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01. Note	From D. Allan Bromley to John Sununu Re: Attached Material on Identification of an Endangered Species (1 pp.)	4/2/91	P 5	

Collection:

Record Group: Bush Presidential Records
Office: Chief of Staff, White House Office of
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Date Closed: 1/4/2005	OA/ID Number: 29154-003
FOIA/SYS Case #: 1998-0004-F[2]	Appeal Case #:
Re-review Case #: 2005-0426-S	Appeal Disposition:
P-2/P-5 Review Case #:	Disposition Date:
AR Case #:	MR Case #:
AR Disposition:	MR Disposition:
AR Disposition Date:	MR Disposition Date:

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Presidential Records Act - [44 U.S.C. 2204(a)]

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 P-3 Release would violate a Federal statute [(a)(3) of the PRA]
 P-4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
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 (b)(9) Release would disclose geological or geophysical information

THE CHIEF of STAFF
has seen

Dear John:

We are in the process of getting as much of the available data as possible from the Seattle Marine Fisheries folks. In the meantime I thought that you might be interested in the enclosed material.

The identification of an "endangered species" is far more arcane than I had ever believed. A simple physicist also has problems with the logic in these documents and I expect that an engineer will have the same problems!

If there is a scientific rationale I shall track it down. This is a lack of progress report.

Alan
April 2, 91.

Dear John:

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HOT SPOTS
CHEM - ASSESSMENT
POPULATION MANAGEMENT

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

April 2, 1991

MEMORANDUM FOR D. ALLAN BROMLEY

FROM: NANCY G. MAYNARD *NM*
SUBJECT: Sockeye Salmon

Attached are two documents that provide a summary of information on the Snake River Sockeye Salmon and its proposed Endangered status under the Endangered Species Act (ESA). The first, a status review of the sockeye salmon, is attached at Tab A. It provides alot of good background material on the sockeye, its environment and status, and how it qualifies as an endangered species.

The second paper, prepared by the National Marine Fisheries Service Northwest Region Review Team, "Status Review Report for Snake River Sockeye Salmon", describes how they have approached the "distinct population segment" (definition in the ESA) and how that approach is applied to ESA considerations of anadromous Pacific salmonids. (Tab B)

A brief summary of the information presented in the first paper on the status of the Snake River Sockeye Salmon relative to its status as an Endangered Species follows (details can be found in the paper in Tab A):

Summary of Factors Affecting the Species

An Endangered species = any species in danger of extinction throughout all or a significant portion of its range

Section 4 (a) of the Endangered Species Act requires that the listing determination be based solely on the best scientific and commercial data available, without reference to possible economic or other impacts of such determination

Species may be determine to be endangered or threatened due to one or more of the five factors described in section 4(a)(1) of the ESA.

These factors, as they apply to the Snake River Sockeye Salmon are:

1. The Present or Threatened Destruction, Modification or Curtailment of its Habitat or Range

a. Hydropower Development

Dams and reservoirs have substantially reduced the abundance of salmon in the Columbia River Basin (loss of habitat and losses when fish try to get through the 8 projects)

(1) Juvenile Sockeye Salmon Passage

Juvenile Snake River Sockeye Salmon migrants must pass 8 hydroelectric projects between upriver rearing areas and the ocean (direct losses as pass through dams/reservoirs and possible sublethal impacts - stress, injury, delay)

(2) Adult Sockeye Salmon Passage

Cumulative adult passage loss for salmon passing mainstream dams can be substantial. (delay of migration also a problem - involves problems with the temporary physiological change that enables them to make the transition from fresh to saltwater)

b. Water Withdrawal and Storage

Diversion and storage of water within the Columbia River has decreased water availability and altered historical run-off patterns in Basin. Also, unscreened water diversions permit juvenile anadromous fish to migrate onto irrigated lands

2. Over-utilization for Commercial, Recreational, Scientific or Educational Purposes

3. Disease and Predation

(includes fresh water, marine and estuarine predation)

4. Inadequacy of Existing Regulatory Mechanisms

Billing Code: 3510-22

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 222

[Docket No. 910379-107]

RIN 0648-AD90

Endangered and Threatened Species; Proposed Endangered Status for
Snake River Sockeye Salmon.

AGENCY: National Marine Fisheries Service (NMFS), NOAA,
Commerce.

ACTION: Proposed rule.

SUMMARY: NMFS is issuing a proposed determination that the Snake River sockeye salmon (Oncorhynchus nerka) is a "species" under the Endangered Species Act of 1973, as amended, 16 U.S.C. §1531 et seq. (ESA). Furthermore, NMFS proposes to list the Snake River sockeye salmon as endangered under the ESA. The Snake River sockeye salmon has declined to extremely low numbers. Current production is limited to Redfish Lake in the Salmon River Basin in Idaho. Hydropower development, water withdrawal and diversions, water storage, commercial harvest, and inadequate regulatory mechanisms are factors contributing to the decline and represent a continued threat to the Snake River sockeye salmon's existence. Should the proposed listing be made final, the prohibitions of the ESA would be in effect and a recovery program would be implemented.

DATES: Comments from all interested parties must be received by [insert date 60 days after date of publication in the FEDERAL REGISTER]. Public hearings are scheduled as follows:

1. May 8, 1991, at 9:30 a.m., Seattle, Washington;
2. May 9, 1991, at 9:30 a.m., Portland, Oregon;
3. May 10, 1991, at 9:30 a.m., Boise, Idaho.

ADDRESSES: Comments on this proposed rule should be sent to the Environmental and Technical Services Division, NMFS, Northwest Region, 911 N.E. 11th Avenue, Suite 620, Portland, OR 97232, or provided at any one of the public hearings. The hearings will be held at the following locations:

1. NOAA, Western Administrative Support Center, Building 9, 7600 Sand Point Way, NE, Seattle, Washington;
2. 1st Floor West Side, Federal Complex, 911 NE 11th Ave., Portland, Oregon;
3. Boise Interagency Fire Center, 3905 Vista Ave., Boise, Idaho.

FOR FURTHER INFORMATION CONTACT: Tracey Vriens, Environmental and Technical Services Division, NMFS, Portland, Oregon, 503-230-5420 or FTS-429-5420.

SUPPLEMENTARY INFORMATION:

Background

NMFS initiated a status review of sockeye salmon (Oncorhynchus nerka) in the Salmon River, a tributary of the Snake River, on April 9, 1990 (55 FR 13181). NMFS also received a petition (April 2, 1990) from the Shoshone-Bannock Tribes of the Fort Hall Indian Reservation to list Snake River sockeye salmon as endangered under the ESA. NMFS published a notice on June 5, 1990 (55 FR 22942), that the petition presented substantial scientific information indicating that the listing may be warranted and requested information from the public.

NMFS has reviewed all available scientific information pertaining to the status of Snake River sockeye salmon. To assist in this review, NMFS convened a Technical Committee to provide information and to review and comment on the data in the record. The Technical Committee consists of representatives from Federal and state fisheries agencies, Indian tribes, industries, and public interest groups that have technical expertise relevant to sockeye salmon. NMFS Northwest Region Biological Review Team has prepared a technical paper "Status Review Report for Snake River Sockeye Salmon" (Waples et al. 1991) that is available upon request (see FOR FURTHER INFORMATION CONTACT).

Snake River Sockeye Salmon

The Snake River (Redfish Lake) sockeye salmon is one of three remaining stocks of sockeye salmon in the Columbia River system, the other two being in the upper Columbia River. Snake

River sockeye salmon enter the Columbia River primarily during June and July. Arrival into Redfish Lake, which now supports the only remaining run of Snake River sockeye salmon, peaks in August and spawning occurs near the shoals along the lake's shoreline primarily in October (Bjornn et al. 1968). Shoal spawning is less typical of sockeye salmon than spawning in lake tributary or inlet streams (Foerster 1968; Scott and Crossman 1979). Kokanee, a permanent freshwater form of O. nerka, are also produced in Redfish Lake and in other Stanley Basin lakes, including Alturas, Pettit, and Yellowbelly Lakes.

Eggs hatch in the spring between 80 and 140 days after spawning. Fry remain in the gravel for 3 to 5 weeks, emerging April through May and, if hatched in inlet (or outlet) streams, move immediately into the lake, where juveniles feed on plankton for 1 to 3 years before migrating to the ocean (Bell 1986). Juvenile residence of sockeye salmon in Redfish Lake rarely exceeds 2 years (Bowles and Cochnauer 1984).

Migrants leave Redfish Lake when temperatures are between 38° to 50° F, from late April through May (Bjornn et al. 1968), and smolts migrate almost 900 miles (1440 kilometers) to the ocean, where they remain inshore or within their home river's influence zone for the early summer. Later, they migrate through the northeast Pacific Ocean (Hart 1973; Hart and Dell 1986). Snake River sockeye salmon usually spend 2 years in the ocean and return in their fourth or fifth year of life. The survival rate for Snake River sockeye salmon, from the time they migrate from

the lake to returning adults, is between 0.14 to 1.83 percent (Bjornn et al. 1968).

Consideration of Snake River Sockeye Salmon as a "Species" under the ESA

To consider the Snake River sockeye salmon for listing, it must qualify as a "species" under the ESA. The ESA defines a "species" to include any "distinct population segment of any species of vertebrate . . . which interbreeds when mature." NMFS published an interim policy (March 13, 1991; 56 FR 10542) on how it will apply the ESA species definition in evaluating Pacific salmon stocks. A salmon stock will be considered a distinct population, and hence a species under the ESA, if it represents an evolutionarily significant unit (ESU) of the biological species. The stock 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 would be met if the population contributed substantially to the ecological/genetic diversity of the species as a whole. Further guidance on application of this policy is contained in the NMFS paper "Definition of Species under the

Endangered Species Act: Application to Pacific Salmon" (Waples 1991).

In this case, the question of population distinctness is complicated by the presence of kokanee in Redfish Lake. One hypothesis is that the sockeye and kokanee share a common gene pool. If so, they should be considered as a unit in ESA evaluations. If the two forms are reproductively isolated, they should be considered separately.

No adult sockeye salmon from Redfish Lake were available for genetic studies to compare them with kokanee sampled from the lake in 1990. However, other evidence suggests that the two forms are distinct (Waples et al. 1991). Recent studies of O. nerka in other areas of the Pacific Northwest (Foote et al. 1989) found substantial genetic differences between the two forms, in spite of occasional cross-spawning behavior and viability of hybrids through early life-history stages in culture. Foote et al. (1989) found significant differences in the frequencies of alleles between sockeye salmon and kokanee in each of the lake systems they studied, and also found that the magnitude of genetic divergence between sympatric sockeye salmon and kokanee increased with distance upriver from the ocean. An electrophoretic survey conducted by NMFS for this status review also found substantial genetic differences between sockeye salmon and kokanee in two river/lake systems where they co-occur (Monan 1991). Thus, it is likely that, historically, sockeye salmon and kokanee were reproductively isolated in Redfish Lake. Recent

observations at Redfish Lake support the hypothesis that the two forms remain distinct. Kokanee continue to spawn in the inlet (Fishhook Creek) in August/September, but sockeye salmon spawn later (generally October) and only along the shores of the lake (Bjornn et al. 1968; Fulton 1970; Bowler 1990).

An alternative hypothesis, that Sunbeam Dam caused the extinction of the original sockeye salmon gene pool and that recent anadromous O. nerka in Redfish Lake have resulted from the seaward drift of kokanee, was also considered (see discussion under "Status of Snake River Sockeye Salmon" below). Although it is known from studies in other geographical areas that kokanee can occasionally produce anadromous fish, the number of outmigrants that successfully return as adults is typically quite low. There is no evidence that kokanee anywhere have naturally produced a sustained run of sockeye salmon. Thus, if kokanee were responsible for post-Sunbeam Dam anadromous O. nerka in Redfish Lake, it would be an unprecedented occurrence for the species (Waples et al. 1991).

Given evidence that sockeye salmon continued to pass Sunbeam Dam prior to its removal, and given the uncertainty regarding the ability of Redfish Lake kokanee to produce anadromous O. nerka in the numbers observed, NMFS is proceeding on the premise that the original sockeye salmon gene pool still exists in Redfish Lake and is distinct from the kokanee (Waples et al. 1991).

Available information indicates that Snake River sockeye salmon are also reproductively isolated from other sockeye salmon

populations and represent an important component in the evolutionary legacy of the species. The great distance (over 700 river miles (1,127 kilometers)) separating Redfish Lake from the nearest sockeye salmon populations in the upper Columbia River ensures a strong degree of reproductive isolation. There is no evidence of straying of sockeye salmon from the upper Columbia River or elsewhere into Redfish Lake (Waples et al. 1991).

Redfish Lake supports the world's southernmost natural sockeye salmon population. Sockeye salmon returning to Redfish Lake also travel a greater distance from the sea (almost 900 miles (1,448 kilometers)) and to a higher elevation (6,500 feet (1,219 meters)) than do sockeye salmon anywhere else in the world. In contrast, sockeye salmon in the upper Columbia Basin spawn at elevations more than 4,000 feet lower. Furthermore, the upper Columbia River populations are in a different ecoregion domain (humid temperate) than is Redfish Lake (dry) (Waples et al. 1991). Collectively, these data argue strongly for the ecological uniqueness (with respect to sockeye salmon) of the Snake River habitat and make it likely that the Redfish Lake population contains unique adaptive genetic characteristics.

Electrophoretic studies of sockeye salmon throughout North America and Asia typically have found substantial genetic differences between sockeye salmon stocks from different river systems (e.g., Utter et al. 1984; Foote et al. 1989; Monan 1991). Furthermore, a recent study (Monan 1991) demonstrated that samples of kokanee from Redfish and Alturas Lakes are genetically

similar to each other but quite distinct from samples from other lakes in Idaho, Washington, and British Columbia. These results suggest that, although the relevant data are not available for Redfish Lake sockeye salmon, this population is probably genetically distinct from other sockeye salmon populations.

NMFS concludes that the best available information indicates that this stock meets both of the criteria necessary to be considered an ESU. Therefore, NMFS is issuing a proposed determination that the Snake River sockeye salmon is a "species" under the ESA.

Status of Snake River Sockeye Salmon

Historically, sockeye salmon were produced in Idaho in the Stanley Basin of the Salmon River in Alturas, Pettit, Redfish, Yellowbelly and Stanley Lakes and may have been present in one or two other Stanley Basin lakes (Bjornn et al. 1968). Welsh et al. (1965) also included Little Redfish Lake, on Redfish Creek downstream from Redfish Lake, as sockeye salmon habitat. Outside of the Salmon River Basin, but within the Snake River Basin, sockeye salmon were produced in Big Payette Lake on the North Fork Payette River and in Wallowa Lake on the Wallowa River (Evermann 1895; Toner 1960; Bjornn et al. 1968; Fulton 1970).

In 1881, 2,600 pounds (1,180 kilograms) of fresh sockeye salmon were taken by prospectors at Alturas Lake, near Redfish Lake in the Stanley Basin (Evermann 1896). However, agricultural

diversions using all the water in Alturas Lake Creek currently prevent adult sockeye salmon from migrating upstream and eliminates production in Alturas Lake. Treatment of Pettit and Yellowbelly Lakes with piscicides (chemicals used to kill fish) in 1961 and 1962 and the operation of migration barriers to prevent warmwater fish species from reinhabiting the lakes eliminated juvenile sockeye salmon and prevented adult salmon access.

There is no reliable information on the numbers of sockeye salmon spawning in Redfish Lake in the early 1900s (Bjornn et al. 1968). However, Evermann (1895, 1896) reported that there were plans to build a cannery there.

Construction of Sunbeam Dam in 1910, 20 miles (32.2 kilometers) downstream from Redfish Lake Creek on the mainstem Salmon River, seriously impeded sockeye salmon access to the Stanley Basin lakes. The original adult fishway was constructed with wood and was ineffective in passing fish over the dam (Kendall 1912; Gowen 1914). It was replaced in 1920 with a concrete adult fishway that improved passage.

There is a difference of opinion regarding the effects of Sunbeam Dam on the original sockeye salmon run to lakes in the Stanley Basin. Some argue that the dam represented a complete barrier to upstream passage for enough years that the original anadromous run was eliminated (Chapman et al. 1990). On the other hand, eyewitness accounts (Jones 1991) document adult sockeye salmon spawning in Redfish Lake in a number of years

prior to and immediately after partial removal of the dam in 1934. Subsequently, Parkhurst (1950) reported sockeye salmon spawning in the lake in 1942.

Escapement of sockeye salmon to the Snake River has declined dramatically in recent years. Counts made at Lower Granite Dam (the first dam on the Snake River downstream from the confluence of the Salmon River) since 1975 have ranged from 531 in 1976 to 0 in 1990. It should be noted that the number of fish counted at a dam may differ from the number actually passing; some fish may pass during non-counting periods or may pass through navigation locks. Records are available on escapement into Redfish Lake for the years 1954 through 1966 and from 1985 through 1987. During these years, the Idaho Department of Fish and Game (IDFG) enumerated adult sockeye salmon at Redfish Lake weirs. In the years from 1954 through 1966, the number of adults counted by IDFG varied from 4,361 in 1955, to 11 in 1961, to 335 in 1964. In the years 1985 through 1987, IDFG operated a temporary Weir at Redfish Lake Creek. The total escapement in these years was 12 in 1985, 29 in 1986, and 16 in 1987. In 1988, IDFG also conducted spawning ground surveys that identified four adults and two redds (gravel mounds in which the eggs are deposited). In 1989, one adult was passed into Redfish Lake and one redd and a second potential redd were identified. No redds or adults were identified in 1990.

Summary of Factors Affecting the Species

An endangered species is any species in danger of extinction throughout all or a significant portion of its range; a threatened species is any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Section 4(a) of the ESA requires that the listing determination be based solely on the best scientific and commercial data available, without reference to possible economic or other impacts of such determination. Species may be determined to be endangered or threatened due to one or more of the five factors described in section 4(a)(1) of the ESA. These factors, as they apply to Snake River sockeye salmon, are discussed below.

1. The Present or Threatened Destruction, Modification or Curtailment of its Habitat or Range.

(a) Hydropower Development. Dams and reservoirs have substantially reduced the abundance of salmon in the Columbia River Basin. The Northwest Power Planning Council (NWPPC) estimated that current annual salmon and steelhead production in the Columbia River Basin is more than 10 million fish below historical levels, with 8 million of this annual loss estimate attributable to hydropower development and operation (NWPPC 1987). The NWPPC further estimated that approximately half of the 8 million fish loss was caused by the loss of habitat blocked by Chief Joseph and Hells Canyon Dams in the upper Columbia and Snake Rivers. The remaining 4 million fish loss was attributed

to ongoing annual passage losses at and between the eight mainstem projects below Chief Joseph and Hells Canyon Dams. Although the specific number of Snake River sockeye salmon lost is unknown, they are included in the overall numbers presented by the NWPPC.

(1) **Juvenile Sockeye Salmon Passage.** Juvenile Snake River sockeye salmon migrants must pass eight hydroelectric projects between upriver rearing areas and the ocean. Each project includes a dam and a reservoir, both of which decrease the survival of juvenile migrants. System mortality estimates include loss at the dams and in the reservoirs. Additional impacts not included in these estimates could also occur due to sub-lethal effects attributable to passage. These sub-lethal impacts (e.g., stress, injury and delay) can affect long-term survival (Matthews et al. 1987; Johnson et al. 1990; and Hawkes et al. 1991).

Although no system mortality studies have been conducted specifically with sockeye salmon, studies have been conducted with other species of salmon in the Columbia and Snake Rivers. Studies using Snake River steelhead and chinook salmon released above the dams and later recovered in the lower Columbia River provide an annual loss estimate per project (dam and reservoir) in the range of 13 to 54 percent (average 28 percent). Assuming the average rate per project, the cumulative mortality over eight dams would be 93 percent. The greatest mortality occurred in years when Snake and Columbia River flows during the spring

water during the spring and summer snowmelt. Impounded water is used for hydroelectric power in fall and winter when the regional energy demand is greatest.

The present management of water in the Columbia River system does not provide adequate flows and velocity to move downstream migrants safely to saltwater. As a result, many stocks of salmon and steelhead (including Snake River sockeye salmon) are continuing to decline.

(2) **Adult Sockeye Salmon Passage.** Cumulative adult passage loss for salmon passing mainstem dams can be substantial. Analysis of adult Columbia and Snake River sockeye counts for Bonneville and Priest Rapids/Ice Harbor Dams (Ross 1991b), adjusted for commercial, ceremonial and subsistence fisheries, showed an average annual loss of 10.5 percent (2.7 percent per dam) in the lower Columbia River since completion of the last dam in this reach in 1968 (Washington Department of Fisheries and Oregon Department of Fish and Wildlife, 1990). Assuming a similar loss per project in the Snake River, an additional 8 percent loss would occur from Ice Harbor Dam to Lower Granite Dam.

Delay at dams can also be an important factor in the survival of Snake River adult sockeye salmon. Factors influencing delay include the effectiveness of fish passage facilities, powerhouse and spillway operations, flow, and water quality. Average delay for adult salmonids at a Columbia River mainstem dam is about 1 to 3 days when good passage conditions

other factors that affect the condition of the environment or the fish at the time of their transition to saltwater. Dissolved gas supersaturation due to spill of water at the dams was also identified as a significant cause of mortality in the 1970s, but increased hydraulic capacity at the mainstem projects, greater flow control, and structural modifications to some spillways have substantially reduced this problem. Some fish also lose the urge to migrate. These fish remain in the reservoir and are lost to the migrating population.

Delay of migration during reservoir passage may also result in a loss. Because salmon and steelhead must undergo a temporary physiological change that enables them to make the transition from fresh to saltwater, delay can cause the fish to either cease migrating or to arrive at the ocean and be unable to adapt to salt water. Delay can also increase predation due to both increased exposure time and an increasing predation rate that accompanies a rise in temperatures through the spring and into summer (Columbia Basin Fish and Wildlife Authority (CBFWA) 1991).

Juvenile fish passage through reservoirs has been estimated to take one-third to one-half longer than passage through free-flowing water stretches (Raymond 1988). Delay in mainstem reservoirs is the result of low water velocity from two causes. The first is increased cross-sectional area of the river due to impounding the water above the dam. The second is the reduction in spring and summer flows due to withdrawals of water for irrigation and the use of headwater storage reservoirs to impound

exist (Ross 1983; Turner 1984). Average delay at a lower Snake River mainstem dam is about 1 to 2 days when little or no spill is occurring, increasing to about 5 to 7 days during high spill (Turner 1983; Turner 1984). Radio-tagged sockeye salmon had a mean passage time of 74 (range 5 to 150) hours at Bonneville Dam in 1982 (Ross 1983) and 24 (range 3 to 73) and 16 (range 2 to 49) hours at McNary and John Day Dams, respectively, in 1985 (Shew 1985).

Delay can be greater when adult passage facilities are not operated consistent with established criteria (i.e., at reduced hydraulic head and weir depths attraction flows at entrances are reduced). Inadequate water velocity inside fish ladders also increases delay. Fish Passage Center (FPC) Adult Fishway Inspections Annual Reports (1988, 1989, 1990) indicate that mainstem dam adult fishways are operating below velocity criteria a substantial amount of time (Ross 1991a).

Because sockeye salmon do not feed during their upstream migration, delays during migration may deplete limited energy reserves and reduce survival. Delays of as little as 3 to 4 days at migration barriers have been associated with pre-spawning mortality (CDE and IPSFC 1971).

Adult salmon fall back through spillways at dams can be as high as 58 percent (Monan and Liscom 1975). Most adult fish that fall back reascend the fishways and continue their migration. Fallback can also occur through turbines, which can result in mortalities of at least 22 to 41 percent (Wagner and Ingram

migration were low. Estimates of cumulative losses of inriver migrants past eight dams approached 100 percent in these low flow years (Raymond 1979; Sims and Ossiander 1981). Similar studies with chinook salmon in the Columbia River above the confluence with the Snake River resulted in an estimated annual loss per project in the range of 13 to 25 percent (Chapman and McKenzie 1980; McKenzie et al. 1983; and McKenzie et al. 1984). The Columbia River studies included no low flow years.

Injury and mortality can occur through each dam passage route (turbines, spillways, ice and trash sluiceways, and juvenile fish bypass systems), but there are numerous studies documenting that loss rates from passage through turbines is generally high relative to the other routes of passage.

One means of avoiding juvenile losses at dams is to collect and transport juveniles around the dams. While such transportation has been shown to have positive benefits for some salmon and steelhead stocks, for other stocks, the benefit is unclear. Most of these studies used steelhead, chinook or coho salmon. No studies have been done specifically on Snake River sockeye salmon. Limited information on Columbia River sockeye salmon suggests that this species is more susceptible to physical injury and mortality in project passage and handling than are other species (Gessel et al. 1988; Johnsen et al. 1990; Koski et al. 1990; Parametrix 1990; and Hawkes et al. 1991).

Fish mortality also occurs while juveniles are in reservoirs. Causes include predation, disease, temperature, and

1973). Dissolved gas supersaturation caused by large amounts of water spilling over dams can also result in injury and death to adult salmon.

(b) **Water Withdrawal and Storage.** Diversion and storage of water within the Columbia River has decreased water availability and altered historical run-off patterns in the Columbia River Basin. In addition, unscreened water diversions have often permitted juvenile anadromous fish to move onto irrigated lands and be lost.

Within the Snake River system, the major consumptive use of water is for agricultural irrigation. Both Federal and private reservoirs store natural flows from the Snake River Basin for agriculture. The total annual discharge of the Snake River is approximately 36 million acre-feet (MAF) (44.4 cubic kilometers). Approximately 16 MAF (19.73 cubic kilometers) are diverted annually from the Snake River and of this, 6 MAF (7.4 cubic kilometers) are consumed by agriculture.

Total active storage (the amount of water that can be removed from a reservoir) in the Snake River Basin above Hells Canyon Dam (including Brownlee Reservoir) is approximately 11.3 MAF (13.94 cubic kilometers). The amount of active storage available for use varies from year to year, depending on rainfall and run-off. This storage alters timing of peak flows in the Snake River that would, under natural conditions, have occurred during the spring run-off when juvenile anadromous fish are migrating.

Water diversions have had a significant impact on Stanley Basin sockeye salmon populations. Chapman et al. (1990) listed agricultural diversion among the causes of the sockeye salmon's decline from all Stanley Basin lakes, including Redfish Lake. Chapman et al. (1990) notes that more than 68 agricultural diversions are present on the Salmon River and tributaries within the Sawtooth National Recreation Area (SNRA). Agricultural diversion at Busterbach Ranch, on Alturas Lake Creek in the Stanley Basin, completely de-waters the creek, totally blocking sockeye salmon from Alturas Lake (Bowles and Cochnaur 1984; Chapman et al. 1990; IDFG 1990). Screens have been installed in the Salmon River Basin since the mid-1950's to prevent fish from entering diversions (Delarm and Wold 1985). However, many Stanley Basin streams in the SNRA were not screened until the mid to late 1970s and some unscreened diversions still exist.

In the Columbia River Basin above the confluence with the Snake River, a significant amount of water is also withdrawn for agricultural irrigation. For instance, irrigation diversion at the Bureau of Reclamation's (BOR) Columbia Basin Project above Grand Coulee Dam averaged 2.3 MAF (2.84 cubic kilometers) annually between 1968 and 1987 (BOR 1989).

The BOR (1989) evaluated the impact on fishery resources from proposed increases in agricultural withdrawals at the Columbia Basin Project. By modeling smolt survival for Columbia and Snake River spring chinook and steelhead at various flows, the BOR demonstrated decreased smolt survival with increased

Columbia River agricultural withdrawal. Thus, water withdrawals from the Columbia River Basin impact the survival of juvenile salmonids by reducing flow during the time they migrate through the Columbia River to the ocean.

2. Over-utilization for Commercial, Recreational, Scientific or Educational Purposes. Data specific to the exploitation of Snake River sockeye salmon are limited, but available information indicates that commercial fisheries in the lower Columbia, and harvest on the spawning grounds, were primary factors in the decline of Columbia River sockeye salmon (Fulton 1970).

The sockeye salmon fishery in the lower Columbia River began in 1889 and peaked in 1898 when harvest exceeded 4.5 million pounds (2.04 million kilograms) (Fulton 1970). Between 1905 and 1930, sockeye salmon production in the Columbia River Basin was effectively limited to the Wenatchee, Osoyoos/Okanogan, and Salmon River systems following the construction of barriers to fish passage in the Yakima, Payette, Wallowa, and Arrow Lakes systems.

In the years from 1960 to 1973, commercial and tribal sockeye salmon fisheries in the Columbia River, downstream from the Snake River, averaged 35,956 fish. Non-treaty and treaty commercial fisheries for sockeye salmon were closed from 1974 through 1983. Harvest figures for tribal ceremonial and subsistence fisheries were first reported in 1977 and averaged more than 1,000 fish annually and ranged up to 2,131 fish (1984)

through 1990. From 1975 to 1983, annual sockeye salmon counts over Lower Granite Dam averaged 221 fish, ranging from 25 to 531. Commercial fisheries for sockeye salmon resumed in 1984 and escapement over Lower Granite Dam from 1984 to 1989 declined to an annual average of only 26 fish, (ranging from 2 to 49).

Salmon River sockeye salmon generally comprised less than 1 percent of the sockeye salmon entering the Columbia River between 1954 and 1966 (Bjornn et al. 1968). It is likely that Salmon River, Wenatchee and Osoyoos/Okanogan sockeye salmon have overlapping inriver migration timing and therefore are harvested at similar rates (ODFW and NMFS 1990). Considering the low abundance of Salmon River sockeye salmon relative to Wenatchee and Osoyoos/Okanogan River sockeye salmon, and their similarly timed migration, Salmon River sockeye salmon may be subjected to excessive exploitation during inriver fisheries. Bjornn et al. (1968) reported that the number of adults returning to Redfish Lake appeared to be related somewhat to the fisheries in the lower Columbia River. A disproportionately high number of Redfish Lake sockeye salmon may have been harvested since Columbia River fisheries were selective for larger fish and Redfish Lake sockeye salmon are relatively large compared to Columbia River sockeye salmon (Bjornn et al. 1968).

The recreational harvest of sockeye salmon in the Columbia River is negligible (Washington Dept. of Fisheries and Oregon Dept. of Fish and Wildlife 1990).

The ocean harvest of sockeye salmon is believed to be

relatively insignificant. The catch of all Pacific salmon off Oregon, Washington, and California includes fewer than 100 sockeye salmon annually (Pacific Fishery Management Council 1990). Other possible areas of ocean catch are in the high seas driftnet fishery and the troll fishery off British Columbia. Although no information is available to identify Snake River sockeye salmon in these high seas and British Columbia catches, the numbers of Snake River sockeye would be expected to be low.

Based on existing records, NMFS concludes that fisheries (other than recreational) in the Columbia River and near the spawning grounds have contributed to the decline of Snake River sockeye salmon.

3. Disease or Predation.

(a) **Disease.** Sockeye salmon are exposed to numerous bacterial, protozoan, viral, and parasitic organisms in spawning and rearing areas, migratory routes, and the marine environment. Specific disease pathogens such as infectious hematopoietic necrosis virus, Flexidacteras columnaris, Tricophera sp., Ceratomyxa shasta, as well as others are known to be present. Even though O. nerka is susceptible to these, their effect on Snake River sockeye salmon not documented.

(b) **Predation.** While predation has been investigated for Columbia and Snake River juvenile and adult salmon migrants in general, little information exists for Snake River sockeye runs specifically. However, because juvenile Snake River sockeye salmon migrate with other Columbia River spring and summer

migrating salmon, the rate of predation should be similar for all of these species.

(1) **Freshwater Predation.** There are several causes of increased freshwater predation on juvenile salmonids. Non-native predatory species such as walleye (Stizostedion vitreum vitreum) have been introduced into the Columbia River system. Native predator populations, including northern squawfish (Ptychocheilus oregonensis) and several species of fish-eating birds, have benefitted from dam impoundments that provide foraging areas. Furthermore, various bird species, such as gulls (Larus sp.) and common mergansers (Mergus merganser), prey on juvenile salmonids in their natal streams and migration corridors. Turbulence at turbine and dam bypass outlets and spillways has increased predator success by disorienting juvenile migrants (Poe et al. 1988). Slack water conditions in reservoirs have increased smolt travel time, resulting in an increased exposure to resident predators.

Studies in John Day Reservoir indicated that native northern squawfish were the primary predator of juvenile salmonids, but introduced predators such as walleye, smallmouth bass (Micropterus dolomieu), and channel catfish (Ictalurus punctatus) also took significant numbers of smolts. These predators were estimated to consume between 9 and 19 percent of the juvenile salmonids entering the reservoir, with northern squawfish accounting for approximately 78 percent of this loss (Poe et al. 1988).

Predation on eggs, fry, and pre-smolt sockeye has been estimated in Alturas Lake at up to 60 percent. This was primarily due to large populations of rainbow trout (Oncorhynchus mykiss) and dolly varden (Salvelinus malma) (Bowles and Cochnauer 1984). Alturas and Redfish lakes were stocked with Kamloops rainbow and eastern brook trout (Salvalinus fontinalis) (IDFG Biennial reports 1923-1942), both of which eat fish (Scott and Crossman 1979). Freshwater predation is a factor contributing to the decline of sockeye salmon in the Snake River.

(2) **Marine and Estuarine Predation.** Marine and estuarine predation of salmonids in general has been extensively investigated, but again, very little information exists for Snake or Columbia River sockeye salmon stocks. NMFS has noted that marine mammal numbers, especially harbor seals and California sea lions, are increasing on the West Coast and increased predation by pinnipeds has been noted in all Northwest salmonid fisheries (NMFS 1988). In 1990, an average of 18 percent of the fish examined at Lower Granite Dam on the Snake River had bite marks thought to be from sea lions (Harmon and Matthews 1990). Of the 34 species of marine mammals known to frequent all salmon occupied waters, 15 are known to prey on salmon (Fiscus 1980). The salmon shark (Lamna ditropis) and Pacific hake (Merluccius productus) are also thought to be important predators of sockeye salmon (Gilhousen 1989, Beachum 1989). Predation by birds on downstream migrants also occurs in the estuary. Information is not available to determine if marine and estuarine predation has

any measurable impact on Snake River sockeye salmon.

4. **Inadequacy of Existing Regulatory Mechanisms.** There is a wide variety of Federal and state laws that impact the abundance and survival of anadromous fish populations in the Columbia River. These laws, such as the Fish and Wildlife Coordination Act, the Federal Power Act, the Pacific Northwest Electric Power Planning and Conservation Act of 1980 and the Water Resources Development Act, concern fish resource measures at water resource developments, including hydropower projects. Other Federal laws applicable to Snake River sockeye salmon include the National Environmental Policy Act, Federal Water Pollution Control Act, and the Salmon and Steelhead Conservation and Enhancement Act. Some of these laws are summarized below. None of these laws has proven sufficient to prevent the decline of Snake River sockeye salmon.

(a) **Fish and Wildlife Coordination Act (16 U.S.C. 661-666c)** (FWCA). The FWCA requires that wildlife conservation receive equal consideration and be coordinated with other features of water-resource development programs. Federal water development and permitting and licensing agencies are to seek the recommendations of the Federal and state fish and wildlife agencies for mitigation and enhancement of fish and wildlife resources. These recommendations are to be given "full consideration." However, because acceptance of the fish and wildlife agencies' recommendations is not mandatory, they are not always adopted, particularly when they affect another purpose for

which a project may be authorized. While the coordination required by the FWCA has been helpful, it is not adequate to protect Snake River sockeye from the harmful impacts of water development activities.

(b) **Federal Power Act (16 U.S.C. 791-825) (FPA).** Non-Federal dam construction and operation for hydropower is authorized by the FPA. Like the FWCA, fish and wildlife agencies have the authority to make recommendations pertaining to project construction and operation actions affecting fish and wildlife. The fish and wildlife agencies' authority was strengthened by the Electric Consumer's Protection Act of 1986, which requires the Federal Energy Regulatory Commission to include conditions in each license, based on fish and wildlife agencies' FWCA recommendations, to equitably protect, mitigate and enhance fish and wildlife.

The Hells Canyon Complex, licensed under the FPA, is currently owned and operated by the Idaho Power Company, and consists of Hell's Canyon, Oxbow, and Brownlee Dams. The Hell's Canyon Dam, the most downstream dam, poses a complete barrier to anadromous fish passage. The complex was authorized under a single FPA license in 1955. At the time of licensing, there were no downstream Federal dams in the mainstem Snake River and minimum flow requirements for juvenile migration were not included in the license. Modifying the license to include flows adequate for migration would take many years, based on experience with other modification proceedings. The only automatic

opportunity for changing the license conditions will come with the project's relicensing, which will likely occur in 2005, at the end of the license's 50-year term.

The overall impact of the FPA has been to increase the number of Columbia River Basin hydropower facilities--some of which adversely impact migrating salmonids, including Snake River sockeye salmon.

(c) Salmon and Steelhead Conservation and Enhancement Act of 1980 (16 U.S.C. 3301 et seq.). This Act authorized formation of a Salmon and Steelhead Advisory Commission (SSAC) comprised of state, tribal, Federal, and Pacific Fishery Management Council representatives. It was charged with preparing a comprehensive report for developing a coordination and management structure to address salmon and steelhead stocks of Washington and the Columbia River. The report was to be approved by the Secretary of Commerce (Secretary), and, if an effective management structure could be established, participating agencies would be eligible to receive additional funds for "enhancement" activities.

A report was prepared and submitted to the Secretary for approval. The Secretary returned the report to the SSAC for further work, but funds supporting the SSAC had been spent and no further action was taken. No additional funds were appropriated by Congress for continued work on the report or for constructing enhancement facilities.

While the effort of the SSAC was very useful in developing

closer coordination of anadromous fish activities among the agencies, it was inadequate in providing any additional protection to upper Columbia River salmonids.

(d) **Mitchell Act** (16 U.S.C. 755-757). The Mitchell Act was intended to compensate for the progressive decline of Columbia River Basin salmonid resources due to destruction of favorable environmental conditions by hydroelectric development, deforestation, pollution, and water diversions. The Columbia River Fisheries Development Program, administered by NMFS under the Mitchell Act, has a number of successful programs that implement stream improvements, screening of irrigation diversions (some of which have been in the Salmon River basin) and hatchery operations. Although the Mitchell Act has increased fish production and survival, it is limited to screening, stream improvement, and artificial propagation, and alone is inadequate to deal with the comprehensive needs of the Columbia and Snake River Basin salmon problems.

(e) **State Laws**. The implementation of the state laws of Oregon, Washington, and Idaho that affect water allocation, water quality, and riparian and wetland protection are very important to the conservation of salmon. One example of water use management that has adversely affected Snake River sockeye salmon is the Busterbach Ranch agricultural diversion, which de-waters Alturas Lake Creek, and prevents sockeye salmon from returning to Alturas Lake.

State laws that require screening of irrigation diversions

may also be inadequate. For example, it is illegal in the State of Idaho to receive or take more than 125 cubic feet per second (cfs) (3.54 cubic meters per second) of water from any stream or lake without installing and maintaining a screen to prevent fish from entering therein. For smaller diversions, Idaho state law permits construction and maintenance of irrigation screens by the IDFG. For comparison, the State of Oregon requires diversions of more than 30 cfs (0.85 cubic meters per second) to be screened when gamefish exist. Since the early 1950s, NMFS has been working with the State of Idaho, through the Columbia River Fisheries Development Program, to install screens on approximately 236 diversions in the Salmon River Basin. However, there are still unscreened diversions.

(f) **Harvest Regulation.** The only direct fishery harvest on Columbia River Basin sockeye salmon is the mainstem river fishery under the management responsibility of the states and the four tribes that are parties to U.S. v. Oregon (302 F. Supp. 899 (D.Or. 1969), aff'd, 529 F.2d 570 (9th Cir. 1976)).

(g) **Pacific Northwest Electric Power Planning and Conservation Act of 1980 (16 U.S.C. 839 et seq.) (NWPB).** The NWPB was passed to encourage efficiency, coordination and regional participation in power planning in the Pacific Northwest while providing protection, mitigation and enhancement of affected fish and wildlife, especially anadromous fish. The NWPB specifically requires that fish and wildlife resources be given equitable treatment in management, operation and regulation of

the Columbia River hydroelectric power system. It also requires the development of a comprehensive program to protect, mitigate and enhance fish and wildlife in the Columbia Basin. The NWPB established the Northwest Power Planning Council (NWPPC) to coordinate power planning and fish and wildlife measures.

In 1982, in accordance with section 4(h) of the NWPB, the NWPPC adopted a Fish and Wildlife Program (FWP) based on recommendations of the Region's Federal and state fish and wildlife agencies and Indian tribes. The agencies responsible for managing, operating and regulating Federal and non-Federal hydroelectric facilities in the Columbia River Basin are responsible for implementing the FWP.

In the case of anadromous fish, the NWPB specifically recognized the need for "improved survival . . . at hydroelectric facilities" and the need for "flows of sufficient quality and quantity between such facilities to improve production, migration and survival."

There are two reasons why the NWPB has not achieved positive results for the survival of anadromous fish: (1) There is no mandate requiring compliance with the FWP--the NWPB only requires that measures be taken into account to the fullest extent practicable; and (2) the lack of specificity in program measures often leads to disagreements over interpretation of how measures are to be implemented. Below is a summary of some of the FWP's more important features.

- (1) **Water Budget.** Mortality of juvenile fish during their

seaward migration is a major problem confronting upper Columbia River stocks, such as Snake River sockeye salmon. Flow is important because delays caused by the combination of flow regulation (storing high natural runoff in the spring and early summer to provide regulated releases for power generation in the fall and winter) and changes in river cross-sectional area (from a free-flowing river to a series of impoundments) result in reduced survival. Passage at the dams is also a problem. Estimates of losses due to passage through turbines at these projects have ranged from 8 to 32 percent (Bell 1981; Long 1968). When the NWPPC solicited recommendations for provisions of the FWP, the fishery agencies and tribes recommended specific minimum and optimum flow levels for each month, with a sliding scale (which would provide additional water in years with better flows) for the critical juvenile fish migration period, April 15 through June 15. The NWPPC response to the agencies' recommendation was to include a "water budget" in the FWP.

The water budget is a specified volume of water to be managed by the fish and wildlife agencies and the tribes and released between April 15 and June 15 to aid the downstream migration of anadromous fish in the Columbia River. It consists of a Snake River component of 1.19 MAF (1.43 cubic kilometers) and a Columbia River component of 3.45 MAF (4.26 cubic kilometers). The greater volume of Columbia River water supplements the Snake River releases in providing flows in the mainstem Columbia River below the mouth of the Snake River. A

water budget has been included in planning for Columbia River water management since 1984. The NWPPC did not address flows outside the April 15 to June 15 period, reasoning that flows from power generation during the rest of the year would be sufficient to provide for fish passage (NWPPC 1984).

While the water budget has been beneficial in improving fish passage and survival, its potential has not been achieved due to a number of problems in both design and implementation. Problems include inadequate amounts of water, the limitation to a 60-day period, the lack of a guaranteed firm base flow, changes by the implementing agencies of the NWPPC-established priorities for water use, and constraints imposed by the operators (such as the Corps of Engineers and the Idaho Power Company) on how water is released.

(i) **Inadequate amount of water.** The NWPPC purposely set the water budget for Lower Granite Dam in the Snake River lower than fishery agency and tribal recommendations for minimum flows due to concerns about the impact on reservoir refill (NWPPC 1984). Further, the amount of water specified in the water budget is not always provided. For example, the water budget provides for 1.19 MAF (1.43 cubic kilometers) in the Snake River, but the amount actually obtained has ranged from 0.44 to 0.48 MAF (0.52 to 0.59 cubic kilometers). This amount of water was fully used in 7 to 17 days in the years 1987 through 1990 and, even during the days of release, it did not provide sufficient flows for adequate fish passage (CBFWA 1990). Monitoring at Lower

Granite Dam indicates that sockeye salmon migrate past this facility between early April and late June, spanning a period of 38 to 73 days (Fish Passage Center 1988; 1989; February 1990). However, the flow at Lower Granite Dam averaged only 77,000 to 88,000 cfs (2,180.4 to 2,491.9 cubic meters per second) during the period (7 to 17 days) of water budget use. This is well below the flow levels identified by the fishery agencies and tribes as needed for passage (CBFWA 1990).

The FWP also does not address the need for flows above the minimum. The fishery representatives had requested a sliding scale that would have made more water available for fish in those years when the annual runoff was greater. This approach was not made part of the water budget. An additional concern is that, in good water years, some of the water budget commitment is made up of increased runoff, and the amount of stored water available for the water budget is subsequently reduced. This results in a water budget that provides water equivalent only to that which would be required during a critically low-flow year.

(ii) Limitation to a 60-day period. The problem with limiting the water budget to a 60-day period is the resulting drop in flows during the subsequent period. Use of water for the water budget in the spring period creates a "hole" in reservoir storage that is then replaced by holding back flows when the water budget request is no longer in force. During these time periods there are still significant numbers of fish passing through the system that are adversely impacted by the low flows

not seem consistent with the stipulation of the Act [Sec. 4(b)(1)(A)] to make decisions "solely on the basis of the best scientific and commercial data available." The process of evolution and differentiation within and between species is manifest in so many different ways that no simple yardstick will be universally applicable. This does not mean that more definitive guidelines for making species determinations under the ESA are not possible. It is hoped that public comment and discussion of ideas presented here will help to focus attention on those characteristics thought to be most important in defining "distinct population segments" of Pacific salmon.

Acknowledgments

This paper has drawn heavily on three sources. First, the paper by Utter (1981) laid a solid foundation to build upon, and many of the ideas expressed in that earlier paper appear here in similar form. Second, NMFS solicited public comments on a summary of the 1981 paper, and a number of suggestions received in response have been incorporated into the present document. Finally, many of the concepts outlined here were discussed in one form or another at the FWS-NMFS Vertebrate Population Workshop in Washington, D.C., in June 1990. In particular, I want to acknowledge Andrew Dizon (NMFS, La Jolla, CA) for introducing the ESU concept and Mark Shaffer (FWS, Washington, D.C.) for stressing the importance of considering ecological and habitat characteristics. A number of people within NMFS and FWS critically reviewed earlier drafts of the manuscript, and Pat Montanio (NMFS, Silver Spring, MD) and Karl Gleaves (Office of NOAA General Counsel, Silver Spring, MD) provided valuable guidance relating to the legislative and legal history of the Endangered Species Act.

DEFINITION OF "SPECIES" UNDER THE ENDANGERED SPECIES ACT:

APPLICATION TO PACIFIC SALMON

by

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February 1991

Summary

For purposes of the Endangered Species Act (ESA), a "species" is defined to include "any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." Federal agencies charged with carrying out the provisions of the ESA have struggled for over a decade to develop a consistent approach for interpreting the term "distinct population segment." This paper suggests such an approach and explains in some detail how it can be applied to ESA considerations of anadromous Pacific salmonids. The following definition is proposed:

A population (or group of populations) will be considered "distinct" (and hence a "species") for purposes of the ESA if it represents an evolutionarily significant unit (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 species.

Isolation does not have to be absolute, but it must be strong enough to permit evolutionarily important differences to accrue in different population units. The second criterion would be met if the population contributed substantially to the ecological/genetic diversity of the species as a whole.

Insights into the extent of reproductive isolation can be provided by movements of tagged fish, recolonization rates of other populations, measurements of genetic differences between populations, and evaluations of the efficacy of natural

barriers. Each of these methods has its limitations. Identification of physical barriers to genetic exchange can help define the geographic extent of distinct populations, but reliance on physical features alone can be misleading in the absence of supporting biological information. Physical tags provide information about the movements of individual fish but not the genetic consequences of migration. Furthermore, measurements of current straying or recolonization rates provide no direct information about the magnitude or consistency of such rates in the past. In this respect, electrophoretic (or DNA) differences can be very useful because they reflect levels of gene flow that have occurred over evolutionary time scales. The best strategy is to use all available lines of evidence for or against reproductive isolation, recognizing the limitations of each and taking advantage of the complementary nature of the different types of information.

If available evidence indicates significant reproductive isolation, the next step is to determine whether the population in question is of substantial ecological/genetic importance to the species as a whole. In making this determination, the following questions are relevant:

- Is the population genetically distinct from other conspecific populations?
 - Does the population occupy unique habitat?
 - Does the population show evidence of unique adaptation to its environment?
- and, more generally,
- If the population became extinct, would this event represent a significant loss to the ecological/genetic diversity of the species?

Several types of information are useful in addressing these questions. Again, the strengths and limitations of each should be kept in mind in making the evaluation. Phenotypic/life-history traits such as size, fecundity, and age and time

of spawning may reflect local adaptations of evolutionary importance, but interpretation of these traits is complicated by their sensitivity to environmental conditions. Electrophoretic data provide valuable insight into levels of overall genetic differentiation among populations but little direct information regarding the extent of adaptive genetic differences. Habitat differences suggest the possibility for local adaptations but do not prove that such adaptations exist.

The framework suggested here provides a focal point for accomplishing the major goal of the Act--to conserve the genetic diversity of species and the ecosystems they inhabit. At the same time, it allows discretion in the listing of populations by requiring that they represent units of real evolutionary significance to the species. Further, this framework provides a means of addressing several issues of particular concern regarding Pacific salmon, including anadromous/non-anadromous population segments, differences in run-timing, supplementation, introduced populations, and the role of hatchery fish.

In conjunction with a review of the biological status of Pacific salmon¹ (*Oncorhynchus* spp.) initiated in 1978 by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS), three policy position papers were drafted for the consideration of Columbia River salmon under the Endangered Species Act (the Act; ESA). The draft papers were intended to provide guidance at three critical stages in ESA evaluations: determination of what constitutes a "species" under the Act (and, therefore, may merit protection), determination of thresholds for listing as threatened or endangered, and determination of the role (if any) of artificial propagation in development of recovery plans for listed "species."

On receipt of petitions to list several populations of Pacific salmon as "species" under the Act (April-June 1990), NMFS sought public comments on draft Policy Position Paper #1, "Definition of Species" [a summary of a longer document by Utter (1981)]. The present document is a synthesis of ideas outlined in the previous draft species definition paper, public comments on that paper, and concepts developed over the past decade.

I. Background of the Endangered Species Act

The stated purposes of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*) are to "provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, [and] to provide a program for the conservation of such endangered species and threatened

¹The term "Pacific salmon" has traditionally referred to species of the genus *Oncorhynchus*, five of which (*O. gorbuscha*, *O. keta*, *O. kisutch*, *O. nerka*, and *O. tshawytscha*) occur in North America. The recent decision to move the western trouts from the genus *Salmo* to *Oncorhynchus* calls this usage into question. In this document, "Pacific salmon" is used to include anadromous forms of *O. clarki* and *O. mykiss*, as well as the five above-mentioned species.

species." A review of legislative history indicates that a major motivating factor behind the Act was the desire to preserve genetic variability, both between and within species. For example, the House of Representatives described the rationale for House Resolution 37, a forerunner to the Act, in the following terms (H. R. Rep. No. 412, 93d Cong., 1st Sess., 1973):

From the most narrow possible point of view, it is in the best interests of mankind to minimize the losses of genetic variations. The reason is simple: they are potential resources. They are keys to puzzles which we cannot yet solve, and may provide answers to questions which we have not yet learned to ask.

Under the 1973 ESA, a "species" was defined to include "any subspecies of fish or wildlife or plants and any other group of fish or wildlife of the same species or smaller taxa in common spatial arrangement that interbreed when mature." Use of this language established that the scope of the Act extends beyond the traditional biological definition of species to include smaller biological units. Amendments in 1978 [Pub. L. 95-632 (1978), 92 Stat. 3751] provided the current language in the Act: a "species" is defined to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature" (emphasis added).

Congress has provided limited guidance for interpretation of this definition. Congress declined to enact a provision in the 1979 amendments recommended by the General Accounting Office (GAO)² that would have removed the authority to list vertebrate populations. The Senate Report to the 1979 amendments, however, stated that "the committee is aware of the great potential for abuse of this authority and expects the FWS to use the ability to list populations sparingly and only when

²GAO, Endangered Species--A Controversial Issue Needing Resolution, Report to Congress (1979).

biological evidence indicates that such action is warranted" (S. Rep 151, 96th Cong., 1st Sess., 1979).

In an attempt to develop guidelines for and consistency in interpreting the language of the Act pertaining to vertebrate populations, FWS and NMFS convened a Vertebrate Population Workshop in June 1990. The goal of the workshop was to recommend a consistent approach for determining whether vertebrate populations are "distinct" under the Act. The framework adopted here reflects concepts discussed at the workshop.

Proposed definition: A vertebrate population will be considered distinct (and hence a "species") for purposes of conservation under the Act if the population represents an evolutionarily significant unit³ (ESU) of the biological species. An ESU is a population (or group of populations) that

- 1) is reproductively isolated from other conspecific population units
- and
- 2) represents an important component in the evolutionary legacy of the species.

Note that the dual criteria reflect two common meanings of "distinct": the criterion of reproductive isolation emphasizes the concept of "separate" or "apart from," whereas the criterion of evolutionary importance focuses on characteristics that are "different" or "unique."

Isolation does not have to be absolute, but it must be strong enough to allow evolutionarily important differences to accrue in different population units.

³The term "evolutionarily significant unit" apparently originated with Ryder (1986). The usefulness of this concept in the context of ESA evaluations was stressed at the Vertebrate Population Biology Workshop by A. Dizon (NMFS, La Jolla, CA). See Dizon et al. 1991 for additional discussion of this and related concepts.

Population characteristics that are important in an evolutionary sense must have a genetic basis; therefore, the second criterion would be satisfied if the population in question contributes substantially to the overall genetic diversity of the species. Because ecological diversity may foster local adaptations (and hence genetic diversity), a population that occupies unique habitat or in other ways represents an important ecological adaptation for the species may also be an ESU.

This framework provides a focal point for accomplishing the major goal of the Act--to conserve the genetic diversity of species and the ecosystems they inhabit. At the same time, it allows discretion in the listing of populations by requiring that they represent units of evolutionary significance to the species. In this framework, reproductive isolation is a necessary but not a sufficient condition for a population to be considered "distinct." Presumably, given enough time, an isolate will evolve into an ESU, but isolation by itself does not confer distinctness. For example, a population recently isolated as the result of human activity probably does not play an integral role in maintaining ecological or genetic diversity of the species. The same might be true for some natural isolates, particularly those of recent origin.

II. Application to Pacific Salmon

Application of the ESU concept to Pacific salmon requires consideration of reproductive isolation and ecological/genetic diversity. For convenience these concepts are considered separately here, but it is recognized that they are inherently related.

A. Reproductive isolation⁴

With Pacific salmon, reproductive isolation is seldom a black-and-white situation; rather, it is a question of degree (e.g., Ricker 1972). Although the homing instinct is well documented in these species, natural straying does occur, and anadromous⁵ spawning populations that are completely isolated from other conspecific populations are probably rare. A relevant question thus becomes, How much exchange with other populations can a salmon population experience and still be considered an ESU? Similarly, it is important to consider whether isolation is a recent phenomenon or whether it represents a long-standing condition.

One approach to this question emphasizes the effects of migration in inhibiting genetic differentiation. The term "gene flow" is commonly used to describe the movement of genes from one population to another; that is, gene flow represents genetically effective migration. An oft-cited maxim based on Sewall Wright's work is that gene flow between populations at the rate of one individual per generation is sufficient to prevent the tendency for different alleles to be fixed by chance (genetic drift) in different populations. Migration (the physical movement of individuals) may occur at a higher rate than gene flow if some migrating individuals fail to reproduce or do not produce viable offspring.

Although gene flow at the level of one individual per generation may prevent extreme genetic divergence, it is not sufficient to equalize allele frequencies across populations, and Wright (1978) also pointed out that genetic differentiation is by no means negligible even if gene flow occurs at several times this rate. Furthermore,

⁴This discussion of reproductive isolation focuses on the degree to which a population is isolated from genetic contact with other natural populations. Straying from hatchery stocks and intentional transfers of fish from one area to another are discussed in Section III-C.

⁵Non-anadromous populations or segments of populations are considered in Section III-A.

the above comments apply to a balance between migration and genetic drift of neutral alleles. If there is local adaptation for different alleles in different populations, the homogenizing effects of migration will be counteracted somewhat by different selective regimes, thus allowing greater differences among populations to be maintained.

Another way to consider the migration problem is to view it as a question of replacement. In this context, the relevant question is, If all individuals in the population in question were permanently removed, would the area naturally be repopulated by individuals of the same biological species, and if so, within what time frame? Presumably, an area that would be repopulated at or near the previous abundance level in a short time would be unlikely to harbor an ESU. This will be a largely theoretical exercise for populations being considered for protection under the Act. However, some insight can be gained from observations of recolonization rates in other populations and/or species.

The level of migration or gene flow occurring among populations can be evaluated in several ways. Approaches that may prove useful for Pacific salmon include:

- 1) Use of tags to estimate straying rates;
- 2) Intentional genetic marking of populations;
- 3) Use of genetic indices [e.g., Wright's (1978) F_{ST} or Slatkin's (1985) private allele method] to estimate levels of gene flow;
- 4) Observations of recolonization rates;
- 5) Identification of physical or geographic features likely to act as barriers to migration.

Since the 1950s, extensive data bases have been developed that provide important information about the oceanic distribution of Pacific salmon (e.g., Hartt 1962).⁶ More recently, physical tags have been used to study migrations of fish from individual populations. However, tagging efforts typically focus on hatchery stocks, and much less is known about straying in natural populations. Furthermore, such studies do not provide direct evidence of gene flow. A salmon may swim into a nearby stream (and perhaps be counted as a stray) before ultimately making its way to its natal stream to spawn. Reproductive success of strays may also be less than that of fish from the local population.

A direct measurement of gene flow can be obtained by monitoring changes over time in the frequency of genetic markers characteristic of different populations. Because Pacific salmon populations are typically characterized by different frequencies of the same suite of alleles, rather than by qualitative differences in the types of alleles present, it often will be difficult to measure gene flow precisely without enhancing the frequencies of different alleles in different populations (intentional genetic marking). Although the few genetic marking studies that have been conducted with Pacific salmon (e.g., Seeb et al. 1986; Lane et al. in press) have provided important information, opportunities for such studies involving populations that are potential candidates for ESA listing are likely to be limited.

An indirect measurement of gene flow is provided by Wright's and Slatkin's methods, which measure some of the genetic consequences of migration. Accuracy of such estimates depends on the degree to which the various assumptions of the models used are satisfied. Notably, both methods assume selective neutrality of the alleles used, and results may be sensitive to the geographic configuration of the study sites included. Both methods are also based on equilibrium models and may

⁶See also subsequent INPFC Bulletins on salmon distribution.

overestimate migration rates if not enough time has elapsed to obtain a balance between the forces of migration and genetic drift.

Opportunities to observe recolonization are not common with Pacific salmon, but they do occur. Aspinwall (1974) described one experiment that eradicated an entire run of pink salmon to study straying. Natural events (e.g., the eruption of Mount St. Helens) sporadically occur that cause temporary extinction of populations or allow access to previously blocked habitat. In evaluating the results of such "experiments," it should be recognized that if intraspecific interactions (e.g., competition) are acting to hinder the success of migrants or strays, recolonization of empty habitat may occur at a higher rate than expected from migration rates among fully-seeded populations.

Because natural straying in Pacific salmon seems to be largely confined to nearby areas, geographic proximity (e.g., linear stream distance) of a population from other conspecific populations can provide a useful approximation of the degree of reproductive isolation. A number of studies of Pacific salmon have found genetic clustering of populations to occur largely along geographic lines. However, exceptions to this pattern have also been found, which emphasize the fact that distance is not the only barrier to gene flow. Consideration should also be given to other factors (e.g., geological history and physical and environmental gradients) that can affect population structuring.

As can be seen from this brief discussion, each of the above approaches has some limitations. Nevertheless, it is important to consider all available information because the various approaches provide different insights into the question of reproductive isolation. Recolonization rates provide the most direct indication of the likelihood that a population, if eliminated, would become reestablished naturally. Approaches 1, 2, and 4 can provide data on current levels of migration or gene flow

(over periods of one or a few generations). It is unlikely, however, that migration rates have been constant over long periods of time. In some cases, significant gene flow may occur only at intervals of decades or centuries. Wright's and Slatkin's methods can be very informative in this context because these indices reflect the cumulative effects of gene flow over evolutionary time scales.

B. Ecological/genetic diversity

If available evidence indicates significant reproductive isolation, the next step is to determine whether the population in question is of substantial ecological/genetic importance to the species as a whole. Because of the emphasis in the Act on conserving native ecosystems, ESA considerations of Pacific salmon should focus on naturally-spawning fish. In determining whether a wild⁷ population is an ESU, it is sufficient to demonstrate that the population in question is "distinct" from other wild populations. Relevant questions to ask in this context are

- Is the population genetically distinct from other conspecific populations?
- Does the population occupy unique habitat?
- Does the population show evidence of unique adaptation to its environment?

and, more generally,

- If the population became extinct, would this event represent a significant loss to the ecological/genetic diversity of the species?

Factors that are important to consider in addressing these questions include (but are not necessarily limited to) the following:

⁷Wild fish in this usage includes all fish that are the progeny of naturally-spawning fish.

- 1) Genetic traits. Examples include characters detected by protein electrophoresis or DNA analyses.
- 2) Phenotypic traits. Examples include morphological and meristic characters, occurrence of parasites, and disease resistance.
- 3) Life-history traits. Examples include time, size, and age at spawning; spawning behavior; fecundity; migration patterns; and timing of emergence and outmigration.
- 4) Habitat characteristics. This category includes such physical characteristics of the spawning and rearing habitat as temperature, rainfall, stream flow, and water chemistry, as well as biological attributes of the local ecosystem. In a broader sense, the habitat for a population also includes areas encountered during the entire life cycle. Thus, a waterfall in the migratory route might select for robust fish capable of surmounting it, and a population with distinctive oceanic migration patterns probably utilizes distinct marine habitat.

Two points are important to consider in evaluating these data. First, such data can be properly evaluated only in relation to similar information for the species as a whole. That is, some reference data are essential before one can determine that a particular population is distinct.

Second, it is unlikely that all relevant information will be available for any given ESA evaluation. This is particularly true for status reviews that must be conducted within a limited time period in response to formal petitions to list. ESA determinations must be made on the basis of the best available scientific information, and all types of data (including genetic, phenotypic, and life-history traits and habitat characteristics) should be considered.

Data from protein electrophoresis or DNA analyses permit direct inferences about genetic divergence and thus are particularly applicable to the question of population distinctness under the Act. However, if the common presumption is correct that the genetic characters detected by these methods are largely neutral with respect to natural selection, then it follows that differences among populations in these characters do not by themselves denote evolutionary significance (except in the sense that neutral genes may provide the raw material for future evolution). Rather, these genetic characters are primarily useful as indicators (or proxies) for evolutionary processes that can lead to local adaptation in other parts of the genome more directly related to fitness.

Several types of genetic analyses can provide information relevant to ESA considerations. Gene diversity analysis can be used to partition the total genetic variance in a species in a variety of ways, including between-population, within-population, and between-years (within population) components. Results can be compared with data for other species (and other salmonids in particular) to provide insight into the degree of genetic distinctness of the population under consideration. Genetic distance indices can be used in a similar fashion, and comparisons of heterozygosity levels may also be informative in some cases.

Phenotypic and life history traits may reflect local adaptations, and for this reason they may be relevant to the evaluation of population distinctness. However, expression of these traits is known to be affected by environmental as well as genetic factors, which complicates their interpretation.

Analysis of habitat characteristics is important in two ways. First, the existence of unique habitat features allows for the possibility of unique adaptations in the local population. Second, identification of unique habitat is one step toward

achieving the broad purpose of the Act--to preserve threatened and endangered "species" and the ecosystems they inhabit.

C. Recommended approach

The following approach is suggested for making a determination regarding population distinctness under the Act.

1) Evaluate the degree of reproductive isolation. If there is gene flow with other populations, it should be at a level low enough to permit evolutionarily important divergence. If apparent migration rates with adjacent populations are high, the population would not be considered isolated unless there is evidence that the genetically effective migration rate is much lower. Approaches outlined in Section A should be used to address the questions of migration rate, gene flow, and recolonization rate.

If the population is believed to be reproductively isolated, an evaluation under Step 2 (below) should be made; if it is not isolated, the population is not an ESU and should not be considered for listing under the Act.

2) Evaluate evidence for ecological/genetic distinctness in the context of similar data from throughout the species range, as well as for other species as appropriate. Often, this process will involve difficult judgments concerning the relative importance to attach to different types of evidence. Although a variety of approaches may prove useful in making this determination, none will provide a completely objective assessment of evolutionary significance. Nevertheless, some general guidelines can be suggested to aid the evaluation process.

The existence of substantial electrophoretic or DNA differences from other conspecific populations would strongly suggest that evolutionarily important,

adaptive differences also exist. The failure to find electrophoretic or DNA differences (or the absence of genetic data) would not rule out the possibility that such adaptive differences exist, but it would place a greater burden of proof on data for other characters.⁸ Data for habitat characteristics should be interpreted in a similar fashion: habitat differences suggest (but do not prove) the possibility of adaptive differences, whereas the inability to detect habitat differences constrains the scope of possible local adaptations but does not prove they do not exist. In evaluating data for phenotypic and life-history traits, every effort should be made to account for environmental effects that are manifested in periods shorter than one generation (and therefore do not reflect adaptations).

III. Special Considerations

A. Anadromy/nonanadromy

Some species of Pacific salmon (*Oncorhynchus nerka*, *O. mykiss*, and *O. clarki*) have nonanadromous as well as anadromous forms that occur together. A similar phenomenon occurs in some species of the genera *Salmo* and *Salvelinus*. This raises the question whether the two forms should be considered jointly or separately in deciding if a population is "distinct" under the Act. The following general guidelines are suggested.

The two forms should be considered separately if they are reproductively isolated. As noted above, the question of reproductive isolation is likely to be one of degree. Again, the key question is whether isolation is strong enough for

⁸Although "electrophoretic and DNA" techniques are considered here together for convenience, there are a variety of parts of the nuclear or mitochondrial genome that can be targeted for study. It is important to realize that the sensitivity of the different approaches can vary considerably, and this factor must be considered in interpreting the results of genetic analyses.

evolutionarily important differences to develop in the two forms. Genetic data can be valuable in making this determination, as can observations of general spawning behavior, including time and place of spawning. Information from other populations (and other species) can help provide a context for making the evaluation. However, such studies have shown that a wide variety of scenarios probably exists in nature (from substantial reproductive isolation of sympatric anadromous and nonanadromous forms to substantial life-history plasticity within presumably a single gene pool). Therefore, such studies are unlikely to provide an unequivocal answer for an unstudied anadromous/nonanadromous system.

If substantial gene flow occurs or has recently occurred between the two forms, they represent polymorphisms of a single population and should be considered as a unit for purposes of the Act. In determining whether such a population unit is an ESU, the anadromous and nonanadromous traits should be considered in the same manner as other population characteristics discussed in Section II-B. That is, the important questions are whether the traits have a genetic basis and whether they help to make the population unit "distinct" from other populations. For example, an anadromous/nonanadromous unit might be considered an ESU if all ecologically comparable populations of the species harbored only the nonanadromous form. In this case, if the population unit is considered to be an ESU solely or primarily on the basis of the anadromous trait, then the potential loss of anadromy should be a legitimate ESA concern. Therefore, an anadromous/nonanadromous population unit could be listed based on a threat to one of the life-history traits, if loss of that trait would compromise the "distinctness" of the population.

B. Differences in run-time

In several species of Pacific salmon, biologists recognize different run-times, or races, of fish inhabiting the same general area. Generally, run-times are determined on the basis of the time of year at which adults enter fresh water to spawn. The question whether such races represent "distinct" populations under the Act can be addressed in the framework developed above.

First, it should be determined whether the different run-times are reproductively isolated. Often, the distinction between spring- and summer-run (for example) is fairly arbitrary, with fish appearing before a certain date classified as "springs" and those appearing after that date as "summers." In such cases, and in the absence of a discrete distribution of run-times, additional evidence (for example, time and place of spawning) needs to be developed to establish reproductive isolation.

Assuming that fish with different run-times are reproductively isolated, they can be considered to comprise distinct populations under the Act if they exhibit evolutionarily important ecological/genetic differences, as outlined in Section II-B above. In the absence of substantial isolation between run-times, a "population" unit consisting of two or more recognized run-times could be considered an ESU if it were isolated from and distinct from other populations.

C. Effects of supplementation and other human activities

Supplementation (or overplanting) is the release of hatchery-reared fish into a wild area occupied by native fish of the same biological species. The effects of supplementation are relevant to the question of population distinctness because a population that has been overplanted with fish of different origin may not be an

ESU even if it once was distinct. However, evidence merely of the release of exogenous fish is not sufficient to disqualify a population from consideration as an ESU. In making that determination, two factors should be considered. It is assumed that the population in question was distinct enough to be an ESU prior to contact with exogenous fish.

First, supplementation (or straying from hatcheries) has a direct genetic effect only if the transplanted fish successfully reproduce and contribute to subsequent generations of the native stock. Results of supplementation efforts with Pacific salmon have been quite variable (Ricker 1972) and at present are largely unpredictable. For example, a recent review (Hindar et al. in press) cited examples in which the native stock had been largely or entirely displaced, examples of hybridization between native and hatchery fish, and examples in which repeated hatchery releases had no detectable genetic effect on the native population. Therefore, it should not automatically be assumed that transplantation efforts have permanently altered the genetic structure of native populations.

Second, a population that does not represent a completely pure native gene pool may still qualify as an ESU if it is adapted to its local environment and is "distinct" by the criteria outlined in Section II-B. This point is important for Pacific salmon, because there are relatively few populations for which the possibility of some genetic influence from transplants or hatchery strays can be completely excluded. How much introgression from other gene pools must occur before a population no longer merits consideration as an ESU depends on the degree of distinctness of the original population. The key question to consider is whether stock mixing has compromised the evolutionarily important adaptations that distinguished the original population.

In evaluating the effects of supplementation on native gene pools, the following types of information should be gathered whenever possible:

- 1) Genetic, phenotypic, and life history traits and habitat characteristics for the transferred stock;
- 2) Brood-stock and rearing protocols for the transferred stock;
- 3) Dates of release, number released, and developmental stage at release;
- 4) Trends in abundance of the local population for a time span bracketing the time(s) of release;
- 5) Evidence for reproductive success of transplanted fish, including evidence for incorporation of foreign genes into the local population.

Other human activities (e.g., fishing, pollution, and artificial propagation) can also affect the genetic structure of native populations, and the importance of these factors to ESA considerations can be evaluated in a similar way. Again, the relevant question is whether the activities have changed the population so much that it no longer represents an evolutionarily significant component of the biological species.

D. Hatchery fish

Hatchery fish may enter into ESA considerations in several ways. For example, the effects of supplementation and straying by hatchery fish should be considered in evaluating whether a wild population is an ESU. Artificial propagation may also play a role in recovery plans for some "species." However, fish hatcheries do not provide a substitute for natural ecosystems that the Act mandates the Department to conserve. The role of artificial propagation under the

Act is to restore populations in natural habitat to the point where they can be removed from formal ESA protection. Therefore, only naturally-spawning populations should be considered in determining whether a population is distinct for the purposes of the Act.

An exception to the rule that an ESU must correspond to a wild stock may be made for a hatchery population that represents the only remaining component of a native gene pool. In that case, the hatchery population could be determined to be an ESU if it met the criteria set out in Section II.

E. Historic population size

For a population that once was abundant but since has declined in numbers, there should be no minimum size for ESA consideration. However, populations may also be small because of limiting physical or biological factors. For Pacific salmon, suitable habitat may severely limit the potential number of spawners and hence the carrying capacity of small streams. Given the large temporal fluctuations in abundance documented for every species (and many populations) of Pacific salmon, and given the likelihood that even greater fluctuations have occurred over evolutionary time, there must be some size below which a spawning population is unlikely to persist in isolation for a long period of time. The fact that small spawning aggregations are regularly observed may reflect a dynamic process of extinction, straying, and recolonization. Such small populations are unlikely to be ESUs, although a collection of them might be. Therefore, the historic size of a population may be useful in evaluating whether it is an ESU.

Both genetic and demographic factors should be considered in making this evaluation. Although there is no consensus among geneticists regarding the

minimum effective population size per generation (N_e) necessary to avoid long-term problems of inbreeding and loss of genetic variability, most estimates are in the range of several hundred.⁹ For a species with average age at spawning of 3-5 years (typical of many populations of steelhead and chinook, chum, and sockeye salmon), this would correspond to an effective number of breeders per year (N_b) of perhaps 50-100.¹⁰ Because not all individuals successfully spawn, and because the variance among individuals in reproductive success may be high, the total number of adults must generally be somewhat more than this (perhaps several times as many).

The long-term persistence of an isolated population also depends on its ability to withstand inevitable (and often large) fluctuations in abundance caused by the interplay of population dynamics, changing environmental conditions, and chance events. The importance of these factors varies among species and among populations within species and must be evaluated on a case-by-case basis. In general, however, such fluctuations may place greater constraints on the long-term survival of small populations than do genetic factors associated with inbreeding.

A Pacific salmon population should not be considered an ESU if the historic size (or historic carrying capacity) is too small for it to be plausible to assume the population has remained isolated over an evolutionarily important time period. In making this evaluation, the possibility should be considered that small populations observed at present are still in existence precisely because they have evolved mechanisms for persisting at low abundance. Population genetics theory indicates that gradual inbreeding over a period of time may purge deleterious, recessive alleles from a population, lessening the effects of inbreeding depression and allowing

⁹See discussions by Lande and Barrowclough (1987) and Simberloff (1988).

¹⁰For a discussion of the rate of loss of genetic variability in Pacific salmon and the relationship between N_e and N_b , see Waples (1990).

a smaller effective size than would ordinarily be the case. It is possible that, in some populations, a similar process--evolution of demographic parameters, for example--may have occurred that modulates the effects of environmental variability. Because such populations would contain adaptations that might truly be considered to be of evolutionary significance to the species, and because small populations in general are a likely source of evolutionary innovation, it is prudent to exercise caution in eliminating a population from ESA consideration simply on the basis of historic size. Nevertheless, this concept should prove useful in focusing attention on populations with the greatest probability of representing ESUs."

F. Groups of populations

Geographical considerations often suggest a natural hierarchical structure for Pacific salmon populations: large river systems may contain several drainages, and each drainage may have major tributaries with smaller streams that support spawning aggregations. Determining the appropriate level for consideration as an ESU is a challenging task. Although the strong homing instinct of these species indicates that even small spawning aggregations may in some sense represent biological populations, such populations may not meet the criteria to be considered "distinct" under the Act. A group of populations, however, might be distinct from, and isolated from, other groups of populations. Such a group of populations can constitute an ESU, and, if determined to be threatened or endangered, can be afforded protection under the Act.

"This concept is related to, but differs from, the concept of minimum viable population size (MVP). The MVP concept considers the future and asks how large a population must be to have an acceptably high probability of surviving a specified period of time. The historic population size concept considers the past and asks how small a population must be before it becomes unreasonable to assume it has persisted in isolation long enough for important adaptations to evolve.

In evaluating the appropriate grouping level, a balance must be struck between two opposing concerns. On the one hand, it is important to identify the smallest units that meet the criteria set out in Section II, because this allows the greatest flexibility in ensuring the appropriate level of protection for different ESUs within a more comprehensive group. On the other hand, we have seen in Section III-E (above) that the smallest units supporting local populations of salmon may not be evolutionarily independent from other nearby populations. A key question is, How can evolutionarily important units be protected without running the risk of artificially maintaining units that might naturally undergo episodes of extinction/recolonization on something short of evolutionary time scales?

The following approach is suggested. Identifiable ESUs should not be combined for the sake of convenience. In general, however, ESUs should correspond to more comprehensive units unless there is clear evidence that evolutionarily important differences exist between smaller population segments. This approach is consistent with the stipulation that NMFS and FWS should use sparingly their authority to list vertebrate populations. Nevertheless, it is recognized that the long-term viability of a larger unit may also depend on the continued existence of multiple, semi-independent units it comprises. Recovery plans for listed "species" could take this into account by ensuring protection for smaller units within a more comprehensive ESU. This might be appropriate, for example, if the smaller units differ in various characteristics but it is uncertain how these differences relate to evolutionary significance.

G. Introduced populations

In general, populations resulting from the introduction of fish into a local area not occupied by the biological species (particularly if the area is outside the historic range of the species) are probably not ESUs because they do not contribute to maintaining diversity of the species in its native habitats. Some introduced populations should not be excluded from ESA consideration, and these include populations occupying habitat that is ecologically similar and geographically proximate to the source population, and those that represent the only remaining component of a native gene pool. In the former case, the introduced population may be determined to be part of the same ESU as the parent population; in the latter case, the population could be determined to be an ESU if it met the criteria outlined in Section II.

H. Interpreting results of statistical tests

1. Sampling considerations

Rigorous analyses of data used in ESA considerations will include testing hypotheses whenever possible, and sampling protocols are important to consider in this context. In general, regardless of the characters being considered, the appropriate null hypothesis to test is that no differences exist between the populations being compared. Sampling from the populations introduces a source of random error with magnitude inversely proportional to sample size. In many statistical tests, the implicit assumption behind the null hypothesis is that the samples being compared were drawn from the same population. There are several ways in which this basic assumption might be violated by the method of sampling, and the effects of violating the assumption are often magnified in small populations

(as may frequently be encountered in ESA evaluations). Furthermore, the unusual life history features of Pacific salmon (e.g., the combination of semelparity with overlapping age classes) provide some additional opportunities for sampling bias. These factors should be kept in mind in designing sampling plans and in evaluating results.

a. Temporal changes within populations. Although most Pacific salmon spend the majority of their life at sea, they exist in recognizably discrete populations only during rearing as juveniles and spawning as adults. By necessity, samples are generally taken from local spawning populations, and often only a single brood year is sampled. It must be realized that the population as a whole includes several brood years, and values for a given character will show year-to-year variation around the mean for the population as a whole. The effects of temporal variation within a population must be considered in comparing single-brood-year samples from different populations; in general, this factor will inflate the observed level of difference above that predicted by the null hypothesis, even if the overall population means do not differ.¹³ A study plan that involves temporally-spaced samples within sites as well as samples from geographically distinct localities is the best way to evaluate the significance and stability of between-population differences.

b. Life history stage sampled. Waples and Teel (1990) showed that, in comparing two (or more) samples, the probability of a statistically significant result may depend on the life history stage sampled. In general, sampling juveniles will tend to produce larger differences than sampling adults. This will be a minor effect if the sample size is small relative to the population size, but this may not always be true for populations under ESA consideration.

¹³See discussion of a similar point in Waples (1989) and Waples and Teel (1990).

c. Non-representative sampling. Most statistical tests assume random sampling, which means that every individual in the population(s) has an equal opportunity to appear in the sample. There are several ways in which this condition might not be met with Pacific salmon. For example, adults may be sampled only during part of the spawning run, or only in limited areas of a stream. Under certain circumstances, samples of juveniles may include large numbers of individuals from the same family. Methods for sampling either life history stage may select for certain types of individuals.

2. Significance of results

It is important to realize that "statistical significance" is a different concept than "evolutionary significance" as it relates to the Act. In the present context, a statistically significant result indicates that the means for a pair or group of samples differ by more than would reasonably be expected if a single population were sampled repeatedly. The conclusion would be that the population means are different for the character under consideration. Being "different," however, is not the same as being "distinct" under the Act. For a population to be considered an ESU, it must differ from other populations in an evolutionarily important way. Statistical tests can be useful in making this determination but do not in themselves provide direct evidence regarding evolutionary significance. Similarly, failure to find a statistically significant difference does not disprove the existence of population differences. Power to detect true differences in population means is a function of sample size, so this factor should also be considered in evaluating results of statistical tests.

IV. General comments

This paper presents a simple, flexible framework for interpreting language in the Endangered Species Act pertaining to vertebrate populations: simple because a pair of criteria can be applied to determine whether a population segment is distinct and hence a "species" for purposes of the Act, and flexible because the two criteria can be used to address a variety of issues of particular concern for Pacific salmon.

By focusing on evolutionary significance, the ESU concept also provides a means of dealing with several recurring problems posed by the term "distinct population segment." For example, in 1979 the GAO pointed out potential abuses in the authority to list vertebrate populations, suggesting that this could lead to absurdities such as the listing of squirrels in a specific city park.¹³ Such a result is unlikely under the present framework. Although squirrels in a park might at present be effectively isolated from squirrels in other parks or natural habitat, such a population would be unlikely to meet the second criterion for an ESU (evolutionary significance). Similarly, a population unit artificially isolated as a result of human activities (e.g., by the construction of a dam) probably also does not meet the second criterion, although it might eventually become an ESU if the isolation were to persist for a long enough period of time.

It will have been noted by many that although this paper establishes a framework for considering populations of Pacific salmon under the Act and provides guidance for its application, it does not provide a simple formula for determining whether the unit under consideration is a "species." To the extent that the process would be simpler and more objective with such a formula, the approach adopted here is a disadvantage. However, use of a simple (or even a complex) formula does

¹³GAO, Endangered Species--A Controversial Issue Needing Resolution, Report to Congress (1979).

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EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

October 17, 1991

MEMORANDUM FOR JACQUELINE KENNEDY, ASSISTANT FOR SCHEDULING

FROM: VICKIE SUTTON, ASSISTANT DIRECTOR, FCCSET *MS*

SUBJECT: REQUEST FOR CLEARANCE

Please clear in the following people for the 11:00 meeting on Monday, October 21, 1991 with Mr. Sununu:

Thomas Lovejoy
DOB: 8/22/41

Edward O. Wilson
DOB: 6/10/29

Robert Brocksen
DOB: 6/24/36

Robert J. Smith
DOB: 4/14/37

Richard L. Stroup
DOB: 1/3/43

D. Allan Bromley
DOB: 5/4/26

Vickie V. Sutton
DOB: 4/9/56

Nancy G. Maynard
DOB: 4/18/41

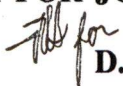
Ralph Brescia
DOB: 11/22/63



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

OCTOBER 17, 1991

MEMORANDUM FOR JOHN H. SUNUNU

FROM:  D. ALLAN BROMLEY

SUBJECT: BIODIVERSITY/ENDANGERED SPECIES EXPERTS MEETING

A small group of leading experts on the science of biodiversity has been assembled for a meeting in your office on Monday, October 21, 1991 for one hour from 11:00 am to 12:00 noon. I have attached the list of attendees, with a brief description of their area of expertise which you and I reviewed together a couple of months ago.

The group has been asked to share their thoughts on biodiversity and endangered species from the scientific perspective. They have not been asked to comment on the policy aspect of these issues or the upcoming consideration by Congress of the renewal of the Endangered Species Act. This legislation is expected to be considered in the fall of 1992.

Please let me know if you would like further information before the meeting on Monday.

Attendance List for October 21, 1991

Tom Lovejoy, Assistant Secretary for External Affairs, Smithsonian Institution

Lovejoy is a member of PCAST and is known for performing the first major long term banding study of birds in the Amazon, introducing the technique of banding to Brazil. He served as vice president for science and also executive vice president of the World Wildlife Fund until 1989, and is currently president of the Society for Conservation Biology. He received his Ph.D. in biology from Yale University in 1971.

Edward O. Wilson, Baird Professor of Science, Harvard University

Wilson serves as Baird Professor of Science and Curator in Entomology at the museum of Comparative Zoology. He is the author or co-author of more than 250 articles and 12 books, including The Insect Societies, Sociobiology: The New Synthesis, On Human Nature, and The Ants, the last two of which received Pulitzer Prizes. He is generally considered to be the world's leading authority on biodiversity.

Robert Brocksen, Adjunct Professor, Department of Zoology and Physiology, University of Wyoming

Brocksen is the vice president of Brocksen and Brand, Inc; executive director of Living Lakes, Inc. He is author of numerous articles and project reports on fisheries, toxicology, energy-related environmental impacts, and ecological analysis. Brocksen has testified on acid rain before a number of congressional and state committees. He received his Ph.D. in fisheries, physiology and limnology from Oregon State University.

Robert J. Smith, Director of Environmental Studies, Cato Institute

Smith is formerly a consultant to the Council on Environmental Quality and the U.S. Department of the Interior. He is the author of Earth's Resources: Private Ownership vs. Public Waste and articles for the Cato Journal, Policy Review, the Conservative Digest, and Outlook. Smith served as president of a New Jersey chapter of the Audubon Society. After studying geology and biology at Stanford University as an undergraduate, Smith did graduate work in economics at New York University.

Richard L. Stroup, Professor of Economics and Agricultural Economics, Montana State University

Stroup is a senior associate of the Political Economy Research Center, and a Cato Institute adjunct scholar. His numerous articles have appeared in such journals and newspapers as the American Economic Review, the Cato Journal, the Wall Street Journal, the Washington Times, National Review, and Reason. He has written chapters for The Yellowstone Primer, Natural Resources: Bureaucratic Myths and Environmental Management, Earth Day Reconsidered, and Managing the Commons, among other books. Stroup earned his Ph.D. in economics from the University of Washington.

Withdrawal/Redaction Sheet

(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
03a. Memo	From Ede Holiday to John Sununu Re: Future Controversial Listings Under the Endangered Species Act (1 pp.)	10/4/91	P/S	

Collection:

Record Group: Bush Presidential Records
Office: Chief of Staff, White House Office of
Series: Sununu, John, Files
Subseries: Issues Files
WHORM Cat.:
File Location: Endangered Species 1991

Open on Expiration of PRA
 (Document Follows)
 By JP (NLGB) on 10/28/05

Date Closed: 1/4/2005	OA/ID Number: 29154-003
FOIA/SYS Case #: 1998-0004-F[2]	Appeal Case #:
Re-review Case #: 2005-0426-S	Appeal Disposition:
P-2/P-5 Review Case #:	Disposition Date:
AR Case #:	MR Case #:
AR Disposition:	MR Disposition:
AR Disposition Date:	MR Disposition Date:

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

P-1 National Security Classified Information [(a)(1) of the PRA]
 P-2 Relating to the appointment to Federal office [(a)(2) of the PRA]
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C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Removed as a personal record misfile.

Freedom of Information Act - [5 U.S.C. 552(b)]

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Meeting Mon

THE WHITE HOUSE

WASHINGTON

October 4, 1991

THE CHIEF of STAFF
has seen

MEMORANDUM FOR GOVERNOR SUNUNU

FROM:

EDE HOLIDAY *EHA*

SUBJECT:

Future Controversial Listings Under the Endangered Species Act

Attached for your review are two documents containing the most controversial upcoming listing of decisions or other actions under the Endangered Species Act (ESA) to be taken by the Department of the Interior's Fish and Wildlife Service (FWS) or the Department of Commerce's National Marine Fisheries Service (NMFS).

Attachment A is a highlighted listing of the dates of the upcoming announcements, the various species and the states that will be impacted by these decisions. The lengthier memorandum, Attachment B, offers you more detailed information on these controversial upcoming decisions or actions.

You should know that currently there are 600 animal species listed as threatened or endangered under the ESA. In addition, FWS has under consideration approximately 40 proposed or final listing decisions under the ESA.

Attachments

cc: Roger Porter

Withdrawal/Redaction Sheet

(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
03b. Memo	Attachment A: Highlights (3 pp.)	n.d.	P5	

Collection:

Record Group: Bush Presidential Records
Office: Chief of Staff, White House Office of
Series: Sununu, John, Files
Subseries: Issues Files
WHORM Cat.:
File Location: Endangered Species 1991

Open on Expiration of PRA
 (Document Follows)
 By JP (NLGB) on 10/28/05

Date Closed: 1/4/2005	OA/ID Number: 29154-003
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HIGHLIGHTS

<u>DATE</u>	<u>SPECIES LISTING</u>	<u>STATES IMPACTED</u>
September, 1991	California Gnatcatcher (Proposed Listing)	Southern California
September, 1991	California Delta Smelt (Proposed Listing)	California
October, 1991	Gulf Sturgeon (Final Rule)	Louisiana/Alabama/ Mississippi/Florida
October/ November, 1991	Florida Black Bear (Final Rule)	Florida
November, 1991	Mexican Spotted Owl (Proposed Listing)	Arizona/New Mexico
November/ December, 1991	Razorback Sucker (Final Rule)	California/Arizona/ Nevada/Colorado/ Utah/Wyoming
December, 1991	Northern Spotted Owl (Critical Habitat and Draft Recovery Plan)	Oregon/Washington/ Northern California
February, 1992	Piping Plover (Critical Habitat)	Maine/New Hampshire/ Massachusetts/Rhode Island/Connecticut/ New Jersey/Delaware/ Maryland/Virginia/ North Carolina
March, 1992	Northern Spotted Owl (Decision of the Endangered Species Committee)	Oregon/Washington/ Northern California
April, 1992	Louisiana Black Bear (Final Rule)	Louisiana/ Mississippi
April, 1992	Snake River Salmon (Final Rule)	Oregon/Washington/ Idaho
June, 1992	Columbia River Salmon (Final Rule)	Oregon/Washington/ Idaho

June, 1992	Marbled Murrelet (Final Rule)	Oregon/Washington/ Northern California
September, 1992	California Gnatcatcher (Final Rule)	Southern California
September, 1992	California Delta Smelt (Final Rule, May Be Extended)	California
November, 1992	Mexican Spotted Owl (Final Rule)	Arizona/New Mexico

Withdrawal/Redaction Sheet

(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
03c. Memo	Attachment B: Discusses Species by Time Period (8 pp.)	n.d.	P /5	

Collection:

Record Group: Bush Presidential Records
Office: Chief of Staff, White House Office of
Series: Sununu, John, Files
Subseries: Issues Files
WHORM Cat.:
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SEPTEMBER/OCTOBER, 1991

California Gnatcatcher

Proposal to list as endangered under the ESA issued on September 5, 1991. The coastal California gnatcatcher is a small songbird native to the coastal range of Southern California and Mexico. Major threats to the bird include habitat loss and fragmentation from decades of land development in Southern California.

The proposed listing begins a one-year process in which public review and comment is taken before a final decision to list is made by the Department of Interior's Fish and Wildlife Service (FWS). Under the current time frame, the final listing decision is due in September, 1992. However, under the ESA, the Secretary of Interior may extend for up to six months the time period for making the final determination, if the one year time frame is insufficient to collect the necessary biological information.

As with every proposed or final listing decision, all federal agencies must "consult" with the FWS when considering actions that are likely to jeopardize the species or its habitat. If FWS determines that the action being reviewed poses a risk to the species, it may issue a so-called "jeopardy opinion," effectively denying the proposed action. Ostensibly, private lands are not effected. However, any private action that requires a federal permit or involves federal funding can be similarly impacted. Further, private landowners have an obligation under the ESA to make sure their activities would not result in a "take" of the species, the occurrence of which could result in criminal sanction.

The impact of this listing decision on local development and the local economy could be substantial due to the dense population in Southern California. Area developers have spent in excess of \$1 million on studies they contend refute federal and state scientists' findings that the gnatcatcher is imperiled. They predict that listing the bird will stall construction, cost jobs, and generally be an economic calamity. FWS is currently working with the State of California, the Natural Community Conservation Planning Program, along with municipalities and landowners, to develop a comprehensive set of guidelines for habitat protection.

The problem directly effects both California Senators and virtually all of Southern California's Congressional Districts.

California Delta Smelt

Proposal to list as threatened under the ESA issued on September 27, 1991. The California delta smelt is a three-inch fish that lives in the brackish waters of the Sacramento/San Joaquin River Delta (greater San Francisco Bay area). As with the proposed listing of the gnatcatcher, the announcement begins a one-year review period during which public comment about the proposed listing will be sought, and additional biological and scientific information will be compiled, before a final decision is made. Under the ESA, that final decision is scheduled for late September, 1992. The time period may be extended for up to six months, however, and the Department of Interior has already indicated that the one-year time period will likely be extended.

The impact of this listing on California could be enormous, particularly with regard to the Federal Bureau of Reclamation's Central Valley Project and California State Water Project operations. For example, to protect the smelt, changes likely would have to be made in the way the Delta area is managed with regard to water project operations. Pumps in the Southern Delta area that send water down aqueducts to Southern California may have to be turned down or off when the smelt spawn in late Winter and early Spring. Those pumps usually run at full capacity during these typically rainy months.

Initial analysis indicates that as much as 2 million acre-feet of water from federal and state projects may have to be dedicated to the Delta area rather than "exported" South for agricultural, municipal and industrial uses, and fish and wildlife management needs. The current drought conditions facing many parts of California will only exacerbate the problem.

The proposed listing of the smelt, along with the gnatcatcher, will involve virtually the entire California Congressional Delegation, including Congressman George Miller, Chairman of the House Interior and Insular Affairs Committee and a strong supporter of the current ESA. The listing of these two species clearly frames the current conflict generated by the ESA between the economy and the environment and, by comparison, could dwarf the current conflict in the Pacific Northwest over the northern spotted owl and Columbia River/Snake River salmon.

Louisiana Black Bear

Final rule to list the Louisiana black bear as threatened under the ESA (originally expected this month) has been

and commercial development near the sturgeon's habitat. States effected include Louisiana, Mississippi, Alabama, and Florida. The Congressional Delegations from each state, particularly those along the Gulf Coast, will be interested in this issue.

Razorback Sucker

Final rule to list the razorback sucker (a small fish found in the Colorado River) as threatened under the ESA is overdue and is undergoing further review by FWS. There is continuing dispute about whether the species is threatened or endangered. The razorback sucker will be the fourth species of fish in the Colorado River listed for protection under the ESA. Their endangered status has directly impacted dam and water project operations along the Colorado River, the most notable of which is the Animus-LaPlatta Water Project.

Negotiations are currently underway to draft a memorandum of understanding amongst the interested parties for the construction and operation of the Animus-LaPlatta Project. FWS fears that an additional listing of the razorback sucker will damage the negotiations and make an agreement less likely. The Colorado River is the focus of several other controversial environmental issues, including the operation of the Glen Canyon Dam. Critics claim that the fluctuating water flows from the dam are increasing the river's salinity and accelerating the erosion of the Colorado River Basin area. In response, the Department of Interior is preparing an environmental impact statement on the dam operations and has proposed interim dam operating guidelines to better regulate the water flow from the dam.

States impacted include Arizona, California, Colorado, Nevada, Utah, and Wyoming. Taking a personal interest in this issue has been Senators Garn, Brown, and (interestingly) Wirth.

NOVEMBER/DECEMBER, 1991

Mexican Spotted Owl

Proposal to list as threatened under the ESA due by early-November. This dark-eyed, chestnut colored owl is a relative of the northern spotted owl and is found in the forests of the Southwest, particularly Arizona and New Mexico. Approximately 90% of the owl's habitat is on Forest Service land.

The Mexican spotted owl engenders the same type of controversy as is found in the Northwest over the northern spotted owl. A proposal to list the species will directly impact the timber industry in this region of the country. While not as substantial as in the Northwest, the timber industry in the Southwest is currently experiencing a slow-down and a listing decision will exacerbate the problems in this economic sector. Senator Domenici and Representative Richardson have convened a timber task force to formulate an owl conservation plan that provides adequate protection of the species yet permits a reliable timber harvest.

Northern Spotted Owl

Final rule designating critical habitat for protection of the northern spotted owl is due in early December. The proposed rule initially recommended 11.6 million acres be so designated in Oregon, Washington, and Northern California. The revised proposed rule reduces the total acreage proposed for critical habitat designation from 11.6 to 8.6 million acres. The reduction was achieved by eliminating private lands from the designation, public forest lands are still directly impacted. The rule is currently being revised to better take into account the economic impacts of the proposed designation. The designation will further exacerbate an already serious decline in timber harvest levels and timber-related employment in the Pacific Northwest.

In addition, a draft of the northern spotted owl recovery plan is due out by mid-December. A spotted owl recovery team has been working on this plan for several months, and the plan should establish a long-term forest management regime that will ensure protection of the owl and permit continued timber harvest on public lands. The report will undoubtedly be the subject of intense media and Congressional attention and litigation.

WINTER/SPRING, 1992

Piping Clover

Proposed rule designating critical habitat for protection of the piping clover, a small bird found along the Northeastern shoreline from Maine to North Carolina. The proposed rule may impact approximately 393 miles of coastline and beaches, particularly during the Spring nesting season. Public use of beaches and use of all-terrain vehicles may be restricted.

extended six months by FWS in order to gather more biological information. The proposal to list the species as threatened was originally issued in June of 1990, and the Sierra Club Legal Defense Fund has filed a 60-day notice of intent to sue for failure to list the bear within the one-year time period.

The black bear is found in the forests of Louisiana and Mississippi and is considered threatened due to state and private logging practices that have damaged much of the bear's habitat. The Congressional Delegations and Governors of both states have requested FWS to withdraw the listing in order to allow the Black Bear Conservation Committee, a group of people from conservation groups, industry, the scientific community, and state and federal agencies to work on a black bear conservation plan. While the rule has not been withdrawn, it has been extended until April, 1992.

The possible listing of the black bear will have a direct impact on the timber industry in both states. In addition, because a greater percentage of forest land in the South is privately held than in the Northwest, there is concern that timber harvesting on those private lands may result in an incidental "taking" of the species, for which there may be criminal penalty. The entire Congressional and Gubernatorial Delegations of Louisiana and Mississippi are impacted by this listing.

Florida Black Bear

Final rule to list the Florida black bear as threatened under the ESA is 90 days overdue. FWS continues to review the rule in its Washington office. The black bear is found in the forests in the Northeastern part of the state. The proposed listing will impact hunting activities in the area as well as development on land adjacent to the National and State forests. The entire Florida Congressional Delegation and the Fund for Animals have asked FWS to list the bear immediately.

Gulf Sturgeon

Final rule to list the gulf sturgeon as threatened under the ESA is overdue and expected from NMFS in October. The Gulf Sturgeon is an anadromous fish that inhabits several river systems from Louisiana to Tampa, Florida, and the Gulf of Mexico.

Critical habitat is difficult to determine, but if proposed in order to protect the species, could be very controversial. Such a designation of critical habitat will impact recreational and commercial fishing and residential

Northern Spotted Owl

Decision of the Endangered Species Committee ("Committee") on whether to exempt from the ESA 44 Bureau of Land Management timber sales in Oregon is due mid-February, 1992. The Committee is a seven member, Cabinet-level committee comprised of the Secretaries of Interior, Defense and Agriculture; the Administrators of EPA and NOAA; the Chairman of the CEA; and a resident from the state most effected (Oregon) nominated by the Governor and appointed by the President.

The practical effect of the Committee's decision will not be felt until later in the year, however, as the decision will certainly be the subject of litigation. The decision of the Committee on whether to exempt from the ESA these timber sales will be the subject of considerable media and Congressional interest.

Snake River Sockeye Salmon

Final rule to list the Snake River sockeye salmon as endangered under the ESA is due in April, 1992. This decision by NMFS, and that involving three other salmon species in the Northwest due out in June, will substantially impact fishermen, farmers, timber companies, and all utility ratepayers in the Pacific Northwest. Affected groups are currently meeting to develop a conservation program for the salmon.

The impact of a final listing decision will likely be greater than the spotted owl listing because a greater diversity of citizens would be effected. Utility and Bonneville Power Administration Officials have suggested that saving the salmon could boost utility rates by 10% to 33% because water used to generate power from the network of hydroelectric dams would have to be released free of the turbines in order to assist the salmon in making their trip to the ocean and back to their river or lake spawning grounds. As with the spotted owl, the entire Northwest Congressional Delegation is impacted by this rule.

SPRING/SUMMER, 1992

Columbia River Salmon

Final rule by NMFS to list two species of Columbia River chinook salmon as threatened under the ESA is expected in June. The impact will help exacerbate the consequences of listing the Snake River sockeye salmon, as discussed above.

Marbled Murrelet

Final rule to list the marbled murrelet as endangered under the ESA is due in June. Found along coastal old growth timber areas in the Pacific Northwest, the Murrelet is a small robin-sized coastal seabird. The bird's habitat is similar to the habitat used by the northern spotted owl. The impact of the decision to list the murrelet will exacerbate the conflict over forest management practices on federal lands in the Pacific Northwest and could further damage the timber industry in that area. As with the spotted owl and the Columbia River/Snake River salmon, the entire Northwest Congressional Delegation is impacted by this listing.

SUMMER/FALL, 1992

California Gnatcatcher

Final rule to list the gnatcatcher as endangered under the ESA due in September. However, the time frame may be extended if additional biological information is needed.

California Delta Smelt

Final rule to list the delta smelt as threatened under the ESA due in late September. However, the time frame will likely be extended due to the need for additional biological information.

Mexican Spotted Owl

Final rule to list the mexican spotted owl as threatened under the ESA due in mid-November. However, the time frame may be extended if additional biological information is needed.

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LISTED IN THE WITHDRAWAL SHEET AT THE FRONT OF THIS FOLDER.