

Species		Historic range	Family name	Status	When listed	Critical habitat	Special rules
Scientific name	Common name						
<i>Malacothrix indecora</i>	Santa Cruz Island malacothrix.	U.S.A. (CA)	Asteraceae—Aster .	E	*	NA	NA
<i>Malacothrix squalida</i>	Island malacothrix ...	U.S.A. (CA)	Asteraceae—Aster .	E	*	NA	NA
<i>Phacelia insularis</i> <i>ssp. insularis.</i>	Island phacelia	U.S.A. (CA)	Hydrophyllaceae —Waterleaf	E	*	NA	NA
<i>Thysanocarpus conchuliferus.</i>	Santa Cruz Island lacepod.	U.S.A. (CA)	Brassicaceae—Mustard.	E	*	NA	NA
*	*	*	*	*	*	*	*

Dated: July 7, 1995.

Mollie H. Beattie,

Director, Fish and Wildlife Service.

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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 227

[Docket No. 950407093-5179-02; I.D. 012595A]

Endangered and Threatened Species; Proposed Threatened Status for Three Contiguous ESUs of Coho Salmon Ranging From Oregon Through Central California

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Proposed rule; request for comments.

SUMMARY: NMFS has completed a comprehensive status review of coho salmon (*Oncorhynchus kisutch*) populations from southern British Columbia to southern California, and has identified six evolutionarily significant units (ESUs) within this range. NMFS is now issuing a proposed rule to list three of these ESUs as threatened (Oregon coast, southern Oregon/northern California, and central California coast). NMFS is also adding two ESUs (Puget Sound/Strait of Georgia, lower Columbia River/southwest Washington coast) to the candidate species list because, while there is not sufficient information available at this time to indicate that coho salmon in either ESU warrant protection under the Endangered

Species Act (ESA), NMFS has identified specific risk factors and concerns that need to be resolved prior to assessing the overall health of the ESUs.

NMFS is requesting public comments and input on the biological issues pertaining to the proposal. NMFS also is soliciting suggestions and input on integrated local/state/federal conservation measures that might best achieve the purposes of the ESA relative to recovering the health of coho salmon populations and the ecosystems upon which they depend. Should the proposed listings be made final, protective regulations under the Endangered Species Act (ESA) would be put into effect and a recovery program(s) would be implemented.

DATES: Comments must be received by October 23, 1995. NMFS will announce the dates and locations of public hearings in Washington, Oregon, and California in a separate **Federal Register** document. Requests for additional public hearings must be received by September 8, 1995.

ADDRESSES: Comments on this proposed rule and requests for public hearings should be sent to the Environmental and Technical Services Division, NMFS, Northwest Region, 525 NE Oregon Street, Suite 500, Portland, OR 97232-2737.

FOR FURTHER INFORMATION CONTACT: Garth Griffin, 503-230-5430, Craig Wingert, 310-980-4021, or Marta Nammack, 301-713-1401.

SUPPLEMENTARY INFORMATION:

Petition Background

On July 21, 1993, NMFS received a petition from Oregon Trout, Portland Audubon Society, and Siskiyou Regional Educational Project (Oregon Trout et al.) to list five or more ESUs (See Consideration as a "Species" under

the ESA) of indigenous, naturally spawning coho salmon in Oregon and to designate critical habitat under the ESA. The five ESUs identified by the petitioners included coho salmon populations from rivers south of Cape Blanco, the Coquille and Coos Rivers, the Umpqua River, rivers between the Umpqua and Nehalem rivers, and the Columbia River. On October 27, 1993, NMFS published a notice of finding (58 FR 57770) that a listing may be warranted, soliciting information about the status of all populations of coho salmon in Washington, Oregon, and California. NMFS determined that such an expanded status review was warranted due to the general decline in many West Coast coho salmon populations.

Supplemental to the July 21, 1993, petition, on October 20, 1993, NMFS received a petition from Pacific Rivers Council and 22 co-petitioners (PRC et al.) to list under the ESA, either on an emergency basis or through normal listing procedures, all coho salmon populations in Washington, Idaho, Oregon, and California, and to designate critical habitat. On January 26, 1994, NMFS published a notice of finding (59 FR 3662) that a non-emergency listing may be warranted, soliciting information about the status of all populations of coho salmon "coastwide" (hereinafter defined as populations in the southern portion of the species' range inhabiting rivers south of Queen Charlotte Strait, British Columbia). The notice also announced that information submitted in response to the PRC et al. petition would be used in NMFS' coastwide review of coho salmon populations already underway (58 FR 57770, October 27, 1993).

Prior to the Oregon Trout et al. and PRC et al. petitions, NMFS received two

separate petitions to list and designate critical habitat for (1) lower Columbia River coho salmon (55 FR 37342, September 11, 1990), and (2) coho salmon in Scott and Waddell Creeks, CA (58 FR 33605, June 18, 1993). For both petitions, NMFS published determinations denying listings because evidence indicated that neither of the petitioned entities constituted a "species" under the ESA (56 FR 29553, June 27, 1991, and 59 FR 21744, April 26, 1994). Information considered in these earlier status reviews was also used in NMFS' coastwide review of coho salmon populations.

During the coastwide status review, NMFS assessed the best available scientific and commercial data and received technical information from Pacific Salmon Biological and Technical Committees (PSBTCs) in Washington, Oregon, and California; a committee was not convened in Idaho because coho salmon are extinct in that state (see ESU Determinations). The PSBTCs consisted of scientists (from Federal, state, and local resource agencies, Indian tribes, industries, professional societies, and public interest groups) that have technical expertise relevant to coho salmon. While NMFS' status review focused on coho salmon populations in Washington, Oregon, and California, the geographic scope was broadened to include populations from southern British Columbia, due to their potential similarity to coho salmon populations in Washington.

A NMFS Biological Review Team, comprised of staff from NMFS' Northwest Fisheries Science Center (NWFS) and Southwest Regional Office, has completed a coastwide status review for coho salmon (Memorandum to G. Smith from M. Schiewe, July 5, 1994, Preliminary Conclusions of the Northwest Science Center's Review of a Petition to List Oregon Populations of Coho Salmon under the U.S. Endangered Species Act; Memorandum to W. Stelle from M. Schiewe, September 2, 1994, Status Review of Coho Salmon from California, Oregon, and Washington; Memorandum to W. Stelle from M. Schiewe, February 22, 1995, Puget Sound Coho Salmon; Memorandum to R. Schmitt from W. Stelle, March 20, 1995, Puget Sound Coho Salmon. Copies of the memoranda are available upon request (see ADDRESSES). The review, summarized below, identifies six ESUs of coho salmon from southern British Columbia, Washington, Oregon, and California. NMFS is now issuing a proposed rule to list three ESUs as threatened under the ESA. Full results of NMFS' status review of coho salmon populations will

be published in a forthcoming NOAA Technical Memorandum.

Biological Background

Coho salmon are anadromous, meaning they migrate from the ocean to spawn in fresh water. The species was historically distributed throughout the North Pacific Ocean from central California to Point Hope, AK, through the Aleutian Islands, and from the Anadyr River, Russia, south to Hokkaido, Japan. Historically, this species probably inhabited most coastal streams in Washington, Oregon, and central and northern California. Some populations, now considered extinct, are believed to have migrated hundreds of miles inland to spawn in tributaries of the upper Columbia River in Washington, and the Snake River in Idaho.

In contrast to the life history patterns of other anadromous salmonids, coho salmon in the region under status review generally exhibit a relatively simple, 3 year life cycle. Adults typically begin their freshwater spawning migration in the late summer and fall, spawn by mid-winter, then die. Run and spawn timing of adult coho salmon varies between and within coastal and Columbia River Basin populations (see Ecological/Genetic Diversity). Depending on temperature, eggs incubate in "redds" (gravel nests excavated by spawning females) for 1.5 to 4 months before hatching as "alevins" (a larval life stage dependent on food stored in a yolk sac). Following yolk sac absorption, alevins emerge from the gravel as young juveniles or "fry" and begin actively feeding. Juveniles rear in fresh water for up to 15 months, then migrate to the ocean as "smolts" in the spring. Coho salmon typically spend two growing seasons in the ocean before returning to their natal stream to spawn as 3 year-olds. Some precocious males, called "jacks," return to spawn after only 6 months at sea.

During this century, indigenous, naturally-reproducing populations of coho salmon are believed to have been extirpated in nearly all Columbia River tributaries and to be in decline in numerous coastal streams in Washington, Oregon, and California. At least 33 populations have been identified by agencies and conservation groups as being at moderate or high risk of extinction. In general, there is a geographic trend in the status of West Coast coho salmon stocks, with the southernmost and easternmost stocks in the worst condition.

Consideration as a "Species" Under the ESA

To qualify for listing as a threatened or endangered species, the identified populations of coho salmon must be considered "species" under the ESA. The ESA defines a "species" to include any "distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." NMFS published a policy (56 FR 58612, November 20, 1991) describing how the agency will apply the ESA definition of "species" to anadromous salmonid species. This policy provides that a salmonid population will be considered distinct, and hence a species under the ESA, if it represents an ESU of the biological species. A population must satisfy two criteria to be considered an ESU: (1) It must be reproductively isolated from other conspecific population units, and (2) it must represent an important component in the evolutionary legacy of the biological species. The first criterion, reproductive isolation, need not be absolute, but must be strong enough to permit evolutionarily important differences to accrue in different population units. The second criterion is met if the population contributes substantially to the ecological/genetic diversity of the species as a whole. Guidance on the application of this policy is contained in a scientific paper "Pacific Salmon (*Oncorhynchus* spp.) and the Definition of 'Species' under the Endangered Species Act" and a NOAA Technical Memorandum "Definition of 'Species' Under the Endangered Species Act: Application to Pacific Salmon," which are available upon request (see ADDRESSES). The following sections describe the genetic, ecological, and life history characteristics, as well as human-induced genetic changes that NMFS assessed to determine the number and geographic extent of coho salmon ESUs.

International ESUs

In the case of Pacific salmon and anadromous trout, it is likely that a coastwide status review will result in the identification of one or more ESUs that, from a biological standpoint, include populations from foreign countries (e.g., Canada). The ESA encourages international efforts to protect threatened or endangered species and authorizes NMFS to list species occurring in foreign countries after taking into account any efforts being made to protect the species.

Reproductive Isolation

A review of published accounts indicates that homing fidelity in coho salmon is generally strong, with low levels of straying (about 1 percent) estimated for most natural populations that have been studied. On the other hand, coho salmon habitat typically includes small tributaries that experience relatively frequent, temporary blockages, and there are a number of examples in which coho salmon have rapidly recolonized vacant habitat that had only recently become accessible to anadromous fish. Because ESU determinations focus on units that are strongly isolated over evolutionarily important time frames, NMFS concludes that, in general, local spawning populations of coho salmon are unlikely to meet the criterion of reproductive isolation. However, groups of local populations among tributaries within a river drainage may experience substantial, long-term isolation from other such groups.

Genetic data provide useful indirect information on reproductive isolation because they integrate information about migration and gene flow over evolutionarily important time frames. The Genetics Project within the NWFSC is developing a coastwide database of protein electrophoretic data for coho salmon, and the database now includes information for 53 polymorphic gene loci in samples from over 100 populations covering a geographic range from the Trinity River, CA, to Bristol Bay, AK. Published results from several other studies of genetic characteristics of coho salmon populations were also considered. These included additional studies based on protein electrophoresis (Olin 1984, Solazzi 1986, Reisenbichler and Phelps 1987, Wehrhahn and Powell 1987, Bartley 1987, Gall 1991), an agglomerative approach based on data from life history, morphology, and protein electrophoresis (Hjort and Schreck 1982), and two recent studies of variation at the DNA level (Currens and Farnsworth 1993, who examined variation at mitochondrial DNA (mtDNA) and Forbes et al. 1993, who examined variation in nuclear DNA).

Although collectively these studies show that the pattern of relationships among populations is complex, there is a strong geographic component to the observed population structure, and several major stock groupings can be identified. While a few individual samples proved to be exceptions to the general patterns, possible explanations for these results include true ancestral relationships, stock transfers, and random variation in an analysis

involving a large number of samples. Major stock groupings resulting from NMFS' analysis are described below.

Southern Oregon/California—Because the NMFS data set included only a single sample from California, the analysis was supplemented with published data from Olin (1984), Bartley (1987), and Gall (1991). This resulted in data for 13 polymorphic gene loci for 26 samples from southern Oregon (south of Cape Blanco) and California, including 4 from the NMFS data set. Limitations of this analysis are that many sample sizes were small, and data were not available for some of the most variable gene loci. Nevertheless, results clearly show two major geographic clusters in this region, separated by a relatively large genetic distance. The northern (and primarily large-river) group includes 12 samples ranging from the Elk River (just south of Cape Blanco) to the Eel River (just north of Cape Mendocino). The southern (and primarily small-river) group includes 11 samples, spanning a geographic range from Fort Bragg to Tomales Bay. There is considerable genetic diversity within both groups, particularly the northern. Three small-river samples from the southern region (Scott, Cottoneva, and Pudding Creeks) are outliers to both of the major groups, and Huckleberry Creek (Eel River Basin) is only loosely allied to the northern group.

Oregon coast—The NMFS study shows that samples of coho salmon from the Oregon coast are genetically distinct from other coastal and Columbia River populations. In addition, there is evidence for genetic differentiation within this group. Samples from four hatcheries on the northern Oregon coast form a group that is well differentiated from other samples. It is not known how accurately these samples reflect genetic characteristics of coho salmon native to this area. Most samples from the Oregon coast are part of a large genetic cluster. This cluster includes both natural and hatchery populations. A third cluster within the Oregon coastal group consists of wild and hatchery samples from the Elk and Umpqua Rivers that also share some degree of similarity with a hatchery sample from the Rogue River.

Hjort and Schreck (1982) also found that a group of hatchery populations from northern Oregon was distinct from other hatchery and natural populations along the Oregon coast. Their study further indicated that Oregon coastal populations of coho salmon differed from those in other regions, including the Columbia River Basin, California, and Washington. Results obtained by Olin (1984) and Solazzi (1986) are

generally consistent with the patterns described above. In addition, Solazzi (1986) found that two wild populations from the north coast of Oregon, which were not included in the NMFS data set, clustered with hatchery samples from northern Oregon.

Recent DNA data for Oregon coho salmon are largely consistent with results based on protein electrophoretic analyses. Currens and Farnsworth (1993) identified three major groups within Oregon: (1) North and central Oregon coastal populations, (2) Columbia River populations, and (3) south Oregon coastal populations and two unusual Columbia River populations—the Clatskanie and Clackamas Rivers. Forbes et al. (1993) reported highly significant differences between Columbia River and Oregon coastal coho salmon, but only marginal differences among stocks within these regions.

Lower Columbia River—Another major cluster in the NMFS analysis includes all of the lower Columbia River samples, as well as samples from the southwest Washington coast. Within this larger group, several smaller clusters can be identified. Two of the subclusters, one dominated by samples from Washington and the other by samples from Oregon, include most of the samples from the lower Columbia River. Another subcluster contains three samples from Willapa Bay on the southwest Washington coast. A final subcluster includes samples from the Clackamas and Clatskanie Rivers in the lower Columbia River and samples from the Humptulips and Simpson Hatcheries on the southwest Washington coast. As noted above, Currens and Farnsworth also found a genetic similarity between samples from the Clackamas and Clatskanie Rivers, based on mtDNA markers.

Puget Sound, Strait of Georgia, and Olympic Peninsula—The few samples NMFS examined from Alaska and the upper Fraser River, Canada, are substantially different genetically from all U.S. populations and are not considered further here. In contrast, samples NMFS has examined from Puget Sound and the Strait of Georgia form a coherent genetic cluster. Closely allied to this Puget Sound/Strait of Georgia group is a group of populations from the northwestern Olympic Peninsula (northern coast of Washington and the western end of the Strait of Juan de Fuca). In earlier studies, Reisenbichler and Phelps (1987) found little geographic structure among samples of coho salmon from the northern coast of Washington, whereas Wehrhahn and Powell (1987) found

significant differences between samples from the upper Fraser River and the lower coastal mainland of British Columbia. However, because some rare alleles were shared between the latter two areas, Wehrhahn and Powell concluded that there are no absolute barriers to dispersal of coho salmon between the lower coastal mainland, lower Vancouver Island, and the Fraser River.

Ecological/Genetic Diversity

Several types of physical and biological evidence were considered in evaluating the contribution of coho salmon from southern British Columbia, Washington, Oregon, and California to the ecological/genetic diversity of the biological species throughout its range. Factors examined included: (1) The physical environment—geology, soil type, air temperature, precipitation, river flow patterns, water temperature, and ocean conditions/upwelling; (2) biogeography—marine, estuarine, and freshwater fish distributions, and vegetation; and (3) life-history traits—smolt size and outmigration timing, age and size at spawning, river entry timing, spawning timing, and marine coded-wire-tag (CWT) recoveries. The relative magnitudes of potential human-induced genetic changes were also considered. The physical and zoogeographic evidence supporting the delineation of each ESU is addressed under "ESU Determinations." Because life history traits provide important insight into the ecological/genetic diversity of the species and can reflect unusual or distinctive adaptations that promote evolutionary processes, a more detailed discussion has been provided below.

Coho salmon life-history traits that show some regional variation include river entry and spawning timing, age at maturity, and marine CWT recovery patterns. River entry and spawning timing patterns of coho salmon are considerably variable in time and space, but some regional patterns exist. Puget Sound coho salmon typically enter the rivers in October, but some basins have very early and late runs. Along the Washington coast, river entry generally occurs in October, with a few exceptionally late or early runs. Historically, Columbia River coho salmon entered fresh water from August through December, while Oregon coho salmon enter rivers in October. Coho salmon in southern Oregon and northern California also enter rivers in September or October. River entry is much later south of the Klamath River Basin, occurring in November and December in basins south of the Klamath River to the Mattole River, CA,

and from mid-December to mid-February in rivers farther south.

Spawning timing shows less variation than river entry, but it has similar patterns. Along most of the Washington and Oregon coasts and in Puget Sound, coho salmon spawn in November and December, with exceptionally early and late runs occurring along the Washington coast, in the Columbia River, and in Puget Sound. Spawning in southern Oregon and northern California also occurs in December, but south of the Mattole River it occurs most frequently in January. Because coho salmon enter rivers late and spawn late south of the Mattole River, they spend much less time in the river prior to spawning than do coho salmon farther north. Coho salmon adults in the three-state area overwhelmingly (>95%) spawn at age 3, spending just over a year in fresh water and a year and a half in the ocean (Sandercock 1991). In contrast, many coho salmon adults from southeast Alaska spend over 2 years in fresh water and return to spawn at age 4. It is not known exactly where the transition occurs between these two age structures, but limited information suggests that an increasing proportion of 2 year-old smolts is seen in coho salmon as one approaches the north end of Vancouver Island from the south.

The life-history trait showing the clearest differentiation coastwide is the pattern of ocean distribution inferred from marine recoveries of hatchery fish carrying CWTs. These data, from the Pacific States Marine Fisheries Commission's regional Mark Information System, show that marked coho salmon from southern Oregon and northern California are most frequently recovered from California coastal waters (65 to 92 percent), with some recoveries off Oregon (7 to 34 percent), but almost none off Washington or British Columbia. In contrast, coho salmon from the Oregon coast north of Cape Blanco are recovered primarily in Oregon waters (57 to 60 percent), with significant appearance in California (27 to 39 percent), and low but fairly consistent recovery levels from British Columbia (2 to 6 percent) and Washington (2 to 9 percent). Compared to the Oregon coast populations, Columbia River populations have approximately the same proportion of British Columbia (2 to 16 percent) and Oregon (36 to 67 percent) recoveries, but the California recoveries are considerably lower (1 to 15 percent) and the Washington recoveries correspondingly higher (22 to 54 percent).

Populations from the Washington coast, Puget Sound, and British

Columbia have much more northern recovery patterns than those from either the Columbia River or the Oregon coast, although distinctive patterns within Washington and British Columbia are not as obvious as those for groups farther south. Coho salmon released from central British Columbia were frequently recovered off Alaska (15 to 39 percent), with the remainder of the recoveries coming from British Columbia (61 to 85 percent). Coho salmon released along the east and west coasts of Vancouver Island and the southwest British Columbia mainland are caught almost exclusively in British Columbia (90 to 99 percent), with infrequent recoveries in Alaska (less than 1 percent), Washington (0 to 9 percent), and Oregon (less than 2 percent). Coho salmon released from Puget Sound, Hood Canal, and the Strait of Juan de Fuca are recovered from Washington (23 to 72 percent), British Columbia (27 to 74 percent), and Oregon (0 to 3 percent), with essentially no recoveries from Alaska or California. Coho salmon from the Washington coast have similar CWT recovery patterns, but have higher Oregon recoveries than Puget Sound/Hood Canal coho salmon.

Because Puget Sound and Hood Canal coho salmon are caught at high levels in Puget Sound, an area not entered by coho salmon from other areas, recoveries from this area might be considered an extension of freshwater recoveries, which were excluded from the above analyses. Removing Puget Sound recoveries from total Washington marine recoveries results in Puget Sound and Hood Canal coho salmon recovery patterns that are intermediate to those of British Columbia and the Washington coast.

Genetic Changes Due to Human Activities

The effects of artificial propagation and other human activities can be relevant to ESA listing determinations in two ways. First, such activities can genetically change natural populations so much that they no longer represent an evolutionarily significant component of the biological species (Waples 1991). For example, in 1991, NMFS concluded that, as a result of massive and prolonged effects of artificial propagation, harvest, and habitat degradation, the agency could not identify natural populations of coho salmon in the lower Columbia River that qualified for ESA consideration. Second, risks to the viability and genetic integrity of native salmon populations posed by human activities may contribute to their threatened or endangered status (Goodman 1990, Hard

et al. 1992). The severity of these effects on natural populations depends both on the nature of the effects (e.g., harvest rate, gear size, or type of hatchery practice) and their magnitude (e.g., duration of a hatchery program and number and life-history stage of hatchery fish involved). Several of these factors may be important to ESA considerations of coho salmon.

Stock transfers—Stock transfers of coho salmon have been (and continue to be) common throughout the West Coast; the nature and magnitude of these transfers varies by geographic region. Compared to areas farther north, hatcheries in central California and southern Oregon/northern California are relatively small and widely dispersed, given the size of both areas. In recent years, large hatcheries in southern Oregon/northern California (e.g., Mad and Trinity Hatcheries) have produced 400,000 to 500,000 juveniles annually, while smaller hatcheries, and most hatcheries in central California, produce no more than 100,000 to 200,000 juveniles each year. There has been considerable transfer of coho salmon among hatcheries or egg-taking stations in central and northern California, with the fish eventually outplanted in either area. Northern California hatcheries have also received fairly large transplants of coho salmon from hatcheries in Washington and Oregon, which have spread to central California through stock transfers. Because of the predominance of hatchery stocks in the Klamath River Basin, stock transfers into Trinity and Iron Gate Hatcheries may have had a substantial impact on natural populations in the basin. In contrast, Cole Rivers Hatchery (on the Rogue River) appears to have relied almost exclusively on native stocks.

Most Oregon coastal hatcheries produce approximately 400,000 to 1,400,000 juveniles annually, although private hatcheries (no longer in operation) recently produced 2 to 5 million juvenile coho salmon annually. Most transfers of coho salmon into Oregon coastal hatcheries have used other Oregon coastal stocks. However, some coastal hatchery programs (notably private hatcheries no longer in existence) made extensive use of Puget Sound coho salmon stocks. Some transfers of Columbia River coho salmon into Oregon coastal hatcheries have occurred, but these were relatively infrequent and minor. Similarly, most outplants of coho salmon into Oregon coastal rivers have used Oregon coastal stocks, with outplants of stocks from other areas being relatively small and infrequent.

Southwest Washington hatcheries are relatively large and numerous for the area, and most produce 1 to 3 million juveniles annually. Hatcheries in southwest Washington have used native stocks in addition to those from Puget Sound/Strait of Georgia, Olympic Peninsula, and the Columbia River. Currently, the magnitude and frequency of stock transfers from outside the area are relatively small. Within southwest Washington, there has been some movement of stocks between rivers draining into Grays Harbor and Willapa Bay. Outplants show a similar pattern to hatchery transfers; coho salmon from Puget Sound/Strait of Georgia, Olympic Peninsula, and a limited number from the Columbia River have been outplanted in southwest Washington, but the most frequent and largest outplants have used southwest Washington stocks.

Hatchery production of coho salmon in the Columbia River far exceeds that of any other area with respect to the number of hatcheries and quantities of fish produced. Many Columbia River hatcheries produce several million smolts annually, with the largest hatcheries releasing up to 10 million smolts in a given year. Extensive stock transfers have occurred within the Columbia River, both within and between hatcheries from Washington and Oregon. Prior to about 1960, transfers of coho salmon from the Oregon coast were also common, and there have been a few introductions of Puget Sound stocks. Columbia River outplanting records show a similar pattern of extensive use of Columbia River and Oregon coast coho salmon, and some Puget Sound stocks. The Clackamas River has also been extensively outplanted with early-running Columbia River stocks and was outplanted with coho salmon from the Oregon coast in 1967.

Most Olympic Peninsula hatcheries produce approximately 1 million juvenile coho salmon annually. In addition to hatchery production, natural production in the area is relatively high, due in large part to nearly pristine habitat within the Olympic National Park. The Quillayute Hatchery has relied primarily on native stocks, while other hatcheries in the area have incorporated stocks from southwest Washington, Puget Sound, and the Columbia River, in addition to Olympic Peninsula stocks. These transfers from outside the Olympic Peninsula are generally considered to represent only a minor contribution to the existing hatchery stocks. Olympic Peninsula drainages are primarily outplanted with Olympic Peninsula stocks; however,

some outplants of Puget Sound/Strait of Georgia, southwest Washington, and Columbia River stocks have occurred.

Hatchery production in the Puget Sound/Strait of Georgia is extensive, and many of the larger hatcheries produce several million smolts annually. However, this geographic area is quite large and considerable natural production also occurs. Stock transfers and outplants have also been extensive, but most stocks involved have been derived from within this area. Net pen production in Puget Sound is also fairly extensive, but unlike hatcheries, has no means to attract and spawn salmon that are released from the pens. This can result in straying of pen-reared coho salmon into adjacent rivers.

Run timing—Advancement and compression of run timing are common phenomena in hatchery populations, and these changes can affect future generations of naturally-reproducing fish. Fry of early-spawning adults generally hatch earlier and grow faster, and can thus displace fry of later-spawning natural fish (Chapman 1962). Conversely, early-spawning coho salmon redds are more prone to being destroyed by early fall floods. Consequently, early-spawning individuals may be unable to establish permanent, self-sustaining populations, but may nevertheless adversely affect existing natural populations (Solazzi et al. 1990). A recent study found that over a period of 13 years, the range of spawning timing of coho salmon at five Washington hatcheries decreased from 10 weeks to 3 weeks, causing the range of the period of return to the hatcheries to decrease by one-half (Flagg et al. in press).

Juvenile outplants—Another common hatchery practice with coho salmon is release of "excess" hatchery production into natural habitat as fry or parr. Outplanting large numbers of large hatchery juveniles into streams already occupied by naturally-produced juveniles may place the resident fish at a competitive disadvantage and may force them into marginal habitats that have low survival potential (Chapman 1962, Solazzi et al. 1990).

Adult size—Ricker (1981) discussed evidence for declines in size and age of Pacific salmon in this century and suggested that size-selective fisheries were an important factor in the observed trends. Gill nets are probably the most size-selective fishing gear in general use, preferentially harvesting larger fish. Gillnet fisheries are important components of coho salmon harvests in most areas of the Pacific Northwest. Between 1972 and 1993, the size of coho salmon sampled from in-river gillnet

fisheries in Puget Sound decreased by about one-half, and a similar declining pattern has been observed by other researchers for the Strait of Georgia (Ricker 1981). There is some evidence for declining size of coho salmon outside the Puget Sound/Strait of Georgia area, but the trends are not as great in other areas.

Declines in adult size can have direct implications for individual reproductive success and population viability. As is the case in other salmon species, coho salmon fecundity is a non-linear function of size (Fleming and Gross 1989), such that a small reduction in size can lead to a substantial reduction in fecundity. Also, smaller coho salmon females dig fewer and significantly shallower redds than do larger females (van den Berghe and Gross 1984). This subjects the redds of smaller individuals to greater risk of destruction by superimposition of other redds or scouring by floods. Flooding frequency has increased throughout much of Puget Sound because of habitat degradation (Booth 1991), further decreasing the survival potential of redds created by small females.

It is not clear whether the dramatic size reductions observed in Puget Sound/Strait of Georgia coho salmon are due to harvest practices, effects of fish culture, declining ocean productivity, density-dependent effects in the marine environment attributable to large numbers of hatchery releases, or a combination of these factors. Similarly, it is not known whether there have been permanent genetic changes related to the size changes in the populations. Regardless of its cause or genetic basis, reduced adult size in itself poses a number of serious risks to natural populations of coho salmon, and could be a sign of other factors placing the population at risk.

ESU Determinations

This is the first NMFS status review that attempts to comprehensively determine ESUs over a broad geographic area. The ESU determinations described here represent a synthesis of a large amount of diverse information. In general, the proposed geographic boundaries for each ESU (i.e., the watersheds within which the members of the ESU are typically found) are supported by several lines of evidence that show similar patterns. However, the diverse data sets are not always entirely congruent (nor would they be expected to be), and the proposed boundaries are not necessarily the only ones possible. For example, in some cases (e.g., on the northern Olympic Peninsula moving from west to east), environmental

changes occur over a transition zone rather than abruptly.

Based on the best available biological and commercial information, including the biological effects of human activities, NMFS has identified six ESUs that include coho salmon populations from southern British Columbia, Washington, Oregon, and California. The six ESUs are briefly described and characterized below. Genetic data (from studies of protein electrophoresis and DNA) were the primary evidence considered for the reproductive isolation criterion, supplemented by inferences about barriers to migration created by natural geographic features and human-induced changes resulting from artificial propagation and harvest. Factors considered to be most informative in evaluating ecological/genetic diversity include data pertaining to the physical environment, ocean conditions/upwelling, vegetation, estuarine and freshwater fish distributions, river entry and spawning timing, and marine CWT recoveries. A brief description of population segments now considered to be extinct has also been provided.

(1) Central California Coast

The geographic boundaries of this ESU extend from Punta Gorda in northern California to the San Lorenzo River, in Santa Cruz, CA, and includes coho salmon populations from several tributaries of San Francisco Bay (e.g. Corte Madera and Mill Valley Creeks). Genetic data indicate that most samples from this region differ substantially from coho salmon north of Punta Gorda. Run- and spawn-timing of coho salmon are very late (peaking in January) and appear to be timed to coincide with the single, brief peak of river flow. Freshwater fishes in the region are derived from the Sacramento River fauna. This area is characterized by very erosive soils in the coast range mountains; redwood forest is the dominant coastal vegetation for these drainages. Precipitation is lower here than in areas to the north, and elevated stream temperatures (greater than 20° C) are common in the summer. Coastal upwelling in this region is strong and consistent, resulting in a relatively productive nearshore marine environment. Limited CWT data indicate that nearly all coho salmon from this ESU are captured in California waters.

Available information indicates that the San Lorenzo River currently is the southernmost population of coho salmon, and this is the geographic boundary for the proposed ESU. However, it should be recognized that

any coho salmon found spawning south of the San Lorenzo River that have not resulted from stock transfers from outside the ESU are also part of the ESU.

(2) Southern Oregon/northern California Coasts

This ESU includes coho salmon from coastal drainages between Cape Blanco in southern Oregon and Punta Gorda in northern California. Genetic data indicate that most samples from this region differ substantially from coho salmon from south of Punta Gorda. In general, populations from southern Oregon also differ from coastal Oregon populations north of Cape Blanco. However, some samples from the Rogue River show an unexplained genetic affinity to samples from outside the region, including some from the Columbia River. In addition, a sample from the Elk River (just south of Cape Blanco) clusters with samples from the Umpqua River. In contrast to coho salmon from north of Cape Blanco, which are most frequently captured off Oregon, coho salmon from this region are captured primarily in California waters. Freshwater fishes in this region include elements of the Sacramento River fauna, as well as from the Klamath-Rogue Ichthyofaunal Region.

Geologically, this region includes the Klamath Mountains Province, which is not as erosive as the Franciscan formation terrains south of the Klamath River Basin. Dominant vegetation along the coast is redwood forest, while some interior basins are much drier than surrounding areas and are characterized by many endemic species. Elevated stream temperatures are a factor in some of the larger river basins, but not to the extent that they are in river basins south of Punta Gorda. With the exception of major river basins such as the Rogue and Klamath, most rivers in this region have short duration of peak flows. Strong and consistent coastal upwelling begins at about Cape Blanco and continues south into central California, resulting in a relatively productive nearshore marine environment.

(3) Oregon Coast

This ESU includes coho salmon from Oregon coastal drainages between Cape Blanco and the Columbia River. Genetically, coastal Oregon populations are distinct from Columbia River, Washington coastal, and northern California/southern Oregon (see above) populations. Within the Oregon coast ESU, hatchery populations from the north Oregon coast form a distinctive subgroup. Adult run- and spawn-timing are similar to those along the

Washington coast and in the Columbia River, but less variable. CWT recovery patterns for coho salmon released from this area are distinctive, compared to recovery patterns for coho salmon released from ESUs to the north or south. Freshwater fish fauna are primarily of Columbia River origin. Most rivers in this area drain the Coast Range Mountains, have a single peak in flow in December or January, and have relatively low flow during summer and early fall. The coastal region receives fairly high precipitation levels, and the vegetation is dominated by Sitka spruce and western hemlock. Upwelling off the Oregon coast is much more variable and generally weaker than areas south of Cape Blanco. While marine conditions off the Oregon and Washington coasts are similar, the Columbia River has greater influence north of its mouth, and the continental shelf becomes broader off the Washington coast.

(4) Lower Columbia River/southwest Washington Coast

NMFS has concluded that, historically, this ESU included coho salmon from all tributaries of the Columbia River below approximately the Klickitat and Deschutes Rivers, as well as coastal drainages in southwest Washington between the Columbia River and Point Grenville. The Columbia River estuary and Willapa Bay and Grays Harbor in southwest Washington all have extensive intertidal mud and sand flats and differ substantially from estuaries to the north and south. This similarity results from the shared geology of the area and the transportation of Columbia River sediments northward along the Washington coast. Rivers draining into the Columbia River have their headwaters in increasingly drier areas, moving from west to east. Columbia River tributaries that drain the Cascade Mountains have proportionally higher flows in late summer and early fall than rivers on the Oregon coast. CWT data indicate a distinctive oceanic distribution pattern for Columbia River coho salmon, with a higher percentage of Washington recoveries than for Oregon coastal stocks and a much lower percentage of British Columbia recoveries than for Washington coastal populations.

Genetic data indicate that Columbia River coho salmon are distinct from coastal Oregon populations but are similar to populations from several coastal streams in southwest Washington. A major cluster includes all of the lower Columbia River samples, as well as samples from the southwest Washington coast. Within this larger

group, several smaller clusters can be identified. Two of the subclusters, one dominated by samples from Washington and the other by samples from Oregon, include most of the samples from the lower Columbia River. Another subcluster contains three samples from Willapa Bay on the southwest Washington coast. A final subcluster includes samples from the Clackamas and Clatskanie Rivers in the lower Columbia River and samples from the Humptulips and Simpson Hatcheries on the southwest Washington coast.

In its 1990–91 status review for lower Columbia River coho salmon (excluding the Clackamas River), NMFS concluded that, historically, at least one ESU of coho salmon probably occurred in the lower Columbia River Basin, but the agency was unable to identify any remaining natural populations that warranted protection under the ESA (58 FR 29553, June 27, 1991). This status review has not uncovered substantial new information on coho salmon populations considered by that earlier status review. However, NMFS has concluded that, historically, coho salmon from the Clackamas River and the southwest Washington coast were probably part of the same ESU as lower Columbia River coho salmon. Late-run Clackamas River coho salmon are thought to at least partially represent native, lower Columbia River coho salmon. The relationship of coho salmon in these two areas to the historic ESU is uncertain.

The Clackamas River historically supported a native, late-run (spawning in December and January) coho salmon population, but access to the upper Clackamas River (above River Mile [RM] 29) was blocked between 1917 and 1939, when the fish ladder on Cazadero Dam failed. After fish passage was restored, late-run coho salmon recolonized the upper Clackamas River. The immigrants are thought to have been primarily natural coho salmon from either the lower Clackamas River, the lower Willamette River, or elsewhere in the lower Columbia River. In 1958, releases of early-run (spawning in October and November) coho salmon of mixed lower Columbia River lineage began in the Clackamas River. Because the timing of early-run and late-run Clackamas coho salmon overlapped extensively, the spawning timings of the two populations may have also overlapped, resulting in mixing of the stocks in the hatchery or on the spawning grounds. Recent (post-1980) divergence of run-timing between early- and late-run coho salmon in the Clackamas River is generally attributed

to intensive fishing pressure during the middle part of the run.

Information available to NMFS at the present time is not sufficient to identify any native populations of coho salmon on the southwest Washington coast that would qualify for protection under the ESA. However, we cannot exclude the possibility that some native late-run coho salmon occur in the Chehalis River basin.

(5) Olympic Peninsula

The geographic boundaries of this ESU are entirely within Washington, including coastal drainages from Point Grenville to and including Salt Creek (Strait of Juan de Fuca). Genetic data show that coho salmon from this region are distinct from populations to the south and somewhat differentiated from populations in the Puget Sound area. Coho salmon from the Olympic Peninsula ESU have a more northern ocean distribution than populations from the Columbia River or coastal regions in Oregon, and are more commonly captured in Canadian and Oregonian waters than are coho salmon from the Puget Sound region. This region is characterized by high levels of precipitation and streams with cold water, high average flows, and a relatively long duration of peak flows, including a second peak later in the year resulting from snow melt. In contrast to the more inland areas of Puget Sound, where western hemlock is the dominant forest cover at sea level, lowland vegetation in this region is dominated by Sitka spruce.

The west coast of Vancouver Island in British Columbia shares many of the physical and environmental features of the Olympic Peninsula ESU. However, NMFS has little biological information for coho salmon from this area. The Strait of Juan de Fuca is potentially a strong isolating mechanism, and, although comparable data are not available for coho salmon, genetic data for chinook salmon show that populations from the west coast of Vancouver Island differ genetically from those on the northern Washington coast. Therefore, at least until more complete information becomes available, NMFS has concluded that this ESU does not include coho salmon from Vancouver Island.

(6) Puget Sound/Strait of Georgia

This ESU includes coho salmon from drainages of Puget Sound and Hood Canal, the eastern Olympic Peninsula (east of Salt Creek), and the Strait of Georgia from the eastern side of Vancouver Island and the British Columbia mainland (excluding the

upper Fraser River). Genetic and CWT data both show substantial differences between coho salmon from this region and those from the Columbia River and more southern coasts, and more modest differences between coho salmon from this region and populations from the Olympic Peninsula. Coho salmon samples from Puget Sound and the Strait of Georgia form a coherent genetic cluster. The few samples NMFS has examined from Alaska and the upper Fraser River are substantially different genetically from all Washington, Oregon, and California populations. This region is drier than the rain forest area of the western Olympic Peninsula and is dominated by western hemlock forests. Streams are similar to those of the Olympic Peninsula, being characterized by cold water, high average flows, and a relatively long duration of peak flows, including a second snow-melt peak.

Drainages entering the Strait of Georgia from both sides share many of the physical and environmental features that characterize the Puget Sound area. From Vancouver Island south, coho salmon typically smolt at age 1, whereas 2-year old smolts are common from southeast Alaska north. Between the north end of Vancouver Island and southeast Alaska is a transition zone for this life history trait. At about this point (north end of Vancouver Island), the British Columbia mainland assumes more of the physical and environmental characteristics of the outer coast of Vancouver Island. However, genetic and life-history data for populations between the Strait of Georgia and Queen Charlotte Strait are insufficient to identify relationships between coho salmon in this area and those to the north and south. Therefore, NMFS has concluded that, at least until further information is developed, the geographic boundaries of this ESU extend into Canada to include drainages from both sides of the Strait of Georgia as far as the north end of the Strait.

Extinctions Within the Historical Range

Historically, coho salmon have been reported to occur in U.S. waters that are outside of the geographic areas covered by the proposed ESUs. There are few early records documenting coho salmon in the Sacramento River Basin, but it is believed that at least some populations may have existed there prior to 1850 (Brown and Moyle 1991, Bryant 1994). After that time, placer mining, dams, water diversions, and other perturbations caused extreme habitat degradation throughout the basin, and any coho salmon living there would have become extinct. In recent decades,

attempts have been made to reintroduce coho salmon to the basin, but these attempts have not been successful. Intermittent reports of small numbers of coho salmon in the Sacramento River are generally attributed to strays or remnants of these stocking programs. NMFS found no evidence that coho salmon eligible for ESA consideration (i.e., indigenous, naturally-reproducing fish) presently occur in the Sacramento River.

Although several tributaries in the upper Columbia River Basin, including the Snake River, once supported coho salmon runs, NMFS is not aware of any native coho salmon production in the upper basin at the present time. Consequently, although the petitioners included Idaho coho salmon in the petition, there are no coho salmon in Idaho that would qualify for listing under the ESA. Columbia River stock summary reports (CIS 1992) identify no coho salmon of native origin in this region, except in the Hood and Deschutes Rivers in Oregon. According to Nehlsen et al. (1991), all coho salmon above Bonneville Dam are extinct, except those spawning in the Hood River. Both the Hood and Deschutes Rivers have had extensive planting of hatchery coho salmon, and no recent natural production estimates are available. Therefore, NMFS has determined that the available evidence indicates that there are no coho salmon populations above Bonneville Dam eligible for ESA consideration at this time.

Status of the Coho Salmon ESUs

The ESA defines the term "endangered species" as "any species which is in danger of extinction throughout all or a significant portion of its range." The term "threatened species" is defined as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." Thompson (1991) suggested that conventional rules of thumb, analytical approaches, and simulations may all be useful in making this determination. In previous status reviews (e.g., Johnson et al. 1991), NMFS has identified a number of factors that should be considered in evaluating the level of risk faced by an ESU, including: (1) Absolute numbers of fish and their spatial and temporal distribution; (2) current abundance in relation to historical abundance and current carrying capacity of the habitat; (3) trends in abundance; (4) natural and human-influenced factors that cause variability in survival and abundance; (5) possible threats to genetic integrity

(e.g., from strays or outplants from hatchery programs); and (6) recent events (e.g., a drought or changes in harvest management) that have predictable short-term consequences for abundance of the ESU.

During the coastwide status review for coho salmon, NMFS evaluated both qualitative and quantitative information to determine whether any proposed ESU is threatened or endangered according to the ESA. Quantitative assessments were based on historical and recent run-size estimates and time series of freshwater spawner and juvenile survey data, angler catch estimates, harvest rate estimates, and counts of adults migrating past dams. Qualitative evaluations considered recent, published assessments by agencies or conservation groups of the status of coho salmon stocks (Nehlsen et al. 1991, Higgins et al. 1992, Nickelson et al. 1992, WDF et al. 1993). A summary of general findings from qualitative assessments follows; specific results will be discussed for each ESU.

Nehlsen et al. (1991) considered salmon stocks throughout Washington, Idaho, Oregon, and California and enumerated all stocks that they found to be extinct or at risk of extinction. They considered 15 coho salmon stocks to be extinct, 2 possibly extinct, 15 at high risk of extinction, 16 at moderate risk of extinction, and 2 of special concern. Coho salmon stocks that do not appear in their summary were either not at risk of extinction or there was insufficient information to classify them. Higgins et al. (1992) used the same classification scheme as Nehlsen et al. (1991), but provided a more detailed review of northern California salmon stocks. Of the 20 coho salmon stocks Higgins et al. identified as being at some risk of extinction, seven were classified as at high risk of extinction and the remainder were classified as of concern. Nickelson et al. (1992) rated coastal (excluding Columbia River Basin) Oregon salmon stocks on the basis of their status over the past 20 years, classifying stocks as "depressed" (spawning habitat underseeded, declining trends, or recent escapements below long-term average), "healthy" (spawning habitat fully seeded and stable or increasing trends), or "of special concern" (300 or fewer spawners or a problem with hatchery interbreeding). Of 55 coastal populations identified, 6 were classified as "healthy", 2 as "special concern", 41 as "depressed", and 6 as "unknown." WDF et al. (1993) categorized all salmon stocks in Washington on the basis of stock origin ("native," "non-native," "mixed," or "unknown"), production

type ("wild," "composite," or "unknown") and status ("healthy," "depressed," "critical," or "unknown"). Of the 90 coho salmon stocks identified in Washington, 37 were classified as "healthy," 35 as "critical" or "depressed," and 18 as "unknown." Of the 37 "healthy" stocks, only 4 (all on the Olympic Peninsula) were identified as "native" and "wild" production.

Despite recent regulations which have resulted in the closure or severe curtailment of ocean and river harvest along much of the west coast, the number of adult coho salmon returning in 1994 was very low in some river basins. Many of the coho salmon populations which are not in decline have a large hatchery-produced component that could hinder the ability of natural populations to sustain themselves in the long term. Habitat degradation, overfishing, inadequate regulatory mechanisms, negative effects of artificial propagation programs, drought and adverse ocean conditions over the last two decades are believed to be factors contributing to the species' decline.

1. *Central California Coast*—Data are limited for determining the status of this ESU. Recent population estimates have been compiled for NMFS (Brown and Moyle 1991; Brown et al. 1994). Other recent status reviews of coho salmon in California (Bryant 1994, CDFG 1994) have expanded some of the work of Brown and Moyle (1991). In compiling estimates of recent spawner abundance, Brown and Moyle relied on a "20-fish rule": If a stream with historic accounts of coho salmon lacked recent data, it was assumed to still support a run of 20 adults; if coho salmon were present in recent stream surveys, they used the larger of 20 or the most recent run estimate. While these estimates are crude, in most cases they are the best data available, and they are generally comparable with other estimates (Bryant 1994, CDFG 1994, Maahs and Gilleard 1994). Unless otherwise indicated, the recent abundance data used to determine the status of this ESU are taken from Brown et al. (1994).

Statewide (including areas outside this ESU) coho salmon spawning escapement in California apparently ranged between 200,000 to 500,000 adults per year in the 1940s (Brown et al. 1994). By the mid-1960s, statewide spawning escapement was estimated to have fallen to about 100,000 fish per year (CDFG 1965, California Advisory Committee on Salmon and Steelhead Trout 1988), followed by a further decline to about 30,000 fish in the mid-1980s (Wahle and Pearson 1987; Brown et al. 1994). From 1987 to 1991,

spawning escapement averaged about 31,000, with hatchery populations making up 57% of this total (Brown et al. 1994). Brown et al. (1994) estimated that there are probably less than 5,000 naturally-spawning coho salmon spawning in California each year, and many of these fish are in populations that contain less than 100 individuals.

Estimated average coho salmon spawning escapement in the central California coast ESU for the period from the early 1980's through 1991 was 6,160 naturally-spawning coho salmon and 332 hatchery spawned coho salmon (Brown et al. 1994). Of the naturally-spawning coho salmon, 3,880 were from tributaries in which supplementation occurs (the Noyo River and coastal streams south of San Francisco). Only 160 fish in the range of this ESU (all in the Ten Mile River) were identified as "native" fish, lacking a history of supplementation with non-native hatchery stocks. Based on redd counts, the estimated run of coho salmon in the Ten Mile River during the 1991-92 spawning season was 14 to 42 fish (Maahs and Gilleard 1994).

Of 186 streams in the range of the central California ESU identified as having historic accounts of adult coho salmon, recent data exist for 133 (72 percent). Of these 133 streams, 62 (47 percent) have recent records of occurrence of adult coho salmon and 71 (53 percent) no longer have coho salmon spawning runs. Nehlsen et al. (1991) provided no information on individual coho salmon stocks in this region, but identified stocks in small coastal streams north of San Francisco as at moderate risk of extinction, and those in small coastal streams south of San Francisco as at high risk of extinction. Higgins et al. (1992) considered only drainages from the Russian River north, but four coho salmon stocks within this ESU were identified as at risk: Three of special concern and one (Gualala River) as at high risk of extinction.

In comparison with ESUs that occur to the north, it is evident that coho salmon populations in the central California ESU are more depressed and at greater risk of extinction since the abundance of fish is generally lower and a larger number of populations which occurred historically have apparently been extirpated. However, the available data for assessing population numbers and trends over time in the northern portion of this ESU are limited for making a determination as to whether or not the ESU warrants listing as threatened or endangered. In the area south of San Francisco, however, it is clear that coho salmon populations are severely depressed. For this reason, the

California Department of Fish and Game (CDFG) has determined that the remaining coho populations south of San Francisco warrant protection as an endangered species under the California Endangered Species Act. However, in that portion of the ESU north of San Francisco, coho salmon populations are more abundant, and in fact most of the fish within the ESU occur there. Thus, while the southernmost populations in the ESU may warrant endangered status, it is not clear that the ESU as a whole is in imminent danger of extinction. In addition to this uncertainty, several actions have been taken or are anticipated which are expected to help protect and conserve coho populations in this ESU.

First, the State of California accepted a petition to list coho populations south of San Francisco in 1994 under the California Endangered Species Act and has been conducting a status review over the past year. Since the petition was accepted, the coho populations proposed for listing by the State have been protected under the State ESA. The CDFG recently completed its review and recommended that these populations be listed under State law as endangered. NMFS anticipates that the State Fish and Game Commission will take action to list these populations, and thereby implement protective actions, in the summer of 1995.

Second, the Pacific Fishery Management Council (PFMC) prohibited the retention of coho salmon in both the commercial and recreational salmon fisheries along the entire west coast in 1994. A similar action prohibiting the retention of coho in all salmon fisheries south of Cape Falcon has been implemented in 1995. These actions were taken because of the depressed status of Oregon and California coastal coho stocks in 1994 and 1995, and are expected to immediately benefit these stocks by increasing escapement.

Finally, the State of California Resources Agency has initiated an effort to coordinate a broad state-wide habitat conservation planning program designed to protect and conserve coho populations in California under the State's Natural Communities Conservation Planning (NCCP) program. This effort will involve the Federal government, all necessary State agencies, county and local jurisdictions, and affected stakeholders, and is aimed at developing a NCCP conservation program for coho salmon which would serve as the basis for an ESA 4(d) rule that could be promulgated by NMFS. The Resources Agency intends to model this planning effort for coho salmon after the NCCP program which was

developed and implemented for the California Gnatcatcher in southern California. In a June 21, 1995 letter to NMFS, the Resources Agency emphasized its belief that the conservation and recovery of coho salmon in California can best be accomplished by development and implementation of a NCCP conservation program and promulgation of a special section 4(d) rule because of the complex nature of the habitats, ownership patterns, and interests within the range of coho salmon. In this regard, the Resources Agency has strongly urged that NMFS propose coho salmon in California be listed as threatened so that the full flexibility of section 4(d) rulemaking can be retained and the NCCP planning process can move forward. NMFS believes that the NCCP conservation planning process envisioned by the Resources Agency is the best approach for developing and implementing a successful conservation and recovery strategy for coho salmon in California. However, NMFS also believes it is essential that a NCCP program be developed and implemented as quickly as possible in order to arrest the decline of coho salmon populations in this ESU and promote their successful recovery. In its letter to NMFS, the Resources Agency recognizes the importance of making demonstrable progress in developing an acceptable program for conserving coho salmon in California.

Based on the uncertainty of the data and the high potential for success of the developing NCCP conservation plan, NMFS concludes that the central California coast coho salmon ESU should be proposed for listing as a threatened species. However, during the period between publication of this proposed rule and publication of any final rule, NMFS will be gathering additional information to aid in making a final determination concerning the status of this ESU. Specifically, NMFS will: (1) Gather additional biological information on the status of coho salmon populations in this ESU; (2) attempt to assess the response of coho populations to the fishery conservation measures implemented by the PFMC; (3) review and evaluate any new protective measures implemented by the State of California resulting from the State listing coho south of San Francisco; (4) review and evaluate any additional protective or conservation measures implemented by State or private entities; and (5) evaluate whether the Resources Agency has made satisfactory progress in coordinating the development and implementation of a

long-term conservation and recovery strategy for coho salmon in California.

NMFS will consider the State's progress in developing a coho salmon habitat conservation strategy to be satisfactory if a framework protection plan and associated implementation schedule are developed in coordination with NMFS, non-federal agencies, and stakeholders within the next 9 months. To be effective, this protection plan should include both interim protective measures and a long-term protection and monitoring plan. Any implementation schedule developed for the plan should commit to implementation of the long-term component of the plan within 1–2 years of any final federal listing determination. Finally, any protection plan must incorporate increased monitoring of coho salmon populations and habitat conditions so that the continuing status of individual populations can be assessed, and the effectiveness of conservation measures can be evaluated. This coordination effort by the Resources Agency should focus on facilitating the development of local Coordinated Resource Management Planning (CRMP) groups which in turn could be integrated into larger scale bioregional planning groups. This would provide for regional coordination of locally based efforts to improve coho salmon habitat conditions. In the event that NMFS determines there is any new information indicating that coho salmon populations in this ESU are at greater risk of extinction than is currently believed, or that satisfactory progress is not being made by the Resources Agency on developing and implementing a coho conservation program, then NMFS will reconsider this determination in its final rulemaking.

2. Southern Oregon/northern California coasts—NMFS examined all available data for naturally-reproducing coho salmon in this ESU. Because this ESU includes spawning runs in both southern Oregon and northern California, information available for inland recoveries and spawning escapements differ widely by geographic area. Data for the Oregon portion of this ESU include adult passage counts at Gold Ray Dam in the upper Rogue River (Cramer et al. 1985), angler catch estimates for all Oregon rivers (ODFW 1992, 1993), and seine-survey estimates of adult coho salmon run size in the Rogue River (Cramer 1994).

Recently, most coho salmon production in the Oregon portion has been in the Rogue River. Recent run-size

estimates (1979–86, Cramer 1994) have ranged from approximately 800 to 19,800 naturally-produced adults, and from 500 to 8,300 hatchery-produced adults. Average run sizes for this period were 4,900 natural and 3,900 hatchery fish, with the total run averaging 45 percent hatchery fish. Adult passage counts at Gold Ray Dam provide a long-term view of coho salmon abundance in the upper Rogue River (Cramer et al. 1985). In the 1940's, passage counts averaged approximately 2,000 adults per year. Numbers declined and fluctuated during the 1950's and early 1960's, then stabilized at an average of fewer than 200 adults during the late 1960's and early 1970's. In the late 1970's, the run increased with returning fish produced at Cole Rivers Hatchery. Angler catch of coho salmon in the Rogue River fluctuated considerably, ranging from less than 50 (late 1970's) to a peak of about 800 in 1991; average annual catch over the last 10 years has been about 250 fish. Angler catch in other rivers in southern Oregon has been low, representing only a minor fraction of the total south of Cape Blanco.

While there have been no directed spawner surveys for coho salmon in this region, the species would be expected to be observed in the annual chinook salmon spawner surveys. However, few coho salmon have been observed in these surveys; for example, in 23 years of chinook salmon surveys in six segments of the Elk River, the highest count of coho salmon was 20 adults in 1971. In Oregon south of Cape Blanco, Nehlsen et al. (1991) considered all but two coho salmon stocks to be at high risk of extinction; of the remaining two, one (Euchre Creek) was identified as extinct and the other (Hunter Creek) was not mentioned. (The status of coho salmon in Euchre Creek is in some doubt: No surveys have been conducted recently, but ODFW biologists believe there may be a small coho salmon population there.) South of Cape Blanco, all Oregon coho salmon stocks were rated by Nickelson et al. (1992) as depressed.

Most information for the northern California region of this ESU was recently summarized by the CDFG (CDFG 1994). They concluded that "coho salmon in California, including hatchery stocks, could be less than 6 percent of their abundance during the 1940's, and have experienced at least a 70 percent decline in numbers since the 1960's" (CDFG 1994, p. 5–6). The Klamath River Basin (including the Trinity River) historically supported abundant coho salmon runs. In both systems, runs have been greatly

diminished and are now composed largely of hatchery fish, although there may be small wild runs remaining in some tributaries (CDFG 1994). Of 396 streams within the range of this ESU identified as once having coho salmon runs, Brown et al. (1994) were able to find recent survey information on 117 (30 percent) streams. Of these 117 streams, 73 (64 percent) still supported coho salmon runs while 42 (36 percent) have lost their coho salmon runs. The streams identified as presently lacking coho salmon runs were all tributaries of the Klamath and Eel River systems (Brown et al. 1994). The rivers and tributaries in the California portion of this ESU were estimated to have average recent runs of 7,080 natural spawners and 17,156 hatchery returns, with 4,480 identified as "native" fish occurring in tributaries having little history of supplementation with non-native fish. In this region of California, Nehlsen et al. (1991) identified coho salmon in the Klamath River as of special concern, and those in small northern streams as at moderate risk of extinction. Higgins et al. (1992) identified 10 coho salmon stocks as of special concern, and 6 as at high risk of extinction.

While there are limited data to assess population numbers or trends in this ESU, NMFS has determined that all coho salmon stocks between Punta Gorda and Cape Blanco are depressed relative to their past abundance. The main stocks in this region (Rogue River, Klamath River, and Trinity River) are heavily influenced by hatcheries, apparently with little natural production in mainstem rivers. The apparent declines in production in these rivers, in conjunction with heavy hatchery production, suggest that the natural populations are not self-sustaining. The status of coho salmon stocks in most small coastal tributaries is not well known, but these populations are small. NMFS concludes that coho salmon in this ESU are presently threatened, i.e., the ESU is likely to become in danger of extinction in the foreseeable future if present trends continue. At least within the California portion of this ESU, NMFS believes that the NCCP conservation planning process described for the Central California Coast ESU is the best approach for developing and implementing a successful conservation and recovery strategy for coho salmon.

3. *Oregon coast*—NMFS bases its proposed listing of this ESU on the following types of information: Historical estimates of abundance, extensive spawner survey records (Cooney and Jacobs 1994), estimates of ocean harvest rates (PFMC 1993), and

previous assessments of stock status. Based on historical commercial landing statistics and estimated exploitation rates, Mullen (1981) estimated escapement of coho salmon in coastal Oregon to be nearly 1 million fish in the early 1900's, with harvest of nearly 400,000 fish. In a more extensive analysis of similar data, Lichatowich (1989) concluded that coho salmon abundance in the same region at that time was about 1.4 million fish. Lichatowich also concluded that current production potential (based on stock-recruit models) for coho salmon in Oregon coastal rivers was about 800,000 fish, a reduction of nearly 50 percent in habitat capacity. Recent spawning escapement estimates indicate an average spawning escapement of less than 30,000 adults (Jacobs and Cooney 1991, 1992, 1993). While the methods of estimating total escapement are not comparable between the historical and recent periods, these numbers suggest that current abundance of coho salmon on the Oregon coast may be less than 5 percent of that in the early part of this century.

Kostow et al. (1994) provide estimates of hatchery composition of naturally-spawning coho salmon in several Oregon coastal rivers, ranging from 18 to 62 percent. These estimates are for rivers that are known to have high hatchery influence, so do not represent the average condition along the Oregon coast. However, these rivers represent a substantial portion of natural coho salmon production in Oregon, and indicate that hatchery fish have an extensive presence within the Oregon coastal ESU.

Based on NMFS's examination of the available information, it is apparent that spawning escapements for coho salmon populations in the Oregon coastal ESU have declined substantially during this century. Average spawner abundance has been relatively constant since the late 1970's, but pre-harvest abundance has declined. Spawner-to-spawner return ratios (based on peak counts) have been below replacement in 5 of the past 6 years, in spite of reductions in harvest, and average recruits-per-spawner may also be declining. Of the 43 Oregon coho salmon stocks north of Cape Blanco identified by Nickelson et al. (1992), 31 were considered as either depressed or special concern, and only 6 stocks were considered healthy (the remaining 6 stocks were listed as "unknown"). In this same region, Nehlsen et al. (1991), classified two stocks (Sixes River and New River) to be at high risk of extinction and 14 stocks at moderate risk of extinction. The heavy hatchery influence on many

rivers within this ESU is a cause for concern about the sustainability of natural production in these systems. Also, coastwide abundance of many stocks appears to be very low this year, and there has been a complete ban of most ocean fishing for coho salmon. For these reasons, NMFS concludes that coho salmon in the Oregon coast ESU are presently threatened.

4. *Lower Columbia River/southwest Washington coast*—A status review of lower Columbia River coho salmon stocks outside of the Willamette River Basin has been published by NMFS (Johnson et al. 1991). NMFS concluded that, historically, at least one ESU of coho salmon probably occurred in the lower Columbia River Basin, but the agency was unable to identify any remaining natural populations that warranted protection under the ESA. The information considered in this earlier status review is not repeated here. Based on its present status review, NMFS has determined that the range of the historic ESU probably extended beyond the lower Columbia River to include coho salmon populations from the southwest Washington coast and the Willamette River below Willamette Falls (including the Clackamas River). However, the relationship of natural populations of coho salmon in these two areas to the historic ESU is uncertain.

Several recent reports have evaluated the status of coho salmon in the Columbia River Basin. Nehlsen et al. (1991) classified all coho salmon stocks above Bonneville Dam (except Hood River) as extinct; Hood River, Sandy River, and all other lower Columbia tributary stocks were classified as at high risk of extinction, except the Clackamas River stock, which was classified as at moderate risk of extinction. The historic ESU also included populations in portions of the southwest Washington coast. Nehlsen et al. (1991) identified coho salmon stocks in Willapa Bay as at high risk of extinction. WDF et al. (1993) identified the Willapa Bay stocks as of unknown status, but of mixed origin and composite production; they identified all stocks in Grays Harbor tributaries as healthy, but of mixed origin and composite production.

The largest production of coho salmon along the southwest Washington coast is in the Chehalis River Basin. Hiss and Knudsen (1993) estimated that current coho salmon run sizes (before terminal harvest) in this basin (including the Humptulips River) total about 266,000 adults, of which 135,000 are naturally-produced and 131,000 are of hatchery origin. They noted that hatchery influence on these runs has

increased rapidly since 1970. Coho salmon in the Chehalis River Basin exhibit two run timings: "Normal," with spawning in early December throughout the basin, and "late," with spawning in January and February in lower Chehalis River tributaries. Hiss and Knudsen suggested that the normal run is composed of a mixture of hatchery and wild fish, while the late run is virtually all wild fish (but they did not specify whether "wild" implies native fish, or simply natural production regardless of origin). The two run timings are treated as a single stock for fishery management purposes, and NMFS has no separate abundance estimates for the late run. Hiss and Knudsen identified three streams known to have late-run fish (Bingham Creek, the upper Wynoochee River, and the Wishkah River), and noted that this run has always been less abundant than the normal run, but has been particularly small in recent years. No escapement estimates are available for other streams in Grays Harbor or Willapa Bay.

Abundance of late-run coho salmon in the Clackamas River has been measured since 1950 as adult passage at River Mill (1950 to 1957) and North Fork (1958 to present) Dams, and total run size (early and late runs) has ranged from 416 (1950) to 4,700 (1968). The late portion of the run has ranged from 309 (1958) to 3,588 (1968), however it is unclear whether these are native fish or naturalized hatchery fish. Cramer and Cramer (1994) concluded that production of the population is depressed due to a variety of factors. They further concluded that, under current harvest rates, the population will remain stable, but it is vulnerable to overharvest. Johnson et al. (1991) briefly reviewed abundance data for this population and concluded that it had a low risk of extinction if population parameters remain stable, but recommended close monitoring of the population.

While the number of naturally-reproducing fish within the lower Columbia River/southwest Washington coast ESU is fairly large, evaluating the risk to this ESU is difficult because of the uncertainty about the relationship of the present natural populations to the historic ESU. If native coho salmon persist in the Clackamas River or in southwest Washington, they would represent a small fraction of the ESU's historical abundance. However, it is not presently possible, with the limited information available, to identify with certainty native, naturally-reproducing populations in lower Columbia River tributaries or along the Washington coast south of Point Grenville.

Therefore, NMFS concludes that a listing is not warranted for the lower Columbia River/southwest Washington coast ESU at this time. However, there is sufficient concern regarding the overall health of this ESU (especially in light of evidence that some native, naturally-reproducing fish may exist). Therefore, NMFS is adding the lower Columbia River/southwest Washington coast ESU to the Candidate List until the distribution and status of the native populations can be resolved.

During the period between this proposed rule and publication of any final rule, NMFS will conduct a thorough reevaluation of this ESU and will reconsider the present decision that a listing is not warranted. In the event that this reevaluation establishes that listing the lower Columbia River/southwest Washington coast ESU is warranted, NMFS would issue a proposed rule to list this ESU as threatened or endangered.

5. Olympic Peninsula—Evidence examined by NMFS for this ESU included trends in terminal run size (i.e., the number of adults returning to the river mouth), hatchery contribution, trends in ocean exploitation rate, and trends in the size of fish in terminal landings. Data on terminal run for stocks in this ESU are collected cooperatively by the Washington Department of Fish and Wildlife (WDFW) and the coastal tribes. Spawning escapements to most streams are estimated by extrapolating from cumulative redd counts on index reaches of the streams. Because streams within the range of this ESU typically have highly variable flows during the spawning season, (making it difficult to conduct accurate counts of spawning fish) WDFW and tribal biologists believe that redd counts provide the most reliable estimates of total escapement (PFMC 1990). These natural escapement estimates, combined with hatchery escapements, form the basis for escapement summaries for the Olympic Peninsula (WDF et al. 1993, PFMC 1994). However, no attempt has been made to estimate the number of hatchery-produced fish that spawn naturally.

No trends were detected in terminal run size, and there is no evidence for trends in ocean exploitation rates. In the stock complexes monitored and reported by the PFMC, hatchery returns accounted for 50 percent of the spawning escapement in the period from 1982 through 1992, with the majority of hatchery production contributing to the Quillayute River summer-run, Quinault River, and Queets River stocks (PFMC 1994). Of

these stocks, the Quinault River and the Salmon River (tributary of the Queets River) were identified by WDF et al. (1993) as of mixed origin, while the majority of other stocks were identified as of native origin. Average recent (1989 to 1993) natural adult escapement estimates for some of these stocks are (PFMC 1994): Quinault River—4,700, Queets River—5,400, Hoh River—3,100, Quillayute River—800 summer run and 7,500 fall run. NMFS found no historical run-size estimates for these stock complexes to compare with recent abundance, but there have presumably been substantial declines in coho salmon production as a result of well-documented habitat degradation since European settlement.

NMFS also reviewed assessments of coho salmon stocks by Nehlsen et al. (1991) and WDF et al. (1993). Nehlsen et al. identified only one at risk coho salmon stock in this ESU: Lake Ozette coho salmon as of special concern. WDF et al. considered most coho salmon stocks in this ESU to be healthy or of unknown status, representing a mixture of native, mixed, and non-native origins and wild or composite (hatchery and wild) production. Some stocks along the Strait of Juan de Fuca were identified as depressed. WDF et al. identified eight stocks of native origin with wild production in this ESU, four of healthy status and four of unknown status.

NMFS has determined that, relative to the other ESUs, coho salmon abundance within the Olympic Peninsula ESU is moderate, but stable. While these stocks have been reduced from historical levels by large-scale habitat degradation in the lower river basins, there is a significant portion of coho salmon habitat in several rivers protected within the boundaries of Olympic National Park. This habitat refuge, along with the relatively moderate use of hatchery production (primarily derived from native stocks), appears to have protected these coho salmon stocks from the serious losses seen in adjacent regions. While there is continuing cause for concern about habitat destruction and hatchery practices within this ESU, NMFS believes that there is substantial native, natural production of coho salmon in the Olympic Peninsula ESU and that it is not threatened or endangered at this time.

6. Puget Sound/Strait of Georgia—To determine the status of this ESU, NMFS examined spawning escapement data, long-term trends in escapement to counting facilities, hatchery contribution rates, ocean and total exploitation rates, and trends in the size of fish in the terminal landings. Spawning escapements in the Puget

Sound portion of this ESU are estimated primarily by spawner surveys conducted by WDFW in index reaches of selected streams (PFMC 1990). Only three rivers have long-term (extending back to the 1930's or 1940's) escapement data from which to estimate trends. Long-term trap counts at Baker River and White River generally showed declining trends in the 1960's and 1970's, with some evidence of recovery in the 1980s. The number of adults passed above the hatchery racks on the Samish River showed neither increasing nor decreasing trends over a 55-year period. More recent spawner survey data are available for numerous rivers within the range of this ESU, but no reliable breakdown of natural and hatchery production is available for these data. Of the stocks examined for this review, two stocks had significant downward trends, five had significant upward trends, and the remainder had no significant trend.

Ocean exploitation rates on wild coho from the Deschutes River, Snohomish River, and Big Beef Creek declined from the late 1970s through the mid-1980s and have increased since then, but have remained in the range of 0.3 to 0.5. Total exploitation rates have shown no apparent trend, but have fluctuated in the range of 0.6 to 0.9. The average hatchery contribution rate for stocks monitored and reported by the PFMC for the period 1981 to 1992 has been 62 percent, with Nooksack/Samish and South Puget Sound stock complexes managed for, and clearly dominated by, hatchery production.

Bledsoe et al. (1989) examined changes in run sizes of Puget Sound salmon since 1896. They failed to find a statistically significant general decline in run sizes for wild runs of coho salmon in this period, although they did report a dramatic 85-percent decline of coho salmon terminal runs in the south sound from 1935 to 1975, which they attribute at least in part to increasing catch in non-terminal fisheries. Overall catch of coho salmon in Puget Sound fisheries shows a substantial decline from 1896 to the early 1940s, but this is largely attributed to the prohibition of fishing for this species with purse seines and fish traps starting in 1935. Overall catch within Puget Sound has increased gradually since that time, but has not returned to earlier levels, possibly as a result of greater interceptions of coho salmon in ocean fisheries (Bledsoe et al. 1989). Of further note is the fact that between 1972 and 1993, the average size of fish in the terminal landings has undergone a sharp decline from an average of about 4 kg to about 2 kg. This dramatic decline in average fish size,

which could result from any of several causes, could seriously reduce the fecundity and fitness of naturally-reproducing fish.

The range of the ESU that includes Puget Sound coho salmon extends into southern British Columbia, for which NMFS has not received detailed abundance information. Northcote and Atagi (in preparation) have reviewed abundance trends for all salmon species in various regions of British Columbia. Two of their regions include fish that are part of this ESU. Coho salmon have shown both historical (1800's to 1953-92 average) and recent (1953 to 1992) declines both on Vancouver Island and along the south-central British Columbia coast (excluding the Fraser River). In both areas, the historical decline was roughly two-fold. On Vancouver Island, coho salmon escapements have recently declined from more than 300,000 in the mid-1950's to about 150,000 at present. Along the south-central coast, escapement declines in the same period have been more dramatic, from about 500,000 in the mid-1950's to less than 100,000 at present. This is a much more severe decline than the trends documented in the U.S. portion of the ESU. Northcote and Atagi did not address levels of hatchery production for British Columbia coho salmon. However, there has been a substantial increase in coho salmon releases from British Columbia hatcheries since 1975 (Hilborn and Winton 1993).

The stock assessment by Nehlsen et al. (1991) identified three coho salmon stocks in this region as at high risk of extinction, and one (Nooksack River) to be possibly extinct. The assessment by WDF et al. considered stocks in this region to range from healthy to critical in status, predominantly of mixed origin, and predominantly of composite production. None of the stocks in this region that they identify as healthy were of strictly native origin. Two stocks (Deer Creek and Sumas/Chilliwack) were identified as of native origin with wild production, but of unknown status.

Systematic assessments of fish habitat conditions have not been routinely conducted within Washington state. Hence it is difficult to directly assess general trends in habitat conditions, either throughout the state or within individual regions or watersheds. However, some general relationships between land use and habitat changes have been well documented. Salmon production is strongly tied to freshwater habitat conditions, which continue to be destroyed or degraded in Puget Sound.

Human population growth is probably the best overall measure of disturbance to freshwater salmonid ecosystems,

because accompanying land use changes can adversely affect freshwater and marine habitats in a variety of ways; examples include reduced infiltration of water into the soil due to increases in impervious surfaces and loss of forest habitats, simplification of stream channel structure, changes in flow patterns, water quality degradation, loss of stream bank cover, loss of wetland habitats, dissociation of wetlands from stream channels, and loss of gravel sources due to bank stabilization. These changes affect all anadromous salmonids, but have particularly severe impacts on coho salmon. The population of Washington state has grown from about 1 million in 1910 to over 5 million today, and is expected to reach 7 million by 2020, with over 70 percent of this total residing in western Washington. Population densities have increased from 1.1 people/mi² for the entire state in 1880 to 725, 496, and 232 people/mi² in King, Kitsap and Snohomish Counties, respectively, in 1990. The counties encompassing the Snohomish, Stillaguamish, Skagit and Hood Canal systems have some of the highest growth rates and population densities statewide, and land use changes in those systems have drastically altered historic habitat conditions.

The areal extent of estuarine wetlands in Puget Sound is one of the few habitat characteristics for which there are historical records that can be compared to results of current surveys. During the last century, the Snohomish, Stillaguamish, and Skagit Rivers have lost 75 to 90 percent of their delta wetlands, and substantial losses (34 percent of wetlands) have also occurred in the relatively rural Skokomish River delta. The loss of freshwater wetlands, which may be even more critical to juvenile coho salmon, has not been quantified, but is extensive and continues at present.

Timber harvest and associated road building can adversely affect fish habitat in a number of ways, including disturbance of forest soils and increased erosion, more frequent landslides and debris torrents. Past logging practices have removed riparian vegetation, which increases stream temperatures and decreases the amount of large, woody debris in streams, a critical component of coho salmon habitat. The volume of timber harvest in Washington increased from approximately 3.5 billion board feet per year in the 1950's to about 5.5 billion board feet per year during much of the 1970's and 1980's. The vast majority of timberlands in Puget Sound have been logged at least once, and many areas have experienced

second or third rotations. Within the Puget Sound area, the acreage of land managed for forest products has actually declined, as timberlands are converted to residential and non-forest commercial uses.

In the marine environment, increasing inputs from point and non-point discharge of pollutants and surface runoff affect water quality and the status of the marine ecosystem as a whole. Concentrations of sediment-associated chemical contaminants and disease prevalence in fish from heavily industrialized sites in Puget Sound are among the highest in the nation.

NMFS has determined that, relative to the other coho salmon ESUs, populations in the Puget Sound/Strait of Georgia ESU are abundant, and with some exceptions, run sizes and natural spawning escapements have been generally stable. However, artificial propagation of coho salmon may have had a substantial impact on native, naturally-reproducing coho salmon populations, to the point that it is difficult to identify self-sustaining, native stocks within this region. In addition, the continuing loss of habitat, extremely high harvest rates, and a potentially severe, recent decline in average size of spawners indicate that there are substantial risks to the remaining native production in this ESU.

However, each of these concerns is based as much on professional judgement as on hard data. Although the magnitude of artificial propagation in the Puget Sound region ensures that there are ample opportunities for adverse effects on natural populations, few studies have been conducted to determine the extent to which such effects actually occur. Similarly, because virtually no information is available on size of naturally spawning coho salmon in Puget Sound, NMFS' evaluation of the decline in adult size is based on data for terminal, in-river fisheries, which primarily target hatchery fish. Although harvest rates on natural populations appear to be high, whether fishing mortality is too high for natural populations to sustain has not been formally evaluated. Finally, during the course of this status review, only limited life history and abundance information was gathered for the substantial portion of this ESU that occurs in British Columbia.

Because of the general lack of definitive information on the identified risk factors, and because the number of naturally-reproducing fish within the ESU is fairly large and apparently stable, NMFS concludes that a listing is not warranted for the Puget Sound/

Strait of Georgia ESU at this time. However, there is sufficient concern regarding the overall health of this ESU, and therefore, NMFS is adding the Puget Sound/Strait of Georgia ESU to the Candidate List. During the period between this proposed rule and publication of any final rule, NMFS will conduct a thorough reevaluation of the status of this ESU and will reconsider the present decision that a listing is not warranted. In the event that this reevaluation establishes that listing the Puget Sound/Strait of Georgia ESU is warranted, NMFS would issue a proposed rule to list this ESU as threatened or endangered.

Summary of Factors Affecting the Species

Section 2(a) of the ESA states that various species of fish, wildlife, and plants in the United States have been rendered extinct as a consequence of economic growth and development untempered by adequate concern and conservation. Section 4(a)(1) of the ESA and the listing regulations (50 CFR part 424) set forth procedures for listing species. NMFS must determine, through the regulatory process, if a species is endangered or threatened based upon any one or a combination of the following factors: (1) The present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or education purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or human-made factors affecting its continued existence.

The factors threatening naturally-reproducing coho salmon populations are numerous and varied. Given the vast geographic scope of NMFS' status review, it is difficult to determine which factors are primarily responsible for the decline of a specific ESU. For most of the coho salmon ESUs proposed for protection under the ESA, the present condition of the population is a result of long-standing, human-induced conditions (e.g., harvest, habitat degradation and artificial propagation) that serve to exacerbate the negative effects of adverse environmental conditions (e.g., drought, poor ocean conditions). The following examples provide an overview of the types of activities and conditions that threaten the conservation of these ESUs over a significant portion of their ranges.

A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Logging, agricultural activities, urbanization, stream channelization, dams, wetland loss, water withdrawals and unscreened diversions for irrigation, and mining have contributed to the decline of numerous West Coast populations of coho salmon. Logging activities, and the associated road networks, often result in soil erosion and stream sedimentation such that spawning habitat is seriously degraded. Removal of trees within the riparian zone of coastal streams has resulted in increased summer water temperatures, eliminated the potential for trees to fall into streams, and altered the natural hydrograph. Decreases in large woody material in streams reduces habitat complexity and contributes to the loss of cover, shade, and pools; these habitat features are required by juvenile coho salmon. Livestock grazing can damage streambanks and eliminate streamside vegetation, thereby preventing riparian species from growing to maturity and has resulted in shallow, warm streams that are not suitable for juvenile and adult coho salmon. Agricultural activities and urbanization often result in pollution from both point and nonpoint sources, and stream channelization (e.g., for flood control) can alter the physical and hydrographic properties of streams such that the quality and amount of habitat available to coho salmon is reduced. Water withdrawals reduce stream flow and the amount of available habitat, sometimes during critical drought periods, and can contribute to high water temperatures.

B. Overutilization for Commercial, Recreational, Scientific, or Education Purposes

This species has historically been a staple of Pacific Northwest Indian tribes, and has been targeted in recreational and commercial fisheries since the early 1800's. Marine harvest of coho salmon in the range of this status review occurs primarily in nearshore waters off British Columbia, Washington, Oregon, and California. Recreational fishing for coho salmon is pursued in numerous streams when adults return on their fall spawning migration. Due to low escapements and increased concern for protecting coho and chinook salmon runs, recent regulations on ocean and river harvest have resulted in the closure or severe curtailment of fisheries along much of the West Coast. Unfortunately, the confounding effects of habitat deterioration, drought, and poor ocean

conditions on coho salmon survival make it difficult to assess the degree to which recreational and commercial harvest have contributed to the overall decline of coho salmon in West Coast rivers. However, it is clear that more stringent fishing regulations have not resulted in increased returns of coho salmon. Scientific research and educational programs are believed to have had little or no impact on coho salmon populations.

C. Disease or Predation

Relative to effects of fishing, habitat degradation, and hatchery practices, disease and predation are not believed to be major factors contributing to the decline of West Coast coho salmon populations. However, disease and predation may have substantial impacts in local areas. For example, Bacterial Kidney Disease (BKD), a bacterial infection that can adversely affect salmon smolts, has been a problem in most California state fish hatcheries and the CDFG has recently initiated a treatment protocol to attempt to control BKD outbreaks in hatchery populations released into the Russian River and Scott Creek (Central California ESU).

D. Inadequacy of Existing Regulatory Mechanisms

Under the ESA, a determination to propose a species for listing as threatened or endangered requires considering the biological status of the species, as well as efforts being made to protect the species. Typically, regulatory mechanisms established by Federal, state, tribal, and local governments provide the most effective means to prevent a species from facing the peril of extinction. Unfortunately, the continued widespread decline of native, naturally-reproducing coho salmon in numerous West Coast streams suggests that management plans and practices followed by the numerous Federal, state, tribal, and local entities within the range of this status review, have not provided adequate protection for this species. Of encouraging note is a Federal interagency cooperative program, the Record of Decision for Amendments to U.S. Forest Service (USFS) and Bureau of Land Management (BLM) Planning Documents Within the Range of the Spotted Owl (i.e., the "Forest Plan", April 1994), that has recently been implemented to provide a coordinated management direction for the lands administered by USFS and BLM. The Forest Plan's region-wide management direction will amend existing management plans, including Forest Plans, Regional Guides, Timber Sale

Plans, and Resource Management Plans for Federal lands within the range of the northern spotted owl (which overlaps considerably with the freshwater range of coho salmon). As part of the Forest Plan, implementation of an Aquatic Conservation Strategy (ACS) on Federal land is expected to reverse the trend of aquatic ecosystem degradation and contribute toward fish habitat recovery. Coordination between the Federal land management agencies and NMFS, the Environmental Protection Agency (EPA), and the U.S. Fish and Wildlife Service (USFWS) should ensure that the ACS objectives are achieved. In addition, the adoption of forest practices regulations and fisheries management plans and policies aimed at protecting and restoring naturally-reproducing fish populations in Washington, Oregon, and California emphasizes the widespread concern over declining wild salmon runs. Because most of these programs are new, it is not possible to determine if they will be adequate to reverse the declining trend in coho salmon abundance. Moreover, it is unclear what level of protection will be afforded to coho salmon habitat on private lands and in non-forested areas. During the period between this proposed rule and a final rule, NMFS will continue to evaluate the efficacy of existing efforts to protect and restore coho salmon populations (see Public Comments Solicited).

E. Other Natural or Human-made Factors Affecting its Continued Existence

Long-term trends in rainfall and marine productivity associated with atmospheric conditions in the North Pacific Ocean may have a major influence on coho salmon production. The effects of extended drought on water supplies and water temperatures are a major concern for California populations of coho salmon. Poor ocean conditions are believed to have played a prominent role in the decline of coho salmon populations in Washington, Oregon, and California. Unusually warm ocean surface temperatures and associated changes in coastal currents and upwelling, known as El Niño conditions, result in ecosystem alterations such as reductions in primary and secondary productivity and changes in prey and predator species distributions. The degree to which adverse ocean conditions can influence coho salmon production was demonstrated during the El Niño event of 1982-83, which resulted in a 24- to 27-percent reduction in fecundity and a 58-percent reduction (based on pre-return predictions) in survival of adult

coho salmon stocks originating from the Oregon Production Index area (Johnson 1988).

As described previously, the widespread use of artificial propagation has undoubtedly had a significant impact on the production of West Coast coho salmon. Potential problems associated with hatchery programs include genetic impacts on indigenous, naturally-reproducing populations (see Waples 1991), disease transmission, predation on wild fish, difficulty in determination of wild run status due to incomplete marking of hatchery releases, and replacement (rather than supplementation) of wild stocks through competition and continued annual introductions of hatchery fish. During the period between this proposed rule and a final rule, NMFS will continue to evaluate the relationship between hatchery and native, naturally-reproducing populations of coho salmon in the proposed ESUs (see Public Comments Solicited).

Proposed Determination

The ESA defines an endangered species as any species in danger of extinction throughout all or a significant portion of its range, and a threatened species as any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Section 4(b)(1) of the ESA requires that the listing determination be based solely on the best scientific and commercial data available, after conducting a review of the status of the species and after taking into account those efforts, if any, being made to protect such species.

Based on results from its coastwide assessment, NMFS has determined that in the region south of Queen Charlotte Strait, British Columbia, there are six ESUs of coho salmon that constitute "species" under the ESA. NMFS has determined that three of the six ESUs are currently threatened, and therefore, proposes to list coho salmon in the central California coast, southern Oregon/northern California, and Oregon coast ESUs as threatened. The geographic boundaries (i.e., the watersheds within which the members of the ESU are typically found) for these ESUs are described under "ESU Determinations." In all three ESUs, only naturally-reproducing populations are being proposed for listing as threatened at this time. However, prior to the final listing determinations, NMFS will examine and attempt to characterize the relationship of existing hatchery populations to the ESUs proposed for listing. This may result in including some existing hatchery populations in

some of the "species" that may be listed in the final rule. NMFS has also determined that the Puget Sound/Strait of Georgia ESU and lower Columbia River/southwest Washington coast ESU do not warrant listing at this time, but because there is sufficient concern regarding the health of these ESUs, NMFS is adding them to the Candidate List. NMFS will conduct a thorough reevaluation of the status of both ESUs and will reconsider the present decision that listings are not warranted. In the event that this reevaluation establishes that listing either ESU is warranted, NMFS will issue a proposed rule to list one or both ESUs as threatened or endangered.

A Technical Memorandum will be prepared by NMFS and will provide more detailed information and references concerning the coastwide status review of coho salmon. The availability of new information may cause NMFS to re-assess these proposed listings.

Prohibitions and Proposed Protective Measures

Section 9 of the ESA prohibits certain activities that directly or indirectly affect endangered species. These prohibitions apply to all individuals, organizations, and agencies subject to U.S. jurisdiction. Section 4(d) of the ESA allows the promulgation of regulations that modify or apply any or all of the prohibitions of section 9 to threatened species. Section 9 also prohibits violations of protective regulations for threatened species promulgated under section 4(d). As announced in a recent joint policy with the USFWS (59 FR 34272, July 1, 1994), NMFS will identify, to the extent known at the time of the final rule, specific activities that will not be considered likely to result in violation of section 9, as well as activities that will be considered likely to result in violation. For those activities whose likelihood of violation is uncertain, a contact will be identified in the final listing document to assist the public in determining whether a particular activity would constitute a prohibited act under section 9.

At this time, NMFS proposes to adopt protective measures to prohibit, with respect to the three ESUs of coho salmon proposed as threatened herein, "taking," interstate commerce, and the other ESA prohibitions applicable to endangered species, with the exceptions provided under section 10 of the ESA. Under the ESA, the term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such

conduct. This adoption is the normal course followed by the USFWS with respect to threatened listings (see 50 CFR 17.31(a)). NMFS is extending the provisions of section 9 and section 10 to these species in order to provide immediate protections to them. However, prior to the final listing determination, NMFS will consider adopting specific regulations under section 4(d) that will apply to one or more ESUs of coho salmon identified as threatened (see Public Comments Solicited). These regulations, promulgated pursuant to the Administrative Procedures Act, 5 U.S.C. 551 *et seq.*, with prior notice and opportunity for comment, may be in lieu of the Section 9 taking prohibition and Section 10 permit exception.

Available Conservation Measures

Conservation measures provided to species listed as threatened or endangered under the ESA include prohibitions on taking, recovery actions, and Federal agency consultation requirements. Recognition through listing promotes conservation actions by Federal and state agencies and private groups and individuals.

Section 7(a)(4) of the ESA requires that Federal agencies confer with NMFS on any actions likely to jeopardize the continued existence of a species proposed for listing and on actions likely to result in the destruction or adverse modification of proposed critical habitat. For listed species, section 7(a)(2) requires Federal agencies to ensure that activities they authorize, fund, or conduct are not likely to jeopardize the continued existence of a listed species or to destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into consultation with NMFS.

Examples of Federal actions that may be affected by this proposal include various Federal land management agency activities (e.g., actions associated with timber harvest, recreation, mining, agriculture, and grazing), U.S. Army Corps of Engineers Clean Water Act section 404 permitting activities, Federal Energy Regulatory Commission licenses for nonfederal development and operation of hydropower projects, and Federal salmon hatcheries.

Based on information presented in this proposed rule, general conservation measures that could be implemented to help conserve the species are listed below. This list does not constitute NMFS' interpretation of a recovery plan under section 4(f) of the ESA.

1. Measures could be taken to promote land management practices that protect and restore coho salmon habitat. Land management practices affecting coho salmon habitat include timber harvest, road building, agriculture, livestock grazing, and urban development.

2. Evaluation of existing commercial and recreational harvest regulations for ocean and river fisheries could identify any changes necessary to protect coho salmon populations.

3. Artificial propagation programs could be required to incorporate practices that minimize impacts upon native populations of coho salmon.

4. Efforts could be made to ensure that existing and proposed dam facilities are designed and operated in a manner that will not adversely affect listed populations. For example, NMFS could require that fish passage facilities at dams effectively pass migrating juvenile and adult salmon.

5. All water diversions could have adequate headgate and staff gauge structures installed to control and monitor water usage accurately. Water rights could be enforced to prevent irrigators from exceeding the amount of water to which they are legally entitled.

6. All irrigation diversions affecting downstream migrating coho salmon could be screened. A thorough review of the impact of irrigation diversions on coho salmon could be conducted.

Should the proposed listings be made final, protective regulations under the ESA would be put into effect and a recovery program(s) would be implemented. NMFS recognizes that to be successful, protective regulations and recovery programs for coho salmon will need to be developed in the context of conserving aquatic ecosystem health. NMFS intends that Federal lands and Federal activities bear as much of the burden as possible for conserving listed populations and the ecosystems upon which they depend. However, throughout the range of all three ESUs proposed for listing, coho salmon habitat occurs and can be affected by activities on state, tribal or private (nonfederal) land. Agricultural, urban and timber management activities on nonfederal land could and should be conducted in a manner that avoids adverse effects to coho salmon aquatic habitat.

NMFS encourages nonfederal landowners to assess the impacts of their actions on potentially threatened or endangered salmonids. In particular, NMFS encourages the formulation of watershed partnerships to promote conservation in accordance with ecosystem principles. These

partnerships will be successful only if all watershed stakeholders (i.e., state, tribal, and local governments, landowner representatives, and Federal and nonfederal biologists) participate and share the goal of restoring coho salmon to the watersheds. To assist with such efforts, NMFS, the USFWS and the EPA, with technical assistance from the Natural Resources Conservation Service, have contracted a study to provide technical guidance and training to agency staff. This guidance is intended to produce a technical foundation and informational support base for fostering development of conservation plans pursuant to section 10 of the ESA and cooperative agreements with the states of Washington, Oregon, and California, pursuant to section 6 of the ESA. Furthermore, NMFS intends to enlist nonfederal jurisdictions, including tribal and county governments, private organizations and affected individuals in recovery plan development and implementation.

Critical Habitat

Section 4(a)(3)(A) of the ESA requires that, to the extent prudent and determinable, critical habitat be designated concurrently with the listing of a species. However, this section of the ESA specifically precludes NMFS from designating critical habitat in foreign countries, e.g., Canada. While NMFS has completed its initial analysis of the biological status of coho salmon populations from southern British Columbia to southern California, it has not completed the analysis necessary for designating critical habitat. Therefore, to avoid delaying this listing proposal, NMFS will propose critical habitat in a separate rulemaking. Also, NMFS is nearing completion of a coastwide status review of steelhead (*O. mykiss*) populations, a species that has similar habitat requirements and considerable geographic overlap with coho salmon. Hence, a delay will allow NMFS to more clearly and efficiently identify proposed critical habitat for threatened or endangered ESUs of both species.

Public Comments Solicited

To ensure that the final action resulting from this proposal will be as accurate and as effective as possible, NMFS is soliciting comments and suggestions from the public, other concerned governmental agencies, the scientific community, industry, and any other interested parties. Public hearings will be held in various locations throughout the range of the proposed ESUs; details regarding locations, dates, and times will be published in a forthcoming Federal Register document.

NMFS is requesting information regarding: (1) The existence of native, naturally-reproducing coho salmon in the proposed ESUs, especially the lower Columbia River/southwest Washington coast ESU, and in the Puget Sound/Strait of Georgia ESU; (2) trends in adult size of native, naturally-reproducing fish, especially in the Puget Sound/Strait of Georgia ESU; (3) progeny/parent return ratios for naturally-reproducing fish, both before and after harvest; (4) coho salmon escapement, particularly escapement data partitioned into natural and hatchery components; (5) the proportion of naturally-reproducing fish that were reared as juveniles in a hatchery; (6) the reproductive success of naturally-reproducing hatchery fish (i.e. hatchery fish spawning in the wild); (7) straying rates of hatchery fish to other hatcheries and into natural populations; (8) efforts being made to protect native, naturally-reproducing populations of coho salmon in British Columbia, Washington, Oregon, and California; and (9) suggestions for specific regulations under section 4(d) of the ESA that could apply to one or more ESUs of coho salmon proposed as threatened. Suggested regulations should address activities, plans, or guidelines that, despite their potential to result in the incidental take of listed fish, will ultimately promote the conservation of threatened ESUs.

In addition to comments on the proposal concerning the biological status of the stocks, NMFS is soliciting suggestions and proposals on conservation measures that might best achieve the purposes of the ESA relating to recovering the health of coho salmon populations and the ecosystems upon which they depend. These conservation measures include: (1) The best approach to integrate federal efforts with state and local efforts on habitat protection and restoration, harvest management regimes and hatchery production programs; (2) the best method to integrate and encourage private efforts at habitat protection and restoration, and the most effective role of NMFS and other federal agencies for promoting private conservation efforts for purposes of achieving the goals of the ESA; (3) the role of successful local watershed protection programs in the larger conservation effort, and the best mechanisms to encourage these efforts; (4) the most appropriate mechanisms for integrating existing harvest management regimes with the needs of coho salmon populations proposed for listing; and, (5) the most effective mechanisms for instituting necessary reforms in the

hatchery production practices to support the recovery effort while achieving other related objectives of the existing programs.

NMFS also is requesting quantitative evaluations describing the quality and extent of freshwater and marine habitats for juvenile and adult coho salmon as well as information on areas that may qualify as critical habitat in Washington, Oregon, and California for the proposed ESUs. Areas that include the physical and biological features essential to the recovery of the species should be identified. Areas outside the present range should also be identified if such areas are essential to the recovery of the species. Essential features should include, but are not limited to: (1) Space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for reproduction and rearing of offspring; and (5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of the species.

For areas potentially qualifying as critical habitat, NMFS is requesting information describing: (1) The activities that affect the area or could be affected by the designation, and (2) the economic costs and benefits of additional requirements of management measures likely to result from the designation.

The economic cost to be considered in the critical habitat designation under the ESA is the probable economic impact "of the [critical habitat] designation upon proposed or ongoing activities" (50 CFR 424.19). NMFS must consider the incremental costs specifically resulting from a critical habitat designation that are above the economic effects attributable to listing the species. Economic effects attributable to listing include actions resulting from section 7 consultations under the ESA to avoid jeopardy to the species and from the taking prohibitions under section 9 of the ESA. Comments concerning economic impacts should distinguish the costs of listing from the incremental costs that can be directly attributed to the designation of specific areas as critical habitat.

NMFS will review all public comments and any additional information regarding the status of the coho salmon ESUs described herein and, as required under the ESA, intends to complete a final rule within 1 year of this proposed rule. The availability of new information may cause NMFS to reassess the status of any coho salmon ESU, including ESUs not proposed for

listing at this time. In particular, NMFS will conduct a thorough reevaluation of the status of the Puget Sound/Strait of Georgia and lower Columbia River/southwest Washington coast ESUs before the final listing determination. Although NMFS has concluded that information available at the present time is not sufficient to demonstrate that a listing is warranted for these ESUs, there is concern over the health of natural populations.

Classification

The 1982 amendments to the ESA, in section 4(b)(1)(A), restrict the information that may be considered when assessing species for listing. Based on this limitation of criteria for a listing decision and the opinion in *Pacific Legal Foundation v. Andrus*, 675 F. 2d 825 (6th Cir., 1981), NMFS has categorically excluded all ESA listing actions from environmental assessment requirements of the National Environmental Policy Act under NOAA Administrative Order 216-6.

This proposed rule is exempt from review under E.O. 12866.

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List of Subjects in 50 CFR Part 227

Endangered and threatened species, Exports, Imports, Marine mammals, Transportation.

Dated: July 19, 1995.

Rolland A. Schmitt,

Assistant Administrator for Fisheries,
National Marine Fisheries Service.

For the reasons set out in the preamble, 50 CFR part 227 is proposed to be amended as follows:

PART 227—THREATENED FISH AND WILDLIFE

1. The authority citation for part 227 continues to read as follows:

Authority: 16 U.S.C. 1531 *et seq.*

2. In § 227.4, paragraphs (j), (k), and (l) are added to read as follows:

§ 227.4 Enumeration of threatened species.

* * * * *

(j) Central California coho salmon (*Oncorhynchus kisutch*).

(k) Southern Oregon/northern California coast coho salmon (*Oncorhynchus kisutch*).

(l) Oregon coast coho salmon (*Oncorhynchus kisutch*).

3. Section 227.21 is revised to read as follows:

§ 227.21 Threatened salmon.

(a) *Prohibitions.* The prohibitions of section 9 of the Act (16 U.S.C. 1538)

relating to endangered species apply to threatened species of salmon listed in § 227.4 (f), (g), (j), (k), and (l), except as provided in paragraph (b) of this section.

(b) *Exceptions.* The exceptions of section 10 of the Act (16 U.S.C. 1539) and other exceptions under the Act relating to endangered species, including regulations implementing such exceptions, also apply to the threatened species of salmon listed in § 227.4 (f), (g), (j), (k), and (l). This section supersedes other restrictions on the applicability of parts 217 and 222 of this chapter, including, but not limited to, the restrictions specified in §§ 217.2 and 222.22(a) of this chapter with respect to the species identified in § 227.21(a).

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