

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

**Section 1. General administrative information**

**Northern Squawfish Management Program**

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**Bonneville project number, if an ongoing project**    9007700

**Business name of agency, institution or organization requesting funding**  
Pacific States Marine Fisheries Commission

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**Business acronym (if appropriate)**    PSMFC

**Proposal contact person or principal investigator:**

**Name**                                Russell Porter  
**Mailing Address**    45 S.E. 82nd Drive, Suite 100  
**City, ST Zip**                        Gladstone, OR 97027  
**Phone**                                (503) 650-5400  
**Fax**                                        (503) 6505426  
**Email address**                        russell\_porter@psmfc.org

**Subcontractors.**

<b>Organization</b>	<b>Mailing Address</b>	<b>City, ST Zip</b>	<b>Contact Name</b>
Oregon Department of Fish & Wildlife	17330 S.E. Evelyn St.	Clackamas, OR 97015	Dave Ward
Columbia Basin Fish & Wildlife Authority	2501 S.W. First Ave, Suite 200	Portland, OR 97201	Frank Yound
Washington Department of Fish & Wildlife	600 Capitol Way N.	Olympia, WA 98501	John Hisata
Columbia River Intertribal Fish Commission	729 N.E. Oregon, Suite 200	Portland, OR 97232	Keith Hatch
Yakama Indian Nation	P.O. Box 151	Toppenish, WA 98948	George Lee
Nez Perce Tribe	P.O. Box 365	Lapwai, ID 83540	Manual Villalobos
Confederated Tribes of the Warm Springs Reservation of Oregon	P.O. Box C	Warm Springs, OR 97761	Mark Fritsch

Confederated Tribes of the Umatilla Indian Reservation	P.O. Box 638	Pendleton, OR 97801	Jed Volkman
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**NPPC Program Measure Number(s) which this project addresses.**

5.7B.1, 5.7B.2, 5.7B.3, 5.7B.4, 5.7B.5, 5.7B.6, 5.7B.7

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

ND-NMFS BO RPA Sec.14

**Other planning document references.**

NMFS Snake river Salmon Recovery Plan

**Subbasin.**

Lower Columbia & Snake River Mainstem

**Short description.**

Reduce juvenile salmonid predation by selective reduction of northern squawfish populations in the lower mainstem Columbia and Snake Rivers by means of a sport-reward fishery, dam angling and site-specific tributary mouth fisheries.

**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	+	Monitoring/eval.	X	Flow/survival
	Other	X	Resource mgmt		Fish disease
			Planning/admin.		Supplementation
			Enforcement		Wildlife habitat enhancement/restoration
			Acquisitions		

**Other keywords.**

predation control, increased smolt survival, predation interaction monitoring, food habits

**Section 3. Relationships to other Bonneville projects**

Project #	Project title/description	Nature of relationship


## Section 4. Objectives, tasks and schedules

### *Objectives and tasks*

<b>Obj 1,2,3</b>	<b>Objective</b>	<b>Task a,b,c</b>	<b>Task</b>
	CONTRACTUAL &ADMINISTRATIVE OVERSIGHT		
1	Provide contractual & fiscal oversight for all components of the Columbia River Northern Squawfish Management Program	a	Contract out the various tasks comprising the Northern Squawfish Management Program to various state and tribal agencies.
		b	Provide fiscal oversight of the work performed by the various agencies, tribes and private vendors participating in the program.
2	Guide development of work statements, budgets, biological assessments and reports	a	Review draft work statements for consistency with Program objectives.
		b	Review draft reports for clarity, accuracy and consistency with work statements and recommend improvements.
3	Coordinate implementation of the Northern Squawfish Management Program	a	Conduct program-wide coordination meetings on a regular basis. Maintain program activity schedule.
		b	Monitor field activities and review weekly reports for consistency with the Biological Opinion
		c	Provide regular status reports on program to CBFWA members
		d	Coordinate with FPAC and fishery agencies
		e	Coordinate with U. S. Army Corps of Engineers
		f	Coordinate with tribal, state and law enforcement agencies

		g	Review Program elements for cost-effectiveness and recommend ways to improve Program efficiency
		h	Assist Program participants in identifying and implementing operational procedures.
4	Provide information on the Program's intent, status & accomplishments	a	Act as centralized point of contact for inquires concerning the Program
		b	Summarize field data from all program participants and distribute weekly field activity reports to BPA, NMFS & others.
		c	Guide development of promotional activities designed to increase participation in the sport-reward fishery.
		d	Provide fishery information and how-to guides to anglers.
	<b>SPORT-REWARD FISHERY</b>		
5	Implement sport-reward fishery for northern squawfish in the lower Columbia and Snake rivers.	a	Coordinate media and promotional plan designed to inform and increase participants in the fishery.
		b	Coordinate activities with agencies and tribes who are affected by or are participating in the program.
		c	Recruit, train and manage creel clerk staff to run registration/creel check stations.
		d	Distribute sport reward fishery vouchers to returning anglers at creel check stations.
		e	Transfer northern squawfish turned into the registration stations to subcontractors for fish disposition.
		f	Create data sets that enable preparation of final report detailing the result of all sport-reward activities.
		g	Recore dand analyze catch data on fishes other than northern

			squawfish caught by sport-reward anglers.
		h	Provide weekly catch data for distribution to interested parties.
		i	Conduct a telephone survey of participating anglers to estimate effect of promotion and receiver public input on management of the program.
6	Issue reward payments, and drawing and tournament prizes to qualifying anglers and provide appropriate accounting, reporting and problem resolution	a	Receive, review and process vouchers mailed in from anglers and issue reward payment on a daily basis.
		b	Mail reward payments and prizes to anglers.
		c	Maintain computerized data base of payments and accounting statistics for tiered-reward payments.
		d	Maintain archives of original vouchers and check payment records and status for all qualified anglers.
		e	Prepare IRS Form 1099's for all anglers receiving in excess of \$600 in payments for the year.
		f	Maintain records of participants and payments for end of year project summaries and current mailing lists.
		g	Receive and answer telephone requests on the "voucher hotline" from anglers concerning status of voucher payments.
		h	Transmit electronic voucher files to WDFW for comparison, accounting and cross check to registration center forms and vouchers issued lists.
	<b>TRIBAL DAM ANGLING &amp; SITE SPECIFIC FISHERIES</b>		
7	Conduct and evaluate	a	Conduct an angling program at

	controlled fisheries for northern squawfish at all eight federal dams on the lower mainstems of the Columbia and Snake rivers.		Columbia River dams involving tribal members and where appropriate local sportsmen volunteers.
		b	Assist tribes with training, coordination and provisioning of angling crews at dams on the Columbia and Snake rivers.
		c	Collect, summarize, analyze and report data from all controlled angling fisheries
		d	Support visitor services at the dams regarding northern squawfish management activities administered by CRITFC and the Tribes.
8	Conduct and evaluate site-specific fisheries for northern squawfish in the lower Columbia and Snake river reservoirs and below Bonneville Dam.	a	Conduct site-specific gillnet fisheries at tributary mouths on the lower mainstem Columbia and Snake rivers as determined appropriate and productive.
		b	Assist tribal contractors with training, coordination, and provisioning of the tribal site-specific gillnet fishery crews on the Columbia and Snake rivers, as needed.
			Collect, summarize, analyze, and report data from all site-specific gillnet fisheries.
	PROGRAM EVALUATION		
9	Evaluate system-wide response of northern squawfish to sustained fisheries.	a	Evaluate response of northern squawfish size structure to sustained fisheries.
		b	Evaluate consumption of juvenile salmonids by northern squawfish after sustained fisheries.
10	Evaluate relative effects of northern squawfish removals on annual loss of juvenile salmonids to predation, and the consequences of program management alternatives.	a	Provide estimates of relative changes in predation related juvenile salmonid losses, and probable long term consequences of the present and possible alternative management programs on losses.

11	Evaluate exploitation rates achieved by program fisheries	a	Conduct boat sampling in the Columbia river downstream from Bonneville Dam, in lower Columbia river reservoirs and in the lower Snake river reservoirs to mark northern squawfish for population studies prior to start of the fisheries.
		b	Collect data on marked northern squawfish caught in the fisheries.
		c	Analyze mark and recapture data for each fishery to compare exploitation rates.

**Objective schedules and costs**

Objective #	Start Date mm/yyyy	End Date mm/yyyy	Cost %
1	4/1999	3/2000	1.90%
2	10/1999	3/2000	0.70%
3	4/1999	3/2000	1.30%
4	4/1999	3/2000	1.30%
5	4/1999	3/2000	36.00%
6	5/1999	2/2000	33.20%
7	4/1999	3/2000	7.30%
8	4/1999	3/2000	10.40%
9	8/1999	3/2000	0.90%
10	8/1999	3/2000	1.50%
11	4/1999	10/1999	5.50%
			TOTAL 100.00%

**Schedule constraints.**

Schedule changes are minor, but are related to yearly flow rates and temperatures in the river which affect northern squawfish availability to anglers and spawning time. Biological Opinion guidelines may affect program duration or start date.

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**Completion date.**

This program is continuous as it relies on continual cumulative removals of predator size northern squawfish from the population in order to reach a sustained reduction in predation on juvenile salmonids..

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## Section 5. Budget

### *FY99 budget by line item*

Item	Note	FY99
Personnel		\$1,290,711
Fringe benefits		\$424,743
Supplies, materials, non-expendable property		\$49,232
Operations & maintenance		\$168,378
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		
PIT tags	# of tags:	
Travel	Mileage, Per Diem & GSA Vehicle Lease costs	\$254,940
Indirect costs		\$428,013
Subcontracts		
Other	Sport-Reward Fund [\$1M] and Radio Station Tournaments	\$1,012,000
<b>TOTAL</b>		<b>\$3,628,017</b>

### *Outyear costs*

Outyear costs	FY2000	FY01	FY02	FY03
Total budget	\$3,651,918	\$3,834,513	\$4,183,238	\$4,224,400
O&M as % of total	4.80%	4.80%	4.80%	4.80%

## Section 6. Abstract

Development of the hydropower system in the lower Columbia and Snake rivers has resulted in increased losses of juvenile salmonids to resident fish predators. Impoundments delay the downstream migration of juveniles, increasing their exposure to predators and high water temperatures. Migrating fish are concentrated and endure stress as they pass dams, increasing their vulnerability to predation. The native northern squawfish *Ptychocheilus oregonensis* is the dominant predator of juvenile salmonids, but introduced smallmouth bass *Micropterus dolomieu* and walleye *Stizostedion vitreum* are also abundant.

A large-scale management program for northern squawfish was begun in 1990 to increase survival of juvenile salmonids in the Columbia and Snake rivers. The Northern Squawfish Management Program consists of a public sport-reward fishery, and agency-operated dam-angling and gillnet fisheries that target northern squawfish  $\geq 250$  mm fork length, approximately the size at which northern squawfish become important predators

on juvenile salmonids. Because consumption of juvenile salmonids generally increases with size of northern squawfish, low exploitation rates may result in relatively large reductions in predation. The goal of the program is to sustain annual exploitation of “predator-size” northern squawfish at 10-20%, which may reduce losses of juvenile salmonids by as much as 50%.

During 1997, program data from the 1990-1996 seasons was evaluated to determine if annual exploitation of northern squawfish was maintained in the target range. Predator populations were monitored to describe the response of northern squawfish, smallmouth bass, and walleye to the management program. Benefits of the management program would be less than expected if surviving northern squawfish or other predators increased their rates of predation, growth, or reproduction. The findings were used to estimate the benefits of the management program in terms of reduced predation on juvenile salmonids.

It was found that the Northern Squawfish Management Program in the Columbia and Snake rivers is effective at removing large northern squawfish. From 1990-96, over 1.1 million northern squawfish  $\geq 250$  mm fork length were removed from the lower Columbia and Snake rivers. Annual exploitation averaged 12.0%, and ranged from 8.1% to 15.5%. Exploitation was greater than 10% all years except 1993. The sport-reward fishery accounted for 86.5% of the harvest. All fisheries targeted large, piscivorous, northern squawfish (96.1-99.5% of reported catch); however, mean fork length was higher in the gillnet (409mm) and dam-angling (401mm) fisheries than in the sport-reward fishery (346mm). No evidence was found that surviving northern squawfish compensated for sustained removals. No evidence of smallmouth bass or walleye response to sustained removals of northern squawfish was found. Finally, no evidence was found that diets of northern squawfish, smallmouth bass, or walleye changed in response to sustained removals of northern squawfish.

## **Section 7. Project description**

### **a. Technical and/or scientific background.**

Development of the Columbia River Basin hydroelectric system created impoundments throughout the basin and enabled establishment and enhancement of resident fish species that prey on juvenile salmonids as they migrate down streams. The hydropower system has further exacerbated the problem because impoundments have delayed migratory juvenile salmonids, resulting in their prolonged exposure to predation (Raymond 1988). Recent studies (Poe and Rieman, editors 1988) indicated that predation-related mortality of juvenile salmonids is significant in John Day Reservoir. Northern squawfish was the most abundant predator (Beamesderfer and Rieman 1988), had high consumption rates on juvenile salmonids (Vigg *et al.* 1988), and accounted for about 80% of the total losses to predation in John Day Reservoir (Rieman *et al.* 1988). In addition, various studies have indicated that local concentrations of northern squawfish tailraces and forebays of

Columbia River Basin dams can be great (Sims *et al.* 1978; Uremovich *et al.* 1980). These results are consistent with previous studies in the Columbia River Basin that showed northern squawfish to be an important predator of juvenile salmonids (Zimmer 1953; USFWS 1957; Thompson 1959; Thompson and Morgan 1959). Poe *et al.* (1988) reviewed the literature describing various measures that have been used to reduce predation and identified those measures that had the greatest potential for success in the Columbia River. Those measures included alterations of project operations (spill), juvenile fish release strategies (time and area), and bypass structures (outfall location), as well as direct removal of predators. Modeling simulations for John Day reservoir indicated that it is not necessary to eradicate northern squawfish to substantially reduce predation-related mortality of juvenile salmonids. The model simulation indicated that a 10% to 20% annual exploitation rate of northern squawfish by means of sustained fisheries could reduce juvenile salmonid losses by northern squawfish by as much as 50% (Rieman and Beamesderfer 1988).

**b. Proposal objectives.**

The goal of the Program is to reduce in-reservoir mortality of juvenile salmonids related to predation by northern squawfish. The primary anticipated benefit at the beginning of this experimental program was a 50% reduction of predation-related mortality caused by northern squawfish within a five to ten year period. In an attempt to realize this benefit, a program was developed that enables managers to 1) select and implement measures demonstrated to effectively harvest northern squawfish, 2) predict effects that selected measures may have on reducing juvenile salmonid mortality, 3) determine whether anticipated benefits are being realized, and 4) adjust the direction and scope of the program depending upon its success. The direction and scope of the Program has been based upon 1) an assessment of the magnitude of predation-related mortality throughout the Columbia River Basin and 2) the current level of understanding of predator population dynamics and their effect on salmonid mortality. As the level of understanding of the dynamics of predation-related mortality improves, measures can be specifically tailored to maximize juvenile salmonid survival.

The overall objectives of the Program as defined in the IPP Annual Implementation Work Plan (1989) are as follows:

1. Determine the significance of predation by northern squawfish in mainstem Columbia and Snake river reservoirs by indexing abundance and integrating abundance indices with consumption indices developed by USFWS.
2. Implement northern squawfish fisheries in the mainstem Columbia and Snake rivers where predation-related mortality is believed to be a problem.
3. Conduct an evaluation of the effectiveness of fisheries implemented in mainstem Columbia and Snake rivers in terms of 1) reducing northern squawfish numbers, 2)

altering northern squawfish populations structure, and 3) reducing predation on juvenile salmonids by northern squawfish.

4. Develop and test promising new methods to harvest northern squawfish and adjust fisheries programs in the mainstem Columbia and Snake rivers to incorporate the most effective harvest technologies.

**c. Rationale and significance to Regional Programs.**

The rationale for this project is that it is the only project that addresses the accepted problem of major smolt mortalities caused by predatory northern squawfish in the lower mainstem Columbia and Snake rivers. The Program model hypothesized up to a 50% reduction in this mortality with a sustained fishery that would remove 10-20% of the predatory sized northern squawfish in the lower mainstem Columbia and Snake rivers. From 1990 through 1996 the removals have averaged about 12% per year. The recent 6 year evaluation of the effects of the program have validated the model and indicated that predation has been reduced 38% from the estimated pre-program levels. Continuation of the program and use of methods to increase the removal averages above 12% should move the reduction in predation closer to the predicted 50% level. To date in excess of 1,000,000 predatory sized northern squawfish have been removed from the population with no compensatory effect by the remaining predators. It is estimated that the program is currently saving close to 3.5 million smolts per year from predation.

**d. Project history**

The Northern Squawfish Management Program began in 1990 with contractual oversight by Oregon Department of Fish and Wildlife. It was moved to contractual and fiscal oversight by the Pacific States Marine Fisheries Commission in 1993. The project number has remained the same as 9007700 since its inception. The past costs are as follows:

1993: \$4,253,600  
1994: \$3,670,707  
1995: \$4,311,186  
1996: \$3,846,248  
1997: \$3,730,347  
1998: \$3,312,014 (Requested)

A summary of the major results achieved are as follows:

<b>1994</b>	<u>Sport-Reward</u>	<u>Dam-Angling</u>	<u>Site-Specific</u>
NSQ Catch:	129,434	16,097	9,024
Total Smolts saved:	22,262,648	4,281,802	2,635,008

<b>1995</b>			
NSQ Catch:	199,600	5,299	9,484
Total Smolts saved:	31,536,800	1,102,192	2,788,296
<b>1996</b>			
NSQ Catch:	156,538	5,455	6,155
Total Smolts saved:	30,368,372	1,363,750	1,750,860
<b>1997</b>			
NSQ Catch:	120,000	3,517	2,806
Total Smolts saved:	22,560,000	935,522	813,740

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Potential smolts saved vs length relationship from Beamesderfer *et al.*, 1996.

Project reports include annual reports published by Bonneville Power Administration. The appropriate reference for any particular year would be as follows:

Bonneville Power Administration, 1995 Development of a systemwide predator control program: stepwise implementation of a predation index, predator control fisheries, and evaluation plan in the Columbia River basin (Northern Squawfish Management), Section I: Implementation. Section II: Evaluation.

These reports are published through 1995. The 1996 report is currently in press.

Numerous papers on evaluation of the program and its successes are published by the program as well as being submitted to scientific journals and presented at scientific fisheries society meetings (American Fisheries Society Annual Meeting, 1997). These papers are provided in the references section and detailed reference lists are provided in each annual report.

**e. Methods.**

To meet the Program objectives, we have divided the Program into three areas, each with its own approach: A. *Implementing Northern Squawfish Fisheries*, B. *Evaluating Success of Northern Squawfish Fisheries* and C. *Developing and Testing Promising New Harvesting Technologies*.

Implementing Northern Squawfish Fisheries

The primary fishery for removals of northern squawfish is the sport-reward fishery. It occurs in five reaches in the lower Columbia River (from its mouth to Priest Rapids Dam) and five reaches in the Snake River (from its mouth to Hells Canyon Dam). Two other fisheries are also currently being utilized. The first is dam-angling fisheries which occur

at the U.S. Army Corps of Engineers (USACE) dams in the lower Columbia and Snake rivers. The second is site-specific gillnet fisheries which target locations where concentrations of northern squawfish occur in both the lower Snake and Columbia rivers.

The sport-reward fishery utilizes fishery registration sites located strategically throughout the lower Snake and Columbia rivers to register participants in the fishery. The location of registration stations is based upon analysis of results from implementation of the sport-reward fishery in 1991 through 1997 and on results from indexing of the relative abundance of northern squawfish throughout the lower mainstem Snake and Columbia rivers (Ward *et al.* 1992). The registration stations are open 7 days a week from 1PM to 9PM from early May through late September. Anglers are permitted to self-register during periods when stations are not manned. Registrations are good for a 24-hour period. In addition to the registration stations, various satellite registration sites in remote areas where fishing effort warrants their use are operated for two hours each day. Only stations which report a reasonable monthly harvest rate (approximately 1,000 fish) will continue to be operated. Vouchers are issued to returning successful anglers delivering predator-sized fish of acceptable quality. The reward paid is \$3.00 per qualifying northern squawfish for the first 100 fish harvested by an individual each season, then increases thereafter to \$4.00 per fish up to a cumulative individual catch of 400 fish and to \$5.00 per fish for individual cumulative season catches exceeding 400 fish. The angler mails vouchers in to Pacific States Marine Fisheries Commission (PSMFC) for processing. PSMFC maintains records of each angler's catch to determine the proper reward for each fish based on the tiered payment structure. Any special tournament prizes or awards that vary by season to stimulate angler effort are also paid by PSMFC. The fish are collected and disposed of through rendering services by Washington Department of Fish and Wildlife. A detailed incentive and promotional plan has been developed and is implemented each year in an effort to maximize the effectiveness and fishing effort generated by the sport-reward fishery. Contributions to fishery effectiveness in terms of increased harvest with result from implementation of incentive and promotional measures are evaluated each year. BPA provides special assistance in implementing promotional aspects of the plan by providing for support services from a promotional consulting firm.

The Treaty Tribes conduct the dam-angling fishery. Crews are hired to conduct angling and long-lining and may work with volunteers to fish at or near Bonneville, The Dalles, John Day, McNary, Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams. These crews will fish from May through September with roving crews so that fishing effort can be deployed where it will be most effective in harvesting northern squawfish. The Program subsamples the dam-angler catch and data is collected for evaluation of this fishery.

The Treaty Tribes also conduct the site-specific fisheries. Crews are hired to fish with gill nets and hook and line at specific Snake River and Columbia River locations (e.g. near hatchery release sites) where northern squawfish concentrations are known or suspected to occur. This site-specific fishery will be implemented in conjunction with

and in close coordination with implementation of the angling fishery to minimize additional costs specific to netting activities.

### Evaluating Success of Northern Squawfish Fisheries

Evaluation of northern squawfish fisheries occurs at two levels. At “Level 1” the concern is whether the fisheries are achieving harvest goals. At “Level 2” the concern is whether the fisheries are having the desired effect on the northern squawfish population, and indirectly, on juvenile salmonid survival. Level 2 evaluation include “indexing”; which not only serves to access the magnitude of predation in a given reservoir, but o measure population characteristics of northern squawfish and other resident fishes before and after implementation of fisheries. Establishment of baseline fish population characteristics and monitoring of those same characteristics after fishery implementation enables the determination of how northern squawfish and other resident fishes are responding to the fisheries. It is the Programs current plan to only conduct most of the level 2 activities every third year. This data is currently being analyzed from 1990-1996 (Ward, 1998; Friesen & Ward, 1998; Zimmerman & Ward, 1998; Knutsen & Ward, 1998; Ward & Zimmerman, 1998; Friesen & Ward, 1998; Zimmerman, 1998) and level 2 analyses will take place again in 1999, 2002 etc. These references discuss the statistical methods for evaluation. Level 1 activities will continue each year. These would also be required of any fisheries that are currently being considered in reservoirs operated by Grant and Chelan County PUD’s with funding provided by the PUD’s. Biological monitoring of fisheries and of fish populations will continue each year as will associated biological simulation modeling.

The general approaches to monitoring fisheries performance (Level 1) and effectiveness (Level 2) are as follows:

Fisheries performance (Level 1) will be monitored by fishery using catch, effort, marks-at-large, and mark-recaptured data stratified by area and time. Analyses to determine how each fishery is contributing to harvest goals will include exploitation, numbers removed, and catch per unit of effort.

Fisheries effectiveness (Level 2) is assessed by means of biological data and fishery effectiveness analyses. Biological data will be collected from the sport-reward, dam-angling, and site-specific fisheries. Data that were collected before fishery effects occurred is referred to as “baseline” data. Data collected when fishery effects are anticipated to have occurred is referred to as “post-treatment” data. Post-treatment data will be collected in the Snake and Columbia rivers from below Bonneville Dam to above Lower Granite Dam by ODFW. Data sets will include catch and effort data by gear, species, area and time; and fork lengths, body weights, and scale samples.

The fishery effectiveness analyses will involve comparisons of fish population characteristics before and during fishery implementation to assess fisheries effects on northern squawfish populations and the fish ecosystem. Analyses will also include comparisons among fisheries of participation levels and success rates to characterize

fishery stability. Simulation modeling that incorporates the spatial structure of the reservoir-predator-salmonid ecosystem and the processes (migration, predation, growth and movement of predators, predator fishery mortality) in a unified mathematical representation will be used to integrate the various data sets and complete the analyses.

The evaluation has shown that: 1) management fisheries in the Columbia and Snake rivers are effective at removing large northern squawfish; 2) No evidence was found that surviving northern squawfish compensated for sustained removals; 3) No evidence was found that smallmouth bass or walleye responded to sustained removals of northern squawfish; 4) No evidence was found that diets of northern squawfish, smallmouth bass, or walleye changed in response to sustained removals of northern squawfish; 5) Losses of juvenile salmonids to predation have probably decreased since implementation of the Program.

Modeling results indicate that if all variables other than exploitation of northern squawfish were held constant, predation by northern squawfish on juvenile salmonids has decreased 38% (range 25%-55%) from pre-program levels (Friesen & Ward, 1998). Estimates of predation by northern squawfish (Zimmerman & Ward, 1998) support results from modeling. Lack of response by surviving northern squawfish and other predators (Knutson & Ward, 1998; Ward & Zimmerman, 1998; and Friesen & Ward, 1998), and lack of changes in diet of these fish (Zimmerman & Ward, 1998; Zimmerman, 1998) increases confidence in the hypothesis that sustained removals of northern squawfish increases survival of juvenile salmonids.

Some of the results are uncertain because of important limitations. Limitations were generally the product of working in a large and complex system. In addition, limitations existed because of the difficulty of controlling conditions during sampling periods. Several important limitations were: 1) Benefits of the NSMP could only be measured indirectly; 2) Estimates of predation are indices, not absolute; 3) Actual predation on juvenile salmonids is influenced by variable we were unable to control.

Based on our findings, we have several recommendations concerning the NSMP. These are 1) Management of northern squawfish should continue to be used as a method to increase survival of juvenile salmonids; 2) Total catch and exploitation rates of the fisheries should continue to be monitored annually; and 3) Response of northern squawfish and other predators should be evaluated every 3-5 years. The methods that we will utilize in the program will incorporate these recommendations.

### Developing and Testing Promising New Harvesting Technologies

The Management Program considers this objective to have been completed. From 1990 through 1996 a number of different gear types and fishery methods were investigated, evaluated and tested in the field. These included Merwin Traps, purse seining below

dams, longlining, gill netting and various pole and line angling methods and use of down riggers. It was determined that all factors considered, that the pole and line sport fishery is by far the most effective from both a cost standpoint and catch per unit of effort. The program will continue to be receptive to possible new technologies, but considers the current pole and line fisheries to have the potential to reach the annual harvest goals during those years when adverse flows or weather conditions do not prevent adequate fishing effort from taking place.

**f. Facilities and equipment.**

The facilities being used for the program include agency offices for: Pacific States Marine Fisheries Commission, Gladstone, OR; Washington Department of Fish and Wildlife, Olympia, Vancouver, North Bonneville, and Pullman, WA; Oregon Department of Fish and Wildlife, Columbia River Program Office, Clackamas, OR; Columbia Basin Fish and Wildlife Authority, Portland, OR; Columbia River Intertribal Fish Commission, Portland, OR; Yakama Indian Nation, Toppenish, WA; Nez Perce Tribe, Lapwai, ID; Confederated Tribes of the Warm Springs Reservation of Oregon, Warm Springs, OR; and Confederated Tribes of the Umatilla Indian Reservation, Pendleton, OR. These facilities are all suitable for program needs relating to office, laboratory facilities and storage and transportation needs. All equipment for the Program is currently on hand from expenditures in previous years of the program. This includes computers(17) at all of the above offices to process and transmit data, field gear, boats, motors and trailers for field operations relating to evaluation and tribal fisheries, field gear for running the creel check/registration stations and fishing handling equipment. Vehicles used in the program amount to about 22 vans, pickups and cars used to run the check stations and conduct field fisheries. These were arranged to be provided from the Federal GSA motor pool four years ago to minimize costs for travel. Current equipment costs are now minimal and related to maintenance and occasional replacement of various equipment items and software and hardware upgrades from time to time.

**g. References.**

## REFERENCES

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## **Section 8. Relationships to other projects**

This project stands alone as it is the only project addressing predation on juvenile salmonids by resident fish. There is an indirect relationship in that it contributes to smolt survival as do other projects relating to flow, bypass systems, intake screening etc. But, it has no direct interaction that is directly dependent on other projects.

## **Section 9. Key personnel**

**Russell Porter**, Field Programs Administrator, Pacific States Marine Fisheries Commission Fiscal, Contractual & Technical Administration - 0.5 FTE

**John Hisata**, Project Manager, Washington Department of Fish & Wildlife: Sport-Reward Fishery Implementation - 1.0 FTE

**Keith Hatch**, Project Leader/Fisheries Scientist, Columbia River Intertribal Fish Commission: Tribal Dam Angling & Site-Specific Fisheries - 1.0 FTE

**Dave Ward**, Program Leader for Columbia Region Research Program, Oregon Department of Fish and Wildlife: Program Evaluation - 1.0 FTE

## **Russell G. Porter**

Pacific States Marine Fisheries Commission  
45 S.E. 82nd Dr., Suite 100  
Gladstone, OR 97027

### Education

University of California (Berkeley)                      B.A., Zoology, 1962  
California State University (Humboldt)                M.S. Fisheries, 1964  
Certified Fisheries Scientist, American Fisheries Society, 1968

### Experience

1977-Present: Pacific States Marine Fisheries Commission, Field Programs Administrator. Coordination of all field programs utilizing Commission employed field samplers and serves as contact for field programs where Commission member states work as partners with PSMFC on field data collection projects. Current and recent projects include: Northern squawfish Management Program - Fiscal and Contractual Administrator (1993-date); Pacific Coast (CA, OR & WA) Marine Recreational Fisheries Statistics Survey - Principal Investigator; Recreational Fisheries Information Network[Coastwide marine sportfish database of catch and effort] - Project Manger; Coastwide commercial albacore, catch, effort and biological sampling - COTR (1984-date); Northwest Emergency Assistance Program [Salmon Disaster Relief] Data Collection Program for at-sea research on hooking mortality, coho/chinook encounter rates and gear selectivity studies - Program Manager (1994-date).

University of Washington:    Lecturer, College of Fisheries - Fisheries Hydrology Course (1976) Teaching Assistant:    Fisheries Hydrology/Engineering Course (9 Semesters)

Milo C. Bell Inc.:    Environmental and fisheries consulting for hydroelectric projects, pipeline river crossings, culverts, fishway and fish hatchery design, power plant intake and screening, and fish passage problems. Major clients included: U.S. Army Corps of Engineers, National Marine Fisheries Service, Portland General Electric, Idaho Power and Light, Douglas and Chelan County PUD's, Consumers Power (Michigan), Arizona Public Service Co., Edison International, EPA, Washington Water Research Center, various Northwest Treaty Tribes, El Paso Gas Co., and Weyerhaeuser, Inc.

U.S. Navy:    Commissioned Officer on Active duty 1964-1969. Instructor of Oceanography, Meteorology, Celestial & Marine Navigation U.S. Naval Academy(1966-1969), Graduate U.S. Naval Justice School; Commanding Officer U.S. Naval Reserve Oceanographic Unit (Seattle) - (1976-77); Graduate Combat Information Center Officer School (San Diego), LCDR, USNR-retired.

Numerous scientific publication on scientific field studies, power peaking/salmonid survival and twenty years of field project management, fisheries management committees and design of scientific studies and preparation of Request For Proposals for numerous fisheries research projects on salmon and other marine species.

## **RESUME**

Principal Investigator:

**John S. Hisata**

Education:

Bachelor of Science in Fisheries Science, 1969  
University of Washington, Seattle, Washington  
Major studies in Invertebrate Fisheries

Current Employer:

Washington Department of Fish and Wildlife  
600 Capitol Way North,  
Olympia, Washington 98501 - 1091

Current Responsibilities:

Fishery Project.                      Project Manager, Northern Squawfish Sport-Reward  
Resident Native Fish Program Assistant.

Previous Employment:

Washington Department of Wildlife  
Regional Fisheries Resource Manager, Spokane,  
Washington  
January 1981 to October 1994

Expertise and Accomplishments:

Experienced as the manager of a multi-species regional fisheries Program through direction of a staff of field Fisheries Biologists and fish Hatchery Managers as the Regional Fisheries Resource Manager for the Washington Department of Wildlife Region One in Spokane, Washington. This Region was one of six in the state. In this position, I directed the development of the steelhead program at the Lyons Ferry Hatchery on the Snake River, and the initial development of the kokanee program at the Sherman Creek Hatchery on Lake Roosevelt. Prior to this, I developed the Department's initial coded wire tag recovery efforts on the Columbia River Tag Recovery Project in 1978 through 1980.

## **RESUME**

Keith Martin Hatch  
Columbia River Inter-Tribal Fish Commission  
729 N.E. Oregon, Suite 200  
Portland, OR 97232  
Phone 503-731-1303

### **Education**

Fisheries, M.S., Oregon State University, Spring 1990  
Biology, B.S., Oregon State University, Spring 1980

### **Employment**

Project Leader, Fishery Scientist Columbia River Inter-Tribal Fish Commission, Big Mouth Minnow Predation Project, Supervise the CRITFC predation project staff. Coordinate the fishing efforts, data handling and reporting of four tribal contractors. Previously, Fishery Scientist on the Gas Bubble Trauma project and the StreamNet Information System (Responsible for coordinating the five volume interstate stock summary report project). Subbasin specific production, catch, escapement, life history, and genetic data were assembled to produce this five volume report on Columbia River Anadromous Salmonids.

Fisheries Management Biologist U.S. Fish and Wildlife Service, Fisheries Assistance Office, Vancouver. Service representative to the TAC, OPI and AFPC committees. Management and interpretation of harvest, effort, test fishing, environmental and dam passage data for the management of Columbia River salmonids. This included run size prediction, cohort, coded wire tag and scale analyses. Field work included instream flow, redd counts, estuary surveys, hatchery spawning, electrofishing, & adult trap operation. Three months were spent studying the Trinity River Restoration Project in California.

Graduate Research Assistant Oregon Cooperative Fisheries Research Unit. Stock identification of coastal Oregon steelhead. Field collections and electrophoretic analysis. Multivariate analysis, writing of quarterly reports and delivery of results at professional meetings.

Fisheries Researcher Oregon Natural Resources Council. Finding and cataloging fisheries information for selected Oregon roadless areas proposed for wilderness protection. Production of brochures and magazine articles.

Foreign Fisheries Observer O.S.U. Dept. of Fish and Wildlife.  
Collecting of biological data in the Gulf of Alaska and the  
Bering Sea aboard Japanese longline fishing vessels.

## Resume for David Ward

### Experience

1984-Present Oregon Department of Fish and Wildlife, 17330 S.E. Evelyn St., Clackamas, OR. (1) Program Leader for Columbia Region Research Program (6 months). Current responsibilities: Coordinate activities of ongoing departmental and interagency projects, identify needs for and develop future projects, provide technical oversight to project leaders, and supervise project leaders and other program staff. (2) Project Leader on evaluation of the Northern Squawfish Management Program (7 years); (3) Project Leader on Portland Harbor Study (3 years); (4) Project Biologist and Technician on various studies (3 years).

### Education:

Humboldt State University, Arcata, CA  
Humboldt State University, Arcata, CA

### Degree and Date Received

M.S. Fisheries, 1985  
B.A. Zoology, 1978

Duties as Principal Investigator on Proposed Study: Supervise project biologist; review and edit project summary reports; provide technical oversight for data analysis and report preparation. FTE: 3 months.

Expertise: Coordinated and integrated activities of cooperating agencies, hired and supervised staff of project leaders, project biologists, and seasonal workers, designed field and laboratory sampling plans, analyzed wide variety of biological data, authored, edited, and reviewed scientific reports and peer-review articles. Organized personnel from cooperating agencies to give symposia at fisheries conferences. Developed and submitted proposals for numerous research projects to various funding sources. Direct experience with methods and gears associated with habitat and fish surveys in streams, rivers, lakes, and reservoirs.

### Publications and Reports

- Ward, D.L., R.R. Boyce, F.R. Young, and F.E. Olney. 1997. A review and assessment of transportation studies for juvenile chinook salmon in the Snake River. North American Journal of Fisheries Management 17:652-662.
- Beamesderfer, R.C., D.L. Ward, and A.A. Nigro. 1996. Evaluation of the biological basis for a predator control program on northern squawfish in the Columbia and Snake rivers. Canadian Journal of Fisheries and Aquatic Sciences 53:2898-2908.
- 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. Transactions of the American Fisheries Society 124:321-334.
- Parker, R. M., M. P. Zimmerman, and D. L. Ward. 1995. Variability in biological characteristics of northern squawfish in the lower Columbia and Snake rivers. Transactions of the American Fisheries Society 124:335-346.

## **Section 10. Information/technology transfer**

Monthly meetings of all agency participants are held to review progress and results as well as coordinate ongoing work. This provides opportunities to transmit data to agency managers when appropriate. Annual reports are published by BPA summarizing each years Program. Evaluation of the program has been published in scientific journals and presented at the 1997 Annual Meeting of the American Fisheries Society by means of three scientific papers given by ODFW program evaluation biologists. Additional papers are currently being prepared for publication in professional fisheries scientific journals.