Bonneville Power Administration
Fish and Wildlife Program FY99 Proposal

Section 1. General administrative information

Inventory Resident Fish Populations in the Bonneville, The Dalles, and John Day Reservoirs

Bonneville project number, if an ongoing project 9079

Business name of agency, institution or organization requesting funding
United States Geological Survey, Biological Resources Division

Business acronym (if appropriate) USGS, BRD

Proposal contact person or principal investigator:

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Subcontractors.

Organization	Mailing Address	City, ST Zip	Contact Name

NPPC Program Measure Number(s) which this project addresses.
Section 10.2, Section 2.1A.1, Section 2.2A, Section 7.1

NMFS Biological Opinion Number(s) which this project addresses.

Other planning document references.

Report of the Independent Scientific Review Panel, Review of the Columbia River Basin Fish and Wildlife Program as directed by the 1996 amendment to the Power Act, III.B.13

Subbasin.

Short description.

Inventory resident fish populations in the Bonneville, The Dalles, and John Day Reservoirs of the Columbia River

Section 2. Key words

Mark	Programmatic Categories	Mark	Activities	Mark	Project Types
	Anadromous fish		Construction		Watershed
X	Resident fish		O & M	+	Biodiversity/genetics
	Wildlife		Production	+	Population dynamics
	Oceans/estuaries	X	Research	X	Ecosystems
	Climate	+	Monitoring/eval.		Flow/survival
	Other		Resource mgmt		Fish disease
			Planning/admin.		Supplementation
			Enforcement		Wildlife habitat en-
			Acquisitions		hancement/restoration

Other keywords.

gear standardization, sampling protocols, ecological interactions, inventory

Section 3. Relationships to other Bonneville projects

Project #	Project title/description	Nature of relationship

Section 4. Objectives, tasks and schedules

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Develop strict sampling protocols, standardized sampling gears, and procedures for implementing a stratified random sampling design to be used in resident fish surveys.	a	Assess the efficacy of various sampling gears to characterize resident fish populations. (FY 1999-2000)
		b	Develop sampling protocols for collecting and recording survey data. (FY 1999-2000)

		c	Develop procedures for implementing a stratified random sampling design to be used in the surveys. (FY 1999-2000)
2	Assess the status of resident fish populations in the Bonneville, The Dalles, and John Day reservoirs, Columbia River.	a	Implement sampling design and evaluate the adequacy of sampling intensity to assess the status of resident fish populations. (FY 2000-2001)
		b	Analyze and summarize data in a final report and develop manuscripts for publication in peer-reviewed journals. (FY 2002)

Objective schedules and costs

Objective #	Start Date mm/yyyy	End Date mm/yyyy	Cost %
1	10/1998	12/1999	22
2	02/2000	10/2002	78

Schedule constraints.

Sampling permits will be required. Sampling will be done in February and March to avoid salmonids.

Completion date.
2002

Section 5. Budget

FY99 budget by line item

Item	Note	FY99
Personnel		$112,066
Fringe benefits	Benefits @ 28%	$31,379
Supplies, materials, non-expendable property		$19,525
Operations & maintenance		$7,880
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		
PIT tags	# of tags:	
Travel		$3,600

Indirect costs	Administrative overhead @ 38%	$66,291
Subcontracts		
Other		
TOTAL		$240,741

Outyear costs

Outyear costs	**FY2000**	**FY01**	**FY02**	**FY03**
Total budget	$389,021	$389,917	$81,681	
O&M as % of total	2.7%	2.7%	0%	

Section 6. Abstract

The Independent Scientific Review Panel recently recommended that the Northwest Power Planning Council require a systematic basin-wide inventory of resident fishes, stating that Section 10.2 of the Fish and Wildlife Program implicitly describes the need for such a survey. The goal of this proposed study is to assess the status of resident fish populations in the Bonneville, The Dalles, and John Day reservoirs. Study objectives are to: (1) develop standardized sampling gears, strict sampling protocols, and a statistically valid sampling design that can serve as a template for designing future surveys of resident fish populations (duration 1999-2000), and, (2) assess the status of resident fish populations in the lowest three impoundments on the Columbia River (duration 2000-2002). Sampling gears will be chosen, fished in appropriate habitats, and experimentally evaluated on one reservoir. Objective 2 involves the implementation and evaluation of the surveys. A stratified random sampling design will be implemented by stratifying the reservoirs by enduring geomorphic and physical features that represent important habitat types for fishes. Potential collection sites will be randomly selected using a geographic information system of important habitats. The proposed project would lay the groundwork for assessing resident fish species in the Columbia River. Once an assessment plan has been rigorously developed (this proposal), resident fish species could be sampled, populations assessed, and trends identified. These data could be used in evaluations of both local (e.g., hydroelectric operations) and regional projects (e.g., watershed activities that influence mainstem river conditions).

Section 7. Project description

a. Technical and/or scientific background.

In a recent review of the Northwest Power Planning Council=s Fish and Wildlife Program, the Independent Scientific Review Panel (ISRP) noted that measures in Section 10 imply a logical sequence beginning with an evaluation of the status of native resident fish populations (ISRP 1997, p. 29). The ISRP specifically recommend that the Northwest Power Planning Council require a systematic basin-wide inventory of remaining native resident fish populations so that restoration opportunities can be

identified and prioritized. The study we propose will develop standardized gears and methodologies for surveys of resident fishes in the Columbia River Basin and provide baseline information on the status of resident fish populations in the Bonneville, The Dalles, and John Day reservoirs. The data from the proposed study will also provide a basis for determining the effects of mitigative actions, whether specifically designed to aid anadromous or resident fishes, on the native resident fish assemblages of this reach of the lower Columbia River.

Determining the relative abundance of resident native fishes in the Columbia River Basin is the first step toward identifying and prioritizing the restoration activities recommended in section 10 of the Fish and Wildlife Program. Fish communities in the Columbia River Basin have been affected by a combination of species introductions and extensive habitat degradation following hydroelectric development in the basin (Li et al. 1987; ISG 1996). The construction and operation of hydroelectric dams in the basin have resulted in a loss of highly productive riverine habitat, altered temperature and discharge patterns, continual export of very fine organic matter and dissolved nutrients, simplification of the channel, and loss of floodplain inundation (ISG 1996). These and other anthropogenic disturbances have allowed non-native fishes, such as smallmouth bass *Micropterus dolomieui* and walleye *Stizostedion vitreum*, to establish robust populations (Beamesderfer and Rieman 1991) and resulted in a loss of native biodiversity and biotic integrity (Li et al.1987; ISG 1996).

If a systematic basin-wide survey of resident fishes is to be conducted in the Columbia River Basin, developing standardized gears and methodologies will be necessary to facilitate efficient data collection and to allow spatial and temporal comparisons among surveys. The development of standardized sampling devices and strict sampling protocols are necessary to reduce variation between samples and to detect changes in relative abundance (Fisheries Techniques Standardization Committee 1992). Information regarding the efficiency and selectivity of sampling gears in capturing most native resident fish species in the basin is lacking. When surveys are conducted to characterize fish communities, the best method to characterize the relative abundance of each fish species is the one that samples the largest number of specimens and captures species in proportion to their occurrences in the sampled area (Guetreuter et al. 1995). Since no single method routinely satisfies both criteria due to gear-related and location-related biases, efficiently and accurately assessing the relative abundance of resident fish will involve the selection and evaluation of several gears prior to conducting the surveys (Guetreuter et al. 1995, Hayes et al. 1996, Hubert 1996, Willis and Murphy 1996).

The value of sampling data is largely determined by the quality or appropriateness of the sampling plan (Brown and Austin 1996). The formation of a statistically valid sampling design increases the utility of surveys of resident fishes by increasing sampling efficiency, allowing comparisons to future surveys by minimizing data biases, and ensuring key statistical assumptions are met (Green 1979). A sampling design based on stratified random sampling will allow unbiased design-based estimates of relative abundance and other statistics (Cochran 1977), and will support other model-based

hypothesis tests. Also, stratification can reduce the overall variance of relative abundance estimates and increase the precision of estimated population characteristics. By ensuring the validity of key statistical assumptions, sample sizes can be estimated for detecting significant differences in certain variables and for detecting trends in population characteristics (Geutreuter 1992).

Information is lacking on the biodiversity of resident fish communities and genetic diversity of resident native fish species in the mainstem Columbia River. The Fish and Wildlife Program recognizes the need to ensure that biodiversity is maintained within the basin to protect the integrity and sustainability of ecosystems (section 7.1) and to conserve the genetic diversity of resident native fish (section 10.2B). Approximately 60% of the native fish fauna in the basin is resident in the Columbia and Snake rivers (Li et al. 1987). However, the status of the native fish fauna (particularly non-salmonid species) and consequently the structure and genetic diversity of resident fish communities, remains largely unknown. Notable exceptions to this are the bigmouth minnow *Ptychocheilus oregonensis* which are major predators on juvenile salmonids and support a large fishery (Rieman et al. 1991, Beamesderfer et al. 1996), and white sturgeon *Acipenser transmontanus* which support important commercial, tribal, and recreational fisheries (Miller et al. 1995, Beamesderfer et al. 1995). The proposed study will provide a starting point for understanding the biodiversity of resident fish communities, and eventually the genetic diversity of resident native fishes.

In addition to providing baseline information on the relative abundance of resident fishes in the Bonneville, The Dalles, and John Day reservoirs, the proposed study will provide information for prioritizing degradations and improvements in the biotic integrity of these areas. While assessing the biotic integrity of the areas to be surveyed is not a specific objective of the proposed study, the nature of the data would inherently lend itself to such an evaluation. The Fish and Wildlife program recognizes the need to explore methods to assess trends in system health (section 2.1A.1). Resident fish communities are routinely sampled to monitor changes in ecosystem quality over time and to assess responses of fish communities to management and other human activities (Fausch et al. 1984, Angermeir and Karr 1986, Hughes and Gammon 1987, Fausch et al. 1990, Lyons et al. 1996). The most commonly used approach to this type of monitoring involves the use of indices collectively known as the index of biotic integrity (Fausch et al. 1990).

The index of biotic integrity (IBI) proposed by Karr (1981) is a multi-metric index that rates the existing structure, composition, and functional organization of fish assemblages based on expectations from comparable high-quality ecosystems. The lack of sufficiently quantitative historical surveys of the native resident fauna in the basin may require that expectations of Aexcellent≅ fish assemblages be based on those found in less perturbed areas, such as the Hanford Reach of the Columbia River (Hughes and Gammon 1987, Li et al. 1987). However, fish assemblage reference conditions may also be based on pre-Columbian stream habitats, ichthyofaunal conditions, and regional fish species pools (Hughes 1995). In a review of the statistical properties of the IBI, Fore et al. (1994) concluded that the IBI was an effective monitoring tool that can be used to convey

quantitative assessments in a legal or regulatory context based on confidence intervals or hypothesis testing procedures. This index has been modified and used successfully in many different types of lotic systems throughout North America and more recently in Europe and Asia (Fausch et al. 1984, 1990; Miller et al. 1988; Lyons et al. 1996; Simon and Lyons 1995). The data from this study will contain sufficient information so that commonly used IBI metrics can be estimated. Future surveys in areas such as the Hanford Reach could characterize communities that are less disturbed than reservoir reaches.

b. Proposal objectives.

1. Develop strict sampling protocols, standardized sampling gears, and a statistically valid sampling design to be used in resident fish surveys. Products: Report describing the protocols, results of our gear evaluations, specifications of gears used in the surveys, and a desciption of and rationale for the sampling design used.

2. Assess the status of resident fish populations in the Bonneville, The Dalles, and John Day reservoirs on the Columbia River. Products: Final report describing the relative abundance and community structure of resident fishes in the Bonneville, The Dalles, and John Day reservoirs; Peer-reviewed publications analyzing various aspects of the proposed project.

c. Rationale and significance to Regional Programs.

An inventory of resident fish in the mainstem rivers is critical to understanding and evaluating the effects of watershed changes, exotic species invasions, and the manipulations of conditions intended to increase the survival of anadromous fishes. Studies in other river systems have shown how restoration efforts in watersheds may influence water quality and fish communities further downstream, and vice versa (Stanford and Ward 1992). Exotic species, such as smallmouth bass and walleye, have invaded the Columbia and Snake rivers, possibly displacing resident species and disturbing community relationships. Impoundment of the Columbia River during the last 60 years has produced changes in the seasonal hydrograph and changes in primary and secondary production (Ebel et al. 1989, ISG 1996), which in turn have changed the physical and biotic environment for native fish species in the river. Ongoing actions in the mainstem rivers, such as seasonal spill, channel dredging, and shoreline development, continue to alter the habitats and populations of resident species.

The Northwest Power Planning Council=s Fish & Wildlife Program (Section 10.2) implicitly describes the need for a basin-wide inventory of native resident fish populations and their status, although it does not explicity call for such an assessment. The Report of the Independent Scientific Review Panel (ISRP) specifically recommended that the A*Council require a basin-wide systematic inventory of remaining native resident fish populations and their status, upon which opportunities for restoration and rebuilding*

native resident fish populations can be identified and prioritized≅ (Recommendation III.B.13).

The proposed project would lay the groundwork for assessing resident fish species in the Columbia River. Once an assessment plan has been rigorously developed (this proposal), resident fish species could be sampled, populations assessed, and trends identified. These data could be used in evaluations of both local (e.g., hydroelectric operations) and regional projects (e.g., watershed activities that influence mainstem river conditions).

d. Project history

Not Applicable

e. Methods.

Objective 1. Task a. Assess the efficacy of various sampling gears to characterize resident fish populations.

Prior to selecting sampling gears to be evaluated, we will use pertinent literature, unpublished information available at the USGS Columbia River Research Laboratory, and personnel from other agencies to obtain information on the efficiency and selectivity of various sampling gears commonly used in the basin. Since sampling is not commonly conducted for native resident fish species, information from individuals from outside the basin may provide valuable information on which types of gears may be conducive to these types of surveys (Geutreuter et al. 1995). Also, information on gear efficiency and selectivity are available for many species introduced into the Columbia River (Hubert 1996). From this information we will decide which gears will be evaluated (e.g., bottom trawls, mid-water trawls, beach seines, gill nets, hoop nets, etc.).

To evaluate the selected gears we will conduct preliminary sampling in Bonneville Reservoir during 1999. Bonneville Reservoir was selected because of its proximity to our laboratory, which will reduce the cost of the evaluation. Preliminary sampling and future surveys will be conducted in February and March to minimize the effects of these surveys on migrating adult and juvenile salmonids. Gears suitable for sampling various habitat strata will be fished and their relative selectivity (size and species) and relative efficiency will be compared (Yeh 1977, Jensen 1986, Beamesderfer and Rieman 1988, Holland and Peters 1992, Kraft and Johnson 1992, Reynolds 1996). For instance, gears appropriate for sampling near-shore habitats will be fished in representative areas of this habitat type and relative selectivities and efficiencies of these gears will then be compared. This procedure will be conducted for all habitat strata. The hypothesis to be tested is: H_o:There are no differences in the relative size and species selectivities and relative efficiencies among different sampling gears. From this evaluation we can decide which gears, or combinations of gears, will be the least selective and most efficient. Geutreuter et al. (1995) have found that combinations of gears are necessary to characterize

community and population characteristics of fishes in the Mississippi River adequately.

Objective 1. Task b. Develop sampling protocols for collecting and recording survey data.

Developing strict sampling and data recording protocols are necessary to ensure the success of these surveys. Detailed sampling protocols, data recording procedures, fish processing protocols, and quality assurance and quality control procedures will be developed prior to the surveys (Geutreuter et al. 1995, Geoghegan 1996).

Objective 1. Task c. Develop procedures for implementing a stratified random sampling design to be used in the surveys.

A stratified random sampling design for the surveys will be implemented by stratifying the reservoirs by enduring geomorphic and physical features that represent important habitat types for fishes (Cochran 1977, Geutreuter 1995). Potential collection sites will be randomly selected using a geographic information system (GIS) of important habitats. Prior to the beginning of the surveys, lists of primary and alternate sample sites will be generated. Sites will be represented by 50 x 50 m grids in a GIS database that will also contain delineations of the known extent of the sampling strata. Within each reservoir, grids will be selected at random with uniform probability from each stratum to generate lists of primary collection sites for each gear. Sampling gears will be deployed independently within strata. For each primary site, the set of all grids of the stratum within a 1 km radius will be identified, and a second random selection of grids will be made, producing a list of alternate collection sites.

Objective 2. Task a. Implement sampling design and evaluate the adequacy of sampling intensity to assess the status of resident fish populations.

Using the methodologies established from the completion of Objective 1, resident fish surveys will be conducted in the Bonneville, The Dalles, and John Day reservoirs. Sampling in all three reservoirs will be conducted during February and March 2000-2001. After the completion of the surveys conducted during 2000, the adequacy of our sampling intensity in detecting among-strata and among-reservoir differences in relative abundances and length distributions of various species will be examined (Geutreuter 1992). We will incorporate the results of these analyses during 2001. There are limitations to the meaningful application of sample size estimation procedures in these types of surveys (Geutreuter 1995). Relative abundance and length distributions will be monitored for all species collected during the surveys. Consequently, many random variables will be generated for which sample size estimates could be calculated. A definitive estimation of adequate sample size will therefore involve subjective decisions about which variables are most important.

Objective 2. Task b. Analyze and summarize data in a final report and develop manuscripts for publication in peer-reviewed journals.

Estimates of the relative abundances of species collected during the proposed study will be calculated by strata and reservoir. Potential hypotheses to be tested include: H_o: There are no differences in the relative abundance of species among habitat strata; H_o: There are no differences in the relative abundance of species in habitat strata among reservoirs. To determine specifically what methodologies (parametric, nonparametric, etc.) will be used to test these hypotheses, initial estimates of variance and a knowledge of the distributional properties of the data will be necessary (Sokal and Rolf 1995). Population structures will be examined through an evaluation of the size distributions of various species. Potential hypotheses to be tested include: H_o: There are no differences in the size distributions of species among habitat strata; H_o: There are no differences in the size distribution of species in similar habitat strata among reservoirs. These hypotheses will be tested by evaluating chi-square tests (Sokal and Rolf 1995).

Fish community structure in each reservoir will be characterized and further examined by strata. Various multi-variate statistical techniques have been used to delineate quantitatively distinctive associations of species (Gauch et al. 1986, Digby and Kempton 1994). Appropriate techniques will be identified and used to examine community structure. Using the classifications of Hughes and Gammon (1987), fish will be classified by the trophic classification of the adults and their relative tolerance to organic pollution, warm water, and sediment. Relative abundances of fish in these categories will be reported by strata and reservoir.

f. Facilities and equipment.

The USGS Columbia River Research Laboratory (CRRL) has been conducting research in the Columbia River Basin since 1978. Approximately 30 research vessels, including electrofishing boats and boats to 26 feet capable of bottom trawling, are routinely deployed throughout the basin to conduct research. The CRRL has state-of-the-art GIS capabilities and modern office equipment and facilities to support the research conducted by the staff.

Specialized equipment purchased for this study primarily consists of fish sampling gears (bottom trawls, mid-water trawls, beach seines, gill nets, hoop nets, etc.) that are to be evaluated and used during the surveys.

g. References.

Angermeir, P. L., and J. R. Karr. 1986. Applying an index of biotic integrity based on stream fish communities: considerations in sampling and interpretation. North American Journal of Fisheries Management 6:418-429.

Beamesderfer, R. C., D. L. Ward, and A. A. Nigro. 1996. Evaluation of the biological basis for a predator control program on northern squawfish (Ptychocheilus oregonensis) in the Columbia and Snake rivers. Canadian Journal

of Fisheries and Aquatic Sciences 53:2898-2908.

Beamesderfer, R. C. P., T. A. Rien, and A. A. Nigro. 1995. Differences in the dynamics and potential production of impounded and unimpounded white sturgeon populations in the lower Columbia River. Transactions of the American Fisheries Society 124:875-872.

Beamesderfer, R. C., and B. E. Rieman. 1988. Size selectivity and bias in estimates of population statistics of smallmouth bass, walleye, and northern squawfish in a Columbia River reservoir. North American Journal of Fisheries Management 8:505-510.

Beamesderfer, R. C., and B. E. Rieman. 1991. Abundance and distribution of northern squawfish, walleyes, and smallmouth bass in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:439-447.

Brown, M. L., and D. J. Austen. 1996. Data management and statistical techniques. Pages 17-62 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Cochran, W. G. 1977. Sampling techniques, 3rd edition. John Wiley and sons, New York.

Digby, P. G. N., and R. A. Campton. 1987. Multivariate analysis of ecological communities. Chapman and Hall, New York, New York.

Ebel, W. J., D.C. Becker, J. W. Mallen, and H. L. Raymond. 1989. The Columbia River-toward a holistic understanding. Pages 205-219 *in* E. P. Dodge, editor. Proceedings of the International Large Rivers Symposium. Vol. 106. Canadian Special Publications in Fisheries and Aquatic Science.

Fausch, K. D., J. R. Karr, and P. R. Yant. 1984. Regional application of an index of biotic integrity based stream fish communities. Transactions of the American Fisheries Society 113:39-55.

Fausch, K. D., J. Lyons, J. R. Karr, and P. L. Angermeir. 1990. Fish communities as indicators of environmental degradation. Pages 123-144 *in* S. M. Adams, editor. Biological indicators of stress in fish. American Fisheries Society, Symposium 8, Bethesda, Maryland.

Fisheries Techniques Standardization Committee. 1992. Fish sampling and data analysis techniques used by conservation agencies in the U.S. and Canada. American Fisheries Society, Fisheries Management Section, Fisheries Techniques Standardization Techniques Standardization Committee, Bethesda, Maryland.

Fore, L. S., J. R. Karr, and L. L. Conquest. 1994. Statistical properties of an index of biotic integrity used to evaluate water resources. Canadian Journal of Fisheries and Aquatic Sciences 51:1077-1087.

Gauch, H. G. 1986. Multivariate analysis in ecology. Cambridge University Press, Cambridge, New York.

Geoghegan, P. 1996. The management of quality control and quality assurance systems in fisheries science. Fisheries 8:14-18.

Geureuter, S. 1992. Systemic features of fisheries of the upper Mississippi River System. 1990 Fisheries Component Annual Report. Technical Report 92-T001, U.S. fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin.

Geutreuter, S., R. Burkhardt, and K. Lubinski. 1995. Long term resource monitoring program procedures: Fish monitoring. National Biological Service, Environmental Management Technical Center, Onalaska, Wisconsin, July 1995. LTRMP 95-P002-1.

Green, R. H. 1979 Sampling design and statistical methods for environmental biologists. John Wiley and Sons, New York, New York.

Hayes, D. B., C. P. Ferreri, and W. W. Taylor. 1996. Active fish capture methods. Pages 193-220 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Holland, R. S., and E. J. Peters. 1992. Differential catch by hoop nets of three mesh sizes in the lower Platte River. North American Journal of Fisheries Management 12:237-243.

Hubert, W. H. 1996. Passive fish capture techniques. Pages 157-192 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Hughes, R. M., and J. R. Gammon. 1987. Longitudinal changes in fish assemblages and water quality in the Willamette River, Oregon. Transactions of the American Fisheries Society 116:196-209.

Hughes, R. M. 1995. Defining acceptable biological status by comparing with reference conditions. Pages 31-47 *in* W. S. Davis and T. P. Simon, editors. Biological assessment and criteria: tools for water resources planning and decision making. Lewis Publishers, Boca Raton, Florida.

Independent Scientific Group (ISG). 1996. Return to the river: restoration of

salmonid fishes in the Columbia River Ecosystem development of an alternative conceptual foundation and review and synthesis of science underlying the Fish and Wildlife Program of the Northwest Power Planning Council. Prepublication Copy.

Independent Scientific Review Panel (ISRP). 1997. Review of the Columbia River Basin Fish and Wildlife Program as directed by the 1996 amendment to the Power Act. ISRP Report 97-1.

Jensen, J. W. 1986. Gillnet selectivity and the efficiency of alternative combinations of mesh sizes for some freshwater fish. Journal of Fish Biology 28:637-646.

Kraft, C. E., and B. L. Johnson. 1992. Fyke-net and gill-net size selectivities for yellow perch in Green Bay, Lake Michigan. North American Journal of Fisheries Management 12:230-236.

Li, H. W., C. B. Schreck, C. E. Bond, and E. Rextad. 1987. Factors influencing changes in fish assemblages of Pacific Northwest Streams. *In* W. J. Matthews and D. C. Heins, Editors. Community and Evolutionary Ecology of North American Stream Fishes. University of Oklahoma Press, Norman, Oklahoma.

Lyons, J., L. Wang, and T. D. Simonson. 1996. Development and validation of an index of biotic integrity for coldwater streams in Wisconsin. North American Journal of Fisheries Management 16:241-256.

Miller, D. L., and 13 coauthors. 1988. Regional application of an index of biotic integrity for use in water resource management. Fisheries 13:12-20.

Miller, A. I., T. D. Counihan, M. J. Parsley, and L. G. Beckman. 1995. Columbia River Basin white sturgeon. in Laroe, E. T., G. S. Farris, C. E. Puckett, P. D. Doran, and M. J. Mac, editors. Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. U.S. Department of the Interior, National Biological Service, Washington, DC.

Reynolds, J. B. 1996. Electrofishing. Pages 221-253 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Simons, T. P., and J. Lyons. 1995. Application of the index of biotic integrity to evaluate water resources integrity in freshwater ecosystems. Pages 245-262 *in* W. S. Davis and T. P. Simon, editors. Biological assessment and criteria: tools for water resources planning and decision making. Lewis Publishers, Boca Raton, Florida.

Sokal, R. R., and F. J. Rohlf. 1995. Biometry, 3rd edition, Freeman, New York.

Stanford, J. A. And J. V. Ward. 1992. Managment of aquatic resources in large catchments: Recognizing interactions between ecosystem connectivity and environmental disturbance. Pages 91-126 *In:* R. J. Naiman (ed.), Watershed Management: Balancing Sustainability and Environmental Change. Springer-Verlag, New York.

Willis, D. W., and B. R. Murphy. 1996. Planning for sampling. Pages 1-15 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Yeh, C. F. 1977. Relative selectivity of fishing gear used in a large reservoir in Texas. Transactions of the American Fisheries Society 4:309-313.

Section 8. Relationships to other projects

While the proposed project is not directly related to other work currently funded in the Fish and Wildlife Program, there is potential for the methodologies developed during the study to be employed in future resident surveys. As stated previously, a primary objective of the proposed project is to develop standardized sampling gear, protocols, and methodologies, and to implement a statistically valid sampling design that can be used in future resident fish surveys.

Section 9. Key personnel

Co-principal investigators:

James H. Petersen. 0.25 FTE. Dr. Petersen will assist with the development of the procedures for implementing the stratified random sampling design, analysis of the gear evaluations, analysis of the adequacy of sampling intensity, and all other statistical analysis of the data collected.

Timothy D. Counihan. 1.0 FTE. Mr. Counihan will coordinate all project activities and with the assistance of Dr. Petersen, be involved in all aspects of data collection and analysis.

Research Biologist:

Craig A. Barfoot. 0.25 FTE. Mr. Barfoot will provide technical expertise in the sampling of near-shore habitats and will also provide assistance with data analysis.

Resume for: James H. Petersen

Experience

1995-Present Research Fishery Biologist, U.S. Geological Survey, Biological Resources Division, Columbia River Research Laboratory, Cook, WA.
Current responsibilities: Project leader on research project to determine survival of summer steelhead over their first winter in the Wind River Basin (WA). Co-leader on various mainstem Columbia and Snake River projects concerning juvenile salmon passage, predation, and reservoir drawdown.

1994 Acting Director, Columbia River Research Laboratory, USGS, Cook, WA.

1988-93 Research Fishery Biologist, Columbia River Research Laboratory, U.S. Fish and Wildlife Service.

1984-88 Associate Research Curator, Section of Fishes, Natural History Museum of Los Angeles County, Los Angeles, CA.

1983-84 Environmental Scientist, Section of Fishes, Natural History Museum of Los Angeles County.

1977-83 Graduate Teaching Assistant, University of Oregon, Eugene, OR.

Education: Degree or training, School, and Date Received
Ph. D., Marine Ecology, University of Oregon, 1983
Rotary Fellowship, University of Queensland, Australia, 1976
B. S., Biology, Boise State University, Idaho, 1975

Expertise: Primary areas of expertise include predator-prey dynamics, population dynamics, and application of various modeling techniques to fisheries.

Publications and Reports (five most relevant)

Petersen, J. H., A. E. Jahn, R. J. Lavenberg, G. E. McGowen, and R. S. Grove. 1986. Physical-chemical characteristics and zooplankton biomass on the continental shelf off southern California. Calif. Coop. Oceanic Fish. Invest. Rep. 27:36-51.

Petersen, J. H. 1994. The importance of spatial pattern in estimating predation on juvenile salmonids in the Columbia River. Trans. Am. Fish. Soc. 123:924-930.

Petersen, J.H. and D.M. Gadomski. 1994. Light-mediated predation by northern squawfish on juvenile salmon. J. Fish Biol. 45: 227-242.

Ward, D. L., J. H. Petersen, and J. J. Loch. 1995. Index of predation on juvenile salmonids by northern squawfish in the lower and middle Columbia River and in the lower Snake River. Trans. Am. Fish. Soc. 124:321-334.

Petersen, J. H. and D. L. Ward. In review. Development and corroboration of a bioenergetics model for northern squawfish feeding on juvenile salmonids in the Columbia River. Trans. Am. Fish. Soc.

Resume for: Timothy D. Counihan

Experience

1993-Present Research Fishery Biologist, U.S. Geological Survey, Biological Resources Division, Columbia River Research Laboratory, Cook, WA.
Current responsibilities: Team leader on research project examining various aspects of the early life history of white sturgeons in the Columbia River Basin.

Principal investigator on tasks including: Comparing the use of gill nets to bottom trawls to characterize white sturgeon young-of-the-year recruitment; Examining the relation of the recruitment of white sturgeon young-of-the year to climactic variables; Evaluating the effect of short-term dam operations on white sturgeon spawning.

1991-92 Fisheries Technician, Idaho Department of Fish and Game, Coeur D=Alene, ID.

1989-91 Research Specialist, New Mexico State University, Las Cruces, NM.

Education: Degree or training, School, and Date Received

M. S., Wildlife Science, New Mexico State University, 1991

B. S., Biology, Montana State University, 1989

Expertise: Primary areas of expertise include the design of fish and ichthyoplankton surveys, white sturgeon ecology, and larval fish ecology.

Publications and Reports (five most relevant)

Counihan, T. D., A. I. Miller, and M. J. Parsley. *In press**. Indexing the relative abundance of young-of-the-year white sturgeon in an impoundment of the lower Columbia River from highly skewed trawling data. *In* T. Rien, editor. Effects of mitigative measres on the productivity of white sturgeons in the Columbia and Snake rivers. Report to Bonneville Power Administration (Project 86-50).

*-In review for publication in the North American Journal of Fisheries Management

Counihan, T. D., A. I. Miller, M. G. Mesa, and M. J. Parsely. *In press*. The effects of dissolved gas supersaturation on white sturgeon larvae. Transactions of the American Fisheries Society.

Miller, A. I., T. D. Counihan, M. J. Parsley, and L. G. Beckman. 1995. Columbia River Basin white sturgeon. Pages 145-157 in E. T. Laroe, editor. Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. U.S. Department of the interior, National Biological Service. Washington, D.C.

Parsley, M. J., T. D. Counihan, A. I. Miller,, and L. G. Beckman. 1995. Report C *in* K. T. Beinengen, editor. Effects of mitigative measures on the productivity of white sturgeon populations downstream from McNary Dam and the status and habitat requirements of white sturgeon populations in the Columbia and Snake rivers upstream from McNary Dam.

Counihan, T. D., A. I. Miller, M. J. Parsley, and L. G. Beckman. 1994. Report C. Pages 90-134 *in* K. T. Beinengen, editor. Effects of mitigative measures on the productivity of white sturgeon populations downstream from McNary Dam and the status and habitat requirements of white sturgeon populations in the Columbia and Snake rivers upstream from McNary Dam.

Experience

1992-Present Research Fishery Biologist, U.S. Geological Survey, Biological Resources Division, Columbia River Research Laboratory, Cook, WA.
Current responsibilities: Team leader for a project studying possible effects of lower Snake River drawdown on predation-related juvenile salmonid mortality
Co-investigator for project examining the abundance and distribution of larval and juvenile fishes in the Columbia River Basin.

1990-92 Research assistant. Biology Department, Montana State University, Bozeman, MT

Education: Degree or training, School, and Date Received
M.S., Fish and Wildlife Management, Montana State University, 1993
B.S., Biology, South Dakota State University, 1989

Expertise: Primary areas of expertise include fish assemblage structure. Larval and juvenile fish ecology. Sampling methods and ecology of shallow-water reservoir habitats.

Publications and Reports (five most relevant)

Barfoot, C.A. In preparation. Changes in near-shore fish community composition in a lower Columbia River impoundment.

Barfoot, C. A., D.M. Gadomski, and R. H. Wertheimer. In review. Growth and mortality of age-0 northern squawfish *Ptychocheilus oregonensis* during early rearing in shoreline habitats of a Columbia River Reservoir, U.S.A. Environmental Biology of Fishes.

Gadomski, D. M., and C. A. Barfoot. In press. Diel and distributional abundance patterns of fish embryos and larvae in the lower Columbia and Deschutes rivers. Environmental Biology of Fishes.

Barfoot, C.A., D.M. Gadomski, A.M. Murphy, and G.T. Schultz. 1994. Reproduction and early life history of northern squawfish *Ptychocheilus oregonensis* in the Columbia River. pp. 7-40 In Gadomski, D.M. and Poe, T.P. (eds.), System-wide significance of predation. Annual report by the National Biological Survey to the Bonneville Power Administration, Portland, OR.

Barfoot, C.A. 1993. Longitudinal distribution of fishes and habitat in Little Beaver Creek, MT. M.S. Thesis. Fish and Wildlife Management, Montana State University, Bozeman, MT.

Section 10. Information/technology transfer

Results of the study we propose will be summarized in annual progress reports, final reports and will be submitted for publication in peer-reviewed journals.