Standard Operating Procedure

Collection Methods for Fish in Wadeable Streams

Commonwealth of Kentucky
Energy and Environment Cabinet
Department for Environmental Protection
Division of Water

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1.0 SCOPE & APPLICABILITY

This SOP has been developed by the Kentucky Division of Water (DOW) as guidance for the uniform and accurate collection, field processing, field handling, and quality assurance/quality control (QA/QC) of fish samples collected from the wadeable waters of Kentucky. The methods defined herein are required for all fish collection, field processing, field handling, and QA/QC activities resulting in information that could be used for water quality assessments. The Kentucky Index of Biotic Integrity (KIBI) is used to assess stream health by examining fish community structure (Compton et al. 2003). Advantages of using fish as biological indicators include their 1) widespread distribution from small streams to all but the most polluted waters; 2) utilization of a variety of trophic levels; 3) stable populations during summer months; and 4) the availability of extensive life history information (Karr et al. 1986). The methods used for collecting fish community structure data for use in the KIBI are outlined in this document. Collection methods used in large-wadeable and non-wadeable streams (>200 mi.^{2} drainage area) may not provide reliable KIBI results; separate methods and assessment criteria for larger streams and rivers are found in (DOW 2016).

Any data submitted to DOW for review will undergo QA/QC and those identified as not following the methods set forth in this document will be flagged as not suitable for the Integrated Report to Congress on the Condition of Water Resources in Kentucky (305(b) and 303(d) Reports). These data may be retained in DOW files for other data purposes.

2.0 SUMMARY OF METHOD

This document summarizes ichthyofauna sampling methods performed by various DOW programs in wadeable streams. On the occasion that DOW field personnel determine that any of the procedures described in this manual are inappropriate, inadequate, or impractical, the variant procedure will be documented in field log books or field observation sheets, along with a description of the circumstances requiring its use.

This manual should be considered a dynamic document that is reviewed and updated as new procedures and methods are used.

3.0 DEFINITIONS & ACRONYMS

303(d) – Section 303(d) of the Clean Water Act (33 USC §1313(d)).
305(b) – Section 305(b) of the Clean Water Act (33 USC §1315(b)).
Anode – The positive electrode. The anode is always a probe when backpack electrofishing.
Backpack Electrofisher – A device carried on a sampler's back that applies electricity to a body of water for the purpose of stunning fish.

Back Pack Electrofishing (BPEF) – Electrofishing with a backpack electrofisher (ex. Smith-Root. Inc. LR20B or LR24).
Cathode – The negative electrode. The cathode can be either a rat tail or probe.
DC – Direct current, electrical current only flows in one direction.
Dip Net – A net (of appropriate size for fish being collected) with 3/16 inch mesh affixed to a fiberglass handle.
DOW – Kentucky Division of Water
Duty Cycle – Expresses the ratio, in %, of on time for electrical signal.
Electrofishing – The use of electricity to provide a sufficient electrical stimulus in fish to stun and facilitate capture by netting.
KIBI – Kentucky Index of Biotic Integrity
K-WADE – Kentucky Water Assessment Data for Environmental Monitoring. A database used by the Kentucky Division of Water to store water quality data.
MS222 – Tricaine methanesulfonate, powder used to anesthetize or euthanize fish.
Netter – The individual who nets the captured fish during electrofishing operations.
PMP – Project Management Plan
Pool – An area of a stream characterized by deep (usually > 0.5 m), slow velocity and a variety of substrate types.
PPE – Personal protective equipment
Probe – Pole fitted with a metal ring and serves as either the anode or cathode (with two probe method).
PSP – Project Study Plan
PDC – Pulsed direct current, also known as standard pulse. Most commonly used waveform in electrofishing.
Rat Tail – Cable attached to backpack electrofisher and dragged through water to serve as the cathode.
Riffle – An area of a stream with an observable decrease in gradient characterized by shallow (<0.5 m), fast velocity and **stable, layered** rock substrate. The surfaces of some substrate could be exposed above the waterline.
Run – An area of a stream characterized by deep (usually > 0.5 m), fast velocity and a variety of substrate types. Runs are commonly found below riffles. In low-gradient streams, runs (also called glides) are the dominant habitat where velocity is faster than the surrounding habitats.
Sample Stations – K-WADE station that denotes location of sampling site.
Seine – A 10 or 15 foot length by 6 foot width net with 3/16-in mesh affixed to two brails.
Shocking seconds – Time (in seconds) recorded on the electrofisher that the unit is actively electrofishing.
Taxis – Induced swimming action, fish move towards anode/net and recover quickly, usually within 5 seconds of placement into holding tank.
Tetany – Locking of muscles, fish is stiff and quivering observed. Very high probability of mortality/injury. If fish exhibit signs, electrofisher settings need to be altered.

Tote barge – Gasoline generator electrofishing barge that can be pushed by a crew in wadeable streams too large for backpack units. Typically has three anode poles and a livewell. Requires a minimal crew of 3, with 4 being desired.
Waveform – Can be AC, DC, PDC, or Burst of Pulses Current and each one causes electrons to move through water differently.

4.0 HEALTH & SAFETY STATEMENT

All field staff should review Worksite Hazard Assessment Guidance Document (DOW 2017). In addition, each employee will be individually trained by his/her supervisor, or designee, to perform assigned job tasks safely, prior to his/her performing the task.

Field staff working in and around potentially contaminated surface waters should receive immunization shot for Hepatitis A in accordance with DEP Departmental Policy Memorandum SSE-708 (revision, 2007). In addition, staff should receive immunization for Hepatitis B and tetanus, to aid in the prevention of contracting those pathogens. All field staff should also be trained in CPR, First Aid, and Blood Borne Pathogens in accordance with DEP Departmental Policy Memorandum SSE-711 (2001). Pertinent field crew allergies, such as bee stings, should be identified before the sampling trip. Members of a field crew should familiarize themselves with the nearest hospital, doctor's office, or urgent medical care provider prior to leaving for site visit.

Streams can vary considerably in depth over a short distance, and may have sudden, unexpected drops. It is recommended that field staff use personal floatation devices when collecting samples in streams with depths >1m or where swift currents are present. If any team member determines conditions are unsafe, discontinue work and re-evaluate the situation.

4.1 Electrofishing Safety

Supervisors must ensure employees are aware of proper safety procedures before the employee is allowed to engage in electrofishing. Prior to field work, new crew members should receive orientation on equipment, procedure, and risks involved. This orientation should include an explanation of equipment components and their function, demonstration of equipment, and hazards associated with electrofishing.

For general safety purposes, field crews must consist of more than one field person.

Each field crew shall use the following personal protective equipment (PPE) for each sampling trip: waders, rubber gloves, boots, long pants, hearing protection (if using generator-powered unit), eye protection, bug repellent, sunscreen, and hand sanitizer. If additional PPE is deemed necessary and not available the site must not be sampled.

Each field crew shall take an inventory/checklist of PPE before each sampling trip making sure that all equipment is working properly. If any PPE is found to be inadequately working, such as leaking, ripped, etc., it must be repaired or replaced before leaving for the sampling trip.

Field crews must be properly dressed for the weather conditions. Coats, gloves and head coverings should be used during the late fall, winter and early spring to reduce the threat of hypothermia.

Drinking water and other liquids need to be readily available to field crews during sampling trips. Water coolers with ice can assist in reducing dehydration and heat exposure illnesses.

4.2 Chemical Safety

When transporting formaldehyde containers, they must be transported in a secondary, leak proof container. Formaldehyde containers should be kept outside of the crew compartment when possible. When pouring formaldehyde into collection jars, nitrile gloves must be worn to prevent skin exposure.

Unless placing a specimen into a collection jar, the lid shall remain closed to prevent the splashing of formalin out of the jar and reduce exposure to fumes. Jars should be kept away from the facial area to reduce splashing and inhalation exposure. Collection jars should be inspected before use to check for damage. If damage is found, the jar is discarded. Plastic collection jars should be utilized.

Gasoline cans must have tight seals to eliminate the escape of fumes. Tote barge generator must be refueled in an open area. Care should be taken when pouring gasoline into the generator so that spillage, inhalation, and skin exposure risks can be reduced.

Field crews should ensure containers are properly sealed before transport to prevent spill and release of fumes.

5.0 CAUTIONS & INTERFERENCES

While following these sampling techniques, it is important to keep the sampling reach intact and undisturbed. Field personnel should not walk through the reach until sampling has occurred. Doing so may result in degradation of the sample. If the sampling reach has been disturbed by other activities, sufficient time should be allowed for the water to clear and fish to settle back into normal habitats. Electrofishing in turbid water can result in underestimates of the fish community.

The experience of the crew and their ability to see and net the fish improves the effectiveness of sampling the reach. Polarized sunglasses are recommended when electrofishing, as they will cut down on the glare of the water. In addition, features such as water clarity, flow, depth, and time of day need to be considered to obtain optimal success in sampling. If these conditions are not adequate or practical, sampling should be postponed until an efficient sampling effort can be obtained.

The sampling reach must not be associated within the immediate area (<100 meters) of major tributary confluences or human structural influences, such as bridges, road crossings (fords), low head dams, or any other similar structure, unless the purpose of obtaining the fish community data is related to these influences.

Collectors shall be aware of the advantages and shortcomings of seining and electrofishing techniques. DOW has observed electrofishing to be more effective in streams that have numerous boulders, undercut banks, and woody debris. DOW also has observed that electrofishing tends to be biased toward catostomid and centrarchid members while not fully representing the schools of cyprinids (i.e., *Lythrurus* and *Notropis* spp.) in large pools. However, cyprinids can be effectively sampled with a seine in large pool habitats to yield a better representation of their presence in the community (Onorato et al. 1998). Both methods have advantages and disadvantages in different habitat types and species groups. The combination of seining and electrofishing yields better results than one technique independently (Onorato et al. 1998; Yoder and Smith 1999). Due to habitat variability, a combination of seining and electrofishing is used in wadeable streams but care must be taken to keep sampling efforts separate. Sampling consists of using a backpack electrofisher unit working in an upstream direction in a side-to-side/bank-to-bank sweeping technique and seine (if appropriate). While sampling, it is important for staff members to release fish downstream after identification into areas that minimize the risk that they will be recaptured thus decreasing the risk of being double counted.

6.0 PERSONNEL QUALIFICATIONS

All field crew members will meet at least the minimum qualifications for their job classification. Fish sample collection will be conducted by Division of Water or partner agency biologists with specialized expertise in fisheries management, fisheries biology, fisheries science, or a related field. The nature of the sampling protocols for this group requires specialized knowledge of habitats and taxonomy. Technical staff are considered to be qualified if they have specific advanced academic training and/or several years professional experience in field collection of fish assemblages. Division of Water personnel with the required expertise usually hold the job title of Environmental Biologist Specialist, Environmental Biologist Consultant, or Environmental Scientist V. Individuals assisting with sampling will be under the direct supervision of a designated fish field lead.

7.0 EQUIPMENT & SUPPLIES

(Modified from Barbour et al. 1999)

- Field Datasheet: High or Low Gradient Stream Data Sheet
- Waterproof Notebook
- Dipnets (minimum of 2)
- Backpack shocker (ex. LR24 or LR20B) or tote barge
- 1 anode pole with ring (When using tote barge up to 3 anode poles may be used)
- 2 spare anode poles and anode rings (6in and 11in)
- Rat tail cathode for backpack electrofisher unit
- Fuel: gasoline for tote barge system or 24v batteries for electrofisher
- Field guide (e.g. Peterson's Field Guide to Freshwater Fishes)
- Seine (10 ,15, or 20 foot length)
- Formaldehyde and SDS sheet
- Buffer for formalin solution (borax or similar additive)
- MS222 with SDS/Clove Oil
- Fish jars (1L or 2L)
- 5 gal bucket and/or activity leader approved fish holding container (i.e. laundry basket with internal netting to prevent fish escapes)
- Battery powered aerator with bubble stone
- Waterproof paper for sample labels
- Lineman's gloves if using tote barge, non-insulated probes, or nets
- Waders (non-breathable required when using tote barge) and boots (equipped with wading cleats, when necessary)
- Polarized sunglasses
- Copies of field protocols
- Pencils
- Clipboard
- First aid kit
- Global Positioning System (GPS) unit
- Range Finder
- Conductivity probe

8.0 STEP-BY-STEP PROCEDURE

8.1 Instrument Calibration

Select the electrofisher settings based on the conductivity of the water. To minimize stress and mortality, it is important to use the minimum amount of electrical energy to stun fish. Select the following initial setup:

- Initial voltage setting:
  - 150-400 V for high conductivity (>300 µS/cm)
  - 500-800 V for medium conductivity (100 to 300 µS/cm), and
  - 900-1100 V for low conductivity (<100 µS/cm) waters)
- Pulse width (2-6 ms), and
- Pulse frequency (40-60 Hz).

In waters with high conductivity (>800 µS/cm) a small anode ring (6”) should be utilized instead of the standard anode ring (11”).

Adjust the voltage, pulse width and pulse frequency to efficiently capture fish via taxis, without inducing excessive stress and mortality. Stress can be observed in fish that are immediately incapacitated by electrofisher and not swimming, exhibiting tetany, banding caused by being too close to anode and very slow recovery times in holding vessel. Additionally, the LR24 unit has a quick setup option that will automatically set the waveform, duty cycle and output voltage to the present water conductivity.

A sampler can use the following steps to determine effective settings for electrofishing unit (Reynolds and Kolz 2012):

1. Use conductivity probe to determine conductivity of water.
2. Start with lowest voltage setting for conductivity recommended above and 40-50hz with 10% duty cycle.
3. Start electrofishing and increase voltage in 25-50v increments until satisfactory results obtained (proper exhibition of taxis and not tetany).
4. If efforts are not satisfactory, then increase duty cycle and repeat step 2-3.
5. If duty cycle reaches 25% and satisfactory results are still not being obtained reset duty cycle to 10% and increase frequency then repeat steps 2-4.
6. Continue until satisfactory results achieved.

8.2 Type of Collections

To ensure collection of standardized fish community data, stream size (i.e., drainage area) has been used to designate streams into two classes, headwater and wadeable, and a standard method is outlined for each category.

- Headwater streams are streams with a drainage area < 5 mi^2.
- Wadeable streams are streams with a drainage area 5 mi^2 to 200 mi^2.

8.3 Sampling Periods

The sampling index period is March through September with:

- March 1st thru May 31st being the sampling period for headwater streams, and
- May 1st thru September 31st being reserved for wadeable streams.

In some cases, sampling outside of these index periods is necessary to assess immediate impacts (e.g. chemical spills) or to adhere to specific guidelines set forth by the U.S. Fish and Wildlife Service or DOW for trend monitoring and bioassessment in streams containing federally listed threatened or endangered species. For routine bioassessment or baseline data collection, samples collected outside of these index periods will be considered unacceptable. Also, fish samples should not be collected during periods of excessively high or low flows or within 14 days of a known scouring flow event.

8.4 Sample Reach

Each sample reach ideally consists of two riffles, two runs, and two pools. In cases where this criterion cannot be met, one riffle-run-pool sequence is sampled or the recommended reach maximum length is sampled. A minimum reach length is necessary to ensure the collection of representative samples of the fish community, and a maximum reach length is needed to prevent oversampling and to minimize crew fatigue (and associated reduction of sampling efficiency) (Meador et al. 1993). Meador et al. (1993) found that a sampling reach length minimum of 100m and a max of 300m for wadeable streams met the aforementioned criteria. Based on the aforementioned publication, DOW sampling efforts for headwater and wadeable streams shall have a minimum sample reach length of 100 m, and a maximum reach length of 300 m. The maximum reach length of 300 m allows for longer reaches to be sampled at sites where macro habitat may not be available within the 100 m reach minimum. A range finder can be used to ensure that reach lengths are met. The time limits of each sampling effort, outlined in the electrofishing section, should be observed in the sampling reach.

8.5 Sampling Methods

A backpack electrofishing crew consists of at least two members and must include a qualified fish sampling lead. One individual operates the electrofishing unit (minimum of 400 watts) while the other(s) work(s) the seine and dip net(s), and carry the bucket used to transport captured fish. The electrofishing operator should also carry a dip net (Barbour et al. 1999) if using one anode. The lower and upper ends of the reach should be associated with a natural in stream barrier such as a riffle, if possible. Best professional judgment of the crew is used to sample available habitat with electrofishing or seining techniques.

In cases of utilization of tote barge a minimum crew of three is needed. One individual will have the sole responsibility of pushing the barge and controlling safety switch for output control, while two crew members will operate anodes and dipnets and net fish similar to methods described for backpack electrofishing. A livewell will be present on the barge in lieu of carrying a bucket for fish collection.

Collected fish should be frequently transferred from dip nets and seines to a bucket of water to lessen stress and mortality. Avoid temptation to continue netting fish while fish are in net and electrofisher is on. In addition, water in the bucket should be changed periodically (warmer water temperatures require more frequent water changes) to reduce stress and mortality of fish. A battery powered aerator should also be used with the bucket/livewell to provide surface agitation and increase the oxygen content of the water. Efforts to keep the bucket or livewell out of direct sunlight should be taken as well. In streams where large volumes of fish are collected, fish should be tallied and released periodically downstream of the sampling reach to help minimize fish mortality in the bucket. Likewise additional fish holding devices can be used such as a rectangular laundry basket with affixed netting to prevent escapes. Such a device could be kept in stream if properly weighed down and fish transferred from bucket to it thereby reducing incidental mortality and affords fish better opportunity to recover. Care should be taken to keep fish from being able to jump out and small darters from escaping through the mesh.

When tallying fish it is best to utilize a rite in the rain style notebook and for each site visit denote the day, site ID, collectors, and settings used for electrofishing. Electrofishing and seine species lists are kept separate for KIBI data entry purposes. Any pertinent habitat notes and deviations from sampling methodology should be noted as well. At completion of electrofishing and seining efforts the recorder should denote the shocking seconds and seine time in the notebook.

<u>8.5.1 Electrofishing</u>

The electrofishing duration within the sample reach should be a minimum of 600 “shocking” seconds in headwater and wadeable streams to a maximum of 1000 seconds in headwater streams and 1800 seconds in wadeable streams. Electrofishing consists of using a backpack electrofisher unit and working in an upstream direction in a side-to-side/bank-to-bank sweeping technique. Crew members with dip nets walk alongside and behind the electrofishing operator to collect stunned fish. The electrofishing operator may need to dislodge specimens caught in the substrate. One pass of the reach is sampled from the downstream end to the upstream end, with all recognizable habitats thoroughly sampled (Barbour et al. 1999).

In addition, some circumstances (e.g. swift and/or deep water) may require the use of a seine (rather than a dip net) and electrofishing. The seine may be set perpendicular to the current (to act as a block net) by two crew members and the electrofishing operator applies current upstream to downstream to the seine. Stunned fish are carried by current into the seine where they are captured. It is important to remember that even though a seine was used the activity still falls under electrofishing and should be recorded on the data sheet as such.

In some large wide wadeable streams with reaches approaching 300m, the duration of BPEF may exceed 1800 seconds if all habitats cannot be thoroughly sampled within the time limit. These exceedances of maximum times should be noted and recorded. In addition, at some large sites a BPEF may not provide sufficient power to collect fish. In these circumstances a tote barge or similar electrofisher capable of producing 2,500 watts may be used.

Record the time-spent electrofishing (in seconds) on the field datasheet and in field notebook. When tallying fish in streams where seining efforts shall be conducted after electrofishing, tallied fish must be released downstream of the sampling area and ideally below a habitat break to avoid fish moving back into the sampling area and being counted again.

8.5.2 Seining

Habitats not effectively sampled by electrofishing (e.g. pool habitat and swift runs) are sampled after electrofishing by seining. Seine hauls are generally preformed in a downstream direction (Etnier and Starnes 1993; Jenkins and Burkhead 1993; and Hendricks et al. 1980) starting from the upstream portion of the reach. Seining with the current is more efficient because there is less drag on the net and takes advantage of a fish's tendency to escape upstream. Seine operators can also move more quickly to trap fish, and there is no pressure wave in front of the seine, which can cause fish to move away from the net. When the seine haul is finished, the seine is beached by dragging it onto the shore. When there is only a small shoreline area to beach the seine, the brails are brought close together at the shoreline and the lead line slowly pulled into shore by hand. If the seine cannot be beached, then in one motion, the seine is quickly lifted out of the water and carried onto shore.

Certain situations may dictate the use of other seining techniques (i.e. kick seining technique or specific habitat seining). Kick seining involves two crewmembers holding the seine in a position downstream of the area to be sampled. The brails are slightly angled downstream so that the flow forms a pocket in the seine. A third crewmember disturbs (or kicks) the substrate while moving toward the seine. After reaching the seine, crewmembers lift the seine out of the water. For small specific habitats, the habitat (e.g. woody debris pile) should be encircled with a seine and the brails thrusted into the habitat (or crew member disturbs the habitat) to force fish out. After disturbing the habitat the seine is lifted out of the water. Other seining techniques may be warranted to sample unique situations. During all seining, it is important to keep the lead line of the seine in contact with the stream bottom in order to prevent fish from escaping under the net unless that would result in float lines being immersed allowing fish to escape over the net or the effort objective is to catch more pelagic fish species.

After each seine haul, fish are briefly examined by the activity lead for the species present and then placed in a bucket of water. Large fish are identified, recorded and released immediately after each seine haul to areas outside of next seine haul to avoid recapture. Smaller fish are identified and released or retained as a voucher after all seining has been completed (see section 8.6.2).

A seine is used for a minimum of 30 minutes and continues until no new species are collected in three consecutive hauls or until a maximum of 90 minutes of effort is reached. If 30 minutes of effort has been expended and no new species were encountered in the last three hauls, seining may cease if all appropriate habitats in the reach have been sampled. Minimum and maximum times are defined as the start to finish of the seining effort. Record the time spent seining (in minutes start to finish). Tallying of collected fish does not count towards seine time.

Seining may not be appropriate in some headwater streams, particularly if electrofishing can be used to confidently collect all individuals from the sample reach. Best professional judgment should be used to determine if seining is appropriate in headwater streams. All wadeable streams should be seined. If conditions prevent a seine from being used in wadeable waters (e.g. too many obstacles in the channel such as downed trees or numerous large boulders), this should be noted on the field data sheet and as a note in logbook.

8.6 Sample Processing and Preservation

Seining and electrofishing fish collections should be kept separate. This will result in one jar for electrofishing and one jar for seining for each site where both efforts are employed.

8.6.1 Labeling

While at the sampling location, all fish samples will receive a label. One label will go on the outside of the jar and will include the site number, stream name, county, date sampled, collection method and collector names. A second label is placed in the sample jar (labels placed in the jar will be written in No. 2 pencil on waterproof paper). The inside label will include the site number (if known), stream name, location, county, date sampled, collectors' initials and collection method. Additional label information may include: shocking seconds, seine time and distance sampled.

8.6.2 Voucher Specimens

Fish collections are preserved in the field with a 10%-15% buffered formalin solution. Prior to placement into buffered formalin, specimens should be humanely euthanized using either a strong dose of MS222 or clove oil (AVMA 2020; Jenkins et al. 2014). In most cases large specimens (>150mm) are identified in the field, recorded and released, unless the specimen(s) represent a significant ichthyological find (e.g. state or drainage record), then they are to be preserved as voucher specimens. In those cases large specimens should have a slit made in the abdomen to permit entrance of preservative into the body cavity or injected with a formalin solution. This is particularly important in warm weather to prevent partial decomposition of internal organs. Field containers should be large enough to accommodate the largest specimen without distorting it. Easily identified fish that are collected in large numbers (i.e. *Campostoma* spp.) are also recorded in the field and released. Young of the year fish are not retained as voucher or included in field counts.

At least two and up to five specimens of each species released should be kept as vouchers from the sample event. Common species such as *Percina caprodes*, *Semotilus atromaculatus* and *Luxilus chrysocephalus* can be photo vouchered instead of having physical vouchers. When using photo vouchers, key characteristics must be visible in the photograph and multiple photos of a specimen should be taken. Examples of key characters to photograph are full body, head shot, dorsal view shot, extended dorsal and anal fins that allow for fin ray counts and any other character that is known to separate that fish from others. A small plastic/acrylic case capable of holding water can be utilized to photograph fish in water allowing for natural extension of fins. In some cases a full body shot is all that is needed. Additionally large specimens not retained in the field should be photographed for voucher, in cases of *Moxostoma* pictures should include full body that allows for lateral scale counts, extended dorsal fins, and pictures of lips that show shape and texture. Vouchers (retained specimens or photographs) need to be made for verification. If a species or genus is viewed but not collected and if positively identified, these records should be noted (i.e. *Hypentelium nigricans*, *Micropterus* spp. or *Lepomis* spp.). Federally protected species must be identified, photographed and released immediately.

9.0 TROUBLESHOOTING

A list of problems that could occur while sampling for fish in wadeable waters and the recommended solutions are listed in Table 1. Field staff should always use best professional judgement when problems occur while sampling. Additionally troubleshooting guides for backpack electrofishing units along with GPP totebarge units can be found on the manufacturer’s website. Many companies like Smith-Root also have technical support that can be accessed on their website.

Table 1. Troubleshooting guide for sampling fish in wadeable streams

Problem	Solution
Unit fails to power on	• Verify that battery cover is properly installed. ○ Still doesn't power on double check battery connections and ensure terminals are clean. Replace battery. **If using tote barge** • Ensure all connections to generator are properly attached. • Generator has been filled with gas to appropriate level. • Generator is level in tote barge. • If it still fails to start contact manufacturer or seek trained mechanic for servicing.
Unit fails to generate electrical current.	• Ensure that the anode and cathode are properly attached. • Replace anode pole. • Verify anode ring is free of corrosion. • Replace battery if using backpack unit.
Fish are not exhibiting signs of electrotaxis	• Refer to section 8.1 for recommendations on adjusting settings.
Exceeded shocking time for reach length	• Note in field notebook reasons why time was exceeded. Example entries include numerous microhabitat in reach that had to be sampled and increased shocking effort to drive fish to collection point (such as upstream to cascade break).
Failed to exceed shocking time for reach length	• Ensure that the 2 riffle, 2 pool, 2 run sequence has been met or you have reached the maximum reach length. If neither criteria has been met continue shocking. If either criteria has been met then make note in field notebook and cease activity.
Water too deep for backpack shocker (sensor submerged)	• Assess the reach if there are areas where the backpack unit can be used, then sample those areas and seine in areas where backpack unit cannot be used. If entire reach is too deep for backpack shocking, and project requires stream to be sampled, then utilize tote barge. If the tote barge is unavailable, then fish sampling should be omitted or seine only. If seine only, fish should not be used to calculate KIBI but can be used to supply a taxa list for the stream.
Water very turbid, cannot see substrate	• In such cases best professional judgement should be used. If fish cannot be seen, then the risk of miscalculating a KIBI score is great. If turbidity is a result of recent rain events or activities in area consider coming back at a later date when conditions may have improved. If sampling must occur that day consider shocking into a seine and shocking short distances from the dip net to increase capture rate. Make note of conditions in field notebook.

10.0 DATA & RECORDS MANAGEMENT

The fish lead will record time spent shocking (in seconds) and seining time (in minutes) on the field data sheet and in a field notebook. Released fish are counted and documented in the field notebook (usually curated by the fish lead). Additionally, photographed fish are noted in the field notebook, and the associated file number from the camera is provided if available. If required by the project, a High or Low Gradient Stream Data Sheet is completed at each sample station visit. All sampling efforts and their respective times and distances must be recorded on the data sheet. All records (photo vouchers, field sheets, etc.) are to be named appropriately, stored in project files, and uploaded to K-WADE. All records, including hardcopy and electronic files, that are collected by DOW staff or that are collected for the explicit use by DOW must be kept according to DEP record retention policy (KDLA 2006).

11.0 QUALITY CONTROL & QUALITY ASSURANCE

A field crew will consist of at least one staff member who is knowledgeable of the identification and nomenclature of Kentucky fishes. This staff member is to ensure that voucher collections of all fish are taken, specimens are preserved correctly for laboratory examination, and sample jars are labeled correctly. All released specimens will be noted in field notebooks or datasheets. After any sampling has been completed, all sampling gear will be thoroughly cleaned to remove all fish and potential contaminants so that no fish or other organisms are carried to the next site. The equipment shall be examined prior to sampling at the next site to ensure that no foreign objects are present.

Field duplicates are conducted at a frequency described in the yearly QAPP and associated PMP/PSP(s). Results shall be considered acceptable if the same narrative KIBI rating is attained or if the KIBI score falls within 14 points on both sampling occasions. If this does not occur, all taxonomists will meet to assess the issue and take corrective actions which will be documented with other QA files.

Field data must be complete and legible and entered on field data sheet or field notebook. While in the field, the field team should possess sufficient copies of standardized field data forms as well as copies of all applicable Standard Operating Procedures.

12.0 REFERENCES

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