RECOMMENDATIONS OF BEST PRACTICES REGARDING PROTOCOL SURVEY ELECTROFISHING

Results of the Electrofishing Technical Workgroup for TFW Policy Committee

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FOREST PRACTICES ADAPTIVE MANAGEMENT PROGRAM

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Executive Summary

This report summarizes the findings of the Electrofishing Technical Group (ETG) regarding the use and effectiveness of protocol electrofishing surveys in detecting fish. The ETG was asked to consider a number of questions related to the efficacy of backpack protocol survey electrofishing and this report addresses each of those questions with a concluding statement followed by a discussion of the evidence supporting the conclusion. This evidence includes published scientific papers as well as the collective experience of members of the ETG who have strong backgrounds in sampling small streams. Where appropriate, specific recommendations are also given.

Electrofishing is part of implementing a protocol survey that informs the process of stream typing. While this report presents the group's findings about modern electrofishing techniques and survey protocols, it is important to note that it does not address the question of how electrofishing survey results inform where the F/N boundary (division between fish bearing and non-fish bearing segments of the stream) should be located. Electrofishing is an important tool for informing the process of establishing the F/N boundary but it is not the only tool. Our report is restricted to questions about the protocol electrofishing survey technique itself.

A large number of questions were put to the ETG and there was considerable subject overlap among some of them. Rather than repeat each of the questions in the executive summary, we summarize our findings relative to four general topics: (1) probability of detection, (2) adequacy of single site visits, (3) seasonality of fish occupancy, and (4) harm to individual fish or their populations. More detailed answers to specific questions are found in the body of the report.

1. *Probability of detection*

Electrofishing remains the method of choice for detecting fish in streams. Such sites are typically characterized by channels that do not easily lend themselves to other types of fish sampling. Other survey technologies such as environmental DNA (eDNA) are under development and refinement and show great promise, but electrofishing is still the most widely used, effective and efficient method at this time. Site characteristics including water chemistry and clarity, stream size, and the presence of structures in the water that provide escape cover (e.g., undercut banks and log jams) affect capture efficiency, making it impossible to confirm with absolute certainty that fish are absent from a site. However, in the majority of cases electrofishing is the preferred method of detecting fish presence in headwater streams and is the technique most likely to provide accurate information.

2. *Adequacy of single site visits*

Single site visits are believed to be sufficient to establish fish presence, particularly when surveys extend at least one quarter mile above the location of the last sampled fish. The consensus of the ETG was that multiple site visits are not necessary provided the survey protocols are followed and conditions for electrofishing are favorable. This includes sites above natural and man-made barriers to fish passage.

3. *Seasonality of sampling*

The current protocol electrofishing survey guidelines provide a sufficient time window for electrofishing when flows are typically low or declining, but not at the lowest point in the hydrologic year. The ETG acknowledges that seasonal fish movements occur, but based on current evidence the occupied length of perennial headwater streams does not change much over a year in the absence of significant channel altering events such as debris flows. Therefore, surveys carried out according to the existing timelines have a high likelihood of detecting fish if they are present at a site.

4. *Harm to fish or fish populations*

In most situations, protocol electrofishing surveys are unlikely to result in harmful demographic effects on headwater fish populations as long as appropriate precautions are taken to avoid damage to active redds, damage to instream and riparian habitats, or to cause extensive downstream movement of population members. Special cautions or postponement of electrofishing surveys should be exercised if the population is known to contain very few breeding individuals (scientific literature suggests 25 breeding pairs as a lower threshold). The electrofishing technique itself does have the potential to harm individuals and eggs exposed to electrical fields. Spinal injuries are most common. The risk of injury can be minimized by employing modern equipment and using settings that are least harmful to fish. The ETG suggests that training and possible certification of electrofishing crews can also reduce risk, as well as ensuring that protocol surveys are conducted in a consistent manner.

INTRODUCTION

The Type F Permanent Water Typing Rule has been a Forest Practices Board (Board) and Policy priority for the past several years. The issue went through Stages 1 and 2 of the dispute resolution process, ending in the submittal of majority/minority reports to the Board in February 2014. At that time the Board directed Policy to work on two specific issues that are necessary for development of a permanent rule (electrofishing and off-channel habitat). By directing the issue back to Policy with more specific guidance, the Board continued following the adaptive management process for resolving formal dispute according with the adaptive management board manual (Section 22) on those two components.

At its February 2014 meeting, the Board approved a motion associated with development of a permanent water typing rule, and both the Board and Policy work plans were amended to reflect the motion. The identified steps are essential for the Board to consider when making a final determination of the appropriate approach to take in the development of a permanent water typing rule. Policy was directed to complete recommendations for options on a permanent water typing rule, beginning with two tasks: (1) development of “best practices” recommendations regarding protocol survey electrofishing, including an evaluation of published relevant literature, minimizing potential site-specific impacts to Incidental Take Permits covered species, and options for reducing the overall extent of the surveys' use, and (2) an evaluation of the current rule process to identify off-channel habitat under the interim water typing rule, including recommended clarifications in field implementation guidance, or rule language. The evaluation must be based, in part, on field review of approved Forest Practices Applications and water type modification forms.

The motion adopted by the Board directed Policy to evaluate electrofishing best practices in the context of protocol surveys, not electrofishing as a general practice. The Board motion also asked that Policy convene a technical group to help evaluate these best practices. The AMPA convened a technical group that included practitioners and other caucus representatives to identify best practices regarding electrofishing within the context of protocol surveys, including how to reduce site-specific impacts of practices of protocol survey electrofishing and how to reduce the overall extent of the surveys' use. This document is produced by the technical group to meet the intent of a "best practices recommendation".

Policy reviewed a draft work plan for what the technical group would do to meet the Forest Practices Board motion, which included a list of items that the technical group would review/consider. Policy specifically asked the technical group: "What can the technical group identify to inform Policy's recommendations on how to reduce site-specific impacts of electrofishing and the overall extent of the protocol surveys' use?" To assist the technical work group, Policy generated a list of questions and concerns the technical group should consider (including implementation issues and other relevant documents and questions previously raised by Policy including – memo from UCUT to AMPA (Dec 2013), Tech/Op memo, FFR sections, draft water typing Charter documents (2013), comments to the draft electrofishing literature review (May/June 2015), comments to the electrofishing workshop summary (Feb 2015), etc.). The AMPA convened the technical group (ETG) in October 2015.

The technical group was tasked with identifying technical and scientific issues related to the application and use of electrofishing associated with the protocol surveys to determine how it may be possible to maximize the efficient and effective application of all available information including electrofishing to minimize both site specific impacts to Incidental Take Permit relative to Endangered Species Act-listed fishes and the overall use of electrofishing. Members of the technical group were in complete agreement that the final product of their work must be grounded in science. With this in mind their first action was to draft a purpose statement to guide the development of a final product. The resulting purpose statement of this report is:

"Use science and data to develop "best practices" recommendations regarding protocol survey electrofishing, including an evaluation of relevant literature, to minimize potential site-specific impacts to all fishes including Incidental Take Permit covered species, and identify options for optimizing the overall extent of the surveys' use."

The technical group was initially tasked with a set of questions regarding the use of protocol surveys in water typing consistent with their purpose statement, identifying which questions/concerns from the items provided by Policy they considered relevant to the electrofishing topic and which issues they would not address as part of the electrofishing review process. The technical group identified those questions and concerns outside their purview so Policy would be able to address them through other venues.

This report summarizes the issues identified, topics addressed, and proposed recommendations that resulted from the technical group's work. The ETG notes that there was overlap among some of the questions we were asked to address; therefore, there is some duplication of content in several of the answers.

RESPONSES TO POLICY'S QUESTIONS

Responses were developed to assist members of Policy in responding to the Board's February 2014 Motion. Questions have been separated into five categories: site specific impacts of electrofishing on fish, optimization of the overall extent of survey use, seasonal distribution of fish and timing of surveys, alternatives to electrofishing, and training and/or certification.

SITE SPECIFIC IMPACTS OF ELECTROFISHING ON FISH

1. Do single visit surveys affect fish populations?

Conclusion:

Under most survey conditions, population-scale damages from a single visit protocol electrofishing survey seem improbable. Exceptions can occur where surveys affect very small breeding populations of fish that are isolated above natural or man-made barriers to fish passage.

Discussion:

It is important to recognize the difference between the effects of electrofishing on individual fish and the effects of electrofishing surveys on fish populations. Potential physiological impacts of electrofishing on individual fish and fish eggs are discussed below. Population-level impacts caused by electrofishing can occur if surveys cause significant alterations of Viable Salmonid Population (VSP) parameters – population abundance, population growth rate, population spatial structure, or population diversity – such that the long-term viability of a fish population is compromised (McElhany et al. 2000). To determine potential electrofishing impacts on VSP parameters it is necessary to know the effective population size (number of breeding individuals) in a local population and the possibility for immigration into or emigration from local breeding populations to occur, both of which can influence the true effective population size. Large populations are less vulnerable to harm from single visit surveys than small populations in cases where a site visit affects a relatively small fraction of the overall breeding group. Small, closed populations on the other hand are at greater risk of harm if electrofishing results in impairment of the reproductive success, survival, or distribution of a significant fraction of breeding adults. Nielsen (1998) suggested that an effective population size of 25 or fewer breeding pairs of trout could be vulnerable to potential electrofishing damage. In practice it is very difficult to know the number of potentially breeding adults in a population without sampling the population's entire distribution and being aware of the distribution of natural and man-made barriers to migration.

Most fisheries managers seek to obtain data on the total abundance of fish inhabiting a particular stream system. However, for smaller, high-order, streams, such abundance data may not exist. In the absence of data for the total abundance of a population, effective population size may serve as a surrogate for abundance. Since effective population size focuses solely on the relative genetic contributions of adults, the concept does not account for abundance of egg to fry, and fry to smolt, life stages, nor does effective population size necessarily reflect the carrying capacity of a particular habitat. For ESA-listed populations, VSP criteria may matter more than simple estimates of abundance. This becomes critical where sensitive populations that are important to recovery of ESA-listed stocks inhabit headwaters that do not support large numbers of adults.
In most cases, trout will occur higher in a drainage network than non-salmonid species. The following tables give the species identified in last fish surveys conducted in western (Fransen et al. 2006) and eastern (Cole and Lemke, unpublished) Washington CMER investigations.

Table 1. Species present within the stream reaches immediately below the terminal upper limits of occurrence among streams in western Washington State. More than one species was identified at some sites.

	Sites where present	
Species	Percent	Number
Cutthroat trout *Oncorhynchus clarkii*	88.9	256
Sculpin *Cottus* spp.	10.4	30
Coho salmon *Oncorhynchus kisutch*	5.2	15
Rainbow trout *Oncorhynchus mykiss*	2.8	8
Brook trout *Salvelinus fontinalis*	2.1	6
Threespine stickleback *Gasterosteus aculeatus*	0.3	1

Table 2. Fish species observed in each watershed during 2002 last fish resurveys in eastern Washington (Cole and Lemke, unpublished data).

Watershed	Cutthroat trout	Brook trout	Bull trout	Redband trout	Sculpin spp.
Big Sheep		X			
Cabin	X				
Cooper	X	X			
Deer	X	X			
Le Clerc	X	X			
Naneum	X				X
NF Deep	X				
NF Touchet			X	X	
Rattlesnake	X				
Taneum	X	X			

Previously, trout inhabiting small headwater streams were believed to reside in fresh water throughout their life histories and to undertake limited, if any, migrations. Evidence supporting this assumption came largely from marking studies in the UK where the same fish was captured on successive years from the same small stream, often from the same pool (Elliot 1989). If it is assumed that headwater resident fishes do not move, one consequence is that riverine drainage systems contain a mosaic of breeding populations substantially isolated from each other as a result of restricted or absent gene flow. In theory, this can lead to very small effective population sizes in tributaries where trout have access to short segments of the channel and where interbreeding among adjacent tributary populations is absent or minimized.

More recent evidence suggests that movement of adult trout among headwater streams does occur where no natural or unnatural fish passage barriers are present, even though the same fish can occasionally be found at the same place at certain times of the year. Fausch and Young (1995) documented the movement of adult Cutthroat Trout among headwater tributaries in the northern Rocky Mountains and suggested that the ability to move around was an important adaptive mechanism for surviving in seasonally variable and often unpredictable environments. Walter et al. (unpublished CMER study) found that nearly 100% of the fish sampled and tagged immediately below the F/N break in western Washington were absent from the same reach a year later, yet densities often were similar year to year. The development and refinement of PIT-tag (passive integrated transponder) technology has facilitated a better understanding of fish movements in small Pacific Northwest streams, and since PIT-tags have been widely employed most monitoring studies have concluded that movement is widespread and is an important attribute in resident fish life histories. However, large-scale PIT tagging of juvenile fish creates its own set of risks, primarily due to tag burden, sub-lethal tag effects, and delayed mortality.

It is possible that single site visit surveys could directly affect small headwater fish populations, but damaging effects would only occur under specific circumstances. The population inhabiting the stream segment of interest would have to be truly isolated by an impassable barrier from the recruitment of new adults moving up into the stream. That is, fish could leave the segment by moving downstream but new recruits would not be able to enter the population by moving upstream. The location of such specific circumstances in Washington's watersheds has not been fully mapped, but isolated Cutthroat Trout populations upstream from natural and/or anthropogenic barriers are common in the Pacific Northwest (Guy et al. 2008). In these watersheds, a single debris flow or other large disturbance can cause an immediate decrease in intra-population genetic diversity that persists in locations where no subsequent immigration to the population occurs (Guy et al. 2008). Based on available evidence, headwater fish populations upstream from natural and man-made migration barriers are vulnerable to genetic and demographic harm if surveys cause a loss of adult fish that reduce the breeding population size to a level that impairs one or more VSP parameters. In102 protocol site visits in 2015, Weyerhaeuser scientists usually encountered fewer than 4 fish in a population survey (graph below, unpublished data of B. Fransen). Therefore, the breeding population would have to be very small and the site visit would have to result in displacement, reproductive impairment, or mortality of adults in order to cause population level impacts.

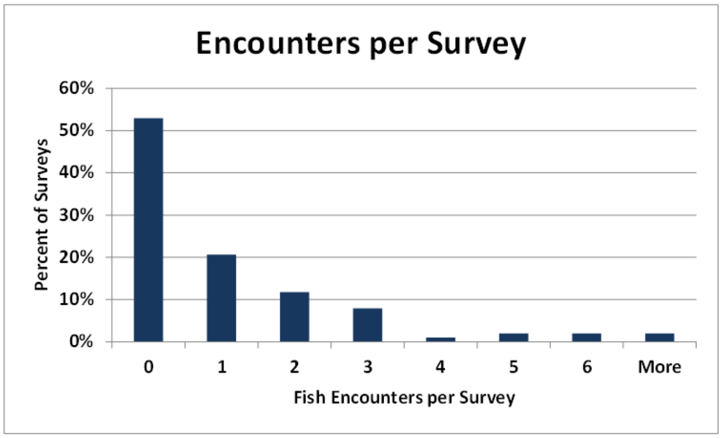


Figure 1. Number of fish encountered per survey at 102 protocol survey sites (B. Fransen, unpublished data).

Based on DNR's RMAP (Road Maintenance and Abandonment Plans) reports, the vast majority of impassible culverts that have been removed and/or replaced are located in the lower portions of watersheds as a result of RMAP's prioritization of anadromous fish passage (DNR annual RMAP reports, DNR / WDFW fish passage database). Impassible culverts historically installed in steep headwater areas are often located underneath deep road fills making them very costly to replace with fish passable culverts. Impassable headwater culverts yet to be replaced can isolate fish populations and form boundaries for areas within watersheds where negative impacts from electrofishing could occur if isolated breeding populations upstream of the barriers are very small.

The barrier effect could be exacerbated if there was significant downstream movement of fish from the sampled reach as a result of volitional avoidance of the electrical field or disturbances related to wading in the stream, or alternatively, if there was drift of stunned fish downstream during the electrofishing procedure itself. To have a significant effect on the population, fish moving downstream out of the sampled reach would need to pass over the barrier that would prevent them from moving back into the site. Finally, a fish population could be negatively impacted if single visit electrofishing led to immediate or delayed mortality of enough shocked individuals or eggs to cause a significant reduction in one or more VSP parameters.

As outlined above, the potential to reduce the number of breeding adults depends on the geomorphic setting of the stream segment in question and the ability of new colonists to move into the site, thus expanding the effective population size. It is important to note that even in intensively monitored watershed studies where headwater populations (not isolated) have been repeatedly electrofished for a decade or more (Hall et al. 1987; Hartman et al. 1987) there is no direct evidence that long-term harm to salmon and trout populations related to electrofishing has occurred. Given the importance of understanding the effects of protocol single site visits on headwater fishes, additional studies focusing on the demographic and genetic impacts of electrofishing on small populations would be helpful.

Recommendations:

Careful attention to electrofishing technique minimizes risks to individual fish, prevents both adults and juveniles from being driven downstream out of the site, and blocks egress from shocked areas by stunned fish, thus reducing the likelihood of long-term demographic impacts. Environmental conditions that may compromise the effectiveness of an electrofishing survey include extremes in flow (low or high), turbidity, extremes in conductivity and water temperature (low or high, see NOAA and e-fishing equipment manufacturers guidelines), and dense or impenetrable riparian vegetation. Carrying out effective surveys using techniques that result in low risk to fish populations will require careful adherence to protocols and board manual guidance, particularly NOAA electrofishing guidelines for ESA-listed fish and WDFW Scientific Collection Permit conditions, and training that provides both proper instruction to electrofisher operation as well as hands-on field experience. It may be helpful to conduct repeat surveys in a small subset of sites for quality control purposes.

Specific recommendations include:

- Use electrofisher settings appropriate for a stream’s conductivity.
- Ensure environmental conditions at time of survey are appropriate and within limits of protocols.
- Follow manufacturer recommendation on when and how to use equipment.
- Avoid electrofishing over active redds.
- Minimize walking in the stream.
- Use procedures to minimize egress of fish.
- Ensure adequate training of survey leads and crews.

2. Is there evidence of direct harm from electrofishing on incubating eggs and gravid females (especially in headwaters where cutthroat spawn)?

Conclusion:

With proper training, experience, and equipment, direct harm from electrofishing can be minimized. However, the procedure itself has the potential to harm all fish life history stages through lethal and sub-lethal injury and stress.

Discussion:

Electrofishing has been used as a survey tool for more than a half century. Over that time there have been many advances in sampling technology as well as a number of studies on the specific effects of electrofishing on physiological performance. Nielson (1998) provides a useful synthesis of electrofishing impacts on trout populations in the Sierra Nevada Mountains of California. Relative to Question 12, potential harm from protocol surveys goes beyond harm associated directly with electricity effects. A two-person survey team walking carelessly through wadeable channels during a spring survey window can impact eggs and alevins in active redds. Cutthroat Trout typically spawn from late winter to early summer, depending largely on a stream's thermal and discharge regimes, with eggs potentially incubating at spawning locations from March to July. Steelhead or resident Rainbow Trout typically spawn between December and June, with eggs incubating at spawning locations throughout that period or longer. Physical damage to incubating eggs can take place if redds are disrupted by wading when eggs and alevins are crushed or washed from the egg pocket. Owing to their small size, resident Cutthroat or Rainbow Trout inhabiting headwater streams do not excavate deep redds and the substrates selected for spawning are composed of smaller gravel than those selected by larger, anadromous salmonids. Eggs may be deposited only a few centimeters below the substrate surface where they may be vulnerable to wading; therefore, it is important for surveyors where possible to avoid wading in stream habitats likely to be used for spawning such as pool tail-outs and low gradient riffles with small to medium diameter gravels. In most cases spawning, gravel incubation, and fry emergence have been completed by early August, and surveys after that time have reduced likelihood of impacting reproductive success.

Evaluating the direct physiological harm from electrofishing to eggs and gravid females is more difficult because electrofishing equipment has been increasingly refined over the years and the published literature on the effects of electrofishing on developmental physiology, based on older technology that is no longer be used, can be outdated. Nevertheless, what literature does exist points to the possibility of some electrofishing-related injury (Sharbor and Carothers 1988; Thompson et al. 1997), although the injury rates have been found by some investigators to be low if proper techniques are followed (Ainslie et al. 1998; McMichael et al. 1998). Spinal injuries, by far, are the most commonly cited injury type and such injuries occur when rapid contraction of muscles during electric shock causes vertebrae to deform or fracture. This can happen at any life history stage.

Visible evidence of electrofishing-related injury does not always reveal the extent of spinal damage. In one study, 40% of fish held in aquaria for a year after exposure to electrofishing showed X-ray evidence of some spinal injury, whereas only 2% exhibited external signs of injury immediately after being shocked (Dalbey et al. 1996). Voltage, wave form, and pulse rate can affect egg development, although some authors believe that the potentially harmful effects of increased voltage are more important than either wave form or pulse rate (Dwyer and Erdahl 1995; Roach 1999). Sharbor and Carothers (1988) found that exponential and square wave pulse patterns were less harmful than quarter-sine waves, and virtually all investigators recommend that surveyors utilize the lowest possible voltage with a wave form that causes the least injury to eggs, juveniles, or adults. However, the ability of electrical currents to effectively stun fish is size-dependent; voltages and wave forms optimized for capturing adult trout are not the most effective for fry, and vice-versa.

The best equipment settings will likely involve a compromise between shocking effectiveness and the potential for injury, a compromise best gained through experience and by adherence to NOAA electrofishing guidelines (http://www.westcoast.fisheries.noaa.gov/publications/reference_documents/esa_refs/section4d/electro2000.pdf), as well as any state permit requirements. The NOAA guidelines state

“Electrofishing in the vicinity of adult salmonids in spawning condition and electrofishing near redds are not discussed as there is no justifiable basis for permitting these activities except in very limited situations (e.g., collecting brood stock, fish rescue, etc.)”. In addition, because of temperature-related physiological stress associated with warm summer conditions, the greatest risk to ESA-listed fish during surveys may consist of failing to follow stream temperature restrictions on electrofishing during warm survey periods.

<u>Recommendations:</u>

Minimizing harm to individual fish and eggs will require that:

- Surveyors be properly trained and experienced.
- The proportion of the stream exposed to electrofishing be limited.
- Modern equipment and machine settings that cause the least amount of damage while still effectively detecting fish.
- Available knowledge of potential fish use in and/or upstream of reaches being surveyed (species, size, spawn-timing, etc.) be utilized.
- The amount of physical disruption to the channel be minimized.

3. What is currently being done to reduce site-specific impacts *of protocol electrofishing surveys*?

<u>Conclusions:</u>

Landowners currently have several options to reduce site-specific impacts of single visit surveys. While some of these options are described in Board manual guidance, they are not rules and therefore the extent to which these options are used is currently unknown.

<u>Discussion:</u>

Several options exist to minimize site-specific impacts of single visit surveys, including:

(a) Follow protocol electrofishing survey guidelines using the best available equipment and careful survey procedures. Careful attention to the setting of the stream reach in question (appropriateness of an electrofishing survey, flow regime, presence of passage barriers, suitable fish habitat upstream and downstream), employing fish shocker settings that result in the least injury while providing for effective capture, avoiding excessive wading in the channel (especially in potential spawning habitats), and taking care to prevent the downstream displacement of fish when performing the survey all contribute to reducing site-specific impacts.

    - Conductivity is used to measure the concentration of dissolved solids that have been ionized in a solution such as water. The unit of measurement commonly used is one millionth of a Siemen per centimeter (micro-Siemens per centimeter or µS/cm). Charges (electrons) transfer along these ions between the two electrodes of the electrofisher. Higher conductivity allows for easier transfer of electrons and lower conductivity causes reduced transfer of electrons. The key to successful electrofishing is to minimize the difference between the internal conductivity of a fish and the ambient conductivity of the surrounding water. Fish are generally accepted to have a conductivity of 115 microSiemens/cm (Miranda 2009).

(b) Use visual observation prior to electrofishing. Visually spotting fish from the stream bank does not injure fish or eggs, and in most cases it is possible to identify fish to the species level based on known distributions of species in the drainage. However, relying solely on visual observations to determine fish presence is more prone to false negative errors than electrofishing, i.e., concluding that fish are not present when in fact they are. Visually observing fish in very small streams can be especially difficult when the channel is small, the fish species present are cryptic, the fish populations are small, water is turbulent, and cover is abundant. For bottom-dwelling species that are occasionally the uppermost stream residents such as sculpins or lampreys, visual observations are virtually impossible. While visual observation is an acceptable method to document fish presence, it is not an acceptable tool for documenting fish absence.

(c) When appropriate, use an alternative technique for determining presence such as environmental DNA (eDNA). This technique is very benign compared to electrofishing because it simply involves filtering several liters of stream water and assaying it for DNA from species of interest. While this technique is currently gaining traction many investigators still feel that it risks false negative errors when target species are rare and thus contribute a very small fraction of detectable DNA in the sample. The difficulty is compounded when the library of reference DNA sequences for species of interest is incomplete. Nevertheless, a recent study demonstrated that improvements in the technique have the potential to make it a more reliable tool for headwater fish detection (Wilcox et al. 2015), and continued technique refinement and development of reference genetic libraries may make eDNA a viable alternative to electrofishing in the future.

(d) Survey coordination. Contact WDFW, local Tribes, private landowners, DNR, and/or NGOs to determine what surveys have already been performed in the watershed of interest.

Recommendation:

- Training and/or demonstration of requisite experience is needed for all field crew leaders. Electrofishing can have direct impacts on fish and under specific circumstances can have population-level impacts. Electrofishing protocol surveys are performed by individuals and organizations representing a wide range of backgrounds and experience. To ensure the proper level of consistency, effectiveness, optimization, and accountability, survey leader proficiency should be demonstrated periodically and survey crew members should be instructed in correct techniques, such as: Training as it relates to issue of impacts.
- Type of equipment – proper use including equipment settings.

- Prior investigation of fish presence (pre-mission planning).
- Create a widely available database of known fish distributions. If changes to stream location or water types are proposed and accepted for a FPA those changes should be reflected in a centralized GIS database to prevent unnecessary surveys.
- Reduce impact by limiting length of stream surveyed.
- Assess use alternative methods for documenting fish presence.
- Personnel guidelines (number of staff).
- Avoid multiple site visits during appropriate season once fish presence determined.
- Environmental conditions at time of survey – ensure that conditions are appropriate and within limits of protocols.
- Be aware of isolated habitats and existing stressors.

4. What is the availability of state and/or federal agencies to provide electrofishing and protocol survey assistance to landowners?

State and federal agencies do not currently provide this service. Private consulting firms, NGOs, and tribes have offered electrofishing assistance to landowners.

OPTIMIZATION OF THE OVERALL EXTENT OF SURVEY USE

1. Are surveys ineffective at low flow?

Conclusion:

Based on practitioner experience protocol electrofishing surveys are generally effective at detecting fish during low flow conditions when those flows fall within the normal long-term range for a given stream and time of year.

Discussion:

The ETG interpreted ‘low flow’ to represent average flows that fall within the normal long-term range for a given stream and time of year. There was general agreement that:

- Protocol electrofishing surveys are generally effective at low flow.
- Periods of low flow may, in fact, represent the most effective time to survey due to there being more fish per unit channel area, clear water conditions, etc.
- In cases of extreme low flow conditions, electrofishing effectiveness may be compromised when stream depth is too shallow for electrode submersion. The most acute example is when a stream reach dries up completely. In these cases, the loss or lack of flow can reduce or eliminate the opportunity to detect fish and thereby impair survey effectiveness.

With regard to isolated habitats and existing stressors, there are no published environmental thresholds for determining when habitats are too physically isolated (presumably, this means situations where flows are intermittent and fish are concentrated in a few pools) or water quality conditions are such that stress on fish associated with electrofishing would be likely to cause injury or death. However, when surveying ESA-listed fish, NOAA electrofishing guidelines contain specific temperature thresholds above which electrofishing is not permitted. Fish that remained stunned for extended periods of time may become easy prey for predators. Protocol experience and training sessions should discourage surveyors from electrofishing in residual pools where inhabitants are likely to be temperature- or food-stressed, and/or exceedingly susceptible to predation. Experience and professional judgment on the part of the surveyors will be needed when deciding whether or not electrofishing is appropriate.

2. Are surveys ineffective at high flow?

Conclusion:

Based on practitioner experience, protocol electrofishing surveys can be effective at detecting fish during high flow conditions when those flows fall within the normal long-term range for a given stream and time of year.

Discussion:

The ETG interpreted ‘high flow’ to represent average flows that fall within the normal long-term range for a given stream and time of year. There was general agreement that:

- Protocol electrofishing surveys are not “ineffective” at high flow, but may be “less effective” than at normal or low flow.
- High flow conditions may not represent the optimal time to conduct protocol electrofishing surveys. Furthermore, there is a high flow threshold where surveys should not be conducted due to potentially difficult (and unsafe) sampling conditions resulting from increased water volume and depth, higher stream velocity, higher stream turbidity and/or reduced fish response to the electrical field. These conditions may result in reduced likelihood of detecting fish which could result in “false negatives”.
- Surveyors tend to avoid sampling in high flow conditions so this may be a non-issue in practice.

3. Are protocol surveys ineffective in streams over 5 feet wide?

Conclusion:

Based on practitioner experience, protocol electrofishing surveys are generally effective at detecting fish in streams greater than 5 feet bankfull width.

Discussion:

For the purposes of this discussion the ETG interprets the "5 feet wide" criteria to mean channel bankfull width (BFW) because that is the stream metric referenced in Board Manual 13. Some research investigating the relationship between stream channel size and overall electrofisher effectiveness/efficiency has been done, however, results are highly variable. Kruse et al (1998) found that stream width was the most important measured stream variable that influenced capture probability and catch efficiency. Weyerhaeuser Company (unpublished data for CMER) shows a catch efficiency of 84% (16% probability of not capturing fish) for streams that are 1 meter wide, 82% (18% probability of not capturing fish) for streams that are 2 meters wide, and 79% (21% probability of not capturing fish) for streams that are 3 meters wide. This report states: "Stream width appears to be a poor predictor of likely catch efficiency within the ranges of stream widths typically encountered during (protocol) electrofishing surveys."

Protocol electrofishing surveys are not generally ineffective in streams over 5 feet wide, but electrofishing effectiveness can be negatively correlated with stream size. Larger streams may have a higher expectation or presumption of fish use. These larger streams also have a wider cross-sectional area and deeper water column that may require more electrofishing effort (e.g. multiple electrofishers, multiple surveys) in order to increase the probability of detection.

Recommendation:

The metric of "5 feet wide" (BFW) should be revisited, as this does not necessarily represent what practitioners would consider a "larger stream" in the context of protocol electrofishing surveys.

4. Is ¼ mile sufficient to demonstrate fish absence?

Conclusion:

Protocol electrofishing surveys conducted over a distance of ¼ mile upstream from the last detected fish are generally sufficient to indicate fish absence with a high probability.

Discussion:

For the purposes of this discussion the "¼ mile" criterion is in reference to the surveyed stream length upstream of the last detected fish. Published data supports the assertion that the ¼ mile survey criteria is generally sufficient to indicate fish absence. Bliesner and Robison (2007) report that: "In streams with low gradient a minimum of 300 m should be surveyed… In streams where a gradient break of a minimum of 8-12% exists this study has indicated that 60 m is sufficient to indicate the Class I (fish bearing), Class II (aquatic life) break." There was general agreement among the ETG that if fish have not been detected within ¼ mile survey and there is no potential habitat upstream (including above permanent, temporary or gradient barriers), then absence is implied. However, the need to survey additional distance upstream from the last detected fish may depend on habitat type, stream size, water level, and other stream properties.

5. Are multiple surveys necessary to demonstrate absence?

Conclusion:

Multiple protocol electrofishing surveys conducted on a single stream segment are not generally needed to indicate fish absence. However, there may be exceptions where stream size, atypical flows, seasonal or annual fish distribution patterns, recent restoration of fish passage, or recent channel disturbances suggest that multiple surveys would be worthwhile.

Discussion:

The single survey criterion is usually sufficient depending on habitat type, stream size, water level, etc. For the purposes of this discussion the term "multiple surveys" means surveys conducted at a single site over multiple days, seasons, and/or years, not multiple survey passes conducted on a single day. Some published data (Cole et al. 2006) supports the assertion that a single protocol electrofishing survey is generally sufficient to indicate fish absence. The authors, however, do acknowledge the fact that: "Longer term studies that include sampling over a wider range of stream flows and that occur after catastrophic environmental events may further characterize variability in the upper limits of fish distribution". There was general agreement within the ETG that in specific instances where seasonality in fish distribution may be expected, where flow conditions at the time of an initial survey are not "normal", or when a survey is conducted in very wide streams channels, additional survey effort may be necessary. In addition, stream segments that have been subject to recent channel disturbance events such as debris flows may require additional survey effort (even in subsequent years), particularly if stream conditions have been significantly altered.

6. Are surveys effective above man-made barriers where fish occur above the barrier?

Conclusion:

Based on practitioner experience, protocol electrofishing surveys are generally effective in stream reaches above man-made barriers where viable fish populations exist, and where the abundance and/or species composition of fish within that reach does not appear to be influenced by the presence of the man-made barrier.

Discussion:

There is no evidence to suggest that electrofishing would be less effective above man-made barriers than below them for the purpose of determining fish presence, particularly when habitat conditions and fish composition and abundance are similar between reaches. The appropriateness of using protocol electrofishing surveys for determining fish presence above man-made barriers may be influenced by the characteristics of the fish population in the reach upstream from the barrier relative to the population downstream. In situations where the presence of a man-made barrier influences the abundance and/or species composition of fish above the barrier and that this influence could impact the upstream distribution of fish, protocol electrofishing surveys may not be appropriate. Board Manual 13 addresses this situation and recommends using physical criteria unless otherwise approved by DNR through consultation with WDFW, Department of Ecology, and affected Tribes in these cases.

7. Is detection poor in small headwater streams?

Conclusion:

The probability of detecting fish in headwater streams using protocol electrofishing surveys can be influenced by population density and numerous other factors previously mentioned above, but is generally not poor.

Discussion:

Headwater streams may support low densities of fish, which can result in reduced electrofishing efficiency and detection probability. The probability of detecting fish is directly related to the population size (Weyerhaeuser Company, unpublished CMER data). The draft CMER Preliminary Assessment of Variable Catch Efficiency states, "Likelihood of detection was lower in sites where fish abundance was low and estimated reduced catch efficiency in response to smaller population size". Some research has shown that electrofishing efficiency is negatively correlated with increasing stream size (Kruse et al. 1998, Rosenberger and Dunham 2005), while others have found no significant difference when testing this population abundance and capture efficiency (Foley et al. 2015). However, the ETG felt that in the majority of cases electrofishing is the preferred method of detecting fish presence in headwater streams and is the technique most likely to provide accurate information.

8. Are two shockers [electrofishers] required in larger streams?

Conclusion:

Based on practitioner experience, multiple electrofishers are not generally required when conducting protocol electrofishing surveys in streams larger than 5 foot bankfull width.

Discussion:

The ETG found no specific documentation or data to support the need for two electrofishers in headwater streams wider than 5 ft. BFW. The use of multiple electrofishers should be approached with caution as two shockers may increase the potential risk of site-specific survey impacts on fish. There likely is an upper channel width threshold above which two (or more) electrofishers would result in greater probabilities of detection, but these conditions are generally not encountered during protocol electrofishing stream surveys.

9. Use of protocol surveys during drought years (2015 and future years). Should we be making permanent calls during these years?

Conclusion:

At this time there is a lack of consensus among the ETG on this question. There is agreement, however, that the question may not necessarily be appropriate for this group. This question relates more to if/how drought conditions may impact where to establish the F/N boundary in relation to the last observed fish, and therefore when and where water type maps should be updated.

10. Effectiveness of "single-pass" electrofishing surveys to account for seasonal and long term distribution variability of fish populations within a stream system (snapshot in time).

Conclusion:

By definition a "single pass" or "snapshot in time" sample cannot address distribution variability. Multiple surveys would be needed at a given site to assess actual variability in fish use between seasons and/or years. The ETG concluded this is less a question about the effectiveness of the protocol electrofishing survey itself and more about how and where to establish the F/N break point in relation to the location of the last observed upstream fish, in order to account for potential seasonal and/or long term variability in fish distribution.

Discussion:

Studies investigating longitudinal variability in fish distribution have evolved over time. Early research by Shuck (1945) and Miller (1954 and 1957) indicated that resident trout are sedentary, while more recent research has indicated otherwise. Cole et al. (2006) and Cole and Lempke (2003) report that changes in the location of the "last upstream fish" were limited in eastern Washington streams during a two-year comparison where surveys were conducted under similar flow conditions and at the same time of year, and the changes that did take place were not biologically significant. Changes in the location of the last upstream fish were more common, and distance of change was greater, however, when the same sites were resurveyed four years later (Cole and Lempke: Final ABR Report 2006). Cole and Lempke (2006) suggested that this increased variability in last fish locations was attributable to both inter- and intra-annual variability, and that surveys captured different flow conditions and sampling seasons. In the same report, however, Cole and Lempke (2006) also reported that: "… these data suggest that the upper limits of fish distribution are not highly variable among seasons, at least when seasonal flow conditions are similar…".

Walter et al. (in review) reported that PIT tagging and recapture data for cutthroat trout sampled at the upstream extent of fish distribution within 6 headwater catchments in western Washington suggests a high rate of mortality within and/or emigration from these small stream reaches from year to year. This, coupled with the fact that fish density in these reaches was relatively consistent through time, suggests that while individual fish in these habitats may be highly mobile, the habitat that the fish population as a whole occupied did not change significantly.

Another study to assess seasonal movement of cutthroat trout in a coastal Oregon stream using both mark-recapture and radio transmitters (Gresswell and Hendricks 2007) reported most fish moved short distances, while a few individuals moved significant distances over the course of the 14-month study. Other research on cutthroat trout movement report similar results.

11. What is the risk of not finding fish that are actually present (detectability) when conducting a protocol electrofishing survey?

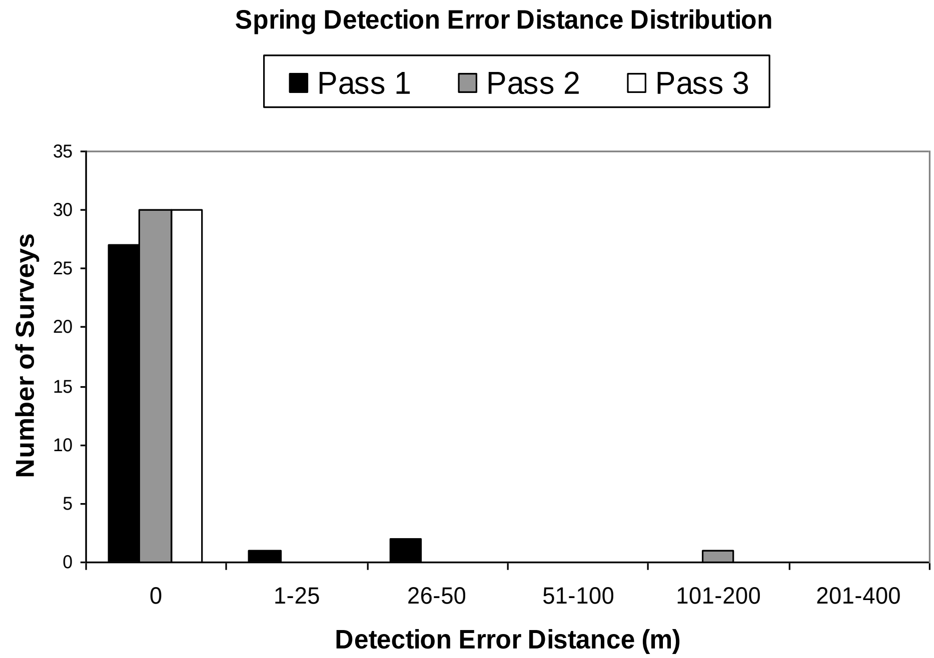
Conclusion:

The ETG agreed that there is chance of not finding fish that are actually present. The detectability of fish is influenced by site-specific attributes.

Discussion:

Some investigations have addressed electrofishing efficiency and/or the probability of detecting fish using a backpack electrofisher, while many more examined catch efficiency. For the purposes of this discussion the term catch efficiency is used when fish had to be netted and/or brought to hand in order to be counted, where detection probability applies to situations where fish only had to be observed while electrofishing. When conducting protocol electrofishing surveys, detecting a fish is sufficient to classify a stream segment as Type-F. Fish do not necessarily have to be captured.

CMER sponsored research (Cole et al. 2002) evaluated the reliability of a single pass electrofishing survey to detect the uppermost fish. Detection error surveys were conducted in 28 streams with terminal Type-F/N break points where no permanent natural barrier to upstream fish movement was present at or within 400 meters (m) of the break. After locating the uppermost fish by protocol electrofishing survey, additional electrofishing surveys were conducted in the reach upstream of the uppermost fish. If fish were found upstream from this point, the distance from the new uppermost fish to the original last fish location was recorded. Surveys were repeated until no fish were detected above the original location of the uppermost fish in a minimum of 4 consecutive surveys. No fish were found above the uppermost fish location identified during the initial protocol electrofishing in 27 of the 28 sites evaluated. At one site, one fish was found 0.5 m upstream on the second pass and another fish 14 m upstream in the third pass. Average error distance across all sites was 0.5 m. As part of another CMER-sponsored study (Cole and Lempke 2006), detection error was evaluated in both spring and summer. A random sample of 30 streams with fish distribution data collected during previously conducted protocol electrofishing surveys, again with terminal F/N break points where no permanent natural barrier to the upstream movement of fish was present at the break point, was selected for each season. The same resurvey protocol was followed as in the Cole et al. (2002) study mentioned above. Cole and Lempke (2006) report that fish were encountered upstream of the original uppermost fish location in only 3 of the 30 sites resurveyed in each season. Average error distance was higher than observed in the 2002 samples, and averaged 47 and 44 meters in spring and summer samples, respectively



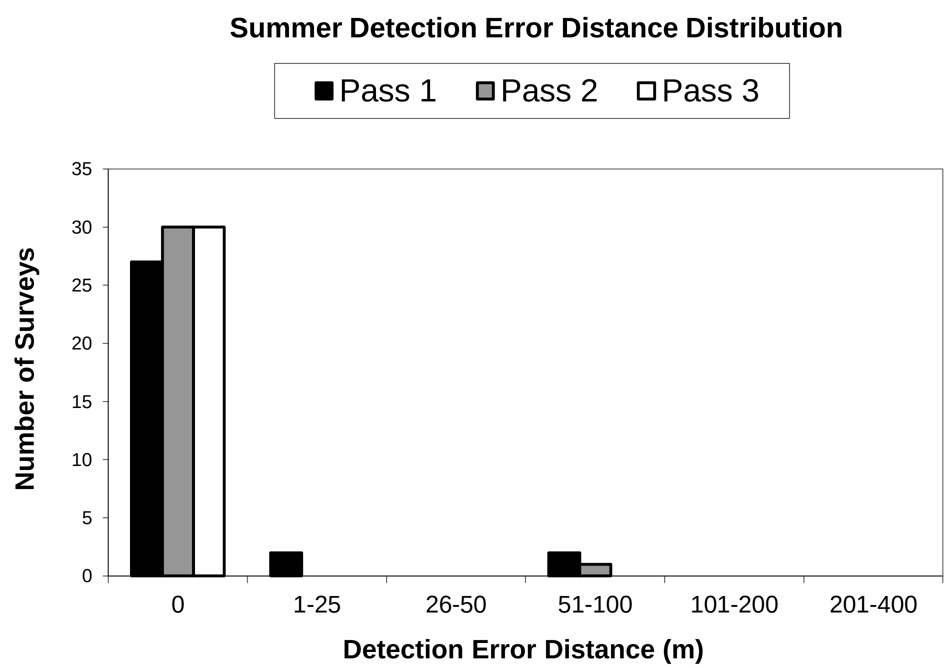


Figure 2. Frequency distribution of spring (upper graph) and summer (lower graph) detection error distances of last fish surveys performed in seven eastern Washington watersheds in 2005.

It is important to note that these data likely over-state survey detection error across all sites because sample sites were selected to include only those where not detecting fish that were present was more likely (e.g. terminal streams, and streams with no upstream barrier). "These data are therefore a conservative estimate of survey error across the study area" (Cole and Lemke 2003).

The reported range of catch efficiencies in the literature is somewhat variable, and can be influenced by channel characteristics such as stream width. Catch efficiencies may be lower than detection probabilities in similar habitats as it is possible to detect (observe) a fish without actually capturing it. Kruse et al. (1998) estimated a first pass survey catch efficiency of 82% (18% probability of not capturing fish that are present) in small mountain streams. Similar catch efficiencies of 84% (16% probability of not capturing fish) were reported in forested streams in Washington that are 1m wide, 82% (18% probability of not capturing fish) for streams that are 2m wide, and 79% (21% probability of not capturing fish) for streams that are 3m wide (Weyerhaeuser Company, unpublished CMER data).

SEASONAL DISTRIBUTION OF FISH AND TIMING OF SURVEYS

1. What is the appropriate period to conduct an electrofishing survey?

Conclusion:

Based on practitioner experience, no "perfect window" exists and the current window as defined by Board Manual 13 (March 1-July 15) is appropriate in most cases for western Washington.

Discussion:

The ETG is aware of no specific documentation or data to answer this question, and more research is needed on the subject. Results of research reported by Cole and Lempke (2006), however, do address the issue of changes in the upper distribution of fish between seasons and are included in the responses to other questions.

Board Manual 13 reads: "Survey information collected to determine fish use or the maximum upstream extent of habitat utilization must be collected during the time window when the fish species in question are likely to be present... In most cases, this period extends from March 1st to July 15th…". For the purposes of this discussion the term "appropriate period" would refer to the time window during which fish species are most likely to be present. The key is knowledge of target species' life histories. It is important to maintain flexibility in potential survey timing on behalf of both surveyors and reviewers. The need for this potential flexibility is supported by Board Manual 13 language (above) in stating "In most cases…". Surveys conducted outside of the Board Manual 13 window to capture potential seasonal fish use can be resolved through consultation with WDFW and affected tribes.

Additional discussion is necessary for appropriate protocol survey windows for eastern Washington.

2. **Do differences exist between headwater streams and streams lower in the watershed in relation to fish presence (seasonal use), adult spawner presence, eggs in gravel, juvenile presence, etc.?**

Conclusion:

The ETG concluded that differences do exist between headwater streams and streams lower in the watershed in relation to fish presence (seasonal use), fish abundance, adult spawner presence, eggs in gravel, and juvenile presence.

Discussion:

Fish populations in headwater streams typically occur at lower densities, have fewer spawners and eggs in the gravel, and offer less juvenile rearing habitat than downstream reaches. The impact of these differences on protocol electrofishing survey effectiveness have been addressed in a number of other responses in this document.

3. **Are there reasons to vary approach when dealing with anadromous vs resident vs all fish use – especially where resident fish are not yet spawning when e-fishing window opens?**

Conclusion:

There are reasons to vary survey approaches when encountering different species and/or life stages. Most important are consideration of timing and abundance of different life stages in the targeted survey reach. The key is knowledge of target species. If unfamiliar with the life history traits of target species, consultation with WDFW and affected tribes prior to conducting surveys is recommended.

Discussion:

For ESA-listed species, adherence to NOAA electrofishing guidelines (http://www.westcoast.fisheries.noaa.gov/publications/reference_documents/esa_refs/section4d/electro2000.pdf), as well as any state permit requirements, should be followed. The NOAA guidelines state "Electrofishing in the vicinity of adult salmonids in spawning condition and electrofishing near redds are not discussed as there is no justifiable basis for permitting these activities except in very limited situations (e.g., collecting brood stock, fish rescue, etc.)". In addition, because of temperature-related physiological stress associated with warm summer conditions, the greatest risk to ESA-listed fish during surveys may consist of failing to follow stream temperature restrictions on electrofishing during warm survey periods.

4. **Any proposed change in the timing of e-fishing window may not fit with and may actually be in opposition to NOAA and WDFW guidelines.**

Conclusion:

This will be an important consideration when reviewing the appropriate protocol survey window for a particular site.

Discussion:

This issue should be acknowledged when considering the question, "What is the appropriate period to conduct an electrofishing survey?"

5. When should a protocol survey be used in situations such as:

a. Streams with disturbance/habitat degradation (e.g. debris flows, fires)?

Conclusion:

Consultation with DNR, Ecology, WDFW and affected tribes is the best way to ensure survey results are accepted.

Discussion:

This is very much a "site specific" question. There is a wide spectrum of disturbance influence on habitat and channel conditions that can influence both fish distribution and the ability to survey effectively. Board Manual 13 requires documentation of how disturbance or habitat degradation may have affected fish distribution. The ETG concludes that (1) natural events such as debris flows and fires are part of the natural and historic disturbance regime in headwater stream systems, (2) stream segments which have been subject to recent channel disturbance events may require additional survey effort (even in subsequent years), particularly if stream conditions have been significantly altered, (3) the need for survey flexibility is supported by data presented by Cole et al. (2006), and (4) in locations of obvious and recent disturbance events the protocol survey may document presence but is a less reliable indicator of absence.

b. Above man-made barriers (MMBs)?

Conclusion:

Board Manual 13 addresses this situation and recommends using physical criteria unless otherwise approved by DNR in consultation with WDFW, Department of Ecology, and affected Tribes in these cases.

Discussion:

This topic has been addressed under question 6 "Are surveys effective above man-made barriers where fish occur above the barrier?" in the section on optimization of the overall extent of survey use.

c. Ponds, wetlands, and off-channel habitats?

Conclusion:

Electrofishing surveys are not the preferred tool for establishing fish presence in ponds and wetlands, especially those that are not wadeable. Protocol electrofishing surveys are not applicable to defining off-channel habitats under current rules.

Discussion:

There are two distinct questions that must be considered here. First, the appropriateness of using protocol electrofishing surveys in ponds and wetlands, and second the appropriateness of using the survey method to define off-channel habitat. Electrofishing surveys can under certain circumstances (small, shallow ponds and wetlands with good water clarity) be appropriate for documenting fish presence in ponds and wetlands, but not usually for documenting absence. The definition of off-channel habitat is currently being reviewed by a TFW Policy technical committee.

Recommendation:

Other methods (minnow trapping, seining, hook and line sampling, etc., or a combination of multiple sampling techniques) are likely to be more appropriate in ponds and wetlands.

d. How soon to shock after removal of man-made barrier or disturbance?

Conclusion:

There is no specific documentation or published data to answer this question, and more research is needed on the subject. Data (unpublished) are currently being collected by Weyerhaeuser and the Tulalip Tribe to help answer the question.

Discussion:

The ETG believes that timing will largely depend on a number of physical and biological variables including the characteristics of the fish population downstream from the blockage and the characteristics of the stream segment upstream from the blockage. We assumed that the question addresses the issue of time it takes for fish to recolonize stream habitat upstream from natural disturbance or removal of blocking anthropogenic structures.

e. No or insufficient pools meeting protocol "size" are present?

Conclusion:

Many surveys in headwater and small tributary streams simply cannot meet the qualifying pool criteria, as sufficient numbers of qualifying pools are not present in the surveyed reach. Surveyors should sample and document the pool habitat that is available.

Discussion:

This issue is not a major concern in terms of the effectiveness of protocol electrofishing surveys. For the purposes of this discussion we assume that this pool count includes the surveyed stream segment upstream of the last detected fish.

Recommendation:

Revise the survey protocols related to the number of pools of sufficient size to more accurately reflect conditions in small headwater streams.

f. Larger streams (streams that should naturally be fish habitat); is there a stream size that should automatically be considered fish habitat?

Conclusion:

There is no scientific evidence to support a single default stream size that should automatically be considered fish habitat.

Discussion:

ETG members concluded that there are some larger streams that do not contain fish, particularly those reaches upstream from permanent natural barriers.

ALTERNATIVES TO ELECTROFISHING

1. Are there alternatives that can achieve FFR/HCP precision and accuracy targets while reducing e-fishing?

Conclusion:

There are a number of alternatives to electrofishing and each has its advantages in terms of cost savings or reduction of harm to fish. However, not all have been evaluated relative to achieving FFR/HCP precision and accuracy targets.

Discussion:

a. eDNA

Environmental Deoxyribonucleic acid (eDNA) sampling is quickly becoming a useful tool in the detection of organismal DNA in water. The emerging information from eDNA researchers on fish detection indicates that legacy DNA can create false positives that still necessitates the need to validate eDNA results with tools like electrofishing. eDNA could be used to identify streams that lack fish, but the technique is prone to false negative results when fish are rare. Whereas, streams with positive eDNA detections could be further explored with electrofishing surveys for occupancy and distribution in the drainage network.

b. Continued use of default physical criteria

TFW Policy is currently re-examining default physical criteria to see if they accurately reflect fish presence.

c. Model

This includes examining models, remote sensing (e.g., LiDAR), and other screening tools that could potentially target field validation efforts resulting in a reduction in the use of electrofishing.

d. Lentic sampling techniques

For areas (ponds, wetlands, other slow-flowing waters) where electrofishing is not the appropriate approach there are other alternative methods such as minnow traps, seining, and hydroacoustic surveys that can be used. If the water body is large enough and boat access is possible, a boat shocker can be used.

e. Visual Observation

Snorkeling can be used in pools to visually observe fish and can be effective where streams are too deep to be wadeable. Some fish species, because of their habitat preferences, small size, or cryptic coloration, are difficult to observe by snorkeling. Another technique utilizing visual sighting is simply to walk the banks of the stream and watch for fish, but in small channels with considerable instream and riparian cover fish are hard to observe.

f. Trapping

Trapping using wire minnow traps is a tool used to sometimes supplement electrofishing in deeper habitats/pools or where electrofishing is not appropriate for specific species. The efficacy of trapping is highly dependent on fish species. Traps in streams may be more useful for capturing invertebrates such as crayfish. Other methods, like snorkeling, are more often used for observing fish. Standardization of trapping currently has not been developed.

<u>Recommendation:</u>

There may be a need to re-examine listed alternatives to determine if they meet FFR/HCP precision and accuracy targets, and understanding advantages and disadvantages of implementing each method.

TRAINING AND/OR CERTIFICATION

Conclusion:

Protocol electrofishing surveys rely on both accuracy in establishing fish presence at a site and consistency of technique when multiple sites are surveyed over a field season. Experience can help ensure that surveys cause a minimum of harm to fish and eggs that might be present at a site, but keeping up with modern equipment and technique is important too. Additionally, leaders of survey crews need to maintain data quality control among crew members and assure that field protocols and other rules are followed. For these reasons, the ETG concluded that there would be value in having a training and/or certification program available to organizations engaging in protocol electrofishing surveys. We note that protocol electrofishing training would involve receiving instruction in both electrofishing theory and field techniques, while protocol certification would add an element of testing and (possibly) prior experience in electrofishing and stream classification. We anticipate that field crew leaders would be protocol electrofishing certified.

Discussion of alternatives:

1. Certification Process

a. Would training and/or certification be creating an issue rather than solving one?

Training needs not only to focus on electrofishing, but also on the process of water typing as a whole. This will ensure that current practices are well understood and new individuals entering the field continue with this established process. Certification can be incorporated into the training process by providing a test so that attendees can demonstrate aptitude in the material. Short term, a mandatory training and certification program would put a burden on training all practitioners. Additionally, it would create the need to identify organizations who can develop a training course and subsequently train and certify people. Further, it would require specifying how often this training/certification needs to be renewed and what costs are associated with potential training and certification. Many current practitioners are resistant to needing certification, but do understand the need for future practitioners to be properly trained and certified.

Other potential questions included:

- Would the experience of an operator be considered when establishing requirements for training/certification?
- Would the information needed to secure a Scientific Collection Permits already capture much of the requirements related to experience?
- Would training and/or certification be designed for both surveyors and water type modification (WTM) application reviewers?

The ETG was not sure if both practitioners and WTM reviewers would need to be certified (comparable level of training?). If certification simply focuses on the use and operation of electrofishing equipment, then reviewers may not need to be trained and certified. But, if certification and training includes water typing methodology, then reviewers and users would both find value in training and certification. Is certification/training more a topic item for compliance rather than for refinement of the WTM form? If during review it is discovered that a survey did not follow the protocol, then it should be documented that alternative methods were approved. Certification and training will only resolve this issue if the training includes instruction on how to follow the protocol and prepare a WTM that satisfies reviewers.

Certification programs are currently being offered by USFWS, Smith-Root, and NWETC that cover electrofishing safety, equipment use, and fish handling while electrofishing. There is no formal certification program for the methodology of assessing stream type modification. Therefore, it will be important to determine what information training and certification would encompass, at what point the entire training and certification process could be integrated into one course. To be clear, training involves instruction, whereas certification involves a demonstration of proficiency on the training material, often evaluated by passing a test.

Currently, training is left to practitioners training one another. This can create inconsistencies and sometimes spread misinformation. Formalized training minimizes inconsistencies and mitigates against the spread of misinformation. However, certification and maintaining certification records does create an oversight issue of who would be in charge of maintaining the database and informing those who need updated training.

Some members of the ETG expressed concern that the safety aspects of training would cover primarily safety for electrofishing crew members and that there is also a need to include proper training in fish handling, minimizing the risk of spreading invasive species, and other issues relative to protecting aquatic ecosystems. There was the suggestion that practitioners could opt out of certification and/or training if they could establish a history of professional experience, while another suggestion was that prior experience with protocol surveys and WTM forms should not necessarily be required for certification.

Typical information relative to fish presence or absence submitted with WTM forms is often not standardized. Some ETG members felt water type modifications or proposed changes to the current water type at any given site should follow one standard process. Small landowners seem to be reluctant to use the WTM form. ETG members were not sure why, but felt that incorporation of WTM instructions could be included in a training/certification program, resulting in increased use of the form.

b. Scientific Collection Permit

A Scientific Collection Permit is useful to further demonstrate electrofishing competence. The ETG felt a Collecting Permit should not be used as a surrogate for training and certification, but rather as a supplement. The suggestion was made that the WTM form could include a box where the Collection Permit number could be included. If some other survey method was used (e.g., visual observation) the form should indicate that as well.

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