PART I - ADMINISTRATIVE

Section 1. General administrative information

Title of project

Evaluate The Feasibility And Risks Of Coho Reintroduction In Mid-Columbia

BPA project number: 9604000
Contract renewal date (mm/yyyy): 10/2000 ☐ **Multiple actions?**

Business name of agency, institution or organization requesting funding
Yakama Indian Nation

Business acronym (if appropriate) YIN

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NPPC Program Measure Number(s) which this project addresses
7.1H, 7.4A, 7.4O, 7.4F

FWS/NMFS Biological Opinion Number(s) which this project addresses
Section 7 Consultation on 1998 Coho Releases in Methow River Basin (no # assigned)

Other planning document references
Wy Kan Ush Me Kush Wit, Spirit of the Salmon

Short description
Determine the feasibility of re-establishing a naturally spawning coho population within the mid-Columbia tributaries, while keeping adverse ecological impacts on other salmonid species of concern within acceptable limits.

Target species
Coho

Section 2. Sorting and evaluation

Subbasin
Wenatchee, Entiat, Methow

Evaluation Process Sort

CBFWA caucus	Special evaluation process	ISRP project type
Mark one or more caucus	If your project fits either of these processes, mark one or both	Mark one or more categories
☒ Anadromous fish ☐ Resident fish ☐ Wildlife	☒ Multi-year (milestone-based evaluation) ☐ Watershed project evaluation	☐ Watershed councils/model watersheds ☐ Information dissemination ☐ Operation & maintenance ☐ New construction ☒ Research & monitoring ☒ Implementation & management ☐ Wildlife habitat acquisitions

Section 3. Relationships to other Bonneville projects

Umbrella / sub-proposal relationships. List umbrella project first.

Project #	Project title/description

Other dependent or critically-related projects

Project #	Project title/description	Nature of relationship
9603302	Yakima River Coho Restoration	9604000 and 9603302 have similar goals. Certain study objectives are non-basin specific. Therefore, in the experimental design and monitoring/evaluation plan several of the generic questions will be developed and implemented in the Yakima River Basin.

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?
1992	Yakima Basin - Evaluation of coho predation on fall chinook.	No, predation affect inconclusive due to low sample size, the relatively high percentage of unidentified material in the gut analyzes, the fact that the investigators did not use diagnostic bones for fish identification, and limited sampling.
1997	Yakima Basin - Evaluation of coho predation on fall chinook.	Yes, based on the rigorous sampling conducted in 1997 and 1998, it estimated that the impact by coho predation on the total number of fall chinook smolts consumed above Prosser was no higher than 0.1% (based on the upper 95% bound),
1997	Yakima Basin - Evaluation of coho predation on fall chinook (CONTINUED).	and in reality was likely much lower. These levels of impacts equate into approximately 3.7 adults based on a 1% smolt-to-adult survival rate for Yakima River fall chinook (Bruce Watson, YIN personal communication).
1998	Yakima Basin - Evaluation of coho predation on fall chinook.	Yes, sample sizes in 1998 provided precise estimates of the total number of fall chinook consumed in the river. Max. # of fall chinook smolts consumed in the entire Yakima River was no higher than 349 smolts (3.5 adult equivalents). Neglig. impact.
1998	Yakima Basin - Evaluation of coho predation on spring chinook.	Yes, based on the upper 95% bound for the consumption exponential model, estimate of consumption is a worst-case scenario. Represented a negligible proportion of the spring chinook produced in this study reach (maximum; 7 adult equivalents).
1998	Yakima Basin - Evaluation of coho competition with rainbow/steelhead and cutthroat trout in Little Naches River and tributaries.	Yes, found no evidence that coho salmon influenced the abundance of cutthroat or rainbow trout ($p > 0.05$) when we compared the abundance

		of each species in allopatry and sympatry with coho salmon.
1998	Yakima Basin - Determination of Little Naches River mainstem coho distribution.	Yes, as observed in the tributaries, the coho fry remained close to their initail release site. The greatest abundance was observed in the immediate vicinity of the North-Middle Forks of the Little Naches, which is where about half the fish were released.
1996	Methow Basin - Evaluation of vulnerability associated with hatchery coho smolts upon emergent summer chinook fry.	No, funding constraint thus limited data. Snorkel survey (daytime) recorded summer chinook fry ranging in length from about 40 to 55 mm. Indication that the summer chinook are too large to be susceptible to predation by the hatchery coho (115-130mm)
1997	Methow Basin - Define the “window”of summer chinook fry vulnerability.	Yes/No, surveys determined summer chinook fry ranged in length from ~40 to 65 mm; April through early May (the river was out-of-shape by May 15). Additional sampling necessary.
1997	Methow Basin - Observe the macrohabitat utilization between hatchery coho smolts and other juvenile salmonids (primarily summer chinook fry).	Yes/No; found emergent summer chinook fry in association with quiet (near zero velocity water), shallow (<6 inches) off-channel or near-shore macro habitat. Substrate was typically large cobble (near-shore) or grassy vegetation or brushy material
1997	Methow Basin - Macrohabitat habitat utilization (CONTINUED).	within the the water column. Larger fish (i.e., spring chinook and steelhead smolts) were located off-shore, in deeper and higher velocity macrohabitat. Too few coho released (70K) to observe habitat utilization preference.
1998	Methow Basin - Monitor hatchery coho residualism.	Yes, found no indication of residualism after surveys for 8 weeks after release. No coho smolts were observed in the reach immediately up- or downstream of the Winthrop National Fish Hatchery (100K release).

1998	Methow Basin - Monitor hatchery coho residualism (CONTINUED).	In the Chewuch River, in association with the Eight-Mile acclimation/release site, a total of 13 coho smolts (100 K release) were seen within a two-mile reach downstream from the point of release.
1998	Methow Basin - Evaluation of spring chinook fry presence/absence.	Yes, using snorkel surveys, spring chinook fry were located only in habitats with specific biological parameters: 1). small, clear spring brook or spring-fed, 2). off-channel side channels and 3). in the mainstem in association with
1998	Methow Basin - Evaluation of spring chinook fry presence/absence (CONTINUED).	instream large woody debris.

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Wenatchee Basin - Measure smolt-to-smolt survival rates for hatchery coho released in the Wenatchee Basin.	a	A portion of each release group (approximately 7K fish per treatment/release group) will be PIT tagged to evaluate absolute smolt-to-smolt survival to the lower Columbia River.
2	Wenatchee Basin - Measure smolt-to-adult survival rates for hatchery coho released in the Wenatchee Basin.	a	Smolt-to-adult survival will be monitored based on Rock Island minus Rocky Reach dam counts and/or Tumwater Dam adult fish passage counts.
3	Wenatchee Basin - Determine the geographic spawning areas of returning and naturally produced coho spawners.	a	Boat/foot surveys will be conducted initially in stream reaches close to the smolt release sites, and will branch out from these release sites if the appropriate numbers of redds are not located.
4	Wenatchee Basin - Evaluate the potential for direct predation of hatchery coho smolts on salmonid fry.	a	Identify the highest density spring chinook of redds in Nason Creek. A direct predation experiment conducted at this location would represent a worst-case predation scenario. Apply rates of coho predation on spring chinook

4	CONTINUED	a	observed in the upper Yakima (1998 study) in order to determine the number of coho smolts to release in Nason Creek. Operate a rotary trap during the coho smolt outmigration period to collect stomach samples.
5	Wenatchee Basin - Monitor the long-term productivity of the coho supplementation program.	a	Stock productivity will be expressed as the number of returning hatchery adults (F2) resulting from the initial number of adults (including jacks) spawned for a specific broodyear (F1).
5	CONTINUED	a	The number of returning hatchery adults will be estimated based on the mainstem Columbia River counts between Rock Island and Rocky Reach, and Tumwater and/or the Chiwawa adult weir
6	Methow Basin - Measure smolt-to-smolt survival rates for hatchery coho released in the Methow Basin.	a	See the Wenatchee discussion. The only differences in experimental design with respect to smolt-at-release to smolt-to-the-lower Columbia River survival are that a larger number of fish (8K) will be PIT-tagged to account for the lower passage
6	CONTINUED	a	(2 more dams).
7	Methow Basin - Measure smolt-to-adult survival rates for hatchery coho released.	a	Smolt-to-adult survival will be calculated based on the Wells Dam passage counts.
8	Methow Basin - Determine the geographic spawning areas of returning and naturally produced coho spawners.	a	The location and date of each redd found will be recorded. In addition, physical data will be recorded from a random sample of redds in each subbasin (i.e., Methow, Twisp and Chewuch basins).
9	Methow Basin - Determine the extent of hatchery coho residualism.	a	If residualization is a serious problem, it most likely will be detectable near the points of smolt release. Snorkel survey reaches will be established between one river mile upstream and three river miles downstream of the release point.
10	Methow Basin - Monitor the long-term productivity of the coho supplementation program.	a	Productivity will be expressed as the number of returning hatchery adults (F2) resulting from the initial

			number of adults (including jacks) spawned for a specific broodyear (F1). The number of returning hatchery adults will be estimated at Wells Dam.
11	Wenatchee/Methow basins - Develop facilities to meet the objectives of the experimental program.	a	Modify/construct experimental production facilities which include those for adult capture, holding and spawning, egg incubation, juvenile rearing, acclimation and release, and monitoring.
12	Wenatchee/Methow basins - Operation of experimental facilities.	a	Operate/maintain experimental facilities associated wth the task listed in Objective 11 directly above.
13	Wenatchee/Entiat/Methow basins - Determine whether it is feasible to establish a viable localized broodstock for hatchery supplementation in the mid-Columbia.	a	Release coho smolts from mid-Columbia locations and capture returning adults at various established traps with the intent of egg banking at an existing, yet to be determined mid-Columbia facility.
14	Wenatchee/Entiat/Methow basins - Evaluate the long-term changes in the genetic and life history profiles of a non-native stock of hatchery coho introduced to mid-Columbia River tributaries.	a	Monitor divergence between lower Columbia River hatchery stocks (LCRHS) and broodstock used by the YIN to obtain information on traits of adaptive value within the mid-Columbia basin.
15	Wenatchee/Entiat/Methow basins - NEPA. Develop an Environmental Impact Statement on the long-term restoration phase of the project.	a	Follow the policies and guidelines as defined in the National Environmental Policy Act.

Objective schedules and costs

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
1	4/1999	12/2007	Wenatchee Basin - Smolt to smolt survival	X	7.00%
2	9/2000	12/2020	Wenatchee Basin - Smolt to adult survival	X	4.50%
3	9/2000	12/2020	Wenatchee Basin - Spawning ground counts	X	4.00%
4	9/2000	12/2002	Wenatchee Basin-Direct predation on salmonids	X	17.00%
5	9/2000	12/2020	Wenatchee Basin -	X	2.50%

			long-term productivity		
6	4/1998	12/2007	Methow Basin - Smolt to smolt survival	X	5.00%
7	4/1998	12/2020	Methow Basin - Smolt to adult survival	X	2.50%
8	4/1999	12/2020	Methow Basin - Spawning ground counts	X	1.50%
9	4/1998	4/2001	Methow Basin - Coho residualism	X	2.50%
10	4/1999	12/2020	Methow Basin - Long-term productivity	X	2.50%
11	6/1997	12/2007	Wenatchee/Methow ba. Facility development	X	16.00%
12	9/1997	12/2020	Wenatchee/Methow ba. Facility Oper./Main.	X	18.00%
13	9/1999	12/2015	Wen./Entiat/Methow ba. Broodstock develop.	X	8.00%
14	4/1999	12/2020	Wenatchee/Methow ba. Genetic monitoring	X	3.00%
15	6/1999	12/2001	Wen./Entiat/Methow ba. NEPA	X	6.00%
				Total	100.00%

Schedule constraints
Resolving the objectives of the project depends on efficient collection of mostly field data. Unforeseen logistical problems caused by watershed environmental conditions, like hydrology and it effects on trapping, may cause schedule changes.

Completion date
2020

Section 5. Budget

FY99 project budget (BPA obligated): $700,000

FY2000 budget by line item

Item	**Note**	**% of total**	**FY2000**
Personnel		%15	212,000
Fringe benefits	26%	%4	55,000
Supplies, materials, non-expendable property		%2	25,000
Operations & maintenance		%13	190,000
Capital acquisitions or		%5	75,000

improvements (e.g. land, buildings, major equip.)			
NEPA costs	EIS	%4	50,000
Construction-related support		%2	30,000
PIT tags	# of tags: 20,000	%4	58,000
Travel		%2	25,000
Indirect costs	24%	%13	178,000
Subcontractor	Egg banking USFWS	%5	65,000
Subcontractor	Fish health USFWS	%1	20,000
Subcontractor	Acclimation design	%1	15,000
Subcontractor	Acclimation construction	%12	175,000
Subcontractor	Genetic monitoring	%2	25,000
Subcontractor	WDFW, USFS, Colville Tribe	%14	200,000
Other	Vehicle, Insurance	%1	20,000
		TOTAL BPA FY2000 BUDGET REQUEST	$1,418,000

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount ($)
		%0	
		%0	
		%0	
		%0	
		Total project cost (including BPA portion)	$1,418,000

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget	$1,650,000	$2,550,000	$2,850,000	$1,850,000

Section 6. References

Watershed?	Reference
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PART II - NARRATIVE

Section 7. Abstract

The indigenous stock of coho salmon is extinct in the mid-Columbia River Basin. The Yakama Indian Nation (YIN) has set a goal to establish locally adapted stocks of coho to this area. The Northwest Power Planning Council (NPPC) has endorsed this project as one of the 15 high priority supplementation projects in the Fish and Wildlife Program. This project addresses Program measures 7.1H,7.4A, 7.4F,and 7.4O.

Specifically, the YIN's long-term goal is to achieve an adult-to-adult recruitment productivity level of 1.5 - 2.0 within the next six to nine generations within each of three subbasins in the mid-Columbia region--Yakima, Wenatchee and Methow. In other words, within 13-18 years, a coho rebuilding regime will be attained in which one adult's contribution to natural production through its offspring will be 1.5 to 2.0 adults.

To achieve the goal, the program proposes a two-phased approach. The first phase is experimental in nature and is designed to begin resolution of several critical uncertainties related to the reintroduction of coho into tributaries of the mid-Columbia. The first phase evaluates the initial feasibility and risks associated with coho restoration through intensive experimental monitoring and evaluation. It will last at least 5-8 years depending on ability to collect significant data. However, answers to questions about whether a viable broodstock can be established and whether productivity goals can be achieved will take much longer.

The scope, magnitude and biological approach of the second phase will be determined by the results of the risk/feasibility phase. The second phase can best be described as potentially more production oriented, toward the goal of restoration of natural coho stocks, with less emphasis on resolution of uncertainty.

Section 8. Project description

a. Technical and/or scientific background

Wild stocks of coho salmon *Oncorhynchus kisutch* were once widely distributed within the Columbia River Basin (Fulton 1970; Chapman 1986). Mid-Columbia coho salmon populations were decimated in the early 1900s by impassable dams and unscreened irrigation diversions along with an extremely high harvest rate in the lower Columbia River. The indigenous stock of coho salmon is extinct from the mid-Columbia. Efforts to restore coho within the mid/upper Columbia Basin will rely largely upon releases of hatchery coho. The two predominant issues related to restoration of coho utilizing hatchery stocks are: 1). the potential ecological risks to those species that inhabit the same areas. Ecological risks may be greatest for endangered species or those of critically low abundance; and 2). the feasibility of utilizing lower river hatchery stocks (nearest coho source) to establish locally adapted populations of coho with acceptable productivity.

ECOLOGICAL RISKS

Many types of ecological interactions are theoretically possible between coho and other native fish species. The following literature review discusses potential interactions including predation, competition, behavioral anomalies, or disease transmission.

Predation: Coho salmon have been shown to prey on several species of salmonids including sockeye salmon *O. nerka* fry (Ricker 1941; Foerster and Ricker 1953; Ruggerone and Rogers 1992), pink *O. gorbuscha* and chum *O. keta* salmon fry (Hunter 1959), and fall chinook salmon (Thompson 1966). In order to resolve the scientific uncertainty associated with the impact of coho salmon predation on spring and fall chinook populations within the mid-Columbia basin, YIN conducted experiments during 1992, 1997 and 1998 to address the issue. The results to date indicate that predation by coho smolts on both fall and spring chinook is negligible. Further field evaluation work will add power to the current data.

Competition: The biological significance of non-predatory types of interactions is less straightforward, even at the level of individual animals. In particular, competition for space and food may clearly alter patterns of microhabitat utilization, while having no effect on productivity or viability (Spaulding et. al 1989). Indeed, the small-scale shifts in niche partitioning that may result from "interactive segregation" may represent a significant benefit at the community level because they result in more efficient utilization of environmental resources (Nilsson 1966). The YIN was unable to find any published studies that demonstrated complete competitive exclusion (species extirpation) by coho for any species.

Coho salmon and rainbow/steelhead trout *O. mykiss* are reported to be sympatric along the western coast of North America from California to British Columbia (Frasier 1969; Hartman 1965; Johnston 1967; Burns 1971), with both species residing in freshwater for extended periods (Groot and Margolis 1991). However, the reported impacts of the presence of coho salmon on rainbow/steelhead trout are conflicting. Coho were shown not to affect steelhead habitat utilization or growth in the Wenatchee River (Spaulding et al. 1989), and only affected steelhead habitat utilization to a small extent in another Washington stream (Allee 1974; 1981). However, Hartman (1965) concluded that strong habitat selection occurred in the spring and summer as a result of agnostic behaviors which were differentially directed by coho against steelhead in pools and by steelhead against coho in riffle habitats. Coho salmon have been shown to displace cutthroat trout *O. clarkii* from pool habitat into riffle habitat (Glova 1984;1986; 1987; Bisson et al. 1987), even though both species preferred pool habitat in allopatry. Tripp and McCart (1983) observed increasing negative impacts on cutthroat trout growth and survival as coho stocking densities increased up to 2.5 g of coho fry/m^2. The YIN conducted field experiments to address the impacts which coho had on the growth, abundance, and broad scale geographical displacement of cutthroat and rainbow/steelhead trout in 1998. Further work is planned to verify results observed in 1998.

Behavior and Disease Transmission: Behavioral interactions may alter the dynamics of the community but have no effect on its stability or productivity. Behavioral anomalies such as the "pied piper" effect are largely theoretical for coho (Chapman et al. 1991; Spaulding et al. 1989) as are disease-related interactions (Miller 1990). Work with these types of interactions has not been discussed within the TWG but maybe evaluated if results from other studies deem it important.

FEASIBILITY

The goal of restoring an extirpated natural population utilizing a "domesticated" hatchery stock which is geographically distant from the mid-Columbia is charting new scientific territory. To the best of the TWG's knowledge, the concept of naturalizing a hatchery stock through

broodstock development and genetic monitoring as proposed in this project has not been documented. However, with the current listings under ESA and the potential for several populations to become extinct in the Columbia River basin, results of this project may become increasingly more valuable if salmon are going to continue to exist in the basin.
Smolt to smolt and smolt to adult survival data from the Yakima River indicates restoration is possible. Just by acclimating (versus direct stream release) out of basin hatchery pre-smolts, smolt to smolt survival has increased 3 fold (~20% to ~70%) and adult returns to the Yakima River have gone from a few hundred fish 5 years ago to over 4,000 in 1998. Survival rates are comparable to lower river hatcheries coho hatcheries located below all mainstem dams.

b. Rationale and significance to Regional Programs

The Northwest Power Act requires that the Northwest Power Planning Council (NPPC) develop a program to protect and rebuild Columbia Basin fish and wildlife resources (NPPC, 1994). Several aspects of the mid-Columbia coho restoration effort directly support the NPPC's program.

- The NPPC's 1994 Fish and Wildlife program demonstrates the NPPC's commitment to the use of reprogrammed fish form lower Columbia River hatcheries in rebuilding upper river runs in Measure 7.1 H Reprogramming of Existing Hatchery Stocks and Facilities.
- Measure 7.4A Identify, Evaluate and Implement New Production Initiatives states "such initiatives may include measures to address the needs of weak stocks, such as sound supplementation, *restoration of eliminated populations*, demonstrations of captive brood stock….."
- Measure 7.4O Small-Scale Production Projects discusses the advantages of low- capital propagation. This project's acclimation/release sites which include side channels, back water and beaver ponds are an integral part of the program.
- Measure 7.4F Portable Facilities for Adult Salmon Collection and Holding, and for Juvenile Salmon Acclimation endorses the basic approach to this project of utilizing decentralized low-tech acclimation/release ponds.

This project is one of 15 high priority supplementation projects recommended for funding by the NPPC in April, 1996. These high priority supplementation projects were forwarded with strong endorsements from both the *US v. Oregon* Policy Committee and the NMFS.

The project's goal is *in place, in kind* mitigation. A locally-adapted coho stock would be developed to mitigate for the extirpation of coho from the mid-Columbia tributaries.

c. Relationships to other projects

While the coho research and restoration programs for the Yakima basin *(Yakima River Coho Restoration – BPA Project #960 3302)* and for the other mid-Columbia basins as proposed in this project (*Coho Restoration Mid-Columbia Tributaries – BPA Project # 960 4000)* are administered by separate groups and contracts, the restoration goals for the entire region mirror the goals for the Yakima River basin as described in the *Yakima Coho Salmon, Draft Status Report* (1998 in draft). The experimental approach is basically the same; the studies have similar objectives. Some of the experimental uncertainties are basin-specific: results from monitoring are not transferable to another basin but apply only to the specific habitat area studied. However, resource managers have agreed that some of the study results can be applied to the entire region. Therefore, in the experimental design and monitoring/evaluation part of the mid-Columbia program, several of the generic questions to be addressed in Phase 1 will be developed and implemented in the Yakima River basin.

The mid-Columbia River Coho Restoration Program for the Wenatchee and Methow basins is being coordinated with fishery and natural resource agencies through an informal technical working group (TWG). This TWG is responsible for designing the research objectives associated with coho re-introduction. The TWG is comprised of technical personnel from the following agencies:

- Washington State Department of Fish & Wildlife (co-manager)
- United States Fish & Wildlife Service
- United States Forest Service
- National Marine Fisheries Service
- Confederated Tribes of the Colville Reservation
- Bonneville Power Administration

The YIN's approach to coho salmon restoration in the mid-Columbia basin is based upon the four Columbia River treaty tribe's *Wy-Kan-Ush-Mi-Wa-Kish-Wit* document, commonly referred to as the Tribal Restoration Plan (TRP) (CRITFC 1995). The Umatilla and Nez Perce tribes presently have implemented similar coho restoration programs.

d. **Project history** (for ongoing projects)

The Tribal goal to restore extirpated stocks of coho Columbia Basin-wide was formally established with the adoption of the Tribal Restoration Plan in 1995 by the four Columbia River treaty tribes (Nez Perce, Umatilla, Warm Springs, and Yakama). The Yakama Indian Nation, working through the *U.S. v. Oregon* administrative process and in coordination with the NPPC, implemented the project in 1996 as part of the NPPC's Fish and Wildlife Program.

Since implementation of the project in 1996, coho have been released in the mid-Columbia under authority of the *U.S. v. Oregon* Columbia River Fish Management Plan (CRFMP). These coho are lower river early returning stock reprogrammed from Lewis River Hatchery as pre-smolts. The project managers have used these CRFMP releases of coho to address broad questions related to the feasibility and risks of reintroducing coho into tributaries of the region.

- Determine the feasibility of returning natural production of coho salmon to the Wenatchee and Methow river basins.
- Determine the feasibility of establishing an upriver restoration broodstock by egg banking using adult returns from the releases of lower river hatchery stocks in the mid-Columbia.
- Determine the F_1 and F_2 ecological interactions of coho on species of concern in the Wenatchee and Methow river basins.
- Determine the long-term changes in the genetic and life history profiles of a non-native stock of hatchery coho introduced to mid-Columbia River tributaries.

The following is a summary of studies to date. (Results for the Yakima River basin studies are discussed in the *Yakima River Coho Restoration – Project # 960-3302* FY 2000 proposal).

Methow Basin 1996, 1997 & 1998

1996

In 1996 approximately 300,000 smolts were acclimated and released from 2 sites in the Methow River basin. Minimal experimental data was collected as contracts had not been finalized at the time field work needed to be done. The 1996 monitoring objective was to follow the growth summer chinook fry throughout the period coho would be migrating through their habitat in the river. The interest behind this goal was the need to know the "window" of vulnerability of hatchery coho smolts upon emergent summer chinook fry. A single snorkel and beach seine survey was conducted in mid-May to determine the current length distribution of summer chinook fry. Surveys were conducted between the towns of Twisp and Carlton. The snorkel survey (daytime) recorded two groups of summer chinook fry ranging in length from about 40 to 55 mm. Beach seining proved to be unsuccessful due to the large cobble that occurs in the Methow River.

Conclusions

The data was very limited but there is an indication that the summer chinook are too large to be susceptible to predation by the hatchery coho (115-130mm). The rule of thumb is coho will not consume a prey species one third or greater to its own body size (Todd Pearsons, WDFW, pers. comm.).

1997

In 1997 only 70,000 were released in the same basin after an acclimation facility malfunction resulted in a high mortality for the majority of the population.

The 1997 objectives were to; (1) define the "window" of summer chinook fry vulnerability (the 1996 objective), (2) to evaluate direct predation of coho upon summer chinook fry, and (3) observe the macrohabitat utilization between hatchery coho smolts and other juvenile salmonids (primarily summer chinook fry). Unfortunately, the loss of all but about 70k of the hatchery coho smolts, combined with higher river discharge (spring snow melt) negatively impacted data collection towards all three objectives.

Conclusions

Objective 1: Through the use of weekly, night snorkel surveys (~4 surveys) we determined summer chinook fry to range in length from ~40 to 65 mm. Surveys were conducted from early April through early May (the river was out-of-shape by May 15). On May 20 a electrofishing survey determined summer chinook fry ranged in length from 36 to 66 mm, with most under 40 mm in length.

Objective 2: This objective was not addressed due the loss of hatchery smolts at the Chewuch acclimation site, and because of the excessive river discharge negating the operation of the rotary trap.

Objective 3: Through the surveys it was determined that emergent summer chinook fry are found in association with quiet (near zero velocity water), shallow (<6 inches) off-channel or near-shore macro habitat. Substrate was typically large cobble (near-shore) or grassy vegetation or brushy material within the water column. Larger fish (i.e., spring chinook and steelhead smolts) were located off-shore, in deeper and higher velocity macrohabitat.

1998

Hatchery Coho Residualism

In 1998 about 170,000 smolts were released at two sites in the Methow basin and 100,000 from one site in the Chewuch basin. The study goal was to monitor hatchery coho residualism after release from the acclimation ponds.

Methow River

Results - No hatchery coho were observed in the Methow survey reach. The following salmonids were recorded: wild rainbow/steelhead trout fry (~40-45 mm in length), wild rainbow/steelhead trout parr, hatchery steelhead smolts, wild spring chinook parr (~50-80 mm in length), whitefish *Prosopium williamsoni* , bull trout *Salvelinu confluentus* (1), brook trout *Salvelinus fontinalis* (1), and brown trout *Salmo trutta* (1).

Chewuch River

Results – Thirteen hatchery coho were observed throughout the survey reach. Most occurred in the middle portion of the reach. With one exception, coho were observed in the vicinity of other species of salmonids. One hatchery coho was observed in association with a pod of five spring chinook parr in a small lateral pool along the bank margin. The remaining coho were observed further offshore in less than 24 inches of water. There were about 20 hatchery coho remaining in the lower Eight-Mile acclimation pond. These fish all appeared to be much smaller than the mean release size of 15 fish per pound, as did the 13 fish observed in the river.

Other salmonids observed included wild steelhead/rainbow trout parr, wild spring chinook parr, whitefish and bull trout (n=1).

<u>Conclusions</u>

Given that no fish were seen in the immediate release area in the Methow and few fish were observed in the Chewuch (near Eight-Mile Creek) indicates that residualism of hatchery coho smolts is not a significant issue. Additional monitoring will further verify the observed results.

Methow River Spring Chinook Fry Surveys

The monitoring objective was to identify spring chinook fry rearing areas of the upper Methow River .

Results - A single sucker fry was observed during the three surveys in the Rockview side channel, a supposedly pristine spring chinook rearing area off the Methow River (John Easterbrooks, WDFW, Pers. Comm.). Spring chinook fry were instead located in spring-fed or spring brook-type channels and along the mainstem margins in association with large woody debris. In general, the mainstem river was turbid to varying degrees during the surveys, while the spring-fed and spring brook channels remained clear and were somewhat warmer than the mainstem. Fry were located in three notable side channel areas: a spring brook channel (right bank), 0.25 mile downstream to the Rockview side channel; the Hancock spring channel (right bank) located near the Little Boulder Creek confluence; and a spring-fed channel (left bank) at the Highway 20 overlook immediately west of Winthrop. Fry numbers ranged between 100-400 fish at these three sites, which are located in the Weeman Bridge-to-Wolf Creek reach.

Conclusions

Emergent spring chinook fry were found in association with shallow (<12 inches), low-velocity backwater and spring brook channels, or in close proximity to large woody debris along shallow stream margins. Because coho smolts prefer deeper and faster water conditions (personal observation) to that of spring chinook fry, there is minimal spatial overlap, and therefore limited opportunity for direct predation.

Methow Basin Smolt-Adult Estimated Survival Rate (1996-97)

Coho smolt-at-release to adult-at-Wells Dam survival rates are available for smolt-release years 1996 and 1997. In 1996 and 1997 a total of 300,000 and 70,000 smolts were released, respectively. The estimated survival for both release groups was 0.001% based on adults counted at Wells Dam.

Conclusions

It is readily apparent that various habitat improvements must be made to establish a viable coho population. This illustrates the need to better identify (by mainstem project) the degree of smolt loss as it pertains to the overall smolt-to-smolt survival rate using PIT-tagged fish. The use of PIT-tagged fish will also be useful to determine smolt timing through the projects and how synchronous it is with each project's spill program. In addition, the use of a locally adapted broodstock should improve the smolt-to-adult survival rate.

Technical Papers and Costs

Two important technical documents have been developed as a result of this project. The first is: the YIN (Confederated Tribes and Bands of the Yakama Indian Nation). 1998**.** ***Mid-Columbia Coho Study Plan.*** Submitted to Bonneville Power Administration and NMFS to meet Terms and Conditions of ESA Bio. Opinion. November, 1998. The second is an unpublished "white paper" with experimental results, discussions, and conclusions to date: Dunnigan, J. and J. Hubble. 1998. ***Results From YKFP and Mid-Columbia Coho Monitoring and Evaluation Studies.*** Prepared for the Mid-Columbia Technical Work Group.

The costs for the entire project by fiscal year are the following: FY 96 - $179,582; FY97 - $324,800; and FY98 - $625,000.

e. Proposal objectives

Section "f" *methods* is included in this section

Project work proposed for FY 2000 in the Wenatchee and Methow river basins builds on the work described above and is divided into categories that address five types of issues: Natural Production, Ecological Interactions, Reproductive Success, Long-Term Fitness, and Culturing/Genetics. The proposal is organized by basin and then by objective, according to the kinds of questions each objective addresses. The egg banking/broodstock and genetics monitoring programs are not basin-specific. *The Entiat River basin is under evaluation for use as a potential egg banking location only utilizing available space at the Entiat NFH. No research or restoration is proposed at this time in the Entiat itself.*

Natural Production – Wenatchee Basin

Objective 1 and 2. Relative Smolt-to-Smolt and Smolt-to-Adult Survival.

Objective: Determine whether or not sufficient survival rates can be achieved to re-establish a natural run in the mid-Columbia, and during which portion of the life history the fish are performing the best.

> **Question:** What are the smolt-to-smolt and smolt-to-adult survival rates for hatchery coho released in the Wenatchee basin?

Rationale: In order to interpret stock productivity, it is critical to understand limiting factors by lifestage. This information will be used annually to estimate stock performance, and relate survival to those biotic and abiotic variables which influence survival by lifestage.

Duration: Will be monitored annually for each release, beginning in 1999.

Experimental Design: A portion of each release group (approximately 7K fish per treatment/release group) will be PIT tagged to evaluate absolute smolt-to-smolt survival to the lower Columbia River. (The approximately 7K smolts PIT tagged would be part of the 1 M smolts acclimated/released in the Wenatchee basin. *Approximately 950K of the 1M coho released is to support the egg banking and brood stock development objective which is discussed under Objective 13.*

A multiple capture history of PIT-tagged fish at Columbia River projects (Doug Neeley, personal communication) will be used to calculate mainstem survival. Briefly, this methodology makes use of the number of PIT-tagged smolts interrogated at each mainstem project (where PIT interrogation gear exists) to estimate absolute smolt survival.

Smolt-to-adult survival will be monitored based on Rock Island minus Rocky Reach and/or Tumwater Dam adult fish passage counts.

Question Testing Procedure: Compare smolt-at-release to smolt migration through the lower Columbia River; and smolt-at-release to adult over Rock Island minus Rocky Reach dams, and/or Tumwater Dam.

Risks: The release of thousands of hatchery coho smolts potentially risks direct and indirect predation on other fish species. However, direct predation is deemed a negligible risk based on results from the Yakima basin direct predation studies (*Results From YKFP and Mid-Columbia Coho Monitoring and Evaluation Studies*, Dunnigan/Hubble 1998). Furthermore, in concert with this task, a direct predation study will be undertaken (Objective 4). It is also recognized that a potential exists for indirect predation through the mechanism of chumming; however, to date in the Yakima, studies have not proven whether or not this occurs.

These potential risks will be managed through coho release size, release location(s) and release dates agreed upon by the TWG.

Objective 3. Spatial and Temporal Redd Surveys.

Objective: Determine the geographic spawning areas of returning and naturally produced coho spawners in the Wenatchee basin.

> **Question:** What is the spatial and temporal distribution of returning coho spawners in the Wenatchee basin?

Rationale: It is important to know where and how many adults return to spawn with respect to the juvenile release sites. A key feasibility issue is whether or not coho are in fact spawning in proportion to the number of adults counted past an in-basin monitoring site, and if coho adults are spawning in areas considered suitable for coho. The suitability of a spawning area would include the hydrological stability within the watershed. In the future, we will try to determine the reliability of redd surveys to be used to assess basin productivity.

Duration: Surveys in the Wenatchee basin will be initiated when sufficient numbers of spawners (i.e., 100 fish) return over Rock Island or Tumwater dams.
Experimental Design: Boat/foot surveys will be conducted initially in stream reaches close to the smolt release sites, and will branch out from these release sites if the appropriate numbers of redds are not located.
Question Testing Procedure: Each spawner survey will record the following data: survey date, survey reach, stream/weather conditions, redd location (to the nearest 0.1 mile), immediate substrate size (using the USFS watershed analysis substrate classification method), habitat type (i.e., main channel, side channel and distance from stream bank), and spawn timing.
Risks: No risks have been identified with this field task.

Ecological Interactions – Wenatchee Basin

Objective 4. Direct Predation.
Objective: To evaluate the potential for direct predation of hatchery coho smolts on salmonid fry in the Wenatchee basin.

$\mathbf{H_o}$: There is no significant predation of hatchery coho smolts on spring chinook fry.

Rationale: A fundamental issue of the coho program is to minimize negative interactions upon species of concern. The TWG agreed that, given the proposed ESA listing of spring chinook in Wenatchee basin, direct predation studies specific to the Wenatchee basin need to be conducted.
Duration: To be initiated in 1999, with future work contingent upon the 1999 Wenatchee and Yakima study results.
Experimental Design: A suitable study reach has not been identified by the TWG. Logistically, Nason Creek is probably the first choice given its relatively small size and its road access. Based on 1998 spring chinook spawner surveys (Chelan PUD, unpublished data 1998), 20 redds were deposited between rivermile 8.3 to 15.4 (out of 29 redds present in the entire watershed). This section represents the index reach which historically supported the highest density of redds in Nason Creek. A direct predation experiment conducted at this location would represent a worst-case predation scenario. A preliminary site survey was done in November 1998, and the Highway Two bridge site looks favorable for the location of a rotary trap (Hubble and Dunnigan, personal communication, 1998).
National Marine Fisheries Service will determine the maximum allowable spring chinook take for this experiment (J. Hard, NMFS, personal communication, 1998). We propose to apply rates of coho predation on spring chinook observed in the upper Yakima in order to determine the number of coho smolts to release in Nason Creek, so as not to exceed the take established by NMFS. We then will weigh the likelihood of capturing an adequate sample size to achieve meaningful results.
Hypothesis Testing Procedure: The test parameter is the estimated percent of spring chinook fry consumed by the coho smolt population. The four primary variables required to calculate this parameter are:

- average smolt residence time;
- average gastric evacuation rate;
- observed incidence of predation at the screw trap; and
- total number of spring chinook fry present.

Risks: The greatest risk from this task is that of an undesirable level of direct predation upon emergent spring chinook fry. We are willing to accept this risk by monitoring it—the task is designed to measure the risk because it is potentially a major risk of the proposed coho restoration program itself. This task's risk will be managed by sizing the number of coho smolts released relative to the number of potential fry available for consumption.

Long-Term Fitness – Wenatchee Basin

Objective 5. Coho Productivity.
Objective: Monitor the long-term productivity of the coho supplementation program.

Question: What is the stock productivity in the Wenatchee basin?

Rationale: The survival information gained will, over the next several years, help evaluate the feasibility of re-establishing coho in the Wenatchee basin. If, for example, observed productivity falls short of the program goal, factors limiting survival must be identified and corrected if the program is to succeed.
Duration: This will be measured on an annual basis as return data become available.
Experimental Design: Stock productivity will be expressed as the number of returning hatchery adults (F_2) resulting from the initial number of adults (including jacks) spawned for a specific broodyear (F_1). The number of returning hatchery adults will be estimated based on the mainstem Columbia River counts between Rock Island and Rocky Reach, and Tumwater and/or the Chiwawa adult weir. The number of adults spawned for a given year is the number of adults comprising a specific broodyear. Initially external marks will not be required to make this calculation. However, as natural production increases, there will be a need to externally mark fish (some portion so that an expansion factor can be established), so that the natural and hatchery productivity components can be separated. An estimate of natural productivity will be based on dam counts (as opposed to dam and redd counts) since it is unlikely (at least initially) that 100% of the redds will be counted because of the difficulty finding them.
Question Testing Procedure: The number of returning hatchery adults (F_2) resulting from the number of adult broodstock spawned (F_1) for the hatchery component; and for the natural component, the number of returning hatchery adults (F_2) to the dam(s) resulting from the dam(s) count for the corresponding broodyear (F_1).
Risks: No direct risks have been identified for this task. Potential risks caused by the acclimation/release of the fish needed to make these calculations are discussed under Objectives 1 and 2.

Natural Production – Methow Basin

Objectives 6 and 7. Relative Smolt-to-Smolt and Smolt-to-Adult Survival Study
Objective: To determine whether or not sufficient survival rates can be achieved to re-establish a natural run, and during which portion of the life history the fish are performing the best.

Question: What are the smolt-to-smolt and smolt-to-adult survival rates for hatchery coho released in the Methow basin?

Rationale: In order to interpret stock productivity, it is critical to understand limiting factors by lifestage. This information will be used annually to estimate stock performance, and relate survival to those biotic and abiotic variables which influence survival by lifestage.
Duration: Will be monitored annually for each release, beginning in 1999.
Experimental Design: See the Wenatchee discussion (Objectives 1 & 2). The only differences in experimental design with respect to smolt-at-release to smolt-to-the-lower Columbia River survival are that a larger number of fish (8K) will be PIT-tagged to account for the lower passage survival (2 more dams); and smolt-to-adult survival will be calculated based on the Wells Dam passage counts. A *total of 500K will be released in the Methow River basin the majority of which address Objective 7 (smolt to adult survival) and Objective 8.*
Question Testing Procedure: Compare smolt-at-release to smolt migration through the lower Columbia River; and smolt-at-release to adults past Wells Dam.
Risks: See discussion for Objectives 1 & 2 for the Wenatchee basin.

Objective 8. Spatial and Temporal Redd Survey.

Objective: Determine the geographic spawning areas of returning and naturally produced coho spawners in the Methow basin.

> **Question:** What is the spatial and temporal distribution of returning coho spawners in the Methow basin?

Rationale: Same as for Objective 3 (Wenatchee basin).
Duration: Surveys in the Methow basin will be initiated when sufficient (i.e., 100 fish) number of spawners return over Wells Dam.
Experimental Design: See description for Objective 3 for the Wenatchee basin.
Question Testing Procedure: The location and date of each redd found will be recorded. In addition, physical data will be recorded from a random sample of redds in each subbasin (i.e., Methow, Twisp and Chewuch basins). The type of data recorded would include redd distance from bank, redd dimensions, pocket depth, water depth over tail-spill, type of nearby adult holding habitat available, water velocity over the redd, and gravel quality.
Risk: No risks have been identified with this field task.

Ecological Interactions – Methow Basin

Objective 9. Coho Residualism.
Objective: Determine the extent of hatchery coho residualism.

> **Question:** Is there evidence, and to what degree, of coho smolt residualism?

Duration: 1999-2000.
Rationale: This is an important issue from an ecological interaction(s), risk containment, and smolt contribution perspective. Knowledge of the presence of residualized coho smolts, their quantity and location are important to develop risk containment measures. From an ecological risk management perspective, an excessive number of residualized coho smolts represents a potential for direct predation on spring and summer chinook and steelhead fry or for other negative ecological interactions. From the point of view of smolt contribution, a high number of residualized coho may result in a lower smolt-to-adult survival rate since they would spend an extra year in freshwater or never initiate smolt outmigration. This knowledge could then be applied to alter smolt release methods to improve fish smoltification. We assume that the likelihood of hatchery coho smolt residualism is equal across the three basins (i.e. non-basin specific) because the size of fish at release and the parent stock is similar between basins. However, the conclusions of this study may have little relevance when applied to F_2 coho, due to differences in environmental productivity between basins and behavioral differences between hatchery and wild fish.
Experimental Design: Because of the extensive geographic area (~220 river miles) in which fish could potentially be residing, snorkel surveys will be conducted near the acclimation/release sites. The underlying assumption is that, if residualization is a serious problem, it likely will be most detectable near the points of smolt release. Snorkel survey reaches will be established between the release point and 20 river miles downstream. An attempt will be made to determine the point farthest downstream that residual coho occupy. Surveys will be conducted once, six to eight weeks after the release date(s).
Question Testing Procedure: The number of residualized hatchery coho smolts counted during the surveys relative to the number released will be the basis from which the TWG will make their evaluation.
Risk: No direct risks have been identified for this task. Potential risks caused by the acclimation/release of the fish needed to make these calculations would be associated with Objective 1 and 2.

Long-Term Fitness – Methow Basin

Objective 10. Coho Productivity in the Methow Basin
Objective: Monitor the long-term productivity of the coho supplementation program.

Question: What is the stock productivity in the Methow basin?

Rationale: The survival information gained will, over the next several years, help evaluate the feasibility of re-establishing coho in the Methow basin. If, for example, observed productivity falls short of the program goal, factors limiting survival must be identified and corrected if the program is to succeed.

Duration: This will be measured on an annual basis as return data become available.

Experimental Design: Stock productivity will be expressed as the number of returning hatchery adults (F_2) resulting from the initial number of adults (including jacks) spawned for a specific broodyear (F_1). The number of returning hatchery adults will be estimated based on the Wells Dam count. The number of adults spawned for a given year is the number of adults comprising a specific broodyear. Initially external marks will not be required to make this calculation. However, as natural production increases, there will be a need to externally mark fish (some portion so that an expansion factor can be established), so that the natural and hatchery productivity components can be separated. An estimate of natural productivity will be based on dam counts (as opposed to dam and redd counts) since it is unlikely (at least initially) that 100% of the redds will be counted because of the difficulty finding them.

Question Testing Procedure: The number of returning hatchery adults (F_2) resulting from the number of adult broodstock spawned (F_1) for the hatchery component; and for the natural component, the number of returning hatchery adults (F_2) to the dam(s) resulting from the Wells Dam count for the corresponding broodyear (F_1).

Risks: No direct risks have been identified for this task. Potential risks caused by the acclimation/release of the fish needed to make these calculations are discussed under Objective 1 & 2 (Wenatchee basin).

Culturing/Genetics - All Basins

The number of returning adults to the Yakima basin has steadily increased over the period of hatchery coho smolt releases in the basin. Returns to the Yakima basin at Prosser Dam over the past three years have exceeded 1,000 adults. This is partially due to increased numbers of smolts released and the survival benefit of releasing acclimated smolts versus direct releases of smolts into the system. Arguably, Yakima basin returns of this magnitude combined with improved survival of a locally adapted stock imply that the potential exists to re-establish returns to the Yakima of at least the size of those estimated for the period 1944-67 (YIN 1998, in draft).

The Yakama Indian Nation began collecting broodstock in the Yakima from the 1997 return and will continue to develop a locally adapted broodstock for release of fish in the Yakima basin. This procedure will take many years and is currently using returning lower Columbia River hatchery fish as broodstock. As the number of returning naturally produced fish increases to a level considered to be more than trivial, the program will transition into the use of naturally produced fish as broodstock, eventually completely phasing out the use of lower Columbia fish stocks

A similar approach will be followed for work to be performed in the mid-Columbia. We first need to determine whether or not survival of hatchery acclimated smolts is high enough to provide adult returns to begin development of a locally adapted broodstock to be used in this region of the basin, and then begin development of that broodstock.

Objective 11 and 12 are outlined in the "g part" ***facilities and equipment***

Objective 13. Egg Banking/Broodstock Program

Objective: To determine whether it is feasible to establish a viable localized broodstock for hatchery supplementation in the mid-Columbia.

> **Question:** Can a viable coho broodstock program be established in a mid-Columbia basin hatchery facility for the purpose of providing eggs/smolts for off-station acclimation/releases in the Methow and Wenatchee basins? (C/G-1)

Rationale: It is the TWG's belief that the most expedient method to establish a locally adapted coho stock, and the method that offers the best opportunity for program success, is to establish an egg bank program.

Duration: To be determined by the TWG.

Experimental Design:

Below is an outline of the estimated number of smolts and assumed parameters necessary at release to achieve a full smolt production level of 400K fish[1]:

Egg-Smolt Survival Rate	90.0%
Smolt-Adult Survival Rate	0.3%
ENFH Capacity for Yearly Program	400,000
Average Fecundity	3,000
Sex Ratio (% Female)	60.0%
Adult Collection Rate (%)	100.0%
Pre-spawning Mortality	15.0%
Number of Adults to ENFH Capacity	244
Number of Smolts to Release	**543,210**

This is just an example utilizing an existing facility that may be available for egg banking. Any facility is acceptable though mid-Columbia ones reduce transportation stress. The experimental importance is for released smolts to experience natural selection up to adult collection. Collection would occur at various existing facilities (Tumwater Dam, Dryden Dam, Chiwawa River Weir Trap, Priest Rapids Dam, and Wells Dam).

Question Testing Procedure: The number of potential returning adults and the number captured for broodstock will be the basis for evaluation by TWG.

Risk: Risks of the establishment of a localized broodstock and the subsequent release of hatchery smolts into the mid-Columbia basin have potential risks similar to those described for other Phase 1 tasks, namely direct and indirect predation. However, through the tasks outlined above, answers about these potential risks are being sought. The knowledge gained from these tasks will be incorporated, using adaptive management principles, in concert with development of the localized broodstock task.

Objective 14. Genetics Monitoring.

Objective: Monitor the long-term changes in the genetic and life history profiles of a non-native stock of hatchery coho introduced to mid-Columbia River tributaries.

> **Question:**

- How long does it take for a distinct locally adapted coho population(s) to diverge from the parent hatchery stock in the mid-Columbia basin?
- What genetic traits or life history parameters are most heavily selected for, and can they be identified such that purposeful broodstock selection can occur to increase overall adult return rates?

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[1] This 400k figure is based on some past discussions by the TWG on the use of the Entiat NFH as a potential facility for establishing a mid-Columbia localized broodstock.

Rationale: From a purely academic perspective, the mid-Columbia basin coho re-introduction program provides an opportunity to monitor the naturalizing of a hatchery salmon stock. From a program perspective, genetic monitoring coupled with monitoring of key life history parameters (i.e., smolt outmigration timing, spawn time, adult return time, pre-spawning survival rates) has the potential to be a useful tool for the broodstock collection task, to maximize the collection of spawners that demonstrate successful traits.
Duration: Monitoring will be conducted on a annual basis initially, and then at some point on a less frequent basis (i.e., every five years).
Experimental Design: The YIN will seek to derive broodstock for future supplementation within the mid-Columbia basin from individuals returning from initial reintroduction. Monitoring divergence between lower Columbia River hatchery stocks (LCRHS) and broodstock used by the YIN would therefore yield information on traits of adaptive value within the mid-Columbia basin. However, monitoring divergence in this manner requires that returning mid-Columbia fish be the sole source for broodstock in the YIN program once adult returns become sufficient for program maintenance. As a practical tool, genetic monitoring could be used to avoid small effective population size within the YIN program.
1. We will begin collection of baseline allelic frequency data of the LCRHS and YIN broodstocks. These data would be useful in monitoring divergence of LCRHS broodstock and YIN broodstock.
2. Initially, genetic monitoring of mid-Columbia coho will be useful in determining traits of adaptive value for reintroduction in the basin. However, the opportunity to test allelic frequencies as a measure of diversity is of great importance for hatchery populations and management throughout the basin. In addition, calculations of temporal changes in stray rates and colonization will be invaluable for future reintroductions.
3. Since the stock to be used for supplementation is non-indigenous to the mid-Columbia, hatchery practices which minimize the loss (or select for) characters important to fitness in the new environment are critical for long-term success. Unfortunately, it is difficult to predict which character traits will impart a fitness advantage. Selection for optimal traits will occur naturally over several generations. However, immediately defining traits important to fitness could increase the probability of a successful reintroduction. One method for determining traits of adaptive value is to mark offspring of specific pair matings. Hard, NMFS (Pers. Comm.) recommends mating ten or more pairs of adults which have returned to spawn naturally and which have a wide range of phenotypes. The progeny should be marked in a family-specific fashion and released to the wild. Upon return, at least 10 individuals from each pair mating should be analyzed for the same suite of characters as their parents. If the slope of the regression of offspring characters on parent characters is significantly nonzero, it implies that the additive genetic variance of that character is important to fitness. The hatchery program should then seek to minimize loss of these characters.
Monitoring allelic frequencies is recommended. Changes in allelic frequencies are particularly interesting in this case. Since electrophoresis seeks to measure neutral alleles, divergence of allelic frequencies between the mid-Columbia stock and the LCRHS stock should only arise exclusively through genetic drift or mutation. Since we would expect that the mid-Columbia stock is undergoing extreme selection (particularly for run-timing and endurance), this program provides an opportunity to test the neutrality assumption necessary for electrophoresis. If divergence cannot be explained through mechanisms such as genetic drift, it would indicate that allelic neutrality is questionable, which has consequences for the use of allelic frequency as a measure of population divergence. Unfortunately, with α<10% and β=<10% (power = 90%) a sample size of at least 240 individuals from each group is required to detect a divergence of 0.3 standard deviations. For α<5% and β=<5% (power = 95%) about 700 individuals from each group would be required. Monitoring divergence would focus more on the rate for a suite of allozymes and/or haplotypes.

4. In addition, we will compare the mid-Columbia stock and other LCRHS outplants for a variety of physical and behavioral traits, e.g., age at outmigration, fecundity, emergence timing, juvenile outmigration timing, body morphometry, stamina, and others. These measures would provide another test of the reliability of electrophoresis for predicting divergence between two stocks. In the absence of allelic frequency changes, changes in physical and behavioral traits should result exclusively from phenotypic plasticity. If phenotypic plasticity exceeds published coefficients, it would suggest that there is an insufficient link between frequencies coding for neutral alleles and those coding for adaptive traits.

5. Finally, we will monitor colonization rates and genetic/behavioral/physical traits between subpopulations. There is currently a dearth of information regarding stray rates versus colonization rates of pacific salmonids. It has been hypothesized that initially stray rates will be high after reintroduction as stocks colonize new habitat. Over time as subpopulation sizes increase, the stray rate may decrease as returning adults migrate to specific subpopulations. Over time, these subpopulations should display divergence in heritable traits if the scale of colonization is sufficiently large. Monitoring rates of straying over time could yield information valuable for determining allowable stray rates for hatchery populations throughout the Columbia Basin.

Question Testing Procedure: Discussed in above text.

Risk: The only risk is not having the data to track genetic divergence of stocks and important traits related to fitness and long-term success.

NEPA – All Basins.

Objective 15. NEPA Compliance.

The work funded by BPA has previously been categorically excluded under the National Environmental Policy Act (NEPA). BPA is currently initiating an Environmental Assessment on the feasibility/ risk tasks to be implemented in 1999 and beyond for Phase 1. An Environmental Impact Statement will be initiated in 1999 with completion in 2000 that will address the environmental impacts of Phase 2, the long-term restoration/production program.

f. Methods

METHODS ARE DISCUSSED ABOVE WITHIN “E”.

g. Facilities and equipment

Facilities needed for the mid-Columbia coho experimental program include those for *adult capture, holding and spawning, egg incubation, juvenile rearing, acclimation and release, and monitoring.* To date, only coho acclimation facilities exist, and only in the Methow basin. Side channels and existing irrigation canals have been utilized for short-term acclimation and release of coho produced at lower Columbia River hatcheries under the jurisdiction of the CRFMP. Ultimate coho salmon production numbers and the facilities required to produce and monitor them will be determined after species interaction and productivity studies have been conducted. **Bold faced facilities/equipment reflect FY 2000 budget expenditures.**

Wenatchee River Basin

***Adult Capture* –** Adult broodstock collection could occur at Priest Rapids, Rocky Reach and/or Wells dams on the Columbia River; at tributary sites such as Tumwater Dam and at the Chiwawa River weir (Eastbank facility); and from stray adults returning to any of the mid-Columbia hatcheries.

Adult Holding and Spawning -- Tentatively this will occur at the Entiat National Fish Hatchery, but it could occur at another facility. Potentially adults could be held and spawned at the Icicle side channel at the Leavenworth National Fish Hatchery.

***Egg Incubation and Juvenile Rearing* –** This could be done at the Entiat National Fish Hatchery. Potentially, if incubation and/or rearing space was limited at ENFH, this activity could occur at one of the aforementioned lower Columbia River facilities as is occurring for Yakima coho.

***Acclimation and Release* –** The best candidate stream reaches or geographic areas in the Wenatchee basin are: Nason Creek (along Highway 2), lowermost Chiwawa River, the Chumstick River, the Icicle side channel, and lower Wenatchee River side channels near the town of Monitor. **Budget includes acclimation pond design/construction.**

***Monitoring* –** Juvenile migration monitoring would most likely incorporate the use of **rotary traps** located in the river/creek channel or in an irrigation diversion (i.e., Dryden) upstream to the fish screens, and **box traps** for small tributaries. Juvenile distribution/abundance monitoring will be done primarily through snorkel surveys and limited use of electrofishing **(electroshockers**).

Adult monitoring can occur at Rock Island and Rocky Reach dams on the Columbia River, at Tumwater Dam on the Wenatchee, and at the adult broodstock weir on the Chiwawa River. The potential exists to install remote **underwater video camera monitoring systems** (i.e., Nason Creek). **Rafts** will be used for spawning surveys.

Methow River Basin

***Adult Capture* –** Primarily Wells Dam but secondarily at Priest Dam, Tumwater Dam and possibly Prosser Dam.

***Adult Holding and Spawning* –** Winthrop NFH.

***Egg Incubation and Juvenile Rearing* –** Winthrop NFH, Prosser Tribal Hatchery, and Entiat NFH.

***Acclimation and Release* –** Eight Mile Creek Ponds (Chewuch River), Fulton Canal (Chewuch River), Biddle Ponds (Wolf Creek), Upper Methow River (site yet to be determined, possibly on Early Winters Creek), site to be determined on Twisp River. **Budget includes acclimation pond design/construction.**

***Monitoring* –** Juvenile distribution/abundance/residualism monitoring will be done primarily through snorkel surveys and limited use of electrofishing **(electroshockers**). Juvenile smolt to smolt survival monitoring will be at Rocky Reach and McNary dams. Adult monitoring will occur at Wells, Rocky Reach and McNary dams. **Rafts** will be used for spawning surveys.

h. Budget

Costs have increased substantially in FY 2000 from those approved in FY 1999. The justification for this increase is a result of the following:

1. NEPA costs incurred by BPA will be from this budget for the first time.
2. The project is expanding from the Methow only to the Wenatchee and Entiat (egg banking only) basins. Rearing/acclimation/experimentation/monitoring will be increased as well as travel in 2000.
3. Egg banking/broodstock development is being initiated which will incur adult capture, transportation, and fish culture costs.
4. Funding for TWG and NEPA participation has been requested by WDFW, US Forest Service, and the Colville Tribe.
5. US Fish and Wildlife Service will be contracted to monitor and administer all fish health for the project.

Personnel – Tribal employees to perform experimental and fish rearing tasks plus project management and administrative support.

Supplies, materials… - office equipment, genetic monitoring, tools, snorkeling gear, electroshocking, fencing, sand and gravel, lumber.

Operation/maintenance – Fish rearing/acclimation (feed, fish culture equipment and costs), fish marking, adult capture and transportation, juvenile transfer to release sites.

Capital acquisitions – 2 computers, trailers for acclimation site (office and security), land lease for acclimation sites, backup generators, water pumps, rotary trap.

NEPA – BPA costs associated with scoping, public meetings, and development of EIS. Includes hiring a consultant technical writer and cultural resource specialist.

Construction related… - Tribal support for design/construction activities.

Pit tags – Number of tags discussed in Section 8, *"e" proposal objectives*.

Travel – Per diem, lodging for all activities in mid-Columbia basins.

Indirect costs – YIN tribal rate - 24%.

Subcontractor – USFWS to do egg banking at federal hatchery in mid-Columbia.

Subcontractor – USFWS to do fish health monitoring for project.

Subcontractor – Acclimation pond design. Sea Springs Co. designed Methow and Yakima coho acclimation sites plus Prosser and Marion Drain facilities.

Subcontractor – Construction of rearing/acclimation/release ponds.

Subcontractor – CRITFC to do genetic monitoring. WDFW Genetics Lab may actually process tissue samples.

Subcontractor – WDFW, US Forest Service, and the Colville Tribe have requested funding assistance to participate in the mid-Columbia Coho TWG and the EIS process.

Other – Project vehicles, insurance, building rental space at Tribal Headquarters.

Section 9. Key personnel

Tom Scribner, Project Manager

Responsibilities: oversees all aspects of the project; experimental objective development and data collection, fish rearing, subcontracts, personnel, chairman of the TWG. Coordinates closely with BPA on contract compliance and NEPA.

THOMAS BROWNE SCRIBNER

EDUCATION

1975-77 University of Washington
Master of Science Degree, 1977
Major: Fisheries

Thesis: "The Relationship Between Growth and Population Density of Sockeye Salmon Fry." The study was undertaken to help determine the growth potential of sockeye in natural lake systems.

1967-71 Middlebury College
Bachelor of Arts Degree, 1971
Major: Biology (Dean's List)

EXPERIENCE

7/82 - present Yakama Indian Nation

Title: Fisheries Enhancement Manager

Oversee all salmon and trout production for the Tribe including all fish propagation/outplantings done by the Yakima Nation or any other fisheries agency.

Tribal representative on the Integrated Hatchery Operations Team. The team's purpose is to both develop and coordinate regional hatchery policies concerning fish health, genetics and ecological conditions and to provide hatchery performance standards. The team is also developing a hatchery audit procedure and policy implementation plans.

Tribal representative on the Production Advisory Committee (PAC) established to exchange information and to review and analyze present and future artificial and natural production programs pursuant to the U.S. v. Oregon Columbia River Fish Management Plan. Committee Chairman, 1993; re-elected for 1994 and 1995.

Tribal representative on the Mid-Columbia, Rock Island, and Wells Dam Coordinating Committees. The interagency committees are responsible for implementing measures to protect migrating salmonids, i.e. spill, bypass, adult passage and hatchery compensation for calculated dam losses.

Technical representative on interagency work groups responsible for tasks associated with: 1) the design of a $25 million supplementation hatchery; and 2) the conceptualization of the various experiments on supplementation to be conducted at the hatchery.

PUBLICATIONS

M.S. Thesis, 1977. Relationship Between Growth and Population Density in Sockeye Salmon Fry, 111 pgs.

"Recommendation for Proposal and Evaluation of Salmonid Facilities", 84 pgs. (Publication for Congressional Act; Salmon and Steelhead Enhancement Act, 1980).

"Evaluation of Potential Species Interaction Effects in the Planning and Selection of Salmonid Projects", 72 pgs. (same publication conditions as above).

Scribner, T.B. 1993. "Spring Chinook Spawning Ground Surveys of Methow River Basin." Report to Public Utility District No. 1 of Douglas County. Yakima Indian Nation, Fisheries Resource Management Program. Toppenish, WA.

Joel Hubble, Research Manager

Responsibilities: Develops and implements experimental objectives and tasks, oversees field crews, analyzes data and reports findings through progress reports, presents experimental approach, results, and implications to TWG on a regular basis.

EDUCATION

Master of Science, Biology

Central Washington University, Ellensburg, Washington- 1992

Thesis research focused on the juvenile life history of steelhead salmon in intermittent tributaries to the Satus Basin.

Bachelor of Science, Fisheries

University of Washington, Seattle, Washington- 1978

EXPERIENCE

Yakama Indian Nation, Fish. Res. Management, Toppenish, WA 1993 - Present

Fisheries Biologist III (research biologist)

My primary responsibility is to develop monitoring/evaluation studies for various tribal fisheries projects, perform EDT habitat modeling analysis, and to provide oversight in the implementation of these field studies. I'm most involved with the BPA funded Yakima/Klickitat Fisheries Project (YKFP) and the Douglas PUD funded Methow Basin Spring Chinook Supplementation Project.

Other responsibilities include preparation of annual work statements and budgets; data analysis and annual report writing; and the direct supervision of two field biologists and three video monitoring fisheries technicians.

Yakama Indian Nation, Fish. Res. Management, Toppenish, WA 1989 - 1993

Fisheries Biologist II

Project Leader for the BPA funded Yakima\Klickitat Fisheries Project. Duties included oversight of the YIN's work statement, preparation of the annual budget, work plan and report, and oversight of field research activities and data analysis.

Yakama Indian Nation, Fish. Res. Management, Toppenish, WA 1982 - 1988

Fisheries Biologist I

Field biologist for the BPA funded Yakima Basin Spring Chinook Enhancement Study. Duties included supervision of field crews, collection of field data, data analysis and report writing.

PUBLICATIONS

Fast D., J. Hubble, M. Kohn, B. Watson. 1991. Yakima River Spring Chinook Enhancement Study, Final Report. Project No. 82-16. Bonneville Power Administration. Portland, Oregon.

Andre Talbot, CRITFC Geneticist/Ecologist

Responsibilities: Provides expertise and guidance on genetic monitoring program. Oversees collection of genetic data and interprets results. Works with other agency geneticists to evaluate significance and meaning of the data. Reports to TWG on findings and their implications to the restoration goal.

ANDRÉ TALBOT, *Ph.D.*

Columbia River Inter-Tribal Fish Commission, 729 NE Oregon St., Suite 200, Portland, OR 97232 Phone: (503) 238-0667; Direct Line: (503) 731-1250; Fax: (503) 235-4228; E-mail: tala@critfc.org

AREAS OF EXPERTISE:

Evolutionary biology, quantitative genetics, life history ecology, habitat productivity, population dynamic modelling, biostatistics, salmon biology

EDUCATION

- Ph.D. (Biology) in population dynamics, with emphasis on modelling and statistical methods. Dalhousie University, Biology Dept. 1994. THESIS: Habitat-dependence of population abundance and variability in juvenile Atlantic Salmon (*Salmo salar*).
- M.Sc. (Biology), in evolutionary ecology. McGill University, Biology Dept., 1983.
- B.Sc. Honours (Biology) in ecology and systematics, with graduation *Cum laude*. University of Ottawa, Biology Department, 1980.

EXPERIENCE

Position	***Dates***	***Institution and description***
Senior Fisheries Scientist	1997-present	Columbia River Inter-Tribal Fish Commission
Regional Unit Manager and Biostatistician	1994-1997	CARICOM Fisheries Resource Assessment and Management Programme (CFRAMP)
Managing Partner & Consultant	1989-1994	Talbot and Associates (biostatistics, population dynamics, genetics, development)

Research Associate	1990-1994	Département des Sciences Fondamentales, Université du Québec à Chicoutimi, Québec, Canada
Research Associate & Project Manager	1983-1989	Biology Department, Dalhousie University, Halifax, Nova Scotia

RELEVANT PROJECTS

Expertise	*Project description*	*Institution or Client*
Resource Assessment & Conservation Biology	Development of a conceptual framework for ecological genetics of Pacific salmon conservation	CRITFC
	Stock structure of lamprey, Chinook and steelhead	CRITFC
	Virtual Population Analysis of Chinook (*Oncorhynchus tshawytscha*) and steelhead salmon (*O. mykiss*)	CRITFC
	Evaluation of management requirements for the Saguenay Marine Park groundfish fisheries and population dynamics of the turbot(*Reinhardtius hippoglossoides*), cod (*Gadus morhua*) and redfish (*Sebastes mentella*).	Environment Canada / Fisheries and Oceans
	Development of a population estimation method based on the Bayesian principle of simultaneous analysis of removal data from many sites.	Fisheries and Oceans Canada (Saint-John's, Newfoundland)
	Development of a monitoring methodology for the evaluation of the exploitation and fishing activities of landlocked Atlantic salmon (*Salmo salar ouananiche*) in Lac St-Jean	Ministry of the Environment and Fauna, Québec (Saguenay-Lac St-Jean Region)
	Analysis of the effect of fishing pressure on the burbot (*Lota lota*) populations in Lac St-Jean	Ministry of the Environment and Fauna, Québec (Saguenay-Lac St-Jean Region)
Fisheries & Aquaculture	Genetic improvement of common carp (*Cyprinus carpio*) and Tilapia (*Oreochromis spp.*) stocks. (Several individual projects, including cryopreservation of sperm)	International Development Research Centre (IDRC)
	Genetics of growth and productivity of fish in aquaculture and the inter-relationship of life history strategies in relation to intraspecific competitive ability in fish.	International Development Research Centre (IDRC)
	Dynamics of habitat use in relation to population abundance in Atlantic salmon parr: Test of ecological principles.	Fisheries and Oceans Canada (Saint-John's, Newfoundland)
	Study of the fecundity of Atlantic salmon (*Salmo salar*) in relation to growth at time at sea and its impact on production in rivers.	Ministry of the Environment and Fauna, Québec (Direction Générale du Québec, Québec)

Analysis of the effect of fishing pressure on landlocked salmon (*Salmo salar ouananiche*) populations in Lac St-Jean.	Ministry of the Environment and Fauna, Québec (Saguenay-Lac St-Jean Region)
Determination of productive capacity of habitat for juvenile Atlantic salmon; and the application of juvenile density and production models in assessing the status of salmon stocks.	Fisheries and Oceans Canada (Saint-John's, Newfoundland)
Determination of a classification method for the productive capacity of juvenile salmon habitat.	Ministry of the Environment and Fauna, Québec (Direction Générale Du Québec, Québec)
Prediction of the productivity of juvenile salmon from insular Newfoundland in relation to physical and biological stream parameters.	Fisheries and Oceans Canada (Saint-John's, Newfoundland)

RELEVANT PUBLICATIONS

TALBOT, A. and R. A. MYERS. 199x. Density-dependent habitat use and population expansion in juvenile Atlantic salmon. Can. J. Fish. Aquat. Sci. In press.

TALBOT, A. and J.-M. SÉVIGNY. 1994. Caractéristiques de la population du flétan du Groënland (*Reinhardtius hippoglossoides*) du fjord du Saguenay. *in* Sévigny, J.M. et C. Couillard (eds.) 1994. Le Fjord du Saguenay: un milieu exceptionnel de recherche. Rapp. tech. can. sci. halieut. xxxx : xx + xx p.

TALBOT, A., A. BOURGEOIS and J.-M. SÉVIGNY. 1994. Évaluation de l'exploitation du Sébaste atlantique (*Sebastes mentella*) par la pêche sportive hivernale sur le Saguenay. *in* Sévigny, J.M. et C. Couillard (eds.) 1994. Le Fjord du Saguenay: un milieu exceptionnel de recherche. Rapp. tech. can. sci. halieut.xxxx: xx + xx p.

TALBOT, A. 1994. Habitat-dependence of population abundance and variability in juvenile Atlantic Salmon (*Salmo salar*). Ph.D. Thesis, Dalhousie Univ., Halifax, Nova Scotia, Canada B3H 4J1. 214 pp.

CARON, F. and A. TALBOT. 1993. Re-evaluation of habitat classification criteria for juvenile salmon, p. 139-148. *In* R.J. Gibson and R.E. Cutting [ed.] Production of juvenile Atlantic salmon, *Salmo Salar*, in natural waters. Can. Spec. Publ. Fish. Aquat. Sci. 118.

TALBOT, A.J. and R.W. DOYLE. 1992. Statistical interrelation of length, growth, and scale circulus spacing: II. Use of marginal ossification to detect non-growing fish. Can. J. Fish. Aquat. Sci. 49(4):701-707.

TALBOT, A.J. and R.J. GIBSON. 1992. Habitat utilization by juvenile Atlantic salmon in Newfoundland rivers. p. 163-184 *In* J.B. Dempson [ed.] Collected papers on fish habitat with emphasis on Salmonids. Canadian Atlantic Fisheries Scientific Advisory Committee. CAFSAC Res. Doc. 90/77. 423 pp.

DOYLE, R.W., N.L. SHACKELL, Z. BASIAO, S. URAIWAN, T. MATRICIA and A.J. TALBOT. 1991. Selective diversification of aquaculture stocks: a proposal for economically sustainable genetic conservation. Can. J. Fish. Aquat. Sci. 48(1):148-154.

TALBOT, A.J. and R.W. DOYLE. 1990. Statistical properties and power of growth estimation using scale microstructure. p. 421-424 in R. Hirano and I. Hanyu (eds.). The Second Asian Fishery Forum. 991 pp. Asian Fisheries Society, Manila, Philippines.

MATRICIA, T., A.J. TALBOT and R.W. DOYLE. 1989. Instantaneous growth rate of Tilapia genotypes in undisturbed aquaculture systems. I. "Red" and "Gray" morphs in Indonesia. AQUICULTURE. 77:295-306. (also internal report to IDRC)

DOYLE, R.W. and A.J. TALBOT. 1989. Repeatability of relative size-specific growth in Tilapia. p. 451-456 in R.S.V. Pullin, T. Bhukasawan, K. Tonguthai and J.L. MacLean (eds.) The Second International Symposium on Tilapia in Aquaculture. ICLARM Conference Proceedings 15. 623 pp. Department of Fisheries, Bangkok, Thailand, and International Centre for Living Aquatic Resources Management, Manila, Philippines.

TALBOT, A.J., T.K. HAY, R.W. DOYLE and A.E.L. McNAUGHTON. 1989. "Current growth" estimators in Tilapia. p. 509-513 in R.S.V. Pullin, T. Bhukasawan, K. Tonguthai and J.L. MacLean (eds.) The Second International Symposium on Tilapia in Aquaculture. ICLARM Conference Proceedings 15. 623 pp. Department of Fisheries, Bangkok, Thailand, and ICLARM, Manila, Philippines.

DOYLE, R.W., A.J. TALBOT and R.R. NICHOLAS. 1987. Statistical interrelation of length, growth and scale circulus spacing: appraisal of a growth-rate estimator for fish. Can. J. Fish. Aquat. Sci. 44(9):1520-1528.

DOYLE, R.W. and A.J. TALBOT. 1986. Effective population size and selection in variable aquaculture stocks. Aquaculture. 57:27-36.

DOYLE, R.W. and A.J. TALBOT. 1986. Artificial selection on growth and correlated selection on competitive behaviour in fish. Can. J. Fish. Aquat. Sci. 43(5):1059-1064.

Reports (Selected)

TALBOT, A.J. 1992. Le développement du suivi de la pêche à la ouananiche du lac St-Jean: Rapport final. Présenté au Ministère de l'Environnement et de la Faune, Direction du Saguenay/Lac Saint-Jean. Javier 1992.

TALBOT, A.J. 1991. Simultaneous analysis of removal data from many sites. Presented to the Salmon Association of Eastern Newfoundland, St-John's, NFLD A1C 5N8 as part of the Habitat Modelling Project. 33 pp.

TALBOT, A.J. 1990. Production of juvenile Atlantic salmon in Newfoundland rivers: Test of habitat models using a structural approach. Final report of the habitat modelling project, Phase I, presented to the Salmon Association of Eastern Newfoundland, St-John's, NFLD, A1C 5N8. 84 pp. et 1 app.

TALBOT, A.J. and R. J. GIBSON. 1990. Habitat utilization by juvenile Atlantic salmon in Newfoundland rivers. Report to the members of the Canadian Atlantic Fisheries Scientific Advisory Council (CAFSAC, #90/118).

TALBOT, A.J.1989. Improved abundance estimation of Atlantic salmon parr. Contract with Fisheries and Oceans (Number XAQ88-00132-(021)). Also presented to the CAFSAC committee.

Nancy Weintraub, BPA Environmental NEPA Specialist

Responsibilities: Oversees compliance with all federal environmental requirements related to the project. Lead person on development of the EIS.

Nancy H. Weintraub

Experience

1991–present Bonneville Power Administration Portland, OR

Senior Environmental Specialist

- Team Lead for Fish and Wildlife Program Environmental Group
- Prepared NEPA documents on fish and wildlife projects and transmission projects
- Lead for Endangered Species Act consultations on fish species

1982–1991 Western Area Power Administration Sacramento, CA

Environmental Manager

- In charge of all environmental matters for Sacramento Area Office
- Lead Federal staff person on California-Oregon Transmission Project EIS
- Prepared NEPA documents, supervised contractor in charge of compliance with hazardous materials/waste laws

1980–1982 USDA-Forest Service Ketchum, ID

Fish Biologist

- Sawtooth National Recreation Area fish biologist (trainee)
- Completed stream habitat surveys for anadromous fish streams
- Completed inventory of streams and water bodies for Forest Plan

Recent NEPA Documents Prepared

1997. Methow Valley Irrigation District Project Environmental Assessment and Finding of No Significant Impact DOE/EA 1181.

1996. Hood River Fisheries Project Environmental Impact Statement and Record of Decision DOE/EIS 0241.

1996. Yakima Fisheries Project Environmental Impact Statement and Record of Decision DOE/EIS 0169.

1995. South Fork Snake River/Palisades Wildlife Mitigation Project EA and Finding of No Significant Impact DOE/EA 0956.

Education

1976–1979 Texas A&M University College Station, TX

- M.S., Zoology.
- Master's Thesis: A Modification of MacArthur's Broken Stick Model and its Application to Aquatic Coleopteran Populations in a Fishless Pond

1972—1976 University of Wisconsin Green Bay, WI

- B.S., Ecosystems Analysis
- Two quarters of wildlife courses at University of Montana during Junior year

Section 10. Information/technology transfer

The Mid-Columbia Coho Technical Work Group which meets on average once a month will be the core group in which information is transferred. With representation from tribal, state and federal entities, the TWG forms a broad base for information exchange. Annually, a "white paper" with project results will be developed and put up on BPA's Fish and Wildlife web page. Presently, *Mid-Columbia Coho Salmon Study Plan* (YIN, 11/98) and *Results from YKFP and Mid-Columbia Coho Monitoring and Evaluation Studies* (Dunnigan and Hubble, 8/98) are available for public review. The NEPA process will also form a nexus for project information exchange. BPA project reviews and scientific workshops (ex. AFS meetings) will also be used to present results from this project.

Congratulations!