Puget Sound Chinook Salmon Recovery Plan

MONITORING AND ADAPTIVE MANAGEMENT PLAN

VOLUME III

DRAFT

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APPENDIX A

MASTER IMPLEMENTATION MONITORING SCHEDULE

This document consists of a series of tables representing each of the regional strategies from the Puget Sound Chinook Salmon Recovery Plan, and the actions/tasks that must be accomplished to move those strategies forward. Benchmarks for progress or completion of each item (depending upon what needs to be done) are set for each strategy. Triggers are set to ensure that policy discussions occur when a critical event (or inaction) occurs and has the potential to derail progress on a strategy.

The tables include the following regional strategies:

A. Habitat Strategies:
    1. Protection of Existing Physical Habitat and Habitat-Forming Processes
    2. Protection and Restoration of the Nearshore, Puget Sound and Pacific Ocean
    3. Water Quantity – The Strategy for Achieving and Protecting Instream Flows[1]
    4. Water Quality Strategies
    5. Forests and Fish and Salmon Recovery
    6. Prosperity of Farming
B. Harvest Management
C. Hatchery Management
D. H-Integration of Habitat, Harvest and Hatchery Strategies and Actions
E. Monitoring & Research Actions

There are currently no implementation strategies in the Recovery Plan to address the impacts of hydropower, ocean conditions, climate change, predation and disease. These additional listing factors will require further discussion and work in the coming year(s) to address them. In addition, some of the Habitat strategies listed above require further refinement to create specific actions to carry out the strategies listed. (For example, the are no actions listed for the Nearshore strategies). This MAMA Plan has attempted to identify where further attention and work is needed as part of the adaptive management process.

It is presumed that the tables set forth in the Master Implementation Monitoring Schedule (MIMS) will eventually be placed into a database that will be viewable on the web by the public and by those parties working to implement the Recovery Plan. It is proposed in Volume II of this Plan that the MIMS will be maintained by the Puget Sound Partnership on behalf of the Recovery Council during 2008 while the

[1] Recovery Plan Instream Flow Strategy is found on pages 394-400.

transition of salmon recovery work to the Partnership occurs. Thereafter, it may make sense for another agency or organization to maintain the MIMS database to ensure implementation of the Recovery Plan.

APPENDIX A

MASTER IMPLEMENTATION MONITORING SCHEDULE

RECOVERY PLAN STRATEGY:

A. Protection of Existing Physical Habitat and Habitat-Forming Processes

1. Regional Strategy

Actions/Tasks (from RP with refinements)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
a. Create a Pilot Study clarifying the long-term results of existing protection programs on habitat; identify gaps relative to salmon population and ESU recovery needs.	Pilot study complete by December, 2008.	Assessment Methodology must be complete by December 2007. (Note: Plan says 2006 at page 373).	Habitat Monitoring Program (See below)	Shared Strategy/Puget Sound Partnership staff
b. Assess protection programs across entire ESU based on Pilot Study model. Determine gaps and develop and implement locally acceptable solutions. (?)	All ESU's completed within 5 years (by December, 2012)	More than 6 watersheds are not underway by December 2010.	Same as above.	Puget Sound Partnership? TBD
c. Update critical areas ordinances according to statutory deadlines.	All tasks completed by statutory deadlines:	Repeal, significant amendment or court interpretation that diminishes the habitat protection set forth in existing	Same as above.	Cities and Counties within the ESU are each responsible for compliance with

Actions/Tasks (from RP with refinements)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
Group I – Jefferson, Clallam, King, Kitsap, Pierce, Snohomish, Thurston, and Whatcom counties and cities. *Next Update Due (7 yrs.):* Group II – Island, Mason, San Juan and Skagit counties and cities. *Next Update Due (7yrs):*	Group I – DUE NOW (Dec. 2004) Ordinances to Planning Commission/Council by Sept. 2011; adopted by Dec. 1 2011. Group II – DUE NOW (Dec. 2005) Ordinances adopted by Dec. 1 2012.	regulations. Legislative adoption process not started by June 2010.		the Growth Management Act (GMA). CTED Monitors compliance under GMA.
Update shoreline master programs by statutory deadlines. Group I – City of Port Townsend, City	All tasks completed by statutory deadlines: Group I – DUE NOW	Trigger 1 - Repeal, significant amendment or court interpretation that diminishes the	Same as above.	Ecology pre-approves Master Programs and monitors compliance

Actions/Tasks (from RP with refinements)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
of Bellingham, City of Everett, Snohomish County and Whatcom County (Dec. 1 2005) Group II – King County and all cities of 10,000 population or greater. (Dec. 1 2009) Group III – Clallam, Jefferson, Kitsap, Pierce, Thurston and Whatcom counties and cities, plus the cities within King, Snohomish counties. (Dec 1, 2011) Group IV – Island, Mason, San Juan, and Skagit counties and cities. (Dec. 1, 2012)	Benchmark for others – Programs sent to DOE for approval 4-6 months prior to the adoption deadline.	habitat protection set forth in existing regulations. Trigger 2 - Legislative adoption process not started by June of preceding year for any city or county.		under SMA. Individual cities and counties are responsible for complying with the SMA.
c. Create Outreach and Education Programs	Draft a program by Fall of 2008	No action by summer of 2008		Puget Sound Partnership
d. Implement voluntary protection programs (land trusts, TDRs, PDRs other?)				??
e. Create new incentive programs for habitat protection (e.g., tax incentives, permitting priorities; lower fees, etc.)				??

Actions/Tasks (from RP with refinements)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
f. Consider ecosystem and VSP criteria in issuing HPA permits				DFW
g. Manage 2 million acres of state-owned aquatic lands to benefit salmon recovery				DNR
h. Manage aquaculture programs to benefit salmon recovery.				DOH, DNR, DFW
Manage federal regulatory programs in a way that considers and protects ecosystem processes during permitting process (e.g., 404 Permits, Rivers and Harbors Act permits; FERC permits);	Complete by December 2012.			US Army Corps of Engineers

RECOVERY PLAN STRATEGY:

B. Protection and Restoration of the Nearshore, Puget Sound and Pacific Ocean

Result A: Protection of key habitats and freshwater and saltwater processes from physical or biological disruptions

Strategies/Actions/Tasks	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
1A. Improve existing protection programs and continue implementation through local, state, tribal and federal governments				
1B. Evaluate the effects of existing protection programs and their contribution to salmon recovery.				

1C. Coordinate protection actions at the sub-basin or appropriate scale to ensure levels of protection needed for salmon recovery are met.				
1D. Implement, evaluate and change strategies and actions where necessary.				

Result B: Creation of additional estuarine habitat and processes in the major river deltas

Actions/Tasks (from RP)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
B1. Add significant new estuarine habitat and restore processes in and near estuarine deltas where salmon populations first encounter tides and saltwater.				
B2. Conduct further technical assessments and/or build public support where local communities are not ready for restoration.				
B3. In highly urbanized deltas, target short term investments in actions that support ESU recovery by providing migratory corridors. Determine long-term restoration goal and				

subsequent strategies.				
B4. Preserve future opportunities in all major river deltas.				

Result C: Restoration of marine shorelines (including freshwater inputs) outside of major deltas where there is a significant benefit for population/ESU viability

Actions/Tasks (from RP)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
C1. Improve our understanding of what are 'enough' places and the 'right' places to restore outside of major deltas in order to support ESU viability.				
C2. Restore habitats (where processes are intact) or key processes where such restoration is linked to a likely population response.				

Result D: Protection and restoration of fresh- and saltwater quality

Actions/Tasks (from RP)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
D1. Implement protection and restoration strategies in areas prone to low dissolved oxygen levels.				
D2. Implement protection and restoration strategies in areas prone to high temperatures.				
D3. Implement strategies that prevent toxic chemicals, including those borne in stormwater, from entering Puget Sound, and restore contaminated areas.				

Result E: Protection and restoration of freshwater quantity

Actions/Tasks (from RP)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
E1. Use Department of Ecology's Instream Flow program and other processes to protect and restore freshwater quantity				

Result F: Reduction of the risk and damage from catastrophic events

Actions/Tasks (from RP)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
F1. Prevent Oil Spills				
F2. Prepare for Oil Spills				
F3. Response to Oil Spills				
F4. Determine expected results from existing efforts for hazardous waste and nonhuman catastrophic event response.				

Result G: Reduction of the risk and damage from non-indigenous species and other alterations to food webs

Actions/Tasks (from RP)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)

G1. Complete studies that advance the knowledge of the following issues: o Non-native species impact on habitats and food webs used by salmon. o Hatchery fish inputs that impact salmon through competition, predation, and alterations in community structures o Relationship between key food web species and salmon o Fish and shellfish harvest effects on community structures that affect salmon. o Other ecological/biological issues of critical bearing on reaching salmon recovery goals				
G2. Develop management strategies supporting salmon recovery based on the results of research into the topics listed above and other key topics				

Result H: Overall improvement of ocean ecosystems

Actions/Tasks (from RP)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
H1. Assess impacts of US Ocean Action Plan on salmon recovery				

Result H: Incorporation of ocean condition factors into Puget Sound strategies

Actions/Tasks (from RP)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
I1. Use population ocean survival information from harvest management and marked wild fish (e.g., in Skagit studies) to refine Puget Sound strategies and actions based on what we can count on for survival during the ocean phase of the Chinook life cycle.				
Analyze the robustness of restoration strategies under different assumptions of ocean conditions. Adjust the strategies to be successful, regardless of what is assumed for ocean survival.				

RECOVERY PLAN STRATEGY:

C. Water Quantity – The Strategy for Achieving and Protecting Instream Flows[2]

Instream Flow Strategy – Part 1: Establish fish-protective instream flows to prevent future degradation

Actions/Tasks (from RP with refinements)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
1E. Establish Instream flow rules in watersheds that don't have regulatory flows, using ecosystem-based methodology:	All tasks completed by the end of 2008	(see task-specific triggers below)	1. DOE instream flow program budget – science, outreach, enforcement, etc. 2. DOE instream flow program staffing	Dept of Ecology

[2] Recovery Plan Instream Flow Strategy is found on pages 394-400.

1A1. Nooksack – WRIA 1	Completion in 2007	NA	(see above)	(see above)
1A2. Lower Skagit/Samish – WRIA 3	Completion in 2008	Draft rule in 2007	(see above)	(see above)
1A3. Stillaguamish – WRIA 5	COMPLETED in 2006	N/A	NA	NA
1A4. Skokomish – WRIA 16	Litigation status update 2Q 2007	N/A	(see above)	(see above)
1A5. Quilcene/Snow – WRIA 17	Completion in 2008	Draft rule fall 2007	(see above)	(see above)
1A6. Elwha/Dungeness – WRIA 18	Completion in 2008	Draft rule fall 2007	(see above)	(see above)
1A7. Lyre/Hoko – WRIA 19	N/A - out of ESU?	N/A – out of ESU	(see above)	(see above)

Actions/Tasks (from RP with refinements)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
1F. Update existing (as of June 2005) instream flow rules (other than those in 1A above) using ecosystem-based methodology – start with watersheds with critical flow needs for salmon, then volunteer watersheds, then all	All rules evaluated for ecosystem-basis and updated, incorporating current flow-VSP science, as needed by 2017	1. Rule review framework approved 2009 2. Review of 60% of rules completed by 2011 3. All rules reviewed by 2014 4. All necessary rule revisions in RCW by 2017	1. DOE instream flow program budget – science, outreach, enforcement, etc. 2. DOE instream flow program staffing	Dept of Ecology
1B1. San Juan Islands – WRIA 2	TBD (completed no later	TBD	(see above)	

	than 2017)			
1B2. Lower Skagit (except for Samish– WRIA 3	TBD (completed no later than 2017)	TBD		(see above)
1B3. Upper Skagit – WRIA 4	TBD (no later than 2017)	TBD	(see above)	
1B4. Whidbey Island – WRIA 6	TBD (no later than 2017)	TBD	(see above)	
1B5. Snohomish – WRIA 7	TBD (no later than 2017)	TBD	(see above)	
1B6. Lake Washington – WRIA 8	TBD (no later than 2017)	TBD	(see above)	
1B7. Green River – WRIA 9	TBD (no later than 2017)	TBD	(see above)	
1B8. Puyallup/White – WRIA 10	TBD (no later than 2017)	TBD	(see above)	
1B9. Nisqually – WRIA 11	TBD (no later than 2017)	TBD	(see above)	
1B10. Chambers Creek – WRIA 12	TBD (no later than 2017)	TBD	(see above)	
1B11. Deschutes – WRIA 13	TBD (no later than 2017)	TBD	(see above)	
1B12. Kennedy-Goldsborough – WRIA 14	TBD (no later than 2017)	TBD	(see above)	
1B13. Kitsap – WRIA 15	TBD (no later than 2017)	TBD	(see above)	

Actions/Tasks (from RP with refinements)	Benchmark	Trigger(s)	Monitoring Focus	
1G. Update all instream flow rules based on salmon status and trends monitoring information	All rules revised to reflect status and trends data and	1. Review framework approved 2018 2. All necessary rule	1. DOE instream flow program budget – science, outreach, enforcement, etc.	Dept of Ecology

	anticipated significant ecosystem factors (e.g., climate change)	revisions completed by 2027, with maximum time lag from prior rule revision 10 years 3. Updates may also be necessitated by clear instances where instream flows are causing chronic problems linked to decline in VSP status	2. DOE instream flow program staffing	

Instream Flow Strategy – Part 2: Advance the science relating instream flow to salmon recovery

Actions/Tasks (from RP)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
2A. Develop and implement prioritized research agenda for improving understanding of flow-VSP relationships				
2A. Convene expert scientists for input on state of knowledge, research priorities, and monitoring emphasis	2Q/3Q 2007	Meeting agenda and objectives by April 15; participants confirmed by May 1	WQS Meeting agendas and member participation; TRT engagement	Water Quantity Subcommittee; TRT
2B. Develop summary of state of knowledge discussion and share with watersheds at fall 2007 workshop in prep for PEP development	3Q/4Q 2007	Draft for circulation to experts one month after workshop	WQS Meeting agendas and member participation; TRT engagement	Water Quantity Subcommittee; TRT
2C. Develop 10 year (?) prioritized research agenda and share with watersheds at fall 2007 workshop in prep for PEP development	3Q/4Q 2007	Draft for circulation to experts one month after workshop	WQS Meeting agendas and member participation; TRT engagement	Water Quantity Subcommittee; TRT

2D. Meeting with Dept of Ecology /WDFW water program staff to review 2B and 2C products and identify implications for rule making	1Q 2008	Scheduled for one month after the PEP workshop (Flow Strategy Part 3)	WQS Meeting agendas and member participation; TRT engagement; agency engagement	Water Quantity Subcommittee; TRT
2E. Provide written summary and presentation of research results, advances in knowledge, emerging scientific uncertainties, and recommendations for revising research agenda	Annually starting 4Q 2008	Research leads report verbally on status of work annually starting 2Q 2008	Research progress reports; funding availability	Water Quantity Subcommittee; TRT; research leads

Instream Flow Strategy – Part 3: Implement programs to ensure instream flows support salmon recovery in each watershed and the nearshore

Actions/Tasks (from RP)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
3A. Develop and implement instream Flow Protection and Enhancement Programs in each watershed				
3A. Identify the key flow management decision-makers for each watershed and invite them to PEP workshop	3Q 2007	Watershed-by-watershed list complete by May 30; workshop date and site chosen invites sent by June 30	WQS Meeting agendas and member participation	Shared Strategy/Puget Sound Partnership; Water Quantity Subcommittee
3B. Hold PEP workshop for entities that have a role in protecting and enhancing instream flows for the purpose of achieving salmon recovery goals.	4Q 2007	Gantt chart timeline and milestones by May 15; final agenda July 30	WQS Meeting agendas and member participation	Shared Strategy/Puget Sound Partnership; Water Quantity Subcommittee
3C. Work with watersheds or other appropriate instream flow group to set goals for instream flow conditions on key salmon streams	4Q 2007/1Q 2008	Follow-up meetings with all watersheds take place by March 2008	Involvement of parties identified in Task 3A; schedules for setting goals	Watersheds or other appropriate instream flow group; Shared Strategy/Puget Sound Partnership; Water Quantity Subcommittee; Carol and Margee; TRT
3D. Work with watersheds or other appropriate instream flow group to develop spatially and temporally explicit flow management strategies	2008-2009	Draft instream flow strategies by June 2009	Involvement of parties identified in Task 3A; schedules for developing strategies	Watersheds or other appropriate instream flow group; Shared Strategy/Puget Sound Partnership; Water Quantity Subcommittee;

				Carol and Margee; TRT
3E. Formalize watershed-specific PEP incorporating instream flow goals/objectives and strategy	1Q 2010	PEPs proposed to decision-body by September 2009	Involvement of parties identified in Task 3A; schedules for developing strategies	Watersheds or other appropriate instream flow group; Shared Strategy/Puget Sound Partnership; Water Quantity Subcommittee; Carol and Margee; TRT
3F. Incorporate instream flow goals and strategies into Comprehensive Plans, water system plans, dam operations manuals, FERC licenses, HCPs, stormwater manuals, and other appropriate management guidance through regular update processes	2010-2017+	Schedule of key decision processes; review of draft decision content; deadlines for commenting	Update schedules for key regulations and other vehicles; content of decision processes affecting instream flows	Decision process parties; Shared Strategy/Puget Sound Partnership; Water Quantity Subcommittee
3G. Update PEP goals and strategies based salmon status and results of status and trends monitoring	All PEPs revised to reflect status and trends data and anticipated significant ecosystem factors (e.g., climate change)	TBD	Scheduling of PEP effectiveness evaluations; participation of key parties; adaptation of PEPs	Watersheds or other appropriate instream flow group; Shared Strategy/Puget Sound Partnership; Water Quantity Subcommittee; Carol and Margee; TRT

D. Water Quality Strategies

Actions/Tasks (from RP with refinements)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
Effectively implement water quality protection tools at the local, state, and federal levels				Dept. of Ecology; Phase I and II

				NPDES jurisdictions
Ensure water quality by adhering to the policies of the Clean Water Act:				
1. Establish and periodically review and revise water quality standards				Dept. of Ecology
2. Perform water quality assessments to identify water bodies that are not meeting the standards, and to list such water bodies every two years				Dept. of Ecology, Phase I and II NPDES jurisdictions; Others
3. Develop cleanup plans ("total maximum daily loads," or TMDLs) for listed water bodies				Dept. of Ecology

Note: There are no specific strategies here other than those shown. This needs to be further scoped by DOE as to what benchmarks and triggers should be set.

RECOVERY PLAN STRATEGY:

E. Forests and Fish and Salmon Recovery:

Context

- Forest management governed by Northwest Forest Plan, Forest and Fish Rules/HCP, Clean Water Act, Federal Indian Law…
- Maturity and composition of forest cover and riparian vegetation are key factors in the health of freshwater aquatic habitat
- Forestlands managed sustainably within an ecosystem management framework can make important economic and ecological contributions to the region
- To date forest management and salmon recovery planning have moved forward in separate venues

Actions/Tasks (from RP with refinements)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)	Status/Issues

1. Sustain a regional focus on coordinating the appropriate linkages between specific watershed groups and forest land managers	(Task-specific, see below)	(Task-specific, see below)	(Task-specific, see below)	(Task-specific, see below)	
1A. Establish regional partnerships with watershed councils, USDA Forest Service, WDNR, Washington Forest Practices Board, large and small timberland owners and other forest managers to ensure effective information sharing and coordination of management actions	Each watershed and key timberland managers agree on the appropriate mechanism(s) (e.g., point person, conference, workshop, etc) to ensure effective coordination	2008 check-in with watersheds and timberland managers on the status of their coordination and recommendations for improvements		Partnership; Recovery Council; watersheds; timberland managers	
1B. Incorporate forest management actions into watershed 3-year Work Plans to ensure effective coordination and sequencing	2008 Updates to 3-year work plans incorporates forest management actions	Work plan update guidance to watersheds specifies need to incorporate forest management actions; outreach to forest managers		Recovery Council; watersheds; timberland managers	

Actions/Tasks (from RP with refinements)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)	Status/Issues
2. Sustain an economically viable forestry industry to help keep forested areas as forests	Convene discussions with timberland managers to highlight actions and solutions that support the timber industry and salmon recovery	2008 check-in with timberland managers		Partnership; Recovery Council; watersheds; timberland managers	

Actions/Tasks (from RP with refinements)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)	Status/Issues
3. Ensure strong linkages to timberland managers who aren't covered by the NWFP or Forest and Fish Rules to ensure their salmon-recovery contributions are supported	Convene discussions with timberland managers to highlight actions and solutions that support the timber industry and salmon recovery	2008 check-in with timberland managers		Partnership; Recovery Council; watersheds; timberland managers	

Actions/Tasks (from RP with refinements)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)	Status/Issues

4. Develop and implement monitoring and research strategies that provide an integrated picture of habitat conditions at the watershed scale and could advance knowledge across the region.	Discussion and consensus on key research priorities; joint funding proposals to the Forest Practices Board and other funders	2008 check-in with timberland managers			Existing programs that should be incorporated include the Forest and Fish Adaptive Management Program, the Intensively Monitored Watersheds for Effectiveness Monitoring, and Watershed-specific monitoring programs that encompass forest management activities and/or ecological questions that are influenced by conditions on timberlands
5. Track the progress toward implementation of recommendations developed from monitoring and research programs including the Forest and Fish adaptive management	Discussion with F&F adaptive management program manager and or action implementer; annual review and assessment of	Continuation of existing tracking mechanism if it exists or creation of one is it doesn't			

program	reporting results				

RECOVERY PLAN STRATEGY:

F. Prosperity of Farming and Salmon: [Millie Judge]

Actions/Tasks (from RP with refinements)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
Strategy 1 – Protecting and Restoring Fish Habitat				Identify Owner PSP?
Develop joint farm/watershed groups to identify goals and means for habitat enhancement and restoration projects.				
a. Identify objectives for the farm community contribution based on local science and recovery needs;				
b. Identify a means for jointly identifying priority areas where projects are needed and provide support to individual land owners who take the initiative to implement specific projects; and				
c. Set a series of benchmarks to measure progress and identify areas for revised planning.				
Provide more flexibility for farmers that want to engage in salmon				

recovery actions.				
Increase state funding for programs to lease land and share costs of restoration activities. (e.g. CREP)				
Broaden the WA CREP program to cost-share a wider range of environmental projects.				
Promote conservation and restoration programs for small family forestlands.				
Increase funding for the Forest Land Enhancement Program.				
Encourage the development and implementation of stewardship plans on all Puget Sound farms and small family forest lands.				
Strategy 2 - Tools for Keeping Farmland in Farming				
Provide more state and federal funding for PDR programs.				
Prioritize the allocation of funds for best effect.				
Ensure that local planning efforts work to preserve salmon friendly farmland and forestland.				
Ensure that farmers can undertake ditch maintenance activities to protect drainage and salmon.				

Strategy 3 – Tools for Improving Farming's Bottom Line				
Provide economic development support for the agricultural community.				
Remove current, fiscally based regulatory impediments to agriculture.				
Promote local, fish-friendly agricultural and forestry products in the marketplace (e.g., Puget Sound Fresh brand).				

RECOVERY PLAN STRATEGY:

G. Research, Monitoring and Adaptive Management : [?] Draft

Actions/Tasks (from RP with refinements)	Benchmark	Trigger(s)	Monitoring Focus	Task Owner(s)
Strategy 1 – Implemetn Primary VSP and Habitat Monitroing Program	Recovery Council Decide on Plan to Endorse 1-4			
Adult Monitoring Implemented with specified protocol and SOP				
Identify Juvenile population to monitor				
Implement Habitat Monitroing Design system to track where monitoring of master sample has				

occurred				
Strategy 2				
Strategy 3				
Strategy 4				
Strategy 5				

RECOVERY PLAN STRATEGY:

HARVEST MANAGEMENT

BACKGROUND

The Puget Sound Salmon Recovery Plan did not have a complete plan for adaptive management although the Plan deferred a number of important habitat, harvest, hatchery, and H-integration issues to the adaptive management process. This is the first draft of the harvest component of the regional adaptive management plan Master Implementation Monitoring Schedule.

Table 1. ESU harvest strategies, benchmarks, and triggers.

Strategy	Benchmarks	Triggers to Act
1. Ensure sufficient spawners to maintain stability of all populations based on current habitat conditions and productivity	• All 22 populations in the ESU are protected by fishing exploitation rate (ER) ceilings based on abundance and natural productivity thresholds by 2010.	• All populations have a designated Low Abundance Threshold by 2010 Associated Action: Populations that are predicted to fall below a minimum number of spawners ("low abundance threshold", LAT) trigger a extraordinary conservation measures that must be met by all Washington Treaty and Non-Treaty fisheries to achieve a very low exploitation rate ("critical exploitation rate ceiling," CERC) set for that population • All populations have a designated Upper Management Threshold by 2010 Associated Action: Populations where abundances are predicted to be above the LAT but not at a level that would provide harvestable surplus ("upper management threshold", UMT) trigger fishery management regimes consistent with rebuilding exploitation rates (RER) set for each population. • Rebuilding exploitation rates (RER) based on estimates of current abundance and productivity identified for all "low risk" populations

		by 2010, where data are adequate. • Where harvest management units contain multiple populations, the abundance thresholds of the weakest populations apply to the management unit.
	• Total fishery mortality (landed catch and non-landed mortality) is accounted for each year	• Analysis of all sources of fishery mortality is reported in an Annual Chinook Management Report the includes o Description of planned and actually fisheries, including actions taken to respond to changed circumstances o Catch and non-landed mortality o Statistical sampling used for catch and escapement o Description of predicted versus actual exploitation rates • WDFW and tribes monitor catch in all fisheries annually • WDFW and tribes jointly maintain and update catch databases annually
	• Population abundances are predicted each year that incorporate the best estimates of uncertainty (measurement error, management error, and population variability) • Escapement assessed annually	• Estimates available annually before the Pacific Fishery Management Council meetings and reported in the subsequent Annual Chinook Management Report • Annual Chinook Management Report includes o Description of predicted versus actual escapement o Statistical sampling used for catch and escapement o Status of actual escapements relative to LATs and UTs • Estimates of uncertainty reviewed and revised every 3-5 years
	• Technical tools for assessing fishery mortality are improved with new information	• Annual Chinook Management Report includes o Annual analysis of expected versus actual catch o Biannual analysis of predicted and actual exploitation rates based on the FRAM harvest model

	• Technical tools for assessing fishery mortality are improved with new information (Continued).	• Every 5 years o Revision of cohort reconstruction and exploitation rates estimated from coded-wire tags (CWT) or other mark analysis methods o Comparison of CWT with FRAM model estimates of exploitation rates to identify biases and correct the model predictions o Update description of methods and assumptions
	• Technical tools for assessing population abundance, productivity, and diversity are improved with new and better information	• Data collecting is improved, including o Implementation of coded-wire tagging of hatchery fish for all ESU “low risk” populations (or other mark analysis of equal or greater accuracy and precision where appropriate, by 2010 o Description of age structure, sex ratios, size and hatchery-wild ratios of spawners for all ESU “low risk” populations by 2010 • Population parameters used in spawner-recruit analyses to generate ERs and spawner abundance thresholds (LAT, UMT) are updated and revised every 5 years • Forecast methods are reviewed and updated as necessary every 5 years or sooner if concerns arise
	• Enforce fishery rules and regulations • Evaluate effectiveness of regulations	• Annual fishing regime based on population abundance thresholds is established each year at the Pacific Fishery Management Council and North of Cape Falcon fishery management forums. • Annual fishing regime must comply with the guidelines of the Pacific Salmon treaty to conduct fisheries based status of key indicator stocks • Tribes promulgates and enforces regulations in their respective “usual and accustomed areas” • WDFW promulgates and enforces regulations on non-tribal and recreational fisheries • Annual Chinook Management Report reports compliance

		rates and other relevant enforcement statistics for treaty and non-treaty fisheries reported in the Annual
2. Allow populations to rebuild as other constraining factors are alleviated by limiting mortality rates on individual populations to levels that are consistent with achieving ESU viability	• Identify RERs for all populations by 2010[3]	• Identify total RERs based on spawner-recruit analyses for all ESU "low risk" populations where data are sufficient by 2010[2] • Populations that are predicted to be above the UMT may be subject to directed fisheries at exploitation rates that meet the long-term ESU viability criteria.
3. Provide harvest opportunity on other species while rebuilding the ESU	• Fishing opportunities occur for other Pacific salmon species while preventing further declines of Chinook populations due to harvest	• Assess mortality of Chinook salmon from incidental catch on other species annually • Implement program to assess alternative technologies to minimize incidental catch of Chinook salmon in other salmon fisheries by 2010.
4. Adhere to principles of the Puget Sound Salmon Management Plan (PSSMP) and other legal mandates pursuant to *U.S v Washington* and the terms of the Pacific Salmon Treaty (PST) and its annexes	• Harvest management occurs as a government-to-government process among Tribal, state, and federal managers • Annual fishing regime is established each year following procedures in PSSMP. • Preseason forecasts and management agreements occur annually • In-season modifications of harvest regulations follow procedures specified in PSSMP	• Tribal, state, and federal governments are represented in harvest management process, such as the Pacific Fishery Management Council and North of Cape Falcon fishery management forums • Annual Chinook Management status reports per the requirements of the PSSMP • Co-managers maintain a system for recording, transmitting, cross-indexing, and storing fishery regulations • U.S. and Canadian representatives meet each year to exchange information and discuss issues as required under the PST • Joint technical committee reports provide information to assess whether PST guidelines and annex provisions for harvest allocation and conservation objectives are being met

[3] Recovery exploitation rates (RER) may be developed by a variety of analyses. As used here, total RERs refer to rates developed by using CWT data to quantify total mortality and spawning ground escapement and age information to develop spawner-recruit relationships.

	U.S. and Canada manage fisheries consistent with the terms of the PST annexes.	

How Will We Get the Information Needed to Measure Progress?

Table 2. Implementation Monitoring of ESU Harvest Actions

Action	Indicator	Tool	Frequency	Locale
Set exploitation rate (ER) ceilings based on abundance and natural productivity thresholds	+/- LAT +/- UMT +/- CERC +/- RER	• Pacific Salmon Treaty (PST) and annexes • Fishery resource management plans (RMP) • Annual Fishing Regime	5-7 years Annual	ESU, individual populations, and northern (British Columbia and Alaska) fisheries
Monitor fisheries	• Projected & actual catch • Distribution of fishing effort and patterns • Estimates of uncertainty • Stock composition	• Annual Chinook Management Report • Pacific Fishery Management Council reports • 5-year RMP review • PST reports • Pilot studies	Annual Annual 5 years 1-3 years Annual	ESU, British Columbia, Alaska, Ocean
Forecasts population abundances prior to fish season	• Publication of pre-season forecast	• Annual Chinook Management Report (subsequent year) • Annual PFMC reports	Annual	ESU
Improve technical tools		• 5-year RMP review	5-7 years	

Enforce fishery rules and regulations	• Publication of rules & regulations • % compliance		Annual	
Harvest management occurs as a government-to-government process	• Attendance of tribal, state, and federal representatives • % deadlines exceeded for PSSMP, PST, and PFMC reports • Annual fishery agreements, PST and PFMC reports			
In-season modifications of harvest regulations follow procedures specified in PSSMP	• Number of Fishery Advisory Board legal challenges • Documentation of changes to preseason plans	Annual Chinook RMP Management Report		

Table 3. HARVEST Effectiveness monitoring

Parameter	Indicator	Tool	Frequency	Locale	Cost
Exploitation Rate/Catch (adult equivalent catch + escapement).					
Non-landed fishing mortality					
Age					
Size					
NOR spawner abundance					
Hatchery spawner abundance					
Total Fishery Mortality					

"Adult equivalent catch" is the probability that a fish at any age will spawn without fishing mortality.
"Total fishery mortality" means catch + incident mortality (discards, drop off mortality, drop-out mortality with nets, and estimated predation related to fish that are caught.

RECOVERY PLAN STRATEGY: HATCHERY MANAGEMENT

Table 4 – ESU Hatchery actions, implementation benchmarks and triggers.

ESU Hatchery Actions	Benchmarks	Triggers
1. Promote recovery of indigenous populations to levels necessary for viable ESU and that can sustain harvest	• Implement ESU hatchery actions (Table 2) by 2012	• Implement actions 1-3 by 2010
2. Re-establish and sustain natural production in watersheds that no longer have indigenous populations but where natural production is possible	• Implement ESU hatchery actions (Table 2) by 2012	• Implement actions 1-3 by 2010
3. Provide for fisheries in areas where impacts of natural populations can be kept below acceptable levels	• Implement ESU hatchery actions (Table 2) by 2012	• Implement actions 1-3 by 2010
4. Identify clearly defined goals and objectives for all hatchery programs consistent with ESU wide strategies (Table 1)	• Goals and objectives for all Chinook salmon hatchery programs identified by 2010 • Develop contingency plans with triggers for initiating hatchery programs for all indigenous populations at immediate risk of extinction by 2009.	• All Chinook salmon hatchery programs have identified goals by 2008. • Each hatchery has clearly defined numerical objectives for each stage of artificial production (brood stock selection, collection, spawning, incubation, rearing, and release) by 2009 • Identify indigenous populations at immediate risk of extinction by 2007 • Co-manager and NMFS technical workgroups formed to develop contingency plans by 2010
5. Implement the production strategy[4] that best meets the goals and objectives for the watershed	• Production strategies for all Chinook salmon hatchery programs implemented	• All the hatchery programs in the watershed have been reviewed and changed, if necessary, to be consistent with watershed goals and ESU-wide

[4] The two possible hatchery production strategies are 1) integrated production and 2) isolated production. These refer to the demographic relationship of the hatchery produced fish to the natural population, where integrated production refers to intentional interbreeding of hatchery and naturally produced fish and isolated production

	by 2008	recovery strategies by 2008 • New hatchery programs are designed and reviewed for consistency with goals and strategies before being implemented.
6. Implement fish culture guidelines for producing healthy fish with the desired characteristics that are consistent with goals and objectives of the program	• Fish culture guidelines exist and are implemented for all Chinook salmon hatchery programs by 2010 • Fish culturists are trained in the guidelines and necessary tasks by 2010	• Each hatchery program has operating guidelines to achieve the objectives of each stage of artificial production (brood stock selection, collection, spawning, incubation, rearing, release, and fish health) for that program by 2009 • Each hatchery has contingency guidelines for rare events (e.g., too few brood stock, epizootics, facility failures) by 2009 • Continuing education program that includes instruction in the guidelines and associates task is available for fish culturists by 2009
7. Evaluate results of hatchery program efforts.	• Each hatchery program has a monitoring and evaluation plan and is implementing it by 2012 • Co-managers conduct systematic review of hatchery programs every 5-7 years beginning in 2010 • Independent, programmatic review of Chinook hatchery programs occurs every 10-12 years	• Each hatchery program has a draft implementation and effectiveness monitoring plan by 2010 • Each hatchery program implements a record keeping system for the monitoring plan by 2011 • Each watershed has implemented a population monitoring plan by 2010 • Co-managers have developed a process for aggregating information collected by the individual hatchery programs for use in analysis by 2009 • Co-managers have developed analytical tools to risks (e.g., listing factors such as genetic impacts, competition & predation, brood stocking mining) and benefits of hatchery programs by

refers to hatchery fish that are not intended to interbreed in the wild with natural fish. For more detail see the hatchery resource management plans (Puget Sound Treaty Tribes and Washington Department of Fish and Wildlife 2004, Washington Department of Fish and Wildlife and Puget Sound Treaty 2004).

		2009 • WDFW and tribes secure funding for independent review
8. Incorporate results of evaluation into a decision making framework for changing and prioritizing hatchery actions	• A decision-making process is in place for making and reporting intra-annual, annual, or long-term changes in hatchery programs by 2012.[5]	• Consistency with Puget Sound Salmon Management Plan • Revision and implementation of Co-managers' Fish Disease Policy by 2007 (intra-annual process) • Development and implementation of co-manager genetic guidelines for fish transfers by 2009 (intra-annual process) • Annual evaluation of Future Brood Document and recommendations of Hatchery Scientific Review Group (or other independent science groups established under #4). • Co-manager and National Marine Fisheries Service review and revision of hatchery and genetic management plans (HGMPs) every 5 years or as required by changes in programs • Co-managers develop reporting mechanisms for reporting decisions and analyses to the public by

[5] See Table 3 and accompanying text in the hatchery resource management plans (Puget Sound Treaty Tribes and Washington Department of Fish and Wildlife 2004, Washington Department of Fish and Wildlife and Puget Sound Treaty 2004) for more detail.

		2010.

How Will We Get the Information Needed to Measure Progress?

Table 2. Implementation Monitoring of ESU Hatchery Actions (see Table 2 for descriptions).

Action	Indicator	Tool	Frequency	Locale	Cost
1. Identify goals and objectives	% programs to meet benchmarks (TRIGGERS?)	HGMP	With required revision of ESA Section 4(d) and 7 authorization (5-7 years?)	All programs	
2. Implement best production strategy	% programs to meet benchmark (TRIGGERS?)	HGMP	With required revision of ESA Section 4(d) and 7 authorization (5-7 years?)	All programs	
3. Implement guidelines	% programs to meet benchmark (TRIGGERS?) OR Qualitative score (e.g., 1-5) on how well the guidelines are being implemented	Co-manager survey	Annual	All programs	
4. Evaluate programs	% programs to meet benchmarks (TRIGGERS?)	Co-manager survey	Annual	All programs	
5. Incorporate evaluation into decisions	% programs to meet benchmark (TRIGGERS?) OR Qualitative score (e.g., 1-5) on how well the guidelines are being implemented	• HGMP • Co-manager survey	Annual	All programs	

Table 3. Pre-release effectiveness monitoring at individual hatchery programs. This table does not include monitoring of environmental parameters such as water temperature, flow, oxygen levels, etc., which would be part of most hatchery monitoring programs.

Parameter	Indicator[6]	Tool	Frequency	Locale
Brood stock selection	• % desired brood stock	Genetic survey or tag/mark survey	5 years	All indigenous populations
Brood stock collection	• Number • Origin (hatchery or natural) • Entry timing • Age	Hatchery survey	Annual	All programs
Brood stock holding	• % Mortality • Ripeness	Hatchery survey	Annual	All programs
Spawning	• Number spawned by sex and method • Fecundity	Hatchery census Hatchery survey	Annual	All programs
Incubation	• % fertilization • % egg survival	Hatchery survey	Annual	All programs
Rearing	• % survival • growth rate • feed conversion	Hatchery survey	Annual	All programs
Release	• % survival	Hatchery survey	Annual	All programs

[6] These are possible indicators. The actual indicators, tools, and frequency need to be consistent with the specific numerical objectives for the program (see Table 2, Action #1).

	• release size • release date • release location			
Fish health	• Incidence of pathogens • Response to treatments	Fish health survey	Monthly? (CHECK THIS)	All programs

Table 4. Post-release effectiveness monitoring of hatchery programs. Note: These address the relationship of hatchery impacts on other objectives but the monitoring is not normally part of the domain of hatchery programs.

Parameter	Indicator[7]	Tool	Frequency	Locale
Post-release survival	• % survival to saltwater	• Trapping surveys in lower river • Surveys in nearshore or estuary	Annual	"Low risk" populations[8] that do not directly enter saltwater (minimum)
Watershed nutrient dynamics	• Number of carcasses planted • Disposition of carcasses planted • Change in stable C, N isotopes over time	• Stream surveys • Isotope monitoring	Determined by sampling plan	Watersheds where nutrient dynamics are a major limiting factor
Ecological interactions	• Ranking of risk[9] • % predation	• Risk assessment models • Predation surveys	Minimum of every 5 years	"Low risk" populations (minimum)
Adult homing	• % straying	• Marking & surveys	?	?
Contribution to fisheries	• % harvest mortality in different fishing areas	• Harvest monitoring and modeling	Annual	"Low risk" pops –min.
Abundance	• Natural-origin fish (NOR) escapement • Hatchery-origin fish (HOR) escapement to spawning grounds • Outmigrant production	• Escapement surveys • Marked hatchery fish • Smolt trapping/surveys	Annual	All populations

[7] These are possible indicators. The actual indicators, tools, and frequency need to be consistent with the specific numerical objectives for the program (see Table 2, Action #1) and importance of these parameters for the specific populations.
[8] "Low risk populations" refers to the populations that need to attain low risk viability criteria to recovery the Puget Sound ESU.
[9] Information on a variety of biological parameters will help these risk assessments, such as including size and age of hatchery and wild fish, rate of outmigration, size or age depended habitat preferences, and geographical and temporal overlap but none of these directly assess ecological interactions.

Productivity	• Adult recruits/spawner • Outmigrants/spawner • Lambda	• Calculated from abundance metrics	Annual	All populations
Diversity	• Proportion of NOR and HOR • Proportion of natural influence (PNI) • % sub-yearling outmigrants • Return & spawn timing	• Calculated from abundance metrics • Smolt trapping/surveys • Escapement surveys	Annual	All populations "Low risk" populations (minimum)
Spatial Structure	• Geographical spawning distribution • Rearing distribution	• Escapement surveys • Freshwater surveys • Nearshore surveys	Annual 5 years	"Low risk" populations (minimum)

RECOVERY PLAN STRATEGY: H-INTEGRATION

How Will We Know We Are Making Progress?

Table 5. ESU H-INTEGRATION OF STRATEGIES AND ACTIONS

Strategy	Benchmarks	Triggers to Act
1. Get the right participants Involve those with authority to manage salmon populations & authorities whose actions directly or indirectly affect salmon	• ESU has a comprehensive group of decision makers and stakeholders that can implement changes in management to benefit salmon • All watersheds have assembled a comprehensive group decision makers and stakeholders that can implement changes management to benefit salmon (i.e. "H-integration group")	• Regional group formed by 2007 • Identify priority watersheds to begin H-integration by 2007 • All watersheds have assembled H-integration groups by 2010

2. Get the participation right Design participation to acknowledge participants needs, incorporate their rights, and uses their ability to implement change.	• Participants have agreed upon common goals that reflect salmon recovery needs and community values • Each watershed has a trained H-integration facilitator • Participants use an agreed-to a process to examine, evaluate, and choose between suites of complementary actions that will achieve outcomes • Participants have identified a set of measurable outcomes across the H-sectors that describes when and what they want to achieve for these goals • Participants use a deliberate, iterative process of examining desired outcomes and analytical results of different suites of actions to choice between suites of actions.	• Completed in priority watersheds by 2008 • Completed in all watersheds by 2010
3. Get the right science • Use technical analyses that allow participants to understand the combined effects of all H-sector actions on salmon populations • Analyses meet scientific standards for data, analytical methods, and treatment of uncertainty; results are communicated accurately	• Participants have agreed on a set of analytical tools to gain a common understanding of how H-sectors interact to affect salmon • Tools are capable of examining and evaluating suites of different actions together and sequentially • Tools are revised and updated regularly • Each watershed has access to competent technical staff to assist with analyses • Analyses and reports are available to make timely decisions. • All analyses document sources of data, model structures, assumptions, outcomes, and accuracy and precision of estimates • Results of decisions are monitored	• Completed in priority watersheds by 2008; all by 2010. • Description of existing analytical tools, their assumptions, data requirements, advantages and disadvantages is available to watersheds by 2008. • The All-H-Analyzer model is revised to address weaknesses identified by scientific reviews by 2008. • Program to develop or refine tools has begun by 2008 • Available for priority watersheds by 2008; all by 2010. • Completed in priority watersheds by 2008; all by 2010. • Monitoring plan developed by 2008 • Initial monitoring plan implemented by 2009 • Reports available for all watersheds by 2010

How Will We Get the Information Needed to Measure Progress?

Table 6. Implementation Monitoring of ESU H-Integration Actions

Action	Indicator	Tool	Frequency	Locale	Cost
Salmon recovery H-integration groups formed	% of watersheds achieving benchmark	Recovery Council MAMA report	Annual	ESU, watershed	
Agree on common goals reflecting salmon recovery needs and community values	% of watersheds achieving benchmark	MAMA report	Annual	ESU, watershed	
Enlist trained H-integration facilitator	% of watersheds achieving benchmark	MAMA report	Annual	ESU, watershed	
Agree on an inclusive, iterative process of technical analysis and policy deliberation to examine, evaluate, and choose between suites of complementary actions across H-sectors that will achieve outcomes	% of watersheds achieving benchmark	MAMA report	Annual	ESU, watershed	
Identify set of measurable outcomes across the H-sectors that describes when and what to achieve to move towards goals	% of watersheds achieving benchmark	MAMA report	Annual	ESU, watershed	
Agree on set of analytical tools to gain a common understanding of how H-sectors interact to affect salmon	% of watersheds achieving benchmark	MAMA report	Annual	ESU, watershed	
Choose tools that are capable of examining and evaluating suites of different actions together and sequentially	% of watersheds achieving benchmark	MAMA report	Annual	ESU, watershed	
Revise and update analytical tools regularly	% of watersheds achieving benchmark	MAMA report	Annual	ESU, watershed	
Enlist support of competent technical staff to assist with H-integration analyses	% of watersheds achieving benchmark	MAMA report	Annual	ESU, watershed	
Conduct analyses and complete reports to make timely	% of watersheds achieving	MAMA report	Annual	ESU,	

decisions	benchmark			watershed	
Document sources of data, model structures, assumptions, outcomes, and accuracy and precision of estimates and analyses	% of watersheds achieving benchmark	MAMA report	Annual	ESU, watershed	
Monitor results of decisions	% of watersheds achieving benchmark	MAMA report	Annual	ESU, watershed	

APPENDIX B

INVENTORY OF CURRENT AND PLANNED MONITORING PROGRAMS FOR OF PUGET SOUND SALMON VIABILITY

Note: Monitoring in light grey shaded areas was proposed for state funding during the FY07-09 Legislative Session..

ESU	Major Population Group	WRIA	Target Species	Populations (primary pops[1] are in boldface)	Juveniles				Adults		
					Smolt Sites	Production/ Index[2]	Smolt Trapping Agency	Funding	Spawners (stocks)	Data Quality[3]	Fund Source
Puget Sound	North Sound	1 to 2	Chinook	**NF Nooksack** **SF Nooksack**	Nooksack	Index	Lummi	Tribal	NF/MF Nooksack SF Nooksack Samish/MS Nooksack	Very Good Very Good Poor	State General Fund State General Fund
	Whidbey Basin[4]	3 to 7	Chinook	Upper Skagit	Skagit	Production	WDFW	Federal (Dingall/ Johnson)	Lower Skagit MS/Tribs	Good	

[1] Primary populations are those that have a high significance and must achieve a low risk of not meeting viability criteria as identified in recovery plans (GSRO 2006).
[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] Primary populations have not been identified for the Whidbey Basin MPG; however, at least two to four populations will be needed at low risk status, at least one of which is an early-run population.

ESU	Major Population Group	WRIA	Target Species	Populations (primary pops[1] are in boldface)	Juveniles				Adults		
					Smolt Sites	Production/ Index[2]	Smolt Trapping Agency	Funding	Spawners (stocks)	Data Quality[3]	Fund Source
				Lower Skagit				50% Seattle PU 50%	Upper Skagit MS/Tribs	Very Good	
				Upper Sauk (early)					Lower Sauk	Good	
				Lower Sauk					Upper Sauk	Excellent	
				Suiattle (early)					Suiattle	Excellent	
				Cascade (early)					Upper Cascade	Excellent	
				NF Stillaguamish	Stillaguamish	Production	Stillaguamish	Tribal	NF Stillaguamish	Good	GFS
				SF Stillaguamish					SF Stillaguamish	Good	GFS
				Skykomish	Skykomish/	Production	Tulalip	Tribal	Skykomish	Good	GFS
				Snoqualmie	Snoqualmie				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	Sammamish - Bear Creek	Production	WDFW	King Co.	N Lk Washington Tribs	Good	King Cons Dist GFS
				N/A	Green-Duwamish River	Production	WDFW	SRF Board	Green R (Duwamish)	Good	90% State GFS/ 10% Fed (PST)

ESU	Major Population Group	WRIA	Target Species	Populations (primary pops[1] are in boldface)	Juveniles				Adults		
					Smolt Sites	Production/ Index[2]	Smolt Trapping Agency	Funding	Spawners (stocks)	Data Quality[3]	Fund Source
				N/A	Puyallup	Production	Puyallup	Tribal	Puyallup	Poor (total esc est)	State General Fund 50% / Tribal 50%
				White River (early)					White River Adult Trap	Good	GFS 10%/ Tribal 90%
									White River Spawner Surveys		GFS 50%/ Tribal 50%
				Nisqually	Nisqually	Proposed	WDFW	GF-S	Nisqually		GFS 50%/ Tribal 50%
	Hood Canal	16	Chinook	N/A	Hamma Hamma	Index	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%

ESU	Major Population Group	WRIA	Target Species	Populations (primary pops[1] are in boldface)	Juveniles				Adults		
					Smolt Sites	Production/ Index[2]	Smolt Trapping Agency	Funding	Spawners (stocks)	Data Quality[3]	Fund Source
				Dosewallips	Dosewallips	Proposed	WDFW	GF-S	Mid-Hood Canal/Dosewallips	Good	State General Fund (GFS) 90% / LLTK 10%
			Summer Chum	**Quilcene**					Quilcene	Good	GFS 100%
				Dosewallips	Dosewallips	Proposed	WDFW	GF-S	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[5]	LLK/HCSEG/ Port Gamble/ WDFW	USFWS (DOI) /Tribal/ State	Hamma Hamma	Good	GFS 100%
	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%

[5] 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.

ESU	Major Population Group	WRIA	Target Species	Populations (primary pops[1] are in boldface)	Juveniles				Adults		
					Smolt Sites	Production/ Index[2]	Smolt Trapping Agency	Funding	Spawners (stocks)	Data Quality[3]	Fund Source
			Summer Chum	**Jimmycomelately**					Jimmycomelately		NOSC 60% /GFS 40%
				Salmon/Snow					Salmon/Snow		NOSC 30% / GFS 70%

APPENDIX C

Summary of Effectiveness Monitoring Metrics for Regional Habitat Protection and Restoration Strategies

PROTECTION AND RESTORATION OF HABITAT – EFFECTIVENESS MONITORING				Scale	
Management questions	**Metrics**	**Indicators**	**Reporting Cycle**	**WS**	**R**
Are the implemented salmon recovery actions effectively addressing the listing/limiting factors identified in the Federal Register Notice and individual watershed plans? (Are actions supported by credible hypotheses)?	Percentage of actions supported by a detailed hypothesis that is based on credible science and includes expected physical habitat change, expected biological response, and a time frame to see each change.	Descriptive table organized by categories of restoration or protection actions that includes a description of expected physical/biological outcomes, timeframe for expected outcomes to be realized, and references that support expected outcomes and timeframe Trend line displaying % actions supported by a detailed hypothesis	Annual (or as hypotheses gain/ lose scientific credibility)	X	X
Are restoration actions effective?	Percentage of restoration actions that produced hypothesized physical habitat change within specified time frame.	Trend line displaying % restoration actions that produced hypothesized change.	Annual	X	X
Are protection actions effective?	Percentage of protection actions that preserve the habitat conditions and processes they are intended to preserve or protect future restoration options	Trend line displaying % protection actions that produced hypothesized effect			
Are the physical changes persisting?	% of effective actions where physical changes persisted	Trend line displaying % effective actions where physical changes persisted; For actions where change did not persist, include a reasoned description of why hypothesized changes did not persist and whether or not this is acceptable considering current habitat needs	Every 5 years		
What is the overall habitat protection and restoration effectiveness in the region?		Rate of habitat destruction versus rate of restored habitat	Annual	X	X

PROTECTION AND RESTORATION OF HABITAT – EFFECTIVENESS MONITORING				Scale	
Management questions	**Metrics**	**Indicators**	**Reporting Cycle**	**WS**	**R**
Is habitat carrying capacity increasing?	Percentage of existing habitat carrying capacity relative to potential capacity.	Trend line displaying % habitat carrying capacity relative to potential capacity	Every 5 years	X	X
Are watershed, nearshore/marine, and ocean habitat conditions improving for salmon in the ESU?	Sum of all metrics below.	Sum of all indicators.	Every 5 Years		
Is floodplain and in-river channel structure habitat improving?	% pool area Length channel edge Length natural bank Length stabilized bank Fine sediment load Substrate embeddedness Bed scour Stream width-depth ratio Pool-riffle ratio Thalweg profile Area side channels Area off-channel ponds	For all metrics in this table, trends lines will be reported over time	Annual* *(Based on rotational status and trends monitoring data collection cycle across the ESU)		
Is nearshore/marine and estuarine habitat improving?	Area tidal marsh Area pocket estuaries Area blind tidal channels % armored shoreline % feeder bluff Area covered by piers and docks Area eel grass Area shoreline vegetation		Annual		
Is riparian and in-river large woody debris (LWD) habitat improving?	Riparian area vegetated Area mature riparian forest LWD density LWD jam density % canopy cover		Annual		

PROTECTION AND RESTORATION OF HABITAT – EFFECTIVENESS MONITORING				Scale	
Management questions	**Metrics**	**Indicators**	**Reporting Cycle**	**WS**	**R**
Is habitat quality being negatively affected by sedimentation?	Fine sediment load Substrate embeddedness Water turbidity		Annual		
Are water quality parameters improving?	Water temperature # of identified chemicals at toxic levels Concentrations of Chemicals at toxic or lethal levels Dissolved oxygen Nutrient loads		Annual		
Are instream flow regimes improving?	Annual hydrograph (Peak flows and low flows) # road crossings Area impervious surface		Annual		
Are fish passage barriers improving?	Area of available spawning & juvenile rearing habitat.		Annual		

Note: The Xs in the right hand columns denote at which scales (WS = watershed; R = regional) these metrics will need to be reported.

Appendix D

Table 5. Overview of status of current effectiveness monitoring, needs, and gaps by recovery strategy.
Symbols: ● = on-going; ○ = none; ? = unknown.

Major Recovery Strategies & Tools		Existing Monitoring Programs	Questions Answered	Needs & Gaps
HABITAT : **Protect existing habitat**				
Federal, State & local Regulatory Programs **(CAO, SMA, GMA, 404, 401, Section 7, NPDES etc.)**	○		• **ESA Listing Factor 4.**	• **Regional programmatic evaluations with exp design (e.g. BACI design)** • **Local monitoring of specific objectives** • **San Juan Initiative is a pilot study on impact decisions that may**
Forest & Fish	●	**a) Forest & Fish CMER program: http://www.dnr.wa.gov/forestpractices/adaptivemanagement/** **b) Department of Natural Resources (DNR) Habitat Conservation Plan: http://www.dnr.wa.gov/hcp/**	**ESA Listing Factor 4** **Is Forest and Fish effective at addressing Riparian, passage, temperature limiting factors?**	
Farming & Salmon	○		**ESA Listing Factor 4** **Are Agricultrual programs effective** **CREP** **WPD** **Chemical & Sediment**	• **Regional programmatic evaluations with exp design (e.g. BACI design);** • **Local monitoring of specific objectives**
Federal land management & regulatory programs	●	**Aquatic and Riparian Effectiveness Monitoring Plan (AREMP):**	•	• **Integration of data from AREMP into other ar**

		http://www.reo.gov/monitoring/watershed/		
Nearshore strategy; state aquatic lands	**?**	• **Department of Natural Resources (DNR)** • **Puget Sound Nearshore Partnership (PSNERP)**	•	• **Integration of monitoring objectives and plan by PSNERP nearshore science team with obj salmon**
Individual watershed programs	**?**		•	• **Compilation and review of existing effectiven monitoring programs for protecting habitat i watersheds to identify gaps and priorities.**
Major Recovery Strategies & Tools		**Existing Monitoring Programs**		**Needs & Gaps**
HABITAT : **Restore habitat and habitat-forming processes**				
• **Forest & Fish**	●	**Forest & Fish CMER program**		
• **Farming & Salmon**	○		•	• **Regional programmatic evaluations with exp design (e.g. BACI design);** • **Local monitoring of specific objectives**
• **Federal land management programs**	●	**AREMP**		
• **Nearshore strategy; state aquatic lands**	**?**	• **DNR** • **PSNERP**	•	• **Integration of monitoring objectives and plan by PSNERP nearshore science team with obj salmon and local monitoring by cities, count**
• **Individual watershed programs**	●	• **Local entities** • **Intensively Monitored Watershed (IMW) Project**	•	• **Compilation and review of existing effectiven monitoring programs for protecting habitat i watersheds to identify gaps and priorities** • **Adoption and implementation of regional mo program develop through this plan** • **Review of statewide IMW network**

				• **Consider IMW for restoration and protection developed watersheds. This could be tied to evaluation of state regulatory programs (abo**
Water Quantity: Implement fish-protective in-stream flows				
Flow Protection & Enhancement Program (PEP)	○	**Department of Ecology**	•	• **Develop and implement effectiveness monito of the Instream Flow Protect and Enhanceme (PEP)**
Major Recovery Strategies & Tools		**Existing Monitoring Programs**		**Needs & Gaps**
Water Quality: **Protect & restore water quality**				
TMDL Program	●	**Department of Ecology: http://www.ecy.wa.gov/ PROGRAMS/wq/wqhome.html**	•	• **Integration of current monitoring for impaire TMDLs with needs of listed salmonids.**
NPDES Program	●	**Department of Ecology: http://www.ecy.wa.gov/ PROGRAMS/wq/wqhome.html (See also counties and cities)**	•	• **Implement water quality monitoring consiste NPDES permit requirements**
HARVEST: **Ensure sufficient spawners**				
• **Set minimum abundance thresholds & fishing exploitation rates**	●		•	• **Needs and gaps that would improve effectiv monitoring of harvest are outlined in the har this document**
• **Monitoring fisheries**	●		•	• **See Recovery Plan Harvest Section**
• **Make in-season fishing adjustments**	●		•	• **See Recovery Plan Harvest Section**
• **Enforce regulations**	●		•	• **See Recovery Plan Harvest Section**

HATCHERIES**: Manage hatcheries for recovery**				
• **Protect against extinction**	●	**Monitoring of hatchery programs by the WDFW and Puget Sound Treaty Tribes on the White River, North Fork Stillaguamish, Nooksack, Elwha, and Dungeness populations**		**See Recovery Plan Hatchery Section for more**

Major Recovery Strategies & Tools		Existing Monitoring Programs	Needs & Gaps
HATCHERIES**: (continued)**			
Reestablish populations where extirpated	○		• **Complete and implement monitoring plan for reintroductions into the Elwha River** • **Develop monitoring plan for reintroductions into the North Fork Skokomish River.**
Sustain natural production as habitat recovers	○	**Washington Department of Fish and Wildlife and the Puget Sound Treaty Tribes**	• **Regional programmatic evaluation of reproductive success in recovery hatchery programs**
Provide fishery where impacts are low	●	**Washington Department of Fish and Wildlife and the Puget Sound Treaty Tribes**	• **See Recovery Plan Harvest Section**
H-INTEGRATION:			
Integrate all Habitat, Harvest & Hatchery strategies, actions and decisions	○	• **Recovery Council?** • **Puget Sound Partnership?**	• **Regional programmatic evaluations with explicit statistical design (e.g. BACI design);**

APPENDIX E

PREDATION FACTOR

SUMMARY OF RESEARCH AND MONITORING OF KILLER WHALES

EASTERN NORTH PACIFIC SOUTHERN RESIDENT STOCK (aka SOUTHERN RESIDENT ORCA WHALES)

Research is necessary to better understand the effects of potential risk factors that have been linked to periods of decline in the Southern Residents. Study results will be an important resource for developing science-based management actions to address the threats. Many research tasks should involve repeated sampling efforts to monitor future trends and to assess the effectiveness of management actions. Monitoring is necessary to track the status of the population and the effectiveness of the conservation measures.

Note that the ranking of activities listed below does not imply an order of importance. The priority of each action, plus a cost and timeline for completion, appear in the Implementation Schedule. Research and monitoring will support an adaptive management approach, as new information is obtained, priorities can be adjusted. The NWFSC held a "Symposium on Southern Resident Killer Whales" in April 2006 to bring researchers together to present recent study results. The proceedings from the conference and a Draft Southern Resident Killer Whale Research Plan are posted on the NWFSC web page (http://www.nwfsc.noaa.gov/research/divisions/cbd/marine_mammal/marinemammal.cfm).

A. Monitor status and trends of the Southern Resident killer whale population.

A.1 Continue the annual population census.
Annual photo-identification surveys remain one of the most important activities involving Southern Resident killer whales. Counts are performed by the Center for Whale Research and provide a complete yearly inventory of the population dating back to 1974. Counts are conducted by boat primarily in and around the San Juan Islands during June and July, with supplementary information gathered whenever the whales can be observed during the remainder of the year. The surveys yield vital information on annual population changes and demographic parameters, such as sexual composition, age class structure, longevity, birth and survival rates, and reproductive performance of individual females. These data are crucial to determining population trends, analyzing threats, and studying population viability.

A.2 Maintain a current photo-identification catalog for the Southern Residents and expert staff able to photographically identify the whales.
The photo-identification catalog for the Southern Residents is an integral part of identifying individual whales during annual censuses and other encounters throughout the year, and should be maintained as a long-term resource. The Center for Whale Research has managed the catalog since 1976. It is equally important to keep at least one expert skilled in photographic identification of individual whales on the staff of the organization or agency holding the catalog.

A.3 Standardize the results of annual population surveys. Small discrepancies exist in the annual count results used by different agencies and organizations. The results should be reviewed and standardized dating back to the November 2006 153 NMFS 1970s to eliminate minor confusion among users. Refinement of data on births and deaths will improve population modeling and demographic analyses.

B. Conduct research to facilitate and enhance recovery efforts for Southern Resident killer whales.
Long-term studies of the Southern Residents have gathered unprecedented data on the individual whales in this small population. However, many important gaps in our understanding of these whales remain, and substantially more research is required to address critical questions about the biology and conservation of the population. Killer whales are inherently difficult to study for a variety of reasons, including their marine habits, large body size, intricate social structure, large geographic ranges, and long life span. In 2003, 2004, 2005, and 2006 funding was made available to expand the research and conservation of Southern Resident killer whales. Studies are needed to address some of the complex cause-and-effect relationships to determine the relative impacts of various extrinsic and intrinsic factors on Southern Resident whales. This research will necessarily require the application of new techniques, the use of more sophisticated and costly technology, the collection of larger sample sizes, and for some, the use of moderately invasive methods (e.g., tissue sampling, telemetry). Long-term commitments of funding and support will be needed to sustain much of this work. Intergovernmental coordination is desirable in these efforts (Task 5.1).

Outlined below are 11 of the most critical research tasks, with subtasks, that need to be addressed by future investigations of the Southern Resident population. For many of these tasks, studies should ideally be designed to identify both similarities and differences among the three commonly recognized Southern Resident pods: J, K, and L. Recent data have highlighted some interesting pod-specific demographic and distribution patterns, and future studies should be designed to identify factors that may be causing disproportionate changes in some pods. When appropriate, research results should be compared to similar data from other North Pacific killer whale populations, especially the Northern Residents and southern Alaskan residents, to gain a broader perspective on biological issues and risks to the Southern Residents. Studies of captive killer whales and other marine mammal species may also be useful, particularly on health-related issues, contaminants, and the development of techniques. For a number of topics, examination of archived data is recommended to compare past and present conditions.

B.1 Determine the distribution and habitat use of the Southern Residents.

The population inhabits an extensive geographic range that is currently known to extend from northern British Columbia to central California. Movements are relatively well known during the warmer months of the year when the whales regularly occupy the protected inland waters of Washington and southern British Columbia, but are very poorly understood when the animals visit the outer coast.

B.1.1 Determine distribution and movements in outer coastal waters.
November 2006 154 NMFS
One of the highest research priorities is to document the population's use of offshore areas, where only 34 sightings have been verified over a 33-year period. Considerable time is spent in this portion of the range, especially during the winter and early spring, with ranging patterns varying among pods. Information is needed on areas of regular occurrence, movement patterns, distances traveled offshore, habitat selection, and relationships with spatial/temporal occurrence of prey.

B.1.2 Improve knowledge of distribution and movements in the Georgia Basin and Puget Sound.
Much remains to be learned about distribution and movements in inland waters, especially for individual pods and matrilines. Such information will be useful for identifying interpod differences in range, diet, habitat use, and threats; changes in range use over time; and areas worthy of special protection.

B.2 Investigate the diet of the Southern Residents.
Many aspects of diet are poorly known for the population and require study. Such information will shed light on many vital issues, including potential contaminant sources and whether prey abundance is sufficient to support the population. Whenever possible, pod-specific and matriline-specific diet preferences should be identified.

B.2.1 Determine the diet of the Southern Residents.
Another urgent priority is to identify the year-round food habits of the Southern Residents in all parts of their range. Salmonids, especially Chinook, are generally thought to be important prey. However, prey selection likely varies both in time and space. Therefore additional dietary information is needed to confirm the relative importance of Chinook and to identify the contributions of other prey, including other salmon species, groundfish, herring, and squid. Information on preferred prey size, annual variation in diet, and prey selection by age and sex class of whale in relation to species availability is also of interest.

B.2.2 Determine the importance of specific prey populations to the diet.
Seasonal salmonid runs from particular river systems likely play a large role in the diet and distribution of the Southern Residents, but researchers have thus far failed to correlate whale occurrence with the presence and availability of any specific prey population. Identifying prey populations of special significance to the whales is needed (Task 2.1).

B.2.3 Determine the extent of feeding on hatchery fish.

Hatchery fish comprise a large portion of salmonid populations in much of the range of the Southern Residents, but few data exist on their importance to their November 2006 155 NMFS diet. This should be established because the characteristics (e.g., energy content and contaminant loads) of hatchery salmon may differ somewhat from those of wild salmon. This information may also help evaluate whether future changes in hatchery management and production levels will impact the whales.

B.3 Analyze the demographics of the Southern Residents.
The population history and maternal genealogy of the Southern Residents are completely known for individual whales born after 1974. Existing studies of these data (Olesiuk et al. 1990a, 2005, Krahn et al. 2002, 2004a) have been quite useful in describing the dynamics of the population, but efforts should be expanded to provide more comprehensive analyses. This information will provide greater insight into the processes affecting the Southern Resident population, especially during periods of decline, and will improve the accuracy of future population viability analyses. Demographic comparisons should be made among pods and with other resident populations.

B.3.1 Determine mortality rates and potential causes of mortality.
Mortality rates are one of the most important factors affecting population changes in killer whales. Comprehensive studies of mortality patterns and associated influences are therefore needed for the Southern Residents. Two high priority tasks are to determine the reasons behind the alternating 7-year periods of higher and lower mortality in the population, and L pod's disproportionately higher death rate since the mid-1990s.

Definitive causes of death have not been established for any of the more than 80 Southern Residents that have died since 1974. This is largely due to the lack of carcasses for necropsy and difficulties in distinguishing direct causes of death (e.g., starvation and disease) from indirect factors impacting health (e.g., contaminant burdens, food limitations, and vessel interactions). Although few killer whales strand, necropsies to determine causes of mortality for all age and sex classes should be conducted on all available carcasses (Task 4.2.3).

B.3.2 Evaluate population growth rates and survival patterns.
Reproductive patterns also affect population trends and should be described in detail for the Southern Residents. Major influences on birth rates and reproductive trends should also be investigated. Areas of particular interest include the reasons for 1) the population's cyclic periods of higher and lower birth
rates, 2) its longer mean interval between births of viable calves, as compared to other resident populations, 3) L pod's poor reproductive success during the 1990s, and 4) temporal trends of sex-bias in the production of calves. In addition, identification of factors causing poor reproductive success in females is important. Increased monitoring of the population during the winter and spring November 2006 156 NMFS will allow researchers to better determine true birth rates. Determination of paternal genealogy is also needed (Task B.9.1).

B.3.3 Evaluate population structure.

More detailed analyses of age and sex structure patterns over time in the Southern Resident population are needed to assess threats, determine effects on population stability, and predict future growth. Potential constraints on population growth, such as a limited number of reproductive age males, should be evaluated.

B.3.4 Evaluate changes in social structure.
Highly stable matrilines are a major feature of Southern Resident biology. Detailed assessments of social structure dynamics (e.g., intrapod structure or associations) should be made to search for evidence of potential stresses on the population and to examine effects on population stability. Evaluation of changes in intrapod structure on survival and fecundity, and the impacts of reduced
population size on social structure are also needed. One particular topic deserving study is the consequences of the losses of key individuals from the population, particularly matriarchal and post-reproductive females, which could result in reduced alloparenting and loss of long-term cultural knowledge, thereby lowering population fitness.

B.4 Investigate the health and physiology of the Southern Residents.
Knowledge of individual health and physiology of the species is beneficial in evaluating a population's status, dynamics (e.g., survival and fecundity), and threats. Both topics require much additional study for the Southern Residents.

B.4.1 Assess the health of population members.
Hormone levels, blubber depth, respiratory conditions, reproductive status, and other aspects of physical condition should be assessed in sufficient numbers of individual whales representing particular age and sex classes to appraise the population's health. Evaluations should be done through the application of proven tissue sampling methodologies, or the application of emerging health monitoring techniques (e.g., collection of respiratory gases, blowhole residues, and fecal samples; use of ultrasound) that do not require the physical restraint or capture of animals.

B.4.2 Assess individual growth rates.
Growth rate comparisons among different cohorts of calves may offer another way of evaluating the effects of changing environmental conditions on the Southern Residents. This work will require the development of suitable morphometric indices. Dorsal fin measurements, which are obtainable from November 2006 157 NMFS photographs taken during regular population monitoring, may achieve this need and have the added benefit of being retrievable from photos archived since the 1970s. Monitoring changes in body condition following seasonal movements would be helpful in determining if prey availability limits thee growth of individuals.

B.4.3 Determine metabolic rates and energy requirements.
Earlier studies of captive killer whales have provided limited data on the species' energy demands, but may not accurately reflect the needs of the Southern Residents. More comprehensive metabolic and energetic studies should be conducted on captive killer whales using modern techniques. Knowledge of year-round metabolic rates and caloric requirements of different age and sex groups will help determine whether critical periods of the year exist when prey levels are inadequate. Physiological indicators of nutritional stress should also be developed.

B.5 Investigate the behavior of the Southern Residents.
Comparisons of behavioral data are potentially valuable for evaluating changes in activity patterns over time that may indicate stresses on the population. Information on numerous behaviors (e.g., foraging, socializing, traveling, resting, diving, vocalizations, responses to vessels, and habitat selection) should be collected year-round and analyzed at the individual and group levels, and when possible compared with past data. Consistency and coordination of behavioral data collected by different researchers will assist with comparisons. Other needs include further clarification of the contexts of different behaviors and determination of nighttime activity patterns.

B.6 Assess threats to the Southern Residents.
Southern Resident whales face a number of threats, with reduced prey abundance, elevated contaminant burdens, excessive marine ambient sound and vessel interactions, lack of knowledge about risk factors outside of the Georgia Basin and Puget Sound and elevated contaminant burdens usually cited as the most serious conservation concerns (Task 1). Additional research is needed to characterize these problems and their effects on the population, and to identify other possible extrinsic factors affecting it. One goal of this work should be to determine whether synergistic effects are occurring, whereby multiple factors act in combination to harm the whales. Whenever possible, research activities should assess threats at the level of the pod or matriline to examine differences in exposure to the identified threat factors.

B.6.1 Assess the effects of changes in prey populations.
Human activities have profoundly altered populations of salmon and other Southern Resident prey during the past 150 years. The role that changes in prey November 2006 158 NMFS abundance, availability, and quality have played in past declines of the Southern Residents or are currently limiting population growth requires further study.

B.6.1.1 Determine historical changes in prey abundance and distribution, and their effects on Southern Resident population dynamics.
Collection of data and comprehensive assessments of past and present prey abundance and availability are needed throughout the Southern Resident's range at both regional and watershed scales. These data should be used to understand the role that changes in prey populations may have had on the Southern Residents' population dynamics. In particular, Ford et al. (2005b) suggestion of a direct relationship between Chinook abundance and whale mortality needs fuller evaluation for the Southern Residents. With improved information on dietary preferences, efforts can be focused on current favored prey species, but a broad perspective is also desirable to consider other prey that may have been formerly important to the whales.

B.6.1.2 Assess changes in prey quality and their effects on Southern Resident population dynamics.
Better data are needed on body condition traits (e.g., size; age; caloric, fat, and nutrient content; and contaminant burdens) of important prey. Such information should be gathered for a variety of prey subcategories, including different populations and age groups within a species, and wild

versus hatchery fish. When possible, these studies should make inferences on changes in body condition between past and present prey populations. This information should be used to consider potential impacts on Southern Resident health and population dynamics.

B.6.1.3 Determine whether the Southern Residents are limited by critical periods of scarce food resources.
Information on the Southern Residents' distribution, movements, diet, foraging behavior, and physiology and changes in prey abundance, availability, and quality should be collected and analyzed to determine whether the Southern Residents face critical periods when food resources limit the population, either annually or more infrequently.