FISH PASSAGE CENTER

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MEMORANDUM

TO: Trevor Conder, NMFS

FROM: Fish Passage Center Staff

DATE: September 17, 2015

SUBJECT: SMP Sampling Protocol

As NOAA looks to decrease the handling of listed species, there has been discussion regarding the overall handling, and the ESA "take" of listed species, associated with the Smolt Monitoring Program (SMP). There have been several questions regarding the justification for sampling 300-500 fish per day at the mainstem Columbia and Snake River SMP sampling sites. At the September 15, 2015, Fish Passage Advisory Committee (FPAC) meeting you asked for the documentation associated with the determination of these sampling numbers.

The establishment of a target daily sample size at the mainstem sampling sites has historically been responsive to the regional concerns, needs, and use of the SMP data. Consequently, there is no one document to describe the establishment of the sample size criteria, as these evolved with changes in the hydrosystem and the regional needs and use of the data. The following is a chronology of how the current sample size guidelines were developed.

1989–1993

In the fall of 1989 the Fish Passage Center (FPC) distributed a proposal for the upcoming 1990 SMP. Both the National Marine Fisheries Service (NMFS) and the Columbia River Inter-Tribal Fish Commission (CRITFC) recommended that confidence intervals were needed on the passage indices developed by the SMP. The FPAC assigned the FPC to have the Biometrician Group (Drs. Lyle Calvin, Doug Neely and Cliff Pereira) develop a confidence interval estimation procedure. The Biometrician's group developed a report in January, 1990 (attached) outlining the procedure and describing appropriate applications of the data.

In the ensuing years the determination of an appropriate sampling size was approached among the FPC, the NMFS CZES and the Biometrician's group. Accurate estimations of the daily collection based on the SMP sample were of particular importance to NMFS at the collector projects because of the smolt transportation project. At that time only the transportation collector projects were equipped with timed mechanical gate samplers. The recommendation made in 1992 by NOAA and Lyle Calvin for the collector projects (LGR, LGO and MCN) was:

- 500 fish per day when estimated totals were < 50,000 fish,
- 1% of the number collected at Lower Granite Dam when daily estimated totals were > 50,000 fish,
- 1.67% of the number collected at Little Goose and McNary dams when daily estimated totals are > 50,000 fish.

These sample sizes were based on keeping the coefficient of variation (CV = standard error of collection/estimate of collection) less than 5% assuming a binomial distribution of the sample.

The FPC proposed a modification establishing a sample size based on hourly sample rates. During the years of implementation of the SMP the effort had been to divide an hourly sample rate into several subsamples over the entire hour, due to the observations of a clumped emigration pattern of fish exiting from the wet separator (see attached memo dated October 19, 1992). The optimal setting was for six subsamples to occur over an hourly period. The FPC also requested a minimal sample rate (12 sec) due to concern with the limitations of settings on the mechanical timers and possible edge effects from short duration opening and closing of the sample gates. The proposed FPC sample rates were implemented at the collector projects (including LMN beginning in 1992). At the John Day Dam gatewell sampling was conducted with dip nets. And at Bonneville Dam a manually timed sample was taken from the bypass channel at Bonneville First Powerhouse during this time period.

1995

The FPC was asked to reduce the large numbers of fish sampled during peak passage with the existing criteria. A new sample rate was developed (0.677%) when collection numbers exceeded 100,000 fish to address this concern.

1998–2000

In 1998 the JDA juvenile facility went into operation and in 2000 the Bonneville Second Powerhouse facility began operation. All projects now had timed sampling capability and multiple subsamples were collected within the hourly sample rate.

2002

By 2001 all the old mechanical timers had been replaced with electronic timers, where sample rates can be more finely adjusted, allowing for more variation in sample rates. The targeted daily number of fish was between 250 and 750 fish, dependent on daily collection and corresponding sample rate, maintaining a CV of less than 0.05.

These sample rates (see Minimum sample rates for SMP dams, attached) remained in effect until 2010.

2008–2010

In 2008 the FPC was requested by FPAC to work with the Corps of Engineers (COE) to develop a standard procedure for fish condition monitoring. At the same time the FPC undertook the task of standardizing the SMP data collection and recording procedures among its sampling sites. Through these efforts the FPC identified (memo dated March 31, 2009) procedures that differed among sites that when corrected would allow for a reduction in fish handling. These included: differences in barge loading reporting requirements; the need for the determination of a standard sample size requirement for condition monitoring; and the standardization of fish condition procedures.

FPC staff worked to address regional concern regarding fish handling and to decrease daily sample rates, while preserving the integrity of the SMP. A reduction in sampling was possible by assuring that all sites used the same barge loading criteria and relaxing the daily CV to near 5%, rather than to less than 5%. Given the operational changes at the dams (i.e., spill programs at the collector projects), the issues of overcrowding in transportation barges occurred less often. The new guidelines issued to all the mainstem projects in the SMP in 2010 was to target a daily sample collection of 300–500 fish, using the sample rate protocol described in the following table.

Estimated Daily Collection	Sample Rate (%)	Equivalent Multiplier (1/sample rate)	Sample Sec./Hour	Subsamples per Hour	Subsample Duration (sec.)	Estimated Number of Fish in Sample
Emergency	0.5	200	18	2	9	
50,000-75,000	0.7	143	25.2	2	12.6	350-525
35,000-50,000	1.0	100	36	3	12	350-500
20,000-35,000	1.5	66.6	54	4	13.5	300-525
15,000-20,000	2.0	50	72	6	12	300-400
10,000-15,000	3.0	33.3	108	6	18	300-450
7,500-10,000	4.0	25	144	6	24	300-400
6,500-7,500	5.0	20	180	6	30	300-375
4,500-6,000	7.0	14.3	252	6	42	315-420
3,000-4,500	10.0	10	360	6	60	300-450
2,500-3,000	12.5	8	450	6	75	313-375
1,500-2,500	20.0	5	720	6	120	300-500
1,000-1,500	25.0	4	900	6	150	250-375
600-1,000	50.0	2	1,800	6	300	300-500
<600	100.0	1	3,600	1	3,600	<600

These guidelines have been in place since 2010. It is recognized that daily samples may exceed these guidelines in the event that sudden changes in fish populations occur that could not be predicted when setting a sample rate based on the previous day's sample, or when sites are required to collect fish for research purposes.

In 2010, the COE also established a daily sample target of 100 fish for each of the predominate species for the purposes of conducting condition monitoring. That 100 fish sample is taken from the total sample (300–500 fish) collected for SMP purposes of species composition and relative project passage.

As you can see from this chronology the SMP has consistently been responsive to, and has addressed regional needs and concerns. This process will continue. We hope this addresses your questions regarding the daily sample sizes associated with the SMP and the COE's condition monitoring program. Please contact us if you have any additional questions.

MEMORANDUM

Date: March 20, 1990

To: FPAC

From: Michele DeHart

RE: Report from Biometrician Group regarding confidence intervals for Passage Indices

Last fall NMFS and CRITFC commented on the 1990 Smolt Monitoring Program regarding the need for confidence intervals on the passage indices. The question was brought up at FPAC, and FPAC gave the FPC the assignment to have the Biometrician Group, which consists of Drs. Lyle Calvin, Cliff Pereira, and Doug Neeley, address this question. The attached report is the result of their effort to develop a meaningful confidence interval for the cumulative fish passage index. Following discussions with the FPC on how the passage index data is used, they recommended that confidence intervals be developed for the cumulative fish passage index instead of the daily fish passage indices.

The Biometrician Group's report to the FPC provides a methodology for computing a confidence interval, but it also provides words of caution in how we interpret and use these confidence intervals. It must be emphasized that just as FGE is not factored into the passage index, neither is its variability factored into the confidence intervals defined in this report. A confidence interval around an annual passage index would incorporate only a small part of the variability that would occur around estimates of population magnitude. At most these confidence intervals incorporate day-to-day sampling variability, and provide a measure of precision about the annual fish passage index, which does not necessarily reflect how close the annual index represents the population magnitude.

As stated in our response to NMFS and CRITFC, and concurred in the Biometrician Group report, confidence intervals are desirable, but can be misleading without an explicit definition of what they are intended to measure or represent. The audience who is interested in using the confidence intervals must be cognizant of their limited utility. Their expectation of what the confidence intervals represent will influence what applications they try to make of these confidence interval around cumulative fish passage indices.

~initials

Report of Biometrician Group on a confidence interval for the cumulative fish passage index

January 1990

Biometrician Group members:

Cliff Pereira

Lyle Calvin

Doug Neeley

Introduction

In November, 1989 the Fish Passage Center asked the Biometrician Group (Lyle Calvin, Doug Neeley, and Cliff Pereira) to look at the methods used in calculating the daily and annual fish passage indices (FPI's) to determine the feasibility of obtaining confidence interval (CI) estimates. This was the result of discussion between the FPC staff and the Fish Passage Advisory Committee on behalf of the fishery agencies and tribes.

The Biometrician Group agreed to this assignment and received background material and assistance from the FPC in obtaining a full understanding of the problem and the methods presently used. In particular, Michele DeHart and Tom Berggren met with the group on November 21 and Tom Berggren again on December 22. Several documents were developed and exchanged in November and December; these are not included in the report but are being held in the Fish Passage Center. Some of them deal with methods that appeared promising but which were eventually discarded after gaining further understanding of the situation at each of the dams.

A number of issues related to the determination of the daily and annual passage indices as well as to the estimation of confidence intervals arose in our discussions. Some of those seemed important enough to include in our report and do constitute several sections of the report.

Initially most of our efforts were spent on developing a method of calculating confidence intervals for the daily fish passage index. With the realization that primary interest was really in the cumulative fish passage index (over some number of days within a year) and, speicifically, in the annual fish passage index, our emphasis changed to a procedure for estimating a confidence interval for an annual or other cumulative fish passage index. The method recommended provides a method that can be used at any site where a daily fish passage index can be calculated for each day. It is simple to use and should serve to provide a confidence interval estimate when needed.

The FPI: An index of what?

If the FPI is to be useful, it must be considered to be highly correlated with some parameters of interest. There seem to be two parameters with which the FPI could be correlated and for which other estimates are not readily available. These are (1) the population count (number of fish in the river at the point of collection), and (2) the inherent survival rate. Both are parameters which provide information of interest to fish managers and policy makers.

In this memo we will treat the FPI as being correlated with the population count within a year at a given location. Except for the problem of accounting for the FGE, the FPI is estimated as if it were intended to serve as a population count (i.e. as the population count would be estimated). It reflects the effects of varying inputs of hatchery and wild fish, smolt condition, flow patterns, and project operations in addition to any factors affecting survival of juvenile fish in the river at this location and time. Changes in FGE would affect any actual population estimates as calculated from sample counts but do not affect the FPI since no adjustment for FGE is made. The FPI can, therefore be considered as an estimate of the population count but uncorrected for FGE. As such, it must be considered a finite population index within a year at a given location.

If the FPI were intended to reflect the inherent survival rate, it would have to be adjusted for varying input of fish (particularly hatchery releases) each year and at different locations. Such an input adjustment would be difficult but perhaps no more difficult than interpreting population estimates while recognizing varying inputs.[1]

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[1]Some attempt is made to account for hatchery releases in the Fish Passage Center annual report by presenting the ratio of FPI to hatchery releases. The Biometrician Group has not studied the use of such a ratio in any detail.

Need or value of confidence intervals (CI) on FPI.

Although the Biometricians Group has been asked to look at the feasibility of calculating confidence intervals for the FPI, there is not a clear recognition of how the CI will be used or how important they are. The FPC uses the FPI in a fairly general way that would probably not change much whether the CI were small or large.

Because only a sample of the fish that enter bypass facilities are counted each day, sampling variation is present. The within-day sampling variation will form the basis for confidence intervals presented in this report. Also present may be non-sampling errors due to such things as varying FGE or the failure of fish passage to be proportional to flow volume. In general, non-sampling errors reduce the value of the FPI as an index and such errors are difficult to assess.

There is validity to the argument that additional information is provided by CI estimates compared to point estimates. Presuming the CI estimates are reliable, an answer is provided to the question of precision of the point estimates. This, in itself, may be sufficient reason for calculating CI when possible. In the case of the FPI, however, there seems to be less use of CI than there would be for the usual statistical estimates because (1) the FPI is an index, not a direct estimate of a parameter, (2) non-sampling errors which cannot be measured may contribute a large part of the total error, and (3) the uses to which the FPI is put are general and do not require high precision.

Comparison of the FPI among projects and among years.

The FPI has been used as a relative measure of the magnitude of the runs of a species at a given location and a given time. The CI estimates that are being recommended apply only to that location and time and are not intended to adequately reflect the variation due to FGE or the changes in the proportion of fish to flow volume.

While these factors vary considerably within any one project and year, the variation among projects and years is even greater and certainly large enough to question the validity of comparing the indices across projects or years.

Looking at the major non-sampling errors, those due to variation in FGE and fish per flow volume, it appears likely that both probably vary more across projects than across years. One might, therefore, expect to have better comparisons among years at the same project, than among projects in the same year. Any such comparisons, however, should recognize the presence of non-sampling errors not included in the CI estimates.

The sampling and non-sampling errors make up the uncontrollable errors constituting the total variation inherent in any comparison of or inference about the FPI. Evaluation of any differences or changes in FPI should also include available information or factors influencing the FPI, e.g. timing and size of hatchery releases, smolt condition, wild stocks, flow patterns and conditions, transportation programs, and project operations.

One may also wish to compare migration timing for different projects. This might be done looking at the consistency of the differences in timing from one project to the next. In addition to the factors listed above, variation in migrational timing may be caused by hatchery releases affecting one dam but not the other.

FGE adjustment for the FPI

The calculation of the FPI includes no adjustment for the FGE of screens, as one would want to do for a population estimate. This is not necessarily a great concern, however, for an index that only needs to be highly correlated with the population count. At least it is of little concern unless the FGE varies considerably among days. If it does, and there is evidence that it does, this will decrease the correlation between the

FPI and the population count and make the FPI less useful.

If the FGE could be measured well each day, an adjustment could be made which would increase the correlation between FPI and the population count. Unfortunately the FGE cannot be measured with any reasonable degree of precision, at reasonable cost, each day and has therefore been excluded from consideration in the FPI calculation. An average FGE value could be used for adjustment but this would not increase the correlation and hence the value of the FPI.

Two additional factors that can reduce the usefulness of the FPI

If hand counts are available only every 24 hours and the sampling rate varies within a day, then variation in the within-day species composition can have the effect of decreasing the correlation between the FPI and the population count. This happens because the data is not available to calculate species-specific 24-hour average sampling rates. The single overall average sampling rate that is used in calculating the daily FPI may be too high for some species and too low for others. Some insight into the effect of within-day variation in species composition may be obtained at projects where hourly hand counts are made. Note that there will not be a problem of this type as long as there is a constant within-day sampling rate or there are separate holding areas for fish sampled at different rates (as at McNary Dam).

Another factor which can vary within a day is the percent of the flow sent through the sampled unit or powerhouse. The flow adjustment used in calculating the daily FPI is based on a single average percent of flow for the day. Depending on the relationships within each day between 1) flow percent, 2) number of fish passing the facility and 3) species composition, the currently used daily flow adjustment can result in decreased correlation between FPI and population count. This problem may potentially be studied at facilities with hourly hand counts, however, a long lag time between entry

into the bypass and entry into the sampling device could make it difficult or impossible to adequately relate the hand counts to within-day flows for this purpose.

Possible confidence intervals for the FPI

We discussed three approaches for generating confidence intervals for the FPI. After briefly describing each, the rationale for rejecting the first two will be summarized.

Approach 1. The first is to consider the day to be stratified into L periods, within which the hourly counts could be assumed to be random counts from a common population (but possibly different for each period). Confidence intervals are then calculated for the total daily count as for a stratified random sample. Consideration needs to be given to the finite population correction needed when subsampling is used. Confidence intervals for cumulative FPI can be obtained in the usual way by summing variances over days. Approaches 1 and 2 both require hourly counts of fish, either by Smith Root counters or hand counts.

Approach 2. The second approach would be to fit a common pattern of hourly counts within the day to be use for all days within some time period and use the deviations from the expected count at each hour to estimate the error for the daily FPI. This should work well if the pattern is fairly consistent across days within the period. The average pattern might be obtained from 7 or 14 days and deviations taken from it. Using the same data to establish the pattern and to calculate the error causes the estimated error to be a little too small, but this is counterbalanced by the failure of the pattern to be common over 7 or 14 days.

Approach 3. This approach does not require hourly counts, although, like the first, it is a stratified approach. The difference is to define strata as periods of several days and use the variation among daily FPI within periods as an estimate of error. For

example, if strata of two days are established, the estimated error variance for each stratum would have one degree of freedom. The error variance for the annual (or other cumulative) FPI is obtained by summing the variances over all strata and the confidence interval is calculated from this.

The third approach was taken because the first two assume that the variance for the daily FPI could be estimated using variation in hourly counts. This would be possible if appropriate within-day stratification of hourly counts were possible. However, there are many daily patterns and activities that could not easily lend themselves to stratification. These include:

1. within-day changes in flow patterns at a project,
2. within day surges of fish caused by hatchery releases, and
3. the long lag-time at some facilities between entry of fish into the bypass and their subsequent entry into the sampling device.

There were other problems associated with the use of variation in hourly counts as a basis of estimating the variance. At some facilities there are no hourly counts of any kind, so that neither approaches 1 nor 2 would be possible. A number of assumptions would be required to use approaches 1 and 2 including that:

1. species composition can be treated as constant over a day,
2. percent flow through the sampled unit or powerhouse can be treated as constant over a day, and
3. (if SR counts are used) the relationship between hand-counts to SR counts can be treated as constant (and known) over a day.

It should be mentioned that approach 3 is not without problems. True day to day variations in such things as hatchery fish inputs, flows, and FGE will tend to bias the confidence interval estimates toward being too large. However, since the variance estimate is based on variation in FPI's between adjacent days only, the bias should be

minimized.

In summary, because the primary interest in confidence intervals is for cumulative FPI's (and not daily FPI's), approach 3 above is the one recommended for use by the Biometrician Group. It is also simpler to compute and incorporates the appropriate components of variances better than the other methods and with fewer assumptions. The method is illustrated below.

Recommended confidence interval for FPI

Let y_i = sample count of a species on day i

f_i = sampling fraction = fraction of time used in collecting sample fish[2]

p_i = proportion of flow from which sample fish taken = index flow

If the sampling fraction changes during the day, an average sampling fraction is calculated by weighting the known sampling fraction in each period (partial day) by the estimate of total fish collected in that period. The average sampling fraction is then used as the sampling fraction for that day.

The FPI for day i is given by

$$(\text{FPI})_i = \frac{y_i}{f_i p_i} = I_i$$

[2]The sampling fraction is a weighted average on days when the sampling fraction varies.

Establishing L strata, with n_h days in each stratum, the estimated variance of the cumulative FPI over the n_h days in the hth stratum, is

$$\hat{V}(I_h) = n_h s_h^2$$

where s_h^2 is the sample variance of the daily FPI in the hth stratum calculated in the usual way.

The annual FPI (API) is obtained by summing the I_h over all strata, i.e.

$$API = \sum I_h$$

and the estimated variance of the API from

$$\hat{V}(API) = \sum \hat{V}(I_h)$$

The (1-α) CI for the API is given by

$$API \pm Z_\alpha \sqrt{\hat{V}(API)}$$

where Z_α is the normal deviate at $P = \alpha$.

The above confidence interval should work well when the sampling fraction within each day is fairly small. If the sampling fraction is large on a number of days each year, the Fish Passage Center may want to again consult with the Biometrician's Group to have them consider ways to reduce the positive bias of the recommended method. If the

sampling fraction on any particular day reaches 100%, some adjustment should be made to account for the fact that the sampling variation is zero for the FPI on that day. One approach that could be considered by the Biometrician Group is to break up the stratum in question, placing the day with less than 100% sampling into an adjacent stratum and placing the 100% sampling day into its own stratum with a known total and, hence, zero variance.

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MEMORANDUM

DATE: October 19, 1992

TO: FPAC

FROM: Tom Berggren

RE: Minimum sample rates for Lower Granite, Little Goose and McNary dams

On October 7, NMFS provided the FPC with additional comments on the 1993 Smolt Monitoring Program. One comment pertained to determining minimum sample rates at collector dams. According to their letter, CZES in consultation with Dr. Lyle Calvin, arrived at the following recommended sampling criteria:

- 500 fish per day when daily estimated totals are < 50,000 fish, and
- 1% of the number collected at Lower Granite Dam when daily estimated totals are >50,000 fish.
- 1.67% of the number collected at Little Goose and McNary dams when daily estimated totals are >50,000 fish.

The rationale for this criteria is that sample sizes should be selected that keep the coefficient of variation (cv = standard error of collection/estimate of collection) less than 5%. By assuming that the sample size (n) follows a binomial distribution, we are saying that for practical purposes, smolts exit the wet separator uniformly in time during each hourly collection period.

But we know this is not true, and that the emigration from the wet separator is more clumped or aggregated over time within any particular hourly sample period. Therefore, at each of the collector dams, a series of subsamples are taken during the hourly sample period because of this non-uniform emigration behavior. At Lower Granite Dam, 10 subsamples per hour have been used as the optimum number when hourly sample rates exceed 3%. Last year, the FPC requested that the minimum duration of any subsample be no less than 12 seconds, and that a minimum of 5 subsamples per hour (equivalent to a minimum hourly sample rate of 1.67%) be taken. Because the mechanical sample timers at each collector site can only be set to the nearest tenth of a minute, the only other option would have been to drop the subsample duration to 6 seconds, which we feel would increase the likelihood of biasing the estimated collection total due to a sampling edge effect (most likely an undercount). The recommendation made by NMFS only addresses the overall hourly sample rate, and does not address the fact that a series of subsamples are currently taken within each hour because of the non-uniform emigration pattern from the wet separator prior to the sample gate.

In the following set of plots and tables, we look at the question of number of subsamples per hour, and the effect on coefficients of variation and confidence intervals about the estimated collection totals. We provide FPC recommendations of sample rates that meet the goal of handling fewer fish than in previous years, but retain the larger number of subsamples per hour as was used in prior years.

The first three plots show a comparison between the coefficient of variation and the number of 12-second subsamples taken per hour for a collection total of 25,000 fish, 50,000 fish, and 100,000 fish. In each plot, the coefficient of variation curves begin to taper off at five to six 12-second subsamples (1.67% to 2% sample rates). These can be viewed as threshold levels above which lesser changes in coefficient of variation per added subsample occur, and below which larger changes in coefficient of variation occur. The FPC recommends that five to six 12-sec subsamples per hour be retained at Lower Granite Dam at least until collection numbers exceed 150,000 fish. The NMFS recommendation would allow only three 12-second samples whenever collection numbers exceeded 50,000 fish. Even at 150,000 fish collected, the FPC recommendation would still allow four 12-second samples. Only after reaching 200,000 fish collected would we recommend dropping to three 12-second samples.

These levels of sampling effort for Lower Granite Dam are shown in Table 1 for the FPC and NMFS recommendations. Basically, the NMFS plan would use a 1% sample rate beginning at 50,000 fish, while the FPC plan would be at 2% at 50,000 fish and drop to 1% at 200,000 fish. The effect during this time would be the handling of no more than 500 additional fish per day under the FPC recommendation. As stated in the previous paragraph, the benefit of the higher sample rate would be the ability to take more subsamples per hour. From collection totals of 2,000 to 25,000 fish the two recommendations are the same. Below 2,000 fish, we assume that NMFS is still recommending 500 fish sampled per day. This level of effort would be needed to keep the coefficient of variation below 5%, but we feel that a lower sample rate around 25% would be adequate enough until collection numbers drop below 500 fish. When collection numbers are below 500 fish per day, then either samples up to 100 fish (early in season) or complete enumeration (late in season) should be made. At the low collection range below 1000 fish, the FPC recommendation would typically handle up to about 250 fish less than the NMFS recommendation.

The minimum sample rate for Little Goose and McNary dams was set at 1.67% (1 minute) in the NMFS recommendations, and thereby provides a minimum of 5 12-second subsamples per hour whenever collection totals exceed 37,500 fish (Tables 2 and 3). At Little Goose Dam, the FPC sampling effort recommendations are the same as the NMFS recommendations, except that FPC would recommend maintaining a 2% sample rate from collection totals of 25,000 fish through 50,000 fish (Table 2). The effect would be handling less than 200 fish additional over the NMFS recommendation. The benefit would be the ability to take six 12-second subsamples instead of five. At the low collection range below 1000 fish, the FPC recommendation would be the same as we suggested for Lower Granite Dam.

At McNary Dam, the FPC would recommend higher sample rates than NMFS when collection numbers range between 15,000 and 50,000 fish (Table 3). The number of subsamples would be maintained at six per hour, but the duration of each subsample would increase from 12 seconds up to 30 seconds. In prior years, McNary Dam has typically taken fewer subsamples per hour, but each of longer duration than is typical at the Snake River projects. With the increased sampling effort, no more than 500 fish over what NMFS recommended would be handled. At the low collection range below 1000 fish, the FPC recommendation would be the same as we suggested for the Snake River projects. However, it would be difficult to exceed sample rates of 20-25% whenever large

numbers of shad are present or whenever debris load is heavy in the lower Columbia River.

As you consider these tables regarding minimum sample rates at the collector dams, pay particular attention to the 95% confidence intervals about the estimated collection total, and how these confidence intervals relate to the coefficient of variation. Under the assumption of sample size being distributed as binomial, the 95% confidence interval about the estimated collection total is approximately equal to $\pm 2cv*N$, where cv is coefficient of variation and N is collection total. Therefore, trying to meet a common coefficient of variation will result in wider confidence intervals about the larger collection totals. Likewise, trying to met a common sample rate would result in coefficient of variations decreasing in half for every 4-fold increase in collection totals, and confidence intervals doubling in size. In either case, wider confidence intervals result for the larger estimates of collection total.

All of the above recommended sample rates should be considered the standard level of effort whenever no special marking programs are taking place. To meet the 1993 smolt monitoring program PIT tagging quotas at Little Goose Dam, sample rates may occasionally have to exceed the standard levels above. At McNary Dam, sample rates during periods of fish marking would virtually always have to exceed the standard levels above. Typically, about 4,000 to 5,000 fish per day need to be handled in order to meet freeze brand quotas.

cc: Dr. Lyle Calvin

492-92.tb

Table 1. Recommended sample rate table for Lower Granite Dam

NMFS Recommendated Sample Size Criteria						FPC Recommendated Sample Size Criteria				
Collection Number	Subsample #/dur per hr	Sample Rate	Sample Number	Coeff of Variation	95% CI +\-	Subsample #/dur per hr	Sample Rate	Sample Number	Coeff of Variation	95% CI +\-
300000	3/12sec	0.0100	3000	0.0182	10900	=^				
200000	3/12sec	0.0100	2000	0.0222	8899	=				
150000	3/12sec	0.0100	1500	0.0257	7707	4/12sec	0.0133	2000	0.0222	6663
100000	3/12sec	0.0100	1000	0.0315	6293	5/12sec	0.0167	1667	0.0243	4858
60000	3/12sec	0.0100	600	0.0406	4874	5/12sec	0.0167	1000	0.0314	3763
50000	3/12sec	0.0100	500	0.0445	4450	6/12sec	0.0200	1000	0.0313	3130
37500	4/12sec	0.0133	500	0.0444	3332	6/12sec	0.0200	750	0.0361	2711
25000	6/12sec	0.0200	500	0.0443	2214	=				
15000	10/12sec	0.0333	500	0.0440	1319	=				
10000	10/18sec	0.0500	500	0.0436	872	=				
7500	10/24sec	0.0667	500	0.0432	648	=				
5000	10/36sec	0.1000	500	0.0424	424	=				
3750	10/48sec	0.1333	500	0.0416	312	=				
3000	10/1min	0.1667	500	0.0408	245	=				
2000	10/1.5min	0.2500	500	0.0387	155	=				
1000	10/3min	0.5000	500	0.0316	63	10/1.5min	0.2500	250	0.0548	110
500		1.0000	500	0.0000	0	10/1.5min	0.2500	125	0.0775	77
200		1.0000	200	0.0000	0	10/3min	0.5000	100	0.0707	28
100		1.0000	100	0.0000	0	=				

^= denotes no difference between NMFS and FPC recommendations.

Table 2. Recommended sample rate table for Little Goose Dam

Collection Number	NMFS Recommendated Sample Size Criteria: Subsample #/dur per hr	Sample Rate	Sample Number	Coeff of Variation	95% CI +\-	FPC Recommendated Sample Size Criteria: Subsample #/dur per hr	Sample Rate	Sample Number	Coeff of Variation	95% CI +\-
300000	5/12sec	0.0167	5000	0.0140	8414	=^				
200000	5/12sec	0.0167	3333	0.0172	6870	=				
150000	5/12sec	0.0167	2500	0.0198	5950	=				
100000	5/12sec	0.0167	1667	0.0243	4858	=				
60000	5/12sec	0.0167	1000	0.0314	3763	=				
50000	5/12sec	0.0167	833	0.0343	3434	6/12sec	0.0200	1000	0.0313	3130
37500	5/12sec	0.0167	625	0.0397	2975	6/12sec	0.0200	750	0.0361	2711
25000	6/12sec	0.0200	500	0.0443	2214	=				
15000	10/12sec	0.0333	500	0.0440	1319	=				
10000	10/18sec	0.0500	500	0.0436	872	=				
7500	10/24sec	0.0667	500	0.0432	648	=				
5000	10/36sec	0.1000	500	0.0424	424	=				
3750	10/48sec	0.1333	500	0.0416	312	=				
3000	10/1min	0.1667	500	0.0408	245	=				
2000	10/1.5min	0.2500	500	0.0387	155	=				
1000	10/3min	0.5000	500	0.0316	63	10/1.5min	0.2500	250	0.0548	110
500		1.0000	500	0.0000	0	10/1.5min	0.2500	125	0.0775	77
200		1.0000	200	0.0000	0	10/3min	0.5000	100	0.0707	28
100		1.0000	100	0.0000	0	=				

^= denotes no difference between NMFS and FPC recommendations.

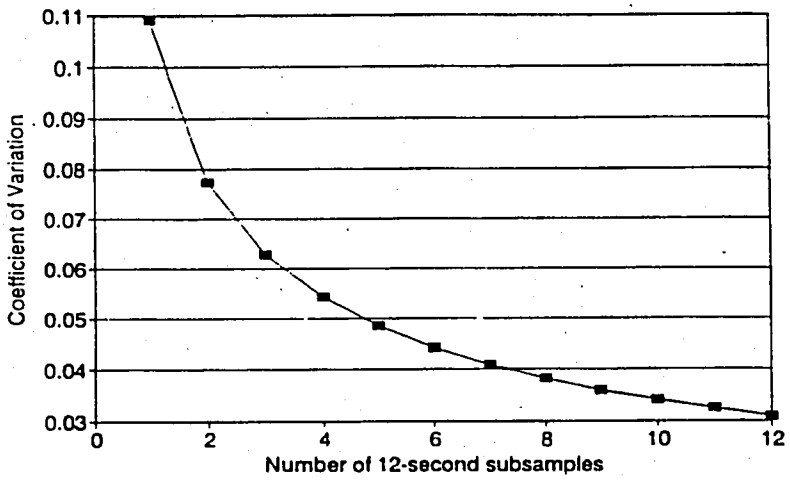
Table 3. Recommended sample rate table for McNary Dam

Collection Number	NMFS Recommendated Sample Size Criteria: Subsample #/dur per hr	Sample Rate	Sample Number	Coeff of Variation	95% CI +\-	FPC Recommendated Sample Size Criteria: Subsample #/dur per hr	Sample Rate	Sample Number	Coeff of Variation	95% CI +\-
300000	5/12sec	0.0167	5000	0.0140	8414	=^				
200000	5/12sec	0.0167	3333	0.0172	6870	=				
150000	5/12sec	0.0167	2500	0.0198	5950	=				
100000	5/12sec	0.0167	1667	0.0243	4858	=				
60000	5/12sec	0.0167	1000	0.0314	3763	=				
50000	5/12sec	0.0167	833	0.0343	3434	6/12sec	0.0200	1000	0.0313	3130
35000	5/12sec	0.0167	583	0.0410	2873	6/18sec	0.0300	1050	0.0304	2128
25000	6/12sec	0.0200	500	0.0443	2214	6/24sec	0.0400	1000	0.0310	1549
15000	10/12sec	0.0333	500	0.0440	1319	6/30sec	0.0500	750	0.0356	1068
10000	10/18sec	0.0500	500	0.0436	872	6/30sec	=	=		
7500	10/24sec	0.0667	500	0.0432	648	8/30sec	=	=		
5000	10/36sec	0.1000	500	0.0424	424	=				
3750	10/48sec	0.1333	500	0.0416	312	=				
3000	10/1min	0.1667	500	0.0408	245	=				
2000	10/1.5min	0.2500	500	0.0387	155	=				
1000	10/3min	0.5000	500	0.0316	63	10/1.5min	0.2500	250	0.0548	110
500		1.0000	500	0.0000	0	10/1.5min	0.2500	125	0.0775	77
200		1.0000	200	0.0000	0	10/3min	0.5000	100	0.0707	28
100		1.0000	100	0.0000	0	=				

^= denotes no difference between NMFS and FPC recommendations.

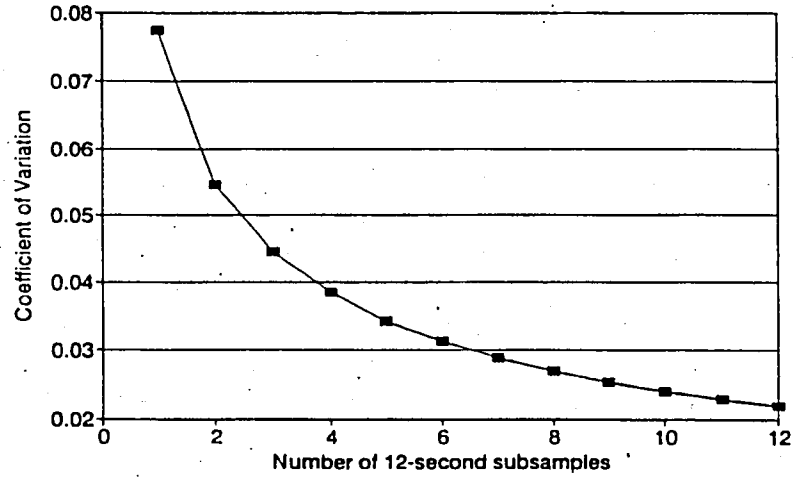
Comparison of CV and sample durations

Based on collection of 25,000 fish



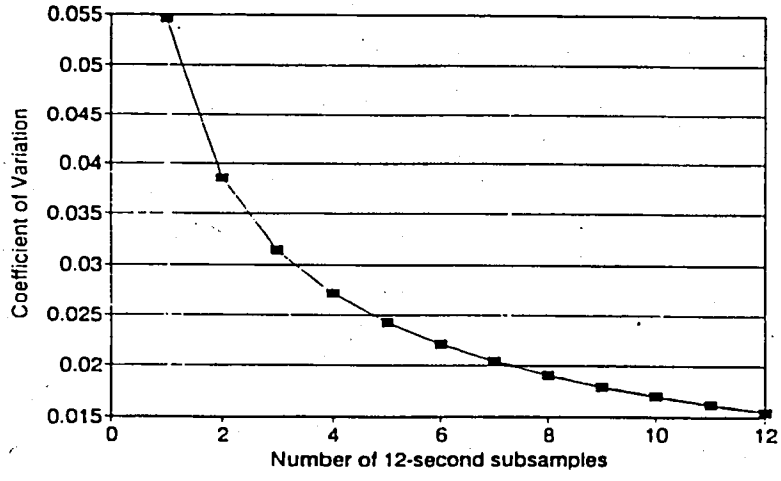
Comparison of CV and sample durations

Based on collection of 50,000 fish



Comparison of CV and sample durations

Based on collection of 100,000 fish



Minimum sample rates for SMP dams

On October 7, 1992, NMFS provided the FPC with additional comments on the 1993 Smolt Monitoring Program. One comment pertained to determining minimum sample rates at collector dams. According to their letter, CZES in consultation with Dr. Lyle Calvin, arrived at the following recommended sampling criteria:

- 500 fish per day when daily estimated totals are < 50,000 fish, and
- 1% of the number collected at Lower Granite Dam when daily estimated totals are >50,000 fish.
- 1.67% of the number collected at Little Goose and McNary dams when daily estimated totals are >50,000 fish.

The rationale for these criteria is that sample sizes should be selected that keeps the coefficient of variation (standard error / estimate) of the collection less than 5%. Within each hour the series of systematic sub-samples are taken at fixed intervals. Including "enough" sub-samples per hour to account for the non-uniform (*i.e.*, clumped or aggregated) emigration pattern of fish from the wet separator to the sample gate was an important consideration in establishing the hourly sampling protocol. In 1991, the FPC requested that the minimum duration of any sub-sample be no less than 12 seconds, and that a minimum of 5 sub-samples per hour (equivalent to a minimum hourly sample rate of 1.67%) be taken. The minimum sub-sample duration was set at 12 seconds. With the old mechanical sample timers, which could only be set to the nearest tenth of a minute, the lowest duration of 6 seconds would have increased the likelihood of biased (mostly undercounted) estimates of collection totals due to the sampling edge effect created by the time it takes to open and close the sampling gates.

In 1995, the FPC was asked to look at reducing the handling of large numbers of smolts during periods of peak passage. A new minimum allowable sample rate of 0.667% was established for use when collection numbers were rising above 100,000 at the dams. By 2001, all the old mechanical timers had been replaced at the COE dams with modern electronic timers, which are programmed to create sample rates changeable at increments of tenths of a percent. In 2002, a new set of sample rates was established to replace the old rates, *e.g.*, the 0.667% rate was replaced with a 0.7% rate. Also in 2002, the FPC was asked by the COE biologist at Little Goose Dam to allow for even lower sample rates during periods of excessively large numbers of fish being collected, as was occurring at that site. We added an emergency level of 0.5% for use during those periods, with the stipulation that the normal minimum rate remains at 0.7%. The optimal number of sub-samples per hour is still set at 6 until the sample rate drops below the level that allows for a minimum 12-second duration per sub-sample. When sample rates drop to 1.5%, 1.0% and 0.7%, the corresponding number of sub-samples drop to 4, 3, and 2 sub-samples per hour, respectively in order to sub-sample durations of at least 12 seconds.

At sample rates below 25%, the minimum number of fish in the sample will be approximately 500 fish, the goal in effect since 1992. At sample rates of 25% and higher, the number of fish actually sampled may drop below 500 as the collected population

decreases. The maximum rate at the lower Columbia River dams is 25%, whereas it goes to 100% at Snake River dams when the transportation in mini-tankers begins. The following table lists the current sample rates, number of sub-samples per hour, and range of daily number of fish desired for each sample rate.

Sample rate recommendations at John Day, Bonneville, McNary, Lower Monumental, Little Goose, and Lower Granite Dams

Recommended electronic timer-controlled sample gate settings.

Estimated Daily Collection	Sample Rate (%)	Equivalent Multiplier 1/sample rate	Sample Sec/ hour	Subsamples per hour	Subsample Duration in seconds	Estimated number of fish in Sample
Emergency	0.50%	200	18	2	9	
> 75,000	0.70%	143	25.2	2	12.6	> 525
50,000 - 75,000	1.00%	100	36	3	12	500 - 750
35,000 - 50,000	1.50%	66.6	54	4	13.5	525 - 750
25,000 - 35,000	2.00%	50	72	6	12	500 - 750
16,500 - 25,000	3.00%	33.3	108	6	18	495 - 750
12,500 - 16,500	4.00%	25	144	6	24	500 - 660
10,000 - 12,500	5.00%	20	180	6	30	500 -625
7,500 - 10,000	7.00%	14.3	252	6	42	525 - 700
5,000 - 7,500	10.00%	10	360	6	60	500 - 750
4,000 - 5,000	12.50%	8	450	6	75	500 - 625
3,000 - 4,000	15.00%	6.66	540	6	90	450 - 600
2,500 - 3,000	20.00%	5	720	6	120	500 - 600
1,500 - 2,500	25.00%	4	900	6	150	375 - 625
500 - 1,500	50.00%	2	1800	6	300	250 - 750
< 500	100.00%	1	3600	1	3600	< 500

For Lower Columbia River sites, the max sample rate is 25% except when a higher rate is needed for several hours to collect fish for tagging studies.

Carry multipliers to 3 digits total, then round(1/multiplier,3) will provide sample rate to nearest 10th place that is correct.

During periods of peak juvenile shad passage, lower sample rates than needed to meet salmonid sample goals may be used to reduce handling and mortalities on shad.

Figure 1 shows a plot of the coefficient of variation that results from the current sample rate criteria. It shows that the goal of having the collection's coefficient of variation be less than 5% is maintained when sample rates drop to 0.7% as long as collections exceed 75,000 fish. At this lowest normal sample rate, two sub-samples of 12.6 seconds duration are possible per hour. As collections decrease in numbers, the sample rates must increase to maintain a coefficient of variation less than 5%. When collections are 25,000 fish or less, then sample rate of 2% or higher are needed to maintain a coefficient of variation less than 5%. As sample rates increase from 2% to higher levels, six sub-samples of 12 seconds or greater duration are possible per hour.

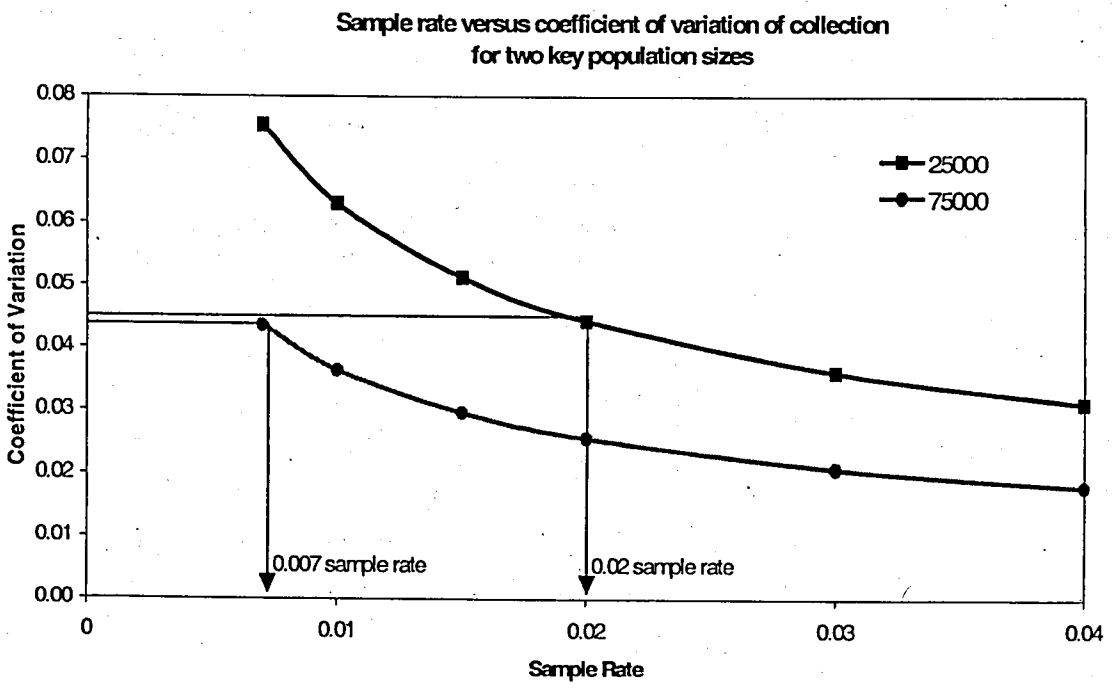


Figure 1. Plot showing minimum sample rates needed to maintain a coefficient of variation of less than 5% for two levels of estimated collected population at a dam facility.

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MEMORANDUM

TO: Tim Dykstra, Walla Walla District COE
Bernie Klatte, Portland District COE
FPAC

FROM: Michele DeHart

DATE: March 31, 2009

RE: Standardized Sample Size requirements for SMP condition sampling and transportation Barge loading data requirements and weight calculations

The FPC has invested considerable effort over the past year in standardizing the Smolt Monitoring Program (SMP) data collection and recording procedures among the SMP sites. In addition, in response to requests from the fishery management agencies and tribes the FPC has worked with the region to develop a standard fish condition monitoring protocol for data collection and reporting. The COE and site personnel requested that their data bases for COE sampling of facility fish impacts and barge loading remain unchanged in this process. The FPC staff expended considerable efforts to build individual tools for each site to maintain their present COE data and procedures. As a result of this process we have noted several issues that can only be addressed by the COE and the fishery management agencies regarding inconsistencies in data collection for COE facility monitoring and transportation program barge loading. We believe that there are opportunities to standardize these efforts among sites and reduce fish handling and fish impact. Since this is the last year of the COE three year contract for sampling for facility impacts and transportation implementation, it may be appropriate to address these issues at this time. There are opportunities to reduce sampling and handling impacts. Specifically:

- Although the management question of barge loading is the same at each transportation site, different data are collected at each site to determine barge loading. For example at LGR poundage is reported for barge loading be species type, and clip type, whereas LGS reports poundage by steelhead clip type and salmon combined. These different

procedures require different sample sizes. The management application is the same, and sample size requirements could be reviewed in terms of reducing sampling and handling and standardization among sites.

- Currently the condition monitoring protocol, as determined by the FPOM subgroup on fish condition monitoring, was set at 100 fish of each species and clip type. This means that during the spring, when potentially four species (clipped and unclipped) of juvenile migrants are present, up to 800 juvenile salmon could be examined on a daily basis for injury and disease information. There may be ways to reduce this amount of handling for detailed condition information and still get necessary information on fish condition.
- Neither rationale nor calculations of sample size requirements for fish condition data collection at individual sites is available. As mentioned above, these sample sizes for each site are currently not consistent. The COE and fishery agencies should consider and review guidelines used to select the target sample sizes, relative to the management application of the data. This should include consideration of the 100 fish criteria per clip type objective, such as detecting a particular incidence of occurrence of injuries or descaling.
- The rationale for different condition sampling at transportation sites versus non-transportation sites is unclear. The rationale for collecting injury information on clipped and non-clipped fish is unclear, specifically as it relates to the resulting management action and whether or not the existing data suggest that injury levels are different enough to warrant the additional sampling and handling.
- Procedures and codes differ among sites. For example, MCN collects weight and length data on incidental fish, but other sites do not. Sample codes differ among sites.

cc. Charlie Morrill, WDFW
Rick Martinson, PSMFC
Pat Kinery, ODFW

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MEMORANDUM

TO: SMP site personnel

FROM: Jerry McCann, Brandon Chockley

DATE: March 3, 2010

RE: **Follow up on SMP Preseason meeting topics**
New SMP protocol and
Recent Changes to data entry program

We (FPC) had a few follow-up topics from the preseason meeting to clarify. Also, FPC has put together a SMP protocol that attempts to answer the question "what data should be collected at the sites". The Smolt Monitoring Program Protocol found at the link provided below: (ftp://ftp.fpc.org/FPC32.net/Manuals/SMP%20Protocol.pdf) is meant to compliment the Data Entry Manual and Condition Monitoring Protocol. Please read it and if there are details that you would like added for next season, or that are confusing, let us know. Essentially it recaps the presentation Jerry McCann gave at the Preseason Meeting about data to collect. We'll keep this updated each season. And, also there are changes to the FPC32.Net program. Changes to the FPC32.Net program since the meeting, as well as changes to the Data Entry Manual are listed below.

A. Follow-up topics from SMP preseason meeting:

1. **CWT interrogation: Please add unclipped sockeye to the list of fish to scan for CWT at LGR, LGS, and LMN.** We have just received notification from IDFG and others that Salmon River sockeye smolt releases will not be clipped in 2010 ,but those releases will have

CWTs. Pre-smolt releases will have ad-clips, however. So a portion of Salmon River sockeye will be clipped and a portion unclipped. All should have CWTs. We are aware this is late notification, but we just learned about this March 1.

2. **Research mortalities.** You are not required to enter research morts in the FPC32.Net program. If you do not currently track research morts, ignore this field. And to clarify, research morts entered into the FPC32.Net program, are fish that died after researchers were given possession of fish from the SMP sample. Research morts should be reported by the researchers on their own ESA permits. So entering this information is only for accounting purposes. Fish Passage Center does not use these numbers to determine research take. Please continue your separate spreadsheet accounting of mortality in the sample that is attributed to the SMP collection, and that attributed to the conduct of research. That accounting will be used to report ESA take at the end of the season.

3. **Orphan facility morts.** Our term for facility mortalities that do not match up with sampled species. Since the program requires sampled fish in order to enter mortalities, facility morts that don't match sampled fish, are typically entered on a subsequent date when there is a match. However, it is important that the data be entered within a few weeks of being collected. If no fish are sampled within 2 weeks matching the species of the mort, resubmit an earlier batch that had the matching species in it. Write in the comments that the resubmission was necessary to enter a mort that did not match and FPC will not count that toward error rate estimates.

4. **Sample Rate Recommendations**

Sites should use table 1 below of recommended sample rates to determine sample rates. Use a rate that achieves the target sample sizes of 300 to 500 fish (when possible). Typically, Lower Columbia sites should limit sample rates to at or below 25% except when increased numbers of fish may be needed for research or to address immediate management needs. Avoid using sample rates between 12% and 25% whenever possible to avoid impacts to sample accuracy as well as to minimize impacts to PIT-tag studies near the divert during sample (DDS) trigger of 20%. Also minimize the number of times per season sample rates switch from above to below 20%, or from below to above 20% to minimize the number of times the DDS is turned on or off.

B. Changes to FPC32.net (Version 3) Since Feb. 23-24 Meetings:

A few minor programming bugs were identified at and since the February 23 & 24 SMP meetings at the FPC. FPC has fixed these bugs and posted a new version of FPC32.net (Version 3) to the FTP site (ftp://ftp.fpc.org/FPC32.net/TouchScreenSetup3.msi) for download and installation by SMP site personnel. Below is a list of the bugs that were identified and a brief explanation as to how they were remedied.

Bug: CWT of "None" is somewhat misleading
Remedy: Label for "None" radio button for CWT has been changed to read "N/A", which implies the site did not look for CWT on this group of fish.

Bug: Default CWT radio button at LGR, LGS, and LMN not always working correctly.
Remedy: For LGR, LGS, and LMN, default CWT radio button for unclipped Chinook, Coho, and Sockeye is "N" in all screens that require this level of entry. This is also true of the condition touch screen. For all other sites, default CWT is "N/A" for all species.

Bug: Editing records in most data entry tabs required that **Cancel** button is pressed after pushing **Save Record**.
Remedy: Pushing **Cancel** after **Save Record** after editing a record is no longer required. There are only two instances where the Cancel button should be used: 1) if a record is chosen for editing but no editing is required and 2) when last record is saved and user wishes to exit "Data Entry Mode" for that data entry tab.

Bug: Fish Condition Summary Report was not putting clipped and unclipped CH1 into proper category.
Remedy: Clipped CH1 are placed in Clipped section and unclipped CH1 are placed in Unclipped section of Fish Condition Summary Report.

Bug: Audible messages were always heard, regardless of whether "Play Sound" check-box was checked or not.
Remedy: The audible messages can now be disabled by un-checking the "Play Sound" check-box.

C. Changes to FPC32.net Manual:

The FPC32.net Manual has been changed to reflect that it is no longer necessary to choose the **Cancel** button after saving a newly edited record. Once **Save Record** has been pressed for an edited record, that record is saved and the user is automatically out of "Edit Mode". A few other minor typos and formatting errors were also corrected. A newer version of the FPC32.net Manual has been posted on the FPC FTP website (ftp://ftp.fpc.org/FPC32.net/Manuals/).