ENDANGERED SPECIES ACT - SECTION 7 CONSULTATION

BIOLOGICAL OPINION

THE FISHERY MANAGEMENT PLAN
FOR COMMERCIAL AND RECREATIONAL SALMON FISHERIES OFF THE COASTS OF WASHINGTON, OREGON, AND CALIFORNIA OF THE PACIFIC FISHERY MANAGEMENT COUNCIL

AGENCY: NATIONAL MARINE FISHERIES SERVICE,
NORTHWEST AND SOUTHWEST REGIONAL
FISHERY MANAGEMENT DIVISIONS

CONSULTATION CONDUCTED BY: NATIONAL MARINE FISHERIES SERVICE,
PROTECTED RESOURCES DIVISION

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I. Background

The objective of this biological opinion is to determine whether fisheries conducted in conformance with the plan entitled "Fishery Management Plan for Commercial and Recreational Salmon Fisheries off the Coasts of Washington, Oregon, and California Commencing in 1978," of the Pacific Fishery Management Council (PFMC), are likely to jeopardize the continued existence of Snake River sockeye salmon, Snake River spring/summer chinook salmon, Snake River fall chinook salmon or Sacramento River winter-run chinook salmon that are listed under the Endangered Species Act (ESA) or result in the destruction or adverse modification of their critical habitat.

In additional to the above listed species, other salmonid species are currently proposed for listing under the ESA including three contiguous evolutionarily significant units of coho salmon from the central California coast, the southern Oregon and northern California coasts, and the Oregon coast, Umpqua River cutthroat trout and Klamath Mountains Province steelhead. Conferencing on species proposed for listing is mandatory or optional depending on whether the existing salmon FMP is likely to jeopardize the proposed species. NMFS is currently reviewing the available information and will issue a conference report regarding the recently proposed species shortly.

The NMFS has issued biological opinions regarding impacts to listed species from the Snake River annually since listing in 1992 based on the regulations implemented each year rather than the FMP itself. The impacts of the FMP on Sacramento River winter-run chinook salmon were considered in a biological opinion issued in 1991 (NMFS 1991a). This opinion will, for the first time, evaluate the potential effects of the FMP on all listed salmonids occurring in the action area. This opinion is consistent with the intentions of the NMFS to provide, where possible, biological opinions that are longer term and more comprehensive in scope. Developing biological opinions with a more comprehensive perspective will be an ongoing effort.

Impacts to Snake River sockeye and spring/summer chinook salmon from PFMC fisheries are reviewed in this opinion. However, the great majority of harvest impacts on listed sockeye and spring/summer chinook salmon occur in the winter, spring and summer season fisheries in the Columbia River and, to a lesser extent, the Snake River. The winter, spring, and summer season fisheries in the Columbia River were recently considered in a biological opinion dated February 16, 1996 (NMFS 1996a). An opinion regarding Snake River Basin fisheries will be forthcoming although impacts to listed sockeye and spring/summer chinook are expected to be quite limited given the current depressed status of the species. Since the ocean impacts for the two species were also generally found to be negligible (NMFS 1996a, PFMC 1995), the February 16, 1996 opinion will serve as the primary document summarizing harvest impacts on listed sockeye and spring/summer chinook salmon.

Snake River fall chinook salmon are caught in ocean salmon fisheries and fall season fisheries in the Columbia River Basin. The NMFS intends to review the effects to Snake River fall chinook of proposed fisheries in Alaska and Canada that are managed under the jurisdiction of the Pacific Salmon Commission (PSC) and fisheries in the Columbia and Snake rivers managed under the Columbia River Fish Management Plan (CRFMP). However, there are substantive issues to be resolved for both the PSC and CRFMP fisheries before consultation can be completed. Preseason planning for the PFMC fisheries occurs primarily in March and April. Guidance from the NMFS regarding impacts to listed species contained in this biological opinion is a necessary part of the preseason planning process. The NMFS therefore chose to provide a biological opinion regarding PFMC fisheries to facilitate the preseason planning process. Once consultation regarding the PSC and fall season CRFMP fisheries is concluded, NMFS will prepare a comprehensive summary of fishery impacts to Snake River fall chinook including those which occur in the PFMC fisheries that are the subject of this opinion.

In the 1991 biological opinion for winter-run chinook, NMFS concluded that the level of incidental harvest by the 1990 ocean salmon fishery should not prevent the winter-run chinook population from growing, and therefore, continued implementation of the FMP was not likely to jeopardize the continued existence of the then threatened winter-run chinook. NMFS also concluded in the opinion that the impacts of the ocean recreational fishery should be reduced to speed the recovery of winter-run chinook to the point that the population was large enough to withstand an unexpected environmental perturbation that would otherwise reduce the population towards an endangered status. Since the issuance of the 1991 opinion, winter-run chinook has been reclassified from threatened to endangered due to continued low returns. Also, new information has recently been developed which estimates the ocean fishery impacts on winter-run chinook based on coded-wire tag (CWT) recoveries from hatchery winter-run chinook. Both the reclassification of winter-run chinook and the new ocean fishery impact information provides the basis for reinitiating consultation on the FMP's impacts on winter-run chinook.

II. Proposed Action

NMFS is proposing to continue implementation of the existing ocean salmon FMP. The ocean salmon fisheries off Washington, Oregon, and California are managed according to annual regulations promulgated under the "framework" FMP. Under the FMP, the PFMC develops management measures for the ocean fishery off the three states (see Figure 1). In developing the management measures, the PFMC analyzes the proposed federal management, and the proposed state management in the ocean and in estuary and freshwater areas. The PFMC makes recommendations to the Secretary of Commerce on a management regime for the ocean salmon fishery. If the Secretary approves the recommendations, he implements the management measures in federal waters. The States of Washington, Oregon and California manage their waters consistent with the management scheme approved by the Secretary of Commerce. Because the Secretary acting through NMFS has the ultimate authority for the FMP, NMFS is both the action agency and the consulting agency in this consultation.

The first FMP for Pacific ocean salmon fisheries was completed in 1978 (PFMC 1978). The FMP was converted to a framework plan in 1984 (PFMC 1984) to provide more flexibility in setting preseason and in-season management measures without the need for continual plan amendments. Although provisions of the framework plan have been amended periodically since 1984, the framework still defines the key elements for current management practice as it evolved from the original 1978 FMP.

The framework FMP provides the mechanism to make pre-season and in-season management adjustments to respond to changes in stock abundance, socio-economic changes and other variations in the fishery. Annual management specifications may include allowable ocean harvest levels, allocations, management boundaries and zones, minimum length restrictions, recreational daily bag limits, fishing gear restrictions, quotas, seasons, and selective fisheries.

The framework plan also defines the management unit for PFMC fisheries as the stocks of salmon that are harvested off the coasts of Washington, Oregon, and California. The management unit is comprised of several specific stocks or stock groupings (see Table 3-1 in PFMC 1984). The framework plan affirms that the component stocks or stock groupings can be modified only by amendment of the FMP. The plan further specifies spawning escapement goals for representative stocks in the management unit (see Table A-1 in PFMC 1995 for a summary of the current goals). The framework plan constrains the PFMC to manage mixed stock salmon fisheries to "...the level of exploitation that can be sustained by the weakest natural spawning stocks for which management objectives have been defined in Section 3.5 ...". None of the currently listed species of salmon are included among the stocks with escapement goals or management objectives. As a result, the framework plan limits the options of the PFMC in recommending management actions specifically to protect listed fish from the Snake or Sacramento rivers when developing harvest regimes.

III. Listed Species and Critical Habitat

Snake River sockeye salmon (Oncorhynchus nerka) are listed as endangered (November 20, 1991, 57 FR 58619). Snake River spring/summer chinook salmon (Oncorhynchus tshawytscha) and Snake River fall chinook salmon (Oncorhynchus tshawytscha) were listed as threatened (April 22, 1992, 57 FR 14653), but were reclassified as endangered through an Emergency Interim Rule (August 18, 1994, 59 FR 42529). The classification of Snake River Spring/Summer chinook and fall chinook reverted to threatened on April 17, 1995 (April 17, 1995 60 FR 19342). However, whether the species is listed as threatened or endangered does not per se affect the consultation process or the conclusions of a biological opinion, which depend on the biological requirements of the species and not their listing status.

Critical habitat was designated for Snake River sockeye salmon, Snake River spring/summer chinook salmon, and Snake River fall chinook salmon on December 28, 1993 (58 FR 68543), effective on January 27, 1994. The designation of critical habitat provides notice to Federal agencies and the public that these areas and features are vital to the conservation of listed Snake River salmon.

The essential features of the critical habitat of Snake River salmon have been further defined to include four components: (1) spawning and juvenile rearing areas, (2) juvenile migration corridors, (3) areas for growth and development to adulthood, and (4) adult migration corridors. PFMC fisheries occur in the Pacific Ocean where growth and development to adulthood occurs.

The Pacific Ocean areas used by listed Snake River salmon for growth and development have not been determined and are not well understood. Accordingly, essential features and primary constituent elements for the ocean have not been identified. Although it is important, critical habitat does not include the open ocean habitat because this area does not appear to be in need of special management consideration as discussed at 58 FR 68547. If additional evidence supports the inclusion of marine areas, NMFS may revise designated critical habitat.

The Sacramento River winter-run chinook salmon (Oncorhynchus tshawytscha) is a unique population of chinook salmon in the Sacramento River. It is distinguishable from the other three Sacramento chinook runs by the timing of its upstream migration and spawning season. NMFS listed winter-run chinook as threatened under emergency provisions of the ESA on August 4, 1989 (54 FR 32085), and formally listed the species on November 5, 1990 (55 FR 46515). The State of California listed winter-run chinook as endangered in 1989 under the California State Endangered Species Act. On January 4, 1994, NMFS reclassified the winter-run chinook as an endangered species (59 FR 442).

On June 16, 1993, NMFS designated critical habitat for the winter-run chinook from Keswick Dam (Sacramento river mile 302) to the Golden Gate Bridge (58 FR 33212). The designated habitat includes the area from the Sacramento River at Keswick Dam downstream to the San Francisco Bay. The open ocean was considered important, but was not designated as critical habitat because degradation of the open ocean did not appear to have significantly contributed to the decline of the species. The essential features of the critical habitat include 1) the river water, 2) the river bottom including those areas used as spawning substrate, 3) the adjacent riparian zone used for rearing, and 4) the estuarine water column and essential foraging habitat and food resources of the Delta and Bay, used for juvenile emigration and adult upmigration.

IV. Biological Information

A. Snake River Sockeye Salmon

Biological information regarding Snake River sockeye salmon is summarized in Attachment 1. Additional information can be found in NMFS (1995a).

Escapement of Snake River sockeye salmon to the Snake River has declined dramatically in recent years. Counts made at Lower Granite Dam since 1975 have ranged from 531 in 1976 to zero in 1990. In 1988, IDFG conducted spawning ground surveys that identified four adults and two redds (gravel nests in which the eggs are deposited). In 1989, one adult reached Redfish Lake and one redd and a second potential redd were identified. No redds or adults were identified in 1990. In 1991, three males and one female returned to Redfish Lake. One male Snake River sockeye salmon returned to Redfish Lake in 1992. Six male and two female sockeye returned to Redfish Lake in 1993 and one female in 1994. No sockeye returned to Redfish lake in 1995. The estimated return of Snake River sockeye salmon to the Columbia River in 1996 is nine fish (TAC 1996).

B. Snake River Spring/Summer Chinook Salmon

Biological information regarding Snake River spring/summer chinook salmon is summarized in Attachment 1. Additional information can be found in NMFS (1995a).

Although Snake River spring and summer chinook stocks have been listed as a single "distinct population segment," based on NMFS' finding that they constitute a single "Evolutionarily Significant Unit (ESU)" (Matthews and Waples 1991), Columbia River spring and summer chinook stocks are treated separately in management-related data bases. Spring and summer chinook are managed during different seasonal fishing periods using different regulatory criteria. The timing distinctions are, therefore, relevant to the understanding of the current management regime and the assessment of impacts.

The return of upriver spring chinook in 1994 was a record low 21,075 including only 2,125 natural-origin spring chinook from the Snake River. The 1995 return of upriver spring chinook was 10,195 including 1,852 listed spring chinook. The anticipate return of upriver spring chinook in 1996 is 37,200 adults which includes 4,600 natural-origin fish from the Snake River (TAC 1996).

The return of upriver summer chinook in 1994 was 17,695 including a record low 411 listed fish from the Snake River. The return of upriver summer chinook fish in 1995 was 15,044 including 534 natural-origin Snake River summer chinook. The forecast for 1996 calls for an expected return of 16,800 upriver summer chinook including 1,700 natural-origin fish from the Snake River (TAC 1996). Comparative run size information for spring and summer chinook for earlier years is contained in the biological assessment of Columbia River winter, spring and summer season fisheries (TAC 1996).

Specific forecasts for years beyond 1996 will be developed annually as the necessary information becomes available. However, qualitative information suggests that returns will be higher than the very low returns observed in 1994 and 1995 through 1998. Both the 1992 and 1993 brood years experienced good outmigration conditions. The jack returns from the 1992 brood in 1995 support expectations for a higher return. The 1992 brood would contribute to returns primarily in 1996 and 1997, and the 1993 brood to returns in 1997 and 1998. After 1998, returns will likely decline again, due to the very low escapements in 1994 and 1995.

C. Snake River Fall Chinook Salmon

Biological information regarding Snake River fall chinook salmon is summarized in Attachment 1.

The Columbia River fall chinook run has five major components: Lower River Hatchery, Lower River Wild, Bonneville Pool Hatchery, Upriver Bright, and Mid-Columbia Bright. Fall chinook from the Snake River are part of the Upriver Bright stock complex.

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 natural spawning is primarily limited to the Snake River below Hells Canyon Dam, and the lower reaches of the Clearwater, Grand Ronde, Imnaha, Salmon, and Tucannon Rivers. 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) with juveniles rearing in backwaters and shallow water areas through mid-summer prior to smolting and migration. They will spend one to four years in the Pacific Ocean before beginning their spawning migration.

Using the available CWT data, it is possible to estimate the ocean distribution and relative fishery impacts on Snake River fall chinook. Since naturally-spawned fall chinook have not been marked or tagged, CWT data from fingerling releases from the Lyons Ferry hatchery most closely represent the stock. An analysis of CWT recoveries indicates that the Lyons Ferry stock is widely distributed and subject to harvest in the Columbia River and marine fisheries from southern California to Alaska (PFMC 1995).

The estimated return of naturally-spawned Snake River fall chinook to Lower Granite Dam averaged 328 from 1986-1992, reaching a low of 78 in 1990. The corresponding return to Lower Granite Dam from 1991 to 1994 was 318, 533, 742, and 406, respectively. The projected return of listed fish to Lower Granite Dam in 1995 was 208. A final estimate for 1995 is not yet available, but is expected to be substantially higher than the preseason estimate. A forecast for 1996 is also not yet available at this time.

D. Sacramento River Winter-run Chinook Salmon

Prior to construction of Shasta and Keswick Dams in 1945 and 1950, respectively, winter-run chinook were reported to spawn in the upper reaches of the Little Sacramento, McCloud, and lower Pit Rivers (Moyle et al. 1989). Specific data relative to the historic run sizes of winter-run chinook prior to 1967 are sparse and anecdotal. Numerous fishery researchers have cited Slater (1963) to indicate that the winter-run chinook population may have been fairly small and limited to the spring-fed areas of the McCloud River before the construction of Shasta Dam. However, recent California Department of Fish and Game (CDFG) research in California State Archives has cited several fisheries chronicles that indicate the winter-run chinook population may have been much larger than previously thought. According to these qualitative an anecdotal accounts, winter-run chinook reproduced in the McCloud, Pit and Little Sacramento Rivers and may have numbered over 200,000 (Rectenwald 1989). Completion of the Red Bluff Diversion Dam in 1966 enabled accurate estimates of all salmon runs to the upper Sacramento River based on fish counts at the fish ladders. These annual fish counts document the dramatic decline of the winter-run chinook population. The estimated number of winter-run chinook passing the dam from 1967 to 1969 averaged 86,509. During 1990, 1991, 1992, 1993, 1994, and 1995, the spawning escapement of winter-run chinook past the dam was estimated at 441, 191, 1180, 341, 189 and 1361 adults, respectively.

The first winter-run chinook upstream migrants appear in the Sacramento-San Joaquin Delta during the early winter months (Skinner 1972). On the upper Sacramento River, the first upstream migrants appear during December (Vogel and Marine 1991). The upstream migration of winter-run chinook typically peaks during the month of March, but may vary with river flow, water-year type, and operation of Red Bluff Diversion Dam. Keswick Dam completely blocks any further upstream migration, forcing adults to migrate to and hold in deep pools downstream, before initiating spawning activities.

Since the construction of Shasta and Keswick Dam, winter-run chinook spawning has primarily occurred between Red Bluff Diversion Dam and Keswick Dam. The spawning period of winter-run chinook generally extends from mid-April to mid-August with peak activity occurring in June (Vogel and Marine 1991). Aerial survey of spawning redds have been conducted annually by the CDFG since 1987. These surveys have shown that the majority of winter-run chinook spawning in the upper Sacramento River has occurred between the upper Anderson Bridge at RM 284 and the Anderson-Cottonwood Irrigation District (ACID) dam at RM 298. However, significant numbers of winter-run chinook may also spawn below Red Bluff (RM 245) in some years. In 1988, for example, winter-run chinook redds were observed as far downstream as Woodson Bridge (RM 218).

Winter-run chinook eggs hatch after an incubation period of about 40-60 days depending on ambient water temperatures. The pre-emergent fry remain in the redd and absorb the yolk stored in their yolk-sac as they grow into fry. This period of larval incubation lasts approximately 2 to 4 weeks depending on water temperatures. Emergence of the fry from the gravel begins during late June and continues through September. The fry seek out shallow, nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. As they grow to 50 to 75 mm in length, the juvenile salmon move out into deeper, swifter water, but continue to use available cover to minimize the risk of predation and reduce energy expenditure.

The emigration of juvenile winter-run chinook from the upper Sacramento River is highly dependent on streamflow conditions and water year type. Once fry have emerged, storm events may cause en masse emigration pulses. Thus, emigration past Red Bluff may begin as early as late July, generally peaks in September, and can continue until mid-March in drier years (Vogel and Marine 1991). Data combined from 1981-1992 trapping and seining efforts show that winter-run chinook outmigrants occur between early July and early May from Keswick to Princeton (RM 302 to RM 158). Emigration monitoring of Glenn Colusa Irrigation District (GCID) at river mile 206 shows that juvenile winter-run chinook migrate past GCID as early as mid-July and may continue through April (HDR Engineering Inc., 1993).

In the Sacramento-San Joaquin Delta, winter-run chinook outmigrants generally occur from September through May as evidenced from trawling, seining, and State and Federal water project fish salvage data (CDFG 1993). Low to moderate numbers of juvenile winter-run chinook may occur in the fall, or later in the spring depending on the water year type. Large winter-run chinook juveniles have been salvaged as late as June (1982, 1983, 1986) at the State fish facilities, as well as at the Federal fish facilities (1987) (CDFG 1993). Peak outmigration through the Delta typically occurs from late January through May (Stevens 1989, Perry 1992).

V. Evaluating Proposed Actions

Evaluating the effects of a proposed action and determining what level of impact constitutes jeopardy is problematic. Listed species are by definition at risk of extinction. The prospects for recovery will be maximized by eliminating all sources of mortality. There are, however, practical constraints to eliminating all human-induced mortality and appropriate considerations, within the context of the ESA, of what may be a reasonable allowance for mortality. In general, the task of determining whether an action is likely to jeopardize a species or not is to identify, given all other potential actions, the level of impact that can reasonably be allowed consistent with the expectation for survival and recovery of the species.

The standards for determining jeopardy are set forth in Section 7(a)(2) of the ESA as defined by 50 C.F.R. Part 402 (the consultation regulations). NMFS discusses the analysis necessary for application of these standards in the particular contexts of the listed species of Snake River salmon in Attachment 2. This analysis involves the following steps: (1) define the biological requirements of the listed species; (2) evaluate the relevance of the environmental baseline to the species' current status; (3) determine the effects of the proposed or continuing action on listed species; (4) determine whether the species can be expected to survive with an adequate potential for recovery under the effects of the proposed or continuing action, the environmental baseline and any cumulative effects, and considering measures for survival and recovery specific to other life stages; and (5) identify reasonable and prudent alternatives to a proposed or continuing action that is likely to jeopardize the continued existence of the listed species.

The analytical procedure described in Attachment 2 was developed using the statutes and regulations of the ESA with special consideration for the unique life history of Pacific salmon species. While the procedure is generally applicable to all Pacific salmon, it was developed first for the circumstances and available information related to the Snake River species. The kind and quality of information available for other species may vary requiring more or less qualitative analyses of certain steps in the procedure. For example, the Proposed Recovery Plan and available life cycle models are important components used in the analysis of actions related to Snake River species. For Sacramento River winter-run chinook, the Recovery Plan is still in preparation and there is no comparable life cycle models that can be used to analyze simultaneously the effects of all actions. Nevertheless, the framework of the analytical procedure is still applicable and is used to the degree possible in evaluating impacts to Sacramento River winter-run chinook.

VI. Evaluating the Effects to Listed Snake River Salmon

The purpose of this consultation is to determine whether the PFMC ocean salmon FMP is likely to jeopardize the continued existence of the listed species. The magnitude of the effects of the proposed action are important. However, the jeopardy determination must be done in the context of the environmental baseline, biological requirements of the species and anticipated effects of other actions that are likely to occur both now and in future years. Attachment 1 provides the context for the more comprehensive impact analysis. The status of the listed species is such that survival and recovery can be achieved only through application of a comprehensive and long term strategy designed to improve survival of each life stage as it is affected by each action such that the biological requirements of the species are met and the species can rebuild to the point of recovery. The necessary comprehensive strategy is laid out in the NMFS Proposed Recovery Plan (NMFS 1995b).

Discussions of the biological requirements for the listed Snake River salmon species and the relevance of the environmental baseline to the species' current status are contained in Attachment 1 and the current biological opinion on the Federal Columbia River Power System (NMFS 1995c). To complete the analysis of the FMP, it is necessary to quantify the magnitude of impacts associated with the proposed action, consider whether the proposed action is consistent with the Proposed Recovery Plan, and finally, whether the Proposed Recovery Plan itself meets the biological requirements of the species.

A. Biological Requirements

The first step in the method NMFS uses for applying the ESA standards of §7(a)(2) to listed salmon is to define the species' biological requirements that are most relevant to each consultation. For this consultation, NMFS finds that these biological requirements are best expressed as trends in population size and variability. This information is summarized in Attachment 1.

B. Environmental Baseline

The current range-wide status of the listed species under the environmental baseline is described in Attachment 1. The biological requirements of the listed species are currently not being met under the environmental baseline. Their status is such that there must be a significant improvement in the environmental conditions of the critical habitat (over those currently available under the environmental baseline). Any further degradation of these conditions would have a significant impact due to the amount of risk the listed salmon presently face under the environmental baseline.

C. Effects of the Proposed Action

1. Snake River Sockeye Salmon

There is no information to suggest that Columbia River sockeye in general, or Snake River sockeye in particular, are harvested in the PFMC ocean management area (November 20, 1991, 56 FR 58619). Few sockeye are harvested by PFMC ocean salmon fisheries. One reason for the low catch is that PFMC ocean salmon fisheries employ hook-and-line gear and fishing strategies to target primarily chinook and coho salmon which are different from those that would be used to target sockeye salmon. Troll catches of sockeye off the Washington coast have not exceeded 100 fish during any year since 1985. There are no CWT data or other information that can be used to determine the distribution of Snake River sockeye. However, the likelihood that any of the few sockeye taken in PFMC fisheries are from the Snake River is extremely remote based on relative magnitude of the runs originating in the Fraser River, Puget Sound and Columbia River basin. The number of Snake River sockeye in the ocean that may return to the Columbia River is likely quite small (probably in the tens of fish at most, based on recent escapement estimates) compared to millions of fish in other sockeye salmon stocks known to enter the PFMC management area and primarily pass through to the Strait of Juan de Fuca and to the Fraser River. The Salmon Technical Team (STT) concluded in their biological assessment that the possibility of harvest of Snake River sockeye by PFMC ocean salmon fisheries is almost nil (PFMC 1995).

2. Snake River Spring/Summer Chinook Salmon

Spring Chinook: Although the available information is limited, there are three lines of evidence related to timing, CWT and genetic stock identification (GSI) studies that suggest that mature Snake River spring chinook are not likely to be affected significantly by ocean salmon fisheries in the PFMC area. Upriver spring chinook begin entering the Columbia River in late February and early March, and reach peak abundance in the lower river below Bonneville Dam in April and early May (ODFW/WDF 1991). The majority of the PFMC's ocean fisheries occur within the May 1 to October 31 time period. As a result, most mature spring chinook have entered the river prior to the start of fishing.

The survival rates for the tagged hatchery release groups that are used to represent the distribution of the spring chinook have been very low. As a result, very few tags have been recovered. This greatly limits our ability to assess impacts. Even less is known about the distribution and impacts on immature fish since sub-legals caught in the fisheries cannot be retained and thus are not sampled. However, the relative number of tags recovered suggests that PFMC area fisheries do not significantly impact spring chinook. Approximately 2.8 million Snake River spring chinook have been tagged from the 1976 to 1987 brood releases at the Rapid River and Sawtooth hatcheries. There are only 4 observed tag recoveries in ocean fisheries compared to the 622 observed recoveries from in-river fisheries and escapement (PFMC 1992).

Berkson (1991) reviewed the tag recovery information from these same facilities and reported what appear to be different results. However, the differences are due primarily to the fact that Berkson reported estimated rather than observed recoveries and expanded the tag recoveries observed in the escapement to account for estimates of inter-dam loss. Berkson estimated that the total ocean exploitation rates for the spring stocks were less than 1% but did not draw any specific conclusions regarding the relative distribution of impacts in the various ocean fisheries.

GSI techniques have also been used to estimate the stock composition of chinook salmon in fisheries off the Washington coast and Strait of Juan de Fuca in recent years. Sampling efforts did not extend further south. Results of the analysis indicate that Snake River spring chinook are not caught in Washington area marine fisheries. However, the STT concluded that there is substantial uncertainty regarding the reliability and high potential for bias when GSI procedures are employed to estimate contributions of stocks that comprise a small proportion of the total catch, as is the case for Snake River spring chinook.

The larger stock aggregate of upper Columbia River spring chinook, which includes those from the Snake River, is still subject to concerns related to bias associated with small stocks. However, the available information for all Washington area fisheries indicates that less than 1 percent of the catch were upriver spring chinook. The proportion of the upriver stock aggregate that originate as naturally spawned fish from the Snake River is on the order of 10 percent based on estimates of relative run size at the river mouth (TAC 1996). This line of evidence suggests that some small fraction of less than 1 percent of the catch in Washington area fisheries may be naturally spawned spring chinook from the Snake River. These results are consistent with the timing and CWT analyses. It is not possible to determine the numerical impact of PFMC fisheries, but based on a review of the available information, the STT concluded that Snake River spring chinook are highly unlikely to be significantly impacted by ocean salmon fisheries in the PFMC area (PFMC 1995).

Summer Chinook: Similar data sources were reviewed in an effort to assess the likely magnitude of impacts on Snake River summer chinook. Recovery data from CWT releases involving the 1976 through 1986 broods of summer chinook from the McCall Hatchery were examined. The reservations concerning low survival rates of tag release groups and the inability to assess the impacts on sub-legals discussed earlier apply here as well. Nevertheless, the estimated number of recoveries from all release groups combined were only 12 by Washington ocean fisheries, 8 by Oregon ocean fisheries and 7 by Canadian ocean fisheries. There were no recoveries in California or Alaska fisheries. A total of 195 were reported by in-river fisheries and escapement (PFMC 1992).

Berkson (1991) considered the same CWT data but again expanded the in-river recoveries to account for inter-dam loss. He estimated that the exploitation rate for all ocean fisheries was less than 1% but again did not draw any specific conclusions regarding the relative distribution of impacts in the various ocean fisheries.

The limited CWT data suggest that Snake River summer chinook may be harvested by PFMC area fisheries. However, the data are not sufficient to determine the ocean distribution of Snake River summer chinook. Total impacts of the PFMC's ocean fisheries on this stock cannot be estimated without better information on patterns of ocean distribution. Results of the GSI analysis are similar to those presented for Snake River spring chinook. Marshall (1991) estimated that no Snake River summer chinook were taken in Washington coastal or Strait of Juan de Fuca fisheries. However, because of the low abundance of the stock, these results may be biased. The weighted average composition (1987 through 1990) of the upper Columbia River stock aggregate that includes Snake River fish, was less than 1% of the total in all but one of the Washington area fisheries (Scott 1991; the weighted stock composition in the Juan de Fuca sport fishery was 1.3%). The proportion of the upper Columbia River stock aggregate that is natural Snake River origin is on the order of 4%, based on an estimate of the relative composition of the terminal area run size (TAC 1996). These results are consistent with the limited information available from the CWT analysis and suggest that the impacts from PFMC area fisheries are probably quite small.

The STT was unable to determine the magnitude of the catch or incidental mortality of Snake River summer chinook caused by PFMC area salmon fisheries because of insufficient data. However, the STT concluded that it is unlikely that PFMC salmon fisheries significantly impact Snake River summer chinook (PFMC 1995).

3. Snake River Fall Chinook Salmon

The PFMC fisheries have been constrained in recent years and will likely continue to be constrained for the next few years because of concerns for both chinook and coho stocks. Coho stocks remain severely depressed relative to historic levels particularly off Oregon and California. Reduced coho fisheries will result in fewer incidental impacts to chinook. Potential impacts to listed fall chinook therefore depend, in part, on the future status of coho stocks.

The status of chinook stocks from California and Oregon are improved relative to recent years. But natural and hatchery stocks from the lower Columbia River in particular remain extremely depressed. Chinook fisheries in the area north of Cape Falcon will be restricted in 1996 and likely beyond because of concerns for chinook stocks from the Columbia River. Chinook fisheries off central Oregon and California will continue to be constrained because of concerns for winter-run chinook from the Sacramento River. It is therefore evident that anticipated impacts in PFMC fisheries to listed fall chinook in 1996 and beyond also depend substantially on the status of other chinook stocks.

Snake River fall chinook are broadly distributed and caught in ocean fisheries from southern California to Alaska (PFMC 1995). There is substantial uncertainty regarding the abundance of Snake River fall chinook in the ocean. Absent reliable estimates of ocean abundance it is difficult to quantify how many listed fish will be killed as a result of the proposed action. NMFS has provided various estimates of total mortality by fishery in past years (see for example NMFS 1995d). For 1995, NMFS estimated that the total mortality of listed fall chinook in the PFMC fisheries was 125 and 28 using different assumptions. These disparate estimates emphasize the degree of uncertainty regarding numerical impacts to listed fall chinook.

The above referenced estimates of total harvest mortality were derived using the PFMC chinook model assuming either the average base period ocean abundance or an ocean abundance scaled to the expected age-specific ocean escapement in 1995 (i.e., 601). These or similar estimates of catch should not be taken out of context or be compared without appropriate qualification to mortality estimates for harvest or other actions derived using different assumptions or models (see PFMC 1995 and NMFS 1993a for more detailed discussion).

Because of the uncertainty related to the estimates of actual catch of listed fish, the STT quantified the magnitude of impacts in terms of a change in exploitation rate relative to a 1988 - 1993 base period (PFMC 1995). Comparative base period analyses such as the one used here are common in fishery management providing a point of reference for measuring change. Selection of a particular base period depends on the point of reference that is of interest and available information. In this case, NMFS is interested in evaluating the degree to which harvest impacts are changing relative to recent years. The 1988 - 1993 base period is a recent series of years with available CWT recovery and catch information. The series begins in 1988 which is the first year where direct information from CWT sampling is available for the listed fall chinook. Fingerling releases from the Lyons Ferry hatchery are used as the indicator stock for listed fall chinook. Releases began with the 1984 brood year. The 1984 brood was first present in the fisheries as 4-year-old fish in 1988. All age classes, including 5-year-old fish were first present in the fishery beginning in 1989.

The base period analysis of the PFMC ocean fisheries on listed fall chinook salmon has been conducted in the past using the PFMC chinook model. For a more detailed discussion of the model and its application for the base period analysis see the Appendix A in the PFMC Preseason Report III for 1995 (PFMC 1995) or the 1993 biological opinion regarding ocean and fall season inriver fisheries (NMFS 1993a).

There are technical complications associated with estimating the exploitation rate of listed fall chinook, particularly when combining impacts from ocean and inriver fisheries (see for example Morishima 1994). The NMFS has previously recommended that a standardized methodology for characterizing harvest impacts be developed. Pending completion of that task, NMFS has used here available information to characterize the magnitude and distribution of harvest mortality. Ocean fishery impacts can be approximated using an age-four, total adult equivalent exploitation rate estimate. Inriver fishery impacts are presented here as a terminal harvest rate (catch/terminal run size) as calculated by the Columbia River Fish Management Plan Technical Advisory Committee (TAC). The ocean and inriver estimates can be combined to approximate the total adult equivalent harvest mortality for each return year.

The age four, total adult equivalent ocean exploitation rate on listed fall chinook averaged 0.43 during the 1988-1993 base period (McIssac 1994). Total ocean harvest mortality was distributed proportionally across the ocean fisheries during the base period as follows (PFMC 1995):

Alaska	12%
Canada	62%
PFMC	26%

The inriver harvest rate of Snake River fall chinook averaged approximately 0.37 during the 1988-1993 base period (TAC 1995). Harvest mortality for ocean and inriver fisheries combined has therefore averaged 0.64 over the base years with 67% of the combined impacts occurring in ocean fisheries and 33% inriver. The PFMC fisheries accounted for 17% of the total harvest mortality.

<u>Calculation Example:</u>

Ocean Abundance:	1,000
Ocean Catch (43%):	430
Terminal Run:	570
River Catch (37%):	211
Total Catch:	641
Harvest Mortality:	64%

D. Cumulative Effects

Cumulative effects are defined in 50 CFR 402.02 as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." No such effects are anticipated. For purposes of this analysis, the action area includes ocean fishing areas off the coast of Washington, Oregon and California. The PFMC regulates fishing in the area outside of the three mile limit while the states have jurisdiction over fisheries inside the three mile limit and in estuary and freshwater areas. However, PFMC and state fisheries are analyzed jointly during the PFMC preseason planning process to ensure that all impacts are considered and implemented through coordinated regulations. Groundfish fisheries in the PFMC and NPFMC areas were considered in previous biological opinions (NMFS 1992a, NMFS 1994a). Ocean fisheries to the north of the U.S./Canada border will be considered during separate section 7 consultation processes. Fall season fisheries in the Columbia River managed under the CRFMP will also be subject to consultation in the near future. These actions are not considered cumulative to the proposed action.

E. Critical Habitat Impacts

The designated critical habitat of listed Snake River salmon does not include the open ocean where PFMC fisheries occur. As a result, PFMC fisheries are not likely to adversely affect the critical habitat of listed salmon from the Snake River. Consideration of critical habitat impacts for PFMC fisheries will therefore not affect the conclusions regarding the jeopardy analysis.

F. Consistency of Proposed Action with Proposed Recovery Plan

1. Snake River Sockeye Salmon

The available information suggests that Snake River sockeye salmon are not adversely affected by ocean fisheries. The Proposed Recovery Plan therefore concluded that management constraints in ocean fisheries for the protection of listed sockeye salmon were unnecessary.

2. Snake River Spring/Summer Chinook Salmon

The available information suggests that the impacts to listed spring/summer chinook from ocean fisheries are insignificant. As a result, no management constraints to ocean fisheries for the protection of listed spring/summer chinook were proposed in the Proposed Recovery Plan.

3. Snake River Fall Chinook Salmon

The Proposed Recovery Plan is less specific than it needs to be with respect to the management of ocean fisheries including those of the PFMC. The Proposed Recovery Plan calls for implementation of a management strategy for Pacific Salmon Commission (PSC) fisheries that is responsive to an array of natural-origin chinook stocks and consistent with PSC's stated objective to attain naturally spawning chinook escapement goals by 1998 based on a rebuilding program that was established in 1984. This approach takes a broad view of stock protection and focuses on the coast-wide status of chinook stocks including those from Puget Sound, the Washington and Oregon coasts and the Columbia River (including Snake River stocks), all of which are under review for listing under the ESA.

Given recent information on stock status, it is clear that achieving the rebuilding objectives referenced in alternative 1 above by 1998 is now not likely to occur. Meeting immediate conservation concerns is now the appropriate priority and it will be necessary to achieve rebuilding in the long term. The intent of the first objective articulated in the Proposed Recovery Plan was to encourage implementation of a management strategy by the parties to the PST that is responsive to an array of natural-origin chinooks stocks affected by PST fisheries. The NMFS would consider an agreement among the PST parties regarding fisheries in 1996 and beyond which meets the conservation needs of stocks subject to the rebuilding program to be consistent with the objective of the first alternative.

NMFS has chosen to rely on the PSC rebuilding program as the preferred alternative, because from a practical point of view, it provided the best prospect for achieving the necessary reductions in ocean fisheries. Nearly two-thirds of the ocean harvest impacts on Snake River fall chinook occurred in Canadian fisheries during the base period. As a result, substantial ocean impact reductions which are necessary to protect the listed salmon can be achieved only with the cooperative involvement of Canada. Canada's cooperation can best be achieved by focusing on the general coast-wide status of wild chinook stocks that have been the concern of the bilateral chinook rebuilding program (and a key element of the Pacific Salmon Treaty) since 1985. Given the current status of stocks coast-wide, ocean harvest reductions, accomplished within the context of the bilateral chinook rebuilding program, would achieve the desired benefit of reducing impacts on Snake River fall chinook.

The NMFS has expressed concern about the ability of the PSC to meet its obligations under the Pacific Salmon Treaty to manage chinook fisheries consistent with rebuilding objectives. The PSC has failed since 1993 to reach agreement on management regimes for chinook fisheries. At the time that the Proposed Recovery Plan was being finalized, discussions regarding the 1995 fisheries were ongoing, but at a sensitive stage. There was concern that release of more specific provisions regarding considerations that would be used for consultation in absence of a PSC agreement could compromise the U.S. negotiating position with Canada. The Proposed Recovery Plan refers to the need to resolve issues related to chinook management necessary for the protection of listed fall chinook if an adequate agreement with the PSC is not achieved.

Although additional measures for the management of ocean fisheries are not specified in the Proposed Recovery Plan, a discussion of alternative measures was included in earlier drafts and was described to U.S. fishery managers during the preseason planning processes both within the PSC and PFMC management forums (see for example CTC 1995 and Stelle 1995). Two alternatives to the preferred option of managing within the context of the PSC rebuilding program were described. The first option was to achieve a 30% reduction in the total adult equivalent exploitation rate of Snake River fall chinook relative to the 1988 - 1993 base period for all ocean fisheries combined. This would result in substantially reduced impacts on listed fish and allow U.S. fisheries to benefit from reductions that might be achieved in Canadian fisheries if done outside the PSC context. The second option was to achieve a 50% reduction in the Snake River fall chinook exploitation rate for all U.S. ocean fisheries combined. This option would require the U.S. fisheries to provide the necessary protection for listed fall chinook if reductions in the combined ocean fisheries fail to meet the obligations specified in the other options. This was the least preferred alternative because it reflected a failure to secure adequate reductions in Canadian fisheries where impacts to listed fish are greatest. However, failure to reach agreement with Canada would not diminish the need to reduce harvest impacts to listed fall chinook to the degree possible in those fisheries that are within the jurisdiction of the U.S. NMFS anticipated that fulfillment of any one of the proposed alternatives would be sufficient for consistency with the Proposed Recovery Plan.

The three alternatives for managing ocean fisheries were designed to encourage agreement among PSC managers to manage fisheries to meet conservation and rebuilding objectives of wild chinook stocks coast-wide and thereby achieve reductions in Canadian fisheries that account for nearly two-thirds of ocean harvest impacts. If a suitable agreement is not reached regarding the management of PSC fisheries, ocean fisheries including those under the jurisdiction of the PFMC must be managed to achieve either a 30% reduction in the exploitation rate for Snake River fall chinook for all ocean fisheries combined, or a 50% reduction in the exploitation rate for U.S. ocean fisheries combined.

The NMFS is now in the process of reviewing comments to the Proposed Recovery Plan in preparation for finalizing the plan. However, until alternative criteria are developed, NMFS intends to continue to rely on guidance provided in the Proposed Recovery Plan for evaluating proposed actions. Once the Proposed Recovery Plan is finalized and if the criteria change, the NMFS would, if necessary, reinitiate any affected long-term consultations.

Since 1992 Section 7 consultations regarding impacts of PFMC fisheries to listed Snake River fall chinook have been based on annual regulations rather than the framework plan itself. Because of concerns for both coho and unlisted chinook stocks, PFMC fisheries have been reduced substantially compared to those of recent years and have been sufficient to meet annual consultation objectives for fall chinook. However, because Snake River fall chinook are not included among the stocks in the framework plan with escapement goals or other management objectives, the FMP does not provide specific protection for listed fall chinook. If and when the status of unlisted stocks improves, allowable catch in the PFMC fisheries and other ocean fisheries could increase to the point that the objectives in the Proposed Recovery Plan for reducing the exploitation rate of listed fall chinook fish would not be met. The Pacific ocean salmon FMP is therefore deficient in providing the necessary protection for listed fall chinook and is not consistent with the provisions of the Proposed Recovery Plan.

G. Effects of Proposed Action, Environmental Baseline and any Cumulative Effects, and Measures for Survival and Recovery Specific to Other Life Stages.

NMFS analyzed in the current FCRPS biological opinion (NMFS 1995c) the proposed action under consideration in this biological opinion in the broader context of the environmental baseline and measures for survival and recovery specific to other life stages that are summarized in the Proposed Recovery Plan. NMFS concluded that the biological requirements are likely to be met for both listed sockeye, spring/summer and fall chinook salmon under the reasonable and prudent alternative for the FCRPS and within the broader context of the environmental baseline and actions affecting other life stages. The analysis was consistent with the expectation of long term survival and recovery of the species.

VII. Evaluating the Effects to Sacramento Winter-Run Chinook

A. Biological Requirements

For this consultation, the biological requirements of winter-run chinook can be best described in terms of the population sizes needed to ensure the continued survival and recovery of the population.

Survival Requirements. Over the short-term, the survival of winter-run chinook will largely depend on its ability to retain sufficient abundances that enable the population to persist in the face of random events that could drive it to extinction. Chance events operate at several levels that affect the likelihood of extinction, including demographic, environmental and genetic stochasticities (Shaffer 1981).

When populations become small, there is concern that qualitative changes in population dynamics can take place which make the populations more susceptible to extinction and less able to recover. One example is a decline in the per capita reproductive success at very small population sizes, which is variously known as depensation, an Allee effect, and inverse density dependence. Average productivity may decline due to a skewed sex ratio, and from decreasing spatial and temporal overlap between male and female spawners. Myers et al. (1995) found in a survey of 128 fish stocks of various species that significant depensation occurred in Pacific salmon stocks which had been driven to extremely low levels by fishing and habitat loss. From this survey, Myers et al. (1995) suggested that depensation may occur in salmonids at population abundances of less than 100 females. Such depensatory dynamics in a population, like winter-run chinook, where abundance has been severely reduced may preclude the population from recovering even when mortality is reduced (Neave 1954; Myers et al. 1995).

Environmental stochasticity usually refers to unpredictable events, such as changes in the weather, food supply, and the populations of competitors, predators and parasites. Some of the largest, past examples of recurrent environmental variability include El Niño events and prolonged drought conditions. El Niño events have likely significantly contributed to an order-of-magnitude decline in the winter-run chinook population (such as with the 1981 broodyear). Prolonged drought conditions, combined with inadequate water management, have also resulted in extreme losses of eggs and larvae, resulting in order of magnitude declines in the winter-run chinook population (1976, 1977, 1986, 1987, and 1988 broodyears). The current very small population probably does not have the buffering capacity to withstand another large mortality event, and would be highly susceptible to extinction in the face of the next El Niño or protracted drought conditions.

Winter-run chinook may be particularly vulnerable to environmental stochasticities because of its narrow age composition. Winter-run chinook return to spawn primarily as three-year olds with few four-year old spawners (Hallock and Fisher 1985), such that the population is very dependent upon this one dominant age-group (Botsford and Brittnacher 1995). This concentration of spawning at age three likely leads to higher interannual fluctuations in abundance, and greater risk to the loss of a brood-cycle. In the event that a environmental stochasticity eliminated or severely reduced a single year-class, the winter-run population would have only a few four-year old spawners to contribute towards rebuilding a severely depleted year-class. In contrast, a chinook population with a broader composition of age-classes would have a larger portion of four- and five-year olds, or three-and five-year olds, to contribute towards rebuilding a depleted year-class and restoration would likely occur more quickly.

Winter-run chinook is also more susceptible to extinction because the run is limited to a single, isolated, undivided spawning population, and does not have multiple subpopulations. Species composed of many subpopulations are likely more resilient to extinction because reservoir subpopulations can repopulate other depleted subpopulations. The winter-run chinook population, however, is isolated receiving no immigrants from other subpopulations, and therefore, it has a very limited ability to withstand random environmental events.

Genetic risks include the loss of genetic variation in a population, which results in decreased fitness through random genetic drift (Ewens et al. 1987). A population remains viable when it maintains sufficient genetic variation for evolutionary adaptation to a changing environment. The genetically effective population size[1] conveys information about expected rates of inbreeding and genetic drift, which can affect fitness and adaptive potential (Hedrick and Miller 1992).

[1] Genetically effective population size is the functional size of a population, in a genetic sense, based on the numbers of actual breeding individuals and the distribution of offspring among families (Meffe and Carroll 1994).

Several minimum effective population sizes have been proposed as general recommendations for species to maintain population numbers and genetic variation (Franklin 1980; Land and Barrowclough 1987). An effective population size (including males and females) of 50 has been prescribed to prevent inbreeding depression (Franklin 1980), which is viewed as the main threat to short-term survival (Shafer 1987). An effective population size of 500 has been recommended to avoid long-term genetic losses (Franklin 1980; Land and Barrowclough 1987), which is considered the primary threat to the loss of genetic variation essential to continuing adaptation (Shaffer 1987). While these are merely 'rules of thumb' and the necessary sizes will vary from species to species, it has been strongly recommended that effective population sizes of at least hundreds of individuals be maintained to preserve evolutionarily important amounts of genetic variation (Lande and Barrowclough 1987).

NMFS has identified a threshold escapement level of 300 natural spawners annually for larger subpopulations of Snake River spring/summer chinook and for fall chinook (NMFS 1995b). This threshold level represents the escapement at which uncertainties about processes or population enumerations are likely to become significant, and at which qualitative changes in processes are likely to occur (BRWG 1994). That is, if the population drops below the threshold, significantly more uncertain, uncontrollable, irreversible or deleterious effects or processes take hold.

For winter-run chinook, NMFS believes that a somewhat higher threshold escapement level than that of Snake River chinook is appropriate. A higher number is considered necessary due to the unique demographic, biological and genetic characteristics of the winter-run chinook population. As discussed, winter-run chinook have a narrow age structure with most spawning adults returning at age three, few as four-year olds and none as five-year olds. In contrast, Snake River chinook populations return as three, four and five year olds and thus, have a greater overlap between year-classes to help buffer the impact on a single brood-year from a potential large mortality event. Also, winter-run chinook is a single, isolated, undivided population which spawns only in the mainstem Sacramento River, and lacks immigration from any reservoir subpopulations. In contrast, Snake River spring/summer chinook salmon have 39 subpopulations. Snake River fall chinook is somewhat comparable to winter-run chinook having one main spawning population below Hells Canyon Dam, but Snake River fall chinook also spawn in the lower reaches of the Imnaha, Grande Ronde, Clearwater, Salmon and Tucannon rivers. Without the potential reservoir of spawning adults from other tributary streams, winter-run chinook may be less resilient in their ability to withstand a substantial environmental event. Hence, the demographic features of winter-run chinook are considered to make the population particularly vulnerable to the potential environmental stochasticities that could drive the population to extinction.

Also, winter-run chinook have a lower fecundity (average of 3,353 eggs per female) than most other chinook populations, including Sacramento fall-run chinook (average of 5,498 eggs per female) (Fisher 1994), Columbia River chinook (average of 5,032 - 5,453 eggs per female), and other chinook populations from the Klamath River north through Alaska (ranging from 3,634-

10,622 average number of eggs per female but most with an average of 5,000 eggs per female and higher) (Healey and Heard 1984). Winter-run chinook salmon therefore have a lower reproductive potential than most other chinook salmon, and probably are less capable of sustaining a similar mortality level, whether from in-river or ocean conditions.

In addition, consideration of genetic variation is important towards determining an appropriate threshold escapement level for winter-run chinook. An genetically effective population size that is adequate for maintaining evolutionary potential has not been quantitatively determined for winter-run chinook, but the relatively conservative value of 500 is recommended to guard against further loss of genetic variation. To calculate the census population size needed to achieve this effective population size, the effective population size is divided by the ratio of the effective population size to census size (Nb:N). The Nb:N ratio for winter-run chinook has been estimated to range between 0.1 and 0.333 (Hedrick et al. 1995). Also, the effective population size of 500 is the value for the total spawning population, which includes the sum of all three of the main year classes. Accordingly, the census size of the total winter-run chinook spawning population to achieve an effective population size of 500 is estimated to range between 1,515 and 5,000 spawning adults. This equates to an annual escapement between about 500 - 1,660 spawning adults.

Considering these various demographic, biological and genetic features, the provisional threshold escapement for winter-run chinook is no fewer than 500 spawning adults annually. At this level, we anticipate that winter-run chinook will not decline further or drop to zero in the short term while conditions are being changed to recover the population. This threshold level should also avoid any population condition that would make recovery impossible or significantly more difficult to achieve.

Recovery Requirements. Demographic or extinction modeling has been conducted to determine the winter-run chinook population abundance that is needed to ensure a low probability of extinction (Botsford and Brittnacher 1995). The model results suggest that mean annual spawning abundances of 10,000 females over any 13 consecutive years would reduce the probability of the population going extinct within 50 years to less than 0.1. These provisional recommendations are being considered by the Winter-run Chinook Recovery Team as the recovery goal for the winter-run chinook population.

B. Environmental Baseline

The winter-run chinook salmon population has remained very low since the 1989 emergency listing. Escapement has steadily declined from 533 spawning adults in 1989, to 441 and 191 adults in 1990 and 1991, respectively. In 1992, the population rebounded to 1180 adults, but declined again in 1993 and 1994 to 341 and 189, respectively, before rebounding again in 1995 to 1361 adults. Hence, four of the seven year classes since listing were below the threshold escapement level of 500. Also, assuming a 1:1 sex ratio, the 1991 and 1994 year-classes fell below 100 females, the level where depensatory effects may occur.

To evaluate whether these population abundances represent an increasing or decreasing trend, the cohort survival of several year classes can be examined based on the winter-run chinook population's age structure. Winter-run chinook return to spawn primarily as two- and three-year olds (25% return as two-year olds, 67% as three-year olds, and 8% as four year olds) (Hallock and Fisher 1985). To evaluate cohort survival, the proportion of spawning females in the population can be tracked, by assuming that there are sufficient spawning males to fertilize the eggs of all the females. To estimate the proportion of females in the winter-run chinook population, two assumptions are made: 1) the sex ratio is 1:1, and 2) returning two-year olds are all males. Accordingly, the proportion of females returning in the population as two, three, and four-year olds is estimated as 0, 0.89 and 0.11, respectively (while the proportion of males as two, three and four-year olds is 0.50, 0.44 and 0.06, respectively). Thus, the cohort survival of winter-run chinook can be examined by tracking the number of spawning females from a parental cohort that return mainly as three-year olds (89%) plus a small fraction returning as four-year old (11%).

As such, the cohort survival can be represented as a cohort replacement rate (CRR), or the ratio between the number of spawning adults in one generation to the number of spawning adults in the next generation. For the years since listing, approximate calculations of CRR for the 1989, 1990, and 1991 year classes are 2.04, 0.74, and 1.66, respectively (Table 1).[2] The geometric mean of the CRRs for 1989-1991 broodyears is 1.36, suggesting an overall increase in the population since listing. It is important to note that this mean estimate is very uncertain because it is based on only three samples. A CRR cannot be calculated for the 1992 year class until the number of four year olds returning in 1996 is estimated. Considering the broodyears over the past eight years, it appears that the steep downward trend observed in the population before listing may be stabilized.

Table 1. Estimates of winter-run chinook escapement and corresponding cohort replacement rates.

Broodyear	Total Run-size	CRR
1985	3962	0.49
1986	2464	0.21
1987	1997	0.21
1988	2094	0.14
1989	533	2.04
1990	441	0.74
1991	191	1.66

[2] Sample approximate calculation of CRR, assuming age structure in each year is the same:
CRR =(# of 3-year old ♀ in 1994 + # of 4-year old ♀ in 1995) / (Total # of ♀ in 1991)
= [(189)(0.89) + (1361)(0.11)] /(191)
= (84 + 75) / 96
= 1.66.

This increasing trend, however, may be primarily a function of one relatively strong year class, which begins in 1989 (533 adults), increases in 1992 (1180 adults), and continues to increase in 1995 (1361 adults). This one relatively strong year class is probably influencing the apparent trend of a positive population growth rate.

It is also important to evaluate the accuracy in these run estimates. Prior to 1986, the entire winter-run chinook population was monitored during the course of their upmigration past RBDD. Beginning in 1986, the gates at RBDD have been raised for various time periods during their migration to enable freer passage to spawning grounds. Since 1990, the gates have been raised for up to 85% of the winter-run upmigration period, such that about 15% of the run has been monitored rather than the entire run. This monitoring level equates to a sampling precision with a variance of 1.0 (in logarithms), such that the ratio of estimated to actual values varies between 0.36 and 2.72 (±1 standard deviation)(L. Botsford, pers. comm.). For example, the 1994 year class had an escapement estimate of 189 spawning adults, but the accuracy of this estimate is fairly low, such that the actual run-size may have varied between 68 and 514 adults.

The status of the winter-run chinook population can also be evaluated from a genetic perspective. Bounds on the genetically effective population sizes for winter-run chinook have been determined for 1991, 1992, and 1993 year classes with minimum estimates of 21.9, 127.3, and 39.0 and maximum estimates of 61.6, 401.0 and 108.6, respectively (Hedrick et al. 1995). The total effective population size for these three runs is approximated by summing the yearly estimates, such that the minimum estimates of the effective population size is 188.2 and the maximum estimate is 571.2. Both estimates are above the limit of 50 proposed to avoid inbreeding depression, but the minimum estimate is below the limit of 500 recommended to retain long-term adaptive variation. This suggests that the winter-run chinook population may have already been genetically affected by low abundance, which may affect the population’s ability to recover.

Considering these trends and the status of winter-run chinook under the environmental baseline, the likelihood of the survival and recovery of winter-run chinook can be mainly qualitatively assessed. Based on the historical record of CRRs, the probability of winter-run chinook going extinct within 50 years is 1.0, i.e. extinction is imminent (Botsford and Brittnacher 1995). However, since the listing, many important actions have been taken to improve freshwater habitat conditions for winter-run chinook (Table 2). Many of these improvements may have contributed to increased survival and the increasing population trend observed in recent years. Ongoing improvements are expected to further improve survival, but the incremental benefit of these actions is not yet known. Yet, even with these improvements to freshwater habitat, current conditions probably do not represent a healthy environment. Some of the remaining problems include: discharges of heavy metals from the Superfund Iron Mountain Mine site; passage problems at the Anderson-Cottonwood Irrigation District’s dam and the Red Bluff Diversion Dam for portions of the migrant population; entrainment from thousands of unscreened or inadequately screened diversions; poor rearing conditions in the river due to loss of riparian habitat and poor water quality conditions; poor rearing conditions in the Bay-Delta due to water project operations, reduced primary and secondary productivity, and the loss of riparian and wetland habitat. These continuing habitat problems likely limit the population's ability to recover.

To consider extinction risks under the environmental baseline, we also need to evaluate what the population's future status could be without harvest. The returning run-sizes of winter-run chinook cannot be projected for the future under the environmental baseline. However, it is possible to generally comment on the potential for increased escapement without harvest impacts. The anticipated level of harvest impacts in the near future, based on the proposed action, is estimated as a harvest fraction (catch/catch + escapement) of about 0.5 (see Section VII.C.). Without this substantial source of mortality, the likelihood of survival would likely improve substantially for winter-run chinook. In the absence of any harvest, it is expected that the very weak year classes (1993 and 1994) would not immediately increase above the threshold level, but would over the course of up to two generations.

Although escapement is expected to improve under the baseline conditions (i.e. without harvest), the likelihood of survival and recovery is still considered low for two main reasons. One, the two weak year classes are expected to remain critically small for several more generations. While these year classes remain below the threshold level, the potential is higher for uncertain, uncontrollable, irreversible or deleterious effects or processes to occur. Second, until the freshwater and estuarine habitats are improved to a healthy condition, in-river survival of winter-run chinook will be limited, and the likelihood of recovery will be tenuous.

Table 2. Actions taken to improve freshwater habitat for winter-run chinook salmon; the year that these actions were implemented and should have improved survival during spawning and rearing; and the year that those actions are expected to contribute to increasing escapement.

Freshwater Habitat Improvements	Actions and/or Benefits	Implement. Year	Year of expected benefit to escapement
Water temperature in the upper Sacramento River improved	• 92-96% survival of eggs • 70-80% survival of eggs • 90-95% survival of eggs • 90% survival of eggs • >99% survival of eggs	•1989 •1990 •1991 •1992 •1993	•1992 •1993 •1994 •1995 •1996+
Iron Mountain Mine water quality problems reduced	• Emergency treatment plant-- reduced spills' toxicity • Upper Spring Creek diversion-- reduced spills' toxicity & duration • Full-scale treatment plant -- reduced spills' toxicity & duration	•1988-1994 •Jan 1991 •Oct 1994	•1991-1997 •1993 •1998

Red Bluff Diversion Dam - fish passage improved	• Dec-Apr gates up • Dec-May gates up • Nov-May gates up • Sep-May gates up	•1989 •1990 •1991-1992 •1993-pres.	•1992 •1993 •1994-1995 •1996+
Ramping flows from Keswick Dam	• Reduced stranding and dewatering	•1993-pres.	•1996+
ACID diversion	• Screening	•1993	•1996+
GCID operations	• Improved hydraulic conditions for fish passage	•1992	•1995+
Delta pumping operations improved[3]	• DCC gates closed • DCC gates closed & QWEST improved • DCC gates closed & export/inflow ratios	•1992 •1993-1994 •1995-pres.	•1995 •1996-1997 •1998+

C. Effects of the Proposed Action

The NMFS proposes to continue implementation of the FMP, as constrained by the 1991 Winter-run Chinook Biological Opinion on Pacific Salmon Ocean Harvest (NMFS 1991). The FMP seeks to achieve specific spawning escapement goals for Central Valley fall-run chinook and Klamath-Trinity river fall-run chinook. The FMP has not established a management goal for winter-run chinook, and therefore, does not directly require that this listed stock be considered in determining maximum fishing rates. The indicator stock for the Central Valley is the Sacramento River fall-run chinook, for which the FMP specifies a spawning escapement goal of between 122,000 and 180,000 combined hatchery and natural adults.

The method used to project annual escapement of Central Valley fall-run chinook has been the Central Valley Index (CVI), which is the annual ocean fishery landings south of Point Arena plus the spawning escapement of adult Central Valley stocks in the same year. Harvest impact on Central Valley stocks is estimated by the Central Valley ocean exploitation index which is the landings south of Point Arena divided by the CVI. The CVI and the ocean exploitation index are recognized as only crude approximations of actual abundance and harvest (NMFS 1996). A considerable level of uncertainty is also associated with pre-season estimates of the CVI and the CV ocean exploitation index (NMFS 1996a).

[3] Delta Cross Channel (DCC) gates are closed to reduce the diversion of juvenile winter-run chinook into the Central Delta (NMFS 1993, State Water Resources Control Board 1995); QWEST refers to the reduction and elimination of reverse flows in the western San Joaquin River (NMFS 1993); export/inflow ratios refers to water export restrictions developed through the Principles for Agreement on Bay-Delta Standards between the State of California and the Federal Government (State Water Resources Control Board 1995).

The 1991 Harvest Biological Opinion concluded that the ocean salmon fishery would not jeopardize winter-run chinook at the impact level observed in the 1990 fisheries, and recommended that management measures be refined to continue to reduce harvest rates. Since different chinook stocks cannot be distinguished in the ocean, it is not possible to directly measure harvest rates specifically on wild winter-run chinook population. The CV ocean exploitation index has been the best and only available tool for estimating relative impacts on winter-run chinook. Accordingly, the primary constraint on the ocean salmon fishery for the protection of winter-run chinook has been to cap the CV ocean exploitation index at the 1990 fisheries level (0.79). In addition, the Incidental Take Statement required that: 1) the ocean recreational fishing season south of Point Arena be reduced by two weeks at the beginning and the end of the normal fishing season, and 2) the commercial fishery not be opened until May 1st.

The recent recoveries of coded-wire tagged (CWT) fish in the ocean and river have provided data to reexamine the impact of ocean harvest on winter-run chinook. The CWT data indicate that the harvest fraction (catch/catch + escapement ratio) on winter-run chinook was 0.54 for the broodyear 1992 (NMFS 1996). The NMFS Biological Assessment indicates that this harvest fraction was estimated based on relatively limited data due to the small size of the juvenile release group. Nonetheless, the recovery of tagged winter-run chinook both verifies the incidence of harvest and provides a rough approximation of present ocean impacts.

The estimated harvest fraction from the 1992 broodyear compares well to previous harvest estimates from an earlier fin-clip marking study (Hallock and Reisenbichler 1980). This study estimated harvest fractions of 0.47 and 0.56 for the 1969 and 1970 broodyears, respectively (NMFS 1996). Thus, the harvest fraction estimate from the recent CWT data are consistent and within the range of estimates based on the earlier fin clip data. This suggests that the present incidental harvest impact on winter-run chinook has not changed from catch levels 20 years ago, and that contrary to expectations, incidental harvest impacts were not reduced by restrictions imposed by the 1991 Biological Opinion on ocean harvest.

The assessment in the 1991 Biological Opinion determined that harvest levels were acceptable because they were below levels sustained by other chinook stocks, namely California Central Valley chinook salmon south of Point Arena and Washington State chinook fisheries (NMFS 1991). However, since the 1991 opinion was issued, the winter-run chinook population has shown critically low spawning abundances and correspondingly, has changed in its listing status from threatened to endangered. Hence, it is necessary to reassess whether a harvest fraction in the range of 0.5 is acceptable for the winter-run chinook population at its present level.

The abundance data indicate that the present winter-run chinook population is critically low, but due to one relatively strong year class, the population appears to be growing. Can this very small but growing population sustain a 0.5 harvest fraction without being significantly impaired in its ability to recover and without substantial risk of extinction? There are several possible approaches to examining this question: one is assessing whether these harvest levels are at a sustainable level, and another is examining the risks of extinction to the population.

Sustainable Harvest Levels
Put simply, a population is harvested at a sustainable level when fish are not harvested at a rate faster than they can be replaced in the population through reproduction. That is, the natural and harvest losses in a population are balanced by recruitment. Since data are so sparse on spawner-recruit relations of winter-run chinook, it is difficult to explicitly evaluate whether this balance is being achieved. However, Riesenbichler (1987) determined that harvest fraction goals (catch/catch + escapement) of 0.60-0.70 result in maximum recruitment for the sustainable harvest of chinook salmon stocks that have an α (the productivity parameter for the Ricker model) of 7-9 and unknown spawner-recruit relations. Riesenbichler's drew these conclusions by evaluating chinook salmon stocks from British Columbia to northern California, including Central Valley fall-run chinook salmon. Thus, the winter-run chinook's harvest fraction of 0.5 is below Reisenbichler's suggested goal for sustainable harvest on chinook salmon.

However, the productivity parameter for winter-run chinook, although not known, is likely below an α of 7 for three reasons.[4] First, the fecundity of winter-run chinook is lower than most other chinook salmon populations, including Sacramento fall chinook and chinook populations from Klamath River north through Alaska (Fisher, pers. comm.; Fisher 1994; Healey and Heard 1984). Second, freshwater survival in the winter-run chinook population although improved is still considered low, and further habitat improvements are needed to attain a healthy, productive spawning and rearing environment. Lastly, several year classes of winter-run chinook have fallen below 100 females, which is the suggested level at which depensation occurs (Myers et al. 1995).

If winter-run chinook are less productive than other chinook salmon stocks, they are less resilient to the suggested harvest-fraction goals of 0.60-0.70. If the α for winter-run chinook is sufficiently low (below 7), then the maximum recruitment level for sustainable harvest of winter-run chinook may be below the 0.5 harvest fraction, suggesting overexploitation at the present harvest level.

Extinction Risks
Another way to examine the impact of the 0.5 harvest-fraction is asking whether the population can sustain this continued level of harvest with an acceptably low risk of extinction. At the presently small population sizes, this seems highly unlikely.

The risks of extinction to the winter-run population become evident upon examining the three main year classes which presently make up the population. Escapements in the 1993 and 1994 year classes (341 and 189, respectively) were both below the threshold escapement level of 500. With a continued harvest fraction of 0.5, these two year classes are expected to remain below the threshold level for up to six more generations (about 18 years), assuming the same population

[4]The productivity parameter is essentially the eggs per spawner multiplied by the survival rate through all life stages where there is no density-dependent effect (Hilborn and Walters 1992)

growth rate observed since listing (1989). If by chance, the one relatively strong 1995 year class experiences some large source of mortality, all three year classes would become depressed. Under these circumstances, the entire spawning population could be vulnerable to depensatory and deleterious genetic effects, placing the population at substantial risk of extinction.

Since ocean harvest is removing an estimated 0.5 fraction of the population in the ocean, harvest is limiting population growth and thereby, impeding recovery--but to what extent? The effects of harvest on population growth and recovery can be illustrated by comparing the relative increases in escapement and population growth expected with reductions in the fishery.

Using the California Department of Fish and Game's (CDFG) Winter-run Chinook Ocean Salmon Harvest Model, we can evaluate the incremental increases to escapement as incidental harvest impacts are reduced (CDFG 1989). The CDFG ocean harvest model was developed as a tool for evaluating the impacts of ocean fishery regulation options on the winter-run chinook salmon and the ocean salmon fisheries in general. This model is best used for comparing the relative impacts of regulation options rather than actual impacts, because of the difficulty in projecting ocean abundance of California chinook salmon stocks (CDFG 1989). The input variables to the model include: ocean natural mortality, which is applied on all age classes and between fishing seasons; shaker mortality; initial stock sizes; minimum size limits; effort response; and fishing contact rates. Assuming a 20% natural mortality rate which is the generally accepted natural mortality rate for salmon (A. Baracco, pers. comm.), the model predicts that eliminating harvest impacts would increase escapement by 84% (Table 3). A 70%, 50% and 30% reduction in incidental harvest of winter-run chinook would increase escapement by 52%, 35%, and 19%, respectively, again assuming a 20% natural mortality rate.

We can also examine how these predicted escapement levels may vary with different ocean conditions, by assuming low and high natural mortality levels in the model (Table 3). Assuming relatively low natural mortality in the ocean, the model predicts that elimination harvest impacts would increase escapement by 103%, while a 50% reduction in harvest would increase escapement by 41%. Conversely, by assuming a relatively high natural mortality, the model predicts that eliminating harvest impacts would increase spawner escapement by 48%, and a 50% reduction in harvest would increase escapement by 22%.

Table 3. Projected increases in escapement of winter-run chinook at various levels of harvest reduction (horizontal axis), and at three levels of natural mortality (low, moderate, and high, on vertical axis), as modeled by the Winter-run Chinook Salmon Ocean Harvest Model (CDFG 1989, A. Baracco, pers. comm.). Reduction in model cells applied equally throughout the recreational and commercial fishing season.

	Reduction in Harvest from base period					
		10%	**30%**	**50%**	**70%**	**100%**
Annual Natural Mortality	**5%**	7%	22%	41%	63%	103%
	20%	6%	19%	35%	52%	84%
	50%	4%	13%	22%	32%	48%

The effects of harvest on population growth can be also examined by evaluating the changes in CRR that could have occurred if the incidental impacts of the fishery had been reduced in the 1989 - 1991 broodyears. Estimates of these changes are presented in Table 4, which were calculated: 1) by using the projected escapement increases modeled by the CDFG Winter-run Chinook Ocean Salmon Harvest Model (Table 3), and 2) by using the observed escapement estimates from 1989 to 1995.

Based on this evaluation, the estimate of CRR suggests that the population would have grown substantially faster by eliminating harvest impacts, specifically from the observed geometric mean CRR of 1.36 to a predicted CRR of 2.50 (Table 4). With a 50% reduction in harvest impacts, the population would have grown somewhat slower but still reasonably fast, at an estimated geometric mean CRR of 1.83. A 30% reduction in harvest also suggests a relatively high population growth rate, with an estimated geometric mean CRR of 1.63. Considering the variability in the data, however, estimates of population growth with a 30% harvest reduction do not indicate a growing population throughout the distribution of the means (CRR at one standard deviation below the mean is less than one).

These predictions are based on limited data, and should only be considered as relative measures of potential population growth as harvest is reduced. Nonetheless, they suggest that incidental harvest impacts are substantially limiting population growth rate, and thus impeding winter-run chinook from rapidly growing to an abundance level where it would be buffered against harmful chance events that could drive it to extinction.

Table 4. The geometric mean and standard deviations for the cohort replacement rate (CRR) for the broodyears 1989 to 1991 (n=3), including: observed estimates, predicted estimates with thirty, fifty and seventy percent reductions in incidental harvest, and predicted estimates in the absence of harvest impacts. A 20% annual natural mortality rate in the ocean is assumed.

Measures of Population Growth	n	Geometric Mean	One Standard Deviation Below Mean	One Standard Deviation Above Mean
Observed CRR:	3	1.36	0.79	2.33
CRR with 30% less harvest:	3	1.63	0.95	2.79
CRR with 50% less harvest:	3	1.83	1.07	3.14
CRR with 70% less harvest:	3	2.06	1.20	3.54
CRR without harvest:	3	2.50	1.46	4.29

D. 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). For the purposes of this analysis, the action area includes ocean fishing areas mainly off the coast of California. The production of salmon by California State hatcheries will likely continue and has the potential to add cumulative impacts on winter-run chinook in the ocean, through competition and predation. State hatchery salmon production may also influence harvest rates in the ocean through increasing salmon abundance above natural salmon abundance. At this time, the extent of cumulative impacts from State hatcheries’ salmon production is not known, but further evaluation is warranted.

E. Critical Habitat Impacts

The designated critical habitat of Sacramento River winter-run chinook does not include the open ocean where PFMC fisheries occur. As a result, PFMC fisheries are not likely to adversely affect the critical habitat of winter-run chinook. Consideration of critical habitat impacts for PFMC fisheries will therefore not affect the conclusions regarding the jeopardy analysis.

VIII. Conclusion

The expected impacts to listed Pacific salmonids from NMFS' proposal to continue implementation of the existing ocean salmon FMP, are listed below:

A. Snake River Sockeye Salmon

Available information indicates that it is highly unlikely that any Snake River sockeye salmon will be taken as a result of the PFMC fisheries. The Proposed Recovery Plan concluded that management constraints in ocean fisheries for the protection of listed sockeye salmon were unnecessary.

No cumulative effects are anticipated as a result of the action considered here. The activities considered in this consultation will not result in the destruction or adverse modification of any of the essential features of the critical habitat.

NMFS has determined, based on the available information, that the PFMC fisheries are not likely to jeopardize the continued existence of Snake River sockeye salmon or result in the destruction or adverse modification of critical habitat.

B. Snake River Spring/Summer Chinook Salmon

Snake River spring/summer chinook salmon may, on occasion, be caught in PFMC ocean salmon fisheries. However, the available information suggests that the overall ocean exploitation rate is less than 1 percent and that it is unlikely that the PFMC fisheries significantly impact Snake River spring/summer chinook salmon. No additional constraints to ocean fisheries for the protection of listed spring/summer chinook were included in the Proposed Recovery Plan.

No cumulative effects are anticipated as a result of the action considered here. The activities considered in this consultation will not result in the destruction or adverse modification of any of the essential features of the critical habitat.

NMFS has determined, based on the available information, that the PFMC fisheries are not likely to jeopardize the continued existence of Snake River spring/summer chinook salmon or result in the destruction or adverse modification of critical habitat.

C. Snake River Fall Chinook Salmon

Although this consultation considers directly only the proposed PFMC fisheries, significant improvements regarding survival and recovery will be achieved only through long term modification of all actions that affect listed fall chinook salmon. The Proposed Recovery Plan specifies levels of harvest for ocean and in-river fisheries that are to be implemented through 1998 and then be reviewed and revised if necessary based on the best available information at that time. The NMFS considers that the combined impact of the fisheries as specified in the Proposed Recovery Plan, when taken in the broader context of the environmental baseline and measures taken that affect other life stages, is consistent with long term survival and recovery of the species (see section VI-G).

The prospects for recovery are maximized by eliminating all sources of mortality. However, there are practical constraints to eliminating all human-induced mortality and appropriate considerations for what may be a reasonable allowance for mortality. NMFS has analyzed the available information on the biological requirements of listed Snake River salmon. This analysis included consideration of genetic risks, potential environmental fluctuations, life history characteristics, and other impacts to listed Snake River salmon. Based on this information, NMFS developed a management regime and adaptive review program that NMFS believes is consistent with the expectation for survival and recovery of the species. NMFS believes that a harvest management system for ocean fisheries, including those of the PFMC, that emphasizes weak stock recovery requirements is a necessary component of a comprehensive program designed to ensure the long-term survival and recovery of listed species.

No cumulative effects are anticipated as a result of the action considered here. The activities considered in this consultation will not result in the destruction or adverse modification of any of the essential features of the critical habitat.

Exploitation rates to listed fall chinook have been reduced substantially in recent years because of constraints related to coho and unlisted chinook stocks. For example, it was estimated that the base period exploitation rate in PFMC fisheries would be reduced by 65% in 1995 (NMFS 1995d). The estimates of exploitation rate reductions in ocean fisheries combined for 1995 ranged from 37% -46% (NMFS 1995e), which was sufficient to meet the second of three alternatives for evaluating ocean fisheries (i.e. 30% reduction in the exploitation rate relative to the 1988-1993 base period).

NMFS, in an effort to maximize the efficiency of fishery management and the consultation process, is extending the scope and duration of its consultations where possible. To this end NMFS has here consulted on the framework FMP rather than the annual regulations implemented under the FMP as was done in recent years. Reductions in harvest in recent years have been sufficient to provide the necessary protection to listed fall chinook even though those restriction have resulted from management considerations for other species or stocks. However, NMFS has determined, based on the available information, that the PFMC salmon fisheries managed under the FMP would not in all cases provide necessary protection for listed Snake River fall chinook by ensuring a reduced exploitation rate and therefore are likely to jeopardize the continued existence of Snake River fall chinook salmon. Fisheries allowed under the FMP are not likely to result in the destruction or adverse modification of critical habitat.

D. Sacramento River Winter-Run Chinook Salmon

Although harvest was not identified as a factor causing the decline of the population upon listing, the incidental harvest of winter-run chinook salmon as evidenced by recent CWT recoveries represents a significant source of mortality to the endangered population. NMFS concludes that incidental harvest impacts contribute substantially to restraining the population at very low abundances and limiting population growth, such that the risks of extinction are high from environmental, demographic and genetic stochasticities. This is particularly evident upon examination of the population, which is composed of two weak year classes and one strong year class. If an extreme environmental event occurred resulting in severe losses to the one relatively strong year class, extinction would likely be imminent. Moreover, harvest on the weak year classes is contributing to the risk of depensatory and deleterious genetic effects, which may also undermine the population's ability to recover. Thus, mortality originating from incidental harvest can reasonably be considered a significant impairment to recovery efforts, and therefore, incidental harvest impacts are likely to jeopardize the continued existence of the winter-run chinook salmon.

In addition, the FMP does not specifically require consideration of the winter-run chinook population when setting maximum fishing rates for a mixed-stock fishery. NMFS considers this an important deficiency in the FMP, which may result in inadequate consideration of protecting winter-run chinook salmon.

Thus, based on an assessment of the effects of the proposed action, NMFS concludes that the continued implementation of the FMP, as constrained by the 1991 Winter-run Chinook Biological Opinion on Pacific Salmon Ocean Harvest, is likely to jeopardize the continued existence of winter-run chinook salmon. The FMP, however, is not likely to result in the destruction or adverse modification of critical habitat.

IX. Reasonable and Prudent Alternative

The regulations implementing section 7 of the ESA (50 CFR 402.02) define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that (1) can be implemented in a manner consistent with the intended purpose of the action, (2) can be implemented consistent with the scope of the action agency's legal authority, (3) are economically and technologically feasible, and (4) would, NMFS believes, avoid the likelihood of jeopardizing the continued existence of listed species and avert the destruction or adverse modification of critical habitat.

NMFS has developed a three part alternative to the proposed action. When taken together as an integrated action, the following Reasonable and Prudent Alternative is not likely to jeopardize listed species. Part 2 of the RPA requires the PFMC to develop management measures for 1996 to implement the ocean harvest objective of NMFS' Proposed Recovery Plan for Snake River fall chinook. Part 3 of the RPA requires the PFMC to reduce incidental harvest of winter-run chinook by a minimum of 50% through its 1996 management measures. Part 1 of the RPA requires the PFMC to develop an amendment to the FMP to address the need for weak stock management and the long term recovery needs of listed species. Taken as a whole, NMFS believes the RPA is not likely to jeopardize the continued existence of winter run chinook, Snake river fall chinook and will assist the recovery of other listed species.

1. The Council must adopt an amendment to the FMP by October of 1996 and NMFS must implement the amendment by May of 1997 to include management objectives for species, that are currently listed under the ESA, that are consistent with immediate conservation needs and the long term recovery of listed species.

In amending the FMP, NMFS and the Council shall include as a requirement that Council fisheries be managed consistent with NMFS proposed or final recovery plan objectives or interim consultation standards, and with the threshold escapement levels identified for listed salmonid stocks. NMFS shall reiterate objectives from current recovery plans or provide interim consultation standards for each listed species to the Council each year prior to the March Council meeting. NMFS shall also ensure that the guidance provided to the Council is consistent with a conclusion of ‘no jeopardy’ for each species. NMFS encourages the PFMC to develop an amendment capable of addressing the needs of stocks that may be listed in the future.

2. Pending implementation of an amendment, NMFS and the PFMC shall manage the ocean salmon fisheries within the jurisdiction of the PFMC to ensure compliance with the ocean management provisions for Snake River fall chinook that were articulated in the Proposed Recovery Plan and during the 1995 consultation process or alternative provisions that may be developed and incorporated in the final Recovery Plan.

Three alternatives have been specified that will be used to evaluate whether ocean salmon fisheries would likely jeopardize Snake River fall chinook. The no-jeopardy alternatives include: 1) implementing a management strategy for PST fisheries that is responsive to an array of natural-origin chinook stocks and is consistent with the Pacific Salmon Commission's stated objective to attain (by 1998) naturally spawning chinook escapement goals based on a rebuilding program that was adopted in 1984; 2) achieving a 30% reduction in the total-adult equivalent exploitation rate of Snake River fall chinook relative to the 1988 - 1993 base period for all ocean fisheries combined; and 3) achieving a 50% reduction in the total adult equivalent exploitation rate of Snake River fall chinook relative to the 1988 - 1993 base period for U.S. ocean fisheries combined. Given the recent information on stock status, NMFS would consider an agreement among the PST parties regarding future fisheries which meets the conservation needs of stocks subject to the rebuilding program to be consistent with the objective of the first alternative (see Section VI.F.). In the event that a PSC agreement is reached, PFMC would be required to meet either the second or third alternative specified above or achieve a 50% reduction relative to the 1988-1993 base period exploitation rate for PFMC Fisheries (see Section VI.G.)

Existing provisions for managing ocean salmon fishery impacts to listed fall chinook may be revised during the process of finalizing the Proposed Recovery Plan. If not, the Proposed Plan recommends that harvest provisions for fall chinook be reviewed and revised if appropriate based on available information after 1998. If and when the management standards are revised, the PFMC shall manage their fisheries consistent with provisions of the Final Recovery Plan, or any subsequent revisions as specified in the first Reasonable and Prudent Alternative.

3. Pending completion of the FMP amendment, NMFS must reduce the incidental harvest of winter-run chinook by a minimum of 50% from the estimated current level of 0.50.

The available data indicate that the incidental harvest fraction of winter-run chinook was 0.54 for the 1992 brood year, which is consistent with the previous estimates of 0.47 and 0.56 for the 1969 and 1970 brood years. Thus, the current level of incidental harvest of winter-run chinook is estimated to be about a 0.5 harvest fraction. This represents the total harvest impact on winter-run chinook because in-river harvest was eliminated in 1990.

NMFS considers a substantial reduction in ocean harvest impacts necessary to increase escapement to levels which will ensure that the two (1993 and 1994) weak year classes of winter-run chinook salmon increase above the threshold escapement level, and that the population exhibits continued growth towards recovery. The benefits of reducing harvest can be evaluated by examining increases in escapement predicted to occur at various levels of harvest reduction. Analysis of the best available data, which is limited (see Section VII.C.), leads NMFS to conclude that escapement could be increased substantially (84%) by eliminating the incidental harvest of winter-run chinook. The available information also suggests that harvest rate reductions ranging from 30-50% below current levels could also result in substantial increases in escapement (19-35%). Considering the biological requirements and current status of the winter-run chinook salmon population, including the genetic risks to the population given the two weak year classes, potential environmental fluctuations, and the life history characteristics of the population, NMFS believes that escapement levels which are increased by at least 35% above current levels should not prohibit or significantly impede the recovery of the population. NMFS believes that increasing escapement levels by at least 35% will substantially contribute both to reducing the risks of extinction and to allowing the recovery of winter-run chinook.

NMFS acknowledges that these projections are based on limited data and assumptions, and that the population may grow faster or slower depending on future in-river and ocean survival conditions. However, these projections provide a means to evaluate the relative benefits of decreasing harvest impacts from current levels. With respect to the ocean fisheries, a complete closure of the chinook fisheries in the winter-run chinook range would be the strongest possible measure that could be taken to increase escapement most rapidly above threshold levels, and to allow winter-run chinook the opportunity to further recover to healthy population levels. However, based on the best available data, and given the variance in population growth estimates with different harvest reduction levels, NMFS believes that a 50% harvest reduction will increase escapement sufficiently to allow the two weak winter-run chinook year classes to increase above the threshold escapement level, and also allow the population to grow towards recovery. Achieving this reduction is expected to reduce fishing in certain components of the fishery, but NMFS has concluded this result is still consistent with the basic purposes of the Salmon FMP. At harvest reduction level of less than 50%, where impacts on the salmon fisheries would be less substantial, NMFS is less confident that sufficient population growth will occur, and therefore, believes that incidental harvest would continue to jeopardize the continued existence of winter-run chinook salmon.

Therefore, NMFS has concluded that a 50% reduction in the incidental harvest from current levels will reduce harvest impacts to a level that is not likely to jeopardize the continued existence of winter-run chinook salmon. This 50% reduction in ocean fishery impacts on winter-run chinook is expected to decrease the harvest fraction to approximately 0.25 and increase escapement by 35% from current levels. As monitoring of incidental harvest and escapement continues, new information may become available which better defines harvest impacts and its relationship to escapement, and allows for additional analyses of needed protection measures. As such information develops, NMFS should further evaluate harvest impacts and consider adjusting harvest constraints.

NMFS acknowledges that a direct measure of winter-run chinook ocean harvest impacts does not exist. NMFS should encourage the PFMC to develop management measures which selectively reduce incidental harvest impacts on winter-run chinook relative to other chinook stocks. If, however, such measures have either no demonstrable selective benefit to winter chinook or are unenforceable over large sectors of the fishery, NMFS may decide that the Central Valley ocean exploitation index provides the best and only available tool to measure relative reductions in harvest impacts to winter-run chinook.

If the Central Valley ocean exploitation index is chosen as a relative measure of winter-run chinook harvest impacts, an appropriate base period must be determined. A direct calculation of harvest rate based on CWT returns is possible only for the 1992 brood year, for which ocean recoveries would be expected in the 1994 and 1995 fisheries. An average of the Central Valley ocean exploitation index for those two years, 0.76, could be used as a base line from which to make reductions. Alternatively, a base period could be determined from a longer time frame of recent Central Valley ocean exploitation indices. The Salmon Technical Team has adopted a time frame of 1986 to the present for developing their annual Central Valley exploitation index projections. Ocean fishing patterns have been relatively stable during this time and notably different from patterns prior to 1986. This time frame is representative of present fishing conditions and an average of 1986 to 1995 indices, 0.74, could be used as a base line from which to adjust the Central Valley exploitation index to meet winter-run chinook harvest reductions. Although either of the above alternatives are reasonable methods for determining a base period, NMFS believes that the use of the two year period, for which winter chinook CWT data exist, is the more appropriate method to calculate a Central Valley ocean exploitation index base period, should that be necessary.

X. Incidental Take Statement

Section 9 and regulations implementing Section 4 of the ESA prohibit any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species without a specific permit or exemption. When a proposed Federal action is found to be consistent with Section 7(a)(2) of the ESA and that action may incidentally take individuals of listed species, NMFS will issue an incidental take statement specifying the impact of any incidental taking of endangered or threatened species.

The incidental take statement also provides reasonable and prudent measures that are necessary to minimize impacts, and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures. Incidental takings resulting from the agency action, including incidental takings caused by activities authorized by the agency, are exempted from the taking prohibition by section 7(o) of the ESA, but only if those takings are in compliance with the specified terms and conditions.

A. Amount or Extent of Take

1. Snake River Sockeye Salmon

No Snake River sockeye salmon are expected to be taken as a result of the 1995 PFMC fisheries.

2. Snake River Spring/Summer Chinook Salmon

Timing considerations suggest that mature spring chinook have largely exited the ocean prior to the start of fishing. Given the timing consideration, the summer component of the species are potentially susceptible to the PFMC area fishery, but the available CWT and GSI data and consideration of relative abundance suggest that impact on the population will be quite small. The number of listed spring/summer chinook salmon that may be taken in PFMC area fisheries cannot be determined, but is expected to be low. Any catch that may occur will be limited specifically by the measures proposed by PFMC to control the total catch of chinook salmon in the ocean fisheries including quotas and other time, area, gear and catch limitations measures that are implemented as part of the package of annual regulations.

3. Snake River Fall Chinook Salmon

Information on the distribution of Snake River fall chinook from the CWT data indicates that they are caught in PFMC area fisheries. Because the ocean abundance is not known, the number of listed fall chinook caught incidentally in PFMC area fisheries cannot be estimated with any certainty. The anticipated catch of listed fall chinook in 1996 and beyond will vary depending on the abundance of listed fish and annual regulations that are implemented. Because of the uncertainties in estimating the actual catch of listed fish in 1996 and beyond, harvest impacts have been evaluated for purposes of consultation largely in terms of relative changes in exploitation rate. NMFS authorizes a level of take consistent with the terms specified in the Reasonable and Prudent Alternatives.

4. Sacramento River Winter-Run Chinook Salmon

The proposed FMP, as modified by the reasonable and prudent alternative, is expected to result in the incidental take of winter-run chinook. However, the magnitude of the take associated with incidental ocean harvest cannot be easily quantified due to 1) an inability to distinguish winter-run chinook from the other runs in the ocean, 2) unknown ocean abundances of winter-run chinook, and 3) uncertainties in future monitoring through CWT recoveries. Therefore, NMFS estimates a level of take associated with the FMP, as modified by the reasonable and prudent alternative, in terms of reductions in the incidental ocean harvest on winter-run chinook, as described in the reasonable and prudent alternative. If takings of winter-run chinook salmon exceed the level described in the reasonable and prudent alternative, NMFS must reinitiate consultation.

B. Reasonable and Prudent Measures

NMFS believes that the following reasonable and prudent measures are necessary and appropriate to minimize the impact from incidental ocean harvest as proposed in the FMP on Snake River sockeye salmon, Snake River spring/summer chinook salmon, Snake River fall chinook salmon, and Sacramento River winter-run chinook salmon: 1) in-season management actions taken during the course of the fisheries shall be consistent with the harvest objectives established preseason that were subject to review for consistency in this biological opinion, and 2) incidental harvest impacts of listed salmon stocks shall be monitored using best available measures.

C. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, NMFS 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 shall confer with the affected states and PFMC chair to ensure that in-season management actions taken during the course of the fisheries are consistent with the harvest objectives established preseason.**

2. NMFS in cooperation with the affected states and PFMC chair shall monitor the catch and implementation of other management measures at levels that are comparable to those used in recent years. The monitoring is to ensure full implementation and compliance of management actions specified to control the various ocean fisheries.

3. NMFS in cooperation with the affected states and PFMC chair shall sample the fisheries for stock composition including the collection of CWTs in all fisheries and other biological information to allow for a thorough post-season analysis of fishery impacts on listed species.

For Sacramento River winter-run chinook, monitoring of harvest through CWT recoveries may be possible for the 1996 and 1997 ocean salmon fishery. However, a portion of these CWT recoveries may be invalid due to the potential hybridization of winter-run chinook with spring-run chinook in the 1993 to 1995 broodyears. Beyond 1997, CWT recoveries cannot be positively relied upon to monitor harvest due to the current difficulties with the artificial propagation of winter-run chinook.

4. NMFS in cooperation with the State of California and the U.S. Fish and Wildlife Service shall ensure that monitoring of Sacramento River winter-run chinook spawning escapement to the upper Sacramento River is continued and that the accuracy of these escapement estimates is improved.

Future improvements in escapement cannot be definitively attributed to harvest reductions, but because run-sizes are expected to substantially increase, escapement estimates shall provide at least a relative indicator of harvest reductions.

However, escapement estimates of winter-run chinook have a relatively low level of accuracy, which should be improved. Approximately 15% of the run is monitored at the RBDD to determine escapement estimates, and the associated variance of these counts is estimated at 1 (see Section VII.B.). New methods must be developed and implemented which improve the accuracy of these estimates, without adding any additional impacts to winter-run chinook.

XI. 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 measures suggested to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, or to develop additional information. NMFS believes the following conservation recommendations are consistent with these obligations, and therefore should be implemented by NMFS.

1. NMFS should develop better estimates of the ocean distribution and fishery impacts on listed Snake River spring/summer chinook.

Very little is known about the ocean distribution or fishery impacts of Snake River spring/summer chinook, primarily because so few tags of the hatchery indicator stocks have been recovered. At this point, it is not possible to determine whether this is due to the very low survival rates of the tagged fish or that the fish are, in fact, not susceptible to ocean fisheries. Prior to the 1996 season, the PFMC should update the analysis of CWT recoveries and seek alternatives to improve available information regarding the ocean distribution and harvest impacts of spring/summer chinook.

2. NMFS should continue to tag representative groups of fall chinook from the Lyons Ferry Hatchery and upriver bright fall chinook.

Tagging of sub-yearling Lyons Ferry chinook will contribute to improved estimates of the impacts of fisheries on listed fall chinook. Tagging of the upriver brights is necessary to facilitate comparative analysis of harvest rates, particularly in the Columbia River fisheries.

3. NMFS should assess whether Lyons Ferry Hatchery stock adequately represents the distribution of Snake River natural fall chinook.

There is a general question about how well tagged hatchery fish represent their natural stock counterparts. It is reasonable to question whether Lyons Ferry Hatchery fish adequately represent the distribution of natural Snake River fall chinook. The responsible agencies should consider the merits of tagging listed fish to assess whether the hatchery and natural stocks have similar distributions. An alternative would be a more thorough analysis of other hatchery/natural stock groups that are presumed to have similar distributions.

4. NMFS should develop better estimates of the ocean distribution and fishery impacts on sub-legal chinook.

There is even less information on the distribution and fishery impacts on sub-legal chinook. This is a problem common to most fisheries and most stocks coast-wide. NMFS and other appropriate agencies should seek alternatives for developing the necessary information.

5. NMFS should develop a measure of adult mortality and escapement that permits direct comparison of ocean and inriver harvest mortality and interdam loss for listed Snake River salmon.

One of NMFS' long term objectives for Snake River listed salmon is to develop estimates of adult-equivalent human-induced mortality for all actions. A new method for estimating fishery exploitation rates that will relate ocean and inriver harvest is underdevelopment and should help provide a consistent basis for accounting of the fate of fish that survive to ocean recruitment. Work on these kinds of accounting tools should continue.

6. NMFS should assess the feasibility of using genetic Mixed Stock Analysis to improve estimates of harvest rate on Sacramento River winter-run chinook salmon.

Alternative methods of monitoring harvest on winter-run chinook may be feasible through Genetic Stock Identification (GSI) (Brodziak et al. 1992). Genetics research is underway to distinguish various Central Valley chinook salmon stocks in the Bay-Delta, and results preliminarily suggest the potential to distinguish winter-run chinook from the other runs using a GSI (Banks et al. 1994; D. Hedgecock, pers. comm). Because salmon populations tend to show fewer genetic differences within the same watershed, and greater differences between watersheds, it is probable that winter-run chinook could be genetically distinguished from other Central Valley and coastal chinook salmon stocks in the ocean. This technique may present a more accurate method of measuring harvest and should be explored.

7. NMFS should develop a life cycle model for the Sacramento River winter-run chinook salmon.

A comprehensive life cycle is essential for evaluating the present management strategies, as well as alternative management strategies, in order to quantitatively determine the likelihood of survival and recovery of winter-run chinook over the long-term.

XII. Reinitiation of Consultation

Consultation must be reinitiated if: the amount or extent of taking specified in the Incidental Take Statement is exceeded, or is expected to be exceeded; new information reveals effects of the action that may affect listed species or critical habitat in a way not previously considered; the action is modified in a way that causes an effect to listed species that was not previously considered; or, a new species is listed or critical habitat is designated that may be affected by the action (50 CFR 402.16).

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Dr. Louis Botsford, Department of Wildlife and Fisheries Biology, University of California Davis.

Dr. Dennis Hedgecock, Bodega Marine Laboratory, University of California Davis, Bodega Bay.

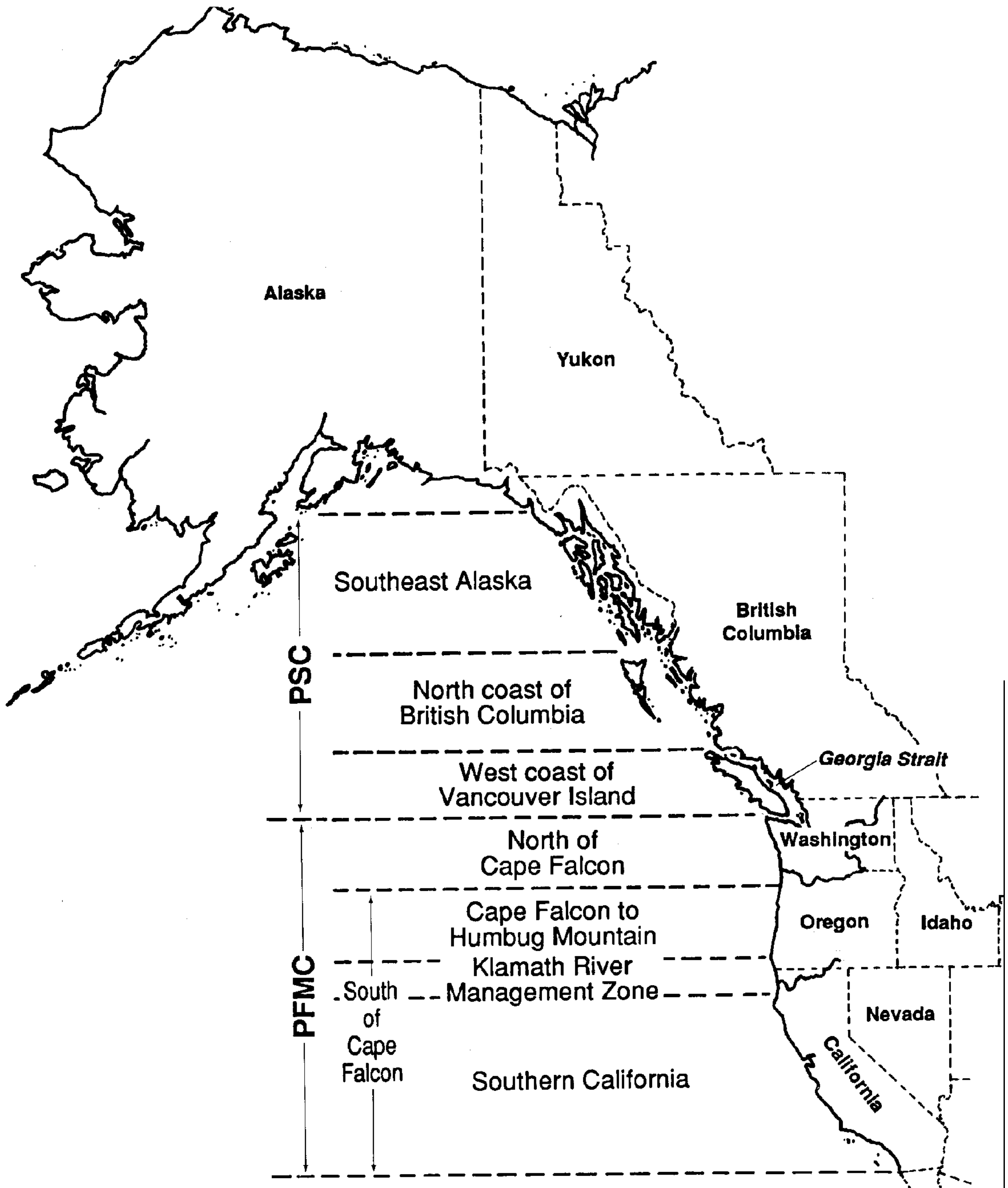

Figure 1. Ocean fishery management areas.

ATTACHMENT 1

LISTED SPECIES, CRITICAL HABITAT, BIOLOGICAL REQUIREMENTS, AND STATUS UNDER ENVIRONMENTAL BASELINE IN 1995

MAY 1995

National Marine Fisheries Service
Northwest Region
7600 Sand Point Way N.E.
Seattle, Washington 98115

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Three Snake River salmon populations are listed under the Endangered Species Act (ESA). Snake River sockeye salmon (*Oncorhynchus nerka*) were listed as endangered (November 20, 1991, 56 FR 58619). Snake River spring/summer chinook salmon (*O. tshawytscha*) and Snake River fall chinook salmon (*O. tshawytscha*) were originally listed as threatened (April 22, 1992, 57 FR 14653). Due to low returns in 1994 and the expectation of lower returns in 1995, NMFS reclassified the Snake River spring/summer and fall chinook salmon as endangered under an interim emergency rule (August 18, 1994, 59 FR 42529) which expired on April 17, 1995. NMFS has published a proposed rule (December 28, 1994, 59 FR 66784) to permanently reclassify the Snake River spring/summer and fall chinook salmon as endangered. However, they will remain classified as threatened until a final rule is published (April 17, 1995, 60 FR 19342).

A. Critical Habitat

Critical habitat was designated for Snake River sockeye salmon, Snake River spring/summer chinook salmon, and Snake River fall chinook salmon on December 28, 1993 (58 FR 68543), it became effective on January 27, 1994. The designation of critical habitat provides notice to Federal agencies and the public that these areas and features are vital to the conservation of listed Snake River salmon.

Essential Snake River salmon habitat consists of four components: (1) Spawning and juvenile rearing areas, (2) juvenile migration corridors, (3) areas for growth and development to adulthood and (4) adult migration corridors.

The essential features of the spawning and juvenile rearing areas for Snake River sockeye salmon consist of adequate: (1) Spawning gravel, (2) water quality, (3) water quantity, (4) water temperature, (5) food, (6) riparian vegetation, and (7) access.

The essential features of the spawning and juvenile rearing areas for Snake River spring/summer chinook salmon and Snake River fall chinook salmon consist of adequate: (1) Spawning gravel, (2) water quality, (3) water quantity, (4) water temperature, (5) cover/shelter, (6) food, (7) riparian vegetation, and (8) space.

Essential features of the juvenile migration corridors for Snake River sockeye salmon, Snake River spring/summer chinook salmon, and Snake River fall chinook salmon consist of adequate: (1) Substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions.

The areas in the Pacific Ocean that listed salmon use for growth and development are not well understood, therefore no essential areas and features have been identified.

The essential features of the Columbia River adult migration corridor for Snake River sockeye salmon, Snake River spring/summer chinook salmon, and Snake River fall chinook salmon include adequate: (1) Substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) riparian vegetation, (8) space, and (9) safe passage conditions.

B. Species' Life Cycle and Historical Population Trends

1. Snake River Sockeye Salmon

Snake River sockeye salmon adults enter the Columbia River primarily during June and July. Arrival at Redfish Lake, which now supports the only remaining run of Snake River sockeye salmon, peaks in August and spawning occurs primarily in October (Bjornn et al. 1968). Eggs hatch in the spring between 80 and 140 days after spawning. Fry remain in the gravel for three to five weeks, emerge in April through May and move immediately into the lake; there, juveniles feed on plankton for one to three years before they migrate to the ocean (Bell 1986). Migrants leave Redfish Lake from late April through May (Bjornn et al. 1968), and smolts migrate almost 900 miles to the Pacific Ocean. For detailed information on the Snake River sockeye salmon, see Waples et al. (1991) and November 20, 1991, 56 FR 58619.

Passage at Lower Granite Dam (the first dam on the Snake River downstream from the Salmon River) ranges from late April to July, and peak passage occurs from May to late June (Fish Passage Center 1992). Once in the ocean, the smolts remain inshore or within the Columbia River influence during the early summer months. Later, they migrate through the northeast Pacific Ocean (Hart 1973, Hart and Dell 1986). Snake River sockeye salmon usually spend two to three years in the Pacific Ocean and return in their fourth or fifth year of life.

Historically, the largest numbers of Snake River sockeye salmon returned to headwaters of the Payette River, where 75,000 were taken one year by a single fishing operation in Big Payette Lake (Bevan et al. 1994). During the early 1880s, returns of Snake River sockeye salmon to the headwaters of the Grande Ronde River in Oregon (Wallowa Lake) were estimated between 24,000 and 30,000 at a minimum (Cramer 1990, cited in Bevan et al. 1994). During the 1950s and 1960s, adult returns to Redfish Lake numbered more than 4,000 fish (Bevan et al. 1994).

Since at least 1985, when the Idaho Department of Fish and Game began operating a temporary weir below the lake, Snake River sockeye salmon returns to Redfish Lake have been extremely small (Table 1). Snake River sockeye salmon have a very limited distribution relative to critical spawning and rearing habitat. Redfish Lake represents only one of the five Stanley Basin lakes historically occupied by Snake River sockeye salmon and which are designated as critical habitat for the species.

Table 1. Returns of Snake River sockeye salmon to Redfish Lake, as determined by trapping at Redfish Lake creek weir and spawning ground surveys.

Year	Adults Observed
1985	12
1986	29
1987	16
1988	4
1989	1
1990	0
1991	4
1992	1
1993	8
1994	1

2. Snake River Spring/Summer Chinook Salmon

The present range of spawning and rearing habitat for naturally-spawned Snake River spring/summer chinook salmon is primarily limited to the Salmon, Grande Ronde, Imnaha, and Tucannon Subbasins. Most Snake River spring/summer chinook salmon enter individual subbasins from May through September. Juvenile Snake River spring/summer chinook salmon emerge from spawning gravels from February through June (Perry and Bjornn 1991). Typically, after rearing in their nursery streams for about one year, smolts begin migrating seaward in April and May (Bugert et al. 1990; Cannamela 1992). After reaching the mouth of the Columbia River, spring/summer chinook salmon probably inhabit nearshore areas before beginning their northeast Pacific Ocean migration, which lasts two to three years. For detailed information on the life history and stock status of Snake River spring/summer chinook salmon, see Matthews and Waples (1991), NMFS (1991a), and 56 FR 29542 (June 27, 1991).

Bevan et al. (1994) estimated the number of wild adult Snake River spring/summer chinook salmon in the late 1800s to be more than 1.5 million fish annually. By the 1950s, the population had declined to an estimated 125,000 adults. Escapement estimates indicate that the population continued to decline through the 1970s. Redd count data also show that the populations continued to decline through about 1980. See Table 2 for the estimated annual number of wild adult Snake River spring/summer chinook salmon returning over Lower Granite Dam in recent years.

Table 2. Estimates of "wild-natural" Snake River spring/summer chinook salmon counted at Lower Granite Dam in recent years. Estimates through 1993 from Tables 26 and 33 of WDFW and ODFW (1994). Preliminary estimates for 1994 from TAC (1994) and for 1995 from TAC (1995).

Year	Spring Chinook	Summer Chinook	Total
1985	6,048	3,196	9,244
1986	7,925	3,934	11,859
1987	8,928	2,414	11,342
1988	10,915	2,263	13,178
1989	3,900	2,350	6,250
1990	4,152	3,378	7,530
1991	2,706	2,814	5,520
1992	8,196	1,148	9,344
1993	6,224	3,959	10,183
1994	1,517	305	1,822
1995	250	346	596
Threshold Escapement Level			Approximately 11,000-22,000
Recovery Escapement Level			31,440

The Snake River spring/summer chinook salmon Evolutionarily Significant Unit (ESU—the distinct population segment listed for ESA protection) consists of 39 local spawning populations (subpopulations) spread over a large geographic area (Lichatowich et al. 1993; see Table 3). The number of fish returning to a given subpopulation is therefore much less than the total run size.

Based on recent trends of redd counts in major tributaries of the Snake River, many subpopulations could be at critically low levels. Subpopulations in the Grande Ronde River, Middle Fork Salmon River, and Upper Salmon River basins are at particularly high risk. Both demographic and genetic risks are causes for concern in such subpopulations and, in some cases, habitat may be so sparsely populated that adults have difficulty finding mates.

Table 3. Snake River spring/summer chinook salmon classification by subbasin (metapopulations) and subpopulation. Based on Lichatowich et al. 1993, Bevan et al. 1994, and BRWG 1994. SP = spring chinook population; SU = summer chinook population.

River System/Subbasin	Breeding Unit/Subpopulation
Tucannon River	• watershed population (SP)
Grande Ronde River	• Minam River (SP) • Lostine and Upper Wallowa Rivers and tributaries (SP) • Wenaha River (SP) • Catherine Creek (SP) • Upper Grande Ronde (SP)
Imnaha River	• mainstem (SP/SU) • Big Sheep and Lick Creeks
Snake River mainstem	• Asotin Creek (SP) • mainstem, Sheep, Granite Creeks `(SP)
Lower Salmon River	• mainstem tributaries, mouth to and including Horse Creek (SP)
Little Salmon River	• watershed except Rapid River (SP) • Rapid River (SU)
South Fork Salmon River	• mainstem, Blackmare to Stolle Creeks (SU) • mainstem, mouth to Poverty Flats (SU) • Secesh River (SU) • Johnson Creek (SU) • East Fork South Fork (SU)
Middle Fork Salmon River	• mainstem, mouth to Indian Creek (SU) • mainstem, Indian to Bear Valley Creek (SP) • Marsh Creek and tributaries (SP) • Bear Valley and Elk Creeks (SP) • Sulphur Creek • Upper Loon Creek and tributaries (SP) • Lower Loon Creek (below TM 23) (SU) • Camas Creek (SP) • Lower Big Creek (below TM 23) (SU) • Upper Big Creek and tributaries (SP)
Lemhi River	• watershed population (SP)
Pahsimeroi River	• watershed population (SU)

River System/Subbasin	Breeding Unit/Subpopulation
Upper Salmon River	• North Fork Salmon River (SP) • East Fork, mouth to Herd Creek (SU) • Herd Creek and Upper East Fork (SP) • Yankee Fork and tributaries (SP) • Valley Creek above Stanley Creek (SP) • Lower Valley Creek (SU) • mainstem Salmon below Redfish Lake Creek (SU) • mainstem Salmon above Redfish Lake Creek (SU)
Clearwater River	• not listed under ESA

3. Snake River Fall Chinook Salmon

Adult Snake River fall chinook salmon enter the Columbia River in July and migrate into the Snake River from August through October. Natural fall chinook salmon spawning is primarily limited to the Snake River below Hells Canyon Dam and the lower reaches of the Clearwater, Grand Ronde, Imnaha, Salmon, and Tucannon Rivers. 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 migration to the ocean. There, they spend one to four years before beginning their spawning migration. For detailed information on the Snake River fall chinook salmon, see NMFS (1991b) and June 27, 1991, 56 FR 29542.

There are no reliable historic estimates of abundance available for Snake River fall chinook salmon (Bevan et al. 1994). The estimated returns of Snake River fall chinook salmon declined from 72,000 annually between 1938 and 1949, to 29,000 from 1950 through 1959 (Bjornn and Horner 1980, cited in Bevan et al. 1994). The estimated returns of naturally-produced adults from 1985 through 1993 range from 78 to 742 fish (Table 4).

Table 4. Estimates of naturally-produced adults to Lower Granite Dam (not adjusted to include naturally-produced adults trapped at Ice Harbor Dam). Estimates for 1985-1993 are from Washington Department of Fish and Wildlife and Oregon Department of Fish and Wildlife (1994). The estimate for 1994 is from LaVoy (1995). Preliminary estimate for 1995 is from TAC (1995).

Return Year	Natural Adults
1985	435
1986	449
1987	252
1988	368
1989	295
1990	78
1991	318
1992	549
1993	742
1994	406
1995	208

Specific projections for returns of fall chinook over the next three to five years (1996-1998) cannot be made, but it is possible to comment generally on the prospects for greater returns. The 1991 brood is weak, based on the record low return of jacks in 1993. There was certainly sufficient escapement in 1992 and 1993 to provide for increased returns after 1995, but higher returns will depend largely on improving passage and ocean survival conditions.

C. Biological Requirements for Listed Snake River Salmon

The first step in the method NMFS uses for applying the ESA standards of § 7(a)(2) to listed salmon (NMFS 1995a), consists of defining the species' biological requirements that are most relevant to each consultation. What follows here is a summary of NMFS' conclusions, based upon the considerations described in NMFS (1995a). Generally, NMFS finds that these biological requirements are best expressed as trends in population size and variability. Environmental requirements are also useful for assessing the effects of some actions.

To a large extent, these biological requirements are based upon the work of a Biological Requirements Work Group (BRWG)(1994) composed of scientists and fishery managers from the Federal agencies, states, and tribes that met as a component of the post judgment discussions of the IDFG v. NMFS lawsuit. The NMFS also was guided by scientific opinion provided by the intervenors to this litigation. The BRWG report is discussed in detail in NMFS (1995b); however, in summary, the approach presented in the BRWG report and, to a large extent that followed by NMFS, is a method of determining the listed species' likelihoods of survival and recovery.

The BRWG considered the "likelihood of survival" to be the probability that a set of actions encompassing all phases of a species' life cycle would result in population levels above threshold escapement levels over a short-term period (24 years) and a long-term period (100 years). The BRWG (1994) proposed that this likelihood should be estimated for Snake River spring/summer and fall chinook salmon using regional life-cycle models. They suggested that for Snake River sockeye salmon, the estimate should be approached in a less complex manner because of their low population level, the lack of passage studies directed at this species, and uncertainties regarding releases from the captive broodstock program.

The BRWG (1994) considered the "likelihood of recovery" to be the probability that a set of actions encompassing all phases of the species' life cycle would result in eight-year (approximately two-generation) geometric mean population levels equal to or greater than recovery population levels. An expected recovery time period is also necessary to make this determination (i.e., to determine the likelihood of reaching an eight-year mean recovery population level within x number of years from the present). The BRWG suggested recovery time periods of 12, 24, and 48 years.

As with the likelihood of survival determination, the BRWG (1994) proposed that the likelihood of recovery should be estimated for Snake River spring/summer and fall chinook salmon using regional life-cycle models. For Snake River sockeye salmon, the estimate would be approached in a less complex manner for the same reasons cited above.

The NMFS finds this, among others, to be a useful approach (see NMFS 1995b), and thus considers determining survival and recovery thresholds to be the first step in applying the BRWG's methodology. The BRWG's methodology is based on the needs and population trends of the species (including population counts), not their ESA status. Therefore NMFS' application of the ESA standards (NMFS 1995a) is the same whether the salmon species are listed as endangered or threatened.

1. Survival Requirements

Each Pacific salmon species is composed of numerous geographically isolated breeding units (stocks). The stock structure of the Pacific salmon is the result of their propensity for returning to their native stream to spawn and their individual adaptations to local environments (Helle 1981).

In small populations, random processes can lead to two major types of risk: demographic and genetic. Demographic risk is the risk of extinction due to environmental fluctuations, random events affecting individuals in the population, and possible reductions in reproduction or survival resulting from low population sizes. Genetic risk is the risk of losing genetic variability or population fitness through inbreeding and genetic drift. Both types of risk increase rapidly as population size decreases.

Severe, short-term genetic problems resulting from inbreeding are unlikely unless population size remains very low for a number of years. However, the erosion of genetic variability due to low population size is cumulative; thus, long-term effects on a population (even if it subsequently recovers numerically) are also a concern.

The BRWG and NMFS considered these factors in defining the potential numerical returning spawner population thresholds to be used in defining biological requirements for particular salmon stocks. The threshold levels recommended by the BRWG, and adopted by NMFS, do not represent levels at which the trend toward extinction is expected to be irreversible. The BRWG's suggested threshold escapement levels (and suggested methods of analysis) indicate that populations will be able to fall below these levels periodically and still recover to higher levels, even when biological processes particular to low population levels are taken into account. This interpretation is consistent with the observation that the proposed threshold levels are substantially higher than any directly identifiable risk levels such as those associated with genetic or demographic bottlenecks.

These threshold levels for survival correspond to the definition of "survival" found in NMFS' and the FWS' "Draft Section 7 Endangered Species Consultation Handbook--Procedures for Conducting Section 7 Consultations and Conferences" (NMFS/USFWS 1994). There, the term requires "sufficiently large populations" to ensure persistence into the future under conditions that will retain the potential for recovery. In an independent peer review of the BRWG report, Barnthouse et al. (1994) concluded that the BRWG's method of developing threshold levels was credible.

(a). Snake River Spring/Summer Chinook Salmon

The primary threshold level recommended by the BRWG was 150 natural spawners annually (for small, concentrated subpopulations of Snake River spring/summer chinook salmon) and 300 natural spawners annually (for larger, dispersed Snake River spring/summer chinook salmon subpopulations and Snake River fall chinook salmon). The NMFS adopts the BRWG-recommended threshold level of 150-300 spawners annually per subpopulation, depending upon size of the subpopulation, for purposes of applying the jeopardy analysis to Snake River spring/summer chinook salmon. Threshold levels associated with the six subpopulations currently available for analysis are presented in Table 5.

Based on the factors described in NMFS (1995b), NMFS concludes that the best available method for characterizing risk to the ESU is to use projections for available subpopulations. Because the few available subpopulations do not, even taken together, represent conditions throughout the entire ESU, it is prudent to require that a high percentage of the available subpopulations have an acceptable probability of being above the threshold level. A "high percentage" is defined as being at least 80% of available "index stocks."

As suggested in BRWG (1994) and Barnthouse et al. (1994), NMFS encourages development of techniques that will incorporate additional subpopulations into future analyses. The NMFS also encourages analysis of ancillary information, such as aggregate assessments based on dam counts, to supplement the subpopulation analyses. If assessments based on dam counts support the conclusions derived from subpopulations analysis, NMFS will have greater confidence in those conclusions. If the two analyses lead to different conclusions, it will be a signal to carefully review the subpopulation assessments; however, as stated above, the final determination will be based upon the latter.

The BRWG did not identify a threshold level for the entire Snake River spring/summer chinook ESU that could be compared with aggregate projections derived from dam counts. It is reasonable to assume that, because the ESU is composed of approximately 39 subpopulations with thresholds ranging from 150-300 spawners annually, the aggregate threshold is between 6,000 and 12,000 spawners annually. This estimate assumes that spawners are distributed among all subpopulations in proportion to each subpopulation's threshold. If this assumption is not valid, the aggregate threshold would be higher than 6,000-12,000 spawners annually.

The BRWG (1994) suggested that Snake River spring/summer chinook salmon returns to six subbasins be used as index stocks for assessing status of the ESU. These subpopulations have generally been below threshold escapement levels since 1989 (Table 5). Cohort replacement rates (which are equivalent to spawner-to-spawner ratios) have been less than 1.0 (i.e., the population has been declining) for most of these stocks during recent years (Table 6).

Though the BRWG did not suggest an aggregate threshold for the entire ESU, one could be estimated in the following manner: Assuming that mortality between Lower Granite Dam and the spawning ground is approximately 40-60% (midpoint 50%) for the spring component and 30-40% (midpoint 35%) for the summer component of the ESU (Chapman et al. 1991), and that there is an average ratio of 65% spring component during the past 10 years (Table 2), the corresponding escapement at Lower Granite Dam would be approximately 11,000-22,000 natural spawners. Adult counts at Lower Granite Dam have generally been well below this level in recent years (Table 2).

Table 5. Estimated spawner counts for six subpopulations of Snake River spring/summer chinook salmon during recent years (reproduced from Table 3.1 of BRWG (1994)). The estimates through 1993 are from Idaho Dept. of Fish and Game and Oregon Dept. of Fish and Wildlife, expanded from redd counts in index areas. Bold values represent estimates that meet or exceed threshold escapement levels recommended by BRWG (1994). Recovery escapement levels are based on 60% of pre-1970 average escapements.

Year	Bear Valley/Elk Creeks	Imnaha River	Marsh Creek	Minam River	Poverty Flats of S. Fork Salmon River	Sulphur Creek
1985	295	**783**	**197**	**479**	**342**	70
1986	235	**1159**	**184**	130	246	**458**
1987	**457**	**535**	**273**	**222**	**508**	77
1988	**1116**	**719**	**395**	**224**	**763**	**289**
1989	91	**439**	80	136	258	14
1990	189	272	104	95	**513**	**155**
1991	184	209	73	94	**515**	**183**
1992	178	184	118	8	**519**	35
1993	**710**	**465**	**218**	144	**779**	**176**
1994	N/A	N/A	N/A	N/A		
Threshold escapement level	300	300	150	150	300	150
Recovery escapement level	968	610	441	389	1669	405

Table 6. Estimated cohort replacement rates (equivalent to spawner-to-spawner ratios) for six subpopulations of Snake River spring/summer chinook salmon in recent years. The estimates are from Idaho Dept. of Fish and Game and Oregon Dept. of Fish and Wildlife and are based on expanded redd counts and age structure in index areas (Wilson 1995). Replacement rates greater than 1.0 are necessary for population growth.

Last Esc. Year	Brood Year	Bear Valley/Elk Creeks	Imnaha River	Marsh Creek	Minam River	Poverty Flats of S. Fork Salmon River	Sulphur Creek
1985	1980	5.7	3.1	10.1	4.3	1.7	3.4
1986	1981	1.7	1.4	1.6	6.9	2.3	6.5
1987	1982	4.7	1.7	3.5	1.5	1.6	9.6
1988	1983	6.8	1.9	7.5	3.8	3.2	5.4
1989	1984	1.0	0.5	0.8	1.2	1.1	N/A[1]
1990	1985	0.5	0.4	0.5	0.3	0.9	1.4
1991	1986	1.0	0.5	0.5	0.5	1.9	0.5
1992	1987	0.2	0.3	0.3	0.1	0.8	0.6
1993	1988	0.7	0.9	0.7	0.3	0.8	0.6
1994	1989	N/A	N/A	N/A	N/A	N/A	N/A

[1]No redds observed in index area.

(b). Snake River Fall Chinook Salmon

The NMFS finds that the threshold escapement level for Snake River fall chinook salmon is 300 adult spawners, as recommended by the BRWG. The logic for this decision is discussed in NMFS (1995b). The BRWG did not suggest a corresponding number of adults at Lower Granite Dam, but a number can be approximated by adjusting natural adult counts at Lower Granite Dam to account for fallback rate (e.g., 31.6% in 1992; Mendel et al. 1993) and prespawning mortality (approximately 15%; Chapman pers. comm. in Fisher et al. 1993). Therefore, an approximation of the threshold escapement level at Lower Granite Dam would be 519 natural adults past Lower Granite Dam ([300 ÷ [(1.0 - 0.32) * (1.0 - 0.15)]). With the exception of the 1992 and 1993 returns, escapements have been below this approximate threshold level, as well as below a cohort replacement rate of one, in recent years (Table 7). The Proposed Recovery Plan defines a recovery escapement level of 2500 spawners and leaves estimation of a corresponding value at Lower Granite Dam to a Scientific Advisory Panel. Using the method described above, the approximate recovery escapement level at Lower Granite Dam would be 4325 natural adults.

Table 7. Estimates of naturally-produced adult fall chinook salmon to Lower Granite Dam (adjusted to include naturally-produced adults trapped at Ice Harbor Dam). Cohort replacement rates calculated by assuming parents composed of total run. Estimates for all years from Dygert (1994a,b). Threshold and recovery escapement levels at Lower Granite Dam are approximations of levels defined at the spawning grounds, as described in the text.

Return Year	Natural Adults	Total Replacement Rate
1985	615	1.22
1986	482	0.90
1987	332	0.52
1988	511	0.82
1989	396	0.56
1990	144	0.14
1991	318	0.40
1992	**549**	0.72
1993	**742**	1.33
Threshold Escapement Level	[519]	
Recovery Escapement Level	[4325]	

(c). Snake River Sockeye Salmon

The BRWG did not recommend a Snake River sockeye salmon threshold escapement level for use in a jeopardy analysis. However, the thresholds identified for spring/summer chinook and fall chinook salmon were not species-specific. Those thresholds should apply to any "large" and "small" Pacific salmon populations. Presumably the threshold for sockeye would fall between 150-300 annual spawners for each relatively isolated population constituting the ESU (i.e., populations established within each lake in the Stanley Basin). As described in BRWG (1994), analyses used to estimate whether or not Snake River sockeye salmon are likely to be above the threshold will be less complex and less precise than analyses based on life-cycle models for other species.

2. Recovery Requirements

The BRWG report also made provisional recommendations for escapement levels representing recovery; however, these are now superseded by delisting criteria in NMFS' Proposed Recovery Plan (NMFS 1995d). The following numerical escapement delisting criteria are specified in the Proposed Recovery Plan as eight-year geometric means: (1) Sockeye: At least 1000 naturally-produced sockeye salmon in one lake and 500 in each of two other lakes in the Stanley Basin; (2) Fall Chinook: at least 2500 naturally-produced fall chinook salmon in the lower Snake River and tributaries, excluding the lower Clearwater River; (3) Spring/Summer Chinook: (a) at least 31,440 naturally-produced spring/summer chinook at Lower Granite dam; and (b) at least 60% of the pre-1971 brood-year average redd counts for 80% of index areas for which at least five years of pre-1971 redd counts are available. The basis for establish these recovery levels is explained in detail in Chapter IV of the NMFS Proposed Snake River Salmon Recovery Plan.

D. Species Status Under Environmental Baseline

In this second step in applying the ESA § 7(a)(2) standards, as discussed in (NMFS 1995a), NMFS analyzes the effects of past and ongoing human and natural factors which have led to the current status of the species and its habitat. The environmental baseline, to which the effects of the proposed action would be added, "includes the past and present impacts of all Federal, State, or private 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 C.F.R. § 402.02 ("effects of the action").

What follows is an evaluation of the listed species' prospects under the environmental baseline

1. Snake River Sockeye Salmon

Based on smolt-to-adult returns to the mouth of the Columbia River for the 1991 and 1992 outmigrating cohorts (0.51% and 0.26%, respectively), two adults out of the 521 smolts that migrated from Redfish Lake in 1993 will be expected to return in 1995 (LaVoy 1994).

Since 1991, a captive broodstock program has been in effect for Snake River sockeye salmon, and all returning adults have been spawned in captivity. The program was instigated as an emergency measure designed to avert the threat of imminent extinction. The first adults produced by this program (from the 1991 returns) were released into Redfish Lake to spawn in 1993 and their progeny are expected to outmigrate in the spring of 1995. The surviving 1993 brood year adults will return to spawn in one to three years, and their progeny (the first cohort of naturally-produced spawners) will not return to spawn in Redfish Lake until three to five years after that (1999-2003). Therefore, it will be well into the next century before natural production of Snake River sockeye salmon can begin to be evaluated.

Given the extremely low sockeye salmon population size, NMFS finds that there is a very low probability that Snake River sockeye salmon population will attain their survival requirements in their critical habitat under the continuing effects of the environmental baseline. The risk is extremely high that listed sockeye will be below the threshold escapement level of 150 fish (which applies only to naturally-produced spawners) until natural production is sufficiently re-established. The likelihood of recovery (which only applies to spawners at least two generations removed from captive broodstock) is even less certain, since there is no recent empirical evidence available for evaluating the productivity of second-generation wild fish.

In summary, it appears that the Snake River sockeye salmon face extreme risks as a result of the baseline environmental conditions. The risks are so grave that there must be substantial improvement in the environmental conditions of the sockeye's critical habitat. Any further degradation in these conditions could have significant detrimental effects due to the fact that the baseline risks are already so high.

2. Snake River Spring Summer Chinook Salmon

It is unlikely that the biological requirements of listed Snake River spring/summer chinook salmon will be met, given the substantial adverse effects occurring under the environmental baseline. The significance of these effects is magnified by the current small population size, projected poor returns over the next one to two years, the influence of those poor returns on subsequent cohorts in 1998-2001, and the poor environmental conditions affecting the species throughout all its life stages. Substantial improvements in the baseline environmental conditions are necessary to ensure the continued existence of this species.

Adult returns of Snake River spring/summer chinook salmon in 1994 were the lowest on record. However, the return of the spring component is projected to be even lower in 1995. This is based on the fact that there is a strong relationship between how many Snake/Columbia River spring chinook jacks arrive one year, and how many four-year old adult spring chinook return in the following year. The 1994 spring chinook jack count was less than half of the 1993 jack count, which represented the previous record low (Roler 1994). The projection for 1995 summer chinook returns is approximately the same as 1994 returns (TAC 1994), which were the lowest on record.

The spring component of Snake River spring/summer chinook salmon is unlikely to increase significantly in 1996 because the five-year old component of the 1996 return will be coming from the very low 1991 brood (Table 2) and because the juvenile outmigration of the four-year old component occurred under below-average flow conditions in 1994 (see section IV.A.1 of NMFS 1995c). Therefore, there is little reason to anticipate that returns of the spring component of Snake River spring/summer chinook salmon will increase substantially until the 1993 brood year contributes to the returns in 1997 and 1998. The 1993 brood will be of particular importance because it was the last year with a substantial escapement of wild fish. After 1998, returns will again be influenced by the very low 1994 and (expected) low 1995 brood years. Again, because spring chinook are generally the stronger component of the run, this situation is likely to represent the entire Snake River spring/summer chinook ESU.

The combination of the fact that escapements have been well below threshold levels in most years since 1989 for four of the six subpopulations listed in Table 5 (and for the aggregated estimate at Lower Granite Dam (Table 2)) and the expectation of low returns for the next one to two years suggests that the likelihood of survival and recovery in the near future is low. This assessment is in agreement with an analysis of risk associated with the "recent" time period represented by 1977-1988 brood years (1981-1993 return years) included in the BRWG report (1994). Furthermore, analyses using both the stochastic (SLCM) and empirical (ELCM) life-cycle models indicate low probabilities of survival and recovery for most stocks, given recent conditions and current population levels, for both "short-term" (24 year) and "long-term" (48 and 100 year) simulations.

In summary, it is unlikely that in the near future the biological and ecological requirements of listed Snake River spring/summer chinook salmon will be met due to the substantial adverse effects occurring under the environmental baseline. The significance of these effects is magnified by the current small population size, the projected poor returns over the next one to two years, the influence of those poor returns on subsequent cohorts in 1998-2001, and the poor environmental conditions affecting the species in all its life stages. The extent to which it is likely that the species will see an improvement in its ability to survive and recover (provided the species' status was subject only to the effects of the environmental baseline) has not been quantitatively estimated. However, based on the needed survival improvements described above, that ability is also limited. It is clear that substantial improvement in environmental conditions under the environmental baseline are necessary if the continued existence of this species is to be ensured.

3. Snake River Fall Chinook Salmon

The natural Snake River fall chinook escapement was well below the threshold level in 1994 (see Table 7). The age structure of recent returns indicates that the returns will continue to decline in 1995. Fall chinook returns in the Snake River system are typically dominated by four-year old fish. The 1994 run was dominated by five-year olds with relatively weak returns of three- and four-year old fish. The low return of three-year olds resulted from a record low return of two-year old fish in 1993. The low four-year old return in 1994 resulted from the relatively low three-year old return in 1993. The 1995 forecast suggests that the return will be about 60% of that in 1994, or about 601 fish will reach the river mouth (TAC 1995). The expected escapements to the Snake River would be proportionally low as well.

It is not possible to make specific projections for returns of fall chinook over the next three to five years (1996-1998), but it is possible to comment generally on the prospects for greater returns. Based on the record low return of jacks in 1993, the 1991 brood is weak. There was certainly sufficient escapement in 1992 and 1993 to allow for increased returns after 1995, but higher returns will depend largely on improved passage and ocean survival conditions.

The NMFS finds that the likelihood of survival and recovery of listed fall chinook salmon in the immediate future is low because of a combination of factors: (1) Escapements are well below threshold levels in most years since 1985, and (2) even assuming only the continuing direct and indirect effects of any environmental baseline, and without factoring in cumulative effects or the likely effects of the proposed action, escapement will continue to be extremely low, at least through 1995.

No analyses of the probability of survival and recovery of Snake River fall chinook salmon under the environmental baseline have been conducted for the longer term (over a 24-to 100-year period). However, assuming only the continuing direct and indirect effects of the environmental baseline, their prospects for survival are likely to be better in the long-term than they are in the immediate future. This is because the level of future incidental harvest of fall chinook salmon, which is not considered to be part of the environmental baseline, is a larger factor in determining their likelihood of survival and recovery than it is for either the listed spring/summer chinook or sockeye salmon. The total harvest rate of fall chinook salmon during recent years, including Canadian harvest, has ranged from 46% to 74% (Snake River Salmon Recovery Team 1994). Based on returns of 1988-92 cohorts, the average total U.S. harvest rate was approximately 36% (CRITFC 1994).

In summary, it is unlikely that in the immediate future the biological and ecological requirements of listed Snake River fall chinook salmon will be met due to the substantial adverse effects occurring under the environmental baseline. This problem is exacerbated by the current small population size, the projected poor returns in 1995, the influence of those poor returns on subsequent cohorts in from 1998 to 2001, and the lag time in achieving increases in survival through habitat changes that affect the environmental baseline in a beneficial manner. No quantitative assessment of risk associated with the environmental baseline over a 24-year period is available, but because such an analysis would not consider the impact of a U.S. fall chinook harvest, such an analysis may be expected to indicate at least a moderate likelihood of survival and recovery.

E. Effects of Environmental Baseline, and Other Potential Reasonable and Prudent Actions in Other Sectors Relative to Species Requirements

As described in NMFS (1995a), the effect of a set of actions is evaluated relative to a species' biological requirements by using the analytical method suggested by the BRWG (1994) or other environmental conditions. NMFS also expects that evaluation of biological requirements will require consideration of factors beyond regional life-cycle models (e.g., other population projections). Additionally, professional judgement will be necessary to interpret the range of model outputs relative to the limitations of life-cycle models, the range of model outputs resulting from competing hypotheses, and the significance of threshold levels identified by the BRWG (1994).

During consultation on the 1995 (and future) operation of the Federal Columbia river Power System (FCRPS) (NMFS 1995c), NMFS considered life-cycle modeling results for actions related to operating the power system while taking into account assumptions about actions in other life stages that are consistent with requirements in the Proposed Recovery Plan (NMFS 1995d). Details of the results are included in NMFS (1995e). Because assumptions (for all life stages) consistent with the Proposed Recovery Plan (NMFS 1995d) were included in modeling, these analyses are relevant to all actions proposed during 1995.

1. Spring/Summer Chinook Salmon

Results of life-cycle modeling tend to support a conclusion that the FCRPS reasonable and prudent alternative (coupled with improvements affecting other life stages that are consistent with the Proposed Recovery Plan) is likely to result in meeting the species' biological requirements. Both life cycle models indicate that there is a high likelihood (under certain assumptions NMFS considers reasonable) that the survival goals described in NMFS (1995e) will be met if the FCRPS reasonable and prudent alternative is implemented. In addition, both models' analyses of alternative scenarios proposed by other parties (which are contemplated in the long-term options of the reasonable and prudent alternative) indicate that there is a high likelihood that both the survival and recovery goals will be met.

2. Snake River Fall Chinook Salmon

For at least one option associated with the FCRPS reasonable and prudent alternative (and under certain assumptions regarding other life stages that are consistent with the Proposed Recovery Plan), FLUSH/ELCM modeling indicates that fall chinook salmon have a probability of at least

70% of being at or above the threshold level in 24 or 100 years. Under a combination of optimistic but plausible assumptions (based on the Proposed Recovery Plan), there is a 50-70% probability of being above the recovery level in 48 years. CRiSP/SLCM results indicate that, under certain assumptions, an acceptable probability can be achieved for reaching both short-term and long-term threshold and recovery goals.

3. Sockeye Salmon

No life-cycle modeling has been done for sockeye salmon. The NMFS expects that improvements in listed sockeye salmon survival will be of the same magnitude as those for listed spring/summer chinook.

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ATTACHMENT 2

APPLICATION OF ENDANGERED SPECIES ACT STANDARDS TO SNAKE RIVER SALMON

MAY 1995

National Marine Fisheries Service
Northwest Region
7600 Sand Point Way N.E.
Seattle, Washington 98115

Introduction

The National Marine Fisheries Service (NMFS) evaluates the effects of proposed Federal actions on the listed Snake River salmon in section 7 consultations by applying the standards of § 7(a)(2) of the ESA, as given in 16 U.S.C § 1536(a)(2), and as interpreted by the NMFS/U.S. Fish and Wildlife Service (FWS) joint consultation regulations (50 CFR Part 402). The discretionary continuation of an action is considered to be a proposed action. When NMFS issues its biological opinion, it uses the best scientific and commercial data available to determine whether a proposed Federal action is likely to (1) jeopardize the continued existence of a listed species, or (2) destroy or adversely modify the designated critical habitat of a listed species. See ESA § 7(a)(2).

The consultation regulations define "jeopardize the continued existence of" 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 the reproduction, numbers, or distribution of that species (50 C.F.R. § 402.02).

The regulations also define the statutory term "destruction or adverse modification" of critical habitat to mean:

> . . . a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical. (50 C.F.R. § 402.02)

Additionally, NMFS and FWS have issued a document that further describes the application of these standards; it is entitled "Draft Section 7 Endangered Species Consultation Handbook -- Procedures for Conducting Section 7 Consultations and Conferences," (NMFS/USFWS 1995) (hereinafter referred to as "the Draft Handbook").

The Draft Handbook defines the regulatory terms "survival" and "recovery," as they relate to analyzing jeopardy and critical habitat, as follows:

> **Survival**: the species' persistence, beyond conditions leading to its endangerment, with sufficient resilience to allow recovery. Said another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficiently large population, represented by all age classes, genetic heterogeneity, and a number of sexually mature individuals producing viable offspring, that exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter.

Recovery: improvement in the status of a species and the ecosystems upon which they depend. Said another way, recovery is the process by which species' ecosystems are restored so they can support self-sustaining and self-regulating populations of listed species as persistent members of native biotic communities.

In implementing these standards for Pacific salmon species, NMFS recognizes certain characteristics of the species' require special consideration. The Columbia River Basin, in which the Snake River salmon originate, drains a vast area of the Pacific Northwest. The basin is approximately 259,000 square miles in size; it drains much of the area of Washington, Oregon, and Idaho, as well as parts of Montana, Nevada, Utah, Wyoming and British Columbia. The listed salmon are born in small mountain streams, lakes and rivers (depending on the species) of the Snake River system in Idaho and eastern Oregon and Washington. Their eggs are deposited and fertilized by spawning adults and incubate within gravel substrates. They emerge from the gravel and rear for a time before they begin, as yearlings or subyearlings, their migration down the mainstems of the Snake and Columbia River systems to the Pacific Ocean. There, they range from the mouth of the Columbia River in all directions. The listed species grow to adult size in the ocean and then complete their life cycle by reversing their migration, moving up the Columbia and Snake Rivers and returning to their natal habitat to spawn the next generation.

Stages of the Analysis

For each consultation concerning the Snake River salmon, NMFS performs the following analysis in applying ESA standards to these unique creatures.

1. Define the biological requirements of the listed species.

To determine whether a proposed or continuing action is likely to jeopardize the continued existence of a listed species or adversely modify its habitat, it is first necessary to know what the species requires for continued existence. (The regulations more specifically express this in terms of the species' survival and recovery.) The Snake River salmon's biological requirements may be described in a number of different ways: For example, they can be expressed as a ratio of recruits to spawners, as a survival rate for a given life stage (or set of life stages), as a positive population trend, or as a threshold population size. Biological requirements may also be described as the environmental conditions necessary to ensure the species' continued existence, and these can be expressed in terms of physical, chemical, and biological prerequisites (e.g., for a particular river reach, the prerequisites would include water temperature and velocity, dissolved gas saturation, etc.). The manner in which these requirements are described varies according to the nature of the action under consultation and its likely effects on the species. For example, in the consultation on the Federal Columbia River Power System (FCRPS) (NMFS 1995a), biological requirements are couched primarily in terms of individual salmon mortalities; whereas in a consultation on an action in spawning and rearing habitat, the biological requirements might be defined by changes in environmental conditions.

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

The environmental baseline represents a basal set of conditions to which the effects of the proposed or continuing action would be added. It "includes the past and present impacts of all Federal, State, or private 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." See 50 C.F.R. § 402.02, definition for "effects of the action." Under this definition, the environmental baseline would not include future discretionary activities (that have not undergone ESA consultation) in the action area. Thus, the species' current status is described in relation to the risks presented by the continuing effects of all previous actions and resource commitments that are not subject to further exercise of Federal discretion. For a new project, the environmental baseline represents the risks entailed by conditions in the action area that exist before the proposed actions begins. For an ongoing Federal action, it is necessary to evaluate the effects of previous resource commitments separately from the effects that would be caused by that action's proposed continuance.

Delineating the "action area" for the proposed or continuing action should be an initial consideration in identifying the environmental baseline. The regulations specify that the environmental baseline of the action area should be used in making the jeopardy determination. The "action area" is defined by the consultation regulations as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" 50 CFR §402.02.

The reason for determining the species' status under the risks presented by the environmental baseline (without the effects of the proposed or continuing action) is to better understand the relative significance of the action's effects upon the species' likelihood of survival and chances for recovery when those effects are added to the environmental baseline. The greater the risks the species face at the time of consultation, the more significant any additional adverse effects caused by the proposed or continuing action will be.

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

In this step of the analysis, NMFS examines the likely effects of the proposed action on the species. The analysis may consider the impact in terms of how many listed salmon will be killed during a particular life stage (and that mortality's effect upon the species' population size and variability), or the analysis may consider the impact on the species' biological requirements, such as water temperature, sediment load, total dissolved gas levels, etc. These are the effects that could be within the action agencies' discretion to cause or not. This decision is influenced by NMFS' advice in its biological opinion.

4. Determine whether the species can be expected to survive (with an adequate potential for recovery) under the effects of the proposed or continuing action, the environmental baseline and any cumulative effects, and considering any measures to increase survival or promote recovery that are taking place with respect to other life stages.

In this step of the analysis, NMFS determines whether the specific action under consultation is likely to jeopardize the continued existence of the listed species. This step has two parts: First, NMFS focuses on the action area and adds the effects of the proposed or continuing action to those of the environmental baseline (and all cumulative effects). The NMFS must determine the significance of that aggregate effect upon the particular biological requirements of the listed species in the action area. In this step, NMFS considers effects such as the frequency of individual mortality and any sublethal effects caused by the action or occurring through the action's adverse modification of environmental conditions important to the species.

In the second part of the analysis, NMFS places the effects of the proposed or continuing action in the context of the full salmon life cycle. This comprehensive analysis is necessary to evaluate fully the significance of each action under consultation with respect to the biological requirements of the listed species in all life stages. The NMFS looks beyond the particular action area for this analysis in order to determine measures likely to be necessary in all life stages and that, in combination, would ensure that the biological requirements of the listed species are met.

At the species level, NMFS believes that the biological requirements for survival (and an adequate potential for recovery) are met when there is a high likelihood that the species' population will remain above critical escapement thresholds over a sufficiently long period of time. Additionally, the species must have a moderate to high probability of achieving its recovery population level within an adequate period of time. The particular thresholds, recovery levels, and time periods must be based upon the characteristics and circumstances of each salmon species under consultation.

The NMFS Proposed Recovery Plan for listed Snake River salmon (NMFS 1995b) calls for measures in each life stage that are based upon the best available scientific information concerning the listed species' biological requirements. The statutory goal of the recovery plan is to conserve the species so they can, at minimum, survive. It must also attempt to add all life-stage specific measures together in such a manner as to bring about the species' recovery. For this reason, the Recovery Plan is the best source for the measures that are necessary in each life stage for meeting the biological requirements of the species throughout their life cycles.

The listed Snake River salmon face circumstances, where their current status, as affected by environmental baseline, is such that there is a low expectation of survival with an adequate potential for recovery. Therefore, the proposed or continuing actions must reduce the risk of adverse effect in the action area to ensure that the likelihood of the species' survival and recovery is not appreciably diminished. The amount of risk reduction necessary to determine that the action will not be likely to jeopardize the listed species depends upon the current status of the species. Again, the Recovery Plan is the best source of the actions and information needed to make improvements in each life stage sufficient to satisfy the requirements of Section 7(a)(2). Therefore, NMFS will first consider whether the proposed action is consistent with the Recovery Plan. If not, NMFS will consider whether the proposed action reduces the risks to the listed species as much as or more than the Recovery Plan.

5. Identify reasonable and prudent alternatives to a proposed or continuing action that is likely to jeopardize the continued existence of the listed species.

If the proposed or continuing action is likely to jeopardize the listed species, NMFS must consider potential reasonable and prudent alternatives that would comply under Sec. 7(a)(2) of the ESA. In that case, the Proposed Snake River Salmon Recovery Plan which lays out measures "for the conservation and survival of endangered species," under § 4(f)of the ESA, is the best source of reasonable and prudent alternatives that the action agency may implement and thereby meet its obligations under ESA § 7(a)(2).

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