Alberta Environment and Sustainable Resource Development	**Title:** **Standard for Sampling Small-Bodied Fish in Alberta (Public Version)**	Date: May - 2013

Principal Issue:

A consistent method of collecting data on diversity, abundance and population structure of small-bodied fishes in Alberta is required. Comparative information on these fishes is necessary to assess changes in ecological integrity. Specific management needs such as commercial bait fish management and ecosystems effects of fishing regulations also require comparative information on small-bodied fishes.

Application:

The field data collection techniques prescribed within this document shall be followed. Depending on the intent of the survey, it is unlikely that one technique on its own will be able to provide a comprehensive assessment of the small bodied fish present in a waterbody. If warranted by survey objectives, seines, small mesh gill nets (modified FWIN nets), minnow traps, electrofishers, and hydro acoustics should be used in conjunction with each other to provide a more holistic picture of the small-bodied fish communities found in Alberta waterbodies.

Developed by:

- Development by Fisheries Management Branch Standards Committee
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- Adopted in conjunction with Alberta Biodiversity Monitoring Institute

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Approved by (Executive): **Original Signed by: Travis Ripley**

Executive Director of Fisheries Management **Date:** Nov 4/13

Standard for Sampling Small-Bodied Fishes in Alberta

Comparative information on small bodied fishes is necessary to assess changes in the ecological integrity of Alberta's waterbodies. Specific management needs such as commercial bait fish management and ecosystem effects of fishing regulations and recruitment also require comparative information on small-bodied fishes (minnows, sculpins, stickleback, trout-perch, and all small juvenile fishes generally of lengths less than 15 cm), found in littoral areas of lakes and in streams.

During field trials in 2005 and 2006, minnow traps were used by the Alberta Biodiversity Monitoring Institute (ABMI) to assess the biodiversity of small-bodied fishes in lakes. The catch rates of species and individuals were very low in these trials (ABMI 2006), and a more efficient technique was desired. In 2006, Sullivan and Patterson conducted a series of casual field tests which compared catch rates for baited minnow traps to the catch rate data recorded by the ABMI field tests (Appendix 1). Results obtained from the minnow trap studies were compared to beach seine catch rates recorded during extensive studies on small-bodied fishes at eight Alberta lakes during 1996 and 1997 (Sullivan 2003). Even though these studies were not direct comparisons (i.e., the same waterbody at the same time and location), it was apparent that beach seines were far more effective in terms of both number of species and number of individuals captured than minnow traps. In terms of manpower efficiency (assuming a two-person sampling crew), beach seining captured approximately 174 fish / crew-hr compared to 20 fish / crew-hr for baited minnow-traps. As a result of these field trials, the ABMI program adopted seine nets for sampling small-bodied fishes in lentic systems.

Since the effectiveness of seining depends on the species sampled (size, swimming speed, water column orientation and macro and micro habitat association), the population of interest, and the habitat that is seined (any object that snags a seine or causes it to lift off the bottom can allow fish to escape), small fish sampling should consist of multiple gear types as one gear type will generally not provide adequate sampling of all species and habitat types. Sampling for small bodied fishes within lentic systems is recommended to take place during the summer months (mid-June through mid-August) when water temperatures are above 15^{o}C. Sampling for small bodied fishes within lotic systems is recommended to take place during open water periods (April through October).

If determining species diversity, abundance, and population structure within surveyed waterbodies, other methods such as small mesh gill nets, minnow traps, electrofishing, and hydroacoustics should be used in combination with seining. Many surveys may miss species unless a variety of sampling gear is used or considerable effort is expended with the various gears. Only by increasing the diversity of gears is it possible to enumerate adequately the species richness of most lakes and streams.

To ensure consistency across the province, the following procedures should be adopted when surveying small-bodied fish within lentic and lotic systems. It is recommended that all techniques or a combination of techniques should be used to get a full understanding of species abundance and diversity within systems. Depending on the objective of the survey, locations and number of hauls, sets and transects required, will have to be determined during development of the study design. For example, if an abundance estimate is desired, a single seine haul per habitat site may be adequate if the seine has been calibrated for efficiency; if the classification of each site is an objective, single samples may be scattered randomly (stratified into habitat types); or if trend data is the objective, non-randomly selected permanent sites may be adequate. Calibration of the equipment will be required when catches must be expanded to estimate the total populations present in the selected habitat or when calculating species diversity indices that incorporate abundance or densities.

Seining

Small-bodied fish surveys using seines in lentic situations are to be conducted using the methods described below, whereas in lotic situations, the protocol outlined in the *Standard for Sampling of Small Streams in Alberta* (AFMB 2013) is to be followed. Method of retrieval and mesh size affects the selectivity of the gear towards certain species and sizes, and must be consistent at all locations surveyed. In lentic situations seining should be conducted parallel to shore. The off-shore seiner should walk in advance of the on-shore seiner. After seining is complete the off-shore seiner is to bring that end of the seine to shore, then the seine is pulled in making sure that the lead line remains in contact with the bottom and the float line in contact with the surface. Seine sites are to be established in water less than or equal to 1.3-m in depth. There is no defined area which must be seined, but the length of each seine haul is to be 30 continuous metres (Drake 2007). The area seined must be determined (m^2) and the fish/species caught are to be reported in number/ m^2. To sufficiently describe the species richness and composition of fish inhabiting the littoral zone of lakes, eight seine hauls equally spaced around the lake, of which the first site is picked at random, is required (Drake 2007). The minimum dimension of the seines to be used shall be 10 x 1.5 m (33 feet x 5 feet), with a recommended mesh size of 6.4 mm (hexagonal mesh). A bag of a smaller mesh size (2mm) is recommended for incorporation into the middle of the seine to help facilitate capture/retention of small fish.

Multiple hauls from the same general area and habitat type allow for more rigorous statistical analysis on mean density data and comparisons among sites for various variables and should be averaged to get the relative abundance for that particular area. Data can be extrapolated to larger areas if species distribution and habitat conditions are similar (water depth, substrate, vegetation, etc.). The reported estimate of fish/m^2 is an index value (unless adjusted for known net efficiency for the specific conditions) that would only be comparable to other results of very similar sampling gear, species composition, size distribution, and habitat conditions. If sampling to identify species richness, rare fish distributions, or simple presence/absence of a species at a particular geographical locale, capture efficiency should be taken into account. Single hauls are not reliable estimators of rare taxa or total abundance. Failure to identify an individual species at a location does not demonstrate that it does not exist there and may be the result of poor sampling efficiency.

The need for evaluating capture efficiency (CE) of a seine depends on the intended use of the data collected. If absolute density estimates or relative taxon abundances are required an evaluation of CE is essential. However, if population trends are being measured or if the fish community consists of species with similar vulnerabilities, computation of CE may not be critical. Experiments to test CE must duplicate the techniques used and the environmental conditions encountered during routine collections.

Small Mesh Gill Nets

Modified Fall Walleye Index Nets (12 and 19 mm meshes separated by a 15m space, added onto the end of regular eight panel FWIN net) have been used to successfully sample small-bodied fish (sport and non-sport species) in lentic waterbodies. These nets are deployed perpendicular to shore in water > 2 m in depth (see Morgan 2000 for a complete description of FWIN protocol). This method appears to be more qualitative than seining if the intent of the survey is to quantify the density of small bodied fishes. This methodology continues to be tested to calibrate small-bodied fish catch rates to density, however, it is recommended that these mesh sizes are included in any lentic sampling targeting small-bodied fish.

The modified FWIN gear to be used is a mono-filament gill net (each panel is 1.8 m deep by 7.6 m long), consisting of 10 mesh sizes (stretched measure). The different meshes are sewn together in ascending order of size (12 mm (0.5 inch); 19 mm (0.75 inch); 25 mm (1.0 inch); 38 mm (1.5 inch); 51 mm (2.0 inch); 63 mm (2.5 inch); 76 mm (3.0 inch); 102 mm (4.0 inch); 127 mm (5.0 inch); 152 mm (6.0 inch)) with no spacers except between the 19 and 25 mm meshes where there is a 15 m space. The filament diameters are: 0.13 and 0.16 mm for the 12 and 19 mm mesh respectively; 0.23 mm for the 25 and 38 mm mesh; 0.28 mm for the 51 and 63 mm meshes; 0.33 mm for the 76 and 102 mm meshes; and 0.52 mm for the 127 and 152 mm meshes. The hanging ratio is 55% and the rigging twine is twisted 1.15 mm nylon. Fish caught are reported as fish/100 m^2/24hrs.

In lotic situations only one or two mesh sizes can be used since the size of the pools inventoried dictate the amount of net which can be used. In these instances the size of mesh sizes chosen should align with project objectives (i.e. species and life stages targeted).

Gill nets are typically used when the sacrifice of fish is either necessary and/or where the risk of the activity is considered low to the fish populations present. The length of the net set is a large factor in the amount of fish mortality observed. If deployed in lotic waterbodies they should be checked and cleared frequently (every two hours or less, particularly where non-lethal sampling is an objective). If deployed in lentic waterbodies they should be set overnight for no greater than 24 hours (net set times should be significantly reduced where non-lethal sampling is an objective).

Multiple net sets allow for more rigorous statistical analysis on mean density data and comparisons among sites for various variables and should be averaged to get the relative abundance for that particular area. A single net set is not a reliable estimator of rare taxa or total abundance. Failure to identify an individual species at a location does not demonstrate that it does not exist there and may be the result of poor sampling efficiency. Number of net sets and locations should ultimately align with project objectives.

Minnow Traps

Minnow traps are a passive sampling technique that is not very efficient at capturing large numbers or species of small fish, but they can catch species that are hard to catch using other methods (i.e., electrofishing or gill netting). The traps generally used are Gee Minnow Traps which consist of two pieces clipped together to form a small cylinder slightly tapered at either end. Each end has a funnel which leads into the centre of the trap which allows fish to enter, but prevents them from escaping. The opening diameter of the funnel is 2–3 cm and the trap consists of a mesh size of 0.5 cm. Traps are to be placed on the substrate in shallow shoreline areas of lakes and streams (depths of 0.5 to 2.0 m) with the long axis of the trap parallel to the shoreline. A length of sideline is used to tie the trap to an anchor to keep it in place. The anchor site must be flagged so that the site can be easily found when returning to check the trap. Traps can be baited or unbaited, depending on whether the intent is to trap fish moving through the area, or attract fish to the trap. If bait is used, the type and amount must be recorded. Traps should be set overnight for a minimum of 18 hrs, however, they should be checked minimally every 12 hours and cleared if large numbers of fish are captured. If applicable, indicate why minnow traps were not able to be set overnight. Sampling effort is to be recorded as the number of hours that the trap is set and fish caught recorded as number of fish caught/hour.

Multiple traps from the same general area and habitat type allow for more rigorous statistical analysis on mean density data and comparisons among sites for various variables and should be averaged to get the relative abundance for that particular area. Data can be extrapolated to larger areas if species distribution and habitat conditions are similar (water depth, substrate, vegetation, etc.). The reported estimate of fish/hour is an index value (unless adjusted for known trap efficiency for the specific conditions) that would only be comparable to other results of very similar sampling gear, species composition, size distribution, and habitat conditions. If sampling to identify species richness, rare fish distributions, or simple presence/absence of a species at a particular geographical locale, capture efficiency should be taken into account. A single trap is not a reliable estimator of rare taxa or total abundance. Failure to identify an individual species at a location does not demonstrate that it does not exist there and may be the result of poor sampling efficiency. Number of traps used and locations of traps should ultimately align with project objectives.

Electrofishing

With the proper settings (90-120Hz for cyprinids), electrofishing can be a valuable tool for collecting small-bodied fish in lentic and lotic situations where seining and minnow trapping are not effective. Electrofishing can be biased towards larger fish (big fish are more likely to be immobilized than small fish due to their larger surface area and the larger head to tail voltage gradient), but by increasing the output frequency of the electrofisher, the head to tail voltage gradient in small fish can be increased making them more vulnerable to capture. Increasing the frequency to catch small fish will put any large fish in the vicinity of the electrofisher at risk by increasing chances of injury and mortality. Electrofishing for small bodied fish is generally more effective at night or twilight. Electrofishing sites in lentic situations should coincide with the seining sites (e.g., eight 30-m sections). Two transects should be electrofished, one along the shoreline and the other at the 1-m depth contour. In lotic situations, follow the procedures outlined in *Standard for Sampling of Small Streams in Alberta (AFMB 2013)*. To ensure consistency, avoid changing the waveform after it is selected. Whether sampling in streams or littoral areas of lakes, record the number of fish caught (by species), time fished (in seconds), distance fished (in metres), and area fished (m^2).

Hydroacoustics

Hydroacoustics is an alternate way of assessing fish stocks by measuring abundances and distributions of pelagic fishes. This technology has been proven an effective method for estimating fish abundance and biomass in lakes, and rivers. Acoustic gear allows sampling of a much larger volume of water than other methods (such as seines), provides a much higher degree of spatial coverage, and may not be as severely influenced by size selectivity common to other gears. This technology, when integrated with other fish sampling methods, provides a size and/or species-specific estimate of fish abundance with high confidence and precision, providing an effective method of sampling small bodied fishes.

Hydroacoustic assessments have traditionally employed mobile surveys from boats to evaluate fish biomass and spatial distributions. Split-beam transducers should be used for counting individual targets, and are required for tracking (in fixed-location applications) individual targets, and for determination of accurate acoustic target strength measurements. Target strength can often be used for size classification of detected targets.

The use of hydroacoustics has several limitations. Species cannot be directly identified, which will require the application of other traditional fish sampling programs (e.g., gill nets, seines, electrofishing, etc.) to verify species identity and to obtain detailed information on size frequency, age, sex, etc. Hydroacoustics can estimate fish size, and this information coupled with multi-frequency and distributional information (e.g., depth or diel distributions) or behavioral data (e.g., swimming path, velocity), frequently aids partitioning of fish abundance estimates by species. Acoustics cannot easily sample fish that are near the surface or within about 0.5 m of the bottom of the water column. In river situations the river must be deep and wide to sample a sufficient volume.

In order to collect accurate information about fish size all sonar equipment must be calibrated prior to data collection. Calibration involves placing a standard acoustic reference (usually a copper or tungsten sphere) of known target strength into the sonar beam. Calibration should be conducted prior to each survey, following the equipment manufacturer’s instructions and specifically where environmental parameters have changed notably since the previous survey. In river situations the ease of calibration is greatly increased with the use of a remotely operated pan and tilt mounted transducer.

Careful consideration and planning of survey design and methodology is crucial when providing meaningful information about population abundance, behaviour, or spatial distribution of aquatic organisms. When designing hydroacoustic surveys a number of questions should be considered: What frequency should be used? In Alberta a frequency of 200 kHz should be used for small bodied fishes. Should the survey be a daytime or night time survey? Where should the transect lines be placed? How long should transects be? To also help in effectively designing a survey, other important considerations include the geographic extent and spatial distribution of the population, the horizontal and vertical movements of the focal species, behavioural characteristics such as schooling and spawning, and budget.

Mobile acoustic surveys should be conducted at a constant speed (1.5 – 3 m/sec along fixed-line transects) and GPS locations taken to provide data points to map fish distributions and to use the data to make population estimates. The design and timing of the acoustic survey depend on the spatial distribution and behaviour of the target species. In combination with an acoustic survey, physical and chemical measurements across the sampled area, biological sampling, acoustic calibration and measurement of fish target strength are required. Measurements that define the physical and chemical habitat of the fish (e.g., temperature, oxygen levels and water depth) should be taken routinely along the transect lines. Biological samples (usually obtained with trawls or gill nets) are needed to help identify acoustic targets and to corroborate acoustic estimates of fish size. Biological samples should be large enough and taken with sufficient frequency to provide estimates of fish sizes and relative species composition.

Sampling Criteria

At each site where small fish are sampled, the following information must be collected as per the *Standard for Sampling of Small Streams in Alberta* (AFMB 2013):

The activity date(s), crew members, station number, sampling location, time activity occurred (i.e. net set/pulled, seining, etc.), if used, the length of seine, mesh size, distance sampled, area sampled, depth of seine, for gill nets; the length of each net panel, mesh sizes and depth of net. In addition, the water depth at both ends of the seine must be recorded (in metres). This will enable volume calculations of the water seined. Also record any hazards which would interfere with seining operations (i.e., boulders or large woody debris, and any emergent or submerged vegetation cover in area seined). If electrofishing, the time fished, distance fished, area fished, pulse width, and frequency is required.

At each site seined and/or electrofished, it is recommended that the shoreline type and substrate type (if seining, electrofishing, or using minnow traps) be recorded as well as an estimate of the percentage of area with no vegetation and percent with emergent and submerged vegetation cover (total must add up to 100%). It is recommended that substrate type (bedrock (>4000 mm), boulders (>256), cobble (65 – 256 mm), large gravel (17-64 mm), small gravel (2 – 16 mm), fines/sand/silt (< 2 mm), be recorded to the nearest 10% (Udden-Wentworth grain-size classification scheme (Wentworth, 1922)).

Capture Efficiency

One of the most practical methods of measuring capture efficiency for a seine net in a lotic system is to use block nets to trap a representative group of fish within an enclosed space, conduct one or more seine hauls within the enclosure (seine 40–70% of the enclosed space), either calculate the number of fish within the enclosure by conducting a population estimate (Peterson or maximum likelihood estimates) or retrieve the block nets carefully (removing all fish left in enclosure), then calculate capture efficiency (Parsley et al 1989; Bayley and Herendeen 2000) by dividing the number of fish caught by seining, by the total number of fish found in the enclosure (seining + number removed by pulling in block nets or from a population estimate) . The first seine haul is used to estimate CE for a single set (as in Bayley and Herendeen 2000), or the entire series of hauls could be used in aggregate (as in

Wiley and Tsai 1983). This allows as natural a situation as possible in which fish can choose all options for escape. Calibration trials should be repeated in several locations to represent as best as possible the habitat sampled and also to compensate for erratic individual CE values caused by schooling fishes (the school might or might not be caught within any one seine haul).

The same principle can be used to determine capture efficiency for electrofishing or minnow traps.

In lentic systems, it may be more difficult to completely enclose an area, however, the principles stated above remain the same.

References:

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