Narrative

Produce Statistically Valid Harvest Estimates

Table 1. Proposal Metadata

Project Number	200850800
Proposer	CRITFC
Short Description	Determine catch sampling protocol and precision of estimates
Province(s)	Mainstem
Subbasin(s)	Mainstem fishing areas
Contact Name	Marianne McClure, Mike Matylewich, Chris Golightly
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Information transfer:

A. Abstract

This project has four long term objectives: 1) ensure that the sample design and estimation methods for producing tribal catch estimates are statistically valid, 2) make accurate harvest data readily available for decision making, 3) improve the transparency and dissemination of catch estimates, with associated variances, and 4) account for the uncertainty of estimates in management. Ultimately, this project will determine and formalize statistically valid sampling protocols for tribal harvest estimates throughout the Columbia Basin.

This project should not be confused with project 200850200, Increased Zone 6 Tribal Fishery Monitoring, which actually involves sampling. This project is to evaluate the sampling design and estimation methods of the sampling program, and calculate precision of the estimates resulting from the sampling program, but this project is not the sampling project.

The majority of tribal harvest and catch sampling occur in the Zone 6 commercial gillnet fishery. Therefore, in 2009, the project will focus on the sampling scheme for this fishery. Primary objectives for 2009 are to 1) observe current sampling methods, 2) document current and historical sampling and estimation methods, 3) improve the sampling scheme, if possible, to maximize precision of estimates under existing funding, and 4) document a formal sampling protocol for future years. Catches in the fall gillnet fishery are comprised of bright and tule fall Chinook, A and B steelhead, and coho. Fish ticket data do not represent the entire catch, due to direct “over-the-bank” sales and subsistence use. Therefore, catch is estimated using creel census techniques, wherein an estimate of catch rate is combined with effort data to estimate total catch of each species and run.

Future years’ work will address similar objectives for other tribal fisheries. Tribal harvest in the mainstem is comprised of commercial gillnet, ceremonial and subsistence gillnet, and commercial and subsistence platform fisheries (using dip and hoop nets, and hook and line).

A secondary objective for 2009 is to improve collection, transcription, and real-time distribution of the data for timely use in making inseason management decisions, by developing a software application for data collection on inexpensive handheld PDAs. This will allow the data to immediately be synchronized with a secure online database using readily available WiFi hotspots. The data can then be automatically collated, error-checked, analyzed, and summarized, to provide the Technical Advisory Committee of the Columbia River Compact with real-time weekly catch estimates.

Weekly harvest management decisions are based on these catch estimates. Compliance with management agreements, including US v. Oregon and the Pacific Salmon Treaty, is evaluated based on these estimates. Catch estimates are also critical in estimating productivity and optimal escapement. It is important to understand the uncertainty associated with the estimates and to use available resources in the most effective way possible to obtain estimates that are as precise and accurate as possible. This project will be completed by Marianne McClure, in the CRITFC offices and throughout the fishing areas, in coordination with tribal staff implementing catch sampling programs.

B. Technical and/or scientific background

Several methods for estimating total catch were tried and discarded prior to the creel sampling methods currently in use being settled upon as the most feasible and effective. Prior to the mid-90s, most of the catch was sold to commercial buyers and accounted for on fish tickets. Thus, total catch was estimated by expanding the fish ticket catch estimate by 10% to account for the fish caught but not sold. Catch monitors were used to estimate scaffold catches separately. As direct over-the-bank (OTB) sale of fish grew, a method was sought for estimating this non-fish-ticketed catch separately. Fishers were interviewed for the number of nets fished and the number of fish destined to be sold OTB. The results from different interviewers was averaged and expanded by the total number of nets to obtain a total OTB estimate. However, it was found that this method led to double-counting of some catch, because a portion of the fish destined for OTB sales were eventually sold to commercial buyers as a last resort, and therefore ended up in both the OTB estimate and the fish ticket sales estimate. There is a need to more fully document catch estimation methods for the historical catch data. Since 1998, the current creel census methods have been used to estimate total landed catch. However, there has been no formal documentation of the methods or reported analysis of their accuracy or precision.

A complete first hand understanding of existing creel procedures is a necessary first step to ensure that the creel census is statistically valid and replicable, to ensure that the sampling protocol is sufficient to estimate variances, to determine the precision of the estimates if so, and to determine how the sampling and estimation framework can be efficiently improved upon. Complete documentation of the existing procedures is part of this project's 2009 objectives, but the following brief description is meant as an aid in understanding this proposal: 1) fishers are interviewed for the number of nets being fished and the number of sets, 2) the resulting catch is counted and identified as to species, run (e.g., A or B steelhead, bright or tule fall Chinook), and size (adult vs. jack), 3) estimates of fish/net are expanded by aerial net counts and effort estimates to obtain a total catch estimate.

An analysis of the accuracy of the total catch estimate requires independent reference values which are not available, but ad-hoc methods can be used to validate the total catch estimate to some extent. For example, catch estimates should exceed fish ticket sales. Such comparisons will

be made throughout the time series of data to identify any existing problems with accuracy. Also, error rates for identification and enumeration of creel samples can be determined. Independent observation of sampling will be used to determine error rates for total number of fish, all species combined, estimated by the creel sample. If fishers are willing to participate, it may also be possible to determine error rates in identification of species, run, or size identification by carefully re-sampling a random subset of samples.

For spring Chinook catch estimates, it may be possible to compare the catch rate of fish passing Bonneville with the loss rate of PIT tags between Bonneville and McNary dams. Since some fish will succumb to predation or non-fishing mortality, the PIT tag loss rate should exceed the catch rate. For fall Chinook, relatively few are PIT tagged due to the small size of subyearlings. Combined with the predominance of wild fish in the fall Chinook catch and the number of fish not destined to go over McNary, this makes it unlikely that PIT tag loss rates would provide a useful comparison for fall Chinook catch rates.

Given a sampling protocol that provides for estimation of variances, the project will address desired precision and recommend sampling rates accordingly. This is prerequisite to evaluating the uncertainty of resulting management decisions, and implementing more advanced decision-theoretic management frameworks that take this uncertainty and specified amounts of acceptable risk into account.

Case studies have shown that implementing data collection systems using handheld data devices can improve sampling speed and therefore increase sampling rates, reduce transcription and summary errors, and make data available faster. For examples, please see the following:
http://www.lokilogic.com/download/fisheries.pdf
http://geonetwork3.fao.org/workshops/workshop2007/PDA-basedSurveyOverview.pdf
http://www.pendragon-software.com/casestudy/cs-SnowCrabSurveys.html
http://www.mesc.usgs.gov/RARMI/rarmi_methods.asp
http://www.pendragonsoftware.com/fws.pdf
http://www.umass.edu/urbantree/palm/
http://www.anesthesia-analgesia.org/cgi/content/full/101/4/1075
http://www.popcouncil.org/horizons/ORToolkit/toolkit/pda.html
http://www.syware.com/company/case_study/gov_use_of_handheld_computers_with_gps.pdf
http://www.syware.com/company/case_study/index.php

Johnson et al. (Transactions of the American Fisheries Society 138:593–601, 2009) found that only 44% of errors in collecting fishery data were “field” errors (resulting from transcription errors in the field), while 56% of the errors were due to data entry errors. Although there is an initial capital expenditure, use of electronic data capture in the field eliminates the need for subsequent data entry, which can result in substantial cost savings. They also found that automated proofing methods were very successful in identifying errors. Data entry using electronic devices allows for immediate proofing, thus encouraging completeness and real-time feedback on data entry errors, so there is a greater possibility of correcting the error and obtaining the proper data.

Handheld electronic devices are used for catch sampling by both the Alaska Dept. of Fish and Game (go to http://www.taglab.org/CWT/, save target of link to Electronic Sample Acquisition in Alaska, under “Field Sampling with hand held computers” to see Powerpoint documentation)

and Oregon Dept. of Fish and Wildlife. This project will draw upon those experiences to develop such capability within the tribal sampling program.

Research/Monitoring/Evaluation

This project will evaluate the monitoring framework for harvest estimates, document the current sampling scheme and catch estimation methods, determine a statistically valid sampling protocol that will provide for estimating precision of catch estimates, calculate precision of past catch estimates, if possible, and identify improvements of the current sample design or estimation methods. Also, monitoring will be improved by implementing better data collection and distribution technologies.

C. Rationale and significance to regional programs

The ISAB report on Harvest Management of Columbia Basin Salmon and Steelhead (June 2005) concluded that an effective harvest management system must be based on a sound scientific basis, that would "(1) provide the best practically obtainable and pertinent data, (2) provide the best available science at the time decisions are made, (3) appropriately account for uncertainty, and (4) ensure transparency…". This project directly addresses these four criteria for tribal catch estimates by (1) optimizing the sampling protocol for accuracy and precision, (2) making the data available sooner for decision making, (3) determining the precision of the catch estimates so that the uncertainty can be incorporated in management decisions, and (4) documenting the sampling protocol and uncertainty of the estimates.

The report makes these further recommendations:

1) "There is an essential need for a core set of quantitative data to be monitored annually…indicators of productivity and trends in abundance…We strongly caution against the collection of data without carefully thought-out design and evaluation."
2) "All sources of fishing mortality should be accounted for and a level of risk tolerance established…we also recommend analysts review whether current levels of harvest impact are consistent with the quality of data and level of uncertainty used in management processes…"

The sampling protocol developed by this project will produce catch estimates that constitute core data that are essential in estimating productivity and trends in abundance of any production units caught within the sampled fisheries. This project also carries out the recommendation to carefully design and evaluate the collection of the data, to improve accounting for fishing mortality, to evaluate the quality of the data, and to determine the level of uncertainty in management.

Most relevant, the report addresses harvest management directly:
"The capacity to constrain harvest of Columbia River salmon requires:

1. consistent quality-assured data acquired for pre-season and in-season monitoring;
2. clear management objectives and timely in-season decision processes; and
3. management accountability."

The implementation of a clearly written sampling protocol will reduce differences in sampling between field personnel, and improve the quality and consistency of the data, as well as ensuring that the sampling is properly designed to provide for estimation of variances needed to account for uncertainty. The implementation of improved sampling methods through the

use of handheld data loggers will improve accuracy, and better provide for timely in-season decision processes. More accurate harvest estimates, along with associated estimates of precision, will both directly improve management accountability.

This project is also relevant to RPA #52 Monitor and Evaluate Fish Performance within the FCRPS in the Hydro BiOp (RM&E strategy 2 – Hydrosystem Research, Monitoring, and Evaluation) "Monitor and evaluate adult salmonid system survival upstream through the FCPRS." Without accurate estimates of removals due to fishing mortality, accurate estimates of survival through the FCPRS cannot be achieved.

Tribal harvest estimates are shared with regional fishery managers as required under the 2008-2017 U.S. v. Oregon Management Agreement. Estimates of harvest are also required to calculate terminal harvest rates, which are used in evaluating the individual stock based management provisions of the Pacific Salmon Treaty.

D. Relationships to other projects

The sampling protocol developed by 200850800 will address tradeoffs between catch sampling rates and the precision of the resulting catch estimates. There may be ways to redistribute sampling efforts relative to run sizes and distribution of fish to improve precision of estimates.

Implementation of 200850800 will require coordination with Tribes' staff who implement catch sampling programs, including observation and documentation of the existing sampling practices, training to disseminate sampling protocols and implement handheld PDA data collection amongst samplers, and collation and analysis of the resulting data to determine precision of the harvest estimates.

This project will also inform implementation of Project #200850200 (Increased Zone 6 Tribal Fishery Monitoring) regarding a desirable sampling protocol, target catch sampling rates, and resulting precision of the catch estimates.

Table 2. Relationship to existing projects

Funding Source	Project #	Project Title	Relationship (brief)
BIA		Tribal Fishery Sampling	Provides data used in this analysis.
BPA	200850200	Increased Zone 6 Tribal Fishery Monitoring	Provides data used in this analysis. Results of 200850800 may be used to modify sampling protocols and data collection methods used in 200850200.

E. Project history (for ongoing projects)
This is a newly funded project with no history.

F. Proposal biological/physical objectives, work elements, methods, and metrics

Related to all Objectives
WE #119 Manage and Administer Project

Develop the SOW and budget, coordinate with tribal samplers and staff, coordinate with leads of related projects, and manage project.

WE #185 Produce PISCES Status Reports
Produce quarterly status reports on 15 Jan, 15 April, etc.

Objective 1) Improve the accuracy and precision of the tribal catch estimates
WE #157 Collect/Generate/Validate Field and Lab Data
Task 1.1 Observe existing creel sampling procedures, sources of error, and error rates. Document the distribution of sampling effort by area relative to catch and fishery effort.

WE #156 Develop RM&E Methods and Designs
Task 1.2 Identify and implement sampling protocol for the Zone 6 commercial gillnet fishery to improve sampling accuracy and provide statistically valid variance estimates that can be used to analyze precision.

WE #162 Analyze/Interpret Data
Task 1.3 Analyze precision of catch estimates.

WE #156 Develop RM&E Methods and Designs
Task 1.4 Construct a model to evaluate trade-offs and optimal allocation of sampling resources.
Task 1.5 Determine an optimal sampling protocol for the Zone 6 commercial gillnet fishery that maximizes accuracy and precision, using available resources.
Task 1.6 Produce report on recommended methodology for calculating precision and reporting uncertainty of the catch estimates for the Zone 6 commercial gillnet fishery.

WE #157 Collect/Generate/Validate Field and Lab Data
Task 1.7 Develop sampling manual for recommended sampling protocol for the Zone 6 commercial gillnet fishery.
Task 1.8 Review sampling manual with field sampling personnel.

Objective 2) Make accurate data readily available for decision making
WE #157 Collect/Generate/Validate Field and Lab Data
Task 2.1 Review handheld data logging programs in place at ODFW and ADFG.
Task 2.2 Decide on software platform and select hardware and application software.
Task 2.3 Develop handheld software application, beta test with samplers, and incorporate feedback to complete application.

WE #160 Create/Manage/Maintain Database
Task 2.4 Develop secure web-server database to receive and synchronize data from mobile application on handheld data loggers.

WE #159 Transfer/Consolidate Regionally Standardized Data
Task 2.5 Develop applications to collate, error-check and summarize catch estimates.

WE #157 Collect/Generate/Validate Field and Lab Data
Task 2.6: Write user's manual for using the handheld application and uploading data.

WE #160 Create/Manage/Maintain Database

Task 2.7: Document the online database, analyses, derived data, and report formats.

Objective 3) Improve the transparency and dissemination of the catch estimates, with associated variances

WE #161 Disseminate Raw/Summary Data and Results

Task 3.1 Develop report queries for dissemination of catch data to stakeholders.

Task 3.2 Report total catch estimates and associated variances online within 3 days of when the fishing period ends.

Objective 4) Account for the uncertainty of the estimates in management

WE #162 Analyze/Interpret Data

Task 4.1 Calculate likelihood profiles of inseason catch estimates.

WE #161 Disseminate Raw/Summary Data and Results

Task 4.2 Provide likelihood profiles to the Technical Advisory Committee of the Columbia River Compact, for use in making inseason fishery management decisions.

G. Monitoring and evaluation

Evaluation of this project will be based on completion of the above work elements.

H. Facilities and equipment

Project will be completed primarily at the Columbia River Inter-tribal Fish Commission in Portland, Oregon. Travel will take place to observe each fishery sampler for each fishery, to identify sources of error and improvements in sampling methods. Implementation of data collection using handheld data loggers will require six WiFi enabled PDA devices, such as the Asus A626, and software and licenses for developing the mobile application.

I. Key personnel

Marianne McClure will be the principal investigator, in consultation with Rishi Sharma and Saang-Yoon Hyun, and will complete the review, analysis reporting and implementation. Time allocation for 2008/2009 to this project is 4 months (FTE).

Marianne M. McClure

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Experience

Biometrician, Columbia River Inter-Tribal Fish Commission, 1/91 to present
Serve on Pacific Salmon Commission Chinook Technical Committee, compile Columbia River data, perform analyses on chinook population and fishery dynamics. Provide tribal policy and decision makers with technical information. Help develop funding proposals and sampling designs, and write or edit reports for contract work.

Asst. Biometrician, Alaska Dept. of Fish and Game, 12/89 to 1/91
Developed SQL database applications to 1) merge fish ticket, catch/sample, and CWT recovery data, and produce inseason reports of weekly hatchery contribution to each fishing district of Prince William Sound.

Research Assistant, Fisheries Research Institute, UW, 12/88 to 6/89
Proofread, prepared tables and figures, and did library research for text on Quantitative Stock Assessment. Supervisor: Ray Hilborn, Seattle, WA

Teaching Assistant, School of Fisheries, UW, 9/88 to 12/88
Fisheries Research Gear and Methods (FISH 340).

Graduate Intern II, Alaska Dept. of Fish and Game, 6/88 to 12/88
Developed general linear model to standardize effort for the Kodiak king crab fishery using vessel characteristics data, and examined relationship between independent abundance indices and CPUE indices. Thesis entitled "Standardized Effort for the Kodiak King Crab Fishery."

Teaching Assistant, Center for Quantitative Sciences, UW, 12/87 to 6/88
Graduate Intern I, Alaska Dept. of Fish and Game, 6/87 to 9/87
Teaching Assistant, School of Fisheries, Univ. of WA, 3/87 to 6/87
Student Helper, Fisheries Research Institute, Univ. of WA, 1/87 to 4/87
Commercial Fisherman, 9/85, 4/86 to 9/86
College Intern IV, Alaska Dept. of Fish and Game, 5/84 to 8/84, 5/85 to 8/85
Research Assistant, Large Animal Research Station, 3/85 to 5/85
Student Intern, U.S. Fish and Wildlife Service, 9/84 to 12/84

Education

Graduate Certificate in GIS, 2007. Portland State University, OR.

Fisheries, Ph.D Candidate, Dec. 1999, University of Washington, Seattle, WA.

Forest Resources, M.S., Quantitative Resource Management/Forest Economics, June 1991 University of Washington, Seattle, WA.

Wildlife Management, B.S., May 1986, University of Alaska, Fairbanks, AK.