, samples, and QC samples. Sample data should be flagged if the analyte was detected in a blank at a concentration similar to that in the sample; flagged data contain more uncertainty than unflagged data. Some investigation into the sampling method may be needed if flagged data are a continual occurrence.
- Refer to SOP 4 for more details regarding data entry and management.

Literature Cited

- Bartz, K. K., C. J. Sergeant, and D. D. VanderMeulen. 2018. Data quality standards for monitoring mercury in resident lake fish – Version 1.0: Southwest Alaska Inventory and Monitoring Network. Natural Resource Report NPS/SWAN/NRR—2018/1731. National Park Service, Fort Collins, Colorado.
- Hubert, W. A. 1996. Passive capture techniques. Pages 157–192 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, second edition. American Fisheries Society, Bethesda, Maryland.
- Secor, D. H., J. M. Dean, and E. H. Laban. 1992. Otolith removal and preparation for microstructural examination. Pages 19–57 *in* D. K. Stevenson and S. E. Campana, editors. Otolith microstructure examination and analysis. Canadian Special Publication of Fisheries and Aquatic Sciences 117. Department of Fisheries and Oceans, Ottawa, Canada.
- Shearer, J., C. Moore, K. K. Bartz, E. C. J. Booher, and J. Nelson. 2015. Monitoring freshwater systems in the Southwest Alaska Network: Standard operating procedures. Natural Resource Report NPS/SWAN/NRR—2015/925.1. National Park Service, Fort Collins, Colorado.
- VanderMeulen, D. D., B. Route, J. Wiener, R. Haro, K. Rolhus, M. Sandheinrich, S. J. Nelson, A. Klemmer, C. Eagles-Smith, and J. Willacker. 2018. Protocol for monitoring mercury in dragonfly larvae and fish (version 1.0): Great Lakes Inventory and Monitoring Network. Natural Resource Report NPS/GLKN/NRR—2018/1726. National Park Service, Fort Collins, Colorado.

Appendix 3.1

SWAN Freshwater Monitoring: Field Form for Resident Lake Fish Sampling														
Electronic Field Form Version 1.1 Developed: June 22, 2015 Updated: January 17, 2018					National Park Service - Southwest Alaska Network 240 W. 6th Ave., Anchorage, AK 99501 Contact: Krista Bartz (907-844-3885; krista_bartz@nps.gov)									
Site Information														
Date(s) and Time(s) Sampled:														
Date(s) and Time(s) Processed:														
Park:														
Waterbody:														
Location(s) Fished:														
Crew Members:														
Data Recorder:														
ID Number	Date Caught	Latitude Caught	Longitude Caught	Species	Fork Length (mm)	Total Length (mm)	Sex	Weight (g) - 1st Measurement	Weight (g) - 2nd Measurement	Weight (g) - 3rd Measurement	Weight (g) - Average	Otoliths Removed?	Stomach Contents	Comments
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
				Lake trout							#DIV/0!			
General Comments:														
Bycatch:														

Figure 3.1.1. Field form for resident lake fish monitoring by the SWAN.

Sample ID: Species: _____ Park: _____ Lake: _____ Date: _____ Replicate: _____ _____	Sample ID: Species: _____ Park: _____ Lake: _____ Date: _____ Replicate: _____ _____
Sample ID: Species: _____ Park: _____ Lake: _____ Date: _____ Replicate: _____ _____	Sample ID: Species: _____ Park: _____ Lake: _____ Date: _____ Replicate: _____ _____
Sample ID: Species: _____ Park: _____ Lake: _____ Date: _____ Replicate: _____ _____	Sample ID: Species: _____ Park: _____ Lake: _____ Date: _____ Replicate: _____ _____
Sample ID: Species: _____ Park: _____ Lake: _____ Date: _____ Replicate: _____ _____	Sample ID: Species: _____ Park: _____ Lake: _____ Date: _____ Replicate: _____ _____
Sample ID: Species: _____ Park: _____ Lake: _____ Date: _____ Replicate: _____ _____	Sample ID: Species: _____ Park: _____ Lake: _____ Date: _____ Replicate: _____ _____
Sample ID: Species: _____ Park: _____ Lake: _____ Date: _____ Replicate: _____ _____	Sample ID: Species: _____ Park: _____ Lake: _____ Date: _____ Replicate: _____ _____

Figure 3.1.2. Sample labels for resident lake fish monitoring by the SWAN.

NPS FISH Park name: _____ Site name: _____ Sampling date(s): _____ Species: _____ Number of samples: _____	NPS FISH Park name: _____ Site name: _____ Sampling date(s): _____ Species: _____ Number of samples: _____
NPS FISH Park name: _____ Site name: _____ Sampling date(s): _____ Species: _____ Number of samples: _____	NPS FISH Park name: _____ Site name: _____ Sampling date(s): _____ Species: _____ Number of samples: _____

Figure 3.1.3. Collection information cards for resident lake fish monitoring by the SWAN.