2007-2009 NPCC/BPA Proposal for a Salmonid Abundance and Productivity Monitoring Framework

Section 10 Narrative

Abstract

The Washington Salmonid Abundance and Productivity Monitoring Framework project proposed by the Washington Department of Fish and Wildlife (WDFW) will fill information gaps in fish abundance and productivity that will be vital for evaluating progress made in recovering salmon listed under the Endangered Species Act. This proposal will provide a framework for evaluating and prioritizing salmon recovery monitoring efforts and will fill key gaps in monitoring data. The monitoring framework is being developed by WDFW in collaboration with Washington's Governor's Forum on Monitoring Salmon Recovery and Watershed Health (Forum), including participation from the National Marine Fisheries Service (NMFS) and salmon recovery regions, and builds upon Washington's Comprehensive Monitoring Strategy. The framework addresses all areas of Washington State, spanning many Columbia River subbasins.

Recognizing that available funds will not be sufficient to monitor all listed populations, the framework incorporates Technical Recovery Team guidance on populations designated as primary, or those necessary to have a high probability for viability in order for the species to recover. In most cases, the TRT has made specific recommendations about which populations are primary for each listed species in the ESU. In other cases, salmon recovery regions have flexibility to identify primary populations based on TRT guidance. In the Lower Columbia and Snake regions of the state, the primary populations are clearly defined in the regional salmon recovery plans. In the Mid and Upper Columbia however, the salmon recovery regions need to complete additional work to flesh out precisely which populations will be designated as primary. After primary populations are designated, WDFW will work with the Forum, NMFS and salmon recovery regions to determine how many and which of the primary populations will be monitored statewide. WDFW is submitting specific proposals under separate cover for the Snake River and Lower Columbia, where the primary populations are clearly defined. The current proposal seeks funding to conduct monitoring for yet unnamed primary populations in the Mid or Upper Columbia regions, including smolt monitoring for two populations and adult monitoring for one population. Work will be completed by WDFW; additional data partners may be identified after the primary populations have been defined. The work described under this proposal would allow monitoring to commence in these regions, without having to wait for the next funding cycle.

Technical and/or scientific background

Population monitoring is essential for assessing salmon recovery and evaluating de-listing criteria. The National Marine Fisheries Service (NMFS), in its Listing Status Decision Framework, has developed four population status attributes, or Viable Salmonid Population (VSP) criteria, to evaluate the recovery of listed populations (Figure 1). These criteria, which include abundance, productivity, spatial distribution, and diversity, are to be assessed at the population, Major Population Group (MPG), and Evolutionary Significant Unit (ESU) spatial scales. Monitoring these criteria for listed West Coast salmonid populations is a substantial undertaking. Clearly, a cohesive monitoring framework is needed to distribute monitoring activities across populations, MPGs, and ESUs. Furthermore, it needs to function as a decision framework that can be used to prioritize funding for population monitoring activities.

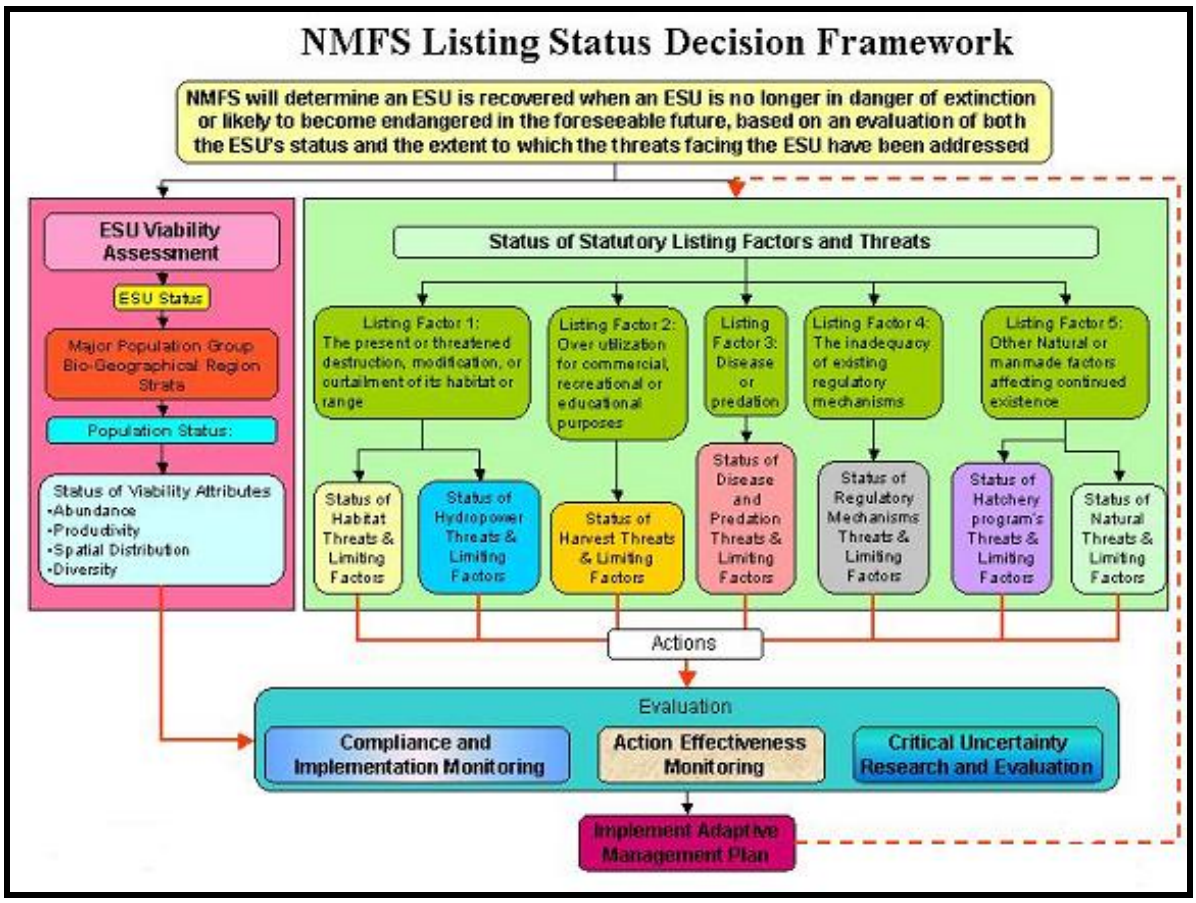

Figure 1. NMFS listing status decision framework with the Viable Salmonid Population (VSP) attributes requiring monitoring listed on the left side.

Traditionally, fishery managers have relied on escapement estimates to monitor anadromous salmonid population status and management effectiveness (Ames and Phinney 1977; Beidler and Nickelson 1980; Hilborn et al. 1999). However, estimation of population abundances at earlier life stages enables partitioning survival among life-stages. Partitioning survival among life stages is extremely useful for evaluating salmon

recovery action (Bilby et al. 2004) and leads to the development of hypotheses for restoration actions (Moussalli and Hilborn 1986, Mobrand et al. 1997). It is the approach used in the Intensively Monitored Watersheds (IMW) studies to validate the effectiveness of salmon recovery actions on salmonid populations.

Monitoring both adult escapement and downstream migrant production for the same population is a powerful tool for assessing abundance, and is necessary for determining productivity (e.g. smolts per spawner), which are two of the four VSP criteria. Furthermore, measuring abundance at these life stages partitions salmonid life history into freshwater and mainstem migrant/marine phases. This enables the separate evaluation of effects from projects designed to improve freshwater rearing conditions from other project types.

This proposal seeks funding to complete the Salmonid Abundance and Productivity Monitoring Framework for the Columbia River basin in Washington. It also seeks funding for new downstream migrant and adult monitoring for yet unnamed populations identified as "gaps" in the framework. The approach outlined in this proposal is being developed for application throughout Washington state. It also provides a model for monitoring these components of the VSP criteria for all anadromous west coast salmon populations.

Rationale and significance to regional programs

This project describes a coordinated package of juvenile and adult salmonid monitoring across Washington State that will provide the conceptual context for prioritizing salmon recovery monitoring efforts. This project will also include data collection necessary to track the abundance and productivity of several anadromous species listed under the Endangered Species Act. Information on abundance and productivity is critical for evaluating success in recovering these listed populations, a key objective for the Council's 2000 Fish and Wildlife Program, for the regional salmon recovery plans which in all cases have included the subbasin plans within the region, and the Governor's Forum on Monitoring (Forum). Abundance and productivity data are used directly in evaluating the success of salmon recovery efforts, and also contribute to efforts to set fisheries for tribal and non-tribal harvest, assess adequacy of hydropower mitigation efforts, and gauge abundance, productivity and diversity of the Columbia Basin Ecosystem as a whole. The approach described here is consistent with the vision and approach of the mainstem plan as well, seeking to clearly define monitoring priorities, recognizing that we cannot possibly monitor every single population of interest. The framework described under this proposal will involve a collaborative scientific process through the Forum with input from several regional salmon recovery groups, tribes, and several agencies at the state and federal level.

Former Washington Governor Gary Locke convened the Forum to coordinate and prioritize monitoring efforts across agencies statewide. In addition to state agencies, federal partners, tribes, and other interested parties participate in the Forum. On

December 1 2005, the Forum issued Recommendations to Salmon Recovery Regions outlining what should be included in regional monitoring plans for recovering listed salmon under the federal Endangered Species Act. The principal recommendation from the Forum is that the VSP parameters of abundance and productivity hold the highest monitoring priority for tracking salmon recovery progress. The VSP parameters of distribution and diversity should be addressed after adequate progress is being made in quantifying abundance and productivity. The Forum further noted that many gaps exist in juvenile and adult monitoring; filling these gaps holds the most immediate need. Specifically, adult and juvenile monitoring needs to occur within the same watershed for at least one primary population within each Major Population Group recognized by the relevant Technical Recovery Team (Table 1). In many cases, the Technical Recovery Team has identified more than one priority population. In these cases, the Forum has recommended that the number of populations monitored be determined collaboratively by the regional recovery board and NMFS (these populations are noted with a question mark in Table 1). The monitoring of these primary populations will provide a concrete means of gauging progress towards recovery goals established by the TRT in each region.

WDFW plays a pivotal role in juvenile an adult monitoring statewide and most salmon recovery regions rely to great extent on WDFW data in their plans. WDFW therefore seeks to incorporate the recommendations of the Forum into a monitoring framework that would accomplish four things:

1. Guide future salmon recovery monitoring statewide
2. Provide a filter for prioritizing monitoring funding for the NPCC, the Washington State Legislature, the Salmon Recovery Funding Board, Pacific Coastal Salmon Recovery Fund, and others;
3. Provide an adaptive management tool for WDFW and others to evaluate the value of existing monitoring programs.
4. Create a vehicle for ongoing dialogue with NMFS on the level of monitoring necessary to gauge success of salmon recovery efforts in each region.

WDFW plans to continue to work with the Forum and the salmon recovery regions to reconcile any disparate approaches between the Forum's statewide recommendations and specific approaches of regional salmon recovery plans. Salmon recovery regions have taken a collaborative approach with the Forum in making their plans consistent with the statewide approach, and the Forum has likewise solicited regional input to ensure that the statewide plan is realistic and reasonable in its expectations of regions. Throughout this process, the Forum has requested and will continue to request involvement from NMFS so that NMFS monitoring guidance will be reflected in the statewide approach.

Table 1. Washington State smolt and adult monitoring of ESA listed species by primary population, major population group, salmon recovery region, agency, and funding source. This DRAFT table is under review.

Draft

Proposed

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Recovery Region	Major Population Groups	WRIAs	Target Species	Primary Populations[16]	Juveniles				Adults		
					Smolt Sites	Production/ Index[2]	Smolt Trapping Agency	Funding	Spawners (Stocks)	Data Quality[3]	Funding
Puget Sound	North Sound	1 to 2	Chinook	**NF Nooksack**	Nooksack	Index[4]	Lummi	Tribal	NF/MF Nooksack	Very Good	State General Fund
				SF Nooksack					SF Nooksack	Very Good	State General Fund
									Samish/MS Nooksack	Poor	
	Whidbey Basin	3 to 7	Chinook	?[17]	Skagit	Production	WDFW	Federal (Dingall/ Johnson) 50% Seattle PU 50%	Lower Skagit MS/Tribs	Good	
									Upper Skagit MS/Tribs	Very Good	
									Lower Sauk	Good	
									Upper Sauk	Excellent	
									Suiattle	Excellent	
									Upper Cascade	Excellent	
				?	Stillaguamish	Production[4]	Stillaguamish	Tribal	NF Stillaguamish	Good	GFS
									SF Stillaguamish	Good	GFS
				?	Skykomish/ Snoqualmie	Production[4]	Tulalip	Tribal	Skykomish	Good	GFS
									Snoqualmie	Good	GFS
	Central/South Sound Basin	8 to 11	Chinook	N/A	Cedar River	Production	WDFW	Seattle PUD	Cedar	Good	King Cons Dist GFS
				N/A	Bear Creek	Production	WDFW	King Co.	N Lk Washington Tribs	Good	King Cons Dist GFS
				N/A	Green River	Production	WDFW	SRF Board	Green R (Duwamish)	Good	90% State GFS/ 10% Fed (PST)
				N/A	Puyallup		Puyallup	Tribal	Puyallup	Poor (total esc est)	State General Fund 50% / Tribal 50%
				White River					White River Adult Trap	Good	GFS 10%/ Tribal 90%
									White River Spawner Surveys		GFS 50%/ Tribal 50%
				Nisqually					Nisqually		GFS 50%/ Tribal 50%
	Hood Canal	16	Chinook	N/A	Hamma Hamma River	Index[6]	LLK/HCSEG/ Port Gamble/ WDFW	USFWS (DOI) /Tribal/ State	Mid-Hood Canal / Hamma Hamma	Good	State General Fund (GFS) 90% / LLTK 10%
				Skokomish					Skokomish	Good	GFS 90%/ Tribal 10%
				Dosewallips					Mid-Hood Canal / Dosewallips	Good	State General Fund (GFS) 90% / LLTK 10%
			Summer Chum	Quilcene					Quilcene	Good	GFS 100%
				Dosewallips					Dosewallips	Good	GFS 100%
				Duckabush					Duckabush	Good	GFS 100%
				Lilliwaup					Lilliwaup	Good	GFS 100%
				Union River					Union River	Good	GFS 100%
				Hamma Hamma	Hamma Hamma River	Production[12]	LLK/HCSEG/ Port Gamble/ WDFW	USFWS (DOI) /Tribal/ State	Hamma Hamma	Good	GFS 100%

Recovery Region	Major Population Groups	WRIAs	Target Species	Primary Populations[16]	Juveniles				Adults		
					Smolt Sites	Production/ Index[2]	Smolt Trapping Agency	Funding	Spawners (Stocks)	Data Quality[3]	Funding
	Eastern JDF	18	Chinook	**Dungeness**	Dungeness River	Production	WDFW	SRF Board	Dungeness	Excellent	GFS 100%
				Elwha	Elwha River	Production	Lower Elwha	Tribal	Elwha	Excellent	GFS 80%/ Tribal 20%
			Summer Chum	Jimmycomelately					Jimmycomelately		NOSC 60% /GFS 40%
				Salmon/Snow					Salmon/Snow		NOSC 30% / GFS 70%
Coastal	Ozette	20	Sockeye	Lake Ozette	Ozette River	Index	Makah	Tribal	Ozette	Excellent	Tribal
Lower Columbia	Coast	25	Chinook	***Grays/Chinook Falls***	*Grays River*	*Proposed*	*WDFW*	*NPCC/BPA*			
				Elochoman/ Skamokawa Falls							
				N/A	Mill Creek	Production	WDFW	SRF Board	Mill/Abernathy/Germany	Good	SRF Board
					Abernathy Creek	Production	WDFW				
					Germany Creek	Production	WDFW				
			Chum	**Mill/Abernathy/ Germany**	Mill Creek	Production	WDFW	SRF Board	Mill/Abernathy/Germany		BPA
					Abernathy Creek	Production	WDFW				
					Germany Creek	Production	WDFW				
				Grays/Chinook Riv	*Grays River*	*Proposed*	*WDFW*	*NPCC/BPA*			
				Elochoman/ Skamokawa	*Elocho/Skamokawa*	*Proposed*	*WDFW*	*NPCC/BPA*			
			Coho	***Grays/Chinook***	*Grays River*	*Proposed*	*WDFW*	*NPCC/BPA*			
				Elochoman/Skamokawa	*Elocho/Skamokawa*	*Proposed*	*WDFW*	*NPCC/BPA*			
				N/A	Mill Creek	Production	WDFW	SRF Board	Mill/Abernathy/Germany	Very Good[7]	SRF Board
					Abernathy Creek	Production	WDFW				
					Germany Creek	Production	WDFW				
	Cascade	26 to 28	Chinook	**Upper Cowlitz Springs**	Cowlitz Falls	Production	WDFW	Tacoma PUD			
				Cispus Springs							
				N/A	Mossyrock Dam	Index	WDFW	State GFS			
				Coweeman Falls	*Coweeman*	*Proposed*	*WDFW*	*NPCC/BPA*			
				Kalama Falls							
				Kalama Springs							
				NF Lewis Falls	Cedar Creek	Index[11]	WDFW	State GFS/ SRF Board			
				NF Lewis Springs							
				EF Lewis Falls							
				Washougal Falls							

Recovery Region	Major Population Groups	WRIAs	Target Species	Primary Populations[16]	Juveniles				Adults		
					Smolt Sites	Production/ Index[2]	Smolt Trapping Agency	Funding	Spawners (Stocks)	Data Quality[3]	Funding
			Chum	EF Lewis							
				Washougal							
			Coho	N/A	Cowlitz Falls	Production	WDFW	Tacoma PUD	Upper Cowlitz	NA[8]	Tacoma PUD
					Mossyrock Dam	Index	WDFW	State GFS			
				Lower Cowlitz							
				SF Toutle							
				NF Toutle							
				Coweeman	Coweeman	*Proposed*	*WDFW*	*NPCC/BPA*			
				N/A	Cedar Creek	Production	WDFW		Lewis	N/A[5, 9]	
				EF Lewis							
			Steelhead	N/A	Cowlitz Falls	Production	WDFW	Tacoma PUD	Upper Cowlitz winter	NA[8]	Tacoma PUD
					Mossyrock Dam	Index	WDFW	State GFS			
				SF Toutle Winters NF Toutle Winters							
				Coweeman Winters	*Coweeman*	*Proposed*	*WDFW*	*NPCC/BPA*			
				Kalama Winters **Kalama Summers**	Kalama River	Production	WDFW	Mitchell Act (NMFS-NOAA)	Kalama summer Kalama winter	Excellent Good	Mitchell Act (NMFS-NOAA)
				N/A	Cedar Creek	Production	WDFW		NF Lewis summer NF Lewis winter	N/A[5, 9] Just starting	State GFS/ SRF Board
				EF Lewis Winters							
				EF Lewis Summers							
				Washougal Summers							
	Gorge	29	Chinook	N/A	NONE[10]				Wind Tule Fall	Good	
									Wind Springs[10]	Poor	
									Wind Bright Fall	Poor	
									White Salmon Tule Fall		
									White Salmn Bright Fall		
			Chum	**Lower Gorge**	Duncan Creek	Production	WDFW	NPCC/BPA	Duncan Creek		
					Hamilton Creek		USFS	Federal: Forest Service	Hamilton Creek		
					Hardy Creek		USFS		Hardy Creek		
			Coho	Lower Gorge							
				Upper Gorge	Wind River[11]	Index	WDFW	NPCC/BPA	Bonneville Tribs	Fair	
			Steelhead	Lower Gorge Winters							
				Upper Gorge Summers	Wind River	Production	WDFW	NPCC/BPA	Wind summer	Good	
									Wind winter	NONE	

Recovery Region	Major Population Groups	WRIAs	Target Species	Primary Populations[16]	Juveniles				Adults		
					Smolt Sites	Production/ Index[2]	Smolt Trapping Agency	Funding	Spawners (Stocks)	Data Quality[3]	Funding
Middle Columbia	Eastslope	29 to 31	Steelhead	**Klickitat summer**	Klickitat River[11]	Index	Yakama	Tribal (NPCC/BPA)	Klickitat summer		Tribal (NPCC/BPA)
									Klickitat winter		
									Rock Creek summer		
	Yakima	37 to 39	Steelhead	Satus or Toppenish Creek summer	Yakima River (Prosser Dam a.ka. Chandler Juv. Eval. Facility)	Production	Yakama	Tribal (NPCC/BPA)	Satus Creek summer	NA	Tribal (NPCC/BPA)
									Toppenish Creek summer	NA	Tribal (NPCC/BPA)
				Naches summer					Naches summer	NA	WDFW 50%; USFS 50%
				Upper Yakima summer					Upper Yakima summer	NA	Tribal (NPCC/BPA); USBR
	Walla Walla	32	Steelhead	**Walla Walla**	Walla Walla[13]	Production	Umatilla	Tribal	Walla Walla summer	NA	Tribal / WDFW
				Touchet	*Touchet*	*Proposed*[15]	*WDFW*	*NPCC/BPA*	Touchet summer	Fair	
Snake	Lower Snake[14]	33 to 35	Chinook	**Tucannon Spring**	Tucannon River	Production	WDFW	BPA	Tucannon spring	Good	BPA
									Snake fall	Good	BPA
				Asotin Spring				BPA	Asotin Spring		BPA
			Steelhead	**Tucannon Summer**	Tucannon River	Production	WDFW	BPA	Tucannon summer	Fair	BPA
				Asotin Summer	Asotin Creek	Production	WDFW	BPA	Asotin Creek summer	Fair	BPA
								Asotin Co. Conservation Dist			Asotin Co. Conservation Dist
Upper Columbia	East Cascades	45, 46, & 48	Chinook	**Wenatchee Spring**	Wenatchee	Production	WDFW	Chelan Co PUD NMFS-NOAA	Chiwawa spring	Excellent	Chelan Co PUD
									Nason Creek spring	Excellent	Chelan Co PUD
									Little Wenatchee spring	Excellent	Chelan Co PUD
									White River spring	Excellent	Chelan Co PUD
				Entiat Spring	Entiat	Production	USFWS	Federal (DOI)	Entiat spring	Good	
				Methow spring	Methow	Production	WDFW	Douglas Co PUD	Methow spring	Excellent	Douglas Co PUD
									Twisp spring	Excellent	
									Chewuch spring	Excellent	
									Lost River spring	Excellent	
			Steelhead	**Wenatchee summer**	Wenatchee	Production	WDFW	Chelan Co PUD NMFS-NOAA	Wenatchee summer	Fair	Chelan Co PUD
				Entiat Summer	Entiat	Production	USFWS	Federal (DOI)	Entiat Summer	Fair	
				Methow summer	Methow	Production	WDFW	Douglas Co PUD			
				Okanogan summer	Okanogan[18]	Production	Okanogan Tribe	BPA	Methow/Okanogan summer	Good	Douglas Co PUD

Recovery Region	Major Population Groups	WRIAs	Target Species	Primary Populations[16]	Juveniles				Adults		
					Smolt Sites	Production/ Index[2]	Smolt Trapping Agency	Funding	Spawners (Stocks)	Data Quality[3]	Funding

Note: Spawner data and data quality ratings were retrieved from the SaSI database.

[1] "Sub-regional groupings" (i.e. Geographic Regions of Diversity and Risk, Meta-population Strata, and Major Population Groups) were designated by the appropriate Technical Recovery Team.

[2] Production" refers to sites where the total number of downstream migrants are estimated; "index" refers to sites at which an index of production (e.g. total catch, or catch per unit effort of fishing time) is made. Traps monitor naturally produced migrants.

[3] Subjective rating; no formal definitions are available. In some individual stock reports, an explanation is provided regarding the assigned rating, especially for data rated "poor".

[4]Traps operated less than 40% of the time; production estimates (rather than index counts) could be developed or substantially improved with additional monitoring.

[6] Data collected but analysis has not been completed to produce production estimates due to lack of funding/prioritization.

[7] Spawner escapement estimates with confidence intervals have been available since 2004, however only two data points are available and therefore escapement estimate ratings are currently not in the SaSI database.

[8] Current efforts would likely be rated as "Good" to "Excellent", however data are not available above Cowlitz dams and therefore ratings are currently not in the SaSI database.

[9] Partial escapement counts for the Lewis River are made at the Cedar Creek trap, however due to insufficient data, escapement estimate ratings are currently not in the SaSI database.

[10] The smolt trap on the Wind River is located at the downstream-most viable trapping site to estimate nearly the entire Wind River production. Yet, nearly all of the listed Wind Tule Fall Chinook spawn downstream of this site. Therefore, estimation of Wind River tule fall chinook production is not viable with existing technology. Chinook production from the Wind and White Salmon Rivers includes non-listed stocks (Wind Spring Chinook, Wind Bright Fall Chinook, and White Salmon Bright Fall Chinook are not native to these systems and therefore are not part of the listed ESU) as well as listed tule fall chinook. Estimation of White Salmon tule fall chinook production would require DNA analysis. The USGS is planning to initiate trapping for chinook, coho, and steelhead on the Big White Salmon River in Spring 2006, with production estimates available in 2007. With funding for DNA analysis, the USGS trap could potentially fill the information gap for estimating listed tule fall chinook production.

[11] Production estimates are anticipated beginning in 2006.

[12] Listed Hood Canal summer chum production is currently estimated from the non-listed fall chum production using run timing. More accurate and precise estimates could be developed using DNA analysis at an additional cost.

[13] Traps are also located in Oregon sections of the mainstem Walla Walla River (USFWS) and on Mill Creek (ODFW), however, these are not listed since they measure production originating in Oregon and the lower Walla Walla trap integrates production from all of these sites.

[14] Downstream migrant traps are also operated on the Grande Ronde (ODFW) and mainstem Snake River (IFG). These are not listed since they measure production largely occurring outside of the State of Washington.

[15] WDFW is seeking funding to begin a smolt monitoring project on the Touchet River directed at assessing summer steelhead production.

[16] Only those populations designated as "Primary" within each Major Population Group are listed. "N/A" is shown for monitoring sites containing only "Contributing" or "Stabilizing" populations.

[17] ? Primary Populations not yet designated for this major population group.

[18] Trapping to begin in 2006.

Relationships to other projects

This proposal provides the overarching context for a coordinated approach to salmon recovery monitoring of abundance and productivity in Washington State. As noted in Table 1, several data gaps exist for primary populations within the Washington portion of the Columbia River Basin. In addition to this proposal, WDFW is submitting several proposals that will fulfill critical data gaps for primary populations:

- *A Proposal to Expand Current Juvenile Salmonid Monitoring in the Columbia Estuary Province to Meet the Monitoring Needs Identified in the Lower Columbia Salmon Recovery and Subbasin Plan*; Project ID 200734300 .
- *Expand Salmonid Monitoring in Grays River to Meet Monitoring Needs Identified in the Lower Columbia Salmon Recovery and Subbasin Plan and maintain an at risk Chum Salmon Population through Supplementation*. Project ID 200715000
- *A Proposal to Expand Current Juvenile Salmonid Monitoring in the Lower Columbia Province to Meet the Monitoring Needs Identified in the Lower Columbia Salmon Recovery and Subbasin Plan*; Project ID 200727400.
- *Determining the Accuracy of Adult Coho Salmon Population Estimates from a Random, Spatially Balanced design using Area-Under-the-Curve in the Estuary Province;* Project ID 200735500
- *Determining the Accuracy of Adult Coho Salmon Population Estimates from a Random, Spatially Balanced design using Area-Under-the-Curve in the Lower Columbia Province;* Project ID 200735600
- *Adult Coho Salmon Monitoring in the Lower Columbia Province*; Project ID 200735400;

The following ongoing projects also contribute to implementation of the framework outlined in the current proposal:

- *Collaborative Walla Walla Subbasin Monitoring and Evaluation Project*; Project ID 200003900. This project is continuing work conducted by the Confederated Tribes of the Umatilla Indian Reservation and WDFW (previously under Project ID 199802000) and now being joined by Oregon Department of Fish and Wildlife.
- *Assess Salmonids in the Asotin Creek Watershed*; Project ID 200205300.
- *Reintroduction of Chum in Duncan Creek;* Project ID 200105300.
- *Monitoring the reproductive success of naturally spawning hatchery and natural spring Chinook salmon in the Wenatchee Watershed* (WDFW and NOAA); 200303900.
- *Yakima/Klickitat Fisheries Project (YKFP) - Monitoring and Evaluation* (Joint project with Yakima Nation and WDFW). Project ID 199506325
- *Policy/Technical Involvement and Planning in the Yakima/Klickitat Fisheries Project (WDFW);* Project ID 199506425.

Downstream migrant abundances or adult escapements for primary populations are currently estimated for a substantial portion of Columbia Basin primary populations. Many of these projects are made possible with non-BPA funding (Table 1). While these projects contribute to the framework and are considered part of the match for the funding requested through this proposal, the actual funding amounts were not available for inclusion in Section 8 of the proposal form.

Project history (for ongoing projects)

New Project, not applicable

Proposal biological objectives, work elements, and methods

The initial goal of the framework is to identify at least one primary population for each listed species within each MPG for juvenile and adult abundance and productivity monitoring. Primary populations are those deemed most important for recovery by the TRTs. The terms "Core" populations and "Major" populations have been used in some regions to describe these populations. This goal may be modified in one or more ESUs at the recommendation of the respective TRTs. For example, the Interior Columbia Basin TRT recommends that all of the primary populations for spring chinook and steelhead in the Upper Columbia ESU be monitored. Most of the monitoring work will occur through projects funded outside of this proposal by BPA, other federal funds/federal agencies, state agencies, and tribes.

First year activities under this proposal include the development and refinement of the Salmonid Abundance and Productivity Monitoring Framework. This activity will determine which populations are of highest priority to receive juvenile and adult population monitoring across the Columbia Basin. A variety of approaches may be used to conduct population monitoring, depending on factors such as spatial distribution, life history diversity, monitoring feasibility, and current monitoring programs. These factors will be used to develop the specific monitoring plans for currently unmonitored primary populations identified for monitoring through the framework. Recognizing that some additional monitoring will be needed to reach our initial goal of monitoring juvenile and adult abundance and productivity for at least one primary population for each species in each MPG, this proposal includes funding to monitor juvenile abundance at two locations and adult abundance at one location. This monitoring is being scoped assuming rotary screw traps will be used to monitor juvenile abundances and spawning ground surveys (2 technicians) will be used to monitor adult abundances. However, work plans may be modified depending on the specific monitoring needs identified to meet these objectives.

Monitoring Questions

Abundance and productivity are the foremost parameters in the VSP criteria. This proposal seeks to monitor these parameters and answer the following questions:

1. What are the statuses and trends in adult and downstream migrant (smolt) abundance for ESA listed primary populations at MPG and ESU scales?
2. How well are primary populations meeting their downstream migrant abundance goals?
3. How well are primary populations meeting their freshwater productivity goals?

Objectives

1. Identify all primary populations for listed species in each MPG in each ESU and evaluate their feasibility as populations where all of the biological objectives outlined in the proposal can be met. Select candidate populations for monitoring.
2. Monitor adult abundance (escapement) for at least one primary population for each listed species in each MPG in each ESU where juvenile abundance monitoring is also conducted.
3. Monitor downstream migrant (smolt) abundance for at least one primary population for each listed species in each MPG in each ESU.
4. Monitor productivity expressed as downstream migrants per spawner for at least one primary population for each listed species in each MPG in each ESU where juvenile and adult abundance monitoring are also conducted.

Work elements (tasks) and methods

1. Development of Salmonid Abundance and Productivity Monitoring Framework
Refine the concept for a statewide plan to monitor and evaluate VSP criteria relating to juvenile and adult abundance and productivity for listed salmonids as described in the Forum Recommendations to Salmon Recovery Regions. Integrate the statewide plan with regional recovery plans.

Methods. Development of the Framework will focus on the VSP criteria of juvenile and adult abundance and productivity status attributes. The framework and these attributes will be developed through the Forum. Primarily technical staff from WDFW, will develop the framework with periodic evaluation by the Forum Fish Subcommittee, made up of Washington and Oregon state, tribal, and federal biologists and the broader FORUM. Tasks for this work are as follows:

1.1 Complete the identification of all ESA-listed primary populations within MPGs and ESUs, downstream migrant and adult monitoring sites, and other attribute information (Table 1).
- 1.1.1 Consult with TRTs to determine and finalize primary populations within MPGs.
- 1.1.2 Consult with monitoring entities to finalize attribute information.

1.2 Determine monitoring gaps identified in the framework.
- 1.2.1 Initially, gaps will be determined based on the goal of monitoring at least one primary population for each species in each MPG. It is proposed that

identified primary populations receive monitoring for both downstream migrants and adults.

1.2.2 Additional primary populations may be identified for monitoring on either a long-term or as part of a rotating panel design as determined by the Forum, TRTs, and regional recovery plans.

1.3 Prepare a specific monitoring plan for each primary population identified in Task 1.2.1.

1.4 Prepare a white paper describing the Salmonid Abundance and Productivity Monitoring Framework as developed in Tasks 1.1 and 1.2 above.

2. Fabricate two rotary screw traps

This work element is being developed with the assumption that two new downstream migrant monitoring sites will need to be established based on the analysis completed in Task 1.2.1. This work task may be modified based on monitoring plans developed in Task 1.3.

Fabricate two pontoon barges and assemble two rotary screw traps to measure juvenile abundance in two yet to be named rivers in the middle/upper Columbia or Snake River basins. Purchase four travel trailers for remote site work stations.

Methods.

WDFW will construct and assemble two screw trap double pontoon barges outfitted with barge decks, trap supporting gear and winches, live box, work stations, anchor winches and other gear. Five or eight foot diameter screw cones will be purchased and installed in the traps as necessary to trap downstream migrants for the sites identified in Task 1.2.1. We will also purchase up to four lightly used travel trailers for field offices as needed at sites identified in Task 1.2.1.

3. Operate two rotary screw traps for listed species monitoring

This work element is being developed with the assumption that two new downstream migrant monitoring sites will need to be established based on the analysis completed in 1.2.1. This work task may be modified based on monitoring plans developed in Task 1.3.

Methods.

Rotary screw traps will be located at the lowest feasible site relative to the distribution of the target populations in order to provide a near equal probability that all members of the population are subject to capture in the trap. Traps will be installed prior to commencement of downstream migration and fished until the end of the migration. For the purposes of this proposal, we assumed the trapping period would be from mid-January through July, which would generally include migration timing for both eastside and Westside migrants (Volkhardt et al. 2005). However, the trapping period would be modified based on requirements for trapping target populations identified in Task 1.2.1.

Captured migrants will be anesthetized, bio-sampled, and examined for marks (Seiler et al. 2003). Groups of downstream migrants were batch marked with either a partial fin clip or bismark brown dye (14 ppm for 1.5 hrs) and released upstream of the trap to assess

trap efficiency (Seiler et al. 2001). Dye marks are used for newly emerged fry migrants for instantaneous (single fishing period) efficiency tests. Partial fin clips are used with larger (>55mm) migrants for either instantaneous efficiency tests or for stratified designs that incorporate the same mark for multiple releases in a given time stratum (e.g. 1 week).

4. Analysis of field data and development of smolt production estimates
Analyzes field data to estimate downstream migrant production for listed species monitored at two locations identified in Task 1.2.1.

Methods. Estimating downstream migrant production is done in two steps. The first step involves estimating or interpolating catch for periods when the trap did not fish. The second step involved estimating the capture rate or trap efficiency. Since trap efficiencies may change in relation to stream flow (Seiler et al. 2003, Chang and Gillianant 2003) a stratified experimental design is proposed, where juveniles are batch marked with a unique mark every few days to one week. The population estimates obtained using this type of experimental design are often referred to as a stratified Petersen or Darroch estimate (Darroch 1961, Arnason et al. 1996, Bannahaka et al 1997, Plante et al. 1998).

Analysis of variance or a non-parametric test (e.g. Kolmogorov-Smirnov two-sample test) will be used to pool data into homogeneous period for population estimates (Schwarz and Taylor 1998). Final estimates will be made using software developed by Bjorkstedt (2000) with later modifications (Bjorkstedt 2005) for smolt population estimates call DARR (Darroch Analysis with Rank Reduction) or with Stratified Population Analysis Software (SPAS) developed by Arnason et al (1996). Annual report will provide annual estimate of smolt yield with estimates of variance for each species trapped, migration timing, and mean length frequency of outmigrants over the trapping period (e.g. Volkhardt et al. 2005).

In addition to estimating downstream migrant production, estimates will be compared with targets developed for "Properly Functioning Habitat Conditions" (PFC), or other conditions representing recovery as determined by the TRTs. The Ecosystem Diagnosis and Treatment (EDT) model, or other models, will be used to estimate smolt production at the measured annual parent brood escapement levels for PFC conditions. Annual smolt production from all sites included in the framework will be compared to these production "targets" to annually estimate the percent of PFC target achieved.

5. Collect escapement information for currently unmonitored listed populations
Conduct spawner surveys to estimate escapement for populations identified in Task 1.2.1. For the purposes of this proposal, it is assumed that a single population will be monitored using a randomized spatially balanced probabilistic survey design using two field technicians for three months. The actual number of populations monitored will depend on manpower efficiencies and measurement techniques that will be identified when monitoring needs are assessed through the framework. The final approach used to estimate escapement may build upon existing infrastructure to provide a more precise estimate than the general approach outlined herein (e.g. mark-recapture).

Methods. Escapement data will be collected a randomized, spatially balanced probabilistic survey design. Since only a portion of the total spawning habitat is sampled using this approach, the distribution of spawners must be know to avoid biasing the sample and estimate. The survey site sample will be drawn from the Salmonscape database (http://wdfw.wa.gov/mapping/salmonscape/index.html). It is likely that the spawning distribution changes from year to year depending on stream flow and other conditions and is not fully understood; therefore, the set of potential survey sites will be drawn from both the "known" and "presumed" distribution of the species. A forty site sample will be drawn with the assistance of the EPA office in Corvallis, OR. It is anticipated that 10 to 30 two kilometer long reaches will be surveyed weekly or bi-weekly (the total number will be dependent on site logistics and streamflow patterns). The unused sample sites will be held in reserve in case resampling is necessary if one or more selected sites cannot be surveyed due to access issues, safety, or other problems.

Surveys will begin at the start of the spawning period and continue weekly or bi-weekly until spawning is completed. Spawning nests (redds) will be counted, flagged, and their position identified using GPS. If satellite reception is unavailable, a hipchain or tape measure will be used to locate the redd relative to a known location. In addition to redds, live fish and carcasses will be counted. At a minimum, carcasses will be sampled for tags, mass marks, and percent spawning success (females). Since tagging, marking, or other studies relative to the downstream migrant trapping operations may also be occurring on the population, carcasses may be sampled for pertinent information relative to these studies as well.

A supplemental survey will be performed following a peak streamflow event to determine the upstream extent of the spawning distribution. This information will be used to guide the expansion of survey data to estimate escapement and to aid researchers in refining survey designs in the 2nd and 3rd year of the study.

6. **Analysis of field data and development of escapement estimates**
Analyzes field data to estimate escapement for one primary population identified in Task 1.2.1.

Methods. Field data will be summarized by survey interval over the spawning period. Since FY2007 represents the first year for estimating escapement for the population, analysis will include post-priori evaluation of the survey and supplemental data to evaluate inclusion of stratification in the design. Potential stratification designs may include stream order (Strahler), sub-basins, above/below partial barriers, inside/outside preferred spawning habitats, and other situations. Analysis of variance or non-parametric tests may be used to determine appropriate stratified designs ($\alpha = 0.05$) if necessary.

Total redd production will be estimated by expansion of the mean redd density found over the survey season. Variance of redd estimates for un-surveyed reaches is estimated by multiplying the variance of the mean redd density by the square of the un-surveyed reach length. The variance of total redd production is estimated by the sum of the estimates for un-surveyed reaches. Total escapement is estimated by the estimated

number of females per redd and the reciprocal of the proportion of females in the spawning population from applicable peer-reviewed or agency literature for the population or species. The variance of the escapement estimate is estimated using the delta method (Goodman 1960).

7. Develop annual freshwater productivity estimates
Develop annual freshwater productivity estimates for monitored species (juveniles and adults) included in the Columbia River Basin portions of the Salmonid Abundance and Productivity Framework. Evaluate annual freshwater productivity estimates with respect to productivity targets developed by TRT's.

Methods. Productivity is estimated by the estimate of downstream migrant production divided by parent brood escapement as estimated in Work Elements 4 and 6, and from other downstream migrant and adult monitoring sites listed in the framework. As habitat quantity and quality improve, a concurrent increase in productivity is expected. However, since the number of downstream migrants produced each year is also a function of density (e.g. Beverton and Holt), the use of productivity as a measure of salmon recovery must factor out the influence of escapement on the number of smolts produced. We advocate accomplishing this by comparing annual estimates of productivity against targets developed through evaluation of PFC, or other conditions reflecting recovery as determined by TRTs. The EDT model, or other modeling approaches used by the TRTs, would determine downstream migrant production based on PFC freshwater habitat conditions at observed escapement levels. Annual estimates of the percent PFC target achieve would be generated for all monitored populations in the framework.

8. Information Transfer

Annual estimates of juvenile abundance, escapement, productivity, and percents of juvenile abundance and productivity targets achieved will be available through the Natural Resources Information Portal (http://www.swim.wa.gov/). The data will be maintained on the Wild Salmon Population Monitoring web site (http://wdfw.wa.gov/fish/wild_salmon_monitor/), and the estimates will also be available through StreamNet (http://www.streamnet.org/).

Facilities and equipment

A team of WDFW scientists will lead the development of the Salmonid Abundance and Productivity Monitoring Framework. Computer leasing will be required during framework development.

For juvenile trapping no major facilities are required. Office space will be provided through the use of travel trailers at remote sites. Locating the travel trailers may require a lease with a private landowner and provision of power, water, and other services. Juvenile trapping sites in the lower portion of various basins often require a landowner

willing to allow access and the anchoring of traps. WDFW has excellent working relationships with most landowners and has always obtained permission for suitable trap sites.

Equipment needed to capture fish includes two rotary screw traps outfitted with winches and cable to anchor traps. Both trap cones will be purchased, but trap frames and pontoon barges to support the traps will be constructed by WDFW. The initial purchase/construction of these traps would be a one-time investment.

Two pick-up trucks will be used to access trap sites, transport fish upstream for trap efficiency tests, and access stream reaches for spawning ground surveys. Crane services will be required to install the traps in the streams to be monitored.

References

Ames, J., and D.E. Phinney. 1977. Puget Sound summer-fall chinook methodology; escapement goals, run size forecasts, and in-season run size updates. Washington Department of Fisheries Technical Report 29, Olympia, WA.

Arnason, A. N., C. W. Kirby, C. J. Schwarz, and J. R. Irvine. (1996). Computer analysis of data from stratified mark-recovery experiments for estimation of salmon escapements and other populations. *Can. Tech. Rep. Fish. Aquat. Sci.* 2106: vi+37 p. http://www.cs.umanitoba.ca/~popan/

Beidler, W.M., and T.E. Nickelson. 1980. An evaluation of the Oregon Department of Fish and Wildlife standard spawning fish survey system for coho salmon. Oregon Department of Fish and Wildlife Information Report Series 80-9, Portland, OR.

Bannehaka, S.G., R.D. Routledge, and C.J. Schwarz. 1997. Stratified two sample tag-recovery census of a closed populations. Biometrics 53: 1212-1224.

Bilby, R.E., W.J. Ehinger, C. Jordan, K. Krueger, M. McHenry, T. Quinn, G. Pess, D. Poon, D. Seiler, and G. Volkhardt. 2004. Evaluating watershed response to land management and restoration actions: intensively monitored watersheds (IMW) progress report. Submitted to the Washington Salmon Recovery Funding Board, July 2004.

Bjorkstedt, E. 2000. DARR (Darroch analysis with rank reduction): A method for analysis of stratified mark-recapture data from small populations with application to estimating abundance of smolts from outmigrant trap data. NOAA-NMFS Southwest Fisheries Science Center. Administrative Report SC-00-02. 28 pp. http://santacruz.nmfs.noaa.gov/files/pubs/00116.pdf

Bjorkstedt, E. 2005. DARR 2.0: Updated software for estimating abundance from stratified mark-recapture data. NOAA-TM-NMFS-SWFSC 68. 21pp. http://santacruz.nmfs.noaa.gov/files/pubs/00439.pdf

Cheng, Y.W., and M.P. Gillinant. 2004. Statistical analysis of the relationship among environmental variables, inter-annual variability and smolt trap efficiency of salmonids in the Tucannon River. Fisheries Research 70 (2004) 229-238.

Darroch, J. N. 1961. The two-sample capture-recapture census when tagging and sampling are stratified. Biometrika 48:241-260.

Goodman, L.A. 1960. On the exact variance of products. Journal of the American Statistical Association. 55:708-713.

Hilborn, R., B.G. Bue, and S. Sharr. 1999. Estimating spawning escapement from periodic counts: a comparison of methods. Can. J. Fish. Aquat. Sci. 56: 888-896.

Mobrand, L.E., J.A. Lichatowich, L.C. Lestelle, and T.S. Vogel. 1997. An approach to describing ecosystems performance "through the eyes of salmon". Canadian Journal of Fisheries and Aquatic Sciences 54: 2964-2973.

Moussalli, E., and R. Hilborn. 1986. Optimal stock size and harvest rate in multistage life history models. Canadian Journal of Fisheries and Aquatic Sciences 43: 135-141.

Plante,N., L.P. Rivest, G. Tremblay. 1998. Stratified capture-recapture estimation of a closed population. Biometrics 54:47-60.

Schwarz, C. J., and C. G. Taylor. 1998. Use of the stratified- Petersen estimator in fisheries management: estimating the number of pink salmon (Oncorhynchus gorbuscha) spawners in the Fraser River. Canadian Journal of Fisheries and Aquatic Sciences 55:281-296.

Seiler, D., G. Volkhardt, and L. Kishimoto. 2001. 1998 Cedar River sockeye salmon fry production evaluation. WDFW Fish Prog Sci Div Rpt #FPA 01-13. 30 p.

Seiler, D., G. Volkardt, and L. Kishimoto. 2003. Evaluation of downstream migrant salmon production in 1999 and 2000 from three Lake Washington tributaries: Cedar River, Bear Creek, and Issaquah Creek. WDFW Fish Prog Sci Div Rpt #FPA 02-07.

Volkhardt, G., S. Neuhauser, P. Hanratty, L. Kishimoto, and L. Peterson. 2004. IMW 2005 Progress Report: Appendix A. 2004 Juvenile Salmonid Production Evaluation and Adult Escapement. WDFW Fish Prog Sci Div Rpt #05-14.

Key personnel

NAME	TITLE	FTE
Jennifer Shefler	Fish Science Division Mgr	In kind
Jim Scott	WDFW Chief Fish Scientist	In kind
Greg Volkhardt	WSPE Unit Leader (acting)	In kind
To be hired	F & W Research Scientist 1	0.75
Casey Baldwin	F & W Research Scientist 1	In kind

The Fish Program Science Division Manager is responsible for contract management and budget oversight. The Chief Fish Scientist will provide oversight on development of the Salmonid Abundance and Productivity Framework. The WSPE Unit Leader (acting) will have overall management responsibility for the project and develop the downstream migrant monitoring elements of the framework. The "as yet unhired" research scientist will develop the escapement monitoring elements of the Framework. The other research scientist (Casey Baldwin) will provide technical assistance on Interior Columbia Basin monitoring project designs.

Other personnel include fish and wildlife biologists (2.25 FTEs) for data analysis and field supervision, scientific technicians (8.5 FTEs) to assemble and operate smolt traps and conduct spawning ground surveys, and WDFW construction shop staff (0.9 FTEs) for screw trap fabrication.

Resumes

Jennifer S. Shefler

Education:

Bachelor of Science, Fisheries, University of Washington. 1981

Current Position:

WA Department of Fish and Wildlife (22 years)
Fish Program / Science Division Operations Manager (6 years)

POSITION OBJECTIVE:

This position supervises the operations of the Science Division and its units, including performance fulfillment and evaluation, administrative assignments, personnel actions, and policy implementation; it is responsible for division budget management, ensuring budget projection and allotment completion, and spending limit compliance. Manages contracts budgets and provides oversight of deliverables and ensures compliance with Federal policies as required by Federal law.

FINANCIAL DIMENSIONS:

This position directly controls a biennial budget of $13,275,931 for the Science Division. The revenue sources and amounts are:

GFS:	$ 3,007,172
WFS:	$ 145,210
Other:	$10,123,549

PRINCIPLE RESPONSIBILITIES:

- Provide contract and budget management and oversight for the Science Division, including development of allotments/expenditure plans and tracking/amending expenditures to meet contract and agency objectives.

- Provide professional management and policy guidance on operational issues to the division.

- Develop and ensure accountable expenditures of budget, including equipment and training.

James B. Scott, Jr.
Chief Fish Scientist
Washington Department of Fish and Wildlife
600 Capitol Way N, Olympia, WA 98501
Ph: 360-902-2736; e-mail: scottjbs@dfw.wa.gov

Education

M.S., Fisheries, University of Washington 1982
B.S., Fisheries, University of Washington 1980

Professional Experience

Mr. Scott joined the Washington Department of Fish and Wildlife (WDFW) in 1999 to lead the newly created Fish Science Division. His primary area of expertise is biometrics, including computer simulation and analytical models of biological systems. This expertise has been applied in a variety of applications in domestic and international forums. He served as co-chair of the Pacific Salmon Commission Chinook Technical Committee from 1991 through 2001, and was a technical advisor for the renegotiation off the Pacific Salmon Treaty in 1999. Since joining WDFW, his work has focused on developing procedures to evaluate the risks and benefits of artificial production and developing recovery plans for listed species of salmonids. As manager of the Science Division, comprised of over 130 FTEs, he has the responsibility of assuring that the production and management of fish resources by WDFW is grounded on a sound scientific basis.

Example Publications:

Scott, J.B., C.R. Steward, and Q.J. Stober. 1983. The effects of urban nonpoint source pollution upon stream fish population dynamics. TAFS 115: 555-567.

Scott, J.B., Jr. 1990. Design of fishery sampling programs. In. P. Knudsen (editor), "14th Northeast Pacific Pink and Chum Workshop", pages 10-13. Washington State Department of Fisheries.

Puget Sound Salmon Stock Review Group. 1992. Assessment of the status of five stocks of Puget Sound chinook and coho as required under the PFMC definition of overfishing. Pacific Fishery Management Council. 113pp. (co-author)

Scott, J.B. 1980. The distribution and abundance of juvenile salmonids in the Nisqually River from spring to midsummer. Final Report, FRI-UW-8102. University of Washington, Fisheries Research Institute. 57pp.

Greg Volkhardt
Washington Department of Fish & Wildlife
600 Capitol Way N.
Olympia, WA 98501-1091
(360) 902-2779

Project Role

Project management, Framework development lead – downstream migrant elements.

Education

B.S., Fisheries, Humboldt State University, Magna cum Laude

Biographical Information

Mr. Volkhardt is the acting unit leader for the WDFW Wild Salmon Production Evaluation Unit. This group currently monitors downstream migrant production at 16 sites for 38 species in Washington and adult escapement for 9 populations. He leads the fish abundance monitoring on Washington's Intensively Monitored Watershed Project. Mr Volkhardt supervises a team of biologists that analyze salmonid population monitoring data, estimate fish abundances and their precision, as well as prepare reports and contract documents. He is co-chair of the Governor's Forum on Monitoring Salmon Recovery and Watershed Health's Fish Sub-Committee and is the lead author on the PNAMP Fish Sampling Protocols for Scoop and Rotary Screw Traps.

Mr. Volkhardt has over 20 years experience in assessing salmonid presence and abundance at various life stages using equipment and techniques including snorkeling, electrofishing, and a variety of netting and trapping gear types. He has also conducted and integrated fish and habitat assessments, and has developed habitat/fish productivity relationships for coho and chinook salmon in Washington.

Publications

Volkhardt, G.C., D.E. Seiler, S.L. Johnson, B.A Miller, and T.E. Nickelson. *In review*. Rotary screw traps and scoop traps: measuring juvenile anadromous salmonid production in rivers and wadeable streams. *in* Johnson, D.H., B.M. Shrier, J. O'Neil, J. Knutsen, J.N. Pearsons, T.A. O'Neil, B. Roper, and X. Augernot (eds). Fish Monitoring Protocols.

Volkhardt, G., S. Neuhauser, P. Hanratty, L. Kishimoto, and L. Peterson. 2004. IMW 2005 Progress Report: Appendix A. 2004 Juvenile Salmonid Production Evaluation and Adult Escapement. WDFW Fish Prog Sci Div Rpt #FPA 05-14

Seiler, D., G. Volkhardt, L. Peterson, L. Fleischer, S. Neuhauser, P. Hanratty, and L. Kishimoto. 2004. 2003 juvenile salmonid production evaluation and adult escapement: Intensively Monitored Watersheds (IMW) annual report. WDFW Fish Prog Sci Div Rpt #FPA 04-09.

Volkhardt, G., P. Topping, L. Fleischer, T. Miller, S. Schonning, D. Rawding, and M. Groesbeck. 2005. 2004 Juvenile salmonid production evaluation report: Green River, Wenatchee River, and Cedar Creek. WDFW Fish Prog Sci Div rept #FPA 05-13.

Seiler, D., G. Volkhardt, and L. Kishimoto. 2003. Evaluation of downstream migrant salmon production in 1999 and 2000 from three Lake Washington tributaries: Cedar River, Bear Creek, and Issaquah Creek. WDFW Fish Prog Sci Div Rpt #FPA 02-07.

Casey Michael Baldwin
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EDUCATION

Utah State University, Logan, UT 84322. 1998. M.S. Fisheries.
Adams State College, Alamosa, CO 81140. 1995. B.S. Biology, minors-Chemistry and Geology

RECENT RELEVANT WORK EXPERIENCE

Washington State Department of Fish and Wildlife

Title: Research Scientist I **Supervisor:** Craig Busack (360) 902-2765
Starting-Ending Dates: March, 1998-Present

Duties and Responsibilities (March 2003-Present): Lead complex and potentially controversial technical analyses of habitat-salmonid productivity relationships that are a key component of multi-jurisdictional efforts to complete watershed and recovery plans in Eastern Washington. Assisted with analysis and writing sections of the assessment for Methow, Okanogan, Upper Middle Mainstem, Asotin, Tucannon, Walla Walla, and Lower Snake Subbasin Plans as well as the Upper Columbia Salmon Recovery Plan. Participate on Interior Columbia Technical Recovery Team (ICTRT). Worked as part of the ICTRT to determine abundance, productivity, spatial structure and diversity requirements for Viable Salmonid Populations throughout the Interior Columbia Basin. Lead project to survey small streams for spawning steelhead. Participate on Upper Columbia Regional Technical Team to assist with evaluating technical merit of protection and restoration projects, as well as developing monitoring strategies and implementation of the Upper Columbia Salmon Recovery Plan.

Salmonid Habitat-Productivity Analysis: Develop, refine, and apply quantitative models that relate aquatic habitat characteristics to the productivity of salmonid populations. Organize and conduct workshops with stakeholders and biologists from tribal, federal, state and local governments to collect and collate information on the aquatic habitat of rivers. Evaluate the effectiveness of proposed management actions on aquatic habitat and fish populations using sophisticated simulation models, analyze the data using stock-recruit analysis, EDT and other tools to identify escapement objectives consistent with current, historical and Properly Functioning Conditions for habitat. Objectively present the results of potentially controversial and sensitive analyses in reports and in oral presentations to agency staff, watershed planning groups and scientific conferences.

JOURNAL PUBLICATIONS

Polacek, M.C., C.M. Baldwin, and K.N. Knuttgen. *Accepted with revisions, 2005.* Status, Distribution, Diet, and Growth of Burbot in Lake Roosevelt, Washington. Northwest Science.

Baldwin, C.M., J. G. McLellan, M. C. Polacek, and K. Underwood. 2003. Walleye predation on hatchery releases of kokanees and rainbow trout in Lake Roosevelt, Washington. North American Journal of Fisheries Management 23: 660-676.

Baldwin, C. M., D.A. Beauchamp, and C. P. Gubala. 2002. Seasonal and diel distribution and movement of cutthroat trout from ultrasonic telemetry. Transactions of the American Fisheries Society .

Baldwin, C. M., D.A. Beauchamp, and J. J. VanTassell. 2000. Bioenergetic assessment of temporal food supply and consumption demand by salmonids in the Strawberry Reservoir food web. Transactions of the American Fisheries Society 129:429-450.

Beauchamp, D.A., C. M. Baldwin, and J. L. Vogel. 1999. Estimating diel, depth-specific foraging opportunities with a visual encounter rate model for pelagic piscivores. Canadian Journal of Fisheries and Aquatic Sciences. Supplement 1. 56:128-139.