WATER QUALITY PROGRAMS DIVISION

Standard Operating Procedure for the Collection of Fish in Streams

Revised and Adopted January 2024

FINAL

OKLAHOMA WATER RESOURCES BOARD
WATER DIVISION
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OKLAHOMA CITY, OK 73118

STANDARD OPERATING PROCEDURE FOR THE COLLECTION OF FISH IN STREAMS [1]
REVISED AND ADOPTED JANUARY 2024
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1.0 General Information

Fish assemblage monitoring is an integral component of the Oklahoma Water Resources Board (OWRB) Water Quality programs. Assessment of the fish assemblage measures the structure and function of the ichthyofaunal community to evaluate the integrity of a stream. Following is a detailed description of sampling procedures. Efficiency is the key and finding a comfortable sequence of sampling is essential. This will vary from person to person and from sampling team to sampling team. Yet, employing consistent sampling patterns at every site will maximize the number of sites sampled per week and decrease the chance for introduction of sampling error.

OWRB's fish collection methodology uses modifications of several well-cited and published protocols including the EPA Rapid Bioassessment Protocol V (USEPA, 1989) and the National Rivers and Streams Assessment (NRSA) Field Collection Protocols (USEPA, 2008, 2013, 2018). Generally, OWRB protocols conceptually mirror what has been developed for national studies, and the OWRB staff has been integral in developing national protocols. Therefore, much of what is used at a state level is reflected nationally. Although Oklahoma's ecological diversity is unique, national protocols are developed to reflect a much broader range of conditions than what can be found in Oklahoma. So, some notable differences do exist that can affect effort, and include: 1) allowance for multiple netters, 2) all collections are over the entire 40x reaches, and 3) use of seines as a collection net below electrofishing equipment in riffles. In general, each stream or river is sampled for a distance of 40x average wetted width (AWW) over a reach that includes representative primary physical features including channel habitats (e.g., riffles, runs, and pools), varying depths, flow (backwaters), and structure (e.g., woody debris, undercut banks, and vegetation).

2.0 Definitions/Terms

- Team Leader—crew member of fish collection team who provides support, expertise, and opinions; gives instruction and has final say on how work will be done; must score a 95% on critical fish identification
- Team Member—crew member of fish collection team who provides support, expertise, and opinions; follows the instructions of the team leader
- 10% Formalin—fixative used in fish collections; is a carcinogen and can also cause permanent damage to mucous membranes and eyes.

[1] Much of this SOP is adopted from three documents: Oklahoma Water Resources Board (1999) Technical Report 99-3: Standard Operating Procedures for Stream Assessments and Biological Collections Related to Biological Criteria and Development,; Oklahoma United States Environmental Protection Agency (2008, 2013, 2018). National Rivers and Streams Assessment Field Operations Manual, Washington, DC.

- Electrofishing—use of an electrical field in the water to stun fish for collection; selective for areas of instream cover as well as for fish with more surface area.
- Seining—wide and deep net dragged through water to collect fish; selective for runs and pools as well as smaller fish with less surface area.

3.0 Safety

Upon reaching the sampling location, site safety determinations should be made before proceeding. Please refer to the OWRB safety manual for instructions. During most fish collections a 2.5 GPP tote barge electrofisher or battery powered backpack electrofisher will be used. Because electrofishers send an electrical current through the water, not following safety procedures may result in serious injury or death. General safety guidelines include:

- Primary responsibility for safety while electroshocking rests with the team leader.
- OWRB personnel are to wear **LIFEVESTS (PFDs)** at all times during fish sampling.
- **DO NOT CHASE FISH!!**
- All crewmembers should receive training in First Aid and CPR. Electrofishing units have a high voltage output and may deliver dangerous electrical shock. Electric shock can cause heart fibrillations and/or death.
- While electrofishing, avoid contact with water unless sufficiently insulated against electric shock. OWRB personnel must wear chest waders with non-slip soles and watertight rubber gloves that cover up to the elbow. If the gloves become wet inside, stop fishing until they thoroughly dry out.
- Avoid contact with the anode at all times. <u>At no time while electrofishing should a crewmember reach into the water for any reason. If a crew member needs to reach into the water the person is to yell ”clear” and await for the unit to be turned off at the generator.</u>
- The backpack electrofishing equipment provided is equipped with a 45-degree tilt switch, which interrupts the current. Do not make any modifications to the electrofishing unit, which would make it impossible to turn off the electricity.
- The tote barge/boat electrofishing equipment provided is equipped with an emergency shutoff switch. Do not make any modifications to the electrofishing unit, which would make it impossible to turn off the electricity.
- If the electrofishing unit is greater than a 5.0 GPP, work will only occur from a boat.
- General safety guidelines should be observed. If waders or gloves develop leaks, OWRB staff must leave the water immediately. <u>DO NOT operate electrofishing equipment near people, pets, or livestock</u>. Discontinue any activity in streams during thunderstorms or heavy rain. Rest if crew members become fatigued.
- Gasoline is extremely volatile and flammable. Its vapors readily ignite on contact with heat, spark, or flame. <u>Never attempt to refill the generator while it is running. Always allow the generator to cool before refilling.</u> Keep gasoline out of direct sunlight to reduce volatilization and vapor release. Always wear gloves and safety glasses when handling gasoline. Keep gasoline only in approved containers.
- Decision to use electrofishing equipment will depend on the size of the site, flow, specific conductivity, and turbidity. If the specific conductivity is below 10 uS or >

3000μs; if the flow is too high; if the site is too deep or too shallow; if the water is too turbid to assure safe footing or locate stunned fish; or if the site cannot be accessed by a boat, the crew may consider using a seine only or determine that site cannot be sampled on that day. This is a safety decision that is made by the crew leader.

- Formalin is a carcinogen and can cause permanent damage to mucous membranes and eyes. Care must be taken when placing fish in formalin so that the fish does not flop around and splash formalin onto people near the jar. Proper precautions should be taken when handling formalin.
    - Protective gloves and eyewear should be worn
    - Avoid inhalation of vapors
    - **Place formalin only in approved containers that are properly and visibly marked as containing 10% formalin.**
- FAILURE TO OBSERVE SAFETY PROCEDURES MAY RESULT IN DISCIPLINARY ACTIONS UP TO AND INCLUDING REASSIGNMENT, PROBATION, OR DISMISSAL.

4.0 Quality of the Measurement

4.1 Training

Principle investigators for the OWRB are required to have degrees and/or experience with biological or other applicable sciences. Principle investigators are defined as crew leaders, and this designation may be made upon the leader of a multi- or a one-person crew. Training is required for all SOPs dealing with water quality and quantity collections and measurements as well as habitat assessments and biological collections. In-house training will be conducted for the use of all meters and digital titrators used for water quality or quantity measurements. Investigators must be familiar with OWRB SOP document, and all training will follow the methods outlined in that document. Extra training will be provided when new SOPs are developed. Training of field crews will be done through dry run exercises in the laboratory to familiarize field crews with sample collection, sample preservation, instrument operation, calibration, and maintenance. In addition, when new personnel are hired or new methods developed, qualified staff will train on sample collection, measurement, and field analysis methods through side-by-side field trips. These trips will familiarize staff with SOP requirements. When training is considered adequate, a qualified staff member will check field staff for adherence to SOPs via an audit system. Prior to collecting fish, all staff should familiarize themselves with Fisheries Techniques (edited by L.A. Nielsen and D.L. Johnson and published by the American Fisheries Society 1983), this SOP, and OWRB Technical Report 99-3 Standard Operating Procedures for Stream Assessments and Biological Collections Related to Biological Criteria and Development.

Investigators are tested for identification abilities with a statewide assemblage of fish fauna before fish collections begin. These fish are comprised of species that are typically found in Oklahoma stream systems. The majority of the test specimens include fish with larger body sizes that are typically field identified and/or found in large numbers. Species of special concern such as the Arkansas River Shiner are also utilized during the testing procedure to insure endangered or threatened species may be correctly identified and released. A test score on critical species of 95% or better

must be achieved before the investigator will be a field crew leader. Investigators that score under 95% will not collect without direct supervision of the crew leader.

4.2 Kinds of Quality Assurance Samples

4.2.1 Replicate Collections

Replicate samples will be collected during each biological season (summer index period June 1-September 30). The scope and number of replicates will be determined by the project Quality Assurance Project Plan.

4.2.2 Revisit Collections

Revisit Collections are specifically made for the purpose of tracking index period timing effects on fish collections. The scope and number of replicates will be determined by the project Quality Assurance Project Plan and/or revisit site selections assigned by EPA NRSA staff during NRSA study years.

4.2.3 Vouchers and Photo-Documentation

Beginning in 2009, the OWRB began identifying all fish collections. To facilitate this process, the policy of the OWRB is to release all identifiable fish in the field, including those in the previously adopted list of critical species (developed by the Oklahoma Conservation Commission). The critical species list includes large fish (>100 gms or 0.25 lbs), fish easily identified (e.g., Longnose Gar), and fishes of special concern (e.g., Leopard Darter). Additionally, all other fish previously considered voucher fish will now be positively identified by a trained crew leader while in the field. As in the past, proper procedures must be taken before fish may be released including photo-documentation and vouchering as necessary in the case that a positive field ID is not able to be made. The following is an updated procedure for ensuring positive identifications for all released fishes.

1. The crew leader will determine if fish can be positively identified in the field. Except for some rarely occurring or unusual fish or potential hybridization in some families, OWRB crew leaders are trained to positively ID all Oklahoma fishes. Fish ID should be performed as a group activity but does not require consensus. **The crew leader does have the final say on releases**. However, care should be taken to verify field Identifications will all qualified team members. Once a fish is identified and proper steps have been taken for verification, it can be photo documented and then returned to the water far enough away so that recapture is unlikely.
2. All released fish must be documented on the electronic fish collection sheet. Included with this documentation should be the common name (species if known) and characteristics noted to make a positive identification. Fish not field identified, must be brought to the laboratory for identification.
3. Easily identified or larger fish are typically photo-documented, while fish that are difficult to identify need to be vouchered for later taxonomic analysis in a controlled environment with proper equipment. However, it is important to photo document all species of fish encountered. Often times photo-documentation along with a voucher specimen can help a fish taxonomist be 100% sure of a

positive ID especially if the photos show coloration/markings that may be lost during the fixation process in 10% formalin.

Photo-documentation will be collected for representative specimens of easily identified or larger fish. All large fish (e.g., smallmouth buffalo, common carp, etc.) or fish easily mistaken for one another (e.g., river carpsucker, Quillback) must be photographed. Background data in the photo should include the common name of the fish, the date and time (24h), station name or number, and county. Characteristics used to make the identification should be prominently displayed in the photo (e.g., lateral line scales of a redhorse). Photos should be managed digitally in the OWRB network.

Representative voucher specimens will be collected for all other field identified fish during NRSA QA fish voucher collections. Vouchers should be representative of phenotypic differences arising from age class or sex. A separate bag will be created for each species to be vouchered. Voucher specimens will be place in an onion bag with an appropriate tag containing the fish voucher tag number assigned by the crew leader that lines up with the electronic tag number in the data collection app (NRSA App). All voucher specimens representing the same species should be placed in the same bag. It is encouraged to keep more than one specimen if deemed necessary by the crew leader to assist in differences between males/females of the same species. It is also encouraged to take multiple photos of the specimens to account for all traits that may assist a person in the verification of an ID. For each species vouchered/released, common identifying remarks should be noted on the electronic fish field sheet for later use in relating vouchered specimens to released members of the same species.

5.0 Personnel and Equipment

5.1 Personnel

Fish collection crews will consist of two to three people. In some instances, a fourth crewmember may be added on larger streams/rivers. The team will consist of a team leader and one to three team members. The team leader is someone with one or more seasons of fish collection experience who has scored above a 95% on critical species identification. Collection experience in other programs may be substituted for that with the OWRB. In certain instances, a team leader may have test scores below 95%. In this case, tests will be reviewed and species that were commonly missed in the scoring will be excluded from releasing. The team leader will have the final say on all crew activities. A team member is someone trained on fish sampling protocols. Team members will be expected to participate in the decision-making and follow the team leader's direction.

5.2 Equipment and Supplies

The OWRB utilizes several methods to fish all sizes of lotic waters including electrofishing and seining. Electrofishing is typically the method of choice because catch per unit effort and richness are usually increased. Depending on wadeability, either a tote-barge or boat is equipped with a live-well, a 2.5 to 9.0 GPP electrofishing unit, a single cathode, and one (tote-barge) or 1-2 (boat) anodes. Depending on crew

size, one or two netters may be used with typically two available for projects other than the NRSA. Additionally, boat electrofishers may be equipped with up to a 9.0 GPP when the following site conditions exist—reach is completely boatable and conductivity exceeds 3,000 us/cm. Backpack electrofishing units are available to staff but are only used when site conditions prohibit a tote barge from being deployed. Lastly, seining may be used as either a supplemental or primary method. As a primary method, seining is only used when the following site conditions exist—reach is not completely boatable and conductivity exceeds 3,000 us/cm. A seine may also be used in the event that an electrofisher becomes inoperable during a site visit, but only if the technique can effectively characterize the fish community. Seining may also be used as a supplemental method either in the mid-channel areas of wide, shallow rivers or as a block net in riffles. This is not a common occurrence though. It is preferable to choose with one method for fish collection and that is typically the rule.

5.2.1 Electrofishers

NOTE: Before operating or assisting with the shocker, READ AND UNDERSTAND THE MANUALS for the generator and the shocker. Starting procedures, safety procedures, and troubleshooting are well documented in these manuals and are not spelled out in this text. The manuals can be obtained from the equipment file in the main OWRB office.

The team leader will provide a detailed explanation of how each unit works as well as safety precautions. Each team member before operating and/or assisting with a unit should read and understand the manuals for the generator and the main unit. Starting procedures, safety procedures and troubleshooting are well documented in these manuals and are not detailed here. The manuals can be obtained from the manufacturer. The boat electrofishing team must consist of at least two people—an operator and a netter. The tote barge electrofishing team must consist of at least three people—an operator, a netter, and a tote garge guide. Because the guide must turn off the unit in case of accident, it is particularly important that this team member stay fully aware. **This unit may be extremely dangerous if used inappropriately and without the proper safety equipment. Please refer to Section 2.0 for further details. All units should be maintained according to manufacturer specifications.**

The electrofisher is the most effective method for characterizing fish communities and should be preferentially used over all other methods. It is most useful in areas with dense in-stream cover, undercut banks, riffles, and in larger waterbodies. However, the 2.5 GPP unit may become ineffective in highly conductive waters (>3000 µS/cm). Electrofishers select for fish differently than a seine. The unit works to develop an electrical field, and everything within that field is subject to electric shock or is attracted to the electrical field. The electrofisher selects for fish with more surface area (i.e., larger, or deep-bodied) such as bass or suckers. Also, the electrofisher is more effective in habitat where seining may be more difficult such as brush piles, root wads, undercut banks, bedrock ledges, cobble substrates, and shallow riffles. To effectively electrofish, the anode should be gradually passed back and forth over and in these areas as the

team works upstream. As fish are stunned, they will usually roll over and become more visible, allowing the netters to see and capture them. Electrofishing may also be done in deep or shallow pools, runs, and riffles.

All electrofishing units are similar in form and function consisting of a power supply (battery of generator), control box, anode (positive probe), and cathode (negative probe). The major difference between units is how the complete unit is set up. A tote barge or boat electrofisher will be the unit of choice for most waterbodies. For tote barge units, the control box will be a 2.5 or 5.0 Smith-Root GPP unit, while for boats a 9.0 GPP unit will be used. The power supply is typically a stand-alone generator rated and manufactured to meet the GPP specifications. The OWRB uses Smith-Root 2.5 GPP units coupled with a 2500-watt Honda generator for most wadeable or partially wadeable applications and uses a Smith-Root 9.0 GPP unit with a 9000 watt generator for boatable collections. **CAUTION: The 9.0 unit should never be used in wading situations.** The anode can take many forms including droppers or rings, and shape of the anode can assist in technique efficiency. The anode for the boat shocker is an array that is lowered by pole off the bow, while the cathode is the whole boat with a set of dropper arrays hung from both gunwales near the bow. For a tote barge unit, the anode is a ringed wand that can operate up to 50 feet from the vessel, while the cathode is a (rat-tail) metal cable array extending into the water. A battery powered backpack electrofisher may also be used for collecting fish when tote barge units are not practical (stream is too narrow and/or too shallow). The OWRB currently uses an Aquashock Solutions battery-powered unit. The backpack electrofisher works effectively in specific conductance ranges from 40-1000 microsiemens (uS) with an optimal range of 150-650 uS. The unit works in principle like a barge or boat unit but is principally different in that the unit is self-contained and consists of an electrode (cathode) and a ring electrode (anode) mounted on the end of two PVC poles.

In general, the following procedure should be followed:

- A minimum of two to three people is required for electrofishing. One operates the unit while another will net the stunned fish. With the tote barge, one person always acts as the boat (canoe) guide staying fully aware so that the unit may be shut off in emergencies.
- Collection begins at the downstream end of the reach and terminates at the upstream end of the reach (40 x AWW). Electrofishing is most effective when the team works upstream. Catch efficiency will decrease in turbid waters or waters with changing conductivity due to upturned mud, silt, or sand. However, this is up to the discretion of the Crew Leader.
- The forward electrode (Anode) should be gradually passed back and forth over the stream width, including brush piles and root wads. As fish are stunned, they will usually roll over and become more visible, allowing the netter(s) to see and capture them.
- In very dense brush or root cover, fish often sense the presence of the team before they are close enough to be stunned and then retreat so deeply into cover that it is impossible to net them when they are stunned. It is often better in situations such as these to insert the electrode into the brush before

it is turned on, give the fish time to acclimate and then turn the current on. Many fish will be much closer to the edge of brush pile when they are stunned in this (sneak attack) manner.

RECORD THE UNIT TYPE, SETTINGS, AND TIME SPENT ELECTROFISHING ON THE APPROPRIATE ELECTRONIC FIELD DATA SHEET.

5.2.2 Seine

Various sized seines may be used to collect fish. Recommended sizes vary from 4 to 6-foot seines in 10, 20, and 30-foot lengths. Seine height is dictated by water depth, and length is determined by width of the water being sampled. If possible, the seine should be 15-25% longer than the width of the waterbody being sampled and about 25% higher than the depth of the water. This will allow the center of the net to form a bag behind the operators where the fish are more likely to stay in the net. However, it is important to remember that the longer the seine is, the more difficult it will be to control in stream currents. Therefore, rule of thumb for length may be discarded. When this occurs, extra time should be spent seining the missed habitats. In general, the OWRB uses 10'X6' and 20'X6' seines. Seines should be a ¼ inch mesh to reduce fishing pressure on some young of the year. **Seines should be stored dry and free of debris and other snags.**

The seine selects for habitat and fish differently than does the shocker. The seine selects for fish with less surface area (i.e., terete or smaller body plan) such as minnows or darters. Also, the seine is more effective in habitat where electrofishing may be more difficult, such as pools. Seining may also be done along banks and around instream cover.

To seine, two people drag the net through the water at a certain rate (slightly faster than the flow) going downstream. This will allow the center of the net to form a bag behind the operators allowing the fish room to move within the net. Generally, the seine is hauled with the current because fish tend to orient towards the current. The leadline should be kept on the bottom, and in front of the float line. If there are many obstructions on the bottom, the leadline will become caught or bounce and most fish will escape underneath the bottom of the net. If this occurs use a smaller net that allows you to avoid obstructions, roll up the ends of the existing net to make it more manageable, or use a trailer to move net over obstructions. The brailles of the net should be used to disturb the area under any undercut banks, bedrock ledges, or beds of macrophytes near the edge to scare fish hiding in cover out towards the middle of the net.

Under ideal conditions the net should be pulled through the water in the manner described above for about 10 meters and dragged out of the water on a gradually sloping preselected beach for fish counting and sorting. The person pulling the seine on the side of the stream opposite the beach should swing ahead of the other person so that the seine is pulled out on the beach stretched over the same distance it was stretched in the stream.

If the stream doesn't have gradually sloping banks, the dip method should be used. This method consists of sweeping around and through the area to be sampled, keeping a wide bag and moving the lead line as much under the undercut bank as possible. Use the brailles to probe repeatedly as far as possible into the undercut area working towards each other until the brailles overlap. The seine should then be swiftly stretched and lifted vertically from the water to trap fish.

Other seining methods may be effective. All will not be discussed here but may be demonstrated in the field. In certain instances, moving with the current may not be possible. In these cases, to keep from losing fish, the bag should be deepened, and the total reach seined should be shortened. Also, it is often not possible to reach a seine the width of a run while keeping an adequate bag. In these cases, seine perpendicular to the flow of the water towards the opposite shore. The downstream person should operate slightly ahead of upstream person forming a “J”.

RECORD ALL APPROPRIATE INFORMATION INCLUDING THE TIME SPENT SEINING AND SEINE LENGTH AND MESH SIZE ON THE FIELD DATA SHEETS.

5.2.3 General Supplies

Clothing

Lineman’s Gloves	One per crew member plus an extra; in good condition
Waders	One per crew member plus an extra; in good condition
Goggles	for use in mixing formalin; in good condition

Documentation

State and federal collection permits and employee ID cards
Dry erase board or white paper and clipboard for photodocumentation
Camera with adequate digital memory; fully charged battery with backup
Tape measure to record released fish length

Chemicals

Gasoline for generators; pre-filled generators
Extra generator oil
10% buffered formalin in labeled jars—always premix in lab and keep jugs stored in separate cooler

Electrofisher Parts

Spare plug, Plug wrench, and screwdriver
Spare anode pole and ring
Spare cathode rat tail

Nets

Zip ties, fishing line, or twine to repair ripped nets
Dip nets to collect shocked fish; 3 short and 2 long

Containers

1000 ml plastic jars, at least 2 per site

Onion bags, inside waterproof labels, and zip ties for fish vouchers

6.0 Collection of Fish

OWRB's fish collection methodology uses modifications of several well-cited and published protocols including the EPA Rapid Bioassessment Protocol V (USEPA, 1989) and the National Rivers and Streams Assessment (NRSA) Field Collection Protocols (USEPA, 2008, 2013, 2018). Generally, OWRB protocols conceptually mirror what has been developed for national studies, and the OWRB staff has been integral in developing national protocols. Therefore, much of what is used at a state level is reflected nationally. Although Oklahoma's ecological diversity is unique, national protocols are developed to reflect a much broader range of conditions than what can be found in Oklahoma. So, some notable differences do exist that can affect effort, and these include: 1) allowance for multiple netters, 2) all collections over 40x reaches, and 3) use of seines as a collection net below electrofishing equipment in riffles. In general, each stream or river is sampled for a distance of 40x average wetted width over a reach that includes representative primary physical features including channel habitats (e.g., riffles, runs, and pools), varying depths, and structure (e.g., woody debris, undercut banks, and vegetation). Another major notable difference is that per OWRB fish collection methods Oklahoma fish crews sample the entire reach and target each habitat that is available within the reach. Therefore, fishing is not limited to certain areas (edge habitats) of a body of water as they are in certain size streams/rivers per the NRSA fish collection methods. For example, open water is counted as a habitat type for OWRB fish sampling on non NRSA fish sampling years and is sampled when available in larger rivers.

Fish collection may involve the use of multiple methods, including both electrofishing and seining. Variations of habitat, type of fish, and water chemistry dictate the use of different collection techniques. Electrofishing is the method of choice, but in some instances, water quality (high conductivity in wadeable streams) or habitat limitations make seining the only viable method. Electrofishing selects for denser habitat (e.g., undercut banks, root wads, etc.) and very shallow riffles while seining selects for more open habitat such as runs or pools. Electrofishing selects for more surface area (e.g., larger or deeper bodied fishes) while seining selects for smaller fishes such as minnows or darters. Backpack electrofishers are not effective in waters with specific conductance <40uS and >800uS, while the 2.5 GPP electrofisher is not effective in waters with specific conductance over 3000 uS. Seining is not effective in areas of dense habitat or higher flows. Though electrofishing is the method of choice, all methods are available when fishing a site and should be used under the knowledge and discretion of the crew leader. Method accounting on electronic field forms should be performed in all instances. Reach length and unit of effort (electrofishing time in seconds/number of seine hauls) is essential information to record at the end of each fish collection and serves as important metadata in the OWRB database. Therefore, this information is collected and recorded at each site where fish are collected.

All fish are either released or placed in 10% formalin immediately after capture for later identification. In accordance with Section 4.2.3 of this SOP, most fish are positively identified and released in the field. However, all released fish should either have representative backup photo-documentation or voucher specimens so that positive identifications can be verified in the lab and a physical record of the collection can be archived. Care should be taken to make notes of distinguishing characteristics. Only a well-trained, experienced taxonomist should make positive field or laboratory identifications of fish.

6.1 Designation of Reach Length (All Biological Sampling Activities)

Before sampling begins, a waterbody should be classified based on size and accessibility. 40x the Average wetted width (AWW) is used to determine the reach length to sample. Wadeable and boatable designations are made during field scouting and although rare that designation can sometimes change in the wake of extreme drought or flooding. Reach length, the site designation, site access, and the study year (NRSA years versus non-NRSA years) all help the crew leader to determine which method of fish collection will be used for a given site. First, the reach length is determined via a direct measurement (5 wetted widths added and then averaged and multiplied by 40) at the site. For these five representative widths it is important to measure areas of varying width including bends, large shallow runs, and riffles. Areas directly around a bridge should be avoided. After the AWW is calculated, the reach length is set at 40x wetted width. Second, fish gear accessibility is determined. If a reach is continuously wetted and greater than 50% of contiguous length can be safely and efficiently fished using a seine or tote barge/backpack electrofishing equipment, the site is classified as wadeable. Conversely, if a reach is continuously wetted and greater than 50% of contiguous length requires at least a 16-foot electrofishing boat to be efficiently fished and can be safely and efficiently accessed, the site is classified as boatable. Based on this information, the following rules should be used to determine reach length.

1. All sites will have a minimum reach length of 150 meters, regardless of wadeability.
2. Wadeable sites can be fished efficiently and effectively with tote barge or seine over greater than 50% of contiguous wetted length. Maximum reach length will be 2000 meters, regardless of calculated reach length during (non NRSA years).
3. Boatable sites can be fished efficiently and effectively with a boat over greater than 50% of contiguous wetted length. Maximum reach length will be 4000 meters, regardless of calculated reach length.
4. The reach length minimum and maximums can be adjusted under extremely unique circumstances, but only after prior consultation with the Monitoring Coordinator and Biological Team Leader and approval has been given.

For large waterbodies, accessibility is not only a safety concern but should be used to help define reasonable effort. Merely because a boat could move unfettered through 3-4 feet of depth, the site is not by default considered boatable. Likewise, merely because a tote barge could be used to fish the near shore areas of a large river, a

particular site should not by default be classified as wadeable. Best professional judgment should be used to determine which method would be most efficient and representative of the site.

6.2 Selection of Fish Collection Methodology and Unit of effort

Once reach length and wadeable/boatable have been determined, fish collections can proceed with the appropriate gear. Based on the gear descriptions and limitations discussed earlier in this section as well as section 5, the crew leader will determine first if the site should be electrofished or seined (wadeable sites only). If electrofishing, the crew leader should further determine if a backpack, 2.5 GPP tote barge, 2.5 GPP boat, 9.0 GPP boat, or combination will be used to most efficiently and effectively characterize the fish community.

For all sites, regardless of size, collections will occur throughout the established reach. Sites are worked continuously in an upstream (wadeables) or downstream (boatables) direction with passes down both banks and throughout the mid-channel (open water area). Every meter of each bank and the mid-channel does not need to be fished, but effort should be made to fish all habitat types thoroughly. Additionally, effort should be proportioned based on habitat complexity with more effort spent on habitats such as woody debris piles, riffles, deep pools, and undercut banks as opposed to more uniform habitats such as shallow runs, undifferentiated banks, or smooth bedrock. Also, units should be proportioned over the reach and no stretch of the reach should be refished, unless a mechanical or personnel problem created a poor fishing pass through the area. Depending on wadeability and fish gear, the following rules will apply to ensure consistent effort on all sizes of waterbodies.

1. Minimum units of effort are 150 meters and 500 seconds of electrofishing
2. Sites will be fished until one of the following is reached:
    a. 40x wetted width (i.e., calculated reach length)
    b. 2000 meters (wadeable) or 4000 meters (boatable)
    c. 4500 seconds (wadeable) or 7500 seconds (boatable)
3. Total units expended should be positively correlated to reach length and habitat diversity. Care should be taken not to overfish or under fish a particular reach. However, if unit time is out of proportion to reach length or diversity, an explanation should be provided in the comments section of the field notes.
4. Deep pools may be “refished” by working in concentric circles over and over and the area to draw fish to the top. This often leads to a large number of units being expended, and therefore, deep pool passes should be documented in the notes section with an approximation of the units expended.
5. Night electrofishing may be used in some waterbodies under special circumstances and is described below (Sanders, 1992).
6. When seining, document number and average length of seine hauls. No minimum or maximum number or length of hauls is defined. However, if every effort is made to work the entire reach in all habitats and proportion work based on habitat complexity, effort should be adequate to characterize the community.

Seining is not used in boatable sites, except to access areas that may be inaccessible by boat (e.g., an inaccessible backwater).

7. If seining is used as a supplement to electrofishing, provide reason as well as overview of number and length of hauls.
8. As with any method, crew leader best judgment should be used to determine if adequate effort has been expended to accurately characterize the reach.

Night electrofishing may be used to increase catch efficiency on certain waterbodies, including the Arkansas River below Muskogee, the Verdigris River below Bird Creek, the Neosho River below Miami, and the Red River below its confluence with the Kiamichi River. These river sections share a combination of traits that might make daytime electrofishing particularly difficult. They are typically greater than 50 meters in average wetted width, have mid-channel depths greater than 7 meters, and near-shore depths greater than 3 meters. Night electrofishing will be used on these stretches of river if: 1) the reach is easily navigable at night and accessible by using a boat ramp, or 2) an overnight plan is developed and approved by the Monitoring Coordinator and Water Quality Section Division Chief. Day electrofishing should always be attempted before a night electrofishing plan is developed. Before site work occurs, the crew leader will also contact a variety of local entities including the US Coast Guard, Oklahoma Highway Patrol, County Sherriff, and local police department, and provide documentation to the Monitoring Coordinator that these entities have been contacted. To ensure staff safety, the electrofishing boat will be equipped with the following.

- Bow and stern navigation lights as required by the US Coast Guard
- Halogen or flood lamps at the bow (minimum 2), along the port and starboard gunwales (minimum 1 per side), and at the stern (minimum 1)
- Backup battery-powered, high beam flashlight (2 minimum)
- Operational cell phone and GPS
- Marine radio

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6.3 Sample Handling & Preservation

CAUTION: Formalin is a carcinogen and can also cause permanent damage to mucous membranes and eyes. Care must be taken when placing fish in formalin so that the fish does not flop around and splash formalin onto people near the jar. The fish should be put into the jar with the lid tilted open away from the operator so that the lid shields the face and body of the operator. Flood any skin exposed to formalin with plenty of water as soon as possible. If it gets in your eyes, flood the eyes with water immediately and go to the doctor immediately after that.

The following steps should be taken to handle and preserve fish:

- Always follow vouchering and photo-documentation guidelines described in Section 4.2.3 of this document.
- Label each jar. Using a pencil, write the date, WBID #, collection time, stream name, number of jars composing one sample, county, legal location, and

crew leader's name on a piece of ~2 x 3-inch waterproof paper and place one label into every jar of fish from each site. Write the same information on the front of each jar using a wax pencil or an indelible marking pen.

- In general, all fish should be placed in 10% formalin immediately after capture. There are a few exceptions made for larger fish (>100 gms or 0.25 lbs), which can be positively identified in the field.
- Field identified fish should be returned to the water far enough away that recapture is unlikely.
- When preserving fish much larger than 0.3 to 5 kg (0.5 to 10 lbs), the fish should be sliced open along the lower rib to allow the formalin to penetrate the body cavity fast enough to prevent decay. A slit through the ribs is preferred to a belly slit to facilitate counting belly scales in the lab.
- Fill out a Chain of Custody Form.
- The Crew Leader is responsible for transferring and logging samples to the OWRB fish identification lab.

7.0 Forms

7.1 Field Forms

Field notes are documents used to annotate and record information that is gathered at the project site. They are a data sheet and should be treated as such. Therefore, they should be written, legible, and complete. To avoid confusion and loss of data, a new sheet should be used at each new project site. Field notes should be initialed and dated by the collecting personnel and data entry personnel. For guidance on proper procedure to complete the field notes, refer to your supervisor and or FTE. Field notes can be found in the OWRB electronic directory.

7.2 Chains of Custody

Chains of custody are documents turned into the taxonomic laboratory for each group of samples delivered. These forms are used for several purposes. They act as a legal document to show proper delivery of samples occurred and they make a general list of the parameters that should be analyzed. They are a data sheet and should be treated as such. Therefore, they should include the date and time for each sample collected and be legible and complete. They should also be signed and dated by field and laboratory receiving personnel at the time of delivery. To avoid confusion and loss of data, a new chain of custody should be used for each group of samples. For guidance on proper procedure to complete the chains of custody, refer to your supervisor and or FTE. Chains of custody can be found in the OWRB electronic directory.

8.0 Data Storage

All completed electronic data collection forms are to be reviewed and approved by the OWRB fish crew leader that led the collection effort. The electronic fish forms are then e-mailed from the NRSA App to the OWRB fish crew leader and the resulting Json files are stored on the OWRB network. The Json files are then converted to Excel files via the NRSA R Shiny App. The converted Excel file is then stored on the OWRB network. Then the data are uploaded into the OWRB database (the Ambient Water Quality Monitoring System (AWQMS)). Each sample should be maintained electronically in the database under a unique sample ID number (4 million numbering system) in the format

4XXXXXX.03Fish. The final fish taxonomic data are housed in AWQMS, and the OWRB fish assessment data are located on the OWRB network in a Microsoft Excel workbook. These data are now available for reporting, etc.

9.0 References

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