

**Bonneville Power Administration
Fish and Wildlife Program FY99 Proposal**

Section 1. General administrative information

**Monitor Supplementation Response Variable For
The YKFP**

Bonneville project number, if an ongoing project 9506406

Business name of agency, institution or organization requesting funding
Washington Department of Fish and Wildlife

Business acronym (if appropriate) WDFW

Proposal contact person or principal investigator:

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Subcontractors.

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NPPC Program Measure Number(s) which this project addresses.
7,4K; 2.2A, 2.2H; 7.2D

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

Other planning document references.

Wy Kan Ush Me Wa Kush Wit, Volume II, p. 59 and Table SP4; Columbia River Fish Management Plan, Appendix B; Columbia Basin System Planning Salmon and Steelhead Production Plan, Yakima River Subbasin, p. 104.

Subbasin.
Yakima River

Short description.

Lead the continued refinement of the Yakima Fisheries Project Spring Chinook Monitoring Plan and implement monitoring and evaluation of the reproductive success and long term fitness response variables for upper Yakima spring chinook.

Section 2. Key words

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

Other keywords.

reproductive success, ecological interactions, power analysis, genetic and ecological risk assessment

Section 3. Relationships to other Bonneville projects

Project #	Project title/description	Nature of relationship
9506402	Yakima Species Interactions Studies	Implements ecological risk assessment and ecological risk containment measures as defined by the Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan.
9506404	WDFW Policy/Technical Involvement and Planning for YKFP	Provides for WDFW policy and technical planning and coordination for the project. Sets goals and objectives for monitoring and evaluation.
9506405	Further Development of the "NIT" and "LNIT" Strategies for the YKFP	Provides field testing and final definition of the new innovative treatments to be used for fish rearing to produce individuals with traits

		similar to their wild counterparts.
8812001	YIN Yakima/Klickitat Project Management	Provides for YIN policy and technical planning and coordination for the Project. Sets goals and objectives for monitoring and evaluation.
9701300	Yakima Cle Elum Hatchery O&M	Operation of the experimental hatchery to test the assumption that supplementation is an effective rebuilding approach.
9506300	Yakima/Klickitat Monitoring and Evaluation Program	Implements portions of the supplementation evaluation as described by the Yakima Fisheries Project Spring Chinook Supplementation Monitoring and Evaluation Plan.

Section 4. Objectives, tasks and schedules

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Refinement of Monitoring Plan	a	Develop procedures for monitoring
		b	Conduct Power Analysis
		c	Develop detailed field protocols for monitoring
2	Development of Supplementation Models for Improved Monitoring and Management		
3	Compare the reproductive success of wild and cultured spring chinook.	a	Characterize the reproductive behavior of wild fish via observations on naturally spawning fish in the upper Yakima and Naches rivers

Objective schedules and costs

Objective #	Start Date mm/yyyy	End Date mm/yyyy	Cost %
1	1/1999	12/1999	35.00%
2	1/1999	12/1999	45.00%

3	1/1999	12/1999	20.00%
			TOTAL 100.00%

Schedule constraints.

none anticipated

Completion date.

2005

Section 5. Budget

FY99 budget by line item

Item	Note	FY99
Personnel		\$108,000
Fringe benefits		\$27,000
Supplies, materials, non-expendable property		20,000
Operations & maintenance		
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		
PIT tags	# of tags:	
Travel		\$13,000
Indirect costs		\$32,000
Subcontracts		
Other		
TOTAL		\$200,000

Outyear costs

Outyear costs	FY2000	FY01	FY02	FY03
Total budget	\$200,000	\$200,000	\$200,000	\$200,000
O&M as % of total	0.00%	0.00%	0.00%	0.00%

Section 6. Abstract

This ongoing project is one of an integrated suite of tasks which, collectively, implement the Yakima/Klickitat Fisheries Project. (YKFP). The goal of the YKFP is to test the assumption that supplementation can be used to restore natural production and increase harvest opportunities while keeping genetic and ecological impacts within specified

limits, as stipulated by the Northwest Power Planning Council (Measure 7.4K). Under this project, Washington Department of Fish and Wildlife scientists will lead the development of detailed monitoring plans stating major objectives, experimental hypotheses, risk containment measures, and specific field protocols to guide evaluation of supplementation success in the Yakima/Klickitat Fisheries Project. Agency scientists will also perform power analyses to evaluate the strength of experimental designs developed through the Monitoring Implementation Planning Team (MIPT). In addition, scientists will conduct field research to begin monitoring and evaluation of various response variables as described in the Yakima Fisheries Project Spring Chinook Monitoring Plan. Results will be reported to the YKFP Policy Group through the Project's Scientific and Technical Advisory Committee (STAC).

Section 7. Project description

a. Technical and/or scientific background.

The Yakima/ Klickitat Fisheries Project is a hatchery-based supplementation research project designed to test the hypotheses that new supplementation techniques can be used in the Yakima River Basin to increase natural production and to improve harvest opportunities, while maintaining the long-term genetic fitness of the wild and native salmonid populations and keeping adverse ecological interactions within acceptable limits (BPA, 1996). The Project responds to Measure 7.4K of the Columbia River Basin Fish and Wildlife Program of the Northwest Power Planning Council (1994).

Because the YKFP is designed as a learning platform based upon adaptive management, a robust monitoring and evaluation process is critical to project success. The Northwest Power Planning Council, in their response to the draft Master Plan for the Yakima/Klickitat Fisheries project (1987) directed the fishery managers to identify critical uncertainties associated with supplementation and to develop a complete experimental program including specific hypotheses to be tested. In addition, the PPC requested a monitoring and evaluation plan to measure results at an acceptable level of precision and accuracy to support the adaptive management framework (letter Brusset to Jura, 1987).

The initial presentation of a monitoring and evaluation plan was provided in the Project Status Report, Vol. 3; Upper Yakima spring Chinook (1995). That document was a reasonably good overview, and presents some important basic principles of monitoring, but was decidedly lacking in specifics. Throughout 1996, the Monitoring Implementation and Planning Team (MIPT), an interdisciplinary group of biologists who have worked on the project for several years, worked to develop a comprehensive spring chinook monitoring plan for the project. Work on the initial draft continued through 1997 and resulted in completion of the Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan (Busack et al, 1997) (the project Monitoring Plan).

In this submittal we propose to continue refinement of the project Monitoring Plan, continue power analysis and modelling, and to continue specific monitoring elements as stipulated in the 1997 plan and implemented during the 1997 field season (see 7b).

b. Proposal objectives.

Objective 1: Refinement of the Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan.

The MIPT developed a spring chinook monitoring plan in 1996. This was a conceptually complete plan that identified what needed to be monitored and why, but its completion marks the end of just the first phase of monitoring plan development. Necessary refinements to the project Monitoring Plan include complete procedure for actual monitoring and detailed protocols for data collection. This proposal supports WDFW participation in the MIPT process (along with YIN biologists).

Objective 2: Development of Supplementation Models for Improved Monitoring and Management.

Realistic modeling of supplementation mechanics is critical to refinement of the natural production measures in the monitoring plan. A model is needed that incorporates survival rate stochasticity, spawner-recruit relationships, domestication selection, flexible broodstock collection rules, densator survival capability, and multiple substocks. Work will be prioritized.

Objective 3: Compare the reproductive success of wild and cultured spring chinook.

This activity responds to evaluation of the relative reproductive success of experimental fish produced in the hatchery environment (two treatment groups; OCT = Optimal/Conventional Treatment and, SNT = Semi-natural Treatment) and their wild counterparts. In this early phase, prior to the expected return of hatchery-produced adults in 2001, field activities will focus on observation and analysis of natural spawning spring chinook adults in the upper Yakima and Naches rivers. Detailed observations will allow scientists to characterize typical spring chinook reproductive behavior to serve as a baseline when the behavior of hatchery fish is ultimately analyzed. Such behavioral observations of naturally spawning fish will facilitate power analyses on eventual comparisons between wild and hatchery fish by assessing how much variation is natural in the frequency and execution of certain behaviors. Results will be reported and submitted to a peer-reviewed journal. (See Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan pp. 137-138).

c. Rationale and significance to Regional Programs.

The Yakima/Klickitat Fisheries Project was identified in the 1982 Columbia River Basin Fish and Wildlife Program (Measure 104(i)(3) and 904(e)(1). A draft Master Plan was presented to the Power Planning Council in 1987 and the Preliminary Design Report in 1990. In both cases the PPC instructed the managers (the YIN and the WDFW) to carry out planning functions that addressed project uncertainties and formulate them into testable hypotheses and a monitoring and evaluation plan. The project managers produced the initial Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan. The project Monitoring Plan provides a framework for monitoring the success of supplementation and can be used as a planning tool throughout the region. Results from project research are designed to provide transferrable information to be used throughout the region. Project scientists believe this project to be unique in having been designed from its inception to test the efficacy of supplementation while keeping genetic and ecological impacts within specified limits.

The cooperating fishery managers on the YKFP are the Yakama Indian Nation and the Washington Department of Fish and Wildlife. A project management framework stipulates that project management is directed by a Policy Group consisting of representatives of the fishery managers. The USBOR is an interested party in the basin and several proposed monitoring facilities are operated by BOR. BPA is the funding entity and has the lead responsibility for NEPA document development and compliance.

d. Project history

Project Reports and Technical Papers: Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan.

Summary of Major Results Achieved: This project has produced the first iteration of the project Monitoring Plan (see above). The Plan has been delivered to BPA and distributed to interested parties for review. The summary version of the plan will be published in the peer-reviewed literature. This project has also produce four supplementation models which include the the elements identified in 7b above. Field observation of naturally spawning adult spring chinook were conducted in 1997 and produced significant behavioral information which will provide the refinements for work proposed herein.

Adaptive Management Implications: The project Monitoring Plan is the central expression of uncertainty resolution measures. The results of work specified in the Monitoring Plan will feed the project adaptive management cycle as described below.

Under the adaptive management structure for the YKFP, project managers propose actions (strategies) in response to a set of agreed-upon objectives. These actions are designed as experiments to test whether the predicted result (or some other result) occurs. They also define operating assumptions needed to accept the strategies, associated uncertainties and the risk of not meeting the stated objectives if the assumptions are incorrect or the strategy is not feasible. The experiments must be carefully designed to obtain valid (i.e., statistically reliable) results in a specified period of time. The

experiments are conducted and carefully monitored to allow statistical evaluation of the results. The process includes a mechanism for review of the previous year's results, which may cause the objectives to be modified, in turn restarting the process.

Years Underway: 1997 – present

Past Costs: \$136,000 FY 97.

e. Methods.

The overall goal of this proposal is to lead the continued development and refinement of the project's Spring Chinook Supplementation Monitoring Plan which states major objectives, experimental hypotheses, risk containment measures, and specific field protocols to guide evaluation of supplementation success in the Yakima/Klickitat Fisheries Project. This process will be iterative over a period of several years as the supplementation evaluation passes through a series of stages from initial adult brood collection to production of F2 progeny from hatchery adults spawned in the wild.

In addition, scientists will continue field research to begin monitoring and evaluation of reproductive success response variables as described in the Monitoring Plan. One of the major questions being raised about salmonid restoration and supplementation programs is whether hatchery produced adults can successfully reproduce under wild conditions. This task is designed to directly investigate and answer that question.

Each of the objectives described herein has been developed in concert with the Monitoring Implementation Planning Team and are consistent with the Project Status Report, Vol. 3; Upper Yakima Spring Chinook (1995).

Objective 1: Refinement of the Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan.

Task a: Develop procedures for monitoring.

Identify the specific response variables to be monitored to implement the project Monitoring Plan. This phase of development is quantitative, determining the scale and size of an effective monitoring effort. MIPT will meet in work sessions periodically throughout the contract period to refine the Monitoring Plan, with highest priority being given to the most immediate life history stages.

Task b: Conduct power analyses

Power analyses will be performed on draft experimental designs to determine with what precision response variables can be measured, and what sample sizes are required. WDFW will conduct power analyses based on draft sampling designs and data sets. Information will be incorporated in Task a and reflected in refined monitoring procedures.

Task c: Develop detailed field protocols for monitoring.

Following completion of tasks a and b, the MIPT will address the third phase of monitoring plan development, detailed protocols for data collection. As noted for previous tasks, this process will be iterative, resulting a continued refinements to the Monitoring Plan as the supplementation project passes through various stages over a number of years.

Objective 2: Supplementation modeling for improved monitoring and management.

Four stochastic dynamic supplementation models (named SSDM-1 through 4) were developed to the beta-test phase in 1997. WDFW scientists, in cooperation with YIN scientistst, will continue to develop these models, working toward a fully age-structured, variable life-history model that can be used for all species of YKFP interest. Simultaneously with the development of more advanced models, the models already developed will be used to refine monitoring methods in terms of power and choice of response variables.

Objective 3: Compare the reproductive success of wild and cultured spring chinook.

Task a: Characterize the reproductive behavior of wild fish via observations on naturally spawning fish in the upper Yakima and Naches rivers.

Project scientists will again locate and observe (via video and audio tape) pairs of naturally spawning spring chinook and quantify discrete reproductive behaviors (both courting and aggressive) from the tapes. From these data we will:

- produce continuous ethograms of the reproductive behavior of wild spring chinook;

- compare data collected from various years to see if there is any inter-annual variation in behavior patterns; and

- perform a power analysis to determine sample sizes that will be required to compare wild and hatchery fish in a spawning setting.

Discussion

Critical assumptions include the following:

- Visual observations can be made and the portable video equipment will function;

- Escapement into natural spawning areas will be breat enough to allow multiple observations and;

- Fish observed are typical of wild spring chinook.

f. Facilities and equipment.

No major equipment is required. Expendable goods such as film, batteries, waders and typical field gear will be acquired through goods and services budget element.

g. References.

1982 Columbia River Basin Fish and Wildlife Program, Northwest Power Planning Council, Portland, OR. 1994.

Morris Brusett, Chairman, Northwest Power Planning Council; letter to James Jura, Administrator, Bonneville Power Administration, November 10, 1987, Attachment 2.

Busack, C., B. Watson, T. Pearsons, C. Knudsen, S. Phelps, and M. Johnson. 1997. Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan. 185 pp.

Yakima/Klickitat Fisheries Project Planning Status Report. Volume 3: Yakima Spring Chinook Salmon. 1995. Prepared for Bonneville Power Administration.

Section 8. Relationships to other projects

This project is one among a suite of integrated projects that, collectively, constitute the Yakima/Klickitat Fisheries Project. Projects 9506404 and 8812001 provide policy and technical planning and coordination for the Washington Department of Fish and Wildlife and the Yakama Indian Nation, respectively. The Policy Group receives technical input from the Scientific and Technical Advisory Committee (STAC), also supported under the above contract numbers. Project 9506402, 9506405, 9701300, 9506300, 8812008, and 8812005 each represent a critical component of the Yakima/Klickitat Fisheries Project, addressing critical uncertainties as reflected in the Project Status Report, Vol. 3, Yakima Spring Chinook Salmon (1995) and the Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan (1997).

Section 9. Key personnel

Craig Busack, PhD Fisheries Research Scientist 6 mos

Dr. Busack is serving as both the leader of the Monitoring Implementation Planning Team and the project specialist on genetics. He has served as the project geneticist since 1989 and has lead the MIPT 1996.

Steve Schroder, PhD Fisheries Research Scientist 2 mos

Dr. Schroder is a behavioral ecologist with broad expertise studying spawning behavior and in comparisons of fertility and egg quality of hatchery and wild salmonids.

Curtis Knudsen Fish Biologist 4 5 mos

Curtis Knudsen has been a member of the MIPT since its inception. His expertise ecology, quantitative science (modeling), and population demographics.

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BACKGROUND

- 1988-present: Research Scientist, Washington Department of Fish and Wildlife (until 1994 Washington Department of Fisheries)
- 1983-1988: Assistant Professor of Biology, University of Mississippi.
- 1981-1983: NSERC Visiting Postdoctoral Fellowship, Pacific Biological Station, Nanaimo, British Columbia.
- 1977-1981: Ph.D. Genetics, University of California, Davis.
1975-1977: M.S. Genetics, University of California, Davis.
1973-1975: B.S. Genetics, University of California, Davis.

SELECTED PUBLICATIONS

Busack, C. 1990. Yakima/Klickitat Production Project genetic risk assessment. In Yakima/Klickitat Production Project Preliminary Design Report, Appendix A. Bonneville Power Administration, DOE/BP-00245-2.

Busack, C., and K.P. Currens. 1995. Genetic risks and hazards in hatchery operations: Fundamental concepts and issues. AFS Symposium 15: 71-80.

Currens, K.P., and C. Busack. 1995. A framework for assessing genetic vulnerability. Fisheries 20: 24-31.

Hoffmann, A., C. Busack, and C. Knudsen. 1994. Experimental designs for testing differences in survival among salmonid populations. Report, DOE/BP-00029-3. Bonneville Power Administration, Portland OR.

Busack, C., B. Watson, T. Pearsons, C. Knudsen, S. Phelps, M. Johnston. 1997. Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan. Unpubl. Report for Yakima Fisheries Project.

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BACKGROUND

- 1990-present: Research Scientist II, Washington Department of Fish and Wildlife (until 1994 Washington Department of Fisheries)
- 1981-1990: Research Scientist I, Washington Department of Fisheries
- 1980-1981: Fisheries Biologist (III & IV), Washington Department of Fisheries
- 1973-1981: Ph.D., University of Washington
- 1971-1973: M.S., University of Washington
- 1969: B.S., University of Washington

SELECTED PUBLICATIONS

Volk, E.C., S.L. Schroder, J.J. Grimm, and S. Ackley. 1994. Use of bar code symbology to produce multiple thermally induced otolith marks. *Trans. Am. Fish. Soc.* 123:811-816.

Schroder, S.L., C.M. Knudsen, and E.C. Volk. 1995. Marking salmon fry with strontium chloride solutions. *Can. J. Fish. Aquat. Sci.* 52:1141-1149.

Schroder, S.L., C.M. Knudsen, E.C. Volk, and J.J. Grimm. 1996. Marking embryonic and newly emerged salmonids by thermal events and rapid immersion in alkaline-earth salts. *Bull. Nat. Res. Inst. Aquacult., Suppl.* 2:79-83.

Maynard, D.J., T.A. Flagg, C.V.W. Mahnken, and S.L. Schroder. 1996. Natural rearing technologies for increasing post release survival of hatchery-reared salmon. *Bull. Nat. Res. Inst. Aquacult., Suppl.* 2:71-77.

Berejikian, B.A., E.P. Tezak, S.L. Schroder, C.M. Knudsen, and J.J. Hard. 1997. Reproductive behavioral interactions between wild and captively reared coho

salmon (*Oncorhynchus kisutch*). ICES Journal of Marine Science 54:000-000 (in press)

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Background:

1985-present: Fisheries Biologist, Washington Department of Fish and Wildlife
1984-1985: M.S. Fisheries, University of Washington
1982-1983: Fishery Biologist, Fisheries Research Institute, University of Washington
1979-1982: B.S. Fisheries Science - University of Washington

Selected Publications:

- Knudsen, C.M. 1988. Bias and variation in stock composition estimates due to scale regeneration. *American Fisheries Society Symposium* 7:63-71.
- Hoffmann, A., C. Busack and C. Knudsen. 1994. Experimental designs for testing differences in survival among salmonid populations. Report to Bonneville Power Administration, Contract No.DEAI79-93BP00029. 71 pp.
- Schroder, S.L. C.M. Knudsen, E.C. Volk. 1995. Marking salmon fry with strontium chloride solutions. *Canadian Journal of Fisheries and Aquatic Sciences* 52:1141-1149.
- Schroder, S.L. and C.M. Knudsen. 1996. Review of fish marking and tagging procedures suitable for the NATURES program. In *Development of a Natural Rearing System to Improve Supplemental Fish Quality, 1991-1995*, ed. D.J. Maynard, T.A. Flagg and C.V.W. Mahnken. BPA Progress Report Contract No. DE-AI79-91BP20651. Pg.128-166.
- Berejikian, B.A., E.P. Tezak, S.L. Schroder, C.M. Knudsen, and J.J. Hard. 1997. Reproductive behavioral interactions between captively-reared and wild coho salmon (*Oncorhynchus kisutch*). *ICES Journal of Marine Science* 54: 000-000.
- Busack, C., B. Watson, T. Pearsons, C. Knudsen, S. Phelps and M. Johnston. 1997. Spring Chinook Supplementation Monitoring Plan. YFP.

Section 10. Information/technology transfer

Results of work will be communicated in three ways; digitally, orally, and in writing. Data will be electronically stored on the YKFP archive repository. Oral presentations will be made to resource groups and schools upon request, YKFP, BPA, and WDFW management meetings, and at scientific meetings. Annual and quarterly reports will be submitted to BPA. As appropriate, manuscripts will be submitted for publication in peer-reviewed literature.