Appendix to ISAB and ISRP Review of the Salmonid Field Protocols Handbook (ISAB&ISRP 2007-5)

Specific Comments on Handbook Sections and Field Protocols

Comments are given under the titles of the respective chapters, as outlined below. The page on which each chapter starts in the Handbook is also indicated. The ISAB and ISRP comments state "no comments offered" for Handbook sections that were not reviewed in detail.

SPECIFIC COMMENTS

A. Essays

These early chapters of the Handbook are general in nature, as introductory material should be. They nicely establish the necessity of well thought out study design, data collection, and data management.

1. Introduction, p.1. No comments offered.

2. Evolving Towards a Common Global Language for Salmon Conservation, p.7 No comments offered.

3. The Role of Sample Surveys: Why Should Practitioners Consider Using a Statistical Sampling Design?, p.11

If users of the Handbook really take to heart the messages in this essay, the accuracy and utility of aquatic data will be greatly improved. The essay includes a review of common sampling designs used for monitoring and collecting fish population data and promotes use of a fairly new method, the EMAP probabilistic GRTS design, which may have promise as a regional aquatic status and trend monitoring design.

Page 11, top: The distinction between sampling design and response design needs to be clarified. The distinction is an important one but a bit ambiguous even in Stevens and Urquhart (2000:15) where they define response design as "deciding what to measure and how to measure it."

By "how to measure it" Stevens and Urquhart are not referring to decisions such as whether to use beach seining or electroshocking but rather to decisions such as whether to take a single sample (by whatever method) at each site or multiple ones, whether to sample weekly, monthly or annually, and so on. The response design would also specify what other variables, such as temperature, current velocity, etc., that would be measured at a site, and exactly where and when those measurements would be made at each site, but NOT the type of measurement device.

Page 16, middle: Allocating relatively more sampling effort to strata with high densities will achieve greater precision in an overall estimate if variances are higher in those strata. Given that there usually is, with abundance data, a correlation between mean and variance, the statement is reasonable. But it is not high mean density per se that produces greater precision with this type of allocation, only the higher variance associated with it.

Page 17, middle: The statements concerning rectangular or triangular grids are confusing.

4. Data Management: From Field Collection to Regional Sharing, p. 25 No comments offered.

5. Methods, p.55 No comments offered.

B. Field Protocols

1. Carcass Counts, p.59

This chapter seems incomplete and does not provide the reader with enough information to implement a study using carcass counts. In addition, the chapter occasionally extends beyond carcass sampling, mentioning methods requiring the capture of live fish (and in one case a mention of genetic sampling for birds). Ideally, the information in this chapter might be combined with the chapters on Redd Counts and Foot-Based Visual Surveys for Spawning Salmon. All three methods require the same basic approach relative to the selection of sampling locations, equipment and data collection. Carcass sampling does differ from these other methods in that data such as length, weight, tissue samples, and such are often collected from carcasses. Nonetheless, the methods are sufficiently similar that they should be addressed in the same chapter. In fact, carcass counts and counts of live, spawning fish are usually conducted during the same survey.

This chapter might include much more detailed information on how count data can be used to estimate various demographic parameters of spawning populations. A description of mark-recapture using opercular punches is given. But this description is so brief that significant additional information would be required to implement the protocol. For example, there is no mention of methods to capture live fish for marking. Nor is there any discussion of the considerations required to identify locations for recapture and what ramifications this selection might have on the reliability of the population size estimate. Similarly, the example given to illustrate a method for estimating age and gender composition is incomplete.

The discussion of tissue sampling procedures also is a bit confusing. The methods do not appear to be specifically for carcasses. In fact, it is suggested that fin samples be collected only from live fish as DNA in the fins of carcasses may be sufficiently degraded to preclude DNA extraction. As this is a chapter on carcass sampling, the protocols should focus only on those appropriate for carcasses. The section captions also are somewhat cryptic.

Page 63: Sampling carcasses for egg retention would be a necessary component of the sampling protocol only if this parameter was required to address the objectives of the study. For example, if nutrient delivery to the system were the question of paramount importance, it would not be critical to measure egg retention.

Page 64: The carcass sampling protocol indicates that the carcass should be “discarded” after all biological data have been collected and the tail cut. What is meant by discarding the carcass? Shouldn’t it be left about where it was found?

Page 68, top: Assumption #4 is not required: if there is recruitment to the population, and no loss from it, the population estimate is valid for the "recapture date" but not the "marking date." Assumption #5 should be modified by adding "... that affects probability of recapture" to it.

2. Cast Nets, p. 87

This technique has good promise for sampling juvenile salmon in shallow river and estuary habitats (e.g., intertidal zone). It likely never has been used in the Columbia River Basin for sampling salmonids. Therefore if it were to be used a totally new data set would be generated. It might also be useful in reservoir sampling, although blockage owing to aquatic vegetation might be a problem.

This method might improve the accuracy of sampling fry and smolts in the intertidal zone of the lower Columbia River relative to beach seining, the most common technique. The latter method is well known to be inefficient and biased. Cross calibration of cast nets and beach seines might be possible, but conversion factors would vary widely with habitat type, season, fish size, etc.

Cast nets sample a relatively small area, and it is likely numerous casts would have to be made to adequately sample intertidal habitats. This would take more time than beach seining. Cast nets are probably most effective in small streams or lake shores, as the author states.

3. Electrofishing: Backpack and Drift Boat, p.95

This chapter discusses mark-recapture, removal-depletion, and catch-per-unit-effort methods of estimating population size. Therefore, there will still be a considerable amount of variation in the methods being employed across the region, even if this volume is designated as the regional standard.

This section provides a reasonably complete overview of the general considerations required for electrofishing sampling. However, the chapter does not contain sufficient detail to fully address all considerations required to successfully design and implement a study based on electrofishing and the reader would be required to consult other sources to fill these gaps. These additional sources of information are specified; the chapter is thoroughly referenced. However, the need to consult additional sources to complete the design of the sampling protocol does raise the possibility that electrofishing sampling protocols developed from this chapter would vary considerably. To the extent that a goal of adopting this book as a regional standard is to ensure compatible sampling methodologies, this may represent a problem.

Pages 95-98: The discussion on the use of power analysis and MSE in developing a sampling design applies to most of the sampling methodologies covered in the book, not just electrofishing. If a revised edition of this book is anticipated, the authors should consider a separate chapter on the use of these tools in developing study designs.

Page 100, middle: Assumption #1 is inaccurate. If there were movement both in and out of the population but "net movement" was zero, the estimate would be biased to an unknown (and generally unassessable) degree. If there is only movement into the population, the estimate remains valid for the population on recapture date. If there is only movement out of the population, the estimate remains valid for marking day, assuming probability of death or departure was the same for marked and unmarked individuals.

Page 101: There should be some discussion of the available alternatives for abundance estimation when the assumption of a closed population cannot be met -- at least a paragraph on the basic theory of how this problem is addressed. Alternatively, this topic should be treated in the ISAB and ISRP's suggested introductory chapter on *Mark-Recapture Methods*.

Page 107: Step 3 of the protocol is not entirely clear. What is meant by "Measure site length along the contours of the stream channel."? Measure along the thalweg? Along the bank?

Page 110: Are there concerns that certain types of fin clipping could impact catchability during recapture and thereby violate an assumption of the method? Specifying the types of fin clips that are the most benign would be useful.

Pages 113-114: Discussion of accumulation or rarefaction curves (they are essentially the same thing) is generally misleading, probably because it is based on unreliable sources. There can be no way, for example, of determining when one has "captured 90% of the species present" or the "true number of species present" - unless one knows the total number of species present to begin with! For any natural system of more than tiny spatial extent, species richness cannot be determined.

When such curves are plotted with an arithmetically-scaled x-axis for sampling effort or sample size, they may *seem* to approach an "asymptotic level." But this is an artifact produced by the rarity of most species combined with the miniscule percentage of individuals in the community that end up in the sample.

Rarefaction curves plotted with a log-scaled x-axis will almost never show sign of approaching an asymptote. Exceptions would occur when dealing with very species poor assemblages, such as stream fish.

Obviously, if all stream fish known to occur in the region are represented in your collection of 2,000 electroshocked specimens, it is reasonably to assume that collecting another 200,000 fish in the stream is not going to discover additional species. But in general, there are never grounds for estimating what percentage of the species present in a stream are present in a sample.

Page 114, Fig. 4: Per the preceding comment, this type of figure is best modified in three ways: a) label y-axis, "no. spp per 200m", or in some way to specify what sampling unit your richness value actually pertains to; b) log-scale the x-axis; c) determine the smooth curves analogous to rarefaction curves, by, e.g., calculating mean number of species per stream segment, mean total number of species for all possible samples of two segments, mean total number of species for all possible samples of three segments, etc. This last procedure will avoid having the shape of the curve being arbitrarily determined by the sequence in which samples are "accumulated."

Page 116, bottom: Some statements concerning assumptions underlying mark-recapture methods are confusing or incorrect. See comments on similar problems in earlier chapters.

Page 118: Step 10 suggests that fish be released 15 m upstream of the boat. Does this mean 15 m upstream from the location where the fish were measured and clipped? Also, is it being suggested that the fish be released from the bank as releasing them 15 m upstream from the boat while in the boat would require very long arms. This step needs a little clarification.

Page 120: It might be mentioned in the safety discussion for backpack sampling that fiberglass handled nets are a good idea for this method as well as with boat shocking.

Page 122-123: The discussion on injury related to electrofishing might be more detailed. This issue is very contentious and injury is a major consideration in the granting of sampling permits, especially for listed stocks. Some discussion of the reduction in injury rates with the new electrofishing technologies introduced over the last 5 - 10 years would be useful. Also, emphasizing again the need to ensure that shocker output levels are set appropriately for the conductivity and temperature of the sample site to reduce injury rates would be valuable in this section.

Page 123-124: The brief data analysis section only provides an overview of the estimate calculations for mark-recapture. Removal-depletion estimates are used as frequently as mark-recapture and some discussion of the basics of calculating this estimator also should be included here or in a chapter earlier in the Handbook.

4. Hydroacoustics: Rivers, p.133

It is not clear why the hydroacoustic (HA) protocols are separated into two chapters. These two chapters could have been combined. The equipment type and basic techniques are the same. Only the locations where they are utilized (also whether fixed or mobile) are different.

Overall, both hydroacoustics chapters seem thorough and useful descriptions of most of the elements needed to consider in conducting a HA survey. The study design requirements are nicely presented, including the specific conditions that need to be met before applying HA. The importance was stressed of “ground-truthing” the HA data with samples of fish species relative abundance taken with traditional fisheries gear such as mid-water trawls, fyke nets, etc. (prior to and during HA sampling).

It is somewhat surprising that protocols for HA studies done at hydroelectric dams were not included in either of these chapters. The specific study designs, set-ups, and potential problems encountered at dams often require differing protocols and should be included in these chapters. There is a large body of work done at Columbia River Basin hydroelectric dams to draw from that is documented in technical reports and the peer-reviewed literature.

5. Hydroacoustics: Lakes and Reservoirs, p. 153

(See comments for previous chapter)

Pages 156, 166: Autocorrelation - there is a lot of misinformation on this topic in the ecological literature, including how autocorrelation is defined and whether corrections for it are needed in particular circumstances. Phrases like "If data are spatially correlated" (p.166) raise a red flag. Samples close to each other in space or time are generally more similar to each other than those distant in space or time. But this sense of autocorrelation does not have much bearing on statistical analyses. It is how one selects sample sites from the domain of interest (i.e., the sampling design) that determines their statistical independence, not the properties of the data themselves.

Page 166, 2d para.: It is implied that it is acceptable to use acoustic transects of variable length when data from multiple such transects will be used for various statistical analyses. A caveat is that this is, in general, very undesirable. It is as undesirable as it is, in other contexts, to use variable net set durations, variable net sizes, variably sized samplers for benthic invertebrates, and so on.

The principal statistical problems created come when there are zeros in data sets. These cannot be "adjusted" in the way that non-zero values can be. But it is clear that a count of 0 in a 50m acoustic transect should not be treated as equivalent to a count of 0 in a 500m transect.

This principle is of sufficient general importance as to merit treatment in an early chapter on sampling design or data analysis.

6. Fish Counting at Large Hydroelectric Projects, p. 173

This chapter is primarily a description of the Smolt Monitoring Program (SMP) and adult counting procedures (i.e., technicians counting at the windows and preliminary descriptions of video interrogation). It does a reasonable job in describing those counting procedures.

This chapter needs to be expanded to include other protocols used at hydroelectric dams for assessing the status and trends of salmonid populations. If not covered in an early chapter, this should include mark-recapture methodology used at mainstem dams because a major part of the Fish and Wildlife Program uses mark-recapture information to assess status and trends of hatchery and wild salmonids (e.g., SARs, mainstem survival estimates, in-river/transport comparisons, travel time, etc.). A variety of tags (PIT tags, radio tags, acoustic tags, etc.) are used to make these estimates and protocols for each tag needs to be included.

Page 174: This section on juvenile passage routes needs to be updated and expanded to include significant juvenile salmonid passage through other routes. It briefly mentions that The Dalles Dam ice-trash sluiceway is another passage route but doesn’t explain its significance (e.g. at times the sluiceway passes 40% of juveniles passing that dam in only 4-7% of the water passing the dam). Other major juvenile salmonid passage routes at Columbia River Basin mainstem dams are at the Bonneville Power House 2 corner collector; the removable spillway weirs at McNary Dam and several Snake River dams; and the corner collector at Rocky Reach dam. For the corner collector at Bonneville Dam there also needs to be a description of the flat plate PIT tag detector that is a significant addition for detection of PIT tags at that dam.

Page 176, 2nd para.: The last couple of sentences of this paragraph briefly describe the PIT tag monitoring system. This is woefully inadequate and needs to be expanded into a major section or chapter. The PIT tag monitoring program is the major program for assessing the status and trends of salmonid populations in the Columbia River Basin. As this is a stated primary objective of the Handbook, this should be a goal for coverage in the next edition.

7. Redd Counts, p.197

This is a very complete chapter and covers all the considerations required to implement a successful redd survey program. This technique shares many features in common with carcass counts and live fish counts; these chapters should be combined. The chapters that address carcass and live fish surveys in this volume are incomplete. However, many of the deficiencies in these chapters are covered in the redd count chapter. Combining the chapters would also bring some consistency to some of the common topics addressed in these three chapters. For instance, the chapter on redd counts favors the use of a spatially-balanced, random design for sample site selection. The foot-based visual survey chapter suggests a random, stratified random, or stratified index design for site selection but doesn't mention the spatially balanced option. Combining the chapters would enable all these options (and their strengths and weaknesses) to be discussed in one location.

8. Rotary Screw Traps and Inclined Plane Screen Traps, p.235

This chapter is very thorough and well written and should be useful. The problems of getting a decent mark-recapture estimate, need for separate marking and recovery sites, and use of Bayesian statistics to improve mark-recapture estimates might be improved with input from a statistician, though this material might be best incorporated into the introductory chapter on mark-recapture methods suggested above.

Page 257, top: Assumptions #1 and #2 are not required. See earlier remarks on this topic.

9. Beach Seining, p.267

In general this is a very thorough chapter containing a lot of practical advice. The description of "types" of beach seines based on their configuration (e.g., circular, semi circular, etc.) is almost too detailed, and it is difficult to see how a field worker could replicate them because of variation in currents, tides, and so on.

It might be mentioned that juvenile Chinook go into the stream gravel in winter and are not available to beach seines at low temperatures.

Purse seines should be treated in a separate chapter, not in this one. Very shallow purse seines can be used which touch the bottom of estuarine nearshore areas. Use of such seines thus can complement beach seining operations.

On very gently sloping beaches (e.g., slope 1:20) such as those found on mud flats in the estuary or perhaps reservoirs it is difficult to find a piece of substrate with a steep enough angle to haul the seine up on. In these situations, one can use a "portable beach", i.e., two pieces of plywood hinged together, one placed over the pontoons of an inflatable boat and the other anchored in the shallow water (<20 cm) deep. The anchored plywood forms a beach to haul the net on.

The use of standardized beach seines (size, mesh) would improve the accuracy and utility of aquatic data sets in the Columbia River Basin. It would also be very important to standardize for habitat type (e.g., sand vs. cobble vs. mud) because this influences capture efficiency.

There is a long time series of beach seining in the Columbia River estuary, started by NOAA-Fisheries and continued by a variety of agencies and groups. Some of the beach seining methods described in the Handbook may match the methods used in the past or presently being used.

At any rate, the contemporary samplers should meet and agree upon a standard protocol (probably one picked from this chapter), because inter-calibration of gear is difficult and should be avoided.

It is uncertain how often beach seines have been used in the freshwater habitats of the Columbia River Basin. Certainly the method is applicable to the margins of tidal river segments (below Bonneville dam), the reservoirs, and lakes.

The use of standard stations (to avoid confusion with spatial variation and minimize temporal variation in capture efficiency) might restrict geographic coverage in some areas. Some habitats are not widespread, of course.

No mention is made of by-catch problems and mortality of non-target species. This former is sometimes a problem. For example, a beach seine full of staghorn sculpins can severely damage juvenile salmonids. Often there is high mortality of by-catch species during sampling operations aimed at salmonids.

A problem with beach seining is that efficiency changes with habitat type and other factors and time constraints may make it difficult to measure efficiency consistently. So while aggregating beach seine data may be a good idea when seines of the same mesh size and area swept are considered, the differences in efficiency may introduce error when the data are assembled from studies that disparate in these regards.

Page 271, middle: Neither species richness (for the stream, lake, whatever) nor any of the other variables listed would ever be reasonably estimated "by a single seine haul", so this statement should be eliminated.

Page 274, middle: “and for larger fish such as salmonids juveniles or adults, recovery efficiency is essentially 100%”: recovery efficiency could be lower when the by-catch of non-salmonids (e.g., herring or cyprinids) is high and the salmon have to be sorted from them.

Page 275, bottom: The use of snorkeling shepherds to minimize fish escapes will be impractical in many situations, especially the turbid Columbia River estuary.

10. **Snorkel Surveys**, p.325   No comments offered.

11. **Tangle Nets**, p. 341   No comments offered.

12. Tower Counts, p.363 No comments offered.

13. Weirs, p.385 No comments offered.

C. Supplemental Techniques

It is not entirely clear why these methods have been put in a separate section.

1. Aerial Counts, p.399 No comments offered.

2. Fyke Nets (in Lentic Habitats and Estuaries), p.411

There is a need to separate out fyke nets which totally block migration (as in tidal creeks where the net is set out across the channel and fish collect behind it as the tide drops) from the more usual application in lakes and rivers. The chapter focuses on the latter application and only mentions the estuarine methodology in passing. As a consequence, the literature review giving examples of application of fyke nets in tidal creeks of estuaries is thin compared to the number of papers available, ranging from Levy et al. (1982) in the Fraser River estuary BC, to Bottom et al. (2005) in the Salmon River estuary OR. The technique is also being used in contemporary studies in the tidal channels of the Grays River estuary in the Lower Columbia River estuary.

Deployment on the river margins in the main part of the Columbia River estuary and the tidal freshwater reaches might be problematic because strong and reversing currents would make anchoring the wings difficult.

Page 416, middle: Frequency distributions for fyke net catches when mean catch is high are said to tend to normality. This is very unusual for abundance data. It suggests some mechanism may be operating that truncates the right hand tail of a frequency distribution that would otherwise show positive skew, the more typical type of distribution. Perhaps this could be due to increased avoidance of the net as it fills with fish.

If so, the problem of inconvenient numerical properties of the data would seem smaller than that of a downward bias in abundance estimates at high densities (similar to what Borgstrsom, 1992, found for gill nets - see p.426 in Handbook).

3. Variable Mesh Gill Nets (in Lakes), p. 425

Some basic principles might be made more explicit here. The probability of catching a fish in a gill net is determined by the probability of the fish encountering the net and the probability of the fish being caught and retained in the net. Probability of encounter is proportional to the distance traveled by the fish during the sampling period. Gill nets are highly selective for certain sizes and species of fishes depending on the mesh sizes used (Hamley 1975) and behavior of the fishes. Selectivity is often measured for a target species by using a series of different size meshes (called experimental gill nets) simultaneously. The estimated selectivity and the probability of encounter are then used to estimate the size composition of the target fish population (Rudstam et al. 1984; Hansen et al. 1997).

Page 429, bottom: Values in the table giving recommended numbers of gill nets for lakes of different sizes seem arbitrary, especially the suggestion of adding one net for every 40ha increase above 40ha. This table might be better omitted, unrelated as it is to specific types of objectives.

4. Foot-based Visual Surveys for Spawning Salmon, p.435

Why this topic was relegated to a supplemental chapter is curious as this is a technique widely employed in the Pacific Northwest to estimate abundance of spawning salmon. The chapter does a good job of providing a general overview of the method, but the brevity of the treatment ensures that some important considerations are omitted. There is no discussion of variability in detection of fish among survey dates, water conditions or observers or what techniques might be employed to account for sampling variation. In contrast, the chapter on redd counts does address these points and some of the information is directly transferable to the live fish count methods. This chapter also could do a better job of describing how the count data can be used to estimate various demographic parameters. Area-under–the-curve is noted very briefly as one commonly used method for estimating spawner abundance from live count data. However, there are other estimation techniques that should be considered.

Page 435: "principal" is misspelled as "principle." Ditto on page v.

5. Video Methodology, p.443

This is basically a plea for standard procedures at local to international scale. This is a very reasonable idea albeit an objective likely to be achieved only over a period of time.

ISAB and ISRP References

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