UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

NOV 9 1999

MEMORANDUM TO: Donald K. Knowles, Director
Office of Protected Resources

FROM: William Stelle, Jr.
Regional Administrator

SUBJECT: Biological Opinion on Approval of the Pacific Salmon Treaty by the U.S. Department of State and Management of the Southeast Alaska Salmon Fisheries Subject to the Pacific Salmon Treaty

This memorandum transmits the final draft National Marine Fisheries Service's (NMFS) biological opinion, issued under the authority of section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1536), on approval of the Pacific Salmon Treaty by the U.S. Department of State and Management of the Southeast Alaska Salmon Fisheries Subject to the Pacific Salmon Treaty.

This biological opinion concludes that the Pacific Salmon Treaty and the decision by the North Pacific Fisheries Management Council to continue to defer its management authority to the State of Alaska is not likely to jeopardize any of the sixteen threatened or endangered Evolutionarily Significant Units (ESUs) of Pacific salmon, steelhead, or cutthroat trout or destroy or adversely modify any of the critical habitat that has been designated for these species. The biological opinion includes an Incidental Take Statement with non-discretionary terms and conditions that must be applied to the proposed fisheries to provide an exemption from the prohibited acts outlined in section 9 of the ESA. The biological opinion also includes discretionary Conservation Recommendations that are intended to help your agency comply with the affirmative conservation responsibilities of section 7(a)(1) of the ESA.

This biological opinion concludes consultation on the Pacific Salmon treaty. As prescribed by section 7 regulations, consultation on the Treaty must be reinitiated if: (1) the amount or extent of taking specified in the Incidental Take Statement is exceeded for any of the actions identified in the biological opinion; (2) new information reveals effects of these actions that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) any of the identified actions are subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or (4) a new species is listed or critical habitat designed that may be affected by the identified actions.

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I request your concurrence with my determination that approval of the Pacific Salmon Treaty by the U.S. Department of State and Management of the Southeast Alaska Salmon Fisheries Subject to the Pacific Salmon Treaty is not likely to jeopardize the continued existence of threatened or endangered species of Pacific salmon or destroy or adversely modify designated critical habitat. Please indicate your concurrence with my recommendation by signing below and by signing the letter (enclosed) transmitting the biological opinion to the U.S. State Department.

If you have any questions, please feel free to call me at (206) 526-6150.

Concur: Don Knowles Date: NOV 12 1999

Do not Concur: ______________ Date: ______________

Endangered Species Act - Reinitiated Section 7 Consultation

BIOLOGICAL OPINION

Approval of the Pacific Salmon Treaty by the U.S. Department of State and
Management of the Southeast Alaska Salmon Fisheries
Subject to the Pacific Salmon Treaty

Agencies: United States Department of State and
National Marine Fisheries Service

Consultation Conducted by
National Marine Fisheries Service,
Northwest Region
Protected Resources Division

Date Issued: 11-18-99

Approved by: Don Knowles
Donald R. Knowles, Director, Office of Protected Resources

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INTRODUCTION

The National Marine Fisheries Service (NMFS) is required under section 7 of the Endangered Species Act (ESA) to conduct consultations which consider the impacts of ocean salmon fisheries to salmon species listed under the ESA. After a protracted period of negotiations, the United States and Canada recently reached agreement under the Pacific Salmon Treaty (PST) on a long-term and comprehensive management plan that would govern salmon fisheries in Southeast Alaska (SEAK), British Columbia (BC), and the Pacific Northwest. A major component of this agreement is a management regime for chinook salmon that specifies an aggregate abundance-based approach for three major ocean fisheries in Alaska and Canada, coupled with an individual stock-based approach for all other fisheries in Canada and the Pacific Northwest. This chinook management regime, designed to meet the rebuilding and conservation needs of natural-origin stocks, establishes rules for determining allowable catches in the various fisheries.

The United States and Canada approved the agreement by an exchange of diplomatic notes in Washington, D.C. on June 30, 1999. The exchange of notes included contingencies on the U.S. implementation of its obligations under the agreement. Specifically, U.S. implementation of its obligations under the agreement is contingent upon 1) a determination that the agreement complies with the legal requirements of the ESA; and, 2) congressional appropriations to fund key elements of the agreement. This biological opinion relates to the first of these contingencies. In particular, as explained below, this opinion considers whether fisheries off Southeast Alaska and in British Columbia, if managed pursuant to the 1999 agreement, are likely to jeopardize the continued existence of listed salmon, steelhead, and cutthroat trout (Table 1) or result in the destruction or adverse modification of their critical habitat.

CONSULTATION HISTORY

NMFS has considered the impacts to listed salmon species in SEAK fisheries each year since 1993. In 1998 NMFS consulted on a proposal to manage the SEAK fisheries under the 1996 U.S. Letter of Agreement Regarding Chinook Salmon Fisheries in Alaska (LOA), an agreement signed by the three voting U.S. Commissioners of the Pacific Salmon Commission (NMFS 1998). This was a programmatic consultation that was intended to provide coverage for the SEAK fishery for the life of the LOA, subject to conditions that require consultations to be reinitiated. That opinion considered the effect on the Snake River Evolutionarily Significant Units (ESU)s, Sacramento River winter chinook, the three coho ESUs, Umpqua River cutthroat and the then-listed steelhead ESUs (Table 1). In that biological opinion, NMFS concluded that only Snake River fall chinook were significantly impacted by the proposed fisheries, that the anticipated impacts were within previously specified jeopardy limits, and that the proposed fisheries were not likely to jeopardize the listed species (NMFS 1998).

Two events occurred which required that consultations regarding the SEAK fisheries be reinitiated prior to the 1999 season. On March 24, 1999, subsequent to the 1998 consultation, nine additional ESUs of chinook, sockeye, and chum salmon and steelhead were listed (Table 1). Later, after the new PST bilateral agreement was reached in late June, Alaska stated its intention to manage its fisheries under the provisions of the new chinook chapter of the agreement, rather than pursuant to the LOA, which was replaced by the new agreement (Marshall 1999). As a result of these events, NMFS reinitiated consultation. Because there was little time between announcement of the agreement and the pending start of the 1999 fishery on July 1, and because NMFS already was obligated to provide a more comprehensive review of the entire PST agreement prior to December 31, 1999, NMFS considered the effects on newly listed species resulting from fisheries managed under the new regime only for the 1999 summer and 1999/2000 winter seasons. NMFS did not reconsider conclusions related to previously listed species (primarily Snake River fall chinook) because 1) fisheries implemented under the new agreement would be more restrictive than those allowed under the LOA; and 2) NMFS had previously concluded that fisheries allowed under the LOA were not likely to jeopardize the previously listed species. The new opinion, dated June 30, 1999, concluded that the proposed SEAK fishery was not likely to jeopardize the continued existence or result in the destruction or adverse modification of proposed critical habitat of Upper Willamette River chinook, Lower Columbia River chinook, or Puget Sound chinook. It also concluded that the other newly listed ESUs were not likely to be adversely affected (NMFS 1999). Since June 1999, two additional chinook ESUs, both from California, have also been listed (Table 1).

Like nearly every fishery regime encompassed in the PST, the specific harvest levels specified in the chinook salmon chapter of Annex IV expired after the 1992 fishing season. Despite repeated negotiation attempts over several years, the U.S. and Canada remained at an impasse over these matters, and managed their respective fisheries unilaterally. Meanwhile, listings of several salmon species affected by PST fisheries occurred, starting with the Snake Basin fall chinook and spring/summer chinook in 1992. Section 7 consultations covering U.S. fisheries have occurred, but those consultations did not consider the merits of any management provisions applicable to Canadian fisheries. Thus, because the 1999 PST agreement represents the first comprehensive bilateral agreement since the salmon were listed, this comprises the first time that NMFS has consulted directly on a proposed fishery management plan that involves specific harvest provisions applicable to Canadian fisheries. (There have been some less comprehensive, one-year interim agreements between the U.S. and Canada in recent years, covering Fraser Panel fisheries for example, but even these occurred prior to the more recent listings and encompassed fisheries that did not affect species listed at the time.) U.S. implementation of the new PST agreement, which includes fishery regimes that will affect listed species, constitutes a federal action that is subject to section 7 consultation.

Although NMFS has never before consulted on a management plan that contains specific provisions governing Canadian fisheries, previous consultations on U.S. fisheries have taken into account impacts expected in Canadian fisheries. For example, the jeopardy standard for Snake River fall chinook that has been applied to both Alaska and Pacific Fishery Management Council (PFMC) fisheries requires, as one alternative, a 30% reduction in the age 3 and 4 adult equivalent ocean fishery exploitation rate (ER) relative to the 1988-1993 base period (NMFS 1998, Stelle and Hogarth 1999). The total ER limit set for Oregon Coast coho pertaining to PFMC fisheries also accounts for mortality that occurs in Canadian fisheries (NMFS 1999b). Although Canadian fishery impacts have been accounted for in previous consultations, this will be the first opinion to directly consider the effect of Canadian fisheries on listed species.

BIOLOGICAL OPINION

I. Description of the Proposed Action

A. Proposed Action

Two proposed actions are considered in this opinion. The first involves the formal commitment of the U.S. to implement its fishery obligations consistent with, and for the duration of, the new PST agreement — essentially a final U.S. approval of the agreement. This action is contingent on a determination that the agreement satisfies the legal requirements of the ESA as specified in the diplomatic notes. The U.S. agreed "to fulfill those [ESA] requirements as expeditiously as possible consistent with U.S. law" and to advise Canada on the date on which the requirements have been met. The U.S. commitment to the agreement essentially endorses Canadian management of its fisheries in accordance with the terms of the agreement; once the U.S. does so, fishing levels in Canada will be set by the provisions of the agreement for its duration, and cannot be re-visited except as may otherwise be agreed by both countries.

The second action is the decision by the North Pacific Fisheries Management Council (NPFMC) to continue to defer its management authority to the State of Alaska. The NPFMC has conditionally deferred regulation and management of Alaska salmon fisheries in the Exclusive Economic Zone (EEZ) off the coast of Alaska to the State of Alaska under the April 1990 Fishery Management Plan For The Salmon Fisheries In The EEZ Off The Coast Of Alaska (FMP) (NPFMC 1990). The NMFS Alaska Regional Administrator oversees state management to assure consistency with the Salmon FMP, the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), the PST, ESA, and other applicable laws. Thus, state management regulations, limited entry licensing programs, reporting requirements, and other management-related actions, are applied to the EEZ unless the NMFS Alaska Regional Administrator determines that he must issue a specific regulation for the salmon fisheries in the EEZ to ensure compliance with applicable Federal law. In addition, the NPFMC reserves the right to specify management measures applicable to the EEZ that differ from those of the state if it is deemed that state actions are inconsistent with the FMP or other applicable law.

Since state regulations governing salmon management do not differentiate between EEZ and state waters, the NPFMC review will apply to salmon fisheries in the EEZ and in state waters within three miles. Under its obligation to coordinate management, the NPFMC decision to continue to defer management will necessarily evaluate the EEZ and state water fisheries. It is this decision to defer that triggers consultation with NMFS to insure that the NPFMC's action does not jeopardize the continued existence of species listed under the ESA. The State of Alaska has indicated its intention to manage the SEAK fisheries subject to the terms of the PST for the duration of the agreement (Rue 1999). This opinion, therefore, considers the combined impacts on listed species of the Canadian and SEAK fisheries when managed as specified by the terms of the 1999 PST agreement, with particular emphasis on Annex IV, Chapter 3, the chinook salmon regime.

Some background information related to the biology of chinook salmon, management of chinook fisheries under the PST, and a description of the proposed management regime under the new agreement follows.

Chinook salmon have a complex life cycle that involves a freshwater rearing period followed by 2-4 years of ocean feeding prior to their spawning migration. Chinook from individual brood years can return over a 2-6 year period, although most adult chinook return to spawn as 4 and 5 year old fish. As a result, a single year class can be vulnerable to fisheries for several years. Chinook salmon migrate and feed over great distances during their marine life stage; some stocks range from the Columbia River and coastal Oregon rivers to as far north as the ocean waters off North/Central B.C. (NCBC) and SEAK. Most chinook stocks are vulnerable to harvest by numerous commercial troll, sport and commercial net fisheries in marine areas. Many are also taken in rivers and streams during their spawning migration by sport, commercial net and subsistence fishermen.

Chinook salmon are taken in directed commercial fisheries using both troll and net gear. The majority of the harvest in SEAK, NCBC, and off the West Coast of Vancouver Island (WCVI) is taken with commercial troll gear. Net gear is the primary gear in terminal areas, i.e., near enhancement facilities, river mouths, and in rivers. Most of the chinook harvested by net fisheries in marine areas and "outside" terminal harvest areas are taken incidentally, i.e., in fisheries directed at other salmon species. Sport fisheries operate in most marine areas and in many freshwater areas. Subsistence and ceremonial harvests with nets occur mainly in the larger rivers.

Their extended migrations and the extreme mixed stock nature of most chinook fisheries greatly complicates the management of chinook salmon. Prior to the mid-1970s, the extent of chinook migration and the impacts of ocean fisheries on particular chinook stocks was poorly understood. This changed with the advent of the coded wire tag (CWT) and extensive tagging programs; large scale tagging of chinook made it possible for fishery managers to determine chinook migration routes, the timing of their migrations, and stock-specific impacts in distant fisheries. This kind of information, though sparse by today's standards, was used to establish the original harvest ceilings for ocean fisheries contained in the 1985 Pacific Salmon Treaty. Those ceilings comprised the cornerstone of the chinook rebuilding program established in the original chinook chapter of the Treaty.

The 1985 chinook rebuilding program relied on the establishment of harvest ceilings for major ocean chinook fisheries for the SEAK, NCBC, WCVI and Strait of Georgia fisheries. Besides immediately reducing the catch, the ceilings were intended to reduce chinook exploitation rates over time. The bulk of the fish "saved" in the ocean fisheries was to be passed through subsequent fisheries to the spawning escapement. The production increases expected to result from the increased escapements, in combination with the fixed ceilings, would further reduce harvest rates over time, resulting in the rebuilding program being completed by 1998. During the initial years of the Treaty, survival conditions for chinook salmon were favorable and improved returns for many stocks made it appear that the ceiling approach was working.

However, during the 1990's, several years of drought in the Pacific Northwest and poor survival conditions in the ocean, in combination with the accumulating effects of chronic habitat degradation reversed the initial rebuilding progress. Chinook survival was so poor and some stocks declined so precipitously, that the ocean harvest ceilings no longer served as an effective constraint on harvest rates, and in some cases the ceilings could not be fully harvested. Additionally, the ceiling levels became viewed by some as catch entitlement; attempts to fully harvest up to the ceiling levels actually resulted in increased harvest rates, just when survival conditions were least favorable for many stocks. After 1992, the PST chinook ceilings expired. Despite several attempts, the countries failed to reach agreement on a new chinook management regime, and each country set its annual harvest objectives unilaterally. This continued through the 1998 fishing season.

Finally, in the late spring of 1999, negotiations successfully produced a comprehensive new agreement, including an amended Annex IV, the part of the Pacific Salmon Treaty that specifies the fishing regimes. The new agreement replaced the previous fixed ceiling-based chinook regime with a new approach based on the annual abundance of salmon. Affecting a large number of stocks of varying status and many different fisheries over a large geographical area, the new regime is considerably more complex than the original chinook management regime. It now includes much greater specificity as to how all fisheries affecting chinook will be managed, and seeks to address the conservation requirements of a much larger number of depressed stocks, including some that are now listed under the ESA.

Since the original treaty was signed in 1985, there has been a vast improvement in the quantity and quality of technical and scientific information available. For chinook salmon, an extensive data base of coded wire tagging information has been assembled, which in turn has allowed the development of increasingly complex and sophisticated computer models for planning and managing fisheries, affecting a large number of "indicator" stocks. These models were used extensively to facilitate the negotiation of the new fishing regimes included in the new PST agreement; they will also be key to its implementation.

As noted above, the new agreement establishes an abundance based chinook management regime for the stocks and fisheries subject to the Pacific Salmon Treaty. This regime will be in effect for the 1999 through 2008 period. The fisheries are classified into two categories, aggregate abundance-based management regimes (AABM) and individual stock-based management regimes (ISBM).

As provided in the new chinook chapter of the agreement: "an AABM fishery is an abundance-based regime that constrains catch or total adult equivalent mortality to a numerical limit computed from either a pre-season forecast or an in-season estimate of abundance, and the application of a desired harvest rate index expressed as a proportion of the 1979-1982 base period." Three fishery complexes are designated for management as AABM fisheries: 1) the SEAK sport, net and troll fisheries; 2) the Northern British Columbia troll (statistical areas 1-5) and the Queen Charlotte Islands sport (statistical areas 1 and 2); and 3) the WCVI troll (statistical areas 21,23-27, and 121-127 and outside sport for specified areas and time periods. The estimated abundance index each year is computed by a formula specified in the agreement for each AABM fishery. Table 1 of the new chinook chapter of the agreement specifies the target catch levels for each AABM fishery as a function of that estimated abundance index.

All chinook fisheries subject to the Treaty that are not AABM fisheries are classified as ISBM fisheries, including freshwater chinook fisheries. As provided in the new chinook chapter of the agreement: "an ISBM fishery is an abundance-based regime that constrains to a numerical limit the total catch or total adult equivalent mortality rate within the fisheries of a jurisdiction for a naturally spawning chinook stock or stock group." In these fisheries the agreement specifies that Canada and the U.S. shall reduce by 36.5% and 40% respectively, the total adult equivalent mortality rate relative to the 1979-1982 base period for a specifed list of escapement indicator stocks (see Attachments IV and V to the agreement). If such reductions do not result in achieving agreed biologically-based escapement objectives for a specified list of natural-origin stocks, ISBM fishery managers must implement further reductions across their fisheries as necessary to meet those objectives or as necessary to equal at least the 1991-1996 ISBM fishery index for those stocks. Although the specified ISBM objectives must be achieved to comply with the agreement, the affected managers may choose to apply more constraints to their respective fisheries than are specifically mandated by the agreement.

The agreement specifies conditions under which additional harvest constraints will apply to both AABM and ISBM fisheries in the event the standard regimes do not result in achieving the specified escapement objectives: A number of other provisions are also specified to address various contingencies; these can be found in Annex IV, Chapter 3 - Chinook Salmon (revised), of the PST.

A number of differences regarding SEAK and Canadian fisheries (collectively referred to as the "northern" fisheries) are particular pertinent to the scope of the proposed action covered by this biological opinion. The bilateral negotiations that led to the new PST agreement focused on how chinook fisheries in SEAK would be managed, because those fisheries significantly affect many different Canadian and southern U.S. chinook stocks. Similarly, Canadian fisheries received much focus, largely because they significantly impact (intercept) many southern U.S. chinook stocks, often to a very large degree. In addition, the SEAK and the Canadian fisheries each are managed by a single management agency within their respective jurisdictions, making it feasible as well as desirable to negotiate detailed management plans in the PST negotiations. Because the northern fisheries affect many stocks from other jurisdictions, it is not surprising that much of the detail in the new PST agreement relates to how the northern fisheries will be managed.

These features of the northern fisheries contrast significantly with the southern U.S. fisheries. Southern U.S. fisheries involve relatively few interceptions of chinook from other jurisdictions. Additionally, the southern U.S. fisheries are actually a complex of fisheries managed by a number of different entities that involve three states and many tribes. The burden of coordinating management among these fisheries each year is a formidable task, which typically occurs in management processes established pursuant to federal court cases in US v Washington or US v Oregon, or in the PFMC and closely-related North of Falcon process. Lastly, southern state and tribal managers are currently developing new, comprehensive management plans, motivated by recent ESA listings and/or the recent expiration of the Columbia River Fish Management Plan in US v Oregon.

Largely as a consequence of these distinctions, the PST agreement focussed on how northern fisheries would be managed. The PST agreement only defines an upper limit of impact on specified natural stocks groups for the southern fisheries. These limits are expressed as specific reductions in the ISBM index, relative to a base period, constraining the aggregate impact across all southern fisheries. The PST agreement does not specify how these impacts will be distributed each year across fisheries, nor take account of numerous other management constraints that may apply to these fisheries, such as allocation between Treaty and non-Treaty fisheries. As noted above, southern managers are currently developing new management plans; for example, new objectives are being developed for Puget Sound chinook with the intent that they be implemented in 2000 fisheries. Because those new management plans are not finished yet, insufficient detail is currently available and no specific management plan has been presented for the southern fisheries. For these reasons, the southern fisheries are not yet ripe for consultations; thus they are not within the scope of consultation in this biological opinion. However, the range of impacts likely to occur in the southern fisheries will be taken into account during the analysis of the proposed northern fisheries. Consultations on specific southern fisheries will occur separately, as appropriate, when sufficiently detailed plans are available. Accordingly, this opinion considers the effect on listed species of the Canadian and SEAK fisheries when managed subject to the provisions of the agreement.

B. Action Area

The action area includes all marine and freshwater fishing areas in SEAK and BC subject to provisions of Annex IV of the PST. For BC this includes in particular all marine and freshwater chinook fishing areas located between the International Boundary in Dixon Entrance and the International Boundary separating BC from the State of Washington. For SEAK this includes particularly all marine and freshwater chinook fishing areas, including waters of the EEZ, between the longitude of Cape Suckling (143 53' 36" W.) and the International Boundary in Dixon Entrance. Southern fishing areas are not included as part of the action area. Southern fisheries will be considered in more detail during consultation on associated future federal actions.

Table 1. Summary of salmon species listed and proposed for listing under the Endangered Species Act.

Species	Evolutionarily Significant Unit	Present Status	Federal Register Notice
Chinook Salmon	Sacramento River Winter-Run	Endangered	54 FR 32085 8/1/89
(*O. tshawytscha*)	Snake River Fall	Threatened	57 FR 14653 4/22/92
	Snake River Spring/Summer	Threatened	57 FR 14653 4/22/92
	Puget Sound	Threatened	64 FR 14308 3/24/99
	Lower Columbia River	Threatened	64 FR 14308 3/24/99
	Upper Willamette River	Threatened	64 FR 14308 3/24/99
	Upper Columbia River Spring	Endangered	64 FR 14308 3/24/99
	Central Valley Spring-Run	Threatened	64 FR 50393 9/16/99
	California Coast	Threatened	64 FR 50393 9/16/99
Chum Salmon	Hood Canal Summer-Run	Threatened	64 FR 14570 3/25/99
(*O. keta*)	Columbia River	Threatened	64 FR 14570 3/25/99
Coho Salmon	Central California Coast	Threatened	61 FR 56138 10/31/96
(*O. kisutch*)	S. Oregon/ N. California Coast	Threatened	62 FR 24588 5/6/97
	Oregon Coast	Threatened	63 FR 42587 8/10/98
Sockeye Salmon	Snake River	Endangered	56 FR 58619 11/20/91
(*O. nerka*)	Ozette Lake	Threatened	64 FR 14528 3/25/99
Steelhead	Southern California	Endangered	62 FR 43937 8/18/97
(*O. mykiss*)	South-Central California	Threatened	62 FR 43937 8/18/97
	Central California Coast	Threatened	62 FR 43937 8/18/97
	Upper Columbia River	Endangered	62 FR 43937 8/18/97
	Snake River Basin	Threatened	62 FR 43937 8/18/97
	Lower Columbia River	Threatened	63 FR 13347 3/19/98
	Central Valley California	Threatened	63 FR 13347 3/19/98
	Upper Willamette River	Threatened	64 FR 14517 3/25/99
	Middle Columbia River	Threatened	64 FR 14517 3/25/99
Cutthroat Trout	Umpqua River	Endangered	61 FR 41514 8/9/96
Sea-Run (*O. clarki clarki*)	Southwest Washington/Columbia River	Proposed Threatened	64 FR 16397 4/5/99

II. Status of the Species and Critical Habitat

Part IV below discusses the effects of the proposed actions on the currently listed ESUs shown in Table 1. It is apparent from that discussion that the expected take in the proposed ocean salmon fisheries in SEAK and BC of many of the ESUs is either zero or at most an occasional event. The following discussion regarding the Status of the Species and the Environmental Baseline therefore focuses on those ESUs that are subject to measurable harvest mortality in the proposed fisheries including four chinook ESUs (Snake River (SR) fall chinook, Puget Sound (PS) chinook, Lower Columbia River (LCR) chinook, and Upper Willamette River (UWR) chinook) and Hood Canal Summer-Run (HCSR) chum. However, sufficient information regarding the other ESUs is provided in Part IV to support the necessary conclusions.

A. Species and Critical Habitat Description

The SR fall chinook ESU includes all natural-origin populations of fall chinook in the mainstem Snake River and several tributaries including the Tucannon, Grande Ronde, Salmon, and Clearwater rivers. Fall chinook from the Lyons Ferry Hatchery are included in the ESU but are not listed.

Critical habitat was designated for SR fall chinook salmon on December 28, 1993 (58 FR 68543). The essential features of the critical habitat include four components: (1) spawning and juvenile rearing areas, (2) juvenile migration corridors, (3) areas of growth and development to adulthood, and (4) adult migration corridors. Marine areas including those within the action area, are not included as part of the designated critical habitat.

The UWR chinook ESU occupies the Willamette River and tributaries upstream of Willamette Falls, in addition to naturally produced spring-runfish in the Clackamas River. Historically, access above Willamette Falls was restricted to the spring when flows were high. In autumn low flows prevented fish from ascending past the falls. The Upper Willamette spring chinook are one of the most genetically distinct chinook groups in the Columbia River Basin. Fall chinook salmon spawn in the Upper Willamette but are not considered part of the ESU because they are not native. None of the hatchery populations in the Willamette River were listed although five spring-run hatchery stocks were included in the ESU.

The LCR ESU includes all native populations from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls. Celilo Falls, which corresponded to the edge of the drier Columbia Basin Ecosystem and historically may have presented a migrational barrier to chinook salmon at certain times of the year, is the eastern boundary for this ESU. Not included in this ESU are "stream-type" spring-run chinook salmon found in the Klickitat River (which are considered part of the Mid-Columbia River Spring-Run ESU) or the introduced Carson spring-chinook salmon strain. "Tule" fall chinook salmon in the Wind and Little White Salmon Rivers are included in this ESU, but not introduced "upriver bright" fall-chinook salmon populations in the Wind, White Salmon, and Klickitat Rivers. For this ESU, the Cowlitz, Kalama, Lewis, Washougal, and White Salmon, are the major river systems on the Washington side, and the lower Willamette and Sandy Rivers are foremost on the Oregon side. The majority of this ESU is represented by fall-run fish and includes both north migrating tule-type stocks and far-north migrating bright stocks. There is some question whether any natural-origin spring chinook salmon persist in this ESU. Fourteen hatchery stocks were included in the ESU; one was considered essential for recovery (Cowlitz River spring chinook) but was not listed.

The PS chinook ESU includes all runs of chinook salmon in the Puget Sound region from the North Fork Nooksack River to the Elwha River on the Olympic Peninsula. Chinook salmon in this area all exhibit an ocean-type life history although there are several populations with an adult spring run timing and ocean distribution. Although some spring-run chinook salmon populations in the PS ESU have a high proportion of yearling smolt emigrants, the proportion varies substantially from year to year and appears to be environmentally mediated rather than genetically determined. Thirty-six hatchery populations were included as part of the ESU and five were considered essential for recovery and listed including spring chinook from Kendall Creek, the North Fork Stillaguamish River, White River, and Dungeness River, and fall run fish from the Elwha River.

The HCSR chum ESU includes summer-run chum salmon populations in Hood Canal in Puget Sound and in Discovery and Sequim Bays on the Strait of Juan de Fuca. It may also include summer-run fish in the Dungeness River, but the existence of that run is uncertain. Five hatchery populations are considered part of the ESU including those from the Quilcene National Fish Hatchery, Long Live the Kings Enhancement Project (Lilliwaup Creek), Hamma Hamma River Supplementation Project, Big Beef Creek reintroduction Project, and the Salmon Creek supplementation project in Discovery Bay. Although included as part of the ESU, none of the hatchery populations were listed.

Critical habitat has not been designated for the UWR, LCR, or PS chinook ESUs or for HCSR chum.

B. Life History

General life history information is presented below for chinook salmon and chum salmon. More specific information regarding species status and recent population trends are provided in the following section for the ESUs that are the focus of this opinion.

1. Chinook Salmon

Chinook salmon is the largest of the Pacific salmon. The species' distribution historically ranged from the Ventura River in California to Point Hope, Alaska in North America, and in northeastern Asia 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 arguably the most diverse and complex life history strategies. Healey (1986) described 16 age categories for chinook salmon, 7 total ages with 3 possible freshwater ages. This level of complexity is roughly comparable to sockeye salmon (*O. nerka*), although sockeye salmon have a more extended freshwater residence period and utilize different freshwater habitats (Miller and Brannon 1982, Burgner 1991). Two generalized freshwater life-history types were initially described by Gilbert (1912): "stream-type" chinook salmon reside in freshwater for a year or more following emergence, whereas "ocean-type" chinook salmon migrate to the ocean within their first year. Healey (1983, 1991) has promoted the use of broader definitions for "ocean-type" and "stream-type" to describe two distinct races of chinook salmon. This racial approach incorporates life history traits, geographic distribution, and genetic differentiation and provides a valuable frame of reference for comparisons of chinook salmon populations.

The generalized life history of Pacific salmon involves incubation, hatching, and emergence in freshwater, migration to the ocean, and subsequent initiation of maturation and return to freshwater for completion of maturation and spawning. Juvenile rearing in freshwater can be minimal or extended. Additionally, some male chinook salmon mature in freshwater, thereby foregoing emigration to the ocean. The timing and duration of each of these stages is related to genetic and environmental determinants and their interactions to varying degrees. Salmon exhibit a high degree of variability in life-history traits; however, there is considerable debate as to what degree this variability is the result of local adaptation or the general plasticity of the salmonid genome (Ricker 1972, Healey 1991, Taylor 1991). More detailed descriptions of the key features of chinook salmon life history can be found in Myers, et al. (1998) and Healey (1991).

2. 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 (Oncorhynchus keta) are semelparous, 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 other Pacific salmonids. Chum salmon, like pink salmon, usually spawn in the lower reaches of rivers, 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 that covers their redds (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).

C. Population Dynamics and Distribution

This section provides more specific information about the ESUs that are the focus this opinion. Included here is information regarding the distribution and population structure of the ESUs, and size, variability, and trends of the components (stocks or populations) of the ESUs. Most of this information comes from observations made in terminal, freshwater areas which are distinct from the action area (marine and freshwater fishing areas in SEAK and BC that are subject to the agreement). The focus of this assessment in freshwater areas is appropriate because the species status and distribution can only be measured in adequate detail as they return to spawn in the terminal areas.

1. Chinook Salmon

Snake River Fall Chinook

The spawning grounds between Huntington (RM 328) and Auger Falls (RM 607) were historically the most important for this species. Only limited spawning activity was reported downstream from RM 273 (Waples, et al. 1991), about one mile upstream of Oxbow Dam. Since then, irrigation and hydropower projects on the mainstem Snake River have blocked access to or inundated much of this habitat—causing the fish to seek out less-preferable spawning grounds wherever they are available. Natural fall chinook salmon spawning now occurs primarily in the Snake River below Hells Canyon Dam and the lower reaches of the Clearwater, Grand Ronde, Salmon, and Tucannon Rivers.

Adult Snake River fall chinook salmon enter the Columbia River in July and migrate into the Snake River from August through October. Fall chinook salmon generally spawn from October through November and fry emerge from March through April. Downstream migration generally begins within several weeks of emergence (Becker 1970, Allen and Meekin 1973), and juveniles rear in backwaters and shallow water areas through mid-summer prior to smolting and migrating to the ocean—thus they exhibit an "ocean" type juvenile history. Once in the ocean, they spend one to four years (though usually, three) before beginning their spawning migration. Fall returns in the Snake River system are typically dominated by four-year-old fish. For detailed information on the Snake River fall chinook salmon, see NMFS (1991) and June 27, 1991, 56 FR 29542.

No reliable estimates of historical abundance are available, but because of their dependence on mainstem habitat for spawning, fall chinook have probably been impacted to a greater extent by the development of irrigation and hydroelectric projects than any other species of salmon. It has been estimated that the mean number of adult Snake River fall chinook salmon declined from 72,000 in the 1930s and 1940s to 29,000 during the 1950s. In spite of this, the Snake River remained the most important natural production area for fall chinook in the entire Columbia River basin through the 1950s. The number of adults counted at the uppermost Snake River mainstem dams averaged 12,720 total spawners from 1964 to 1968, 3,416 spawners from 1969 to 1974, and 610 spawners from 1975 to 1980 (Waples, et al. 1991).

Counts of adult fish of natural-origin continued to decline through the 1980s reaching a low of 78 individuals in 1990 (Table 2). Since then the return of natural-origin fish to Lower Granite Dam (LGD) has been variable, but generally increasing reaching a recent year high of 797 in 1997. The 1998 return declined to 306. This was not anticipated and is of particular concern because it is close to the low threshold escapement level of 300 that is indicative of increased risk (BRWG 1994). It has been suggested that the low return in 1998 was due to severe flooding in 1995 that affected the primary contributing brood year. The expected return of natural-origin adults to LGD in 1999 given the anticipated ocean and inriver fisheries is 518.

Unlike many of the listed salmonid ESUs, SR fall chinook is probably represented by only a single population that spawns in the parts of the mainstem that remain accessible and the lower reaches of the associated tributaries. The more complex population structure that likely existed historically was eliminated by the upstream dams.

The recovery standard identified in the 1995 Proposed Recovery Plan (NMFS 1995a) for Snake River fall chinook was a population of at least 2,500 naturally produced spawners (to be calculated as an eight year geometric mean) in the lower Snake River and its tributaries. The LGD counts can not be compared directly to the natural spawner escapement objective since it is also necessary to account for adults which may fall back below the dam after counting and prespawning mortality. A preliminary estimate suggested that a LGD count of 4,300 would be necessary to meet the 2,500 fish escapement goal (NMFS 1995a). For comparison, the geometric mean of the LGD counts of natural-origin fall chinook over the last eight years is 481.

A further consideration regarding the status of SR fall chinook is the existence of the Lyons Ferry Hatchery stock which is considered part of the ESU. There have been several hundred adults returning to the Lyons Ferry Hatchery in recent years (Table 2). More recently, supplementation efforts designed to accelerate rebuilding were initiated beginning with smolt outplants from the 1995 brood year. The existence of the Lyons Ferry program has been an important consideration in evaluating the status of the ESU since it reduces the short-term risk of extinction by providing a reserve of fish from the ESU. Without the hatchery program the risk of extinction would have to be considered high since the ESU would otherwise be comprised of a few hundred individuals from a single population, in marginal habitat, with a demonstrated record of low productivity. Although the supplementation program likely contributes future natural origin spawners, it does little to change the productivity of the system upon which a naturally spawning population must rely. Supplementation is, therefore, not a long-term substitute for recovery. (See NMFS (1999e) for further discussion on the SR fall chinook supplementation program.)

Recent analyses conducted through the PATH process (Plan for Analyzing and Testing Hypotheses) considered the prospects for survival and recovery given several future management options for the hydro system and other mortality sectors (Marmorek, et al. 1998, Peters, et al. 1999). That analysis indicated that the prospects of survival for Snake River fall chinook were good, but that full recovery was relatively unlikely except under a very limited range of assumptions, or unless draw down was implemented for at least the four lower Snake River dams operated by the U.S. Army Corps of Engineers. Consideration of the draw down options led to a high likelihood that both survival and recovery objectives could be achieved.

The Northwest Fisheries Science Center (NWFSC) has recently considered the extinction risk for SR fall chinook as part of their Cumulative Risk Initiative (CRI). The results indicate that the probability of extinction for SR fall chinook over the next ten years is near zero while the risk of extinction over 100 years is between 6-17% (depending on whether 1980 is included in the baseline analysis).

Table 2. Escapement and Stock Composition of Fall Chinook at Lower Granite Dam[1]

Year	L. Granite Count	Marked Fish to Lyons Ferry Hatch.	L. Granite Dam Escapement	Stock Comp. of L. Granite Escapement		
					Hatchery Origin	
				Wild	Snake R.	Non-Snake R.
1975	1000		1000	1000		
1976	470		470	470		
1977	600		600	600		
1978	640		640	640		
1979	500		500	500		
1980	450		450	450		
1981	340		340	340		
1982	720		720	720		
1983	540		540	428	112	
1984	640		640	324	310	6
1985	691		691	438	241	12
1986	784		784	449	325	10
1987	951		951	253	644	54
1988	627		627	368	201	58
1989	706		706	295	206	205
1990	385	50	335	78	174	83
1991	630	40	590	318	202	70
1992	855	187	668	549	100	19
1993	1170	218	952	742	43	167
1994	791	185	606	406	20	180
1995	1067	430	637	350	1	286
1996	1308	389	919	639	74	206
1997	1451	444	1007	797	20	190
1998	1909	947	962	306	479	177

[1]Information taken from *Revised Tables for the Biological Assessment of Impacts of Anticipated 1996-1998 Fall Season Columbia River Mainstem and Tributary Fisheries on Snake River Salmon Species Listed Under the Endangered Species Act*, prepared by the U.S. v. Oregon Technical Advisory Committee.

Upper Willamette River Chinook

Upper Willamette River chinook are one of the most genetically distinct groups or chinook in the Columbia River Basin. This may be related in part to the narrow time window available for passage above Willamette Falls. Chinook populations in this ESU have a life history pattern that includes traits from both ocean- and stream-type life histories. Smolt emigrations occur as young of the year and as age-1 fish. Ocean distribution of chinook in this ESU is consistent with an ocean-type life history with the majority of chinook being caught off the coasts of British Columbia and Alaska. Spring chinook from the Willamette River have the earliest return timing of chinook stocks in the Columbia Basin with freshwater entry beginning in February. Historically, spawning occurred between mid-July and late October. However, the current spawn timing of hatchery and wild chinook in September and early October likely is due to hatchery fish introgression.

The abundance of naturally-produced spring chinook in the ESU has declined substantially from historic levels. Historic escapement levels may have been as high as 200,000 fish per year. The production capacity of the system has been reduced substantially by extensive dam construction and habitat degradation. From 1946-50, the geometric mean of Willamette Falls counts for spring chinook was 31,000 fish (Myers *et al.* 1998), which represented primarily naturally-produced fish. The most recent 5 year (1995-1999) geometric mean escapement above the falls was 27,800 fish, comprised predominantly of hatchery-produced fish (Table 3). Nicholas (1995) estimated 3,900 natural spawners in 1994 for the ESU, with approximately 1,300 of these spawners being naturally produced. There has been a gradual increase in naturally spawning fish in recent years, but it is believed that many of these are first generation hatchery fish. The long-term trend for total spring chinook abundance within the ESU has been approximately stable although there was a series of higher returns in the late-80s and early-90s that are associated with years of higher ocean survival. The great majority of fish returning to the Willamette River in recent years have been of hatchery-origin.

Historically, there were five major basins that produced spring chinook including the Clackamas, North and South Santiam Rivers, McKenzie, and the Middle Fork Willamette. However, between 1952-1968 dams were built on all of the major tributaries occupied by spring chinook, blocking over half the most important spawning and rearing habitat. Dam operations have also reduced habitat quality in downstream areas due to thermal and flow effects. Dams on the South Fork Santiam and Middle Fork Willamette eliminated wild spring chinook in those systems (ODFW 1997). Although there is still some natural spawning in these systems below the dams, habitat quality is such that there is probably little resulting production and the spawners are likely of hatchery origin. Populations in several smaller tributaries that also used to support spring chinook are believed to be extinct (Nicholas 1995).

The available habitat in the North Fork Santiam and McKenzie rivers was reduced to 1/4 and 2/3, respectively, of its original capacity. Spring chinook on the Clackamas were extirpated from the upper watershed after the fish ladder at Faraday Dam washed out in 1917, but recolonized the system after

1939 when the ladder was repaired. NMFS was unable to determine, based on available information whether this represents a historical affinity or a recent, human-mediated expansion into the Clackamas River. Regardless, NMFS included natural-origin spring chinook as part of the listed populations and considers Clackamas spring chinook as a potentially important genetic resource for recovery.

The McKenzie, Clackamas, and North Santiam are therefore the primarily basins that continue to support natural production. Of these the McKenzie is considered the most important. Prior to construction of major dams on Willamette tributaries, the McKenzie produced 40% of the spring chinook above Willamette Falls and it may now account for half the production potential in the Basin. Despite dam construction and other habitat degradations, the McKenzie still supports substantial production with most of the better quality habitat locate above Leaburg Dam. The interim escapement objective for the area above the Dam is 3,000-5,000 spawners (ODFW 1998a). Pristine production in that area may have been as high as 10,000, although substantial habitat improvements would be required to again achieve pristine production levels. Estimates of the number of natural-origin spring chinook returning to Leaburg Dam are available since 1994 when adults from releases of hatchery reared smolts above the dam were no longer present. The number of natural-origin fish at the Dam has increased steadily from 786 in 1994 to 1,458 in 1999 (Table 3). Additional spawning in areas below the Dam accounts for about 20% of the McKenzie return.

The Clackamas River currently accounts for about 20% of the production in the Willamette Basin. The production comes from one hatchery and natural production areas located primarily above the North Fork Dam. The interim escapement goal for the area above the Dam is 2,900 adults (ODFW 1998a). This system is heavily influenced by hatchery production so it is difficult to distinguish natural from hatchery-origin spawners. Most of the natural spawning occurs above the North Fork Dam with 1,000-1,500 adults crossing the Dam in recent years. There were 380 redds counted above the dam in 1998 and similar counts in 1997 (Lindsay et. al. 1998). There is some spawning in the area below the Dam as well although the origin and productivity of these fish is again uncertain. There were 48 spring chinook redds counted below the North Fork Dam in 1998.

Over 70% of the production capacity of the North Santiam system was blocked by the Detroit Dam. There are no passage facilities at the Dam so all of the current natural production potential remains downstream. The remaining habitat is adversely affected by warm water and flow regulation. The system is again influenced substantially by hatchery production, although the original genetic resources have been maintained since Marion Forks Hatchery stock has been derived almost exclusively from North Santiam brood sources (ODFW 1998a). Despite these limitations there continues to be natural spawning in the lower river. There were 194 redds counted in the area below Minto Dam (the lower-most dam) in 1998, which was marginally higher than during the prior two years (Lindsay et. al. 1998). The origin of the spawning adults or their reproductive success has not been determined.

Mitigation hatcheries were built to offset the substantial habitat losses resulting from dam construction and, as a result, 85%-95% of the production in the basin is now hatchery origin fish. On the one hand these hatchery populations represent a risk to the ESU. The genetic diversity of the ESU has been largely homogenized due to the past practice of broodstock transfers within the basin. Domestication is also a risk given the predominance of hatchery fish. Nevertheless, the hatchery populations also represent a genetic resource. All five of the hatchery stocks were included in the ESU and therefore are available to support recovery efforts. Given the extensive network of dams in the basin and other pervasive habitat degradations, it is clear that most, if not all, of the remaining populations would have been eliminated had it not been for the hatchery programs.

NMFS is currently engaged in a consultation to consider the future operation of the hatchery facilities in the Willamette Basin. This will reduce future risks associated with hatchery operations. Substantial efforts have already been taken to remedy some of the past hatchery practices including limiting the proportion of hatchery spawners in some natural production areas and reincorporating local-origin wild fish into the hatchery broodstock (ODFW 1998a). All hatchery produced fish in the Basin are now externally marked. Once these fish are fully recruited, the mass marking will allow implementation of selective fisheries in terminal areas and thus provide harvest opportunity with limited impacts to natural origin fish. The marking program will also greatly improve the managers' ability to monitor and control hatchery straying and production. The fall chinook hatchery production program was also noted as a risk to the species since fall chinook were not historically present above Willamette Falls. The fall production program at Stayton Ponds has now been closed with the last release made in 1995. It is reasonable to expect that the return of fall chinook will diminish rapidly as a result.

Table 3. Run size of spring chinook at the mouth of the Willamette River and counts at Willamette Falls and Leaburg Dam on the McKenzie River (Nicholas 1995; ODFW and WDFW 1998). The Leaburg counts show wild and hatchery combined and wild only since 1994.

Return Year	Estimated number entering Willamette River	Willamette Falls Count	Leaburg Dam Count: Combined	Leaburg Dam Count: Wild Only
1985	57,100	34,533	825	
1986	62,500	39,155	2,061	
1987	82,900	54,832	3,455	
1988	103,900	70,451	6,753	
1989	102,000	69,180	3,976	
1990	106,300	71,273	7,115	
1991	95,200	52,516	4,359	
1992	68,000	42,004	3,816	
1993	63,900	31,966	3,617	
1994	47,200	26,102	1,526	786
1995	42,600	20,592	1,622	894
1996	34,600	21,605	1,445	1,086
1997	35,000	26,885	1,176	981
1998	45,100	34,461	1,874	1,364
1999	58,000*	40,410	1,458	1,416

*preliminary

Lower Columbia River Chinook

The LCR ESU includes spring stocks and fall tule and bright components. Spring-run chinook salmon on the lower Columbia River, like those from coastal stocks, enter freshwater in March and April well in advance of spawning in August and September. Historically, fish migrations were synchronized with periods of high rainfall or snowmelt to provide access to upper reaches of most tributaries where spring stocks would hold until spawning (Fulton 1968, Olsen *et al.* 1992, WDF *et al.* 1993).

Fall chinook predominate the Lower Columbia River salmon runs. Fall chinook return to the river in mid-August and spawn within a few weeks (WDF et al. 1993, Kostow 1995). The majority of fall-run chinook salmon emigrate to the marine environment as subyearlings (Reimers and Loeffel 1967, Howell et al. 1985, WDF et al. 1993). A portion of returning adults whose scales indicate a yearling smolt migration may be the result of extended hatchery-rearing programs rather than of natural, volitional yearling emigration. It is also possible that modifications in the river environment may have altered the duration of freshwater residence. Adults return to tributaries in the Lower Columbia River at 3 and 4 years of age for fall-run fish and 4 to 5 years of age for spring-run fish. This may be related to the predominance of yearling smolts among spring-run stocks. Marine coded-wire-tag recoveries for lower Columbia River stocks tend to occur off the British Columbia and Washington coasts, though a small proportion of the tags are recovered in Alaskan waters.

There are no reliable estimates of historic abundance for this ESU, but it is generally agreed that there have been vast reductions in natural production over the last century. Recent abundance of spawners includes a 5-year geometric mean natural spawning escapement of 29,000 natural spawners and 37,000 hatchery spawners (1991-95), but according to the accounting of PFMC (1996), approximately 68% of the natural spawners are first-generation hatchery strays.

All basins in the region are affected to varying degrees by habitat degradation. Major habitat problems are related primarily to blockages, forest practices, urbanization in the Portland and Vancouver areas, and agriculture in flood plains and low-gradient tributaries. Substantial chinook salmon spawning habitat has been blocked (or passage substantially impaired) in the Cowlitz (Mayfield Dam 1963, RKm 84), Lewis (Merwin Dam 1931, RKm 31), Clackamas (North Fork Dam 1958, RKm 50), Hood (Powerdale Dam 1929, RKm 7), and Sandy (Marmot Dam 1912, RKm 48; Bull Run River dams in the early 1900s) rivers (WDF et al. 1993, Kostow 1995).

Hatchery programs to enhance chinook salmon fisheries in the lower Columbia River began in the 1870s, expanded rapidly, and have continued throughout this century. Although the majority of the stocks have come from within this ESU, over 200 million fish from outside the ESU have been released since 1930. A particular concern noted at the time of listing related to the straying by Rogue River fall-run chinook salmon, which are released into the lower Columbia River to augment harvest opportunities. The release strategy has since been modified to minimize straying, but it is too early to assess the effect of the change. Available evidence indicates a pervasive influence of hatchery fish on most natural populations throughout this ESU, including both spring- and fall-run populations (Howell et al. 1985, Marshall et al. 1995). In addition, the exchange of eggs between hatcheries in this ESU has led to the extensive genetic homogenization of hatchery stocks (Utter et al. 1989).

The remaining spring chinook stocks in the LCR ESU are found in the Sandy on the Oregon side and Lewis, Cowlitz, and Kalama on the Washington side. Spring chinook in the Clackamas River are considered part of the UWR ESU. Naturally spawning spring chinook in the Sandy River are included in the LCR ESU despite substantial influence of Willamette hatchery fish from past years since they likely contain all that remains of the original genetic legacy for that system. Recent escapements above Marmot Dam on the Sandy River average 2,800 and have been increasing (ODFW 1998b). Hatchery-origin spring chinook are no longer released above Marmot Dam; the proportion of first generation hatchery fish in the escapement is relatively low, on the order of 10-20% in recent years.

On the Washington side spring chinook were present historically in the Cowlitz, Kalama, and Lewis rivers. Spawning areas were blocked by dam construction in the Cowlitz and Lewis. The native Lewis run became extinct soon after completion of Merwin Dam in 1932. Production in the Kalama was limited by the dams and by 1950 only a remnant population remained. Spring chinook in the Cowlitz, Kalama, and Lewis are currently all hatchery fish. There is some natural spawning in the three rivers, but these are believed to be primarily from hatchery strays (ODFW 1998b). The recent averages (1994-1998) for naturally spawning spring chinook in the Cowlitz, Kalama, and Lewis are 235, 224, and 372, respectively. The amount of natural production resulting from these escapements is unknown, but is presumably small since the remaining habitat in the lower rivers is not the preferred habitat for spring chinook. The Lewis and Kalama hatchery stocks have been mixed with out of basin stocks, but are nonetheless included in the ESU. The Cowlitz stock is largely free of introductions and is considered essential for recovery although not listed. The number of spring chinook returning to the Cowlitz, Kalama, and Lewis rivers have declined in recent years, but still number several hundred to a few thousand in each system (Table 4). Hatchery escapement goals have been consistently met in the Cowlitz and Lewis Rivers. The goal has not been met in all years in the Kalama, but WDFW continues to use brood stock from the Lewis to meet production goals in the Kalama. Although the status of hatchery stocks are not always a concern or priority from an ESA perspective, in situations where the historic spawning habitat is no longer accessible, the status of the hatchery stocks is pertinent.

Table 4. Estimated Lower Columbia River spring chinook tributary returns, 1992-1999. (Source: Pettit 1998, ODFW/WDFW 1998.)

Year	Sandy R.	Cowlitz R.	Lewis R.	Kalama R.	Total Returns Excluding the Willamette System
1992	8,600	10,400	5,600	2,400	27,200
1993	6,400	9,500	6,600	3,000	25,500
1994	3,500	3,100	3,000	1,300	10,900
1995	2,500	2,200	3,700	700	9,100
1996	4,100	1,800	1,700	600	8,200
1997	5,200	1,900	2,200	600	9,900
1998	4,300	1,100	1,600	400	7,400
1999		1,600	1,900	600	

There are apparently three self-sustaining natural populations of tule chinook in the Lower Columbia River (Coweeman, East Fork Lewis, and Clackamas) that are not substantially influenced by hatchery strays. Returns to the East Fork and Coweeman have been stable and near interim escapement goals in recent years. Recent 5 and 10 year average escapements to the East Fork Lewis have been about 300 compared to an interim escapement goal of 300. Recent 5 and 10 year average escapements to the Coweeman are 900 and 700, respectively compared to an interim natural escapement goal of 1000 (pers. comm., from G. Norman, WDFW to P. Dygert NMFS, February 22, 1999). Natural escapement on the Clackamas has averaged about 350 in recent years. There have been no releases of hatchery fall chinook in the Clackamas since 1981 and there are apparently few hatchery strays. The population is considered depressed, but stable and self-sustaining (ODFW 1998b). There is some natural spawning of tule fall chinook in the Wind and Little White Salmon Rivers, tributaries above Bonneville Dam (the only component of the ESU that is affected by tribal fisheries). Although there may be some natural production in these systems, the spawning results primarily from hatchery-origin strays.

The LCR bright stocks are among the few healthy natural chinook stocks in the Columbia River Basin. Escapement to the North Fork Lewis River has exceed its escapement goal of 5,700 by a substantial margin every year since 1980 with a recent five year average escapement of 10,000. The forecast in 1999 is for an exceptionally low return of about 2,500 and if correct would obviously be under the escapement goal. The low return in 1999 has been attributed to severe flooding that occurred in 1995 and 1996. Despite this apparent aberration, this population is considered healthy.

There are two smaller populations of LCR brights in the Sandy and East Fork Lewis River. Run sizes in the Sandy have averaged about 1000 and been stable for the last 10-12 years. The fall chinook hatchery program in the Sandy was discontinued in 1977, which has certainly reduced the number of hatchery strays in the system. There is also a late spawning component in the East Fork Lewis that is comparable in timing to the other bright stocks. The escapement of these fish is less well documented, but it appears to be stable and largely unaffected by hatchery fish (ODFW 1998b).

Puget Sound Chinook

This ESU encompasses all runs of chinook salmon in the Puget Sound region from the North Fork Nooksack River in the east to the Elwha River on the Olympic Peninsula. Chinook salmon in this area all exhibit an ocean-type life history. Although some spring-run chinook salmon populations in the Puget Sound ESU have a high proportion of yearling smolt emigrants, the proportion varies substantially from year to year and appears to be environmentally mediated rather than genetically determined. Puget Sound stocks all tend to mature at ages 3 and 4 and exhibit similar, coastally-oriented, ocean migration patterns.

The 5-year geometric mean of spawning escapement of natural chinook salmon runs in North Puget Sound for 1992-96 is approximately 13,000. Both long- and short-term trends for these runs were negative, with few exceptions. In South Puget Sound, spawning escapement of the natural runs has averaged 11,000 spawners. In this area, both long- and short-term trends are predominantly positive.

Puget Sound chinook are the largest and most complex ESU that is considered in detail in this opinion. WDF et al. (1993) identified 28 stocks that were distributed among five geographic regions and 12 management units or basins (Table 5). (The Hoko River stock was included in WDF's initial inventory, but was subsequently assigned to the neighboring ESU.) NMFS is currently engaged in delineating the population structure of PS chinook and other ESUs as an initial step in a formal recovery planning effort that is now underway. These determinations have not been finalized at this time, but it is clear that these 28 stocks represent the greatest level of potential stratification and that some further aggregation of these stocks is likely (Myers, J. NWFSC/NMFS, pers. com. P. Dygert, NMFS, Sept. 2, 1999). By considering at this time the status of the stocks as described by WDF NMFS can be reasonably certain that we are not overlooking population structures that may be important to the ESU.

Table 5. Distribution of stocks identified in WDF et al. (1993) by recovery category. Stock timing designations are spring (SP), summer (S), fall (F), and summer/fall (SF).

Region of Origin	Management Unit	Stock/Timing	Recovery Category
Strait of Juan de Fuca	Strait of Juan de Fuca	Elwha/Morse Cr./SF Dungeness/SP	1 1
Hood Canal	Hood Canal	Hood Canal/SF	2 & 3
North Sound	Nooksack/Samish	NF Nooksack/SP SF Nooksack/SP Nooksack/F	1 1 2
	Skagit Spring	Upper Sauk/SP Suiattle/SP Cascade/SP	1 1 1
	Skagit Summer/Fall	Upper Skagit/S Lower Skagit/F Lower Sauk/S	1 1 1
	Stillaguamish	Stillaguamish/S Stillaguamish/F	1 1
	Snohomish	Snohomish/S Wallace/SF Snohomish/F Bridal Veil Cr/F	1 1 1 1
Mid-Sound	Lake Washington	Issaquah/SF N Lake WA Tribs/SF Cedar/SF	2 2 1
	Duwamish/Green	Duwamish/Green/SF Newaukum Cr/SF	1 1
South Sound	Puyallup	White River/SP White River/SF Puyallup River /SF	1 2 2
	Nisqually	Nisqually River/SF	2
	South Sound Tribs	South Sound Tribs/SF	3

Puget Sound includes areas where the habitat still supports self-sustaining natural production of chinook, areas where habitat for natural production has been irrevocably lost, and areas where chinook salmon were never self-sustaining. In addition, the Puget Sound contains areas where indigenous local stocks persist and areas where local stocks are a composite of indigenous stocks and introduced hatchery fish that may or may not be of local origin. In some areas where natural production has been lost, hatchery production has been used to mitigate for lost natural production. In response to these varied circumstances, the state and tribal co-managers have developed a proposal to stratify stocks to provide a context for analyzing actions and considering recovery efforts. This stratification was initially proposed in conjunction with a now ongoing consultation regarding hatchery activities in Puget Sound. However, the proposal is broadly applicable and used in this consultation as well, thus providing a common framework for analyzing both harvest and hatchery activities. Although this stratification scheme has not been formally adopted by the co-managers, it nonetheless provides a useful construct for analysis.

The stratification assigns stocks to one of three categories:

Category 1 stocks are core stocks that are genetically unique and indigenous to watersheds of Puget Sound. Maintaining genetic diversity and integrity of these stocks and achieving abundance levels for long-term sustainability is the highest priority for these stocks. Twenty stocks have been identified in this category (Table 5).

The status of these stocks varies. Some stocks (Dungeness and Nooksack) have fallen to such low levels that our ability to maintain their genetic diversity may be at risk. Other stocks are more robust and the abundance levels are above what is needed to sustain genetic diversity, but often not at levels that will sustain maximum yield harvest rates. All of these stocks have escapement goals, which are actively managed for, but have not generally been achieved in recent years. In some cases (Elwha, Dungeness, Nooksack, Stillaguamish, and White River) hatchery operations are essential for recovery, and without them, the stocks would likely further decline and go extinct. In one case at least (Green River) the number of hatchery fish spawning naturally is a concern, in part because it masks our ability to evaluate the actual productivity of wild fish. The objective for category 1 stocks is to protect and recover these indigenous stocks.

Category 2 stocks are located in watersheds where indigenous stocks MAY no longer exist, but where sustainable stocks existed in the past and where the habitat could still support such stocks. These are primarily areas in Hood Canal and South Sound that have been managed for hatchery production and harvest for many years. Natural spawning in these systems continues, but is primarily the result of hatchery-origin strays. Stocks have been preliminarily assigned to category 2 based on current information, but further investigations will seek to identify remnant indigenous stocks which, if found, would cause them to be reassigned to category 1. The objective for category 2 stocks is to use the most locally adaptable stock towards reestablishment of naturally sustainable populations.

Category 3 stocks are generally found in small independent tributaries that may now have some spawning, but never had independent, self-sustaining stocks of chinook salmon. Many of these watersheds do not have the morphological characteristics needed for chinook and may be better suited for coho and chum salmon, cutthroat trout or resident species. Chinook salmon that are observed occasionally in these watersheds are primarily the result of hatchery strays. The objective for these systems is directed at habitat protection to ensure the production of other species, but no specific actions are proposed to promote the natural production of chinook salmon.

Based on this framework, category 1 stocks are therefore the core stocks that provide the focus for the analysis of proposed harvest actions in this biological opinion. Category 2 stocks may require additional consideration and possibly more targeted protections in the future. However, category 2 stocks, by definition, occur in watersheds where the indigenous stocks no longer exist. Future decisions regarding the form and timing of recovery efforts in these watersheds will dictate the kinds of harvest actions that may be necessary and appropriate in the future. In the meantime, harvest constraints designed to protect category 1 stocks will benefit category 2 stocks as well.

Circumstances pertinent to the status of each of the category 1 stocks varies considerably. Their status ranges from healthy to critical; some stocks are severely limited by the available habitat. The range of hatchery influence varies from completely dependant to stocks that are largely unaffected by hatchery strays. These circumstances are pertinent to the consideration of the kinds of harvest management constraints that are necessary and appropriate. Following is therefore a brief review of factors relevant to the status of each of the category 1 stocks.

Elwha River Summer/Fall Chinook

Elwha chinook is one of the most genetically distinct stocks in Puget Sound. The Elwha River originates in the Olympic Mountains. Much of the drainage is still pristine and protected in the Olympic National Forest. Two dams at river miles 4.9 and 13.4 block passage to over 70 miles of potential habitat. The remaining habitat below the first dam is degraded by the loss of natural gravel, large woody debris, and the adverse effects of high water temperatures. The high temperatures exacerbate problems with the parasite Dermocystidium; resulting prespawning mortality is sometimes as high as 70%. Because of the limitations on natural production, the hatchery and naturally spawning stocks are fully integrated. Hatchery-origin fish commonly spawn in the river and broodstock is routinely supplemented by collecting adults from the river. No hatchery fish have been brought into the basin in recent years and the stock is considered unaffected by the few transfers that were made in earlier years. The escapement to the system has averaged about 1,900 over the last five years (range 1,546-2,527) compared to an escapement goal of 2,900. However, the goal is largely a hatchery production goal and does not represent the natural production capacity of the current degraded habitat.

Dungeness River Spring/Summer Chinook

Although there is no genetic data for Dungeness chinook, they are considered distinct based on their spawn timing and geographic distribution. The Dungeness River is located in a rain shadow and as a result receives relatively little rainfall (less than 20 inches per year). The Dungeness is therefore particularly dependent on annual precipitation and snow pack and is susceptible to habitat degradations that exacerbate low flow conditions. Agricultural water withdrawals remove as much as 60% of the natural flow during the critical low flow period which coincides with spawning. Other land use practices have also substantially degraded the system. The escapement has averaged 114 over the last five years (range 50-183) compared to an escapement goal of 925. Dungeness River chinook are considered critically depressed. As a result, a captive brood stock program was initiated in 1992 to maintain an egg bank to reduce the risk of extinction and help rebuild the native run. In the last couple of years juvenile releases from the program have been on the order of two million; a variety of release strategies are being tested to evaluate which approach is most effective.

Nooksack River Spring Chinook

The Nooksack River has two distinct natural spawning stocks in the North Fork and South Fork. These stocks are genetically distinct from each other and all other Washington stocks as well. The stocks have differentiated because of the unique characteristics of the two watersheds. The North Fork is a higher elevation glacier fed stream; the South Fork is a lower elevation stream that receives no glacier melt. The South Fork is therefore generally low and clear during spawning. Adaptation to these diverse water flow patterns reinforces the biological isolation of these stocks despite their proximity. There is apparently little straying between the two as indicated by the very few out-of-basin coded-wire tag (CWT) recoveries. Because of the unique characteristics of these stocks, both are considered important to the overall health and recovery of the PS chinook.

Both stocks are depressed due to low spawning in recent years and the South Fork in particular is likely critical. Over the last five years the escapements to the North Fork and South Fork have averaged 354 (range 45-621) and 190 (range 118-290), respectively compared to interim escapement goals of 1,000 each. The North Fork and South Fork have been substantially degraded due largely to timber harvest and associated road building activities. Improvements in habitat quality are considered essential to recovery.

A hatchery program on the North Fork has operated since 1988; the North Fork hatchery stock is considered essential to recovery. There is both an on-station program to maintain broodstock and a system of off-station acclimated release sites to supplement the natural production. Returns from the supplementation program have contributed to escapements in recent years thus helping to reduce the immediate risks associated with very low returns. Early supplementation efforts on the South Fork proved unsuccessful and were discontinued. There is currently no supplementation program and South Fork.

Skagit River Spring Chinook

The Skagit watershed is the largest in Puget Sound, contributing over 20% of the freshwater flowing into Puget Sound. The Skagit has several major stream systems that differ substantially in terms of geomorphology and hydrography. Because of this diversity, six different stock groups are recognized including three spring stocks on the upper Cascade, Sauk, and Suittle Rivers. The spring stocks occupy the upper portions of the watersheds where the gradients are moderate to high and water temperatures are generally cooler. The aggregate escapement goal for the spring stocks is 3,000. The combined escapements in recent years have been about 1,000, but returns have been reasonably well distributed and stable in each system. The average escapements to the Cascade, Sauk, and Suittle Rivers over the last five years have been 247 (range 173-323), 265 (range 130-408), and 389 (range 167-473). Critical threshold escapement levels have not been identified for these stocks in particular, but these stocks are depressed and are at least close to what could be considered critical levels.

The Skagit spring stocks are relatively unaffected by hatchery production. There is a spring chinook hatchery stock on the Cascade River that is used as an indicator stock for harvest and marine survival estimates. As a result, all fish released have a CWT. The program is not designed to supplement natural production.

Skagit River Summer/Fall Chinook

The Skagit also supports summer stocks on the lower Sauk and upper Skagit and a fall stock on the lower Skagit. The status of these stocks varies although all have declined in abundance over the last 20-25 years. The aggregate escapement goal for the Skagit summer/fall management unit is currently 14,900. However, more recent analysis, including that associated with this opinion suggests that the an MSY goal of about 9,000 is more consistent with the available information. The stock specific escapements for the lower Sauk, upper Skagit, and lower Skagit have averaged 450 (range 112-1,103), 7,193 (range 4,203-11,761), and 1,345 (range 409-2,388), respectively over the last five years. Escapements to the lower Sauk have been less than 300 in four of the last six years and so are likely at least approaching critical levels. The lower Skagit stock is depressed although the abundance in recent years is likely well above threshold levels. The upper Skagit stock is the most abundant and productive component with escapements that are rountinely approaching and occassionally exceeding MSY levles. The Skagit summer/fall stocks are also largely unaffected by hatchery production. There is again a harvest and survival rate indicator stock program for Skagit fall chinook that involves the collection of 40 spawning pairs per year and the release of about 200,000 marked juveniles.

Stillaguamish Summer/Fall Chinook

Two stocks are distinguished in the Stillaguamish River. There is a summer chinook stock in the North Fork Stillaguamish and a fall chinook stock in the South Fork. The average aggregate escapement to the system over the last five years is 1,080 (range 822-1,540) compared to an combined escapement goal of 2,000. However, the distribution of escapement has been uneven with most fish returning to the North Fork. Escapements to the South Fork have averaged just 200 over the last five years (range 96-

251) and have been less than 251 since 1985. Although still low, the escapements of the last three years are the highest since 1985. Escapements in the North Fork showed a similar upward trend.

There is a supplementation program in place for Stillaguamish summer chinook which is considered essential for recovery. The program was initiated in 1980. There is no on-station release program; rather brood stock is collected annually from the river (the collection goal is 65 pairs) to provide for a release of 200,000 juveniles. The hatchery-origin fish are all marked and also serve as a harvest and survival indicator stock. The marking also means that returning hatchery fish can be distinguished from natural-origin spawners for assessment purposes. Juveniles are acclimated and released volitionally from a large, spring-fed rearing pond. The program contributes a significant proportion of the annual escapement and is at least partly the reason why escapements to the North Fork Stillaquamish have been higher than those in the South Fork. The fall chinook stock in the South Fork Stillaguamish is largely unaffected by artificial production either from supplementation or fishery enhancement programs.

Production in both systems is limited substantially by poor habitat conditions.

Snohomish Chinook

There are three natural-origin stocks in the Snohomish watershed, including Snohomish summer chinook that spawn in the Skykomish and Snohomish mainstems, Bridal Veil chinook which spawn in Bridal Veil Creek and in the North and South Fork Skykomish Rivers, and Snohomish fall chinook that spawn in the Sultan and Snoqualmie rivers and associated tributaries. There is a fourth population that spawns in the Wallace River that is associated with the Skykomish hatchery. The natural spawners in the Wallace River are primarily hatchery origin. This is the only chinook production facility in the Snohomish Basin. Hatchery strays apparently do not contribute substantially to other parts of the Basin.

The Snohomish system has a combined natural escapement goal of 5,250. The average escapement over the last five years is 4,450 (range 3,176-6,300). The escapement of 6,300 in 1998 is the first time the goal has been met since 1980. The distribution of spawners has also been relatively even across the four stocks with none that suggest critical stock concerns. Returns have been relatively stable, falling below 3,000 only twice since 1968.

Lake Washington Chinook

The Cedar River is the only category 1 stock in the Lake Washington system. Natural spawning occurs in Issaquah Creek, but this is supported primarily by releases from the Issaquah Hatchery which is a harvest-oriented production facility. Additional spawning occurs in several small tributaries that enter north Lake Washington including Big Bear Creek and Cottage Lake Creek. These are considered category 2 populations.

Production in the Cedar River is limited by a water diversion dam at river mile 21 which blocks passage to the upper watershed. Natural production is further limited by stream flows, physical barriers, poor water quality and limited spawning and rearing habitat related to watershed development. The escapement goal for the Cedar River is 1,200 natural spawners and 350 for the combined north Lake Washington tributaries. Escapement over the last five years has averaged 630 (range 294-930) primarily in the Cedar River. It is not known how much may be the result of hatchery straying.

Duwamish/Green Chinook

There is one category 1 stock identified in the Green River system. (The lower 10 miles of this drainage are referred to as the Duwamish; the upper portion of the drainage is known as the Green River.) The Green River population has two components; summer/fall chinook spawn from river mile 25-61 in the Green River, and an aggregation of summer/fall chinook that spawn in Neuwakum Creek. There is a large hatchery program at the Green River Hatchery on Soos Creek. The Green River Hatchery stock was founded using Green River origin fish and was the primary production stock that was distributed throughout Puget Sound in past years. (This practice of cross-basin transfers has now been largely eliminated.) There is considerable straying of the hatchery-origin fish into the Green River, but because there have been no out of basin stock transfer, this integrated Green River natural/hatchery-origin stock presumably retains most of is genetic characteristics.

The natural escapement goal for the Green River system is 5,800 chinook. Escapements to Newaukum Creek and the Green River have averaged 849 and 5,219 over the last five years ending in 1997. (The 1998 data was not immediately available.) However, this includes an unknown, but presumably substantial number of hatchery strays.

White River Spring Chinook

The only category 1 population in south Puget Sound is White River spring chinook. The White River is a tributary of the Puyallup River. White River spring chinook are the last remaining spring chinook population in south Puget Sound. The stock is genetically distinct from neighboring summer/fall stocks and is also distinguished by its life history characteristics.

The abundance of White River spring chinook reached critically low levels in the late 70s and early 80s; returns averaged just 60 fish over a period of 10 years and were below 30 for five years running. As a result, White River spring chinook have been the subject of an intensive rebuilding program since the 1970's. A hatchery program was developed that included both juvenile releases and a full life-cycle captive broodstock program. The hatchery population is considered essential for recovery. The current natural escapement goal is for 1,000 spawners per year. The supplementation program has been successful at substantially increasing the annual returns over the years. Escapements have averaged 469 over the last five years (range 316-628) although much of this is obviously still supported by the supplementation efforts. A number of significant habitat related problems will have to be addressed before the population can be weaned of its dependence on the supplementation program.

2. Chum Salmon

Hood Canal Summer-run Chum

The HCSR chum ESU encompasses those streams with summer chum from the Dungeness River in the eastern Strait of Juan de Fuca throughout Hood Canal in Puget Sound. This group of chum populations is distinguishable from other Puget Sound chum by an early return and spawning timing that creates a temporal separation from fall chum stocks spawning in the same rivers. This allows reproductive isolation between summer and fall stocks (WDF et al. 1993).

Hood Canal summer-run chum use the estuarine and marine areas in Hood Canal and the Strait of Juan de Fuca for rearing and seaward migration as juveniles. The fish spend two to five years in the northeast Pacific Ocean feeding areas prior to migrating southward during the summer months as maturing adults along the coasts of Alaska and British Columbia in returning to their natal streams (PNPTC/WDFW 1999). In general, maturing chum salmon in the North Pacific begin to enter coastal waters from June to November. Stock composition data from Canadian fisheries in the Strait of Juan de Fuca indicate significant Hood Canal summer chum presence in August, trailing off rapidly in early September (data from G. Graves, NWIFC). Little is known about the details of the ocean migration and distribution of salmon from the HCSR chum ESU. In fact, some data suggests that Puget Sound chum, including HCSR chum, may not make an extended migration into northern British Columbian and Alaskan waters, but instead may travel directly offshore into the north Pacific Ocean (Hartt and Dell 1986).

Summer chum mature primarily at three and four years of age, with low numbers returning at ages two and five. Adults delay migration in extreme terminal marine areas for up to several weeks before entering the streams to spawn. Hood Canal summer chum enter freshwater from early August through mid-October and spawn from late August through mid-October (WDF *et al.* 1993). Spawning occurs in the lower one to two miles of each summer chum stream. This characteristic may reflect an adaptation to low flows present during their late summer/early fall spawning ground migration timing, which confines spawning to areas with sufficient water volume. However, this spawning pattern also makes the incubating eggs more vulnerable to scour during periods of high flows (PNPTC/WDFW 1999).

The causes of decline for HCSR chum have been attributed to a combination of high fishery exploitation rates, shifts in climatic conditions that have changed patterns and intensity of precipitation, and the cumulative effects of habitat degradation, especially for those systems in the Strait of Juan de Fuca region of the ESU (Hood Canal Recovery Initiative; Johnson et al. 1998). Total fishery exploitation rates on the Hood Canal summer chum ESU averaged 44.5% from 1974-1994 (range = 12.2%-81.2%). Total exploitation rates dropped dramatically in 1995, to an average of 3.8% (range = 2.7-5.1%) since that time (Table 6) as a result of fishery actions taken to protect summer chum and other salmonid species.

A habitat assessment conducted by the Point No Point Treaty Tribes and Washington Department of Fish and Wildlife (1999) concluded that channel, riparian forest and subestuarine conditions were moderately to severely degraded in all the watersheds due to a history of logging, road building, rural development, agriculture, water withdrawal, and channel manipulations throughout the ESU. Within Hood Canal, the Big and Little Quilcene, and Skokomish were considered the most degraded watersheds, with the Big Beef, Union and Hamma Hamma River watersheds only marginally better. The Union stock, the only stock considered "healthy" in the HCSR chum ESU, is of particular concern because of the rapid urbanization occurring in the watershed. The Tahuya and Dewatto watersheds are considered to be recovering and in good condition which should increase the chances of success for recovery efforts. The other systems in the region are moderately degraded, with areas of good habitat.

Of the sixteen populations of summer chum identified in this ESU, seven are considered to be "functionally extinct" (Skokomish, Finch Cr., Anderson Cr., Dewatto, Tahuya, Big Beef Cr., and Chimicum). The remaining nine populations are well distributed throughout the ESU except for the eastern side of Hood Canal; those populations were among the least productive in the ESU (PNPTC/WDFW 1999).

This ESU has two geographically distinct regions: the Strait of Juan de Fuca (SJF) and Hood Canal (HC). Although the populations all share similar life history traits, the summer chum populations in the two regions are affected by different environmental and harvest impacts and display varying survival patterns and stock status trends.

In the Hood Canal region, summer chum are still found in the Dosewallips, Duckabush, Hamma Hamma, Lilliwaup, Big and Little Quilcene, and Union Rivers. A few chum have been observed in other systems during the summer chum migration period, but these observations are sporadic and are thought to be strays from other areas. Although abundance was high in the late 1970's, abundance for most Hood Canal summer chum populations declined rapidly beginning in 1979, and has remained at depressed levels (Table 6). The terminal run size for the Hood Canal summer chum stocks averaged 28,971 during the 1974-1978 period, declining to an average of 4,132 during 1979-1993. Abundance during the 1995-1998 period has improved, averaging 10,844. However, much of the increase in abundance can be attributed to a supplementation program for the Big/Little Quilcene River summer chum stock begun in 1992. Escapements in the Union have been stable or increasing in relation to historical levels. Escapements to the Dosewallip and Duckabush rivers have been generally above threshold levels of concern, but are highly variable. Escapements in the Hamma Hamma and particularly the Lilliwaup have been below threshold escapement levels that represent an increased risk to the population too often in recent years (Table 6).

Supplementation programs were instituted in 1992 for the Big/Little Quilcene, the Hamma Hamma and Lilliwaup stocks due to the assessment of high risk of extinction for these stocks (PNPTC/WDFW 1999). The Quilcene program has been quite successful at increasing the number of returning adults. The Hamma Hamma and Lilliwaup programs have been hampered by an inability to collect sufficient broodstock. A re-introduction program was also started in Big Beef Creek using the Quilcene stock. It is too early to assess the success of that program. Other re-introduction programs may be initiated in the future, but will depend on the development of additional broodstock sources so as not to become dependent on Quilcene as the sole donor stock.

In the Strait of Juan de Fuca, summer chum stocks are found in Snow, Salmon, and Jimmycomelately Creeks and the Dungeness River. (The Snow and Salmon are treated as a single stock complex.) The terminal abundance of summer chum in the Strait of Juan de Fuca region began to decline in 1989, a decade after the decline observed for summer chum in Hood Canal. Terminal abundance declined from an average of 1,923 for the 1974-1988 period to a average of 477 during 1989-1994 period. During the most recent period (1995-1998) the average for the region has increased to 1,039, however, much of the increase may be due to the supplementation program in the Snow/Salmon system that was initiated in 1992. Escapements in Jimmycomelately have continued to be poor, i.e., less than 100 spawners in the last three years. There are no systematic surveys for summer chum in the Dungeness. However, their presence is routinely noted in surveys for other species. The status of the summer chum population in the Dungeness is therefore unknown.

An assessment of the habitat in the Strait of Juan de Fuca chum watersheds concluded that these were among the most degraded watersheds in the ESU (PNPTC/WDFW 1999). Winter peak and summer low flows, and sediment aggradation are considered problems in the Dungeness, Jimmycomelately and Snow Creeks. Improvement in habitat conditions will be essential for successful recovery of summer chum in this region of the ESU.

Table 6. Hood Canal summer chum terminal abundance by population and year.

(Skokomish River includes only catch data. No escapement data is available.)

		Hood Canal Region											Strait of Juan de Fuca	
Return Year	HC Summer Chum ESU	*Skokomish*	*Tahuya*	Union	B.Quilcene/L. Quilcene	*Big Beef*	*Anderson*	Dosewallips	Duckabush	Hamma Hamma	Lilliwaup	*Dewatto*	Snow/ Salmon	Jimmy comelately
1974	14,548	475	882	68	841	75	-	3,600	3,588	2,453	617	181	1,330	438
1975	29,176	2,601	3,352	203	3,061	1,333	226	2,604	2,598	8,495	1,643	1,427	1,287	348
1976	66,803	4,865	18,661	583	9,861	1,368	250	3,492	6,507	8,165	7,918	3,640	1,129	365
1977	16,790	921	2,129	220	1,742	325	28	3,461	2,641	1,803	1,221	654	1,239	405
1978	27,158	261	548	132	5,279	749	18	2,093	2,090	9,045	2,743	1,121	2,293	787
1979	8,798	100	377	313	620	200	6	1,246	1,247	3,244	526	158	591	170
1980	17,036	78	904	1,051	1,770	310	5	3,061	2,082	828	1,248	591	3,783	1,326
1981	5,416	219	286	84	589	147	2	103	909	1,512	598	84	681	203
1982	9,198	253	267	476	1,161	-	-	1,006	1,369	1,589	261	65	2,152	599
1983	4,411	45	188	372	2,157	-	-	84	105	249	39	33	885	254
1984	4,686	91	196	268	1,372	27	1	260	366	208	258	61	1,212	367
1985	2,715	111	214	585	577	-	-	380	48	372	161	33	171	61
1986	8,085	68	243	4,217	1,325	-	-	124	385	376	216	45	795	292
1987	5,610	61	145	794	2,482	9	-	13	18	38	51	8	1,527	464
1988	8,776	45	153	664	2,269	-	-	679	511	452	290	24	2,638	1,052
1989	2,569	38	21	1,042	781	-	-	34	127	34	100	5	215	173
1990	1,344	75	8	364	389	-	-	9	49	106	3	-	278	63
1991	1,906	3	5	228	853	-	-	262	107	72	33	34	184	125
1992	3,660	7	-	140	952	-	-	657	619	123	90	-	454	616
1993	1,344	2	-	252	163	-	-	105	105	69	72	1	463	110
1994	2,633	1	-	742	744	-	-	226	264	372	106	-	163	15
1995	10,332	-	-	723	4,589	-	-	2,796	828	478	79	-	616	223
1996	21,762	35	5	496	9,597	-	-	7,005	2,661	777	100	-	1,054	30
1997	10,113	-	-	482	8,006	-	-	47	475	104	31	7	901	61
1998	5326	5	-	244	3,066	-	-	336	226	143	24	12	1,172	98
1974-78 Avg.	30,895	1,825	5,114	241	4,157	770	104	3,050	3,485	5,992	2,829	1,405		
1979-94 Avg.	5,512	75	188	724	1,138	43	1	516	519	603	253	71		
1974-88 Avg.	15,280												1,448	475
1989-94 Avg.	2,243												293	184
1995-98 Avg.	11,883	10	1	486	6,314	-	-	2,546	1,048	375	59	5	936	103

III. Environmental Baseline

Environmental baselines for biological opinions include the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR §402.02).

A. Status of the Species and Critical Habitat within the Action Area

The assessments of the size, variability and stability of salmon populations, described in the previous sections, are made in fresh water spawning and migratory environments and closely reflect the status of the ESUs of concern in the marine environment.

Of the four chinook and one chum ESU that are the focus of this opinion, critical habitat has been designated only for SR fall chinook. Marine areas, including those off of SEAK and British Columbia, are not included as part of the designated critical habitat for SR fall chinook. Marine habitats (i.e., oceanic or near shore areas seaward of the mouth of coastal rivers) are clearly vital to all salmonid species, and ocean conditions are believed to have a major influence on their survival and productivity (see review in Pearcy, 1992). To date NMFS has not included marine areas when designating critical habitat for other salmon ESUs because there has been no apparent need for special management action to protect offshore areas. Inshore marine areas, such as those in Puget Sound, may be more critical to the species survival. In the event that marine areas are designated for the listed species of concern, the effect of ocean fisheries on critical habitat will be reconsidered.

B. Factors Affecting Species Environment Within the Action Area

Salmon are taken incidentally in the Bering Seas/Aleutian Islands and the Gulf of Alaska (GOA) groundfish fisheries off of the coast of Alaska. Some of the groundfish fisheries in the GOA occur within the action area. NMFS has conducted section 7 consultations on the impacts of fishing conducted under the Bering Sea and Aleutian Islands and Gulf of Alaska Fishery Management Plans (BSAI/GOA FMP) of the NPFMC on ESA listed species and concluded that impacts on species listed at that time were low and not likely to jeopardize the listed species (NMFS 1994, 1995b). A reinitiated consultation on impacts to the newly listed ESUs has not yet been completed. However, information from these previous opinions can be used to characterize the potential catch of these fisheries on the newly listed ESUs.

Only the easternmost area of the GOA groundfish fishery is within the action area. The total incidental catch of all chinook in the GOA groundfish fisheries has averaged 15,582 annually and 0.04 chinook/metric ton groundfish (range = 0 to 1 chinook/metric ton groundfish) (1990-1998)(NMFS 1999c). The most recent biological opinion on the groundfish fisheries (NMFS 1995b) concluded that it was difficult to determine the region of origin or life history type in the GOA fishery, although it did surmise that the GOA fishery would include more stream-type fish than the SEAK fishery, because of the dominance of stream-type fish in the BSAI fishery which is further north and west. The Upper Willamette spring and Lower Columbia River brights are both ocean-type, far north migrating stocks. It is reasonable to assume that these stocks are less impacted in the GOA groundfish fishery than in the SEAK salmon fishery given the probable lower presence of ocean-type fish in the GOA groundfish fishery. The exploitation rate for UWR chinook in the SEAK salmon fishery averaged 5% over the 1990-1993 brood years. However, the average catch in the salmon fishery during those years was approximately 275,000 compared to less than 16,000 in the groundfish fishery. If we assume that the relative abundance of UWR chinook in the fisheries was similar, the estimated ER in the groundfish fishery would be about 0.3%.

A similar analysis was done for the bright component of the LCR ESU. The average 1990-1992 brood year ER in the SEAK salmon fishery is 12%. Given the relative magnitude of catches in the salmon and groundfish fisheries and assuming a similar relative stock composition, the ER in the groundfish fishery would be about 0.7%. However, much of the bycatch of the groundfish fishery is further north and west along the Aleutian Islands. These are therefore likely substantial overestimates of the actual ERs for UWR chinook and the bright component of the LCR chinook ESU in the GOA groundfish fishery.

Puget Sound chinook and LCR tules are caught less frequently in the SEAK salmon fisheries than UWR or LCR brights. The average exploitation rates for PS spring stocks, PS fall stocks, and LCR tules in the SEAK salmon fisheries are 0, < 1%, and < 2%, respectively. Because of their more southerly distribution and they are even less likely to be caught in the GOA groundfish fishery.

There are also groundfish fisheries in Canadian waters that also catch salmon incidentally. Canadian groundfish fisheries have not under gone prior consultation. The bycatch in the Canadian whiting fishery was considered in NMFS original biological opinion concerning the PFMC groundfish fishery (NMFS 1992). Although that has not been subsequently reviewed or updated, the assumption at the time was that the annual bycatch of salmon would be no greater than 14,000 fish per year. Most of these would be chinook so there would likely be some catch of listed fish. However, the total additional catch of chinook in this fishery is small relative to that being considered as part of the directed salmon fisheries. For example, the catch of chinook in the NCBC and WCVI chinook fisheries in Canada in 1998 was about 150,000, a level much reduced from what would have been allowed under the agreement given the estimated abundance levels. Bycatch in the whiting fishery is therefore not likely to be a significant additional impact. We have not reviewed other components of the Canadian groundfish fishery, but NMFS concluded in reviewing PFMC fisheries that the bycatch from bottom trawl gear was likely the same magnitude as that in the whiting fishery and that other gear types such as long lines or pots would have little or no additional catch of salmon.

There are no state, federal or private actions in the action area that are likely to impact the listed species considered in this opinion.

C. Factors Affecting the Species Outside the Action Area - Fishing Activities

1. Bering Sea/Aleutian Islands Groundfish Fisheries

Salmon are taken incidentally in the Bering Seas/Aleutian Islands groundfish fishery off of the coast of Alaska. NMFS has conducted section 7 consultations on the impacts of fishing conducted under the Bering Sea and Aleutian Islands and Gulf of Alaska Fishery Management Plans (BSAI/GOA FMP) of the NPFMC on ESA listed species and concluded that impacts on species listed at that time were low and not likely to jeopardize the listed species (NMFS 1992, NMFS 1994). A reinitiated consultation on impacts to the newly listed ESUs has not yet been completed. However, information from these previous opinions can be used characterize the potential catch of this fishery on the newly listed salmon species.

The incidental total catch of all chinook in the groundfish fisheries has averaged 40,150 and 0.01 chinook/metric ton groundfish (range = 0 to 6 chinook/metric ton groundfish) (1990-1998)(NMFS 1999c). The most recent biological opinion on the groundfish fisheries (NMFS 1995b) concluded that, given the a bycatch of approximately this size, the catch of ocean-type fall chinook in the BSAI fishery would be on the order of 2,200 per year. The UWR spring and LCR brights are both ocean-type, far north migrating stocks. Since the incidental catch of ocean-type chinook off the Alaskan coast is unlikely to exceed more than a few thousand fish per year including those from British Columbia, the Washington coast and the unlisted hatchery components, the catch of listed UWR spring chinook is likely to be only a rare event. This conclusion is supported by the analysis of exploitation rates in the ocean salmon fishery which are generally low despite a catch in the salmon fishery that is more than an order of magnitude higher than that of the groundfish bycatch. However, the northern distribution of the LCR bright stock and the possibility that the increase in exploitation rate on the LCR bright stock in the SEAK salmon fishery in the last several years may also be occurring in the BSAI fisheries warrants consideration of the incidental catch of LCR chinook in the groundfish fishery as part of the analysis of the effect of the salmon fishery on the ESU.

The available information is insufficient to estimate impacts in the BSAI fisheries on Upper Columbia River spring chinook ESU. However, the Upper Columbia River spring and Snake River spring/summers share similar life history and presumably ocean distribution patterns. In its 1994 biological opinion, NMFS concluded that the catch of Snake River spring/summer chinook in the BSAI fisheries was unlikely to average more than one fish per year. Although PS chinook and LCR tules are caught more frequently than UCR springs in ocean fisheries, they have a more southerly distribution and are therefore also not likely to be caught in BSAI fisheries. Although it is possible that UCR spring, Puget Sound or LCR tule chinook are taken in the BSAI fisheries, the lack of or low numbers of coded-wire tag (CWT) recoveries in the SEAK salmon fisheries which take many more chinook, and the fact that the majority of chinook caught in the BSAI fisheries are of Alaskan or Asian origin (NMFS

1994) suggest that the annual catch of listed fish would be extremely low.

2. Washington, Oregon, California Coast Groundfish Fisheries

Salmon are also taken incidentally in the groundfish fishery off Washington, Oregon, and California. NMFS has conducted section 7 consultations on the impacts of fishing conducted under the Pacific Coast Groundfish Fishery Management Plan (PCGFMP) on ESA listed species and concluded that impacts on species listed at that time were low and not likely to jeopardize the listed species (NMFS 1996). NMFS has reinitiated consultation on the PCGFMP regarding impacts to recently listed species. Most salmon caught incidental to the whiting fishery are chinook. (For example, the 1991-97 average annual catch of pink, coho, chum, sockeye, and steelhead in the whiting fishery are approximately 800, 300, 100, 20, and 0 fish, respectively, out of an annual catch of 143 metric tons of whiting)

Although the reinitiated consultation is not yet complete, the incidental total catch of all chinook in the groundfish fisheries is generally low. The estimated catch of chinook in the whiting fishery for example has averaged 6,300 annually from 1991 to 1997 (Anon. 1998). The incidental catch of chinook in other components of the groundfish fishery are comparable in magnitude to those in the whiting fishery (NMFS 1996a). Since the incidental catch of all chinook off the Washington coast is unlikely to exceed more than a few thousand fish per year, the catch of listed fish is likely to be no more than a few tens of listed fish per year spread across the six listed chinook ESUs. A more definitive analysis of the incidental catch of listed chinook will be made in the reinitiated groundfish opinion.

3. Salmon Fisheries

There are substantial salmon fisheries in Puget Sound and the Columbia River Basin and along the Pacific coast that are outside the action area but impact the species of concern. It is obviously important that the impacts associated with these southern fisheries be considered in conjunction with the analysis of the proposed fisheries to the north. Because of the integrated nature of all of these fisheries, particularly as a result of the new PST agreement, the range of likely impacts associated with the southern fisheries are considered along with those anticipated from the proposed fisheries to the north in the Effects of the Action section.

D. Factors Affecting the Species Outside the Action Area - Other Human Activities

All of the listed species are affected, often substantially, by mortality factors related to other human activities that are commonly referred to as the "Hs". In addition to the harvest H that is considered in detail in this opinion, the species of concern are affected by impacts related to habitat degradation, hatchery programs, and hydro-development. The relative effect of each H to the ESUs, and to each stock within an ESU, differs. However, in general, human development associated with forestry, farming, grazing, road construction, mining, and urbanization have all contributed to the decline of the species. The combined effect of multitude of habitat degradations often poses the greatest risk and greatest challenge to species recovery because they are often the result of multiple dispersed actions, each of which must be addressed. Additionally, habitat degradations by their nature can only be remedied over time as the affected systems slowly recover their properly functioning condition.

Hatcheries have both positive and negative effects. Hatcheries are playing an increasingly important role in conserving natural populations in areas where the habitat can no longer support natural production or where the numbers of returning adults are now so low that intervention is required to reduce the immediate risk of extinction. However, there are also negative consequences associated with hatchery programs, particularly as they were developed and managed in the past. There are genetic interactions associated with the interbreeding of hatchery and wild fish. There are a number of ecological interactions such as predation of wild fish by larger hatchery fish, competition for food and space, and disease transmission. In addition, fisheries that target hatchery fish may over harvest less productive wild populations. Hatchery activities in Puget Sound and the Columbia Basin are currently the subject of ongoing section 7 consultation that are designed to address the adverse effects of ongoing hatchery programs.

Hydro development also has substantially affected or eliminated some populations or even whole ESUs. In some cases, the effects are direct as the dams block access to spawning and rearing habitat. In other cases, the effects are less direct, but nonetheless significant as they increase downstream and upstream passage mortality, change natural flow regimes, dewater or reduce flow to downstream areas, block the recruitment of spawning gravel, or result in elevated temperatures.

Although it is not possible to review here the relative importance of each of these factors on each ESU or stock within the ESUs, it is clear that it is the combined effect of all of the H's that has lead to the decline and resulting current status of the species of concern. In this opinion, NMFS focuses on harvest, in the context of the environmental baseline and the current status of the species. Although harvest can be reduce in response to the species depressed status and the reduced productivity that results from the degradations related to other human activities, the recovery of the listed species depends on improving the productivity of the natural populations in the wild. These improvements can only be made by addressing the factors of decline related to all of the H's that will be the subject of future opinions and recovery planning efforts.

E. Natural Factors Causing Variability in Population Abundance

Changes in the abundance of salmon populations are affected substantially by variations in freshwater and marine environments. For example, large scale changes in climatic regimes, such as El Niño, likely affect changes in ocean productivity; much of the Pacific coast was subject to a series of very dry years during the first part of the decade which adversely affected some the populations. In more recent years, severe flooding has adversely affected other stocks. For example, the anticipated low return of Lewis River bright fall chinook in 1999 is attributed to flood events during both 1995 and 1996.

Chinook salmon are exposed to high rates of natural predation, particularly during freshwater rearing and migration stages. Ocean predation likely also contributes to significant natural mortality, although the levels of predation are largely unknown. In general, chinook are prey for pelagic fishes, birds, and marine mammals, including harbor seals, sea lions, and killer whales. There have been recent concerns that the rebounding of seal and sea lion populations, following their protection under the Marine Mammal Protection Act of 1972, has resulted in substantial mortality for salmonids. In recent years, for example, sea lions have learned to target UWR spring chinook at Willamette Falls and have gone so far as to climb into the fish ladder where they can easily pick-off migrating spring chinook.

A key factor that has substantially affected many west coast salmon stocks has been the general pattern of long-term decline in ocean productivity. The mechanism whereby stocks are affected is not well understood. The pattern of response to these changing ocean conditions has differed between stocks, presumably due to differences in their timing and distribution. It is presumed that ocean survival is driven largely by events between ocean entry and recruitment to a sub-adult life stage. One indicator of early ocean survival can be computed as a ratio of CWT recoveries at age 2 relative to the number of CWTs released from that brood year. The time series of survival rate information for Upper Willamette River spring chinook, Lewis River fall chinook, and Skagit fall chinook are shown as examples. (The Skagit survival rates are are calculated using the same information, but are indexed to a recent year average.) Skagit fall chinook is an indicator of fall-type stocks from Puget Sound. The patterns differ between stocks, but each shows a highly variable or declining trend in early ocean survival with very low survivals in recent years (Figures 1-3).

Recent evidence suggests that marine survival of salmon species fluctuates in response to 20-30 year long periods of either above or below average survival that is driven by long-term cycles of climatic conditions and ocean productivity (Cramer 1999) . This has been referred to as the Pacific Decadal Oscillation (PDO). It is apparent that ocean conditions and resulting productivity affecting many of northwest salmon populations have been in a low phase of the cycle for some time. Smolt-to-adult return rates provide another measure of survival and the effect of ocean conditions on salmon stocks. The smolt-to-adult survival rates for Puget Sound chinook stocks, for example, dropped sharply beginning with the 1979 broods to less than half of what they were during the 1974-1977 brood years (Cramer 1999). The variation in ocean conditions has been an important contributor to the decline of many stocks. However, the survival and recovery of these species depends on the ability of these species to persist through periods of low ocean survival when stocks may depend on better quality freshwater habitat and lower relative harvest rates.

IV. Effects of the Action

The standards for determining jeopardy are set forth in Section 7(a)(2) of the ESA as defined at 50 CFR §402.02. This section of the Biological Opinion applies those standards in determining whether the proposed fisheries are likely to jeopardize the continued existence of one or more of the threatened or endangered salmon species (ESUs) that may be adversely affected by the fisheries. This analysis considers the direct, indirect, interrelated and interdependent effects of the proposed fisheries and compares them against the Environmental Baseline to determine if the proposed fisheries will appreciably reduce the likelihood of survival and recovery of these listed salmon in the wild. For many of the ESUs considered in the opinion critical habitat has not been designated. As a result, this section will not determine, for those species, if the proposed fisheries are likely to destroy or adversely modify critical habitat. For those ESUs with designated or proposed critical habitat, the action area is outside the range of the designated habitat and, as a result, the proposed fisheries are not likely to destroy or adversely modify the critical habitat of any ESU.

The jeopardy determinations in this opinion are based on the consideration of the proposed management actions taken to reduce the catch of listed fish, the magnitude of the remaining harvest, particularly in comparison to the period of decline, available risk assessment analyses, and in some cases estimates of target ERs which were derived to be consistent with recovery. In general NMFS sought to develop analyses that considered the status of the species, the environmental baseline, and the effects of the proposed actions, particularly within the context of other harvest activities that are likely to affect the species. NMFS also paid particular attention to the population structure of each ESU by reviewing both the status and impacts to components that were considered representative or important to the ESU as a whole. The jeopardy determinations are based on quantitative assessments where possible and more qualitative considerations where necessary. Different methods and different types of information were used for the various ESUs, reflecting what was available or could be developed as part of this consultation. NMFS expects that more quantitative and holistic analyses and risk assessments will become available in time. In the meantime, NMFS must rely on the best available information in making its judgement about the risk of the proposed action to the listed species.

The ESUs that were subject to more detailed analyses in this Effects section included HCSR chum, and SR fall chinook, LCR, UWR, and PS chinook. The analysis for HCSR chum relied to a large degree on an analysis that compared observed escapements with those that would have occurred under a proposed management regime that defines the limits of anticipated future harvest for all fisheries.

The analysis related to SR fall chinook considers several sources of information. In recent years, NMFS has used a consistent set of standards for evaluating the effects of ocean fisheries on SR fall chinook. Absent a PST agreement, NMFS has required either a 30% reduction in the total age 3 and 4 adult equivalent exploitation rate of Snake River fall chinook relative to the 1988-1993 base period for all ocean fisheries combined, or a 50% reduction in the base period exploitation rate for all U.S. ocean fisheries combined (NMFS 1998a, Stelle and Hogarth 1999). The basis for the base period reduction standard for the ocean fisheries and a similar standard that has been applied to in-river fisheries in recent years are discussed in more detail in other biological opinions (NMFS 1996b and NMFS 1999e). Now that an agreement is in place that includes Canada, the appropriate extension of the past standard is the 30% reduction standard since it was the alternative that provided the greatest benefits to the species. The effect of the proposed actions that are the subject of this opinion on SR fall chinook are, therefore, evaluated, in part, by assessing the prospects of meeting the 30% base period reduction standard under the provisions of the PST agreement.

Two additional reports regarding SR fall chinook have recently become available. These provide a broader perspective by considering, at differing levels of detail, all the factors of decline and areas of uncertainty and what they tell us about the prospects for survival and recovery of SR fall chinook. The recently updated PATH report on fall chinook (Peters, et al. 1999) is the product of an ongoing, long-term effort to identify and reduce uncertainties associated with the recovery of listed salmonid species in the Columbia River Basin. The procedures and results in the PATH analysis have been under continuous development for several years and have been extensively peer reviewed. Application of the PATH analytical approach to fall chinook is relatively recent.

The NWFSC has taken the lead in developing a different approach that is part of its Cumulative Risk Initiative (CRI). This approach provides estimates of extinction risk and explores the opportunities and feasibility of reducing that risk to acceptable levels. The available information from both the PATH and CRI are considered in reviewing the effects of the proposed actions on SR fall chinook. The PATH and CRI analyses are currently specific to Snake River chinook and steelhead ESUs and so can not be applied to other ESUs considered in the opinion. The CRI analysis in particular is intended to have general applicability to other ESUs that may provide useful guidance as it develops in the future.

Analyzing the effects on the other three chinook ESUs that are most affected by the proposed fisheries (UWR, LCR, and PS chinook) required a different approach since there are no existing standards or alternative life cycle analyses for these more recently listed species. The assessment used here was developed with three objectives in mind. First, NMFS sought to evaluate the proposed fisheries using biologically based measures of the total exploitation rate that occurred across the full range of the species. Second, NMFS sought to use an approach that was consistent with the concepts being developed by the NWFSC for the purpose of defining the conservation status of populations and ESUs. (These concepts are being developed in a draft paper regarding Viable Salmonid Populations (VSP) and the Recovery of ESUs that is summarized in Kareiva et al. (1999)). Finally, NMFS sought to develop an approach for defining target ERs that could be related directly to the regulatory definition of jeopardy. The product of this approach is a set of recovery exploitation rates (RER) for representative stocks within each ESU. Recovery ERs were developed for a limited set of stocks from PS and the LCR ESUs. The proposed fisheries were then evaluated by comparing the RERs to stock specific ERs that can be anticipated under the provisions of the PST agreement recognizing that the jeopardy determination must be made with respect to the overall ESU. More qualitative considerations were used to extrapolate from the available stocks specific RER analyses. NMFS expects that RERs will be developed for additional stocks in the future.

Although appropriate from a biological perspective, there is one practical difficulty associated with using a total ER indicator in this biological opinion to evaluate the proposed actions involving fisheries in only SEAK and BC. Because a substantial portion of the mortality on the species of concern occurs in southern fisheries, conclusions require assumptions about what will occur in the south. Ideally, NMFS would have all of the necessary specificity with respect to southern fisheries to do a comprehensive and simultaneous assessment of all fisheries affecting these stocks. The PST agreement does define upper limits to the allowable ER in ISBM (southern) fisheries for a specified list of wild stocks (see attachments IV and V of the agreement). For example, if stocks are anticipated to return below goal, the agreement contains a general obligation that requires a 40% reduction for southern U.S. fisheries from the 1979-1982 base period ER (36.5% for BC ISBM fisheries); if that stock will still not meet its escapement goal, the ER must then be reduced further (if less) to the 1991-1996 average ER. One alternative for evaluating the agreement, therefore, would be to use these upper limits of allowable ER for the ISBM fisheries. However, the new PST agreement was not negotiated with the expectation that all harvest constraints necessary to meet the needs of the listed species would be accomplished through the reductions in northern fisheries even in combination with ISBM limits (Stelle, 1999). It was expected that further reductions in the south would likely be required. Therefore, it would be inappropriate now to evaluate the agreement by assuming that southern fisheries would always fish up to the maximum limits provided in the agreement.

The proposed actions are evaluated using a combination of quantitative and qualitative considerations. The first quantitative step was to define the upper limit of anticipated impacts. This was done by developing a retrospective analysis that compared what actually occurred from 1985-1997 ("base" conditions) with what would have occurred under the provisions of the agreement during those same years. The retrospective analysis assumed that the SEAK and BC AABM fisheries would be operated up to the limit of the agreement. (This assumption is conservative in that BC has not, and likely will not for the next few years at least, manage up to the limits of the AABM fisheries.) The southern BC and U.S. ISBM fisheries, were assumed to harvest up to the limit allowed thus defining the upper limit of impacts allowed under the treaty[1]. These are referred to as the "maximum treaty" or "treaty" conditions. In the next step NMFS modeled additional reductions in southern fisheries, in combination with those anticipated in the north, for comparison with the RER targets. The results provide a retrospective view with "minimized" southern U.S. fisheries.

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[1]Characterizing the treaty conditions in the retrospective analysis required a number of assumptions about how past fisheries would have been configured in response to particular constraints. NMFS explored several alternatives and ultimately developed two versions of the retrospective analysis to explore the sensitivity of results to different approaches. The first method used the 1995 fishing patterns for Canadian and Puget Sound fisheries to represent an observed distribution of fishing effort that was close to meeting the ISBM requirements. These patterns were combined with 1996 U.S. fishing patterns in PFMC areas. The observed fishing patterns were then "fined tuned" to meet stock specific passthrough obligations for the weakest stock in each major fishing area (Canada, Puget Sound, PFMC). The second method started with the assumption that all ISBM fisheries would be set to meet the general obligation reduction requirement (40% reduction for U.S. ISBM fisheries, 36.5% reduction for Canadian). If further reductions were required for particular stocks to meet passthrough requirements, those reductions were targeted in terminal areas where possible. Results from the two approaches were not judged significantly different for the stocks of concern, except for the Duwamish/Green and the Snake River fall stock. In those cases the first method predicts an average ER of .62 for both the Duamish, and the Snake River stock. The second method predicts an average ER of .52 for the Duamish, and .69 for the Snake River Fall stock. Only the first method is presented to minimize confusion in the presentation.

As a practical way to characterize conditions with minimized southern fisheries, NMFS selected for each fishing area the year with the most restrictive fisheries to date, and its associated ERs, to provide a basis for comparison with the base and maximum treaty conditions and to the target RER. The year used to represent Puget Sound was 1998. Minimized southern fisheries for PFMC were represented by the fishing patterns in 1994. The fishing patterns used for the Columbia River fisheries varied by stock, but again, were selected to represent the most restrictive pattern observed to date for each stock.

In summary, the effects analysis provided herein compares the target RERs:

(1) to ERs estimated to have actually occurred over the base period of 1985-97;

(2) to ERs that would have occurred had the new agreement been in place over that same time period (using the assumption that all fisheries had operated to the maximum limits specified in the new PST agreement);

(3) using the maximum ERs for the northern fisheries combined with ERs actually experienced in southern fisheries in a recent, relatively constrained year (e.g., 1998 for Puget Sound).

The results are summarized graphically in a single figure for each of the stocks considered (see for example Figure 7 below).

It is next useful to briefly describe the process for estimating the RERs. There are four steps involved with determining population specific RERs: 1) identify populations, 2) set threshold abundance levels, 3) estimate population productivity as indicated by a spawner-recruit relationship, and 4) identify through simulation the appropriate RER.

Except for SR fall chinook, determinations about population structure have not been made for any of the ESUs that are of immediate concern in this opinion. The status discussions in section II.C. describe the existing stock structure for the UWR, LCR and PS chinook ESUs. The stock structure of the UWR is relatively simple with only three naturally reproducing stocks. Puget Sound chinook have what may be the most complex structure with nearly 30 identified stocks. The LCR ESU is intermediate in terms of its complexity with three distinct life history types, but with relatively few representative stocks for each. Whether or to what degree these stocks will be aggregated to form populations is not known at this time. However, the intent of the VSP approach is clearly to recognize and protect the diversity of populations that may exist within an ESU and, in assessing the effect of an action, to stratify the ESU adequately to represent the unique population characteristics of the ESU. This should include, for example, unique life history or genetic characteristics, geographic distributions and so on. Although the analysis in this opinion was limited to a degree by available data and time, particularly with respect to PS chinook, the importance of population structure within each ESU provided the focus for the analysis and discussion.

The VSP paper develops the idea of threshold abundance levels as one of several indicators of population status (others being productivity, spatial structure and diversity). The thresholds described include a critical threshold and a viable population abundance level. The critical threshold generally represents a boundary below which uncertainties about population dynamics increase and therefore extinction risk increase. The viable population threshold is a higher abundance level that would generally indicate recovery or a point beyond which ESA type protections are no longer required with the caveat that abundance is not the only relevant or necessary indicator of recovery.

Determinations regarding threshold abundance levels will logically follow population decisions. As indicated above, the VSP work has not yet provided specific guidance related to population structure for any of the ESUs of concern. The VSP paper does provide several rules of thumb, that are intended to serve as guidelines, for setting population specific thresholds (Karieva et al. 1999). Unfortunately these guidelines continue to evolve as part of the ongoing development process. However, because the thresholds were needed to set the RERs, NMFS considered the existing rules of thumb, and other relevant guidance, to make preliminary threshold determinations for selected "populations".

The critical threshold was developed from a consideration of genetic, demographic , and spatial risk factors for each population. Genetic risks to small populations include the loss of genetic variation, inbreeding depression, and the accumulation of deleterious mutations. The risk posed to a population by genetic factors is often expressed relative to the effective population size, or the size of an idealized population that would produce the same level of inbreeding or genetic drift that is seen in an observed population. Guidance from the existing VSP paper suggests that effective population sizes of less than 500-5,000 per generation are at increased risk. The population size range per generation was converted to an annual spawner abundance range of 125-1,250 by dividing by four, the approximate generation length. As escapement level of 200 fish was selected from this range to represent a critical threshold related to genetic risk factors (method 1) since most of the stocks that were subject to the RER analysis were relatively small. For example, the interim escapement objectives for the Nooksack stocks are 1,000 fish each. Threshold values much larger than 200 would be out of context for the stocks of concern.

The Biological Requirements Work Group (BRWG 1994) took genetic considerations and others factors into account in their effort to provide guidance with respect to a lower population threshold for Snake River spring/summer chinook. They recommended that annual escapements of 150 and 300, for small and large populations, represented levels below which survival becomes increasing uncertain due to various risk factors and a lack of information regarding populations responses at low spawning levels. This provides independent support for the use of 200 (within the range of 150-300) as a critical threshold.

Factors associated with demographic risks include environmental variability and depensation. Depensation, or a decline in the productivity of a population (e.g., smolts per spawner) as the abundance declines, can result from the uncertainty of finding a mate in a sparse population and/or increased predation rates at low abundance. Demographic risks were assessed using both the Dennis model (method 2) (Dennis et al. 1991) and a Ricker stock-recruit model (method 3). The Dennis model can be used to provide an estimate of the number of spawners required to have a desired level of probability that the population does not go extinct within a defined period of time. For this analysis, NMFS estimated the population size that would be required to have a 95% probability that the population would not go extinct within 10 years. The final alternative (method 3) for the critical threshold was derived from an analysis of the Ricker stock-recruit relation. Peterman (1977, 1987) provided a rationale for depensation and suggested relating the escapement level at which depensation occurs to the size of the population in the absence of fishing (equilibrium escapement level). NMFS set this measure of the critical threshold equal to 5% of the equilibrium escapement level.

Each of the three measures of the critical threshold were considered in the context of the types and quality of data available, the characteristics of the watershed, and the biology of the population. For "large populations", NMFS typically selected a critical threshold based on method 3 to assure a sufficient density of spawners. Method 1 was used for 1 small population and two populations for which NMFS was unable to estimate the equilibrium population size.

Similar methods were used to establish the viable population or recovery level. In this case, the criteria were 1,875 spawners (genetics; derived from the VSP guideline range of 5,000-10,000 divided by the average generation length of approximately 4 years) or the level of escapement required to achieve the maximum sustainable yield (demographics). The larger of the two alternatives was selected for use as the viable population threshold or recovery level.

The third step in the process of identifying population specific RERs is to estimate the stock-recruit parameters. Estimates of the Ricker stock-recruit parameters for each population were required for both establishing the escapement threshold levels and for the simulations of population dynamics. These parameters were estimated using methods developed by the Chinook Technical Committee and applied on a coast-wide basis (Chinook Technical Committee, in press).

The final step in determining RERs is to use a simulation model to iteratively solve for an exploitation rate that meets specific criteria that are related to both survival and recovery given the specified thresholds and estimated spawner/recruit parameters. The consultation regulations define "jeopardize the continued existence" to mean:

> "... to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing appreciably the reproduction, numbers, or distribution of the species" (50 CFR section 402.2).

The simulation then uses this definition - "... reduce appreciably the likelihood of survival and recovery ..." - and the population specific threshold levels to identify an ER that meets the following criteria:

1) Did the percentage of escapements less than the critical threshold value increase by less than 5 percentage points relative to the baseline?

and, either

2a) Does the escapement at the end of the 25 year simulation exceed the recovery level at least 80% of the time?

or

2b) Does the percentage of escapements less than the recovery level at the end of the 25 year simulation differ from the baseline by less than 10 percentage point?

The baseline condition used for comparison in this context assumes zero harvest everywhere.

Said another way, these criteria seek to identify an ER that will not appreciably increase the number of times a population will fall below the critical threshold and also not appreciably reduce the prospects of achieving recovery. The RER is the highest ER that can meet criterion 1 and criterion 2a or 2b. Once identified, proposed fisheries can be evaluated by considering the likelihood that they will meet the RERs. It is again important to emphasize that the RER analysis is made with respect to populations, while the jeopardy determinations must be made with respect to the anticipated impacts to the ESU. For example, the failure to meet the RER standards for one population in a large ESU does not necessarily indicate jeopardy to the ESU as a whole.

A. Chinook Salmon

1. Snake River Fall Chinook

There is only one population within the SR fall chinook ESU. Fall chinook are primarily mainstem spawners. Hells Canyon Dam blocked off most of the original spawning habitat. The current population is now confined primarily to the mainstem and lower tributaries in the area between Lower Granite and Hells Canyon Dams.

The analysis of the effects of the proposed actions on SR fall chinook first compares the actual ERs from 1985 to 1997 with those that would have occurred had the agreement been in place during that same time period. The ER for SR fall chinook is expressed as an index of the total adult equivalent ER for age 3 and 4 fish in all ocean fisheries relative to that observed during the 1988-1993 base years. (see PFMC 1996 for a detailed description of the index). An index value of 1.0 represents an ER for ocean fisheries of about 0.55.

Figure 4 indicates that the ERs expected to occur under the agreement would be substantially less than what actually occurred in most years. The 30% reduction standard that has been used for evaluating ocean fisheries in recent years as NMFS jeopardy standard would have been met or exceeded (i.e., ER reductions would have been greater than necessary) in 11 out of 13 years analyzed. The average of the Snake River fall chinook index (SRFI) was 0.64 over the 13 years analyzed compared to an estimated actual index value of 0.93 for the same time period and 1.09 for the 1985-1994 time period after which Canada began to take unilateral actions to reduce their fisheries below what would have been allowed for by the agreement because of growing domestic conservation concerns.

Figure 4 also shows that the actual ER was substantially less than expected under the agreement in 1996 and 1997. This is again the result of the very restrictive fishery regimes implemented by Canada for the NCBC and WCVI fisheries during those years in particular. During 1996, for example, the fishery specific SR fall chinook indices for NCBC and WCVI were reduced to about 3% and 10% of the base period; these areas were essentially closed to fishing for chinook salmon. The AABM fishery that is most constrained under terms of the agreement is the WCVI fishery. For example, under the agreement the SR fall chinook index for the WCVI fishery would be reduced by an average of 47% compared to what actually occurred. This reduction benefits SR fall chinook in particular because WCVI is the fishery that has the greatest effect on the species accounting for nearly half of all ocean harvest during the 1988-1993 base years. SEAK and NCBC are less constrained under the agreement than WCVI. In fact, the base period impacts on SR fall chinook would actually increase in SEAK in most years. However, because of their ocean distribution, the impacts to SR fall chinook to the north are offset by the package of fisheries that comprise the agreement. The analysis suggests that the 30% reduction standard would be met under the terms of the agreement with no further restrictions in the ISBM fisheries in most years.

The PATH analysis pertaining to SR fall chinook was just recently completed (Peters et. al. 1999). PATH analyzed the probability of survival and recovery associated with specific future hydrosystem configuration scenarios and a range of assumptions that focused on critical areas of uncertainty. The scenarios considered included status quo operation, maximum transportation, and drawdown of either four or five dams. Because most fall chinook are already being transported, there was little difference between the status quo and transportation options. The differences with respect to survival and recovery associated with the two drawdown options were also small. Ocean and inriver fisheries similar to those that have occurred in recent years were used as the base condition in the analysis. A sensitivity analysis was also conducted that considered a broad range of harvest reduction options.

Survival probabilities were analyzed for 24 and 100 year time frames. The probability of recovery was determined for 24 and 48 year periods. The critical area of uncertainty in the analysis related to the delayed mortality of transported fish. Fish that are trucked or barged to the mouth of the Columbia River survive the trip with little loss. However, there is evidence that the transported fish have a much higher mortality rate during the early ocean phase of their life cycle than fish that are not transported. This relative difference in survival is quantified in the PATH analysis using the "D" parameter which is the ratio of post-Bonneville survival of transported and non-transported fish. This difference is obviously critical to an analysis that contrasts scenarios that maximize either transportation or in-river passage.

The results of the PATH analysis indicate that the 24 and 100 year survival standards are met for both transportation and drawdown scenarios regardless of what is assumed about the early ocean survival of transported fish even with status quo fisheries. (For the ocean, status quo in the PATH analysis was defined as the ERs observed from 1985-1996.) All of the drawdown scenarios meet both the short and long-term recovery standards, again regardless of what is assumed about the early ocean survival of transported fish. The prospects of recovery under the transportation scenario depends more on assumptions about post-transportation survival. At least with respect to recovery, there is greater uncertainty associated with hydrosystem options that propose to leave the dams in place. It is likely that the uncertainty associated with the early ocean survival of transported fish can be resolved in time through further research. Once completed the research results would provide greater confidence about the prospects for survival and recovery under the various future scenarios.

The CRI being developed by the NWFSC is relatively new. However, the initial results regarding SR fall chinook merit consideration. The CRI relies on estimates of short and long-term extinction probabilities (defined as 10 and 100 years, respectively). The analysis breaks the life cycle into distinguishable phases and, in a first step, explores the magnitude of survival improvement that is required in each phase of the life cycle or various combinations thereof, to reduce extinction probabilities to specified levels. The second step in the analysis then focuses on the feasibility of achieving the required improvements in each sector.

Initial results from the CRI for SR fall chinook suggest that the probabilities of extinction over the next 10 and 100 years are 0.0001 and 0.06-0.17, respectively (depending on whether 1980 is included in the baseline) although the confidence intervals for these estimates are quite large (0.0001 -0.16 and 0.0002 -1.0). The point estimates suggest that there is little probability of short-term extinction and a 6-17% probability of extinction over the next 100 years.

One factor not yet taken into account in the CRI analysis is the effect of the existing hatchery supplementation program on the estimates of extinction probability. For the last several years SR fall chinook hatched at the Lyons Ferry Hatchery have been acclimated and released above Lower Granite Dam to increase the number of natural spawning fish (see NMFS 1999e for a more detail discussion of the supplementation program). This kind of supplementation program does relatively little to change the productivity of the system and so can not generally be used as a substitute for the recovery of a system that, from a ESA perspective at least, must support a self sustaining, naturally reproducing populations. However, supplementation may directly change the risk of extinction. The fact that supplementation is not yet accounted for in the CRI analysis, suggests that the current estimates of extinction probability may be too high.

During further analysis, results from the CRI were used to explore the magnitude of harvest reductions that would be required to reduce the probability of extinction over 100 years from 0.06 to 0.01. The results indicated that that could be accomplished by reducing both the ocean and inriver harvest by 50% (relative to the 1993-1996 time period) or by reducing harvest in either the ocean or river by 75%. Alternatively, improvements could be made in other sectors to achieve the same reduction in extinction probability. However, the CRI analysis suggests there is greater uncertainty associated with survival improvements that might be achieved through other actions such as drawdown.

2. Upper Willamette River Chinook

There are three spring chinook stocks in the Willamette River that are still supported to varying degrees by natural origin production. These are found in the McKenzie, North Santiam, and Clackamas Rivers. There has been no determination to date regarding the population structure of the ESU. All of these systems have been substantially influenced by hatchery production and in past years there was substantial exchange of brood stock among the hatcheries with the possible exception of the North Santiam system. The McKenzie River stock is the harvest indicator stock for Willamette spring chinook and, absent other information, it is assumed that the other components have similar distributions and are subject to the same rates of harvest.

Because of their distribution, UWR chinook benefit relatively little from the PST agreement. UWR chinook are a far north migrating stock and so are caught primarily in SEAK and NCBC fisheries. Because they are an early returning spring stock, they tend to be missed by more southerly ocean fisheries off WCVI and the Washington coast. The total ER under base conditions for the 1982-1992 brood years averaged 62% (Figure 5). The average ER under the treaty conditions is unchanged. The average ER in the SEAK and NCBC fisheries under base conditions was 17% with virtually all of the remaining harvest occurring in the terminal area fisheries.

Until recently UWR chinook were subjected to relatively intense commercial and recreation fisheries in the lower Columbia and Willamette rivers that were directed primarily at the hatchery origin fish. Terminal area ERs have been on the order of 40-50% in past years. Spring stocks from the Upper Columbia, Lower Columbia, Snake, and Willamette rivers are now listed, and as a result, it is safe to assume that ESA constraints, if nothing else, will all but eliminate mixed stock fisheries targeting spring chinook in the Lower Columbia River for the foreseeable future. Fishery objectives in the Willamette River have also changed to emphasize the protection of natural-origin fish. A revised management plan for the Willamette River spring chinook is being developed by the State of Oregon although it is still subject to review and approval by NMFS. However, the Oregon has already implemented a mass marking program and intends to manage terminal area recreational fisheries while requiring the release of all unmarked fish. (Commercial fisheries in the Willamette have long since been disallowed.) The marked fish will fully recruit to the terminal fishery in the year 2002. Once the marked fish are fully recruited to the fishery Oregon expects that it can manage the lower Willamette River recreational fishery using selective harvest to limit mortality of natural-origin fish to 5% or less until the abundance of natural-origin fish allows for an increase in harvest. The only other potential sources of harvest mortality would be what little may occur in the Upper Willamette recreational fishery or the limited fisheries in the lower Columbia that may target sturgeon for example.

3. Lower Columbia River Chinook

The LCR chinook ESU is composed of spring run, and fall run tule and bright stocks. There are three spring stocks, three self-sustaining natural tule stocks, and likewise, three identified bright stocks that rely primarily on natural production. The population structure of the ESU has not been determined, but it is intuitively obvious that the spring, tule, and bright life history types warrant independent review with respect to their status and the effect of the proposed action. The effects analysis therefore treats each life history type independently and, where possible, also considers the status of and presumed effect on each stock.

The three remaining spring stocks within the ESU include those on the Cowlitz, Kalama, and Lewis rivers. Although some spring chinook spawn naturally in each of these rivers, the historic habitat for spring chinook is now largely inaccessible. The remaining spring stocks are therefore dependent, for the time being, on the associated hatchery production programs. The hatcheries have met their escapement objectives in recent years thus insuring that what remains of the genetic legacy is preserved. Harvest constraints for other stocks, including those provided specifically as a result of the agreement, will provide additional protection for the hatchery programs until such time that a more comprehensive recovery plan is implemented.

These spring stocks have a wider ocean distribution than most stocks originating in the lower Columbia River, and are impacted by ocean fisheries off Alaska, Canada, and the southern U.S. They were also subject, in past years, to significant sport and commercial fisheries inside the Columbia. A comparison of the total ERs for this stock component show that the average actual brood year ER was 60% (brood years 1981-1991) compared to 53% under the treaty (Figure 6). If southern fisheries are operated at minimum levels, including essentially no inside harvest, the average total ER drops to 32%.

The three tule stocks in the ESU include those on the Coweeman, East Fork Lewis, and Clackamas rivers. These are apparently self-sustaining natural populations without substantial influence from hatchery-origin fish. These stocks are all relatively small. The interim escapement goals on the Coweeman and East Fork Lewis are 1,000 and 300, respectively. Escapements have been below these goals 8 of the past 10 years for the Coweeman, and 5 of the past 10 years for the East Fork Lewis. The 10 year average escapement for the Coweeman is 700 , compared to a recent 5 year average of 995 (range 146-2,100). In the East Fork Lewis, the 10 year average escapement is 300, compared to a recent 5 year average of 279. There is currently no escapement goal for the Clackamas where escapements have averaged about 350 per year.

Until recently tule hatchery production has been prioritized to support ocean and Lower Columbia River fisheries thus providing the potential for very high ERs. The tule stocks are north migrating, but are most vulnerable to catch in fisheries off the Washington coast in WCVI and in the lower river. In recent years, ESA and other unrelated conservation constraints have substantially limited these fisheries in particular even though there have been no specific limits set for natural-origin tule stocks.

Substantial reductions in ERs can be expected under the treaty for this ESU (Figure 7, compare Base and

Treaty conditions). Approximately 60% of the ocean catch of this group occurs in WCVI and PFMC area fisheries. WCVI fisheries will be much reduced under the terms of the agreement. PFMC fisheries are likely to continue to be constrained as they have been in recent years either as a result of the agreement or because of unrelated management concerns.

Escapement information from the Coweeman was used to estimate an RER of 0.65 for natural origin tule stocks. Estimates of RERs are sensitive to assumptions about future survival. For Puget Sounds stocks the trends from high to low survival over the last twenty years have been significant and substantially affect RER calculations (see next section for further discussion). The survival rates for LCR tules have varied substantially over the years, but are without apparent trend. As a result, there is only one estimated RER for LCR tule stocks. A comparison of the RER estimate of 0.65 to ERs expected as a result of the agreement indicates that the targets will easily be met. It is likely that management constraints for other stocks of concern will keep future ERs on the tules substantially below what they have been in the past and well below the RER target.

Three natural-origin bright stocks have also been identified. There is a relatively large and healthy stock on the North Fork Lewis River. The escapement goal for this system is 5,700. That goal has been met, and often exceeded by a substantial margin every year since 1980 with the exception of 1999. This year the return is expected to be substantially below goal because of severe flooding during the 1995 and 1996 brood years. Nonetheless, the stock is considered healthy. The Sandy and East Fork Lewis stocks are smaller. Escapements to the Sandy have been stable and on the order of 1,000 fish per year for the last 10-12 years. Less is known about the East Fork stock, but it too appears to be stable in abundance. However, the retrospective analysis for the North Fork Lewis stock compares the actual ERs with that which would be expected under the agreement and what further reductions might be expected in the southern U.S. fisheries (Figure 8). The North Fork Lewis stock is similar to the UWR spring chinook in that the agreement will do relatively little to reduce harvest, in part because the reductions in SEAK and NCBC are small and because the stocks' distribution is such that less than a quarter of all harvest occurs in SEAK and NCBC fisheries. As a result, there is substantial latitude in southern fisheries to meet necessary conservation objectives.

4. Puget Sound Chinook

Once again, the relationship among stocks within the PS ESU and how they might eventually be aggregated into populations has not been determined. The co-managers have identified nearly 30 stocks that are aggregated into 12 management units from five geographic regions (Table 5). The stocks have been categorized into 3 groups with the category 1 stocks being those that are genetically unique and indigenous to their watersheds. Given the complexity of the Puget Sound ESU and relatively limited time, it was necessary to select a subset of stocks for the more detailed quantitative analyses and then use more qualitative assessments through association about the effects to other stocks. It was logical first to focus the analysis on the indigenous category 1 stocks, and then among these to also consider both spring and summer/fall type stocks.

The retrospective analysis was used to compare observed ERs representing the base condition to the ERs that would have occurred assuming treaty and minimized south conditions. These retrospective analyses are available for Nooksack spring, Skagit summer/fall, and Stillaquamish, Snohomish stock aggregates. Exploitation rate patterns for stocks within these aggregates (e.g., North Fork and South Fork Nooksack) are assumed to be the same. Recovery ERs were calculated for the Nooksack, and Skagit summer/fall stocks. It was possible to calculate RERs either for the aggregates or for the individual stocks. The available information suggests that the North and South Fork Nooksack stocks are isolated and unique and therefore warrant separate treatment. Future determinations related to the population structure of the Skagit stocks will be relevant. However, the available information suggest that there are discernable distinctions in genetics and abundance trends among these stocks. There also seem to be differences in relative productivity with the Lower Sauk stock doing poorly and the upper Skagit stock doing relatively well. Since the upper Skagit stock is relatively abundant, it tends to dominate the results of a combined stock analysis leading to RER estimates that may be inappropriate for the weaker components. These stocks may eventually be aggregated in some way to form a larger population and this would affect the conclusions. However, until the population determinations are made, it is more conservative to do the analysis at the finer level of resolution.

There is a second issue pertinent to the calculation of the RERs. The productivity of these stocks has varied substantially over time. The index for marine survival for Skagit summer/fall chinook (smolt-to-age two survival) indicates that survival rates were high during the decade of the 70s, but then declined and have been low over the last decade (Figure 3). Results of the RER analysis depend greatly on assumptions about future marine survival. The RERs were calculated using the full time series of observed survivals and, alternatively, using just the survivals in more recent years. Using the full time series assumes that the survival rates observed in recent years will improve; using the more recent time series assumes that they will remain comparable to what they have been recently. Although there is discussion in the literature indicating that ocean conditions may be improving, NMFS is not aware of any clear indicators that the survival rates of Puget Sound salmon have improved in recent years.

The retrospective analysis allows us to characterize the magnitude of ER reductions that can be expected as a result of the agreement. Earlier comparisons indicated that the agreement will result in substantial reductions in ER for LCR stocks and SR fall chinook, but relatively little savings for UWR chinook. For PS chinook stocks the savings generally fall between those expected for LCR and SR chinook, and UWR chinook and depend on the distribution of the stocks in relation to the fisheries subject to greatest change. The difference between the base and treaty ERs for the various stocks reflects the minimum anticipated reduction assuming that all fisheries are managed up to the limit allowed by the agreement (Figures 9-15). Greater reductions will occur as a result of any additional actions that may be taken to reduce ERs in either the northen or southern fisheries.

For the Nooksack and Skagit stocks we can compare the expected ERs from the retrospective analysis to the estimated RERs. The results vary substantially by stock and depending on what is assumed about future survival rates, but for some stocks the results indicate that the agreement will not reduce harvest sufficiently to meet RER targets. For the Upper Skagit summer stock the results indicate that, in most years, RERs would be met under treaty conditions and only occasionally would further reductions be required to meet the RERs even under the assumption that survival rates remain low (Figure 9). For Lower Skagit fall chinook, the RERs under the low and high survival assumptions are 0.33 and 0.52, respectively (Table 7.). Assuming high survival the RERs could be met in 8 of 14 years either under treaty conditions or with minimized southern fisheries (Figure 10). If we assume that low survival rates persist, the retrospective analysis indicates that ERs would always exceed the RER even with reduced southern fisheries. The results for the Lower Sauk stock are similar to that of the Lower Skagit (Figure 11). The RER estimates are 0.36 and 0.53 for low and high survival rate assumptions. If low survival rates persist, the ERs, even with minimized south conditions, will always exceed the RER.

These differences among the various Skagit summer/fall highlights the differences in the relative productivities of these systems. The Lower Skagit and Lower Sauk stocks are depressed and can sustain less harvest compared to the Upper Skagit summer stock because the systems in which they reside are less productive. Although there are inherent differences in the productivity of natural systems, these results emphasize the need for habitat improvements in particular areas and further underscores the point that relatively healthy and productive stocks like the Upper Skagit summers can sustain substantial harvest and supply thousands of returning spawners per year. The general goal of recovery should be to improve stock productivity to replicate the success that is characterized by the Upper Skagit summer stock.

The status of Nooksack spring chinook may reasonably be considered "critical" depending on the specific definition. Most of the harvest of Nooksack spring chinook occurs in Canadian fisheries, particularly the Georgia Strait sport fishery which is one of Canada's higher priority fisheries and the fishery closest to the Nooksack terminal area. It was therefore reasonable to expect that the treaty was least likely to meet the needs of Nooksack spring stocks. The status of the North Fork Nooksack is somewhat better than that of the South Fork again reflecting relative differences in system productivity. The RERs under low and high survival rate assumptions are 0.24 and 0.55 for the North Fork. The RER for the South Fork is 0.20 regardless of the survival rate assumption reflecting the fact that the South Fork stock is already at or below the critical threshold used to set the RERs. A comparison of the RERs to the ERs from the retrospective analysis indicates, with the exception of the North Fork under high survival conditions, that the RERs will not be met even with minimized southern fisheries (Figures 12 and 13). The expected ERs will be 0.45-0.55, virtually all of which occurs in Canadian fisheries, compared to a RER that is as low as 0.20.

Estimates of RERs for other stocks are not available at this time. NMFS therefore does not know whether the rather pessimistic results for the Nooksack, in particular, are unique, or if they are just one of several stocks that are depressed to the point that further protections beyond those provided by the agreement are clearly required. Estimates of RERs are influenced substantially by recent escapement levels and their proximity to the lower critical threshold values. For smaller stocks an escapement of 200 was used as a critical threshold. For stocks like Nooksack with escapements close to 200, it is reasonable to expect that RERs will be similar to those estimated for Nooksack. All three of the Skagit spring stocks have escapements that are in the same range as those for the North Fork Nooksack. Escapements on the South

Fork Stillaguamish (a fall stock) are similar to those on the South Fork Nooksack. Escapement of spring chinook to the Dungeness are probably lower still which is indicative of why far more aggressive intervention through the hatchery captive brood stock program was initiated. On the other hand, escapements of fall stocks in the Snohomish system are generally higher with several hundred to a thousand or more per year in each. Recovery ERs for these stocks are therefore more likely to be in the range of those estimated for the Skagit summer/fall stocks. This qualitative review is speculative, but it suggests that the low RERs that were estimated for the Nooksack stocks will be representative of what may be required for several other stocks and in particular the North Sound and Strait of Juan de Fuca spring stocks as a group.

Table 7. Recovery ERs assuming low and high future survival rates (average rates for Coweeman) and expected ERs (minimum, average, and maximum) assuming maximum treaty and minimum south conditions for by stock and ESU.

ESU	Stock	Recovery Exploitation Rates		Expected Exploitation Rates					
		Low	High	Treaty			Min. South		
Puget Sound	NF Nooksack	0.24	0.55	.44	.50	.54	.45	.51	.55
	SF Nooksack	0.20	0.20	.44	.50	.54	.45	.51	.55
	Upper Skagit/S	0.54	0.64	.50	.52	.56	.48	.51	.55
	Lower Skagit/F	0.33	0.52	.50	.52	.56	.48	.51	.55
	Lower Sauk/S	0.36	0.53	.50	.52	.56	.48	.51	.55
L. Col. River	Coweeman (Tule)	0.65	0.65	.23	.45	.62	.17	.28	.34

5. Snake River Spring/Summer and Upper Columbia River Spring Chinook

The PFMC Salmon Technical Team previously reviewed the record of coded-wire tag recoveries of spring and summer chinook from the Snake River and other relevant information regarding distribution and harvest related mortality. The were no CWT recoveries or other information to suggest that SR spring/summer chinook are caught in the Alaskan fisheries (PFMC 1992, Clark et. al. 1995). There were four Snake River spring chinook tags recovered, all in Canadian fisheries, from over 2.8 million tags released from the 1976-1987 brood years. Snake River summer chinook tag groups from the same brood years were recovered in Washington (12), Oregon (8), and Canadian fisheries (7). No recoveries from summer chinook releases were reported from Alaskan fisheries. It is evident that SR spring/summer may be caught occasionally in Canadian fisheries, but that the impact is too low to specifically quantify and of little significance. The recent multi-agency PATH report and NMFS' subsequent review of similar information lead to the conclusion that the ocean harvest of SR spring/summer chinook (and steelhead) is "effectively non-existent" (Marmorek et. al. 1998, NMFS 1999d). In the related life-cycle modeling and risk analysis, the ocean harvest rate on SR spring/summer chinook was assumed to be zero.

The life history of UCRS chinook including the timing and ocean distribution is similar to that of SR spring/summer chinook. The state agencies concluded that there is almost no harvest of UCRS chinook in ocean fisheries (ODFW/WDFW 1998). In an earlier review Chapman et al. (1995) estimated an average ocean harvest for UCRS chinook of 0.6%. Recent life cycle modeling and risk assessment efforts have again assumed that UCRS chinook are subject to no ocean harvest mortality (Cooney, T. NMFS, pers. com. P. Dygert NMFS, August 1999). The available information suggests that UCRS chinook are rarely caught in the proposed SEAK or Canadian fisheries.

6. California Chinook ESUs

California chinook stocks are presumed to reside primarily off California and not migrate to British Columbia or Alaska waters (Healy 1991). Myers et al. (1998) summarized a review of CWT recoveries from ocean fisheries and reported no recoveries in Alaska and Canada for stocks originating from the Rogue River in southern Oregon south. The CWT record for Sacramento River winter chinook (SRW) is relatively limited, but all recoveries except one have been taken off of California and none have been as far north as British Columbia (Viele, D. NMFS, pers. com. P. Dygert, NMFS August 25, 1999). The current harvest management model for SRW chinook assumes that all harvest impacts are limited to California.

Spring chinook released from the Feather River Hatchery are considered most representative of Central Valley spring chinook. The distribution of the expanded CWT recoveries out of a total of almost 13,000 over a twenty year period showed 0.6% in Canadian fisheries, 1.1%, in Washington fisheries, 10.4% in Oregon fisheries, and 87.9% in California fisheries. There was a much more limited CWT program on the Mad River Hatchery that serves to indicate the distribution of California Coastal chinook. The distribution of expanded recoveries from north to south again were 0.9% (Canadian), 7.0%, 29.3%, and 62.9% in California fisheries.

B. Chum Salmon

1. Hood Canal Summer-Run Chum

Stock separation work for chum salmon necessary to define the level of harvest in mixed stock fisheries is relatively limited, particularly as compared to chinook or coho which depend to a large degree on the coast-wide coded-wire tag and recovery system. Genetic stock identification and DNA techniques have been used to distinguish stocks in mixed stock fisheries. However, these applications tend to have a more local focus or provide results that distinguish stock groupings on a broader geographic scale. Although the number of studies is limited, NMFS is not aware of any evidence that HC summer chum are located near-shore in northern areas or taken in SEAK or north BC fisheries. Timing considerations support the conclusion that HC summer chum are not taken in these northern fisheries. The majority of chum catch in SEAK summer fisheries occurs beginning in late July through early September in terminal area (near shore) net fisheries targeted on local stocks of maturing adults. Chum are not targeted in the troll fisheries that occur offshore and chum salmon retention is prohibited in the SEAK winter troll fishery. Hood Canal summer chum enter freshwater beginning in early August. Stock composition information that is available for the Strait of Juan de Fuca/Area 20 fisheries indicates that these fish are clearing the area by early September. It is therefore unlikely that they would be encountered as far north as SEAK or northern BC.

Hood Canal summer chum are substantially affected by fisheries to the south. From 1974-1998, harvest impacts on the Hood Canal summer chum ESU ranged from 0.6% to 43.2% in Canadian fisheries, 0.4% to 10.1% in Washington pre-terminal fisheries and 0.3% to 51.1% in terminal fisheries. (The terminal fisheries occurred in Hood Canal and therefore did not affect the SJF component of the ESU.) Although the total exploitation rates ranged widely over this time period and averaged 38.0%, they have been significantly reduced in recent years (Table 8).

Table 8. Exploitation rates on Hood Canal summer chum by fishery aggregate and year. The terminal area exploitation rates do not apply to the SJF component of the ESU.

Return Year	Exploitation Rates: Escapement	Terminal	WA Preterminal	Canadian Area 20	Total
1974	86.7%	2.4%	2.3%	8.6%	13.3%
1975	63.8%	30.8%	1.9%	3.4%	36.2%
1976	38.5%	49.5%	4.5%	7.5%	61.5%
1977	66.8%	24.0%	4.2%	4.9%	33.2%
1978	79.7%	15.3%	2.5%	2.5%	20.3%
1979	70.2%	14.2%	9.8%	5.7%	29.8%
1980	47.8%	43.8%	3.1%	5.3%	52.2%
1981	46.6%	30.8%	9.5%	13.1%	53.4%
1982	45.4%	32.3%	3.6%	18.7%	54.6%
1983	42.4%	51.1%	5.9%	0.6%	57.6%
1984	59.0%	33.4%	1.4%	6.2%	41.0%
1985	27.8%	28.5%	10.1%	33.6%	72.2%
1986	40.2%	49.1%	1.8%	8.8%	59.8%
1987	44.7%	46.6%	2.4%	6.3%	55.3%
1988	67.8%	21.6%	3.2%	7.5%	32.2%
1989	18.7%	30.0%	8.1%	43.2%	81.3%
1990	36.9%	27.5%	2.2%	33.4%	63.1%
1991	40.2%	32.5%	8.8%	18.5%	59.8%
1992	72.1%	4.6%	2.7%	20.6%	27.9%
1993	87.7%	1.3%	6.5%	4.4%	12.3%
1994	82.2%	1.0%	2.6%	14.2%	17.8%
1995	94.9%	0.3%	0.6%	4.2%	5.1%
1996	97.3%	0.7%	0.5%	1.5%	2.7%
1997	95.9%	1.7%	0.4%	1.9%	4.1%
1998	96.8%	0.7%	0.8%	1.8%	3.2%
1974-98 Avg	62.0%	23.0%	4.0%	11.1%	38.0%
Stand. Error	4.7%	3.5%	0.6%	2.2%	4.7%
Prop. by fishery		60.4%	10.5%	29.1%	

A significant proportion of the estimated harvest mortality on the Hood Canal summer chum ESU occurs outside U.S. waters[2]. Commercial sockeye and pink fisheries in the

[2] These estimates are based on run reconstruction estimates derived from GSI data analysis applied to reported catches.

Canadian Strait of Juan de Fuca (Area 20) are estimated to take significant numbers of chum salmon during the summer chum migration period. Troll fisheries on the west coast of Vancouver Island (WCVI) have reported significant chum catches in some years. While sporadic tag recoveries indicate the presence of Hood Canal summer chum in this fishery, catch sampling programs and tagging efforts have been insufficient to indicate the magnitude of HC-SJF summer chum caught. WCVI troll fisheries begin in July and continue through early September. Although the WCVI troll fisheries may have some effect on HC summer chum, both the chinook and coho troll fisheries have been severely curtailed since 1994. The Georgia and Johnstone Strait areas have significant sockeye and pink fisheries during the time when summer chum may be present in these fisheries. Again, insufficient data exists to determine the magnitude of HC-SJF summer chum caught in these fisheries. However, timing and distribution information suggests that the majority of Canadian impacts likely occur in the Area 20 fisheries.

Estimated exploitation rates on the Hood Canal summer chum ESU in Canadian Area 20 fisheries during the period 1974-1998 ranged from 0.6% to 43.2% (Table 8). Impacts in this fishery were generally low until the 1980's when effort increased significantly due to high sockeye and pink salmon abundance, a low diversion rate (high proportion of adults returning through the Strait of Juan de Fuca), and a Canadian management policy to emphasize fishing in this area. The average exploitation rate in this fishery peaked in 1989 at 43%, and for the period from 1989 through 1992 averaged 28.9%. Exploitation rates have declined from 1989-92, to less than 5% since 1995 due to a more northerly sockeye migration pattern, and more recently, significant restrictions to the fishery to reduce the incidental take of Canadian coho and chinook.

Area 20 fisheries for sockeye and pink salmon begin in late July or early August and may continue through mid September. Peak harvest occurs in mid-late August. In the past, coho fisheries occurred after the conclusion of the sockeye and/or pink salmon season, through the remainder of the month of September. However, Canadian coho fisheries in Area 20 have been closed since 1994. Chum, including summer chum in the Hood Canal summer chum ESU, are caught incidentally in these fisheries. After September 15, it is assumed most of the summer chum salmon populations have moved into terminal areas.

It is pertinent to consider the potential effects of recent protective fisheries actions and other recovery efforts. Although the exploitation rate across all fisheries has been high in past years, averaging 45% from 1974-1994, it has been reduced to an average of 3.8% since 1994. Canada closed its Area 20 fishery will be closed in 1999 (historically, 30% or more of the fishing mortality on the Hood Canal summer chum ESU) and has agreed to release chum from Area 20 fisheries in subsequent years under the new Pacific Salmon Treaty (PST) agreement. U.S. managers are finalizing negotiations on a domestic management plan that is expected to result in overall average exploitation rates of 10.8% or less for stocks in the Hood Canal region and 8.8% from the Strait of Juan de Fuca. The plan mandates protective regulations, including harvest prohibition, for 90% or more of the run timing of each summer chum stock within the ESU. Under the plan and as a result of the actions agreed to in the PST chum annex, the exploitation rate in Canadian fisheries is expected to average 6.3% with an upper bound of 8.3%. The extremely low exploitation rates observed in recent years were primarily the result of extremely restrictive actions taken to protect coho and chinook stocks, and are not expected to continue should these species rebound. However, this plan anticipates these increases and requires that protective measures be taken for summer chum that ensure exploitation rates will remain low. Many of the actions specified in the plan have already been implemented as part of the 1999 fishing regime in Puget Sound. The terms of the plan also require that the effectiveness of, compliance with, and assumptions in the plan be reviewed and updated with new data every five years.

Although this plan has not been formally reviewed or approved by NMFS, it does provide a necessary context for analyzing anticipated impacts in Canadian fisheries that are subject to this consultation in conjunction with expected harvest mortality in southern fisheries. The plan is therefore used to quantify the anticipated harvest mortality and becomes and underlying assumption of the analysis.

To analyze the effect of this proposal, a simple retrospective simulation was conducted that compared the escapement resulting from the exploitation rate targets and ranges expected for Canadian fisheries and all fisheries combined under the co-managers' plan, to those observed during 1974-1991 in particular and to a no fishing regime. The escapements through 1991 have been some of the lowest observed and included a wide range of observed survivals. In addition, supplementation programs had not been implemented prior to 1991 so that escapements were not confounded with adults produced from these programs. The expected exploitation rate in Canadian fisheries for both the Hood Canal and Strait of Juan de Fuca stocks is 6.3%. The upper bound of the range of expected impacts is 8.3%. The expected total exploitation rates for HC and the SJF are 10.8% and 8.8%, respectively with upper ranges of 15.3% and 11.8%, respectively. To provide a more conservative analysis, the simulations compared observed escapements with escapement outcomes using 0, 8.3%, and the upper bound of the total exploitation rates for each region.

The results of the simulation show that trends for populations in both regions are not substantially different than if there had been no fishing, when compared with the abundances observed historically when exploitation rates were much higher. Hood Canal in particular would have benefitted from the reduced exploitation rates (Figure 16). Populations would have been above threshold escapement levels in most years, and dramatically above the observed values. In those years when abundance fell below threshold escapement levels, the results show that fishing would not have been a contributing factor, i.e., the escapement would have fallen below the threshold even if fishing mortality had been 0. Results from the simulation for the SJF indicate that in some years populations would have been depressed even absent all harvest, but that reduced harvest would have allowed for population growth over what was observed in years when the inherent productivity of the system permitted (Figure 17). It is apparent from the model results that the summer chum populations in the SJF region have been constrained by environmental conditions, as opposed to summer chum populations in the Hood Canal region in which reduced fishing would have made a significant difference to annual escapement, and in long-term population growth. Results from both models indicate that survival of populations in the HC summer chum ESU is highly variable. In fact, this kind of highly variable survival is characteristic of chum populations in general and summer chum in particular that spawn in the lower end of rivers and are therefore particularly vulnerable to adverse environmental events during the window between spawning and out migration. Hood Canal summer-run chum are also at the southern end of the distribution of summer-run chum which again suggests their greater dependence on high production in years when environmental conditions are favorable.

2. Lower Columbia River Chum

There is also relatively little information that is specific to the ocean distribution of LCR chum. Quantifying the magnitude of harvest related impacts is therefore difficult. However, the consideration of the timing and location of fisheries directed at chum salmon in relation to the return timing and location of chum spawning grounds suggests that harvest impacts to these stocks in the proposed fisheries are quite limited.

Chum salmon in the Columbia River is currently limited to just two areas: Grays River near the mouth of the Columbia River, and Hardy and Hamilton creeks that are just downstream of Bonneville Dam. Small numbers of adult chum salmon have been observed in several other lower Columbia River tributaries. A few chum cross Bonneville Dam in some years, but these are likely lost to the system as there are no known spawning areas above Bonneville Dam. Grays River chum salmon enter the Columbia River from mid-October to mid-November, but apparently do not reach the Grays River until late October to early December. These fish spawn from early November to late December. Fish returning to Hamilton and Hardy Creeks begin to appear in the Columbia River earlier than Grays River fish (late September to late October) and have a more protracted spawn timing (mid-November to mid-January).

Fall chum salmon stocks, like those from the lower Columbia River, usually originate from larger systems than summer chum stocks. Fall chum stocks enter fishing areas during the September through early November time period after most of the fisheries directed on other salmon species have been closed. Because of their timing, fisheries for chum salmon tend to more system specific and terminal in nature then fisheries that harvest summer chum. As a result, there is relatively little incidental catch of outside stocks, particularly stocks that have a more distant origin.

The fall chum fisheries in SEAK and north/central BC are conducted in terminal or near terminal areas from September through October. Most of the fisheries are located in inside areas or in specific terminal bays or inlets. The distance from the Columbia River and the late timing of these fisheries make it unlikely that LCR chum salmon are caught.

Fall chum salmon stocks are found in the inside waters of southern British Columbia in systems draining into the Strait of Georgia and in systems located on the West Coast of Vancouver Island (WCVI). The inside stocks originate primarily from the Fraser River and mid-Vancouver Island systems including the enhanced Qualicum stock. A number of small WCVI streams and rivers produce fall chum salmon, but only the Nitinat and Nootka stocks are large enough to sustain directed fisheries.

Fisheries on the inside stocks are conducted in Johnstone Strait, the Fraser River and along the mid-Vancouver Island eastern shoreline. These fisheries take place in late October and early November. The inside water location of these fisheries make it unlikely that listed fall chum stocks from the Columbia River drainage would be impacted.

Fall chum fisheries on the WCVI are usually conducted in two areas. The main fishing area is just outside Nitinat Lake, located approximately 12 miles outside of Juan de Fuca Strait, where natural and enhanced fall chum are harvested commercially with nets in a small terminal harvest area, Area 21, located just outside the lake. The Agreement provides that Canada will manage its Nitinat net chum fishery to minimize the harvest of non-targeted stocks. In some years, Nootka Sound chum stocks are large enough to support a net fishery. The Nootka fishery is conducted inside Nootka Sound, Area 25. A limited troll fishery for fall chum salmon off the WCVI (Areas 121-127) occurs some years. These fisheries take place primarily in October and may intercept mature chum from the LCR, but most of the fall chum catch is taken by net fisheries in terminal or near terminal areas. A combination of late timing and the terminal nature of the net fisheries make it unlikely that listed fall chum from the Columbia River drainage could be taken in significant numbers.

PFMC fisheries are closest to the terminal area although outside the action area. However, chum salmon are neither targeted or caught in PFMC fisheries. The available information suggests that the overall ocean impact on LCR chum is therefore likely quite low.

C. Coho Salmon

Coho from the Southern Oregon/Northern California Coast (SONCC) coho ESU are not caught in Alaskan or Canadian fisheries as indicated by the Rogue/Klamath indicator stock (PFMC 1999). Central California Coast coho have a similar, but somewhat more southerly distribution suggesting that they are also not caught in northern fisheries. Oregon Coast coho are occasionally caught in Alaska and Canadian fisheries although the ER is quite low. In 1999 the estimated ERs on OC coho in Alaskan and Canadian fisheries were 0.03% and 0.22%, respectively (PFMC 1999). The estimates for 1998 were similar (PFMC 1998).

Fisheries off the coast of Washington, Oregon, and California are management subject to provisions of Amendment 13 of the PFMC Salmon Fishery Management Plan. Amendment 13 requires that PFMC fisheries be managed subject to a total ER limit that depends on prior escapements and indicators of ocean productivity. The total ER limits includes impacts that occur in the north as well as those in terminal areas that are outside the jurisdiction of PFMC. The effect of Amendment 13 on OC coho was considered in an earlier biological opinion (NMFS 1999b) which concluded that managing under the provisions of Amendment 13 was not likely to jeopardize OC coho. The PFMC opinion specifically accounts for the harvest mortality that will occur in Alaskan and Canadian fisheries and requires that PFMC fisheries be adjusted to stay within prescribed jeopardy limits.

D. Sockeye Salmon

Although the ocean distribution and migration patterns of Snake River sockeye and Ozette Lake sockeye are not well understood, timing considerations and other information suggest that they are unlikely to be caught in proposed ocean fisheries.

The NMFS found no information to suggest that there is any significant harvest of Snake River sockeye salmon in ocean fisheries (November 20, 1991, 56 FR 58619). NMFS previously concluded that Snake River sockeye are not likely to be caught in PFMC ocean fisheries because few sockeye salmon are caught in the hook-and-line fisheries that largely target chinook and coho salmon (NMFS 1996b). Mature sockeye salmon from the Snake River are also not likely to be taken in SEAK or British Columbia because they exit the ocean prior to the onset of intercepting sockeye fisheries. The average of the peak passage timing for sockeye at Bonneville Dam is July 1. The reported entry timing of Ozette Lake sockeye ranges from April to early August (WDF *et al.* 1993) or from May to August (Dlugokenski *et al.* 1981). However, entry apparently peaks in early to mid-June, with an estimated 63% of the run having entered the lake itself by the end of June (M. Crewson and M. Haggerty, Makah Tribal Fisheries, pers. comm., S. Bishop NMFS, August 1999). Some fisheries in Alaska and Northern British Columbia may open as early as mid-June; fisheries in southern British Columbia and off the west coast of Vancouver Island do not begin until July and in recent years, these fisheries have not occurred until late July or August. Fraser Panel fisheries conducted on inside areas also do not generally begin until at least late July. These timing considerations suggest that it is unlikely that SR or Ozette Lake sockeye are encountered in the SEAK or Canadian fisheries since the adults will have largely exited the ocean prior to the start of the proposed summer fisheries (July-September). This conclusion is further supported for Alaskan fisheries by the available stock composition information. Fraser River stocks are the only southern sockeye stocks (south of Queen Charlotte Strait) documented to have been caught in SEAK fisheries (Sands and Gaudet 1999).

E. Steelhead

1. California Steelhead ESUs

Very little is known about the marine distribution patterns of California steelhead. However, the likelihood of their being present as far north as British Columbia can be inferred from the distribution of available mark recovery data by general life history type and from the commonalities in distribution with other salmonids from the region.

The California Central Valley, Central California Coast, South-Central California and Southern California steelhead ESUs are coastal winter-run steelhead stocks (Busby *et al.* 1996). Available fin-mark and coded-wire tag (CWT) data suggests that winter-run stocks tend to migrate further offshore but not as far north into the Gulf of Alaska as summer-run steelhead stocks (Burgner *et al.* 1992). Some limited mark data (CWTs and disc tags) is available. No CWT or disc tags from mature California steelhead were recovered in the North Pacific Ocean. A few immature California steelhead were recovered during the 1956-1995 time period in the open ocean, consistent with the winter-run life history (Myers *et al.* 1996), but no recoveries have been reported in Alaskan or Canadian waters. Coded-wire tags from California coho and chinook are recovered almost exclusively in California and Oregon fisheries, with very few recoveries reported in British Columbia or Alaska. Since California coho and chinook stocks share similar patterns of ocean distribution, it is reasonable to assume that listed California steelhead ESUs would also have a southerly distribution and would not be present in Alaskan or Canadian waters.

2. Columbia River Steelhead ESUs

Lower Columbia River and Upper Willamette River steelhead ESUs are coastal steelhead stocks. The Upper Willamette River stocks are winter run stocks; the Lower Columbia River steelhead stocks are primarily winter run although there are a few summer run stocks in the upriver portion of the ESU. Upper Columbia River, Snake River, and Middle Columbia River steelhead ESUs include inland stocks generally comprised of summer-run fish (Busby *et al* 1996).

The summer-run steelhead generally enter freshwater from May through October (Busby *et al* 1996) with peak entry occurring in July based on timing at Bonneville dam (US/O TAC 1997). Mark recoveries indicate that immature Columbia River steelhead are out in the mid North Pacific Ocean at this time. Data from high seas tagging studies found maturing summer-run Columbia River steelhead distributed off the coast of Northern British Columbia and west into the North Pacific Ocean (Myers *et al* 1996). Coded-wire tag data indicates summer-run steelhead are also present off the West Coast of Vancouver Island, with occasional recoveries in near shore Canadian fisheries.

The Lower Columbia River and Upper Willamette steelhead winter-run stocks enter freshwater from November through April (Busby et al. 1996). As mentioned above, the ocean distribution of winter-run steelhead is far offshore as compared with their summer counterparts, although coded-wire tag data indicates they are found as far east as the west coast of Vancouver Island.

Adults move rapidly back to the Columbia River once the migration begins, averaging 50 km/day mean straight-line-distance (range = 15-85 km/day) (USO TAC 1997).

Southeast Alaska Fisheries

The ocean distributions for listed steelhead are not known in detail, but steelhead are caught only rarely in ocean salmon fisheries and are, therefore, not likely to be caught in Alaskan fisheries (ODFW/WDFW 1998, PSMFC 1999). During 1982-1993, when the SEAK seine landings were sampled for CWTed steelhead, only one tag was recovered, although tag releases of southern U.S. steelhead were quite high. Since then, only one other steelhead CWT has been recovered while sampling for other species.

Canadian Fisheries

The available coded-wire tag data indicates that Canadian fisheries account for 0.9% of the total recoveries of hatchery steelhead from the listed Columbia River ESUs during the 1980-1997 period, an average of

1-8 tags per year depending on the ESU. The percentages range from 0.27% for the Mid-Columbia ESU to 5.4% for the Upper Columbia River ESU[3]. Chapman, et al, (1994) found similar results, estimating impacts from Canadian fisheries on type-A steelhead from the Mid-Columbia to be approximately 0.4%. Although there is some concern about non-reporting of steelhead in Canadian fisheries in more recent years, the percentage of total recoveries in Canadian fisheries has remained low over the entire seventeen year period (1980-1997). The adult freshwater timing, the ocean distribution patterns, and the greater relative abundance of Puget Sound and Canadian-origin steelhead compared with the listed Lower Columbia River and Upper Willamette winter steelhead stocks, make it unlikely that Canadian fisheries would encounter more than a few steelhead per year from any of the listed Columbia River ESUs.

Steelhead catch in southern British Columbia (Johnstone Strait, Juan de Fuca (Area 20), Nitinat and Fraser River fisheries where most Columbia River steelhead tags are recovered averaged several thousand per year in the 1970's (Oguss and Evans 1978, Andrews and McSheffrey 1976). Parkinson (1984) estimated the catch of Columbia River steelhead (as represented by stocks above Bonneville Dam) in these fisheries to be 102-337 in 1978-80, or less than 1% of the total return of steelhead. This is consistent with the CWT estimates. Given a wild/hatchery ratio of 20%, this would result in a catch of 20-60 wild Columbia River steelhead. However, since that time, the duration of fishing and amount of effort in these fisheries have decreased significantly and the catch of steelhead has declined to several hundred in the late 1980's and 1990s (MELP/DFO 1998, Bison 1992, Bison 1990). Therefore, the catch of steelhead from the Columbia River in recent years is probably 25-50 per year with the catch of listed steelhead on the order of 4-10 per year spread across the five ESUs.

F. Cutthroat Trout

Cutthroat trout are rarely caught in ocean fisheries and are unlikely to be found in the action area due to their relatively limited ocean migration (Sands and Gaudet 1999). Cutthroat trout are therefore unlikely to be caught in the proposed fisheries.

V. Cumulative Effects

Cumulative effects are defined as the "effects of future state or private activities, not involving federal activities, which are reasonably certain to occur within the action area of the federal action subject to consultation" (50 CFR 402.02). Because the action area is limited the marine and freshwater areas in SEAK and BC subject to provisions of the agreement, no additional cumulative effects to the listed species are anticipated.

VI. Conclusion

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[3] This average is influenced by 1989 when 44% (4 tags/9 tags) of the Upper Columbia River steelhead tags were recovered in Canadian fisheries. Excluding 1989 brings the average percent recovered in Canadian fisheries to 1.1%.

NMFS has reviewed the current status of each of the listed salmonid species shown in Table 1, the environmental baseline for the action area, the effects of the proposed actions and resulting fisheries in SEAK and British Columbia, and the cumulative effects. Based upon this review, NMFS concludes that the entry into this agreement by the United States and the conduct of the northern fisheries pursuant to it will not jeopardize the continued existence of salmon stocks listed as threatened or endangered under section 7 of the ESA.

A. Chinook Salmon

1. Snake River Fall Chinook

In the first step of the effects analysis NMFS compared the ocean ERs likely to occur under the agreement with those that actually occurred. Except for very recent years when Canadian fisheries were reduced unilaterally well beyond what was required under the agreement, the comparison shows that there would have been, and thus likely will be in the future, a major and substantial reduction in the overall ER (Figure 4). Snake River fall chinook benefit substantially from the agreement, in particular, as a result of limits set on the WCVI fishery since the WCVI is where SR fall chinook are most concentrated. The retrospective analysis suggests that impacts in the WCVI fishery will be limited to about half of what they were in past years. This is offset to some degree because the more northerly SEAK and NCBC fisheries are less constrained, but the effects of these more northerly fisheries are less significant then the WCVI impacts or overall harvest impacts coastwide. In short, the agreement as a whole will appreciably reduce the level of harvest as compared to previous years.

NMFS then considered whether the agreement was likely to constrain fisheries sufficiently to meet the existing 30% ocean ER reduction standard which has been the jeopardy standard applied by NMFS over the last several years in numerous consultations (see section IV.A.1). The retrospective analysis indicates that the standard would have been met in 11 of 13 years. The SR index averaged 0.64 (range 0.56-0.73) indicating that in most years it would be well below the target thus representing a substantial reduction from the 1988-1993 base period ERs. Hence, the fisheries under the agreement have a high probability of meeting the NMFS jeopardy standards as applied in prior harvest-related consultations.

Although the 1988-1993 base period has provided a useful benchmark for analyzing harvest actions in recent years, it is also pertinent to consider what ocean ERs have been in other circumstances. Prior to the PST and the initial agreement regarding chinook in 1985, fisheries were relatively unconstrained. The average ER on SR fall chinook from 1979-1984, again using the SR index, was 1.35 thus providing further perspective about the magnitude of reductions that are being achieved by the agreement.

NMFS also considered the proposed actions given results from the recently available life cycle modeling analyses. The PATH analysis indicates that there is a high probability of both short term (24 years) and long term (100 years) survival for SR fall chinook. In the PATH analysis, survival objectives were met regardless of the future decisions relating to the Federal Columbia River Power System (FCRPS) or assumptions regarding early ocean survival.

The CRI analysis indicates that the probability of extinction in the short term is near zero, and the probability of extinction over 100 years is estimated at 6-17% (depending on whether 1980 is included in the baseline analysis). In the CRI extinction analysis, a population has a high probability of being viable over a long period (and therefore may be argued to be "recovered") if it has a very low probability of extinction over that same period. Both the PATH and CRI analyses strongly suggest that reducing harvest impacts of the SRFC populations may be an important component in their recovery. The CRI analysis concludes that substantial reductions in overall harvest rates provide the greatest certainty of recovery over the long term. Other actions, such as the removal of the Lower Snake River dams, would also contribute to the long-term viability of these stocks. The PATH analysis suggests that drawdown provides the greatest certainty with respect to recovery, but also indicates that lower harvest impacts improve the likelihood of meeting the NMFS recovery goals for the SRFC.

The circumstances related to this consultation are unique in that it is difficult to determine with certainty the effects of the action because the effect of "no action" entails predictions of what level of fishing might occur in the absence of the agreement. Recognizing this uncertainty, NMFS concludes that the agreement provides substantial certainty about how future fisheries will be managed, particularly in the north. NMFS further concludes that the agreement secures major and substantial reductions in harvest impacts upon the SRFC and other listed stocks in the northern fisheries that would likely not occur absent the agreement. The effect of the action is therefore to improve the prospects for survival and recovery over what they would be absent the agreement. NMFS further concludes that the failure to enter into this agreement would likely have substantial negative effects on the SRFC and other listed stocks since the likelihood of achieving a more conservative agreement through further negotiations in a timely manner is extremely low.

Because NMFS based its conclusion, in part, on the point that the proposed agreement is preferable to no agreement, some further elaboration is warranted. First, NMFS ability to implement a more restrictive regime is limited. Because the U.S. has no authority over Canada, it cannot propose a more restrictive fishery regime as it would for a more typical federal action through the usual process of a jeopardy opinion and associated reasonable and prudent alternative. The only recourse if the agreement is rejected would be to try to renegotiate a better outcome. The U.S. and Canada have been without an agreement on chinook for seven years. This agreement took many months of intense negotiations to achieve. The collective judgement of the federal negotiators is that there is little prospect of negotiating a better outcome in the near future.

Recalling past circumstances helps to underscore the significance of this agreement. This agreement settles a long and acrimonious dispute. In recent years bilateral relations were characterized, for example, by retaliatory fisheries, boat seizures, and ferry blockades. Under these circumstances there was little opportunity for cooperative, conservation-base management and the fish stocks suffered the consequences. In more recent years Canada adopted a new and aggressive conservation ethic and made substantial unilateral reductions in their own fisheries similar to those that southern managers had been forced to live with for some time. However, even then there was little constructive dialogue between the countries and little opportunity to develop a rational and comprehensive management system. The new long-term agreement provides an extensive and detailed framework for cooperative management between the two countries. Each of the several chapters provides a specific road map for the management of fisheries for all species in all areas. Additional Attachments to the agreement such as Attachments D and E clarifies the substance of a broader agreement between the governments that seeks to integrate their management processes and use their best efforts to protect and restore the habitat upon which the stocks depend.

The chinook chapter of the agreement resolves the outstanding allocation issues, establishes an abundance-based management framework, makes substantial reductions in harvest, and provides formal and informal mechanisms for further reductions in harvest (specified in paragraph 9 of the chinook chapter) if key wild stocks fail to rebuild as expected. However, the agreement is far more comprehensive in scope and goes well beyond the provisions related to chinook. Other chapters of the agreement resolve issues related to fisheries directed at other species both in the north and south which themselves have been the source of acrimonious dispute. For example, there is a complex resolution of issues related to the Fraser sockeye fishery. There is a partial buy out of U.S. non-Indian commercial licenses that will reduce fleet capacity. There is an unprecedented agreement for unequal sharing of the Indian and non-Indian catch in the U.S. Fraser fishery that was integral to the broader agreement. Other divisive and long-standing legal issues are resolved, at least for the duration of the agreement, through separate but related stipulations among the U.S. parties to the agreement. Many of these cross-species issues are related so that the agreement was possible only through a comprehensive resolution of all issues. The scope and complexity of the agreement underscores the judgement that there is little likelihood of negotiating a better agreement in the foreseeable future.

Finally, the agreement establishes endowed funds for the north and south totaling $140 million that will provide necessary support for critical activities of the agreement related to data improvements, habitat restoration, and wild stock enhancement. Absent the agreement this permanent funding source that is specifically earmarked for the protection and enhancement of wild fish stocks will be lost.

The PST agreement provides certainty about how northern fisheries in SEAK and Canada will be operated in the future and ensures that there will be substantial reductions in the harvest of SR fall chinook associated with these fisheries. These reductions may not be sufficient in themselves to provide for recovery, and further reductions in harvest impacts associated with some southern fisheries and in other sources of mortality may be required. Nonetheless, the agreement does limit future harvest impacts associated with the northern fisheries substantially, and reduces those impacts to levels that could not be achieved absent the agreement. Additionally, and importantly, the agreement establishes a cooperative relationship between the two countries, one more conducive to actions to conserve and restore wild stocks. As a result, Canada is likely to be more receptive to requests for further conservation actions, should they be deemed necessary for the listed species.

Based on these considerations, NMFS has determined that the proposed fisheries are not likely to jeopardize the continued existence of SR fall chinook salmon. Critical habitat has been designated for SR fall chinook, but it does not include ocean areas. The proposed actions are therefore not likely to destroy or adversely modify designated critical habitat.

2. Upper Willamette River Chinook

The retrospective analysis indicates that the actual total ERs for UWR chinook for brood years 1982-1992 averaged 62 % (Figure 5). Under the treaty, the ER would also have been 62% indicating that there would be no reduction in the ER as a result of the agreement. If we assume minimized southern fishery conditions the ERs would be reduced to an average of 33%.

The majority of harvest reductions for UWR chinook will occur in terminal fisheries. From 1985 to 1996, the average terminal harvest rate has been 37%, although in recent years with priorities changing to the protection of wild fish, ERs have been greatly reduced. For example, the terminal harvest rate on UWR chinook in 1997 and 1998 averaged 13%. The State of Oregon has implemented a mass marking program for all hatchery chinook released into the Willamette. Once the marked fish are fully recruited to the sport fishery in 2002, Oregon has proposed to manage their sport fisheries with a release requirement for all unmarked fish. The associated mortality to natural-origin fish in the Columbia River mainstem and Willamette River terminal fisheries is expected to be under 10% at least until there is demonstrated progress in the recovery of the listed fish. The minimized southern fishery conditions referenced above assumed a terminal harvest rate of 12% for UWR. It is therefore reasonable to expect that the total ER in future years will average less than 33% primarily as a result of reductions in the terminal fisheries.

An estimate of the RER for UWR chinook that would permit comparison of a biologically derived target exploitation rate with the ER expect under the agreement is not currently available. However, the abundance trends in recent years, at least for the McKenzie stock, are positive suggesting that the combined reductions in ocean and terminal areas observed in recent years have provided positive results. The counts of natural-origin fish at Leaburg Dam have increased steadily and nearly doubled over the last six years (Table 3) while the proportion of hatchery-origin fish has declined. This suggests that the harvest reductions that have been implemented in recent years, in conjunction with other improvements in the system, will allow for recovery. Although the ER reductions anticipated as a result of the agreement are limited, there is likely sufficient opportunity to reduce harvest in southern fisheries to meet conservation requirements. It is again pertinent, as discussed above for SR fall chinook, that the no action alternative would result in great uncertainty and likely higher overall impacts than can be secured under the current agreement.

The expected harvest reductions will benefit the Clackamas and North Santiam components of the ESU as well. Both systems are heavily influenced by hatchery production. However, escapements of natural spawners on the Clackamas above the North Fork Dam have been averaged 1,000-1,500 fish in recent years compared to an escapement goal of 2,900. The Detroit Dam blocks passage on the North Santiam and therefore greatly limits the immediate prospects for recovery in that system. Until recovery measures for the North Santiam are worked out, the hatchery program may be important to help maintain population levels in a system that otherwise has greatly reduced productivity.

Based on these considerations, NMFS has determined that the proposed actions are not likely to jeopardize the continued existence of UWR chinook salmon. Critical habitat has not been designated for this ESU.

3. Lower Columbia River Chinook

There are three remaining spring chinook stocks in the LCR chinook ESU. All three are supported by associated hatchery programs since dams block passage to most, if not all, of their historic spawning and rearing habitat. Some natural spawning occurs in the lower rivers, but the resulting production is presumably quite limited. The agreement will result in lower ERs for LCR spring stocks. The observed ERs for the Cowlitz River spring chinook indicator stock averaged 64% for the 1980-1992 brood years under base conditions compared to expected rates of 54% under treaty conditions. However, the large terminal harvest incorporated in this comparison masks the reductions that will occur in the ocean fisheries as a result of the agreement. Ocean ERs under the base and treaty conditions for the 1980-1992 brood years would change from 30-18%. Most of the terminal area harvest on the LCR spring stocks actually occurs in the tributary sport fisheries off the mainstem Columbia which target surplus hatchery fish.

The spring stocks in the LCR are limited by the absence of suitable habitat. Given the circumstances, it is appropriate that harvest be managed to insure that hatchery escapement goals are met, thus protecting what remains of the genetic legacy of the ESU until such time that future planning efforts can lay out a more comprehensive solution leading to recovery. The hatchery escapement goals have been met in recent years and with the further harvest reductions anticipated under terms of the agreement it is highly likely that those goals will continue to be met. NMFS therefore concludes that the proposed fisheries are not likely to diminish the prospects that the spring stocks will continue to meet the current escapement goals.

The three remaining tule stocks are all relatively small. Interim escapement goals on the Coweeman and East Fork Lewis are 1,000 and 300, respectively. Recent escapements have averaged 995 on the Coweeman, but have been quite variable ranging from 146 to over 2,100 in recent years. Escapements on the East Fork Lewis have averaged 279. Less is known about the tule stock on the Clackamas, but escapements have averaged about 350 in recent years.

Like SR fall chinook, LCR tule chinook will benefit substantially by the agreement due to their distribution which is centered off the WCVI and Washington coast. The retrospective analysis indicates that the base ERs would have been reduced under treaty conditions from 57% to 45% (Figure 7). As was the case with the LCR spring stocks, the large terminal harvest incorporated in this comparison masks the reductions that will occur in the ocean fisheries as a result of the agreement. Ocean ERs under the base and treaty conditions for the 1980-1992 brood years would change from 45-30%. The RER estimated using the Coweeman to represent the LCR tules stocks was 0.65. In most years the ER on tule chinook in SEAK and BC fisheries would range between 0.15-0.20 leaving substantial latitude in southern fisheries to meet necessary conservation objectives. These tule stocks have persisted over the years despite far more intensive fishing than is anticipated in the future both as a result of the agreement and given the additional opportunity for controlling harvest in southern areas. Based on these considerations, NMFS concludes that the proposed fisheries are consistent with the expected recovery of the fall tule component of the LCR ESU.

The LCR brights appear to be one of the few healthy natural-origin stocks in the Columbia River Basin. The North Fork Lewis River bright stock has exceeded its escapement goal of 5,700, often by a substantial margin, every year since 1980. The low forecast in 1999 has been attributed to severe flooding in the contributing brood years. Escapements on the Sandy are reportedly stable and on the order of 1,000 fish per year for the last decade. Less is known about the bright stock on the East Fork Lewis, but it is reported as stable in abundance. Greater attention to assessing the status of these weaker stocks is warranted.

The LCR brights are distributed more to the north than the LCR spring or tule stocks. As a result, the reductions in ocean harvest in northern fisheries that are related to the agreement are limited (Figure 8). However, much of the harvest on these stocks occurs in U.S. fisheries thus providing the opportunity in domestic management forums to provide necessary management constraints. The relative health of the bright stocks suggests that the anticipated reductions in harvest are unnecessary for the North Fork stock, but will provide further protection for the Sandy, and particularly the East Fork stock about which less in known. NMFS therefore concludes that the proposed fisheries are consistent with an expectation of the future survival or recovery of the LCR bright component of the ESU.

NMFS reviewed the current status of the LCR chinook salmon, the environmental baseline for the action area, the effects of the fishery actions, and the cumulative effects. NMFS considered these factors with respect to the spring, tule and bright components of the ESU and concluded that the proposed fisheries would not reduce the prospects for their survival and recovery. Based on these considerations, NMFS concludes that the proposed actions are not likely to jeopardize the continued existence of listed LCR chinook. Critical habitat has not been designated for this ESU.

4. Puget Sound Chinook

The PS chinook ESU has a large and diverse stock structure. The analysis in this opinion looks at a subset of the stocks in detail and then extrapolates more qualitatively to the expected outcome for a broader range of stocks. Although a determination about the population structure of the ESU has not been made, it is unlikely that it will affect the general conclusion that emerges from this analysis.

The retrospective analysis indicates that significant reductions in total ER will be secured as a result of the agreement. These reductions are stock and year specific, but generally range between 5 and 20 percentage points. These reductions, in combination with other reductions that may occasionally be necessary in southern U.S. fisheries, will be sufficient to meet RER targets for the larger, more productive stocks in Puget Sound like Upper Skagit summer chinook. However, the analysis suggests that the ER reductions secured by the agreement will not be sufficient to meet RERs for smaller, less productive stocks that may already be close to critical threshold levels. Recovery ERs for the Nooksack spring stocks and the two less productive Skagit summer/fall stocks ranged from 0.20-0.24 and 0.33-0.36, respectively. (These estimates assume that marine survival rates remain comparable to those observed in recent years, but that seems an appropriately conservative assumption until there are definitive indications that survival rates have improved.) These RER targets are substantially lower than the ERs expected as a result of the agreement even with minimized fishery conditions in the south (Figures 7-8, 10-11).

Further analysis considers whether the stocks selected provide a pessimistic, worst case view of what is likely to result once similar RER analyses are available for a broader range of stocks. The qualitative review of current escapement levels, although speculative, suggests that RERs for other stocks will vary, but that there will be other stocks, particularly spring stocks, with RERs in the range of those estimated for Nooksack. Recovery ERs for summer/fall stocks will likely be higher and will likely vary between those observed for the Upper Skagit summers and the Lower Sauk or Lower Skagit summer/fall stocks. This suggests that the stocks selected to do not provide a biased view of the more general outcome.

Both the retrospective and RER analyses have generally incorporated conservative assumptions. For example, the retrospective analysis assumed that the northern fisheries will be managed up to the limit of that allowed under the agreement. The SEAK fisheries will most likely be managed up to the limit, but Canadian fisheries may not. Canada has taken unilateral action in recent years to reduce their own fisheries well below that which would now be allowed by the agreement and, given the continuing depressed status of some Canadian stocks, it is reasonable to expect that similar conservation measures will be taken at least for the next few years. The RERs were estimated assuming that future survival rates will remain low and using critical threshold levels that may be higher than deemed necessary once the ESU population and threshold determinations are made. In addition, the analysis focused on stocks at the finest level of resolution that is likely to occur. If these stocks are subsequently aggregated once the population designations are made, RERs will generally be higher. For example, a preliminary analysis for the aggregate of the Skagit summer/fall stocks results in a RER that is close to that calculated for the more productive Upper Skagit component. This generally conservative approach may over emphasize the potential deficiencies of the agreement for some Puget Sound stocks. Further review and development of this analysis and alternative approaches is warranted.

Analyzing the overall effects of this agreement on Puget Sound chinook entails an informed judgement of what might occur in the absence of this agreement and an evaluation of the relative benefits of the agreement in relation to the "no action" alternative. On the one hand the analysis suggests that the ER reductions that are secured as a result of the agreement are insufficient to meet RERs for at least several of the PS chinook stocks. However, as discussed in more detail in the conclusion section dealing with SR fall chinook, it is highly unlikely that rejection of this agreement would lead to a better or more restrictive management regime in the foreseeable future. The substantial ER reductions that are secured as a result of the agreement would be lost with little prospect of securing a better, more conservative agreement. In addition, other substantive benefits associated with the agreement would be lost including the substantial funding that is provided to support the agreement and activities related to wild stock recovery, and the opportunity to finally reestablish a constructive and cooperative management relationship with Canada that is likely to be more conducive to achieving further reductions if they are deemed necessary.

Although the ER savings secured by the agreement for some component of PS chinook may not be fully sufficient, they are very significant for many PS stocks and for other ESUs. The general results of this opinion also highlight the need to look for a broader road to recovery. As was discussed in the Environmental Baseline section, the status of many of these stocks is largely the result of reduced productivity related to habitat degradations and other sources of human induced mortality. The contrast between the status of the relatively abundant and healthy Upper Skagit summer stock compared to the other depressed summer/fall components in the Skagit demonstrates the distinction between more and less productive stocks. The analysis in this opinion suggests that it is unrealistic to expect to achieve recovery through harvest reductions alone without also taking action in other areas to improve the productivity of the stocks. Harvest must be managed conservatively and responsibly, but recovery depends on implementation of a broadly based program that addresses all of the factors of decline.

NMFS concludes that the alternative which carries the greatest benefit for the listed Puget Sound chinook is the entry into force of the agreement and to employ the mechanisms in the agreement itself to address, more surgically, the deficiencies that are apparent with respect to several of the individual stocks of PS chinook where warranted. Paragraph 9 of the Chinook Chapter outlines procedures by which further constraints on fisheries may be achieved. Those reductions may occur as a result of meeting several conditions, but they are initially related to the status of specified stocks or stock groups. Among the specified groups are North Puget Sound Natural Spring stocks (including Nooksack and Skagit spring stocks) and Puget Sound Natural Summer/Fall stocks (including Skagit, Stillaguamish, Snohomish, Lake Washington, and Green River summer/fall stocks). Paragraph 9(g) of the Chinook Chapter further provides the general opportunity for the Parties to recommend, for conservation purposes, reductions that are greater than those identified in the agreement.

In the short term, even apart from the specific "exit gate" provisions provided in the agreement, the Parties have the opportunity to seek reductions beyond those provided in the agreement that may be needed to address critical conservation requirements. Such discussions did occur successfully in 1998 and, as a result, Canada took specific actions in their sport fisheries in 1999 to reduce impacts to Nooksack spring chinook. NMFS therefore believes that the relevant parties should explore opportunities for further shaping specific fisheries when and where necessary in order to provide additional benefits for local populations, as did in fact occur in 1999.

Based on these consideration and after reviewing the current status of the PS chinook salmon, the environmental baseline for the action area, the effects of the fishery actions, and the cumulative effects, it is NMFS' biological opinion that the proposed actions are not likely to jeopardize the continued existence of listed PS chinook. Critical habitat has not been designated for this ESU.

5. Snake River Spring/Summer and Upper Columbia River Spring Chinook

Snake River spring/summer chinook and UCR spring chinook may, on occasion, be caught in SEAK or. BC fisheries. However, the available information suggests that the overall ocean exploitation rate on these species is quite low and for practical purposes is treated as zero in life-cycle modeling efforts designed to assess extinction risk and options to promote recovery. Critical habitat has been designated for SR spring/summer chinook, but it does not include ocean areas. Critical habitat has not been designated for UCR spring chinook. Based on the available information, NMFS has determined that the proposed fisheries are not likely to jeopardize the continued existence of SR spring/summer chinook or UCR spring chinook salmon and is not likely to destroy or adversely modify designated critical habitat.

6. California Chinook ESUs

The available information suggests that SRW chinook are distributed primarily off California with no record of tag recoveries as far north as BC. NMFS therefore concludes that SRW chinook are not likely to be adversely affected by the proposed actions.

Central Valley spring chinook and California Coastal chinook are also distributed primarily off Oregon and California. A few CWTs have been recovered in Canadian fisheries, but these represent less than 1% of all recoveries in ocean fisheries (78 of nearly 13,000 and 3 of nearly 400). Chinook from these ESUs may occasionally be caught in Canadian fisheries, but the available information clearly indicates that the effect of the proposed fisheries are quite low and can reasonably be considered insignificant.

Based on these considerations, NMFS has determined that the proposed fisheries are not likely to jeopardize the continued existence of Central Valley spring chinook or California Coastal chinook salmon. No critical habitat has been designated for these ESUs, therefore, none will be affected.

B. Chum Salmon

1. Hood Canal Summer-Run Chum

The available information suggests that Hood Canal summer chum are not taken in SEAK or northern BC fisheries, but are substantially affected by fisheries in the south, including areas is southern BC. Exploitation rates on the HC and SJF component of the ESU have averaged 38% and 15%, respectively since 1974, but have been much higher in some past years (Table 8). Exploitation rates have been reduced to very low levels in recent years averaging for the Hood Canal and SJF components 3.8% and 2.9%, respectively. These reductions are the result of reductions taken to protect other species in addition to the summer chum stocks. However, these could increase in the future if concerns for other species diminish. To define the limits of likely future harvest mortality NMFS considered the anticipated ER associated with a proposed summer chum recovery plan developed by the co-managers in the southern U.S. The specifics of this plan are not incorporated in the PST, but Canada has committed in the Treaty to take actions to reduce the incidental catch of summer chum. The plan provides the necessary, more specific assumptions about the likely future effects of all fisheries, including proposed fisheries, that are not adequately defined by the agreement itself. If assumed harvest rates are not met in the course of implementing the agreement in future years, it may be necessary to reinitiate consultation.

NMFS used the expected ERs from the plan in a retrospective analysis to consider the likely effect of these fisheries on the listed species. The results indicated, for the HC component of the ESU in particular, a high likelihood of recovery. For the SJF component the analysis indicated that there was an opportunity for population growth during years of high to moderate survival, and that during years of low survival the populations would be depressed and there was little difference in escapement between the zero harvest and 6-8% ERs anticipated by the plan. Summer chum populations in the SJF region, appear to have been much more constrained by environmental conditions than those in Hood Canal and are generally less productive. It is important to note that the retrospective analysis was conservative in that it used the high end of the range of expected ERs rather than the anticipated ERs; actual ERs have been substantially lower than the anticipated rates in recent years.

A final consideration is the existence and initial success of supplementation programs that have been implemented in both HC and the SJF. The programs, if successful, will reduce the risk extinction in the short term until other habitat-related action can be taken to increase survival rates and promote recovery.

Based on the available information, NMFS has determined that the proposed fisheries are not likely to jeopardize the continued existence of HC summer chum. No critical habitat has been designated for this species, therefore, none will be affected.

2. Lower Columbia River Chum

There is also relatively little information that is specific to the ocean distribution of LCR chum. Quantifying the magnitude of harvest-related impacts is therefore difficult. However, consideration of the timing and location of fisheries directed at chum salmon in relation to the return timing and location of chum spawning grounds suggests that impacts to these stocks in the proposed fisheries are quite limited.

There are three primary populations of chum in the Columbia River. The population in the Grays River near the mouth of the Columbia has a somewhat later timing and therefore a greater potential for being caught. However, the escapement of this population has ranged from several hundred to over 5,000 over the last ten years. This population will also benefit from a supplementation program using native broodstock that was initiated in 1996.

There are two additional populations in Hamilton and Hardy Creek that are located just below Bonneville Dam. These are smaller populations with only about a mile of spawning habitat each. Escapements in some recent years have been less than 100 fish each to these systems. However, these fish return earlier and migrate further upriver than the Grays River population making it even less likely that they are caught in fisheries that are late in the season and several hundred miles away.

Based on the available information, NMFS has determined that the proposed fisheries are not likely to jeopardize the continued existence of LCR chum salmon. No critical habitat has been designated for this species, therefore, none will be affected.

C. Coho Salmon

The available information indicates that SONCC coho and CCC coho are not caught in proposed SEAK or Canadian fisheries. NMFS therefore concludes that the proposed actions are not likely to jeopardize the continued existence of SONCC coho and CCC coho. Critical habitat has been designated for these ESUs, but it does not include ocean areas. The proposed actions are therefore not likely to destroy or adversely modify designated critical habitat.

Oregon coastal coho are caught occasionally in SEAK and Canadian fisheries. The estimated ERs in recent years were 0.03% and 0.22%, respectively. Most harvest mortality to OC coho occurs in PFMC fisheries to the south. PFMC fisheries are managed pursuant to provisions of Amendment 13 of the Salmon FMP. Amendment 13 sets limits on the total allowable ER including fisheries in SEAK and Canada and requires that southern fisheries be adjusted to stay with prescribed limits. NMFS previously concluded that managing under provisions of Amendment 13 was not likely to jeopardize OC coho. Based on these considerations, NMFS has determined that the proposed fisheries are not likely to jeopardize the continued existence of OC coho salmon. No critical habitat has been designated for this species, therefore, none will be affected.

D. Sockeye Salmon

The available information suggests that it is unlikely that SR or Ozette Lake sockeye are taken in the proposed SEAK or Canadian fisheries. NMFS therefore concludes that the proposed actions are not likely to jeopardize the continued existence of SR or Ozette Lake sockeye. Critical habitat for SR sockeye has been designated, however, this action does not affect that area and no destruction or adverse modification of that critical habitat is anticipated. No critical habitat has been designated for Ozette Lake sockeye, therefore, none will be affected.

E. Steelhead

1. California Steelhead ESUs

The available information suggests that it is unlikely that steelhead from the California Central Valley, Central California Coast, South-Central California or Southern California ESUs are taken in the proposed SEAK or Canadian fisheries. NMFS therefore concludes that the proposed actions are not likely to jeopardize the continued existence of any of the California steelhead ESUs. No critical habitat has been designated for any of these ESUs, therefore, none will be affected.

2. Columbia River Steelhead ESUs

The available information suggests that steelhead from the Upper Columbia River, Snake River Basin, Lower Columbia River, Upper Willamette River, and Middle Columbia River ESUs are not likely to be adversely affected by the proposed SEAK fisheries. Coded wire tag recoveries indicate that listed steelhead from the Columbia River Basin are caught occasionally in proposed Canadian fisheries. However, the total catch of steelhead in Canadian fisheries is low and consideration of the likely stock composition suggests that the catch of listed steelhead is less than 10 per year from the five steelhead ESUs combined. NMFS therefore concludes that the proposed actions are not likely to jeopardize the continued existence of any of the Columbia River ESUs. No critical habitat has been designated for any of these ESUs, therefore, none will be affected.

F. Cutthroat Trout

The available information suggests that it is unlikely that Umpqua River cutthroat trout are taken in the proposed SEAK or Canadian fisheries. NMFS therefore concludes that the proposed actions are not likely to jeopardize the continued existence of Umpqua River cutthroat trout. No critical habitat has been designated for Umpqua River cutthroat trout, therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by both FWS and NMFS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by both FWS and NMFS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limit to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by the agencies so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The agencies have a continuing duty to regulate the activity covered by this incidental take statement. If the agencies (1) fail to assume and implement the terms and conditions or (2) fail to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the agencies or applicant must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(i)(3)]

I. Amount or Extent of Incidental Take

A. Chinook Salmon

1. Snake River Fall Chinook

The incidental catch of SR fall chinook in the SEAK and Canadian fisheries will vary from year to year depending on the stock abundances and management measures used to set fishing levels in the agreement. The catch will be limited by management measures in the PST agreement that define the limits of catch for each fishery. However, the catch of SR fall chinook is also limited in any particular year such that SEAK and Canadian fisheries in combination with PFMC fisheries not exceed a total age 3 and 4 adult equivalent ER that is 30% less than that observed during the 1988-1993 base period.

2. Upper Willamette River Chinook

The incidental catch of UWR chinook in the SEAK and Canadian fisheries will vary from year to year depending on the stock abundances and management measures used to set fishing levels in the agreement. The catch will be limited by management measures in the PST agreement that define the limits of catch for each fishery.

3. Lower Columbia River Chinook

The incidental catch of LCR chinook in the SEAK and Canadian fisheries will vary from year to year depending on the stock abundances and management measures used to set fishing levels in the agreement. The catch will be limited by management measures in the PST agreement that define the limits of catch for each fishery.

4. Puget Sound Chinook

The incidental catch of PS chinook in the SEAK and Canadian fisheries will vary from year to year depending on the stock abundances and management measures used to set fishing levels in the agreement. The catch will be limited by management measures in the PST agreement that define the limits of catch for each fishery.

5. Upper Columbia River Spring and Snake River Spring/Summer Chinook

Chinook salmon from the UCRS and SR spring/summer chinook ESUs may be taken on occasion in the proposed fisheries, but individual takings will be a rare event.

6. California Chinook ESUs

The available information suggests that chinook from any of the four California ESUs are not likely to be taken in SEAK fisheries. Chinook from the California ESUs may be taken on occasion in the proposed fisheries in Canada, but individual takings will be a rare event.

B. Chum Salmon

No take of HCSR chum or LCR chum is expected in the proposed SEAK fisheries. The expected ER of HCSR chum in the Canadian fisheries is 6.3% with an upper bound of 8.3%. The available information suggests that LCR chum may be taken on occasion in the proposed fisheries in Canada, but that individual takings will be a rare event.

C. Coho Salmon

NMFS does not anticipate that the proposed fisheries will take any coho from the Southern Oregon/Northern California Coast or Central California Coast ESUs. Oregon Coast coho are taken occasionally in the SEAK and BC fisheries. The estimated exploitation rates in recent years in those fisheries were 0.03% and 0.22%, respectively. NMFS does not expect these to increase substantially in future fisheries subject to the agreement.

D. Sockeye Salmon

NMFS does not anticipate that the proposed fisheries will take any Snake River or Lake Ozette sockeye salmon.

E. Steelhead

Steelhead are caught rarely in ocean fisheries. Some of the steelhead that are caught may be from ESUs that are not listed. Others may be unlisted hatchery-origin fish. Steelhead from the four California ESUs are not present in the action areas and are therefore not taken in the proposed fisheries. NMFS estimated that the catch of listed steelhead is on the order of 4-10 per year spread across the five Columbia River Basin ESUs .

F. Cutthroat Trout

NMFS does not anticipate that the proposed fisheries will take any Umpqua River cutthroat trout.

II. Effect of the Take

In the accompanying biological opinion, NMFS determined that the level of anticipated take of the nine chinook ESUs, two chum ESUs, three coho ESUs, two sockeye ESUs, nine steelhead ESUs, and one cutthroat trout ESU listed in Table 1 is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

III. Reasonable and Prudent Measures

In order to minimize and reduce the anticipated level of incidental take of listed species, NMFS believes that it is essential: 1) that management objectives established preseason be consistent with the terms of the agreement, 2) that inseason management actions taken during the course of the fisheries are also consistent with the agreement, 3) that catch and other management measures used to control fisheries be monitored adequately to ensure compliance with management objectives, and 4) that the fisheries be sampled for stock composition and other biological information.

IV. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the specified agencies must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. NMFS Administrator for the Alaska Region and Alaska Department of Fish and Game (ADFG) in consultation with the U.S. Section of the PSC and the NPFMC chair shall ensure that management objectives established preseason for the SEAK fisheries are consistent with provisions of the PST agreement.

2. NMFS Administrator for the Alaska Region and ADFG in consultation with the U.S. Section of the PSC and the NPFMC chair shall ensure that inseason management actions taken during the course of the SEAK fisheries are consistent with the harvest objectives and other management measures established pursuant to the PST agreement.

3. NMFS Administrator for the Alaska Region and ADFG in consultation with the U.S. Section of the PSC and the NPFMC chair shall monitor the catch and implementation of management measures in SEAK fisheries for compliance with the agreement.

4. ADFG in cooperation with NMFS Alaska Region and the NPFMC chair shall sample the SEAK fisheries for stock composition including the collection of CWTs in all fisheries and biological information to allow for a thorough post-season analysis of fishery impacts on listed species.

5. NMFS in consultation with the U.S. Section of the PSC shall review preseason management objectives established annually for the southern U.S. fisheries and Canadian fisheries and subsequent inseason actions for consistency with provisions of the PST agreement.

6. NMFS in consultation with the U.S. Section of the PSC shall assess sampling programs in Canadian and US ISBM fisheries to ensure that sufficient information is being collected to provide for a thorough post-season analysis of fishery impacts on listed species.

7. The U.S. Section of the PSC shall provide NMFS with the results of the annual post-season management review and other tasks required of the PST technical committees, as described in Chapters 3 and 5, Annex 4 of the Pacific Salmon Treaty.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. NMFS believes the following conservation recommendations are consistent with these obligations, and therefore should be implemented by NMFS.

1. NMFS should evaluate the ability of each listed ESU to survive and recover, given the totality of impacts affecting each ESU during all phases of the salmonid's life cycle, including freshwater, estuarine and ocean life stages. For this effort, NMFS should evaluate available life cycle models or initiate the development of life cycle models where needed. As this information becomes available, it should be reviewed by the appropriate technical committees of the PSC and incorporated into the assessment and development of PST management objectives through the PSC technical committees, in order to ensure use of the best available science.

2. The agreement provides that the Parties may recommend, for conservation purposes, that the PSC adopt harvest responses in the relevant fisheries that are more restrictive than those provided for in the agreement (Annex IV, Chapter 3, Paragraph 9(g)). Although the objective of the agreement is to rebuild wild stocks, the agreement was not intended to provide all the protection that may be necessary for listed species. It is reasonable to expect that additional management actions will be required in some years that are targeted to the needs of particular ESUs or stocks within an ESU. For example, the analysis associated with the opinion highlighted concerns related to some of the stocks in the Puget Sound ESU that are affected in the Canadian ISBM fisheries. In response to such circumstances, the Parties to the agreement and the co-managers should use the discretionary provisions of the agreement to the maximum extent possible to achieve necessary reductions in the mortality of the stocks of concern and should do so by focusing on the fisheries that have the greatest impact and thus provide the greatest opportunity to provide the necessary savings.

REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed actions. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the biological opinion; (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, the action agency must immediately reinitiate formal consultation.

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Figure 1. Early ocean survival rate for Upper Willamette River chinook

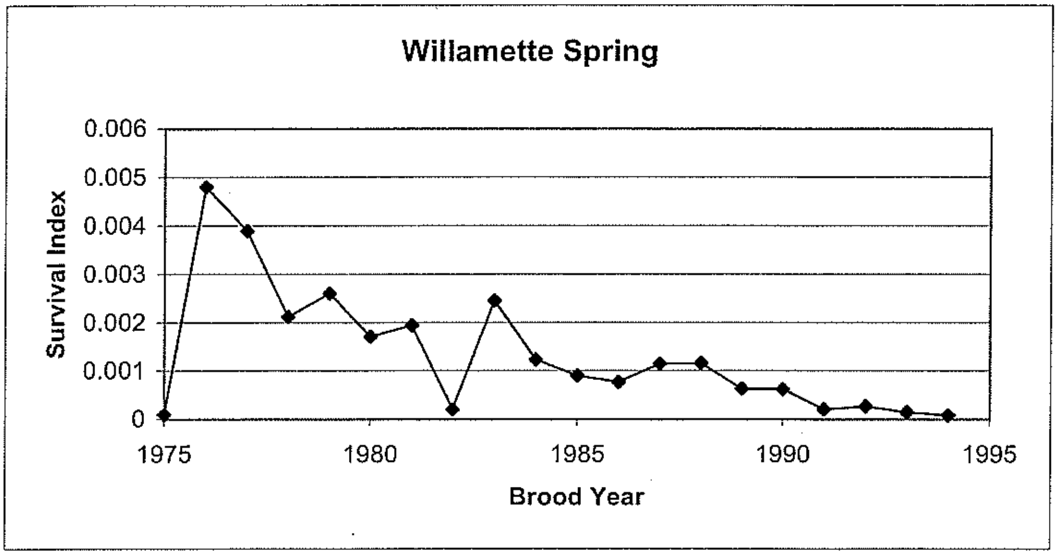

Figure 2. Early ocean survival rate for Lewis River fall chinook

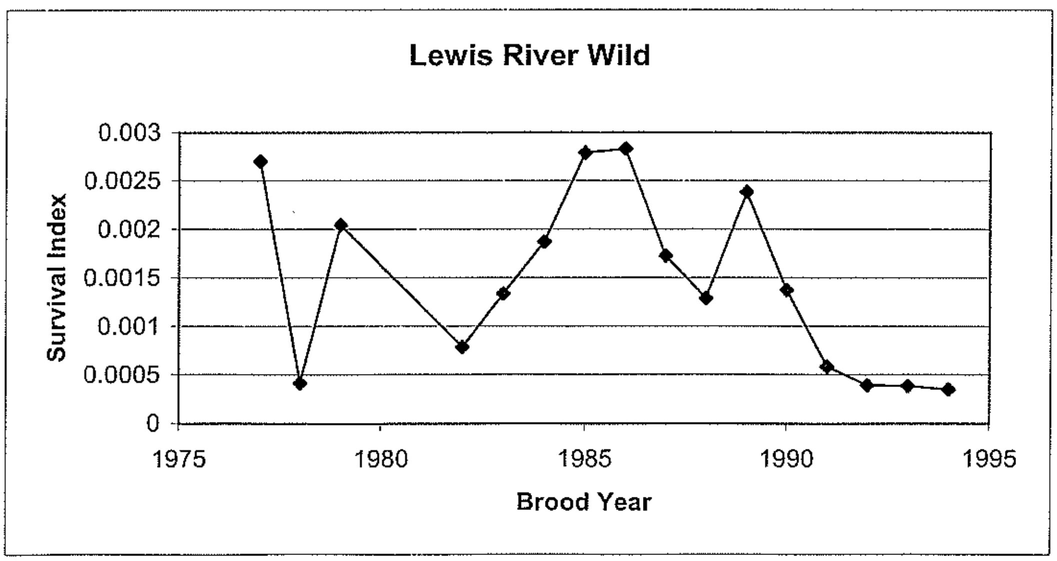

Figure 3. Early ocean survival rate index for Skagit River summer/fall chinook from Puget Sound

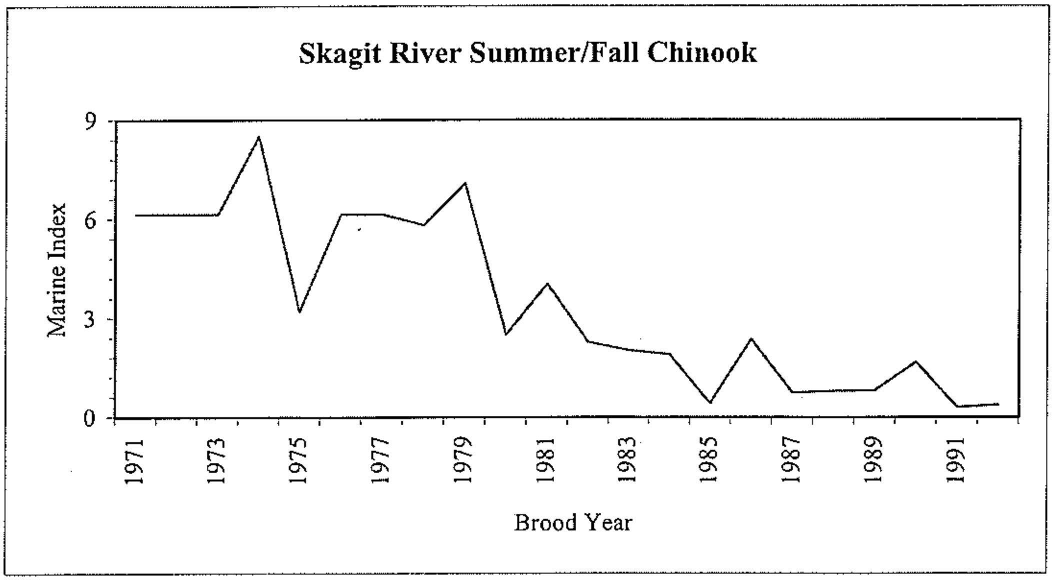

Figure 4. Comparison of Snake River fall chinook exploitation rate indices under varying conditions and the ESA jeopardy standard

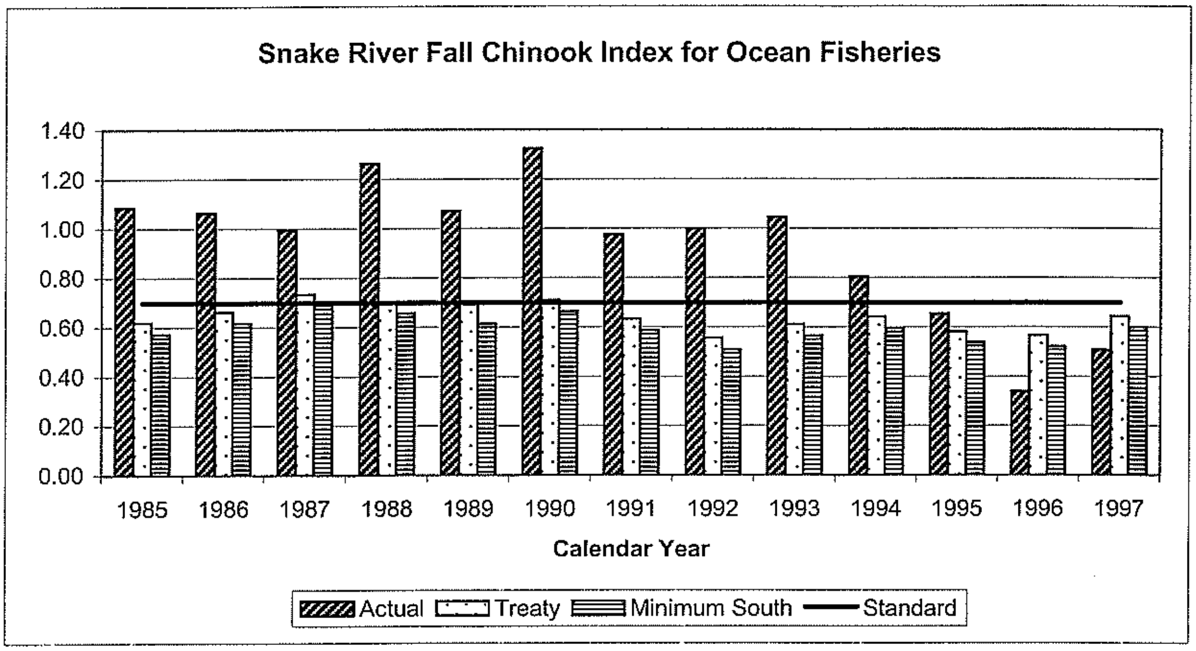

Figure 5. Comparison of Willamette spring chinook exploitation rates under varying conditions

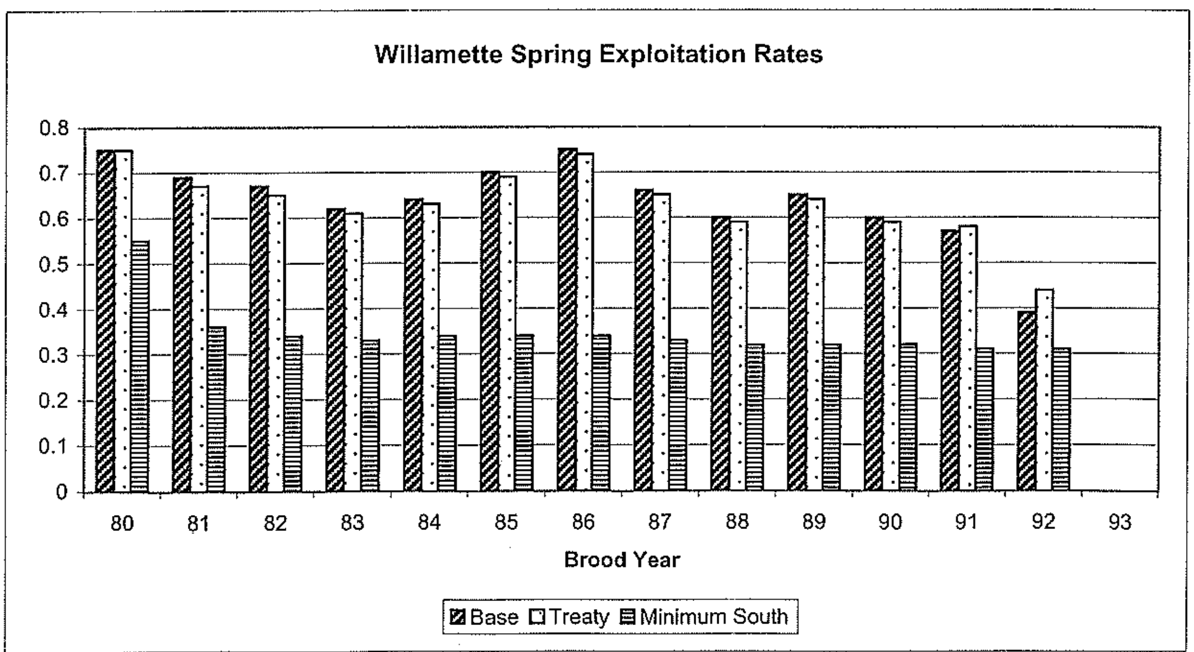

Figure 6. Comparison of Lower Columbia River spring chinook exploitation rates under varying conditions

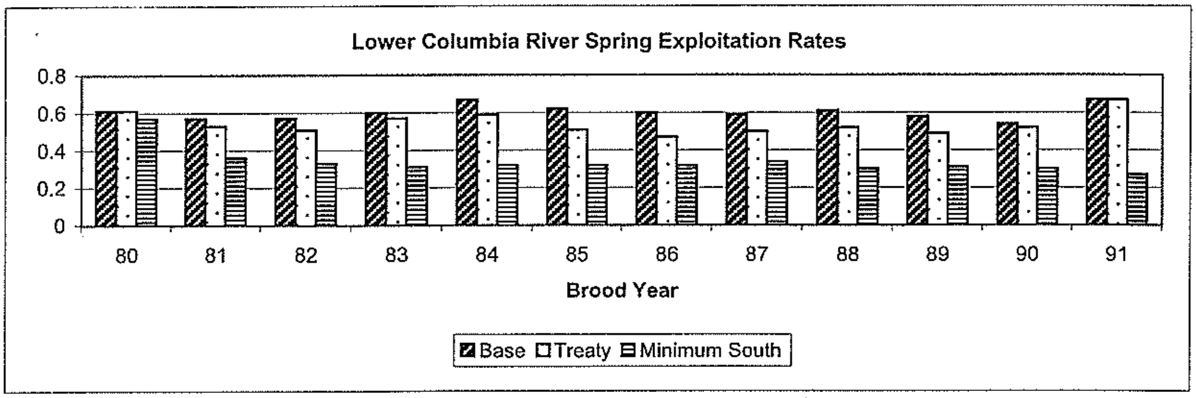

Figure 7. Comparison of Lower Columbia River tule chinook exploitation rates under varying conditions and estimated RERs assuming average survival

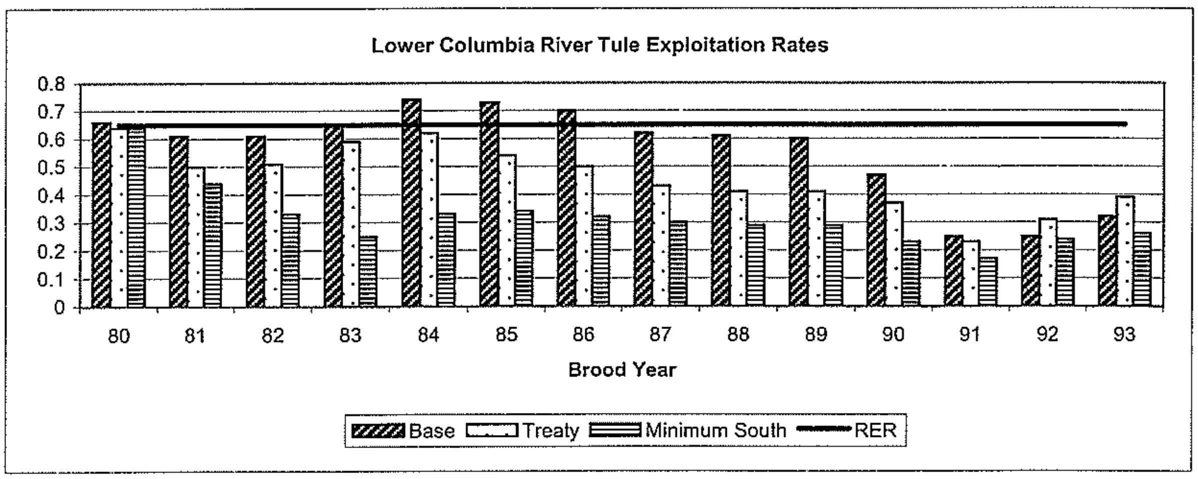

Figure 8. Comparison of Lower Columbia bright chinook exploitation rates under varying conditions

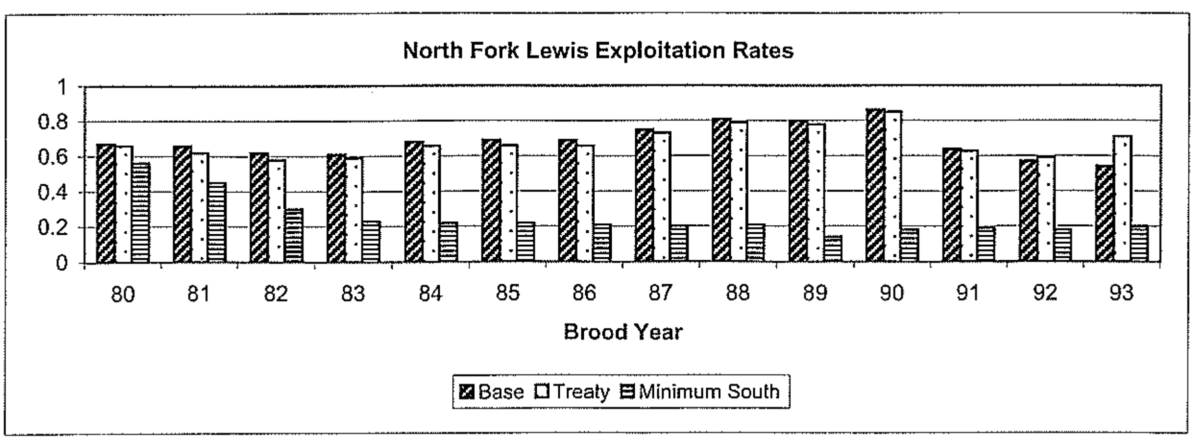

Figure 9. Comparison of Upper Skagit summer chinook exploitation rates under varying conditions and estimated RERs assuming low and high survivals

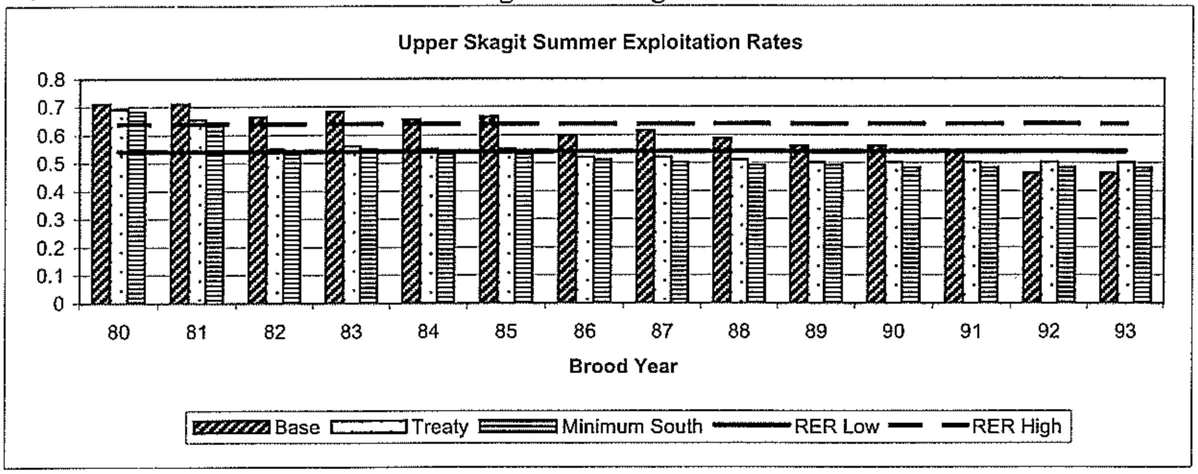

Figure 10. Comparison of Lower Skagit fall chinook exploitation rates under varying conditions and estimated RERs assuming low and high survivals

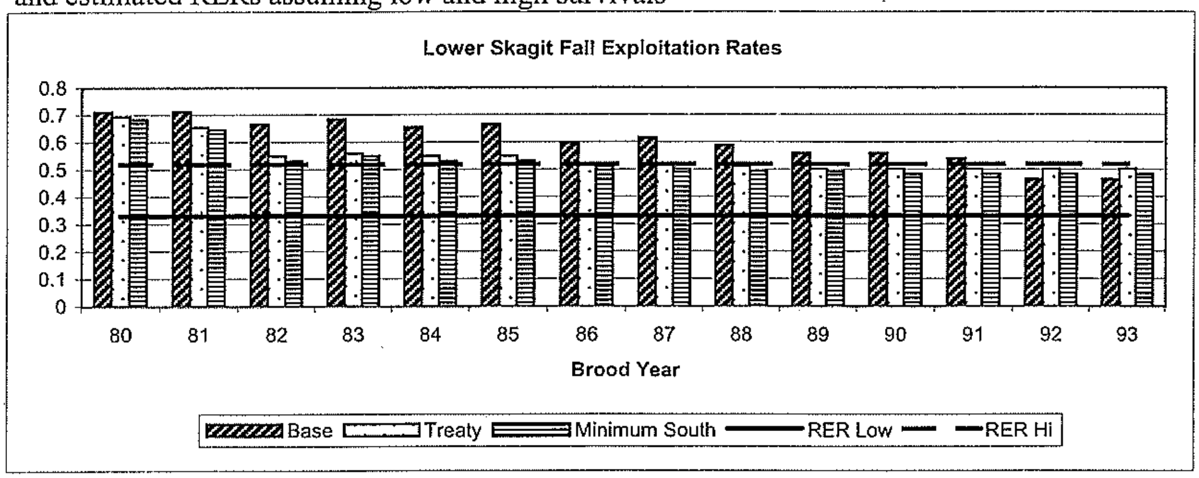

Figure 11. Comparison of Lower Sauk summer chinook exploitation rates under varying conditions and estimated RERs assuming low and high survivals

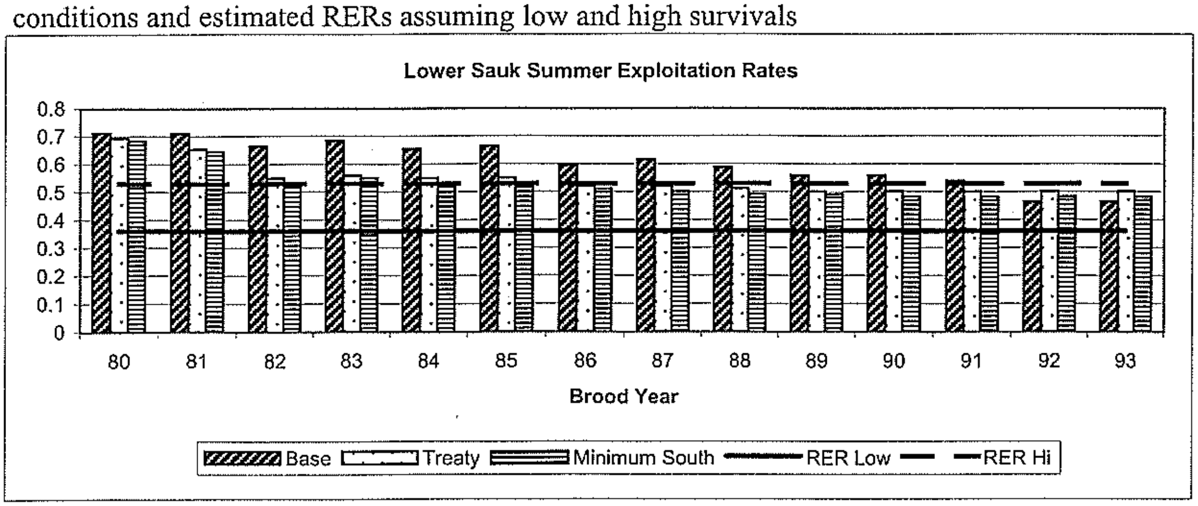

Figure 12. Comparison of North Fork Nooksack spring chinook exploitation rates under varying conditions and estimated RERs assuming low and high survivals

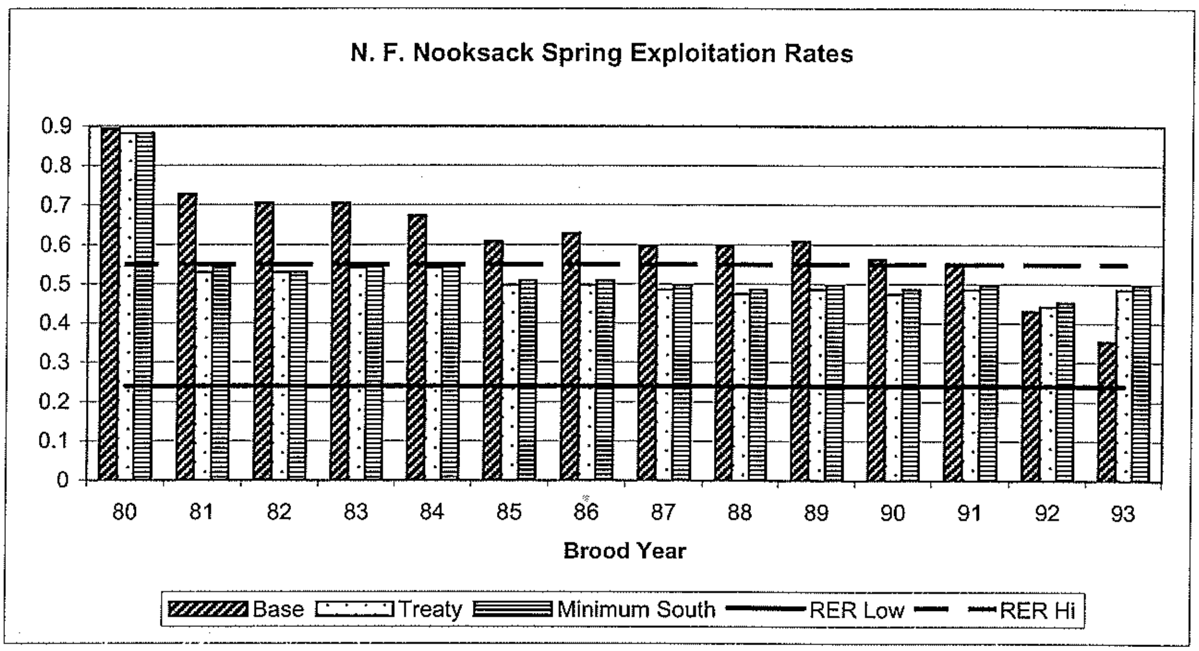

Figure 13. Comparison of South Fork Nooksack spring chinook exploitation rates under varying conditions and estimated RERs assuming low and high survivals

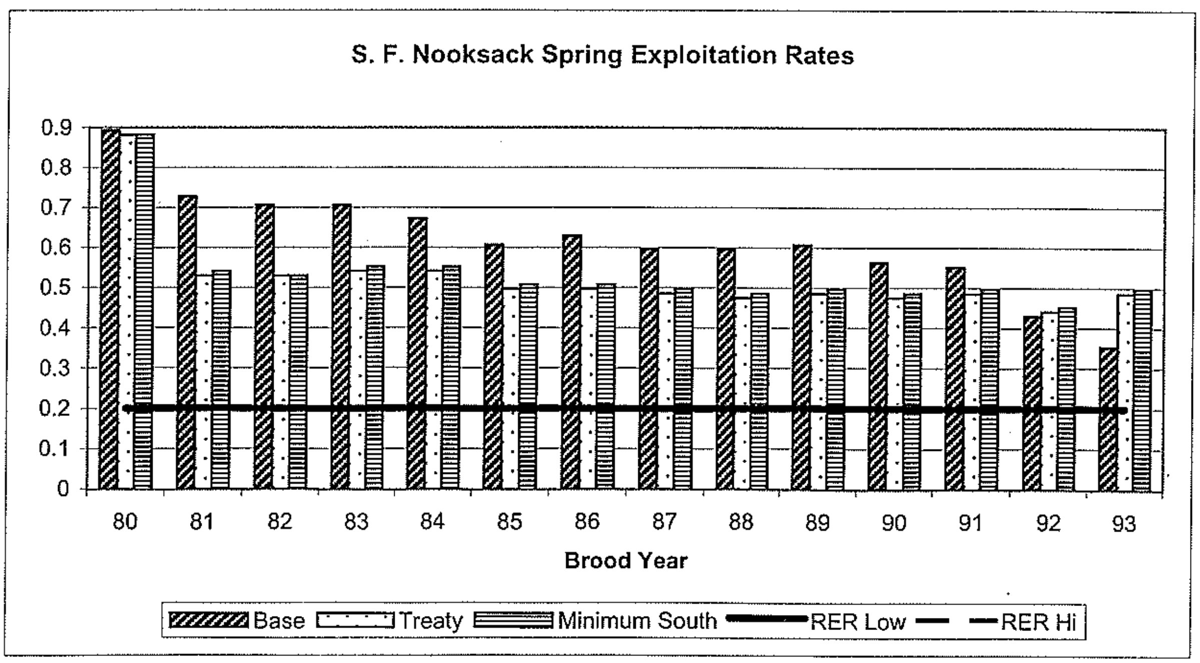

Figure 14. Comparison of Stillaguamish chinook exploitation rates under varying conditions

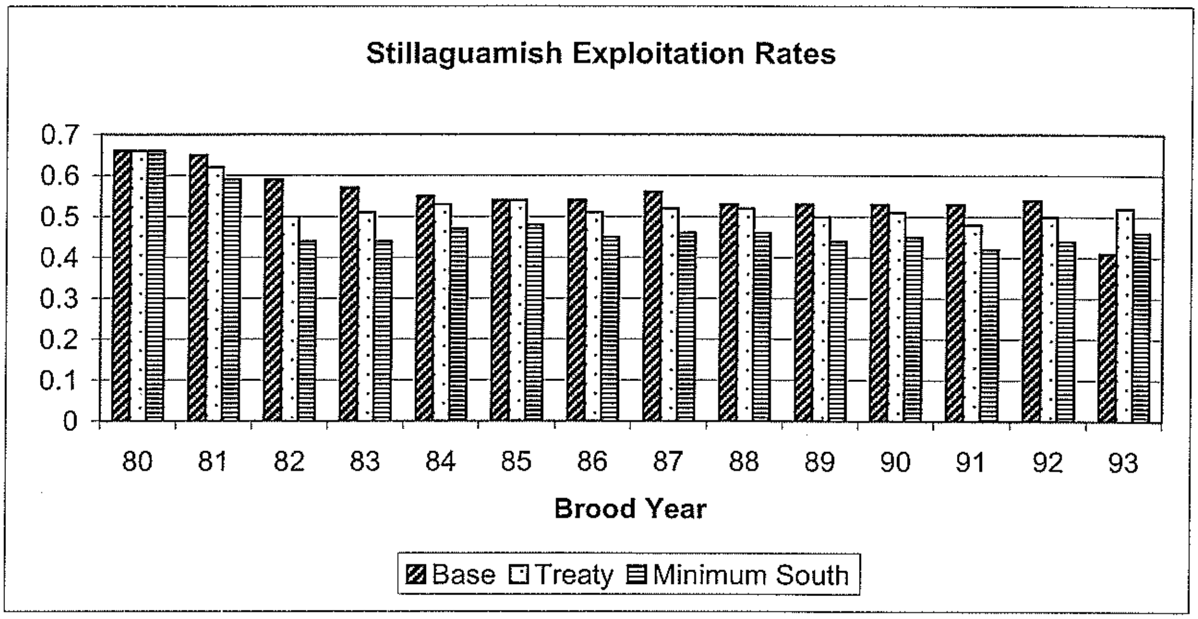

Figure 15. Comparison of Snohomish chinook exploitation rates under varying conditions

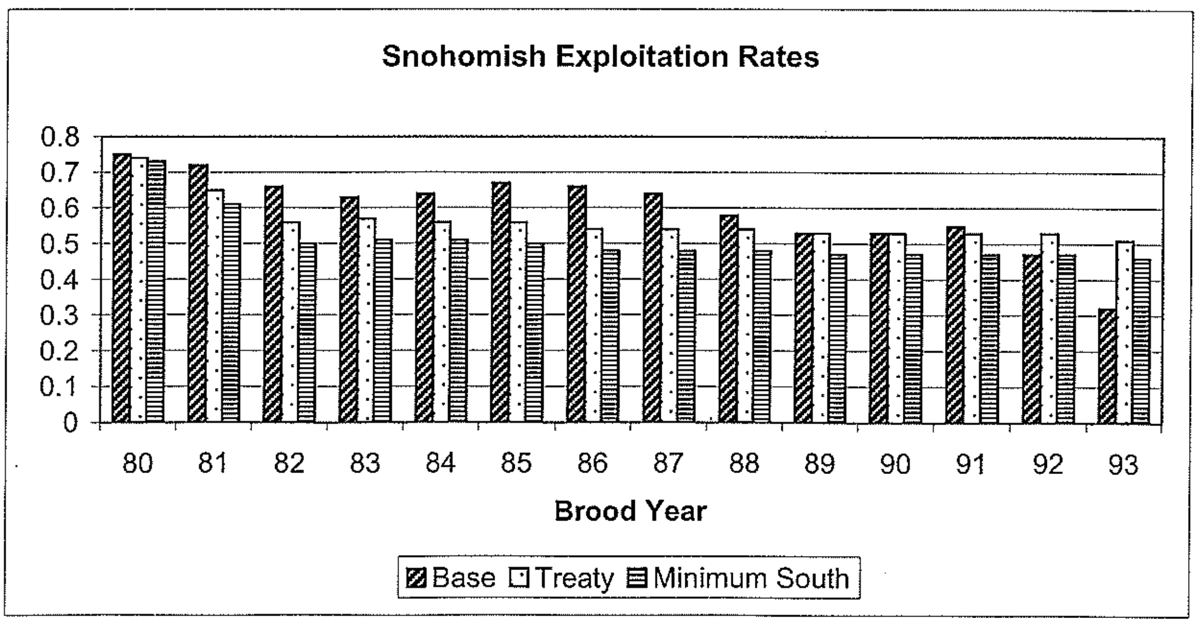

Figure 16. Comparison of Hood Canal summer chum escapements resulting from various exploitation rates

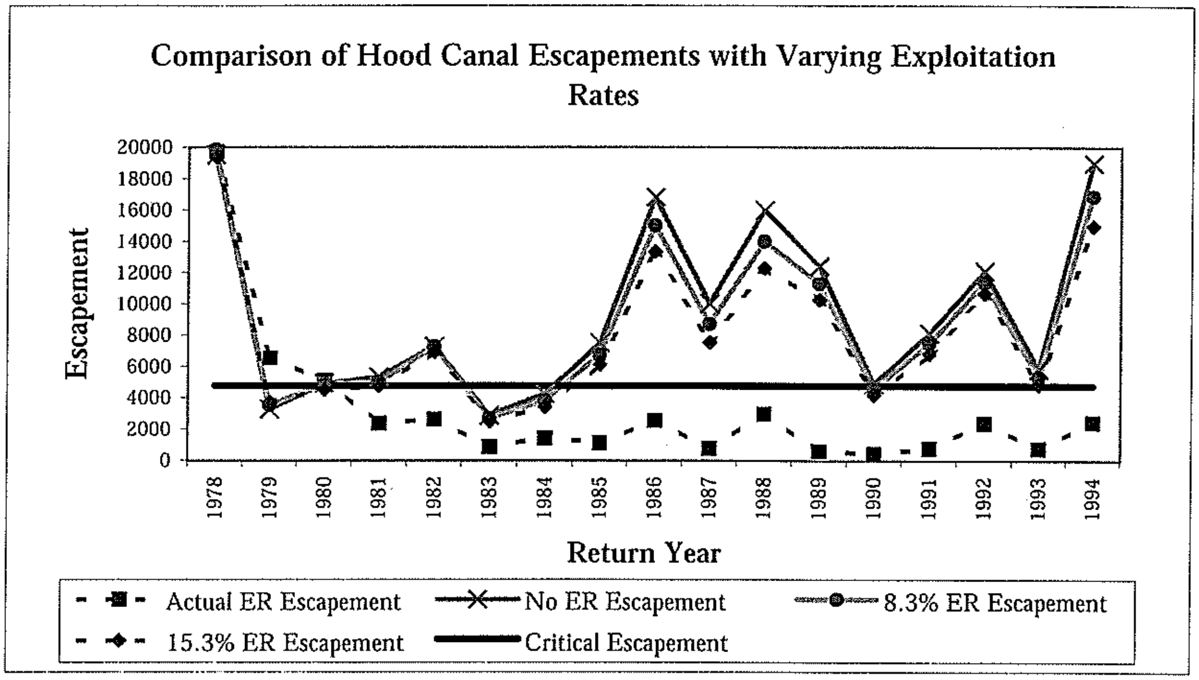

Figure 17. Comparison of Strait of Juan de Fuca summer chum escapements resulting from various exploitation rates