ESA Section 7 Consultation No: 2003/00565

National Marine Fisheries Service
Endangered Species Act Section 7 Consultation
and Magnuson-Stevens Act
Essential Fish Habitat Consultation

Action Agencies:

The National Marine Fisheries Service (NMFS)
The Bonneville Power Administration (BPA)
The Bureau of Indian Affairs (BIA)
The Bureau of Land Management (BLM)
The U.S. Army Corp of Engineers (COE)
The U.S. Environmental Protection Agency (EPA)
The U.S. Fish and Wildlife Service (USFWS)
The U.S. Forest Service (USFS)
The U.S. Geological Survey (USGS)
The U.S. National Park Service (NPS)

Species/ESUs:

Lower Columbia River (LCR) chinook salmon *(Oncorhynchus tshawytscha)*
LCR steelhead (*O. mykiss*)
Upper Willamette River (UWR) chinook salmon (*O. tshawytscha*)
UWR steelhead (*O. mykiss*)
Columbia River (CR) chum salmon (*O. keta*)

Essential Fish Habitat Affected:

Pacific salmon, groundfish, and coastal pelagic species

Actions:

1. Issuance of Permit No. 1140 to the NMFS' Northwest Fisheries Science Center (NWFSC).
2. Issuance of Permit No. 1290 to the NWFSC.
3. Issuance of Permit No. 1291 to the USGS.
4. Issuance of Permit No. 1322 to the NWFSC.
5. Issuance of Permit No. 1335 to the USFS.
6. Issuance of Permit No. 1366 to the Oregon Cooperative Fish and Wildlife Research Unit and the Idaho Cooperative Fish and Wildlife Research Unit (OCFWRU/ICFWRU).
7. Issuance of Permit No. 1379 to the BIA.
8. Issuance of Permit No. 1410 to the NWFSC.
9. Issuance of Permit No. 1421 to the USFWS.
10. Issuance of Permit No. 1427 to the Oregon Department of Environmental Quality (ODEQ).

ESA Section 7 Consultation No: 2003/00565

Consultation Conducted By: Protected Resources Division (PRD), Northwest Region, NMFS
Consultation Number 2003/00565

Approved By: _____ for D. Robert Lohn, Regional Administrator

Date: June 13, 2003 (Expires on: December 31, 2007)

This biological opinion (Opinion) constitutes NMFS' review of ten Endangered Species Act (ESA) section 10(a)(1)(A) permit actions. It has been prepared in accordance with section 7 of the ESA of 1973, as amended (16 U.S.C. 1531 et seq.). It is based on information provided in the applications for the proposed permits and permit modifications, comments from reviewers including NMFS' Northwest Fisheries Science Center, published and unpublished scientific information on the biology and ecology of threatened salmonids in the action area, and other sources of information. A complete administrative record of these consultations is on file with the PRD in Portland, Oregon.

NMFS concludes that the proposed ESA section 10(a)(1)(A) actions discussed in this biological opinion are not likely to jeopardize the continued existence of threatened Lower Columbia River chinook salmon, threatened Lower Columbia River steelhead, threatened Upper Willamette River chinook salmon, threatened Upper Willamette River steelhead, or threatened Columbia River chum salmon. Further, the actions are not likely to adversely affect any designated essential fish habitat.

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CONSULTATION HISTORY

NMFS proposes to issue five permits and five permit modifications and thereby authorize the permit holders to conduct scientific research on listed LCR chinook salmon, LCR steelhead, UWR chinook salmon, UWR steelhead, and CR chum salmon. The Northwest Region's PRD decided to group these actions in a single consultation pursuant to 50 CFR 402.14(c) because they are similar in nature and duration and will affect the same listed species. Though some of the proposed permit actions may affect other species as well, this Opinion constitutes formal consultation and an analysis of effects solely for LCR chinook salmon, LCR steelhead, UWR chinook salmon, UWR steelhead, and CR chum salmon.

The first of the permit requests was received in January of 2003. It, and several others (though not all) were deemed incomplete to varying degrees when they arrived at the PRD. After numerous phone calls and e-mails, each of the applications was determined to be complete and then notice was published in the *Federal Register* asking for public comment. The public was given 30 days on each application, and once that period closed, the consultation began. The full consultation histories for all ten actions are lengthy and are not directly relevant to the analysis for the proposed actions so they will not be detailed here. Nonetheless, the PRD in Portland, Oregon maintains the complete histories for each proposed action in the administrative record for this consultation and for each permit.

DESCRIPTION OF THE PROPOSED ACTIONS

Common Elements Among the Proposed Actions

NMFS proposes to issue five permits and five permit modifications and thereby authorize the permit holders to conduct scientific research involving threatened LCR chinook salmon, threatened LCR steelhead, threatened UWR chinook salmon, threatened UWR steelhead, and threatened CR chum salmon. Although some of these actions may affect listed species other than those listed above, this Opinion constitutes formal consultation and an analysis of effects solely for the Evolutionarily Significant Units (ESUs) that are the subject of this consultation. The effects of taking other species are described in other biological opinions and are not relevant to this consultation. Therefore only those portions of the proposed research actions that would affect LCR chinook salmon, threatened LCR steelhead, threatened UWR chinook salmon, threatened UWR steelhead, and threatened CR chum salmon are discussed here.

It should be noted that some of the activities identified in the proposed permit actions would be funded by Federal agencies listed above. Although these agencies are responsible for complying with section 7 of the ESA because they are funding activities that may affect listed species, this consultation examines the actual actions they propose to fund and thus fulfills their section 7 consultation obligations.

All five new permit actions considered in this Opinion would be in effect for up to five years (i.e., through 2007). All five of the permit modification actions considered in this Opinion are expected to be in effect for the duration of the permits which expire December 31, 2006.

As part of any proposed action to issue research permits, NMFS lays out the terms and conditions to be followed before, during, and after the research activities are conducted. These conditions are intended to: (a) manage the interaction between scientists and listed salmonids by requiring that research activities be coordinated among permit holders and between permit holders and NMFS, (b) require measures to minimize impacts on listed species, (c) ensure compliance with the ESA, and (d) ensure that NMFS receives information about the effects the permitted activities have on the species concerned. All permits NMFS issues would have the following conditions. That is, in all cases:

1. The permit holder must ensure that listed species are taken only at the levels, by the means, in the areas and for the purposes stated in the permit application, and according to the terms and conditions in this permit.

2. The permit holder must not intentionally kill or cause to be killed any listed species unless the permit specifically allows intentional lethal take.

3. The permit holder must handle listed fish with extreme care and keep them in cold water to the maximum extent possible during sampling and processing procedures. When fish are transferred or held, a healthy environment must be provided; e.g., the holding units must contain adequate amounts of well-circulated water. When using gear that captures a mix of species, the permit holder must process listed fish first to minimize handling stress.

4. The permit holder must stop handling listed juvenile fish if the water temperature exceeds 70 degrees Fahrenheit at the capture site. Under these conditions, listed fish may only be visually identified and counted.

5. If the permit holder anesthetizes listed fish to avoid injuring or killing them during handling, the fish must be allowed to recover before being released. Fish that are only counted must remain in water and not be anesthetized.

6. The permit holder must use a sterilized needle for each individual injection when passive integrated transponder tags (PIT-tags) are inserted into listed fish.

7. If the permit holder incidentally captures any listed adult fish while sampling for juveniles, the adult fish must be released without further handling and such take must be reported.

8. The permit holder must exercise care during spawning ground surveys to avoid disturbing listed adult salmonids when they are spawning. Researchers must avoid walking in salmon

streams whenever possible, especially where listed salmonids are likely to spawn. Visual observation must be used instead of intrusive sampling methods, especially when just determining presence of anadromous fish.

9. The permit holder using backpack electrofishing equipment must comply with NMFS' Backpack Electrofishing Guidelines (June 2000) available at http://www.nwr.noaa.gov/1salmon/salmesa/4ddocs/final4d/electro2000.pdf.

10. The permit holder must obtain approval from NMFS before changing sampling locations or research protocols.

11. The permit holder must notify NMFS as soon as possible but no later than 2 days after any authorized level of take is exceeded or if such an event is likely. The permit holder must submit a written report detailing why the authorized take level was exceeded or is likely to be exceeded.

12. The permit holder is responsible for any biological samples collected from listed species as long as they are used for research purposes. The permit holder may not transfer biological samples to anyone not listed in the application without prior written approval from NMFS.

13. The person(s) actually doing the research must have a copy of this permit while conducting the authorized activities.

14. The permit holder must allow any NMFS employee or representative to accompany field personnel while they conduct the research activities.

15. The permit holder must allow any NMFS employee or representative to inspect any records or facilities related to the permit activities.

16. The permit holder may not transfer or assign this permit to any other person as defined in Section 3(12) of the ESA. This permit ceases to be in effect if transferred or assigned to any other person without NMFS' authorization.

17. NMFS may amend the provisions of this permit after giving the permit holder reasonable notice of the amendment.

18. The permit holder must obtain all other Federal, state, and local permits/authorizations needed for the research activities.

19. On or before January 31th of every year, the permit holder must submit to NMFS a post-season report in the prescribed form describing the research activities, the number of listed fish taken and the location, the type of take, the number of fish intentionally killed and unintentionally killed, the take dates, and a brief summary of the research results. Falsifying

annual reports or permit records is a violation of this permit.

20. If the permit holder violates any permit term or condition they will be subject to any and all penalties provided by the ESA. NMFS may revoke this permit if the authorized activities are not conducted in compliance with the permit and the requirements of the ESA or if NMFS determines that its ESA section 10(d) findings are no longer valid.

Additional permit conditions specific to the proposed research may be included in certain permits.

Finally, NMFS will monitor actual annual take of listed fish species associated with scientific research activities, by requiring annual reports or by other means, and shall adjust annual permitted take levels if they are deemed to be excessive or if cumulative take levels are determined to operate to the disadvantage of the listed species.

The Individual Permits

Table 1 displays the overall amounts of take requested in each permit application, the general actions with which that take would be associated, and general location of research activities. "Take" is defined in section 3 of the ESA; it means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect or to attempt to engage in any such conduct. The table's purpose is to depict the total impact—strictly in terms of pure take numbers—that can be expected from the proposed research actions. Detailed, action-by-action breakdowns (i.e., how much take is associated with each activity in each permit) are found in the Effects of the Action section.

Table 1. Summary of the proposed research permits considered in this Opinion.

Permit No.	LCR chinook	UWR chinook	LCR steelhead	UWR steelhead	CR chum	Proposed Actions	Locations
1140	17 juv intentional morts	10 juv intentional morts				Intentional mortality	Nearshore areas in Oregon and Washington
1290 mod 1	84 juv intentional morts					Intentional mortality	Columbia River estuary
1291 mod 2	14,978 juv handle, 281 juv unintentional morts		635 juv handle, 13 juv unintentional morts			Capture/ handle/ mark/ release	Dams on the Columbia River

Permit No.	LCR chinook	UWR chinook	LCR steelhead	UWR steelhead	CR chum	Proposed Actions	Locations
1322 mod 2	755 juv handle, 7 juv unintentional morts, 54 juv intentional morts	7 juv intentional morts			100 juv intentional morts	Capture/ handle/ release; Intentional mortality	Columbia River and estuary
1335 mod 2	500 juv handle, 15 juv unintentional morts	300 juv handle, 6 juv unintentional morts	200 juv handle, 9 juv unintentional morts	300 juv handle, 6 juv unintentional morts		Capture/ handle/ release	Stream systems in the Columbia & Oregon Coast basins
1366 mod 1	546 juv handle, 19 juv unintentional morts, 81 juv intentional morts		7 juv handle, 2 juv unintentional mort			Capture/ handle/ mark/ release; Intentional mortality	Selected dams on the Columbia and Snake Rivers
1379	10 adult handle					Capture/ handle/ sample/ mark/ release	Bonneville Dam
1410	128 adult handle, 4 adult unintentional morts, 358 juv intentional morts	6 adult handle, 32 juv intentional morts	1 juv intentional mort	1 juv intentional mort	5 adult handle, 300 juv intentional morts	Capture/ handle/ release; Intentional mortality	Columbia River plume and surrounding ocean environment
1421	7 adult handle, 30 juv handle, 2 juv unintentional morts		1 adult handle, 2 juv handle		10 adult handle, 100 juv handle, 5 juv unintention al morts	Capture/ handle/ sample/ mark/ release	Franz Lake Refuge, lower Columbia River
1427	1 adult handle, 1 juv handle	4 adult handle, 4 juv handle	1 adult handle, 1 juv handle	4 adult handle, 4 juv handle		Capture/ handle/ release	Lower Willamette River

Juv = juvenile, mort = mortality. Unintentional mortality represents fish that are killed by accident when the research is conducted. Intentional mortality represents fish that are killed on purpose as part of the research.

Permit 1140—NWFSC

Permit 1140 would authorize the NWFSC to conduct studies that would annually take juvenile threatened LCR chinook salmon and juvenile threatened UWR chinook salmon during the course of research activities in nearshore areas in Oregon and Washington. The purpose of the research is to assess the relationship between environmental variables, selected anthropogenic stresses, and bacterial and parasitic pathogens on disease-induced mortality in juvenile salmon. The NWFSC would collect information to: (1) determine contaminant concentrations in fish, (2) understand bioaccumulation in juvenile salmon and determine site-specific factors, (3) analyze for the presence of physiological biomarkers, and (4) investigate the presence of indicators of exposure to environmental estrogens. The NWFSC proposes to collect samples with seines or high speed rope trawls and requests authorization to intentionally kill salmon for pathogen prevalence and intensity, biochemical composition, histopathological attributes, and stomach content analyses.

In addition to all other conditions, the following Special Condition will be included in Permit 1140:

- If any listed juvenile fish are unintentionally killed during these activities they must be used in place of intentional mortalities.

Permit 1290 Modification 1—NWFSC

Modification 1 to Permit 1290 would authorize the NWFSC to increase the number of juvenile threatened LCR chinook salmon taken annually in its research being conducted in the Columbia River estuary. The NWFSC proposes to capture, handle, and release salmonids, and requests authorization to intentionally kill some juvenile LCR chinook salmon. Purse seines or beach seines would be the capture methods. The purpose of the research is to evaluate the importance of the Columbia River estuary to baitfish populations and salmonid marine survival, and the role of disease as a factor affecting survival of juvenile salmonids in the estuarine and marine environments. The research would benefit listed salmonids by contributing information on the extent to which baitfish populations and disease affect the growth and survival of juvenile salmonids in the estuarine and early ocean environments.

In addition to all other conditions, the following Special Condition will be included in Permit 1290:

- If any listed juvenile fish are unintentionally killed during these activities they must be used in place of intentional mortalities.

Permit 1291 Modification 2—USGS

Modification 2 to Permit 1291 would authorize the USGS to use McNary, John Day, and Bonneville Dams on the Columbia River as collection points for fish used in their research. Under the modification, the USGS would annually take juvenile threatened LCR chinook salmon and juvenile threatened LCR steelhead only if sampling occurred at Bonneville Dam. Under the modification, the listed fish would be either (1) captured by Smolt Monitoring personnel (SMP) at Bonneville Dam, handled, and released, or (2) captured by SMP and given to USGS personnel and implanted with radio transmitters, transported, held for as long as 24 hours, released, and tracked electronically. The SMP would act as agents of the USGS under the permit. The USGS does not intend to kill any fish but some may die as an unintentional result of the research activities.

Permit 1322 Modification 2—NWFSC

Modification 2 to Permit 1322 would authorized the NWFSC to increase the annual number of listed fish taken in its research. Under the modification, the NWFSC would increase its annual take of juvenile threatened LCR chinook salmon, juvenile threatened UWR chinook salmon, and juvenile threatened CR chum salmon while conducting research in the Columbia River and estuary. The NWFSC proposes to capture, handle, and release listed salmonids and while most of the fish would be unharmed, some may die as an unintentional result of the research and some would be intentionally killed. Purse seines, trap nets, and beach seines would be used to capture the fish. Captured fish would be anesthetized, identified, and measured. Some fish would be sacrificed to confirm species identification, catch composition, food habits, and timing of estuarine entry. The purposes of the research are to: (1) determine the presence and abundance of fall and spring chinook salmon, coho salmon and chum salmon in the estuary and lower Columbia River; (2) determine the relationship between juvenile salmon and lower Columbia River estuarine habitat; and (3) obtain information about flow change, sediment input, and habitat availability for the development of a numerical model. The research would benefit listed salmonids by serving as a basis for estuarine restoration and preservation plans. The NWFSC plans to transfer tissue samples to the University of Washington, Oregon State University, and Washington Department of Fish and Wildlife.

In addition to all other conditions, the following Special Condition will be included in Permit 1322:

- If any listed juvenile fish are unintentionally killed during these activities they must be used in place of intentional mortalities.

Permit 1335 Modification 2—USFS

Modification 2 to Permit 1335 would authorize the USFS to increase the annual number of

juvenile threatened LCR chinook salmon, juvenile threatened UWR chinook salmon, juvenile threatened LCR steelhead, and juvenile threatened UWR steelhead while conducting research in selected stream systems in the Columbia and Oregon Coast basins. The USFS proposes to capture, handle, and release listed salmonids and while most of the fish would be unharmed, some may die as an unintentional result of the research. Backpack electrofishing would be used to capture the fish. Captured fish would be anesthetized, identified, measured. The purposes of the research are to assess watershed conditions and factors limiting salmonid health and production, and evaluate watershed health under the Northwest Forest Plan. The activities will benefit listed fish by generating information to improve forest management.

Permit 1366 Modification 1—OCFWRU

Modification 1 to Permit 1366 would authorize the OCFWRU (and the ICFWRU as cooperators) to increase the annual number of listed fish taken in its research. Under the modification, the OCFWRU would increase its annual take of juvenile threatened LCR chinook salmon and juvenile threatened LCR steelhead while conducting studies at various dams on the Columbia and Snake Rivers. The OCFWRU proposes to capture, sample for biological information or tag with radiotransmitters, and release listed salmonids and while most of the fish would be unharmed, some may die as an unintentional result of the research and some would be intentionally killed. Lift nets or dip nets at dams would be used to capture the fish or fish would be acquired from the Columbia River Smolt Monitoring Program or NMFS personnel at Bonneville Dam. Captured fish would be anesthetized, sampled, tagged, and released. The purpose of the research is to compare biological and physiological indices of wild and hatchery juvenile fish exposed to stress during bypass, collection, and transportation activities at the dams. The research will benefit the listed species by helping determine what effects the dams and their associated structures and management activities have on the outmigrating salmonids and using that information modify those factors in ways that increase salmonid survival.

In addition to all other conditions, the following Special Condition will be included in Permit 1366:

- If any listed juvenile fish are unintentionally killed during these activities they must be used in place of intentional mortalities.

Permit 1379—CRITFC

Permit 1379 would authorize the CRITFC to conduct studies that would annually take adult threatened LCR chinook salmon during the course of research activities at various points in the Columbia River. The CRITFC proposes to capture, anesthetize, sample for biological information and tissue samples, tag with radiotransmitters or other identifiers, and release listed salmonids. Seines, trawls, traps, hook and line angling, and electrofishing would be used to capture the fish. The purposes of the studies are to gain current information on the status and

productivity of various fish populations, collect data on migratory and exploitation patterns, and develop baseline information on various population and habitat parameters to guide salmonid restoration strategies. The research will benefit listed fish by helping managers set in-river and ocean harvest regimes so that they have minimal impacts on listed populations, prioritize projects in a way that gives maximum benefit to listed species, and design strategies and activities to help recover them.

Permit 1410—NWFSC

Permit 1410 would authorize the NWFSC to conduct studies that would annually take adult and juvenile threatened LCR chinook salmon, adult and juvenile threatened UWR chinook salmon, juvenile threatened LCR steelhead, juvenile threatened UWR steelhead, and adult and juvenile threatened CR chum salmon during the course of research activities in the Columbia River plume and surrounding ocean environment. The purpose of the research is to assess factors controlling estuarine and marine survival. The NWFSC would collect information to help predict and forecast survival potential as a function of easily measured indices of plume and ocean conditions. Further, the information would help hydropower operators develop a set of management scenarios that could benefit survival, growth, and health of juvenile salmon by changing the dynamics of the Columbia River plume. The NWFSC proposes to collect fish with purse seines and trawl nets, sample them for biological data, and release them and requests authorization to intentionally kill juvenile salmon for endocrine assessments, genetic stock identification, pathogen prevalence and intensity, otolith and stomach content analyses, and histopathological attributes. A few additional fish may die as an unintentional result of the research.

In addition to all other conditions, the following Special Condition will be included in Permit 1410:

- If any listed juvenile fish are unintentionally killed during these activities they must be used in place of intentional mortalities.

Permit 1421—USFWS

Permit 1421 would authorize the USFWS to conduct studies that would annually take adult and juvenile threatened LCR chinook salmon, adult and juvenile threatened LCR steelhead, and adult and juvenile threatened CR chum salmon during the course of research activities at the Franz Lake National Wildlife Refuge on the lower Columbia River. The objectives of the study are to: (1) document fish species, (2) evaluate fish distribution relative to habitat features, and (3) describe fish diets in the refuge. The study will be coordinated with a mosquito control study conducted by the OCFWRU. The study will benefit listed fish by generating information on the effects of mosquito control on salmonids and salmonid prey species, and the spacial and temporal relations among fish distribution, fish diets, and areas typically treated to control

mosquitos. The USFWS proposes to capture fish with boat and backpack electrofishing, fyke nets, and minnow traps; anesthetize, measure, check them for tags and marks, sample them for stomach content, and release them. While most of the fish would be released unharmed, some may die as an unintentional result of the research.

Permit 1427—ODEQ

Permit 1427 would authorize the ODEQ to conduct a study that may annually take adult and juvenile threatened LCR chinook salmon, adult and juvenile threatened UWR chinook salmon, adult and juvenile threatened LCR steelhead, and adult and juvenile threatened UWR steelhead during the course of activities in the Willamette River, Oregon. The objectives of the study are to: (1) describe the relationship between mercury in fish tissue and in the water column in order to develop a site-specific bioaccumulation factor, (2) describe the relationship between methlymercury in water and total mercury in water and sediment, and (3) begin to identify and quantify mercury sources and loadings in the Willamette River system. The study will benefit listed fish by helping to reduce mercury loading in the Willamette River and is designed to fulfill requirements of the Federal Clean Water Act. The ODEQ proposes to capture fish with boat electrofishing, count, and release them.

The Action Area

The proposed actions considered in this Opinion may affect five threatened species: LCR chinook salmon, LCR steelhead, UWR chinook salmon, UWR steelhead, and CR chum salmon—including the species habitat. The action area is defined as the geographic extent of all direct and indirect effects of a proposed agency action [50 C.F.R. 402.02 and 402.14(h)(2)]. The action area for this consultation includes all marine, estuarine, and river reaches accessible to listed chinook salmon, steelhead, and chum salmon in the LCR, UWR and CR subbasins in Oregon and Washington. Researchers will conduct their activities throughout this area. The actions have the potential to affect the water, substrate, and adjacent riparian zones of estuarine and accessible riverine reaches in several hydrologic units and counties. Accessible reaches are those within the historical range of the ESUs that can still be occupied by any life stage of salmon or steelhead. More detailed habitat information (i.e., specific watersheds, migration barriers, habitat features, and special management considerations) for these ESUs can be found in the February 16, 2000, *Federal Register* notice designating critical habitat (65 FR 7764) (NMFS, 2000a). It should be noted, however, that the critical habitat designation was vacated and remanded to NMFS for new rulemaking pursuant to a court order in May of 2002. In the absence of a new rule designating critical habitat, this consultation will evaluate the effects of the proposed actions on the species' habitat to determine whether those actions are likely to jeopardize the species' continued existence.

LCR chinook salmon
For the purposes of this Opinion, the action area includes all rivers, streams, and their tributaries accessible to naturally spawned populations of chinook salmon from the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River, and includes the Willamette River to Willamette Falls, Oregon, exclusive of spring-run chinook salmon in the Clackamas River. Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to The Dalles Dam. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 6,338 square miles in Oregon and Washington. The following counties lie partially or wholly within these basins (or contain migration habitat for the species): Oregon–Clackamas, Clatsop, Columbia, Hood River, Marion, Multnomah, Wasco, and Washington; Washington–Clark, Cowlitz, Klickitat, Lewis, Pierce, Pacific, Skamania, Wahkiakum, and Yakima.

LCR steelhead
For the purposes of this Opinion, the action area includes all rivers, streams, and their tributaries accessible to naturally spawned populations of steelhead in streams and tributaries to the Columbia River between the Cowlitz and Wind Rivers, Washington (inclusive) and the Willamette and Hood Rivers, Oregon (inclusive). Excluded are steelhead in the upper Willamette River Basin above Willamette Falls and steelhead from the Little and Big White Salmon Rivers in Washington. Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the Hood River in Oregon. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 5,017 square miles in Oregon and Washington. The following counties lie partially or wholly within these basins (or contain migration habitat for the species): Oregon–Clackamas, Clatsop, Columbia, Hood River, Marion, Multnomah, and Washington; Washington–Clark, Cowlitz, Lewis, Pacific, Skamania, and Wahkiakum.

UWR chinook salmon
For the purposes of this Opinion, the action area includes all rivers, streams, and their tributaries accessible to listed spring-run chinook salmon in the Clackamas River and in the Willamette River, and its tributaries, above Willamette Falls, Oregon. Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to and including the Willamette River in Oregon. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 8,575 square miles. The following counties lie partially or wholly within these basins (or contain migration habitat for the species): Oregon–Benton, Clackamas, Clatsop, Columbia, Douglas, Lane, Lincoln, Linn, Marion, Multnomah, Polk, Tillamook, Washington, and Yamhill; Washington–Clark, Cowlitz, Pacific, and Wahkiakum.

UWR steelhead
For the purposes of this Opinion, the action area includes all rivers, streams, and their tributaries accessible to naturally spawned populations of winter-run steelhead in the Willamette River, Oregon, and its tributaries upstream from Willamette Falls to the Calapooia River, inclusive. Also included are adjacent riparian zones, as well as river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to, and including, the Willamette River in Oregon. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 4,872 square miles in Oregon. The following counties lie partially or wholly within these basins (or contain migration habitat for the species): Oregon–Benton, Clackamas, Clatsop, Columbia, Lincoln, Linn, Marion, Multnomah, Polk, Tillamook, Washington, and Yamhill; Washington–Clark, Cowlitz, Pacific, and Wahkiakum.

CR chum salmon
For the purposes of this Opinion, the action area includes all rivers, streams, and their tributaries accessible to naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon downstream from Bonneville Dam, excluding Oregon tributaries upstream of Milton Creek at river km 144 near the town of St. Helens. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 4,426 square miles in Oregon and Washington. The following counties lie partially or wholly within these basins (or contain migration habitat for the species): Oregon–Clatsop, Columbia, Multnomah, and Washington; Washington–Clark, Cowlitz, Lewis, Pacific, Skamania, and Wahkiakum.

STATUS OF THE SPECIES UNDER THE ENVIRONMENTAL BASELINE

In order to describe a species' status, it is first necessary to define precisely what "species" means in this context. Traditionally, one thinks of the ESA listing process as pertaining to entire taxonomic species of animals or plants. While this is generally true, the ESA also recognizes that there are times when the listing unit must necessarily be a subset of the species as a whole. In these instances, the ESA allows a "distinct population segment" (DPS) of a species to be listed as threatened or endangered.

NMFS developed the approach for defining salmonid DPSs in 1991 (Waples, 1991). Waples' paper states that a population or group of populations is considered distinct if they are "substantially reproductively isolated from conspecific populations," and if they are considered "an important component of the evolutionary legacy of the species." A distinct population or group populations is referred to as an ESU of the species. All of the ESUs addressed in this Opinion are considered DPSs and hence "species" under the ESA.

The threatened salmonids identified in the section above were listed under the ESA because NMFS determined that a number of factors—both environmental and demographic—had caused them to decline to the point where they were likely to be in danger of going extinct within the foreseeable future. The factors for decline affect salmonid biological requirements at every life stage and arise from a number of different sources. This section of the Opinion explores those effects and defines the context within which they take place.

Species/ESU Life Histories

Chinook Salmon

Chinook salmon are the largest of the Pacific salmon. The species' North American distribution historically ranged from the Ventura River in California to Point Hope, Alaska. In northeastern Asia the species range from Hokkaido, Japan to the Anadyr River in Russia (Healey, 1991). Additionally, chinook salmon have been reported in the Mackenzie River area of northern Canada (McPhail and Lindsey, 1970). Of the Pacific salmon, chinook salmon exhibit the most diverse and complex life-history strategies. Healey (1986) described 16 age categories for chinook salmon, seven total ages at maturity with three possible freshwater ages. Gilbert (1912) initially described two general freshwater life-history types: "stream-type" chinook salmon reside in fresh water for a year or more following emergence; "ocean-type" chinook salmon migrate to the ocean within their first year.

The generalized life history of Pacific salmon includes phases of incubation, hatching, freshwater emergence, migration to the ocean, and subsequent initiation of maturation and return to fresh water for completion of maturation and spawning. Juvenile rearing in fresh water can be minimal or extended. Additionally, some male chinook salmon mature in fresh water, thereby

foregoing emigration to the ocean. The timing and duration of each of these stages is related to varying degrees of genetic and environmental determinants and interactions thereof. More detailed descriptions of the key features of chinook salmon life history can be found in Myers et al. (1998) and Healey (1991).

Chinook salmon in the LCR and UWR ESUs exhibit both "ocean type" and "stream type" life histories. Populations tend to mature at ages 3 and 4. Juvenile life stages (i.e., eggs, alevins, fry, and parr) inhabit freshwater/riverine areas throughout the range of the ESU. Parr undergo a smolt transformation as subyearlings or yearlings in the spring at which time they migrate to the ocean. Subadults and adults forage in coastal and offshore waters of the North Pacific Ocean prior to returning to spawn in their natal streams. Adult spring-run chinook salmon typically return to fresh water in April and May and spawn in August and September, while fall-run fish begin to return in August and spawn from late September through January.

LCR Chinook Salmon ESU

The LCR chinook salmon ESU is characterized by numerous short- and medium-length rivers that drain the coast ranges and the west slope of the Cascade Mountains. This ESU includes all native populations from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls. The former location of Celilo Falls (drowned by The Dalles reservoir in 1960) is the eastern boundary for this ESU. Stream-type, spring-run chinook salmon found in the Klickitat River or the introduced Carson spring chinook salmon strain are not included in this ESU. Spring-run chinook salmon in the Sandy River have been influenced by spring-run chinook salmon introduced from the Willamette River ESU. However, analyses suggest that considerable genetic resources still reside in the existing population (Myers et al. 1998). Tule fall chinook salmon from the LCR chinook salmon ESU were observed spawning in the Ives Island area along the Washington shoreline approximately two miles below Bonneville Dam during October of 1999. Most fall-run fish in the LCR chinook salmon ESU emigrate to the marine environment as sub-yearlings (Reimers and Loeffel, 1967; Howell et al., 1985; WDF et al., 1993). Returning adults that emigrated as yearling smolts may have originated from the extensive hatchery programs in the ESU. It is also possible that modifications in the river environment have altered the duration of freshwater residence. Coded-wire-tag (CWT) recoveries of LCR chinook salmon suggest a northerly migration route, but the fish contribute more to fisheries off British Columbia and Washington than to the Alaskan fishery. Tule fall chinook salmon return at adult ages 3 and 4, "bright" fall chinook salmon return at ages 4, 5, and 6.

UWR Chinook Salmon ESU

The UWR chinook salmon ESU includes native spring-run populations above Willamette Falls and in the Clackamas River. Historically, it included sizable numbers of spawning salmon in the Santiam River, the middle fork of the Willamette River, and the McKenzie River, as well as smaller numbers in the Molalla River, Calapooia River, and Abiqua Creek. UWR chinook salmon mature in their fourth or fifth years. Historically, 5-year-old fish dominated the

spawning migration runs. Recently, however, most fish have matured at age 4. Fish in this ESU are distinct from those of adjacent ESUs in life history and marine distribution. The life history of UWR chinook salmon includes traits from both ocean- and stream-type developmental strategies. CWT recoveries indicate that the fish travel to the marine waters off British Columbia and Alaska. More Willamette River chinook salmon are recovered in Alaskan waters than those from the LCR ESU. The timing of the spawning migration is limited by Willamette Falls. High flows in the spring allow access to the Upper Willamette Basin, whereas low flows in the summer and autumn prevent later-migrating fish from ascending the falls. The low flows may serve as an isolating mechanism, separating this ESU from others nearby.

Steelhead

Steelhead can be divided into two basic run types based on the level of sexual maturity at the time of river entry and the duration of the spawning migration (Burgner et al., 1992). The stream-maturing type, or summer steelhead, enters fresh water in a sexually immature condition and requires several months in fresh water to mature and spawn. The ocean-maturing type, or winter steelhead, enters freshwater with well-developed gonads and spawns shortly after river entry (Barnhart, 1986). Variation in migration timing exists between populations. Some river basins have both summer and winter steelhead, others have only one run type. In the Pacific Northwest, summer steelhead enter freshwater between May and October (Busby et al., 1996; Nickelson et al., 1992). During summer and fall, before spawning, they hold in cool, deep pools (Nickelson et al., 1992). They migrate inland toward spawning areas, overwinter in the larger rivers, resume migration to natal streams in early spring, and then spawn (Meehan and Bjornn, 1991; Nickelson et al., 1992). Winter steelhead enter freshwater between November and April in the Pacific Northwest (Busby et al., 1996; Nickelson et al., 1992), migrate to spawning areas, and then spawn in late winter or spring.

Unlike Pacific salmon, steelhead are capable of spawning more than once before death. However, it is rare for steelhead to spawn more than twice before dying, and most that do so are females (Nickelson et al., 1992). Steelhead spawn in cool, clear streams with suitable gravel size, depth, and current velocity. Intermittent streams may also be used for spawning (Barnhart, 1986; Everest, 1973). Steelhead enter streams and arrive at spawning grounds weeks or even months before they spawn and are vulnerable to disturbance and predation during that time.

Depending on water temperature, steelhead eggs may incubate for 1.5 to four months before hatching. Summer rearing takes place primarily in the faster parts of pools, although young-of-the-year are abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Productive steelhead habitat is characterized by complexity—primarily in the form of large and small woody debris. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (Nickelson et al., 1992).

Juveniles rear in fresh water from one to four years, then migrate to the ocean as smolts. Winter

steelhead populations generally smolt after two years in freshwater. Steelhead typically reside in marine waters for two or three years before returning to their natal stream to spawn at four or five years of age. Populations in Oregon and California have higher frequencies of age-1-ocean steelhead than populations to the north, but age-2-ocean steelhead generally remain dominant. The age structure appears to be similar to other west coast steelhead—dominated by 4-year-old spawners (Busby et al., 1996). Based on purse-seine catches, juvenile steelhead tend to migrate directly offshore during their first summer, in contrast to salmon which migrate along the coastal belt. Oregon steelhead tend to be north-migrating (Nicholas and Hankin, 1988; Pearcy et al., 1990; Pearcy, 1992).

LCR Steelhead ESU

The LCR steelhead ESU encompasses all steelhead runs in tributaries between the Cowlitz and Wind Rivers on the Washington side of the Columbia River, and the Willamette and Hood Rivers on the Oregon side. The populations of steelhead that make up the LCR ESU are distinguished from adjacent populations by genetic and habitat characteristics. The ESU consists of summer and winter coastal steelhead runs in the tributaries of the Columbia River as it cuts through the Cascades. These populations are genetically distinct from inland populations (east of the Cascades), as well as from steelhead populations in the Upper Willamette River Basin and coastal runs north and south of the Columbia River mouth. The following runs are not included in the ESU: the Willamette River above Willamette Falls (UWR ESU), the Little and Big White Salmon rivers (Middle Columbia River ESU), and runs based on four imported hatchery stocks (early-spawning winter Chambers Creek/Lower Columbia River mix, summer run Skamania Hatchery stock, winter Eagle Creek National Fish Hatchery stock, and winter run Clackamas River ODFW stock) (NMFS, 1997a). This area has at least 36 distinct runs (Busby et al., 1996), 20 of which were identified in the initial listing petition. In addition, numerous small tributaries have historical reports of fish, but no current abundance data.

UWR Steelhead ESU

The UWR steelhead ESU occupies the Willamette River and tributaries upstream of Willamette Falls, extending to and including the Calapooia River. These major river basins containing spawning and rearing habitat comprise more than 12,000 km in Oregon. Rivers that contain naturally spawning winter-run steelhead include the Tualatin, Molalla, Santiam, Calapooia, Yamhill, Rickreall, Luckiamute, and Mary's, although the origin and distribution of steelhead in a number of these basins is being debated. Early migrating winter and summer steelhead have been introduced into the Upper Willamette River basin, but those components are not part of the ESU. In general, native steelhead of the Upper Willamette River basin are the late-migrating winter variety entering freshwater primarily in March and April. This atypical run timing appears to be an adaptation for ascending Willamette Falls, which functions as an isolating mechanism for UWR steelhead. Reproductive isolation resulting from the falls may explain the genetic distinction between steelhead from the Upper Willamette River basin and those in the lower river. UWR late-migrating steelhead are ocean-maturing fish. Most return at age 4, with a small proportion returning as 5-year-olds (Busby et al., 1996).

Chum Salmon

Historically, chum salmon were distributed throughout the coastal regions of western Canada and the United States, as far south as Monterey Bay, California. Presently, major spawning populations are found only as far south as Tillamook Bay on the northern Oregon coast. Chum salmon spawn primarily in freshwater and, apparently, exhibit obligatory anadromy (there are no recorded landlocked or naturalized freshwater populations, Randall et al., 1987). Chum salmon spend more of their life history in marine waters than do other Pacific salmonids. Chum salmon, like pink salmon, usually spawn in the lower river reaches, with redds usually dug in the mainstem or in side channels of rivers from just above tidal influence to nearly 100 km from the sea. Juveniles outmigrate to seawater almost immediately after emerging from the gravel (Salo, 1991). This ocean-type migratory behavior contrasts with the stream-type behavior of some other species in the genus *Oncorhynchus* (e.g., coastal cutthroat trout, steelhead, coho salmon, and most types of chinook and sockeye salmon), which usually migrate to sea at a larger size, after months or years of freshwater rearing. This means that survival and growth in juvenile chum salmon depend less on freshwater conditions (unlike stream-type salmonids which depend heavily on freshwater habitats) than on favorable estuarine conditions. Another behavioral difference between chum salmon and species that rear extensively in freshwater is that chum salmon form schools, presumably to reduce predation (Pitcher, 1986), especially if their movements are synchronized to swamp predators (Miller and Brannon, 1982).

CR Chum Salmon ESU

Chum salmon from the CR ESU spawn in tributaries and in mainstem spawning areas below Bonneville Dam, most often on the Washington side of the Columbia River (Johnson et al., 1997). Chum salmon enter the Columbia River from mid-October through early December and spawn from early November to late December. Recent genetic analysis of fish from Hardy and Hamilton Creeks and from the Grays River indicate that these fish are genetically distinct from other chum salmon populations in Washington (Salo, 1991; WDF et al., 1993; Johnson et al., 1997).

Overview Status of the Species in the Action Area

To determine a species' status under extant conditions (usually termed "the environmental baseline"), it is necessary to ascertain the degree to which the species' biological requirements are being met at the time of the proposed action and in that action area. For the purposes of this consultation, the biological requirements of these threatened ESUs are expressed in two ways: population parameters such as fish numbers, distribution, and trends through-out the action area; and the condition of various essential habitat features such as water quality, substrate condition, and food availability. Clearly, these two types of information are interrelated; the condition of a given habitat has a great deal of impact on the number of fish it can support. Nonetheless, it is useful to separate the species' biological requirements into these parameters because doing so is a good way to get a full picture of all the factors affecting the survival of listed fish and their

response to those factors. Therefore, the discussion to follow will be divided into two parts: (1) Species Distribution and Trends and (2) Factors Affecting the Environmental Baseline.

Species Distribution and Trends

LCR Chinook Salmon

Historical records of chinook salmon abundance are sparse, but cannery records suggest a peak run of 4.6 million fish in 1883. Although fall-run chinook salmon are still present throughout much of their historical range, most of the fish spawning today are first-generation hatchery strays. Furthermore, spring-run populations have been severely depleted throughout the ESU and extirpated from several rivers. In 1998, NMFS reassessed the status of this ESU (NMFS, 1998). Updated abundance information indicated that smaller tributary streams in the range of the ESU support naturally spawning chinook salmon runs numbering in the hundreds of fish. Larger tributaries (e.g., Cowlitz River basin) contain natural runs of chinook salmon ranging in size from 100 to almost 1,000.

Recent adult data for this ESU are summarized in NMFS' draft report titled Preliminary Conclusions Regarding the Updated Status of Listed ESUs of West Coast Salmon and Steelhead NMFS, 2003b). NMFS calculated adult abundance using the geometric mean of natural origin spawners for last five years of data. The total recent abundance for adult LCR chinook salmon is estimated at 11,720 fish.

It is difficult to make accurate estimations of the numbers of juvenile chinook in this ESU during the coming five years. However, in 2003 approximately 15,553,000 naturally-produced smolts are estimated to reach Tongue Point in the Columbia River (NMFS, 2003a). As with other species, it is reasonable to assume that this figure could be substantially higher when other juvenile life stages are included.

For this ESU as a whole, NMFS (2001) estimates that the median population growth rate over the base period (i.e., data from 1980 to the most recent year available) ranges from 0.98 to 0.88, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of natural origin fish. NMFS estimated the risk of absolute extinction for nine spawning aggregations, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years ranges from zero for the Sandy River late run and Big Creek to 1.00 for Mill Creek. At the high end, assuming that the hatchery fish spawning in the wild have been as productive as natural origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years is 0.99 for all but one of nine spawning aggregations (zero for the Sandy River late).

UWR Chinook Salmon

Based on egg collections at salmon hatcheries, Mattson (1948) estimated the spring chinook salmon run in the 1920s may have been five times the run size of 55,000 fish in 1947, or 275,000 fish. The spring run has been counted at Willamette Falls since 1946, but jacks were not differentiated from the total count until 1952. The geometric mean of the estimated run size from 1946 through 1950 was 43,300 fish, compared to an estimate for 1994 through 1998 of 25,500 (NMFS, 2001). Nicholas (1995) estimated only 3,900 natural spawners in 1994 for the ESU, approximately 1,300 of these naturally-produced. The number of naturally spawning fish has increased gradually in recent years, but many are considered to be first-generation hatchery fish (NMFS, 2001).

Recent adult data for this ESU are summarized in ODFW and WDFW (2002). An estimated 73,800 adult Upper Willamette River chinook salmon were expected to return in 2002. The final run size was reported at 121,700 fish. Run size projections at Willamette Falls for 2003 is estimated to be 109,800 (www.dfw.state.or.us/odfwhtml/infocntrFish/willam.html#graphs).

It is not possible to make accurate estimates of the numbers of juveniles in this ESU during the coming year. However, in 2003, approximately 1,731,554 naturally-produced smolts are estimated to reach Tongue Point in the Columbia River (NMFS, 2003a). As with other species, it is reasonable to assume that this figure could be substantially higher when other juvenile life stages are included.

For this ESU as a whole, NMFS (2001) estimates that the median population growth rate over the base period (i.e., data from 1980 to the most recent year available) ranges from 1.01 to 0.63, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of natural origin fish. NMFS has also estimated the risk of absolute extinction for the aggregate Upper Willamette River chinook salmon population in the McKenzie River, above Leaburg, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years is 0.01. At the high end, assuming that the hatchery fish spawning in the wild have been as productive as natural origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years is 0.85.

LCR Steelhead

Recent adult data for this ESU are summarized in NMFS' Biological Opinion on the Issuance and Funding of Five Section 10(a)(1)(A) Permits and Permit Modifications for Take of Threatened Upper Willamette River Chinook Salmon, Lower Columbia River Chinook Salmon, Lower Columbia River Steelhead, and Columbia River Chum Salmon for Scientific Research and Enhancement Purposes (NMFS, 2002a). For the larger runs (Cowlitz, Kalama, and Sandy River populations), current counts have been in the range of 1,000 to 2,000 fish; historical counts, however, put these runs at more than 20,000 fish. In general, all runs in the ESU have declined over the past 20 years, with sharp declines in the last five years.

As described previously, it is difficult to make accurate estimations of the numbers of adult steelhead in this ESU during the coming year. However, adult escapement estimates compiled for 2002 indicate that approximately 22,000 steelhead have escaped to spawn in this ESU (D. Rawding, WDFW; T. Shibahara, PGE; D. Caldwell, E. Olsen, K. Leader, and R. Boatner, ODFW; pers. comm. February and March 2003). Although this is higher than recent adult returns, ODFW and WDFW staff expect adult returns to stabilize around this number or increase slightly.

It is not possible to make accurate estimates of the numbers of juveniles in this ESU during the coming year. However, in 2003, approximately 227,000 naturally-produced smolts are estimated to reach Tongue Point in the Columbia River (NMFS, 2003a). As with other species, it is reasonable to assume that this figure could be substantially higher when other juvenile life stages are included.

For this ESU as a whole, NMFS (2001) estimates that the median population growth rate over the base period (i.e., data from 1980 to the most recent year available) ranges from 0.98 to 0.78, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of natural origin fish. NMFS has also estimated the risk of absolute extinction for seven of the spawning aggregations, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years ranges from zero for the Kalama River summer run and the Clackamas River and Kalama River winter runs to 1.00 for the Clackamas River summer run and the Toutle River winter run. Assuming that the hatchery fish spawning in the wild have been as productive as natural origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years rises to 1.00 for all but one population (the risk of extinction is 0.86 for the Green River winter run).

UWR Steelhead

Recent adult data for this ESU are summarized in NMFS' Biological Opinion on the Issuance and Funding of 24 Section 10(a)(1)(A) Permits, Permit Modifications, and Permit Amendments for Take of Threatened Upper Willamette River Chinook Salmon, Lower Columbia River Chinook Salmon, Upper Willamette River Steelhead, Lower Columbia River Steelhead, and Columbia River Chum Salmon for Scientific Research and Enhancement Purposes (NMFS, 2002b). Native winter steelhead within this ESU have been declining since 1971 and have exhibited large fluctuations in abundance. In 1997, NMFS reassessed the status of this ESU (NMFS, 1997b). Updated counts of winter steelhead adults above Foster Dam through 1997 showed very low numbers in the past few years (131-311 naturally-produced fish). Run reconstructions for winter steelhead in the Molalla, North Santiam, and South Santiam Rivers indicate moderate sized runs in these streams (850-1,200 adults). In addition, estimated spawner abundance in the Calapooia River indicate that spawners in this basin have recently reached record lows.

It is difficult to make accurate estimations of the numbers of adult and juvenile steelhead in this ESU during the coming year. However, adult steelhead and other species are counted at the Willamette Falls fishway. Counts in 2002 totaled over 14,000 fish, although a small percentage of those fish are artificially-propagated and some are fish that are not part of the ESU (i.e., those returning to tributaries upstream of the Calapooia River). Approximately 40,800 listed adult Upper Willamette River ESU steelhead arrived at Willamette Falls during 2002 (R. Boatner, ODFW, pers. comm. 2/21/03). Estimates of the 2003 adult run is not available at this time but may be conservatively estimated at 30,000 fish. In 2003, approximately 184,000 naturally-produced smolts are estimated to reach Tongue Point in the Columbia River (NMFS, 2003a). As with other species, it is reasonable to assume that this figure could be substantially higher when other juvenile life stages are included.

For this ESU as a whole, NMFS (2001) estimates that the median population growth rate over the base period (i.e., data from 1980 to the most recent year available) ranges from 0.94 to 0.87, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of natural origin fish. NMFS has also estimated the risk of absolute extinction for four spawning aggregations, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years ranges from zero for the South Santiam River to 0.74 for the Calapooia River. Assuming that the hatchery fish spawning in the wild have been as productive as natural origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years ranges from 0.74 for the Calapooia River to 1.00 for the Molalla River and South Santiam River spawning aggregations.

CR Chum Salmon

Historically, the CR chum salmon ESU supported a large commercial fishery, landing more than 500,000 fish per year and chum salmon were reported in almost every river in the lower Columbia River basin. Most runs disappeared by the 1950s (Fulton, 1970). There are now no recreational or directed commercial fisheries for chum salmon in the Columbia River, although chum salmon are taken incidentally in the gill-net fisheries for coho and chinook salmon, and some tributaries have a minor recreational harvest. The estimated minimum run size for the Columbia River ESU has been relatively stable, although at a very low level, since the run collapsed during the mid-1950s. Current abundance is probably less than 1% of historical levels, and the ESU has undoubtedly lost some (perhaps much) of its original genetic diversity (NMFS, 1997c). Currently, WDFW regularly monitors only a few natural "index" populations in the basin, one in Grays River, two in small streams near Bonneville Dam, and the mainstem area next to the latter two streams. Average annual natural escapement to the index spawning areas was approximately 1,300 fish from 1990 through 1998 (ODFW and WDFW, 1999). WDFW has surveyed other (nonindex) areas in 1998 and found only small numbers of chum salmon (typically less than 10 fish per stream) in Elochoman, Abernathy, Germany, St. Cloud, and Tanner creeks and in the North Fork Lewis and the Washougal rivers. The state of Oregon does not conduct targeted surveys, so the current extent of chum salmon spawning on the Oregon side

of the river is unknown.

It is not possible to make accurate estimates of the numbers of adult and juveniles in this ESU during the coming year. NMFS (2003b) summarizes preliminary scientific conclusions of the NMFS Biological Review Team regarding the updated status of 26 listed salmon and steelhead, including Columbia River chum salmon. Preliminary data indicate that the 2002 chum salmon abundance has shown a substantial increase below Bonneville Dam, the location where a majority of these fish are expected to be encountered. In 2002, approximately 2,000 chum were estimated to return to the Hardy and Hamilton creeks and 8,000 or more to the mainstem. While we currently lack data on naturally-produced juvenile chum salmon production for this ESU, it is possible to make rough estimates of juvenile abundance from adult return data. A rough estimate of chum smolt escapement is 880 smolts per female (Northwest Indian Fisheries Commission, 2001). By using the estimated return of 5,000 females (half of the 10,000) to this ESU, roughly 4.4 million smolts may be produced annually. Because chum salmon migrate almost immediately after emergence from the gravel, no other life stages may be affected by the research.

NMFS (2001) estimates an median population growth rate of 1.04 over the base period, (i.e., data from 1980 to the most recent year available) for the ESU as a whole. Because census data are peak counts (and because the precision of those counts decreases markedly during the spawning season as water levels and turbidity rise), the risk of absolute extinction for this ESU has not been estimated.

Summary

The degree to which each of these threatened ESUs' biological requirements are being met in the action area with respect to population numbers and distribution has not improved substantially since the time of listing. While some improvement can be seen throughout a given ESU as a whole, populations in critical subbasins exhibit continuing declining trends. Therefore, while there is some cause for optimism, there has been no genuine change in the status of each of these ESUs since they were listed, and the most likely scenario is that their biological requirements are not being met with respect to abundance, distribution, and overall trend.

Factors Affecting the Environmental Baseline

Environmental baselines for biological opinions are defined by regulation at 50 CFR 402.02, which states that an environmental baseline is the physical result of all past and present state, Federal, and private activities in the action area along with the anticipated impacts of all proposed Federal projects in the action area (that have already undergone formal or early section 7 consultation). The environmental baseline for this biological opinion is therefore the result of the impacts that many activities have had on the threatened ESUs' survival and recovery. Put another way (and as touched upon previously) the baseline is the culmination of these effects

that multiple activities have had on these species' biological requirements and, by examining those individual effects, it is possible to derive the species' status in the action area.

Many of the biological requirements for threatened LCR chinook salmon, threatened LCR steelhead, threatened UWR chinook salmon, threatened UWR steelhead, and threatened CR chum salmon in the action area can best be expressed in terms of essential habitat features. That is, the salmon require adequate: (1) substrate (especially spawning gravel), (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) migration conditions (NMFS, 2000a). The best scientific information presently available demonstrates that a multitude of factors, past and present, have contributed to the decline of west coast salmonids by adversely affecting these essential habitat features. These factors are well known and documented in dozens—if not hundreds—of scientific papers, policy documents, news articles, books, and other media. It is therefore unnecessary to illustrate in this opinion the many ways in which human activities and natural factors have affected the threatened ESUs' habitat-related biological requirements; thus the following paragraphs constitute a brief summary of what the most recent accepted science has to say about how human action and natural processes have degraded essential habitat features in the affected subbasins.

Some factors in the action area (e.g., hydropower and agricultural development) have had adverse effects on every single one of the habitat-related biological requirements listed above, while other factors have only affected some of those essential habitat features. For example, road building in the subbasins has had a sizeable effect on stream substrates and water quality (through siltation), and road culverts have blocked fish passage, but such activities have not had much of an effect on water velocity. Timber harvest and grazing activities have affected—to greater or lesser degrees—all the factors except space. Further, mining has affected most of the factors—but primarily water quality. And urban development has affected them all, and is a substantial factor for these largely urban and suburban subbasins. In fact, three of Oregon's largest cities, Portland, Salem, and Eugene, are within the affected subbasins. In short, nearly every widespread human activity in the basin has adversely affected some or all of habitat features listed above. And by disrupting those habitat features, these activities—coupled with hatchery and fishery effects and occasional natural disturbances such as drought and fire—have had detrimental impacts on the ESUs' health, physiology, numbers, and distribution in every subpopulation and at every life stage. For detailed information on how various factors have degraded essential habitat features, please see any of the following: NMFS (1991), Nehlsen (1991), NMFS (1997a), NMFS (1998), NMFS (2000a), NMFS (2001).

All listed fish are the subject of scientific research and monitoring actions. Most biological opinions issued by NMFS have conditions requiring specific monitoring, evaluation, and research projects to gather information to aid the survival of listed fish. Recently, NMFS issued numerous research permits/authorizations allowing take of threatened LCR chinook salmon, threatened LCR steelhead, threatened UWR chinook salmon, threatened UWR steelhead, and

threatened CR chum salmon (NMFS, 2002a, 2002b, 2003c) which are summarized in Table 2.

Table 2. Total Authorized Take for Scientific Research Actions in 2003.

	LCR Chinook Salmon				UWR Chinook Salmon			
	Adult		Juvenile		Adult		Juvenile	
	Non-Lethal	Lethal	Non-Lethal	Lethal	Non-Lethal	Lethal	Non-Lethal	Lethal
Section 10 Research	58	1	13,631	691	206	3	1,209	55
4(d) Research	5,448	40	549,064	9,289	11,570	74	144,373	5,429
TOTAL	5,506	41	562,695	9,980	11,776	77	145,582	5,484

	LCR Steelhead				UWR Steelhead			
	Adult		Juvenile		Adult		Juvenile	
	Non-Lethal	Lethal	Non-Lethal	Lethal	Non-Lethal	Lethal	Non-Lethal	Lethal
Section 10 Research	78	0	11,233	523	45	0	403	8
4(d) Research	9,391	87	154,427	4,012	5,196	64	27,230	551
TOTAL	9,469	87	165,660	4,535	5,241	64	27,633	559

	CR Chum Salmon			
	Adult		Juvenile	
	Non-Lethal	Lethal	Non-Lethal	Lethal
Section 10 Research	425	4	120,656	1,608
4(d) Research	5,695	35	111,801	1,562
TOTAL	6,120	39	232,457	3,170

Each authorization for take by itself would not lead to decline of the species. However the sum of the authorized takes indicate a high level of research effort in the action area. The effect of these actions is difficult to assess because, despite the fact that fish are harassed and sometimes even killed in the course of scientific research, these actions have a great potential to benefit to listed species. For example, aside from simply increasing what is known about the listed species and their biological requirements, research is essentially the only way to answer key questions associated with difficult resource issues that crop up in every management arena and involve every salmonid life history stage (particularly the resource issues discussed in the previous sections). Most importantly, the information gained during research and monitoring actions will help resource managers plan for the recovery of listed species. Further, there is no way to tell if the corrective measures described in the previous sections are working unless they are monitored, and there is no way to design new and better approaches if research is not done.

The picture of whether threatened LCR chinook salmon, threatened LCR steelhead, threatened

UWR chinook salmon, threatened UWR steelhead, and threatened CR chum salmon's biological requirements are being met is more clear-cut for habitat-related parameters than for population factors: given all the factors for decline—even taking into account the corrective measures being implemented[1]—it is clear that their biological requirements are currently not being met under the environmental baseline. Their status' are such that there must be a significant improvement in the environmental conditions of the species' respective habitats (over those currently available under the environmental baselines). Any further degradation of the environmental conditions could have a large impact because the species' are already at risk. In addition, there must be efforts to minimize impacts caused by dams, harvest, hatchery operations, habitat degradation, and unfavorable natural conditions.

[1] See the following documents for a summary of conservation efforts: Steelhead Conservation Efforts: A Supplement to the Notice of Determination for West Coast Steelhead Under the Endangered Species Act, August 1996; Coastal Salmon Conservation Working Guidance for Comprehensive Salmon Restoration Initiatives on the Pacific Coast, September 15, 1996; NOAA Technical Memorandum NMFS-NWFSC-42, June 2000, Viable Salmon Populations and the Recovery of Evolutionarily Significant Units.

EFFECTS OF THE ACTION

The purpose of this section is to identify what effects NMFS' issuance of scientific research permits will have on the threatened ESUs that are the subject of this Opinion. To the extent possible, this will include analyses of effects at the population level. Where information on the ESUs is lacking at the population level, this analysis assumes that the status of each affected population is the same as the ESU as a whole. The method NMFS uses for evaluating effects is discussed first, followed by discussions of the general effects scientific research activities are known to have and permit-specific effects.

Evaluating the Effects of the Action

Over the course of the last decade and hundreds of ESA section 7 consultations, NMFS developed the following four-step approach for applying the ESA Section 7(a)(2) standards when determining what effect a proposed action is likely to have on a given listed species. What follows here is a summary of that approach:

1. Define the biological requirements and current status of each listed species.

2. Evaluate the relevance of the environmental baseline to the species' current status.

3. Determine the effects of the proposed or continuing action on listed species and their habitat.

4. Determine whether the species can be expected to survive with an adequate potential for recovery under (a) the effects of the proposed (or continuing) action, (b) the effects of the environmental baseline, and (c) any cumulative effects—including all measures being taken to improve salmonid survival and recovery.

The fourth step above requires a two-part analysis. The first part focuses on the action area and defines the proposed action's effects in terms of the species' biological requirements in that area (i.e., impacts on essential habitat features). The second part focuses on the species itself. It describes the action's impact on individual fish—or populations, or both—and places that impact in the context of the ESU as a whole. Ultimately, the analysis seeks to answer the questions of whether the proposed action is likely to jeopardize a listed species' continued existence or destroy or adversely modify its designated critical habitat (if any exists) (NMFS, 1999).

Effects on Habitat

Previous sections have detailed the scope of the habitat in the action area, described the essential

features of that habitat, and depicted its present condition. The discussion here focuses on how those features are likely to be affected by the proposed actions.

Full descriptions of the proposed activities are found in the next section. In general, the activities will be: (a) electrofishing using backpack and boat-based equipment; (b) capturing fish with angling equipment, traps and nets of various types; and (c) marking the captured fish with various types of tags. All of these techniques are minimally intrusive in terms of their effect on habitat. None of them will measurably affect any of the 10 essential fish habitat features listed earlier (i.e., stream substrates, water quality, water quantity, food, streamside vegetation, etc.). Moreover, the proposed activities are all of short duration. Therefore, NMFS concludes that the proposed activities are unlikely to have an adverse impact on habitat, and thus will not jeopardize the fish by reducing the ability of that habitat to contribute to their survival and recovery.

Effects on LCR Chinook Salmon, UWR Chinook Salmon, LCR Steelhead, UWR Steelhead, and CR Chum Salmon

The primary effects the proposed activities will have on the threatened ESUs will be in the form of intentional "take" (the ESA take definition is given in the section introducing the individual permits), a major portion of which takes the form of harassment. Harassment generally leads to stress and other sub-lethal effects and is caused by observing, capturing, and handling fish. The ESA does not define harassment nor has NMFS defined this term through regulation. However, the USFWS defines harassment as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to breeding, feeding or sheltering" [50 CFR 17.4]. For the purposes of this analysis, NMFS adopts this definition of harassment.

As Table 1 illustrates, the various proposed activities would cause many types of take, and while there is some uncertainty between what constitutes an activity (e.g., electrofishing) and what constitutes a take category (e.g., harm), it is important to keep the two concepts separate. The reason for this is that the effects being measured here are those which the activity itself has on the listed species. They may be expressed in terms of the take categories (e.g., how many salmon are harmed, or harassed, or even killed), but the actual mechanisms of the effects themselves (i.e., the activities) are the causes of whatever take arises and, as such, they bear examination. Therefore, the first part of this section is devoted to a discussion of the general effects known to be caused by the proposed activities—regardless of where they occur or what species are involved.

The following subsections describe the types of activities being proposed. Because they would all be carried out by trained professionals using established protocols and have widely recognized specific impacts, each description is described in terms broad enough to apply to

every proposed permit. This is especially true in light of the fact that the researchers would not receive a permit unless their activities (e.g., electrofishing) incorporate NMFS' uniform, pre-established set of mitigation measures. These measures are described previously in this Opinion. They are incorporated (where relevant) into every permit as part of the terms and conditions to which a researcher must adhere.

Observation

For some studies, listed fish will be observed in-water (i.e., snorkel surveys). Direct observation is the least disruptive and simplest method for determining presence/absence of the species and estimating their relative abundance. Its effects are also generally the shortest-lived among any of the research activities discussed in this section. Typically, a cautious observer can obtain data without disrupting the normal behavior of a fish. Fry and juveniles frightened by the turbulence and sound created by observers are likely to seek temporary refuge behind rocks, vegetation, and deep water areas. In extreme cases, some individuals may temporarily leave a particular pool or habitat type when observers are in their area. Researchers minimize the amount of disturbance by moving through streams slowly thus allowing ample time for fish to reach escape cover; though it should be noted that the research may at times involve observing adult fish—which are more sensitive to disturbance. During some of the research activities discussed below, redds may be visually inspected, but no redds will be walked on. Harassment is the primary form of take associated with these observation activities, and few if any injuries or deaths are expected to occur—particularly in cases where the observation is to be conducted solely by researchers on the stream banks rather than in the water. There is little a researcher can do to mitigate the effects associated with observation activities because those effects are so minimal. In general, all they can do is move with care and attempt to avoid disturbing sediments, gravels, and, to the extent possible, the fish themselves.

Capture/handling

Capturing and handling fish causes them stress—though they typically recover fairly rapidly from the process and therefore the overall effects of the procedure are generally short-lived. The primary contributing factors to stress and death from handling are excessive doses of anesthetic, differences in water temperatures (between the river and wherever the fish are held), dissolved oxygen conditions, the amount of time that fish are held out of the water, and physical trauma. Stress on salmonids increases rapidly from handling if the water temperature exceeds 18°C or dissolved oxygen is below saturation. Fish that are transferred to holding tanks can experience trauma if care is not taken in the transfer process, and fish can experience stress and injury from overcrowding in traps if the traps are not emptied on a regular basis. Debris buildup at traps can also kill or injure fish if the traps are not monitored and cleared on a regular basis. To minimize these effects NMFS adds terms and conditions to every permit.

Based on prior experience with the research techniques and protocols that would be used to conduct the proposed scientific research, no more than five percent of the juvenile salmonids encountered are likely to be killed as an unintentional result of being captured and handled and,

in most cases, that figure will not exceed three percent. In addition, it is not expected that more than three percent of the adults being handled will die. In any case, all researchers will employ the mitigation measures described earlier and thereby keep adverse effects to a minimum. Finally, any fish unintentionally killed by the research activities in the proposed permits may be retained as reference specimens or used for other research purposes.

Electrofishing

Electrofishing is a process by which an electrical current is passed through water containing fish in order to stun them—thus making them easy to capture. It can cause a suite of effects ranging from simple harassment to actually killing the fish. The amount of unintentional mortality attributable to electrofishing may vary widely depending on the equipment used, the settings on the equipment, and the expertise of the technician. Electrofishing can have severe effects on adult salmonids. Spinal injuries in adult salmonids from forced muscle contraction have been documented. Sharber and Carothers (1988) reported that electrofishing killed 50 percent of the adult rainbow trout in their study. The long-term effects electrofishing has on both juveniles and adult salmonids are not well understood, but long experience with electrofishing indicates that most impacts occur at the time of sampling and are of relatively short duration.

The effects electrofishing may have on the threatened ESUs would be limited to the direct and indirect effects of exposure to an electric field, capture by netting, holding captured fish in aerated tanks, and the effects of handling associated with transferring the fish back to the river (see the previous subsection for more detail on capturing and handling effects). Most of the studies on the effects of electrofishing on fish have been conducted on adult fish greater than 300 mm in length (Dalbey et al., 1996). The relatively few studies that have been conducted on juvenile salmonids indicate that spinal injury rates are substantially lower than they are for large fish. Smaller fish intercept a smaller head-to-tail potential than larger fish (Sharber and Carothers, 1988) and may therefore be subject to lower injury rates (e.g., Hollender and Carline, 1994; Dalbey et al., 1996; Thompson et al., 1997). McMichael et al. (1998) found a 5.1% injury rate for juvenile Middle Columbia River steelhead captured by electrofishing in the Yakima River subbasin. The incidence and severity of electrofishing damage is partly related to the type of equipment used and the waveform produced (Sharber and Carothers, 1988; McMichael, 1993; Dalbey et al., 1996; Dwyer and White, 1997). Continuous direct current (DC) or low-frequency ($\leq$30 Hz) pulsed DC have been recommended for electrofishing (Fredenberg, 1992; Snyder, 1992, 1995; Dalbey et al., 1996) because lower spinal injury rates, particularly in salmonids, occur with these waveforms (Fredenberg, 1992; McMichael, 1993; Sharber et al., 1994; Dalbey et al., 1996). Only a few recent studies have examined the long-term effects of electrofishing on salmonid survival and growth (Dalbey et al., 1996; Ainslie et al., 1998). These studies indicate that although some of the fish suffer spinal injury, few die as a result. However, severely injured fish grow at slower rates and sometimes they show no growth at all (Dalbey et al., 1996).

NMFS' electrofishing guidelines (NMFS, 2000b) will be followed in all surveys using this procedure. The guidelines require that field crews be trained in observing animals for signs of

stress and shown how to adjust electrofishing equipment to minimize that stress. Electrofishing is used only when other survey methods are not feasible. All areas for stream and special needs surveys are visually searched for fish before electrofishing may begin. Electrofishing is not done in the vicinity of redds or spawning adults. All electrofishing equipment operators are trained by qualified personnel to be familiar with equipment handling, settings, maintenance, and safety. Operators work in pairs to increase both the number of fish that may be seen and the ability to identify individual fish without having to net them. Working in pairs also allows the researcher to net fish before they are subjected to higher electrical fields. Only DC units will be used, and the equipment will be regularly maintained to ensure proper operating condition. Voltage, pulse width, and rate will be kept at minimal levels and water conductivity will be tested at the start of every electrofishing session so those minimal levels can be determined. Due to the low settings used, shocked fish normally revive instantaneously. Fish requiring revivification will receive immediate, adequate care.

The preceding discussion focused on the effects of using a backpack unit for electrofishing and the ways those effects will be mitigated. It should be noted, however, that in larger streams and rivers electrofishing units are sometimes mounted on boats. These units often use more current than backpack electrofishing equipment because they need to cover larger (and deeper) areas and, as a result, can have a greater impact on fish. In addition, the environmental conditions in larger, more turbid streams can limit researchers' ability to minimize impacts on fish. For example, in areas of lower visibility it is difficult for researchers to detect the presence of adults and thereby take steps to avoid them. Because of its greater potential to harm fish, and because NMFS has not published appropriate guidelines, boat electrofishing has not been given a general authorization under NMFS' recent ESA section 4(d) rules. In any case, all researchers intending to use boat electrofishing will use all means at their disposal to ensure that a minimum number of fish are harmed.

Tagging/Marking

Techniques such as PIT-tagging (passive integrated transponder tagging), coded wire tagging, fin-clipping, and the use of radio transmitters are common to many scientific research efforts using listed species. All sampling, handling, and tagging procedures have an inherent potential to stress, injure, or even kill the marked fish. This section discusses each of the marking processes and its associated risks.

A PIT tag is an electronic device that relays signals to a radio receiver; it allows salmonids to be identified whenever they pass a location containing such a receiver (e.g., any of several dams) without researchers having to handle the fish again. The tag is inserted into the body cavity of the fish just in front of the pelvic girdle. The tagging procedure requires that the fish be captured and extensively handled, therefore any researchers engaged in such activities will follow the conditions listed previously in this Opinion (as well as any permit-specific terms and conditions) to ensure that the operations take place in the safest possible manner. In general, the tagging operations will take place where there is cold water of high quality, a carefully controlled

environment for administering anesthesia, sanitary conditions, quality control checking, and a carefully regulated holding environment where the fish can be allowed to recover from the operation.

PIT tags have very little effect on growth, mortality, or behavior. The few reported studies of PIT tags have shown no effect on growth or survival (Prentice et al., 1987; Jenkins and Smith, 1990; Prentice et al., 1990). For example, in a study between the tailraces of Lower Granite and McNary Dams (225 km), Hockersmith et al. (2000) concluded that the performance of yearling chinook salmon was not adversely affected by gastrically- or surgically implanted sham radio tags or PIT-tags. Additional studies have shown that growth rates among PIT-tagged Snake River juvenile fall chinook salmon in 1992 (Rondorf and Miller, 1994) were similar to growth rates for salmon that were not tagged (Conner et al., 2001). Prentice and Park (1984) also found that PIT-tagging did not substantially affect survival in juvenile salmonids.

Coded wire tags (CWTs) are made of magnetized, stainless-steel wire. They bear distinctive notches that can be coded for such data as species, brood year, hatchery of origin, and so forth (Nielsen, 1992). The tags are intended to remain within the animal indefinitely, consequently making them ideal for long-term, population-level assessments of Pacific Northwest salmon. The tag is injected into the nasal cartilage of a salmon and therefore causes little direct tissue damage (Bergman et al., 1968; Bordner et al., 1990). The conditions under which CWTs may be inserted are similar to those required for applying PIT-tags.

A major advantage to using CWTs is the fact that they have a negligible effect on the biological condition or response of tagged salmon; however, if the tag is placed too deeply in the snout of a fish, it may kill the fish, reduce its growth, or damage olfactory tissue (Fletcher et al., 1987; Peltz and Miller, 1990). This latter effect can create problems for species like salmon because they use olfactory clues to guide their spawning migrations (Morrison and Zajac, 1987).

In order for researchers to be able to determine later (after the initial tagging) which fish possess CWTs, it is necessary to mark the fish externally—usually by clipping the adipose fin—when the CWT is implanted (see text below for information on fin clipping). One major disadvantage to recovering data from CWTs is that the fish must be killed in order for the tag to be removed. However, this is not a significant problem because researchers generally recover CWTs from salmon that have been taken during the course of commercial and recreational harvest (and are therefore already dead).

The other primary method for tagging fish is to implant them with radio tags. There are two main ways to accomplish this and they differ in both their characteristics and consequences. First, a tag can be inserted into a fish's stomach by pushing it past the esophagus with a plunger. Stomach insertion does not cause a wound and does not interfere with swimming. This technique is benign when salmon are in the portion of their spawning migrations during which they do not feed (Nielsen, 1992). In addition, for short-term studies, stomach tags allow faster

post-tagging recovery and interfere less with normal behavior than do tags attached in other ways.

The second method for implanting radio tags is to place them within the body cavities of (usually juvenile) salmonids. These tags do not interfere with feeding or movement. However, the tagging procedure is difficult, requiring considerable experience and care (Nielsen, 1992). Because the tag is placed within the body cavity, it is possible to injure a fish's internal organs. Infections of the sutured incision and the body cavity itself are also possible, especially if the tag and incision are not treated with antibiotics (Chisholm and Hubert, 1985; Mellas and Haynes, 1985).

Fish with internal radio tags often die at higher rates than fish tagged by other means because radio tagging is a complicated and stressful process. Mortality is both acute (occurring during or soon after tagging) and delayed (occurring long after the fish have been released into the environment). Acute mortality is caused by trauma induced during capture, tagging, and release. It can be reduced by handling fish as gently as possible. Delayed mortality occurs if the tag or the tagging procedure harms the animal in direct or subtle ways. Tags may cause wounds that do not heal properly, may make swimming more difficult, or may make tagged animals more vulnerable to predation (Howe and Hoyt, 1982; Matthews and Reavis, 1990; Moring, 1990). Tagging may also reduce fish growth by increasing the energetic costs of swimming and maintaining balance. As with the other forms of tagging and marking, researchers will keep the harm caused by radio tagging to a minimum by following the terms and conditions in the permits as well as any other permit-specific requirements.

Fin clipping is the process of removing part or all of one or more fins to alter a fish's appearance and thus make it identifiable. When entire fins are removed, it is expected that they will never grow back. Alternatively, a permanent mark can be made when only a part of the fin is removed or the end of a fin or a few fin rays are clipped. Although researchers have used all fins for marking at one time or another, the current preference is to clip the adipose, pelvic, or pectoral fins. Marks can also be made by punching holes or cutting notches in fins, or severing individual fin rays (Kohlhorst, 1979; Welch and Mills, 1981). Many studies have examined the effects of fin clips on fish growth, survival, and behavior. The results of these studies are somewhat variable; however, it can be said that fin clips do not generally alter fish growth. Studies comparing the growth of clipped and unclipped fish generally have shown no differences between them (Brynildson and Brynildson, 1967). Moreover, wounds caused by fin clipping usually heal quickly—especially those caused by partial clips.

Mortality among fin-clipped fish is also variable. Some immediate mortality may occur during the marking process, especially if fish have been handled extensively for other purposes (e.g., stomach sampling). Delayed mortality depends, at least in part, on fish size; small fishes have often been found to be susceptible to it. Coble (1967) suggested that fish shorter than 90 mm are at particular risk. The degree of mortality among individual fishes also depends on which fin is

clipped. Studies show that adipose- and pelvic-fin-clipped coho salmon fingerlings have a 100% recovery rate (Stolte, 1973). Recovery rates are generally recognized as being higher for adipose- and pelvic-fin-clipped fish in comparison to those that are clipped on the pectoral, dorsal, and anal fins (Nicola and Cordone, 1973). Clipping the adipose and pelvic fins probably kills fewer fish because these fins are not as important as other fins for movement or balance (McNeil and Crossman, 1979). Mortality is generally higher when the major median and pectoral fins are removed. Mears and Hatch (1976) showed that clipping more than one fin may increase delayed mortality but other studies have been less conclusive.

Regardless, any time researchers clip or remove fins, it is necessary that the fish be handled. Therefore, the same safe and sanitary conditions required for tagging operations also apply to clipping activities.

Stomach Flushing

Studies of the food and feeding habits of fish are important in the study of aquatic ecosystems, however food habit studies required researchers to kill fish for stomach removal and examination. Consequently, several methods were developed to remove stomach contents without injuring the fish. Most techniques use a rigid or semi-rigid tube to inject water into the stomach to flush out the contents.

Few assessments of associated mortality rates have been conducted with most nonlethal methods of examining fish stomach contents (Kamler and Pope, 2001). However, the following studies show that stomach flushing does not substantially affect survival in juvenile salmonids. Strange and Kennedy (1981) assessed the survival of salmonids subjected to stomach flushing and found no difference between stomach-flushed fish and control fish that were held for three to five days. In addition, Light et al. (1983) flushed the stomachs of electrofished and anesthetized brook trout. Survival was 100% for the entire observation period. In contrast, Meehan and Miller (1978) determined the survival rate of electrofished, anesthetized, and stomach flushed wild and hatchery coho salmon over a 30-day period to be 87% and 84% respectively.

Intentional Mortality/Sacrifice

In some instances, it is necessary to kill a captured fish in order to gather whatever data a study is designed to produce. In such cases, determining effect is a very straightforward process: the sacrificed fish, if juveniles, are forever removed from the ESU's gene pool; if the fish are adults, the effect depends upon whether they are killed before or after they have spawned. If they are killed after they spawn, there is very little overall effect. Essentially, it amounts to removing the nutrients their bodies would have provided to the spawning grounds. If they are killed before they spawn, not only are they removed from the ESU, but so are all their potential progeny. Thus, killing pre-spawning adults has the greatest potential to affect their ESU and because of this, NMFS rarely allows it to happen. If it does—it does so in very low numbers. Also the adults are stripped of sperm and eggs so their progeny can be raised in a controlled environment such as a hatchery—thereby greatly decreasing the potential harm posed by sacrificing the

adults.

Benefits of Research

Under section 10(d) of the ESA, NMFS is prohibited from issuing a section 10(a)(1)(A) permit unless NMFS finds that the permit (1) was applied for in good faith; (2) if granted and exercised, will not operate to the disadvantage of the endangered and/or threatened species that is/are the subject of the permit; and (3) is consistent with the purposes and policy of section 2 of the ESA. In addition, NMFS does not issue a section 10(a)(1)(A) permit unless the proposed activities are likely to result in a net benefit to the listed species that is/are the subject of the permit; benefits accrue from the acquisition of scientific information.

For more than a decade, research and monitoring activities conducted with anadromous salmonids in the Pacific Northwest have provided resource managers with a wealth of important and useful information on anadromous fish populations. For example, juvenile fish trapping efforts have enabled the production of population inventories, PIT-tagging efforts have increased the knowledge of anadromous fish migration timing and survival, and fish passage studies have provided an enhanced understanding of fish behavior and survival when moving past dams and through reservoirs. By issuing section 10(a)(1)(A) scientific research permits, NMFS will cause information to be acquired that will enhance the ability of resource managers to make more effective and responsible decisions to sustain anadromous salmonid populations that are at risk of extinction, to mitigate impacts to endangered and threatened salmon and steelhead, and to implement recovery efforts. The resulting data will improve the knowledge of the respective species' life history, specific biological requirements, genetic make-up, migration timing, responses to anthropogenic impacts, and survival in the river system.

Permit-specific Effects

In addition to the effects discussed above, each permit's proposed activities may have additional adverse effects that need to be analyzed. Researchers will use measures required through the permit conditions discussed previously to mitigate such adverse impacts on listed ESUs.

In the "Status of the Species" section both juvenile and adult population abundance is discussed. In the following section NMFS analyzes the impacts of the take numbers in the context of those numbers.

Permit 1140

Permit 1140 would authorize the NWFSC to intentionally kill no more than 17 juvenile LCR chinook salmon and 10 juvenile UWR chinook salmon. Sampling activities will occur in nearshore areas in Oregon and Washington.

This research will take place in the marine environment thus it is impossible to determine the exact origin of the affected fish within the ESU. To determine the effects the research may have, take numbers were placed in the context of expected juvenile outmigration for the entire ESU. NMFS estimates an outmigration of approximately 15.5 million juvenile LCR chinook salmon and 1.7 million UWR chinook salmon. If these chinook salmon outmigrations are typical for future years, the annual loss of up to 17 juvenile LCR chinook salmon and 10 juvenile UWR chinook salmon associated with the NWFSC's research will not have a measurable impact on either of the juvenile populations nor on the ESU's status.

Though the negative effects of the research are very low, the researchers will take the following steps to reduce them even further: unintentional mortalities will be reduced or eliminated by safe sampling and handling methods such as carefully guiding fish into seines, keeping seines fully submerged, and immediately releasing non-targeted fish. Additionally, researchers make every effort to coordinate fishing efforts with other researchers in the area to minimize effects on salmonids and their environment. Given these measures, the already stated Permit Conditions, and the need for information on estuaries for use in management and restoration plans, the small losses to be incurred are discountable.

Permit 1290 - modification 1

Modification 1 to Permit 1290 would authorize the NWFSC to increase the number of fish intentionally killed in the permit by 84 juvenile LCR chinook salmon. Sampling activities would occur in the Columbia River estuary.

This research will take place in the Columbia River estuary thus it is impossible to determine the exact origin of the affected fish. To determine the effects the research may have, take numbers were placed in the context of expected juvenile outmigration for the entire ESU. NMFS estimates an outmigration of approximately 15.5 million juvenile LCR chinook salmon. If this outmigration is typical for future years, the annual loss of up to 84 more juvenile LCR chinook salmon associated with the NWFSC's research will not have a measurable impact on either the juvenile population nor on the status of the ESU.

Though the negative effects of the research are very low, the researchers will take the following steps to reduce them even further: unintentional mortalities will be reduced or eliminated by safe sampling and handling methods, all salmonids captured will be anesthetized to reduce stress, and all fish will be allowed time to fully recover before being released. Additionally, researchers make every effort to coordinate fishing efforts with other researchers in the area to minimize effects on salmonids and their environment. Given these measures, the already stated Permit Conditions, and the need for information on salmon estuarine and marine survival, the small losses to be incurred are discountable.

Permit 1291 - modification 2

Modification 2 to Permit 1291 would authorize the USGS to capture, handle, mark, and release

up to 14,978 juvenile LCR chinook salmon and 635 juvenile LCR steelhead but only if activities are conducted at Bonneville Dam in addition to McNary and John Day Dams. The permit would also allow the USGS to kill no more than 281 juvenile LCR chinook salmon and 13 juvenile LCR steelhead as an unintentional result of being captured.

Because it is impossible to determine the origin of these fish within the ESU, the context for the effect of the research is the entire outmigration. NMFS estimates an outmigration of approximately 15.5 million juvenile LCR chinook salmon and 227,000 LCR steelhead. If these outmigrations are typical for future years, the annual loss of up to 281 juvenile LCR chinook salmon and 13 juvenile LCR steelhead associated with the USGS' research (unintentional mortalities due to handling) will not have a measurable impact on either of the juvenile populations nor on the ESU's status.

In all cases, fish will be treated with great care under sterile conditions. After fish handling, fish would be placed in oxygenated water for recovery. Approximately 24 hours after tagging is complete, fish would be released downstream of the dam. Fish condition is monitored continuously. Though the negative effects are negligible and in some ways mitigated by safe handling procedures, the USGS will work to reduce them further. USGS personnel will handle fish only when necessary, complete fish handling as quickly and safely as possible, minimize stress associated with the handling and tagging, and providing adequate recovery times before fish are released. Given these measures, the Permit Conditions stated above, and the critical nature of the information being gathered with respect to fish behavior and survival, the negative effects of the research can be discounted.

Permit 1322 - modification 2

Modification 2 to Permit 1322 would authorize the NWFSC to increase the number of fish captured, handled, and released by up to 755 juvenile LCR chinook salmon. In addition, the permit would allow the NWFSC to intentionally kill up to 54 more juvenile LCR chinook salmon seven more juvenile UWR chinook salmon, and 100 more CR chum salmon to confirm species identification, catch composition, food habits, and timing of estuarine entry. The permit would also allow the NWFSC to kill seven more juvenile LCR chinook salmon as an unintentional result of being captured.

This research will take place in the Columbia River and estuary thus it is impossible to determine the exact origin of the affected fish. To determine the effects the research may have, take numbers were placed in the context of expected juvenile outmigration for the entire ESU. NMFS estimates an outmigration of approximately 15.5 million juvenile LCR chinook salmon, 1.7 million juvenile UWR chinook salmon, and 4.4 million juvenile CR chum salmon. If these outmigrations are typical for future years, the annual loss of up to 61 more juvenile LCR chinook salmon, seven more juvenile UWR chinook salmon, and 100 more juvenile CR chum salmon associated with the NWFSC's research will not have a measurable impact on either of the juvenile populations nor the ESU's status.

Though the negative effects of the research are very low, the researchers will take the following steps to reduce them even further: all salmonids captured will be handled as quickly and as gently as possible, anesthetized to reduce stress, and all non-targeted fish will be allowed time to fully recover before being released. Additionally, researchers make every effort to coordinate fishing efforts with other researchers in the area to minimize effects on salmonids and their environment. Given these measures, the already stated Permit Conditions, and the need for information on the impacts of hydropower operations on estuarine and ocean conditions, the small losses to be incurred are discountable.

Permit 1335 - modification 2

Modification 2 to Permit 1335 would authorize the USFS to increase the number of fish captured, handled, and released by up to 500 juvenile LCR chinook salmon, 300 juvenile UWR chinook salmon, 200 juvenile LCR steelhead and 300 UWR steelhead. The permit would also allow the USFS to kill up to 15 more juvenile LCR chinook salmon, six more juvenile UWR chinook salmon, nine more juvenile LCR steelhead, and six more UWR steelhead as an unintentional result of being captured. Sampling activities will occur in stream systems in the Columbia and Oregon Coastal basins.

Because researchers will be operating in randomly chosen sites throughout the basins, the context of determining effect is the entire outmigration. NMFS estimates an outmigration of approximately 15.5 million juvenile LCR chinook, 1.7 million juvenile UWR chinook salmon, 227,000 juvenile LCR steelhead, and 184,000 juvenile UWR steelhead. If these outmigrations are typical for future years, the annual loss of up to 15 more juvenile LCR chinook salmon, six more juvenile UWR chinook salmon, nine more juvenile LCR steelhead, and six more UWR steelhead associated with the USFS' research (unintentional mortalities due to handling) will not have a measurable impact on any of the juvenile populations nor the ESU's status. Even so, researchers will try to reduce unintentional mortalities as much as possible. They will not sample in areas with salmonid eggs or alevins, they will avoid all adult salmonids, and they will coordinate with state fish and game agencies whenever possible to avoid duplicate sampling. Given these measures, the already stated Permit Conditions, and the need to monitor Federal land use actions and their effect on aquatic habitats, the negative effects of the research may be discounted.

Permit 1366 - modification 1

Modification 1 to Permit 1366 would authorize the OCFWRU to capture, handle, anesthetize, mark, and release up to 546 more juvenile LCR chinook salmon and seven more juvenile LCR steelhead. In addition, the permit would allow the OCFWRU to intentionally kill up to 81 more juvenile LCR chinook salmon. The permit would also allow the OCFWRU to kill up to 19 more juvenile LCR chinook salmon and two more juvenile LCR steelhead as an unintentional result of being captured. Sampling activities will occur at selected dams on the Columbia and Snake Rivers.

Because the research will be conducted at dams on the mainstem Columbia and Snake Rivers, the context for determining effect is the entire Columbia River basin outmigration. NMFS estimates an outmigration of approximately 15.5 million juvenile LCR chinook salmon and 227,000 juvenile LCR steelhead. If these outmigrations are typical for future years, the annual loss of up to 100 more juvenile LCR chinook salmon and two more juvenile LCR steelhead associated with the NWFSC's research will not have a measurable impact on either of the juvenile populations nor the ESU's status. Even so, researchers will try to reduce mortalities as much as possible. Any unintentional mortalities will be used in place of fish intentionally killed. All non-targeted fish will be released after no more than 24 hours of holding. Sampling procedures will allow researchers to select only those fish suitable for the research. Fish will be kept in water at all times. Researchers will coordinate with other agencies to avoid duplicative efforts whenever possible. Also, this research intends to generate crucial information on fish survival and behavior during various modes of operating the hydropower complex and the transportation program thus any negative effects are discountable.

Permit 1379

Permit 1379 would authorize the CRITFC to capture, handle, sample, mark and release up to 10 adult LCR chinook salmon at the Bonneville Dam on the Columbia River.

The proposed number of fish captured are expected to survive the research actions hence the CRITFC's actions will not have a measurable impact on the adult population nor on the status of the ESU. In addition, this research generates critical information used to investigate the status of Columbia Basin stocks and implement the U.S.-Canada Pacific Salmon Treaty.

Permit 1410

Permit 1410 would authorize the NWFSC to capture, handle, and release up to 128 adult LCR chinook salmon, six adult UWR chinook salmon, and five adult CR chum salmon. In addition, the permit would allow the NWFSC to intentionally kill up to 358 juvenile LCR chinook salmon, 32 juvenile UWR chinook salmon, one juvenile LCR steelhead, one juvenile UWR steelhead, and 300 juvenile CR chum salmon. The permit would also allow the NWFSC to kill up to four adult LCR chinook salmon as an unintentional result of being captured. Sampling activities will occur in the Columbia River plume and surrounding ocean environment.

This research will take place in the Columbia River plume and surrounding ocean environment thus it is impossible to determine the exact origin of the affected fish. To determine the effects the research may have, take numbers were placed in the context of expected juvenile outmigration and adult abundance for the entire ESU. NMFS estimates an outmigration of approximately 15.5 million juvenile LCR chinook, 1.7 million juvenile UWR chinook salmon, 227,000 juvenile LCR steelhead, 184,000 juvenile UWR steelhead, and 4.4 million juvenile CR chum salmon. If these outmigrations are typical for future years, the annual loss of up to 358 juvenile LCR chinook salmon, 32 juvenile UWR chinook salmon, one juvenile LCR steelhead, one UWR steelhead, and 300 juvenile CR chum salmon associated with the NWFSC's research

(some of which are unintentional mortalities due to handling) will not have a measurable impact on any of the juvenile populations nor the status' of the ESUs. NMFS estimates the recent abundance of adult LCR chinook salmon at 11,720. If the next five years are anything like the last five years, the annual loss of up to four adult LCR chinook salmon associated with the NWFSC's research (which are unintentional mortalities due to handling) will not have a measurable impact on the adult population nor the status of the ESU.

Though there are negative effects associated with killing adult and juvenile listed fish, the number of listed fish killed represents a small fraction of the ESU as a whole, thus the effect is negligible. One should also consider the fact that a great deal of information will be taken from the dead fish and used (eventually) to develop a set of hydropower management scenarios to benefit salmonid survival, growth, and health.

Permit 1421

Permit 1421 would authorize the USFWS to capture, handle, sample, mark, and release up to seven adult and 30 juvenile LCR chinook salmon, one adult and two juvenile LCR steelhead, and 10 adult and 100 juvenile CR chum salmon. The permit would also allow the USFWS to kill up to two juvenile LCR chinook salmon and five juvenile CR chum salmon as an unintentional result of being captured. Sampling activities will occur at the Franz Lake National Wildlife Refuge on the lower Columbia River.

This research will take place in the lower Columbia River thus it is impossible to determine the exact origin of the affected fish. To determine the effects the research may have, take numbers were placed in the context of expected juvenile outmigration for the entire ESU. NMFS estimates an outmigration of approximately 15.5 million juvenile LCR chinook and 4.4 million juvenile CR chum salmon. If these outmigrations are typical for future years, the annual loss of up to two juvenile LCR chinook salmon and five CR chum salmon associated with the USFWS' research (which are unintentional mortalities due to handling) will not have a measurable impact on the juvenile populations nor the ESU's status. Also, this research is expected to generate important information about the use of certain pesticides in areas where anadromous fish are present, thus any possible negative effects are negligible.

Permit 1427

Permit 1427 would authorize the ODEQ to capture, handle, and release up to one adult and one juvenile LCR chinook salmon, four adult and four juvenile UWR chinook salmon, one adult and one juvenile LCR steelhead, and four adult and four juvenile UWR steelhead during sampling activities in the Willamette River.

The proposed number of fish captured are expected to survive the research actions hence the ODEQ's actions will not have a measurable impact on the adult and juvenile populations nor on the ESU's status. In addition, this research is designed to fulfill requirements of the Federal Clean Water Act and will benefit listed fish by helping reduce mercury loading in the Willamette

River system.

Cumulative Effects

Cumulative effects include the effects of future state, tribal, local or private actions (not involving Federal activities) that are reasonably certain to occur within the action area subject to this consultation. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Act.

State, tribal, and local government actions will likely be in the form of legislation, administrative rules or policy initiatives. Government and private actions may include changes in land and water uses—including ownership and intensity—any of which could impact listed species or their habitat. Government actions are subject to political, legislative, and fiscal uncertainties. These realities, added to geographic scope of the action area which encompasses numerous government entities exercising various authorities and the many private landholdings, make any analysis of cumulative effects difficult and speculative. For more information on the various efforts being made a the local, tribal, state, and national levels see NMFS' Biological Opinion on the Issuance and Funding of 24 Section 10(a)(1)(A) Permits, Permit Modifications, and Permit Amendments for Take of Threatened Upper Willamette River Chinook Salmon, Lower Columbia River Chinook Salmon, Upper Willamette River Steelhead, Lower Columbia River Steelhead, and Columbia River Chum Salmon for Scientific Research and Enhancement Purposes (NMFS, 2002b) and NMFS' Reinitiation of Consultation on Operation of the Federal Columbia River Power System Including the Juvenile Transportation Program and 19 Bureau of Reclamation Projects in the Columbia Basin (NMFS, 2001).

Non-federal actions are likely to continue affecting listed species. The cumulative effects in the action area are difficult to analyze because of the Opinion's large geographic scope, the different resource authorities in the action area, the uncertainties associated with government and private actions, and the changing economies of the region. Whether these effects will increase or decrease is a matter of speculation; however, based on the trends identified in the baseline, the adverse cumulative effects are likely to increase. Although state, tribal and local governments have developed plans and initiatives to benefit listed fish, they must be applied and sustained in a comprehensive way before NMFS can consider them "reasonably foreseeable" in its analysis of cumulative effects.

Integration and Synthesis of Effects

LCR chinook salmon

The vast majority (approximately 95%) of the LCR chinook salmon that will be captured,

handled, observed, etc., during the course of the proposed research (a total of 17,728 juvenile and 150 adult fish) are expected to survive with no long-term effects. Moreover, most capture, handling, and holding methods will be minimally intrusive and of short duration. Because so many of the captured fish are expected to survive the research actions and so few (a maximum of 0.11% of the total juvenile LCR chinook salmon outmigration and a maximum of 1.28% of the total adult LCR chinook salmon escapement) will be affected in even the slightest way, it is likely that no adverse effects will result from these actions at either the population or the ESU level. Therefore, adverse effects must be expressed in terms of the individual fish that may be killed during the various permitted activities. Table 3 summarizes these effects for each permit.

Table 3. Maximum Annual Take of Threatened LCR chinook salmon

	Adult				Juvenile			
	Handle		Mortality		Handle		Mortality	
PERMIT Action	C,H,R	C,T/M,S,R	INTENTIONAL	UNINTENTIONAL	C,H,R	C,T/M,S,R	INTENTIONAL	UNINTENTIONAL
1140	0	0	0	0	0	0	17	0
1290 M1	0	0	0	0	0	0	84	0
1291 M2	0	0	0	0	13,747	1,231	0	281
1322 M2	0	0	0	0	755	0	54	7
1335 M2	0	0	0	0	500	0	0	15
1366 M1	0	0	0	0	514	32	81	19
1379	10	0	0	0	0	0	0	0
1410	128	0	0	4	0	0	358	0
1421	7	0	0	0	0	30	0	2
1427	1	0	0	0	1	0	0	0
TOTALS	146	0	0	4	15,517	1,293	594	324

C,H,R = capture,handle,release, C,T/M,S,R = capture, tag/mark, sample, release

If the total amount of estimated juvenile lethal take for all research activities—918 juvenile LCR chinook salmon—is expressed as a fraction of the 15.5 million smolts expected to reach the lower Columbia River, it represents a loss of 0.006% of the run. However, and for a number of reasons, that number is probably much smaller. First, it is important to remember to account for potential accidental deaths, that every estimate of unintentional lethal take for the proposed studies has purposefully been inflated and it is therefore very likely that fewer than 918 juveniles will be killed by the research—possibly many fewer. Second, some of the studies will specifically affect LCR chinook salmon in the smolt stage, but others will not. These studies are described as affecting "juveniles," which means they may target LCR chinook salmon yearlings, parr, or even fry life stages represented by many more individuals than reach the smolt stage—perhaps as much as an order of magnitude more. Therefore the 0.006% figure was derived by overestimating the number of fish likely to be killed, and treating each dead LCR chinook salmon as a smolt when some of them may not be. Thus the actual number of LCR chinook salmon the research is likely to kill is undoubtedly smaller than 0.006%—perhaps as little as half (or less) of that figure.

Even if the entire 0.006% of the juvenile LCR chinook salmon population were killed, and they were all treated as smolts, it would be very difficult to translate that number into an actual effect on the species. And this effect is even smaller when compared to the loss of an adult in terms of species survival and recovery. This is due to the fact that a great many smolts die before they can mature into adults. Approximately 0.034% of the adult LCR chinook salmon are proposed to be unintentionally killed. It is also difficult to translate the loss of four adult fish into an actual effect on the species. The research is proposed to be conducted in the Columbia River plume and although there is a good chance that adult fish in this area will make it to the spawning grounds and successfully spawn, it is hard to determine an adverse effect.

Nonetheless, regardless of its magnitude, that negative effect must be juxtaposed with the benefits to be derived from the research (see descriptions of the individual permits). Those benefits range from finding ways to identify and quantify factors limiting survival of juvenile salmon (Permit 1410) to mitigating salmon exposure to contaminants (Permit 1427). In all, the fish will derive some benefit from every permit considered in this Opinion. The amount of benefit will vary, but in some cases it may be significant. For the purpose of section 7(a)(2) NMFS must consider the adverse effects when deciding whether the contemplated actions will appreciably reduce the likelihood of the LCR chinook salmon's survival and recovery in the wild—the critical determination in issuing any biological opinion.

UWR chinook salmon

The vast majority (approximately 85%) of the UWR chinook salmon that will be captured, handled, observed, etc., during the course of the proposed research (a total of 359 juvenile and 10 adult fish) are expected to survive with no long-term effects. Moreover, most capture, handling, and holding methods will be minimally intrusive and of short duration. Because so many of the captured fish are expected to survive the research actions and so few (a maximum of 0.02% of the total juvenile UWR chinook salmon outmigration and a maximum of 0.01% of the total adult UWR chinook salmon escapement) will be affected in even the slightest way, it is likely that no adverse effects will result from these actions at either the population or the ESU level. Therefore, adverse effects must be expressed in terms of the individual fish that may be killed during the various permitted activities. Table 4 summarizes these effects for each permit.

If the total amount of estimated lethal take for all research activities—55 juvenile UWR chinook salmon—is expressed as a fraction of the 1.7 million fish expected to reach the Willamette River, it represents a loss of 0.003% of the run. However, and for a number of reasons, that number is probably much smaller. First, it is important to remember to account for potential accidental deaths, that every estimate of lethal take for the proposed studies has purposefully been inflated and it is therefore very likely that fewer than 55 juveniles will be killed by the research. Second, some of the studies will specifically affect UWR chinook salmon in the smolt stage, but others will not. These latter studies are described as affecting "juveniles," which means they may target UWR chinook salmon yearlings, parr, or even fry life stages represented by many more individuals than reach the smolt stage—perhaps as much as an order of magnitude more.

Table 4. Maximum Annual Take of Threatened UWR chinook salmon

	Adult				Juvenile			
	Handle		Mortality		Handle		Mortality	
PERMIT Action	C,H,R	C,T/M,S,R	INTENTIONAL	UNINTENTIONAL	C,H,R	C,T/M,S,R	INTENTIONAL	UNINTENTIONAL
1140	0	0	0	0	0	0	10	0
1290 M1	0	0	0	0	0	0	0	0
1291 M2	0	0	0	0	0	0	0	0
1322 M2	0	0	0	0	0	0	7	0
1335 M2	0	0	0	0	300	0	0	6
1366 M1	0	0	0	0	0	0	0	0
1379	0	0	0	0	0	0	0	0
1410	6	0	0	0	0	0	32	0
1421	0	0	0	0	0	0	0	0
1427	4	0	0	0	4	0	0	0
TOTALS	10	0	0	0	304	0	49	6

C,H,R = capture,handle,release, C,T/M,S,R = capture, tag/mark, sample, release

Therefore the 0.003% figure was derived by overestimating the number of fish likely to be killed, and treating each dead UWR chinook salmon as a smolt when some of them clearly won't be. Thus the actual number of UWR chinook salmon the research is likely to kill is undoubtedly smaller than 0.003%—perhaps as little as half (or less) of that figure.

Even if the entire 0.003% of the juvenile UWR chinook salmon population were killed, and they were all treated as smolts, it would be very difficult to translate that number into an actual effect on the species. Even if the subject were one adult killed out of a population of one thousand it would be hard to resolve an adverse effect. And in this instance, that effect is even smaller because the loss of a smolt is not equivalent to the loss of an adult in terms of species survival and recovery. This is due to the fact that a great many smolts die before they can mature into adults. Nonetheless, regardless of its magnitude, that negative effect must be juxtaposed with the benefits to be derived from the research (see descriptions of the individual permits). Those benefits range from finding ways to identify and quantify factors limiting survival of juvenile salmon (Permit 1410) to mitigating salmon exposure to contaminants (Permit 1427). In all, the fish will derive some benefit from every permit considered in this Opinion. The amount of benefit will vary, but in some cases it may be significant. For the purpose of section 7(a)(2) NMFS must consider the adverse effects when deciding whether the contemplated actions will appreciably reduce the likelihood of the UWR chinook salmon's survival and recovery in the wild—the critical determination in issuing any biological opinion.

LCR steelhead

The vast majority (approximately 97%) of the LCR steelhead that will be captured, handled, observed, etc., during the course of the proposed research (a total of 870 juvenile and two adult fish) are expected to survive with no long-term effects. Moreover, most capture, handling, and holding methods will be minimally intrusive and of short duration. Because so many of the

captured fish are expected to survive the research actions and so few (a maximum of 0.38% of the total juvenile LCR steelhead outmigration and a maximum of 0.01% of the total adult LCR steelhead escapement) will be affected in even the slightest way, it is likely that no adverse effects will result from these actions at either the population or the ESU level. Therefore, adverse effects must be expressed in terms of the individual fish that may be killed during the various permitted activities. Table 5 summarizes these effects for each permit.

Table 5. Maximum Annual Take of Threatened LCR steelhead

	Adult				Juvenile			
	Handle		Mortality		Handle		Mortality	
PERMIT Action	C,H,R	C,T/M,S,R	INTENTIONAL	UNINTENTIONAL	C,H,R	C,T/M,S,R	INTENTIONAL	UNINTENTIONAL
1140	0	0	0	0	0	0	0	0
1290 M1	0	0	0	0	0	0	0	0
1291 M2	0	0	0	0	547	88	0	13
1322 M2	0	0	0	0	0	0	0	0
1335 M2	0	0	0	0	200	0	0	9
1366 M1	0	0	0	0	7	0	0	2
1379	0	0	0	0	0	0	0	0
1410	0	0	0	0	0	0	1	0
1421	1	0	0	0	0	2	0	0
1427	1	0	0	0	1	0	0	0
TOTALS	2	0	0	0	755	90	1	24

C,H,R = capture,handle,release, C,T/M,S,R = capture, tag/mark, sample, release

If the total amount of estimated lethal take for all research activities—25 juvenile LCR steelhead—is expressed as a fraction of the 227,000 juvenile fish expected to reach the lower Columbia River, it represents a loss of 0.011% of the run. However, and for a number of reasons, that number is probably much smaller. First, it is important to remember to account for potential accidental deaths, that every estimate of lethal take for the proposed studies has purposefully been inflated and it is therefore very likely that fewer than 25 juveniles will be killed by the research—possibly many fewer. Second, some of the studies will specifically affect LCR steelhead in the smolt stage, but others will not. These latter studies are described as affecting "juveniles," which means they may target LCR steelhead yearlings, parr, or even fry life stages represented by many more individuals than reach the smolt stage—perhaps as much as an order of magnitude more. Therefore the 0.011% figure was derived by overestimating the number of fish likely to be killed, and treating each dead LCR steelhead as a smolt when some of them clearly won't be. Thus the actual number of LCR steelhead the research is likely to kill is undoubtedly smaller than 0.011%—perhaps as little as half (or less) of that figure.

Even if the entire 0.011% of the juvenile LCR steelhead population were killed, and they were all treated as smolts, it would be very difficult to translate that number into an actual effect on the species. Even if the subject were one adult killed out of a population of one thousand it would be hard to resolve an adverse effect. And in this instance, that effect is even smaller

because the loss of a smolt is not equivalent to the loss of an adult in terms of species survival and recovery. This is due to the fact that a great many smolts die before they can mature into adults. Nonetheless, regardless of its magnitude, that negative effect must be juxtaposed with the benefits to be derived from the research (see descriptions of the individual permits). Those benefits range from finding ways to identify and quantify factors limiting survival of juvenile salmon (Permit 1410) to mitigating salmon exposure to contaminants (Permit 1427). In all, the fish will derive some benefit from every permit considered in this Opinion. The amount of benefit will vary, but in some cases it may be significant. For the purpose of section 7(a)(2) NMFS must consider the adverse effects when deciding whether the contemplated actions will appreciably reduce the likelihood of the LCR steelhead's survival and recovery in the wild—the critical determination in issuing any biological opinion.

UWR steelhead

The vast majority (approximately 98%) of the UWR steelhead that will be captured, handled, observed, etc., during the course of the proposed research (a total of 311 juvenile and four adult fish) are expected to survive with no long-term effects. Moreover, most capture, handling, and holding methods will be minimally intrusive and of short duration. Because so many of the captured fish are expected to survive the research actions and so few (a maximum of 0.17% of the total juvenile UWR steelhead outmigration and a maximum of 0.01% of the total adult UWR steelhead escapement) will be affected in even the slightest way, it is likely that no adverse effects will result from these actions at either the population or the ESU level. Therefore, adverse effects must be expressed in terms of the individual fish that may be killed during the various permitted activities. Table 6 summarizes these effects for each permit.

Table 6. Maximum Annual Take of Threatened UWR steelhead

	Adult				Juvenile			
	Handle		Mortality		Handle		Mortality	
PERMIT Action	C,H,R	C,T/M,S,R	INTENTIONAL	UNINTENTIONAL	C,H,R	C,T/M,S,R	INTENTIONAL	UNINTENTIONAL
1140	0	0	0	0	0	0	0	0
1290 M1	0	0	0	0	0	0	0	0
1291 M2	0	0	0	0	0	0	0	0
1322 M2	0	0	0	0	0	0	0	0
1335 M2	0	0	0	0	300	0	0	6
1366 M1	0	0	0	0	0	0	0	0
1379	0	0	0	0	0	0	0	0
1410	0	0	0	0	0	0	1	0
1421	0	0	0	0	0	0	0	0
1427	4	0	0	0	4	0	0	0
TOTALS	4	0	0	0	304	0	1	6

C,H,R = capture,handle,release, C,T/M,S,R = capture, tag/mark, sample, release

If the total amount of estimated lethal take for all research activities—7 juvenile UWR steelhead—is expressed as a fraction of the 184,000 fish expected to reach the Willamette River,

it represents a loss of 0.004% of the run. However, and for a number of reasons, that number is probably much smaller. First, it is important to remember to account for potential accidental deaths, that every estimate of lethal take for the proposed studies has purposefully been inflated and it is therefore very likely that fewer than seven juveniles will be killed by the research—possibly many fewer. Second, some of the studies will specifically affect UWR steelhead in the smolt stage, but others will not. These latter studies are described as affecting "juveniles," which means they may target UWR steelhead yearlings, parr, or even fry life stages represented by many more individuals than reach the smolt stage—perhaps as much as an order of magnitude more. Therefore the 0.004% figure was derived by overestimating the number of fish likely to be killed, and treating each dead UWR steelhead as a smolt when some of them clearly won't be. Thus the actual number of UWR steelhead the research is likely to kill is undoubtedly smaller than 0.004%—perhaps as little as half (or less) of that figure.

Even if the entire 0.004% of the juvenile UWR steelhead population were killed, and they were all treated as smolts, it would be very difficult to translate that number into an actual effect on the species. Even if the subject were one adult killed out of a population of one thousand it would be hard to resolve an adverse effect. And in this instance, that effect is even smaller because the loss of a smolt is not equivalent to the loss of an adult in terms of species survival and recovery. This is due to the fact that a great many smolts die before they can mature into adults. Nonetheless, regardless of its magnitude, that negative effect must be juxtaposed with the benefits to be derived from the research (see descriptions of the individual permits). Those benefits range from finding ways to identify and quantify factors limiting survival of juvenile salmon (Permit 1410) to mitigating salmon exposure to contaminants (Permit 1427). In all, the fish will derive some benefit from every permit considered in this Opinion. The amount of benefit will vary, but in some cases it may be significant. For the purpose of section 7(a)(2) NMFS must consider the adverse effects when deciding whether the contemplated actions will appreciably reduce the likelihood of the UWR steelhead's survival and recovery in the wild—the critical determination in issuing any biological opinion.

CR chum salmon

A majority (approximately 78%) of the CR chum salmon that will be captured, handled, observed, etc., during the course of the proposed research (a total of 505 juvenile and 15 adult fish) are expected to die as a result of these research actions. No adult fish will be killed. Even though so many of the captured fish are expected to die, they represent a small percentage of the total juvenile CR chum salmon outmigration. A maximum of 0.01% of the total juvenile CR chum salmon outmigration will be affected and a maximum of 0.15% of the total adult CR chum salmon escapement will be affected in even the slightest way. Thus it is likely that no adverse effects will result from these actions at either the population or the ESU level. Table 7 summarizes these effects for each permit.

As referred to above, if the total amount of estimated lethal take for all research activities—405 juvenile CR chum salmon—is expressed as a fraction of the 4.4 million fish expected to reach

Table 7. Maximum Annual Take of Threatened CR chum salmon

	Adult				Juvenile			
	Handle		Mortality		Handle		Mortality	
PERMIT Action	C,H,R	C,T/M,S,R	INTENTIONAL	UNINTENTIONAL	C,H,R	C,T/M,S,R	INTENTIONAL	UNINTENTIONAL
1140	0	0	0	0	0	0	0	0
1290 M1	0	0	0	0	0	0	0	0
1291 M2	0	0	0	0	0	0	0	0
1322 M2	0	0	0	0	0	0	100	0
1335 M2	0	0	0	0	0	0	0	0
1366 M1	0	0	0	0	0	0	0	0
1379	0	0	0	0	0	0	0	0
1410	5	0	0	0	0	0	300	0
1421	10	0	0	0	0	100	0	5
1427	0	0	0	0	0	0	0	0
TOTALS	15	0	0	0	0	100	400	5

C,H,R = capture,handle,release, C,T/M,S,R = capture, tag/mark, sample, release

the Columbia River, it represents a loss of 0.009% of the run. Because chum salmon migrate almost immediately after emergence from the gravel, no other life stages, may be affected by the research. However, that percentage will probably be somewhat smaller because every estimate of lethal take for the proposed studies has purposefully been inflated. It is therefore very likely that fewer than 405 juveniles will be killed by the research and the actual number of CR chum salmon the research is likely to kill will be smaller than 405 fish.

Even if the entire 0.009% of the juvenile CR chum salmon population were killed, it would be very difficult to translate that number into an actual effect on the species. Even if the subject were one adult killed out of a population of one thousand it would be hard to resolve an adverse effect. And in this instance, that effect is even smaller because the loss of a juvenile is not equivalent to the loss of an adult in terms of species survival and recovery. This is due to the fact that a great many juveniles die before they can mature into adults. Nonetheless, regardless of its magnitude, that negative effect must be juxtaposed with the benefits to be derived from the research (see descriptions of the individual permits). Those benefits range from finding ways to identify and quantify factors limiting survival of juvenile salmon (Permit 1410) to mitigating salmon exposure to contaminants (Permit 1427). In all, the fish will derive some benefit from every permit considered in this Opinion. The amount of benefit will vary, but in some cases it may be significant. For the purpose of section 7(a)(2) NMFS must consider the adverse effects when deciding whether the contemplated actions will appreciably reduce the likelihood of the CR chum salmon's survival and recovery in the wild—the critical determination in issuing any biological opinion.

Conclusion

After reviewing the current status of threatened LCR chinook salmon, threatened LCR steelhead, threatened UWR chinook salmon, threatened UWR steelhead, and threatened CR chum salmon, the environmental baseline for the action area, the effects of the proposed section 10(a)(1)(A) permit actions, and cumulative effects, it is NMFS' biological opinion that issuance of the proposed permits is not likely to jeopardize the continued existence of threatened LCR chinook salmon, threatened LCR steelhead, threatened UWR chinook salmon, threatened UWR steelhead, and threatened CR chum salmon, nor destroy nor adversely modify their habitat.

Coordination with the National Ocean Service

The activities contemplated in this Biological Opinion will not be conducted in or near a National Marine Sanctuary. Therefore, these activities will not have an adverse effect on any National Marine Sanctuary.

Reinitiation of Consultation

Consultation must be reinitiated if: The amount or extent of annual takes specified in the permits and this consultation is exceeded or is expected to be exceeded; new information reveals effects of the actions that may affect the listed species in a way not previously considered; a specific action is modified in a way that causes an effect on the listed species that was not previously considered; or a new species is listed or critical habitat is designated that may be affected by the action (50 CFR 402.16).

MAGNUSON-STEVENS ACT ESSENTIAL FISH HABITAT CONSULTATION

"Essential fish habitat" (EFH) is defined in section 3 of the Magnuson-Stevens Act (MSA) as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." NMFS interprets EFH to include aquatic areas and their associated physical, chemical, and biological properties used by fish that are necessary to support a sustainable fishery and the contribution of the managed species to a healthy ecosystem. EFH has been designated for Pacific salmon, groundfish, and coastal pelagic species. For information on EFH for these species, please see this website: http://www.nwr.noaa.gov/1habcon/habweb/msa.htm.

The MSA and its implementing regulations at 50 CFR 600.920 require a Federal agency to consult with NMFS before it authorizes, funds, or carries out any action that may adversely affect EFH—in this case, EFH for Pacific salmon, groundfish, and coastal pelagic species. The purpose of consultation is to develop a conservation recommendation(s) that addresses all reasonably foreseeable adverse effects to EFH. Further, the action agency must provide a detailed, written response to NMFS within 30 days of receiving an EFH conservation recommendation. The response must include measures proposed by the agency to avoid, minimize, mitigate, or offset the impact of the activity on EFH. If the response is inconsistent with NMFS' conservation recommendation the agency must explain its reasons for not following the recommendation.

However, in this instance, no conservation recommendations are necessary. As the Biological Opinion above describes, the proposed research actions are not likely, singly or in combination, to adversely affect the habitat upon which Pacific salmon, groundfish, and coastal pelagic species depend. All the actions are of limited duration, minimally intrusive, and are entirely discountable in terms of their effects, short-or long-term, on any habitat parameter important to the fish.

The action agencies must reinitiate EFH consultation if plans for these actions are substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for the EFH conservation recommendations (50 CFR Section 600.920(k)).

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