

US EPA ARCHIVE DOCUMENT

**STANDARD OPERATING PROCEDURE  
FOR THE SAMPLING OF FISH IN WADEABLE STREAMS THROUGH  
THE USE OF ELECTROFISHING**

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**1.0 Scope & Application:**

The purpose of this procedure is to provide complete documentation of an appropriate technique for the sampling of fish in wadeable streams through the use of portable electrofishing equipment. The procedure will provide for consistency and efficiency of the sampling effort while maintaining proper safety protocols. This procedure can be used for community surveys, comparative studies and impact assessments.

**2.0 Summary of Method:**

The method employed calls for the use of electrical power to momentarily stun fish within an effective range from the backpack shocking unit. Based primarily on ambient conductivity and the size and species of fish targeted for collection, a voltage is selected that effectively stuns fish in a non-lethal manner. This allows for the return of fish to the water body unharmed. The minimum sampling team size is three to four individuals. Additional staff can be selected depending on the width of the water body being sampled and the need for complete coverage across the stream. The configuration for a standard sized team consists of one individual wearing a portable shocking unit, two people positioned on either side of the “shocker” and slightly downstream, and a fourth individual behind the netters to transfer netted fish to a temporary holding bin and record data. The sampling is performed moving in an upstream direction focusing on shocking those areas most likely to harbor the targeted fish species.

**3.0 Health and Safety Considerations:**

The following section outlines health and safety precautions that should be taken while performing the sampling procedures:

- 3.1 When working with potentially hazardous materials or situations, follow EPA, OSHA, and specific health or safety procedures.
- 3.2 All proper personal protection clothing and equipment is to be worn.
- 3.3 The SOP is to be read by all participants in the sampling effort prior to the survey and a briefing held the day of the survey.
- 3.4 A backpack shock unit safety inspection and maintenance inspection will be completed each year. This does not supersede the necessity of pre-survey safety checks.

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- 3.5 A backpack electroshocker safety inspection will be completed prior to each day's use (see Appendix A).
  - 3.6 All waders and gloves should be leak tested daily. Any equipment failing the leak test should be immediately replaced or repaired before use.
  - 3.7 Prior to beginning each day of electrofishing, a team briefing will be held reviewing safety procedures and potential general and site specific hazards.
  - 3.8 Never touch electrodes when the backpack electroshocker is operating.
  - 3.9 At least two members of the electrofishing team should have current CPR certification and Automatic External Defibrillator (AED) training.
  - 3.10 If gloves or boots are encountered leaking, sampling must cease until the equipment is replaced.
  - 3.11 No sampling should take place during heavy rain or snow.
  - 3.12 Individuals with a history of heart problems should not participate in electrofishing activities.
  - 3.13 The power supply should only be connected immediately prior to sampling and disconnected immediately after sampling and before leaving the stream.
  - 3.14 All fuels should be transported in approved gas containers.
- 4.0 Equipment and Supplies:**
- The following is a list of equipment and supplies necessary to perform electrofishing:
- 4.0.1 Battery or gas powered portable backpack shocking unit with safety kill switch, anode ring, and rat tail cathode.
  - 4.0.2 Elbow length rubber lineman's gloves for each team member.

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- 4.0.3 Polarized sunglasses for each team member
- 4.0.4 Large dip nets
- 4.0.5 Small dip nets
- 4.0.6 Holding bucket and/or holding bins
- 4.0.7 Large holding bin to place all the fish in when taking the data
- 4.0.8 Measuring tape or line reel for pacing off survey reach (150 meters min.)
- 4.0.9 Field fish length measuring board
- 4.0.10 Waterproof data sheets and writing utensils
- 4.0.11 Portable cellular phone
- 4.0.12 Chest and hip waders with felt soles
- 4.0.13 Flagging tape
- 4.0.14 100 ft of nylon safety line
- 4.0.15 Inflatable harnesses or safety vests for each team member (if appropriate)
- 4.0.16 Conductivity meter
- 4.0.17 Spare parts box for shock units & ancillary equipment
- 4.0.18 Aerator(s) with battery(s)
- 4.0.19 Fish key
- 4.0.20 First aid kit
- 4.0.21 Felt sole and wader repair kit

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**4.0.22** Head nets

**4.0.23** Conductivity standards of 0.0001M KCL (14.9 *umhos/cm*), 0.001M KCL (147 *umhos/cm*), 0.005M KCL (735 *umhos/cm*)

**4.0.24** 18 megohm deionized water

**4.0.25** Unleaded gasoline and/or spare charged batteries

**4.0.26** TC-W 2 cycle chain saw oil

**4.0.27** 50:1 mixture of gas to oil for generator fuel (1 qt gasoline:½ oz oil)

## **5.0 Personnel Qualifications**

**5.1** At least two people on each survey crew must have taken an electrofishing course either from the US Fish and Wildlife Service or similar. All survey crew members must have completed the Office of Environmental Measurement and Evaluation electrofishing training within a year of survey activities. All electrofishing team members are required to read and be familiar with the contents of this SOP.

## **6.0 Preparation for Sampling**

The following section outlines the procedures for preparing for a sampling run.

**6.1** Determine the conductivity of the water body to be sampled (See G:\ALLSHARE\BIOLOGY\NEWS\SOP's\electro fishing sop.wpd)

**6.2** Identify the stream reach to be sampled and mark the beginning of the sampling reach with flagging tape.

**6.3** Reference the required sampling (power on) time per reach from the sampling plan and zero the time on the left side of backpack with the magnet.

## **7.4 Team member sample preparation**

**7.4.1** Each member of the team entering the water will wear rubber chest waders with felt soles, elbow length rubber gloves, a pair of polarized sun glasses and a floatation device if warranted.



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- 7.4.2 Individuals netting fish will be equipped with a dip net corresponding to the size of fish expected to be caught and the complexity of habitat to be fished.
- 7.4.3 The fourth individual walks behind the main crew, netting any missed fish and carrying an aerated seven gallon bucket to hold fish transferred from the primary netters. The water level in the bucket should be at a depth to hold fish in a healthy state. Stressed fish are evidenced by “foam” in the bucket, fish rising to the water surface, or an inability of the fish to remain upright. Special attention and care are needed when dealing with cold water species (i.e. salmon, trout, sculpin).
- 7.7 Electrofishing backpack unit set-up
- 7.7.1 After disconnecting electrical connections from the side of the generator, remove the generator or battery from the backpack by releasing the latches on the bottom of the unit or the top velcro straps over the battery.
- 7.7.2 Fill the tank with the fuel:oil (70:1) mixture. This is enough for 1.7 hours of running time. Wipe any spilled fuel from the outside and then remount the generator on to the backpack unit. If a battery operated shock unit is used, replace the battery with a freshly charged one.
- 7.7.3 Plug anode (ring/pole) and cathode (rat tail) into their respective connectors on the bottom rear of the instrument case.
- 7.7.4 Have a team member help place the backpack on the individual who will be electrofishing, and check that all straps, connections, and cables are appropriately attached. Check the backpack’s quick release pins if so equipped and ensure they are operable. **All team members should be familiar with doffing the backpack unit in case of emergencies.**
- 7.7.5 Reconnect the AC and DC electrical connections; if battery operated units are used reconnect the quick disconnect plug into the battery (**Note: The battery is only reconnected immediately before electrofishing operations are to begin**).
- 7.7.6 Start the generator by:
- Turn the fuel cap lever to the on position.
  - Set the output selector on the generator to the 300VA position.

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- c. Set the engine switch on the generator to the choke position for a cold engine or to the on position for a warm engine.
  - d. Make certain slack is out of the starter cord and quickly pull.
  - e. When the engine has started and warmed up move the engine switch from the choke to the "ON" position. If the generator is overloaded (rapid beep and indicator light on) turn it off and restart to reset. The generator output selector should be on 300VA.
  - f. If using a battery operated unit, connect the quick disconnect plug to the battery and turn the toggle switch on the side of the backpack to "ON."
- 7.7.7 Select the desired voltage from the voltage range switch located on the right side of the backpack. Effective range for sampling is based on conductivity and any prior sampling experience. In general, 100-400V for water >300 umhos/cm, 700-800V for 100-300umhos/cm and 900-1100V for water <100 umhos/cm.
- 7.7.8 Select the waveform desired (see P.O.W. reference attached to backpack.)  
**Note: Use the lowest effective voltage and keep in mind that larger fish are sensitive to (2-3 times) lower voltages. Consequently, low voltages and lower frequencies are most effective for sampling larger fish.**
- 7.7.9 Place the anode ring in the water and depress the reed switch on the anode pole.
- 7.7.10 Check the overload indicator light. If the light goes on and a rapid beep occurs when the reed switch is engaged reduce the voltage selector until the light no longer turns on. (**Remember never to change the voltage while the reed switch is engaged**). If the overload continues with the anode out of water, return to the manufacturer for service.
- 7.7.11 Check to see that the self test indicator LED is working, the light should be on when the reed switch is activated. If the indicator fails to turn on there is a bad connection or internal problem. With the reed switch off, check to see that the anode and cathode connections are properly seated. If after engaging the reed switch again the LED still does not light up, then the backpack shocker is to be

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returned for service.

- 7.7.12** Check to make sure that the audio alarm is working when the reed switch is depressed. If the audio alarm does not work return to manufacturer for service.
- 7.7.13** Tilt the backpack unit greater than 47 degrees. The self test indicator will be flashing and the output will be disabled. Reset by releasing the reed switch on the anode pole. If the indicator does not flash and/or the power is not cut out then the shock unit should be returned for service.
- 7.7.14** Check to see the response on the fish. Adjust voltage accordingly. **Warning:** Never adjust the voltage when the reed switch on the anode pole is activated.
- 7.7.15** If the unit overloads, a rapid beep will be heard, the overload indicator light will turn on and the output will be disabled. If the electrofisher is overloaded the unit can be reset by disengaging the reed switch. If the generator is overloaded the unit must be shut down and restarted. In either case a lower voltage selection should be made.
- 7.7.16** To reset the timer, place a magnet over the word “reset” found next to the timer, or pass the reed switch (which is magnetic) from the anode pole over the word.

**7.6** Holding bins and transfer bucket set-up

- 7.6.1** The holding bins should be placed in-stream and located in an area of slow current and at a depth to allow the net to hang unencumbered. If using a holding tank in lieu a holding bin, place the tank in a shaded section of the stream to help maintain proper water temperature and with sufficient water to keep it from drifting off. An aerator should be placed in the tank and turned on. The aerator should be tested prior to sampling.
- 7.6.2** Similar to the holding tank, the holding bucket should be filled with stream water at a depth to maintain fish health and minimize stress. An aerator should be placed in the bucket and turned on.

**8.0** Sample Collection

- 8.1** Fish sampling proceeds in an upstream direction. The backpacker will traverse

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the stream, shocking habitats likely to contain the target fish species. Notations

are made for the number and species of fish caught in each habitat or as otherwise specified in the Quality Assurance Project Plan (QAPP). Netters proceed at the same pace as the individual shocking and each netter collects stunned fish on their side of the shock unit. Netters should not cross over the anode pole in an effort to collect fish. Netters will also stay inside the radius of the anode pole to remain clear of the voltage source. If an individual begins to fall he or she loudly shouts the word “down,” alerting the backpacker to immediately release the reed switch. If a fall has taken place and protective gear has become wet inside, the sampling is temporarily suspended and a replacement person or equipment is put in place or sampling is resumed once the equipment has become dry.

- 8.2 Individuals netting fish identify the number and type of each fish species caught and make any other necessary observations. Observations or notations are verbally relayed to the individual carrying the bucket and recorded in a standardized field notebook. Standardized abbreviations for New England fish species may be found in Appendix “B.”

**NOTE:** Some surveys may require statistically valid estimates of the resident fish populations. In these cases “pass depletion” or similar methods will be employed in order to accomplish this objective. Details will be described in the QAPP. See Appendix “C” for detailed guidance on the use of these programs and procedures.

- 8.4 Caught fish will be transferred to the person with the holding bucket. This individual will monitor the health of the fish and make transfers to holding tanks or fish bins if they appear stressed or overcrowded.
- 8.5 At the completion of the sampling run, total shock time for the reach will be recorded.
- 8.6 After completing the sampling reach, turn off equipment by switching the generator to the off position and disconnecting the power supply. If a battery unit was used, disengage the quick disconnect from the battery and the unit *before* heading back downstream.
- 8.8 Upon survey completion, fish will be released and returned to the water body with the exception of any unknown species being held for further identification or

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disposition.

## **9.0 Data and Records Management:**

- 9.1** Data will be recorded on standardized waterproof data sheets in waterproof field notebooks with waterproof writing utensils.
- 9.2** While the exact format and type of data collected will vary from project to project, at a minimum the following should be recorded:
  - 9.2.1** Stream name, site name, and sampling date.
  - 9.2.2** Sampling runs and habitat types should be clearly identified as Sampling Run/habitat #1, #2, etc...
  - 9.2.3** Sampled habitats should be identified (i.e. riffle, run, pool), and descriptions of the habitat characteristics made as defined in the QAPP (i.e. depth, type of substrate, shaded, flow velocity, length of habitat).
  - 9.2.4** Standardized abbreviations will be used for fish species logbook notation. A listing of standard fish abbreviations are provided in Appendix "C."
  - 9.2.5** Actual time electro-fished should be recorded in the field log book. Data is recorded from the LED readout on the side of the backpack. The shock unit logs time in seconds and should be recorded as such.
  - 9.2.6** All field log notes should be clear and legible and the name of the person recording data noted. Errors in data recording should be lined out singularly and initialed.
  - 9.2.7** Voucher specimens may be collected or clear field digital photos taken in lieu for any fish whose species identification is in

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question.

- 10.0 References:** Smith-Root Owners Operation and Maintenance Manual, 1999  
(<http://www.smith-root.com>)

**ATTACHMENT A**

**Electrofishing Principals & Safety**

**ATTACHMENT B**

**Standard Abbreviations for New England Fish Species**



Abbreviation	Common Name	Scientific Name	Tropic	Tolerance
BB	Blueback Herring	<i>Alosa aestivalis</i>	F	M
AW	Alewife	<i>Alosa pseudoharengus</i>	F	M
AS	American Shad	<i>Alosa sapidissima</i>	V	M
RB	Rock Bass	<i>Ambloplites rupestris</i>	P	M
YBH	Yellow Bullhead	<i>Ameiurus natalis</i>	I	T
BBH	Brown Bullhead	<i>Ameiurus nebulosus</i>	I	T
AE	American Eel	<i>Anguilla rostrata</i>	P	M
FSS	Fourspine Stickleback	<i>Apeltes quadracus</i>	I	M
LNS	Long Nose Sucker	<i>Catostomus catostmus</i>	I	M
CWS	Common White Sucker	<i>Catostomus commersoni</i>	O	T
CCS	Creek Chubsucker	<i>Erimyzon oblongus</i>	I	M
LW	Lake Whitefish	<i>Coregonus clupeaformis</i>	V	M
SCL	Sculpin	<i>Cottidae</i>		
SS	Slimy Sculpin	<i>Cottus cognatus</i>	I	M
CP	Carp	<i>Cyprinus carpio</i>	O	T
RBS	Red Breasted Sunfish	<i>Lepomis auritus</i>	I	M
BDS	Banded Sunfish	<i>Enneacanthus obesus</i>	I	M
ECP	Eastern Chain Pickerel	<i>Esox niger</i>	P	M
RFP	Red Fin Pickerel	<i>Esox americanus americanus</i>	P	M
NP	Northern Pike	<i>Esox lucius</i>	P	M
SD	Swamp Darter	<i>Etheostoma fusiforme</i>	I	M
TD	Tessellated Darter	<i>Etheostoma olmstedii</i>	I	I
BDK	Banded Killifish	<i>Fundulus diaphanus</i>	I	T
MMG	Mummichog	<i>Fundulus heteroclitus</i>	G	M
SB	Stickle Back	<i>Gasterosteidae</i>		
TSS	Threespine Stickleback	<i>Gasterosteus aculeatus</i>	I	M
SM	Eastern Silvery Minnow	<i>Hybognathus regius</i>	H	M
ABL	American Brook Lamprey	<i>Lampetra appendix</i>	F	M
CFS	Pumpkinseed	<i>Lepomis gibbosus</i>	P	M
BG	Blue Gill	<i>Lepomis macrochirus</i>	I	M
BRB	Burbot	<i>Lota lota</i>	P	M
SMB	Small Mouth Bass	<i>Micropterus dolomieu</i>	P	M
LMB	Large Mouth Bass	<i>Micropterus salmoides</i>	P	M
WP	White Perch	<i>Morone americana</i>	P	M
CS	Common Shiner	<i>Luxilus cornutus</i>	I	M
GS	Golden Shiner	<i>Notemigonus crysoleucas</i>	O	T
STS	Spottailed Shiner	<i>Notropis hudsonius</i>	I	M
RFS	Roseface Shiner	<i>Notropis rubellus</i>	I	I
BS	Bridle Shiner	<i>Notropis bifrenatus</i>	I	I
BNS	Blacknose Shiner	<i>Notropis heterolpis</i>	I	I
MMT	Margined Madtom	<i>Noturus insignis</i>	I	M
COS	Coho Salmon	<i>Oncorhynchus kisutch</i>	P	M
RT	Rainbow Trout	<i>Oncorhynchus mykiss</i>	P	M
RS	Rainbow Smelt	<i>Osmerus mordax</i>	V	M
YP	Yellow Fin Perch	<i>Perca flavescens</i>	I	M
YP	Yellow Perch	<i>Perca flavescens</i>	I	M
SL	Sea Lamprey	<i>Petromyzon marinus</i>	P	M
BC	Black Crappie	<i>Pomoxis nigromaculatus</i>	P	M
RW	Round Whitefish	<i>Prosopium cylindraceum</i>	I	M
NSS	Ninespine Stickleback	<i>Pungitius pungitius</i>	I	M

NRD	Northern Redbelly Dace	<i>Phoxinus eos</i>	H	M
FD	Finescale Dace	<i>Phoxinus neogaeus</i>	I	M
BND	Black Nose Dace	<i>Rhinichthys atratulus</i>	G	T
LND	Long Nose Dace	<i>Rhinichthys cataractae</i>	I	I
ATS	Atlantic Salmon	<i>Salmo salar</i>	P	M
LLS	Landlocked Salmon	<i>Salmo salar</i>	P	M
BT	Brown Trout	<i>Salmo trutta</i>	P	M
EBT	E. Brook Trout	<i>Salvelinus fontinalis</i>	P	M
LT	Lake Trout	<i>Salvelinus namaycush</i>	P	M
CC	Creek Chub	<i>Semotilus atromaculatus</i>	O	T
FF	Fall Fish	<i>Semotilus corporalis</i>	G	M
WLE	Walleye	<i>Stizostedion vitreum</i>	P	M
NTR	Notropis			
MIN	Minnow			
SNAPT	Snapping Turtle			

Notes:

Trophic Designations: P = Piscivore, H = Herbivore, O = Omnivore  
 I = Insectivore, F = Filter Feeder, G = Generalist feeder,  
 V = Invertivore

Tolerance Designations: I = Intolerant, M = Intermediate, T = Tolerant

ATTACHMENT C

**User's Guide For Generating Population Statistics  
From  
Electrofishing Data**

