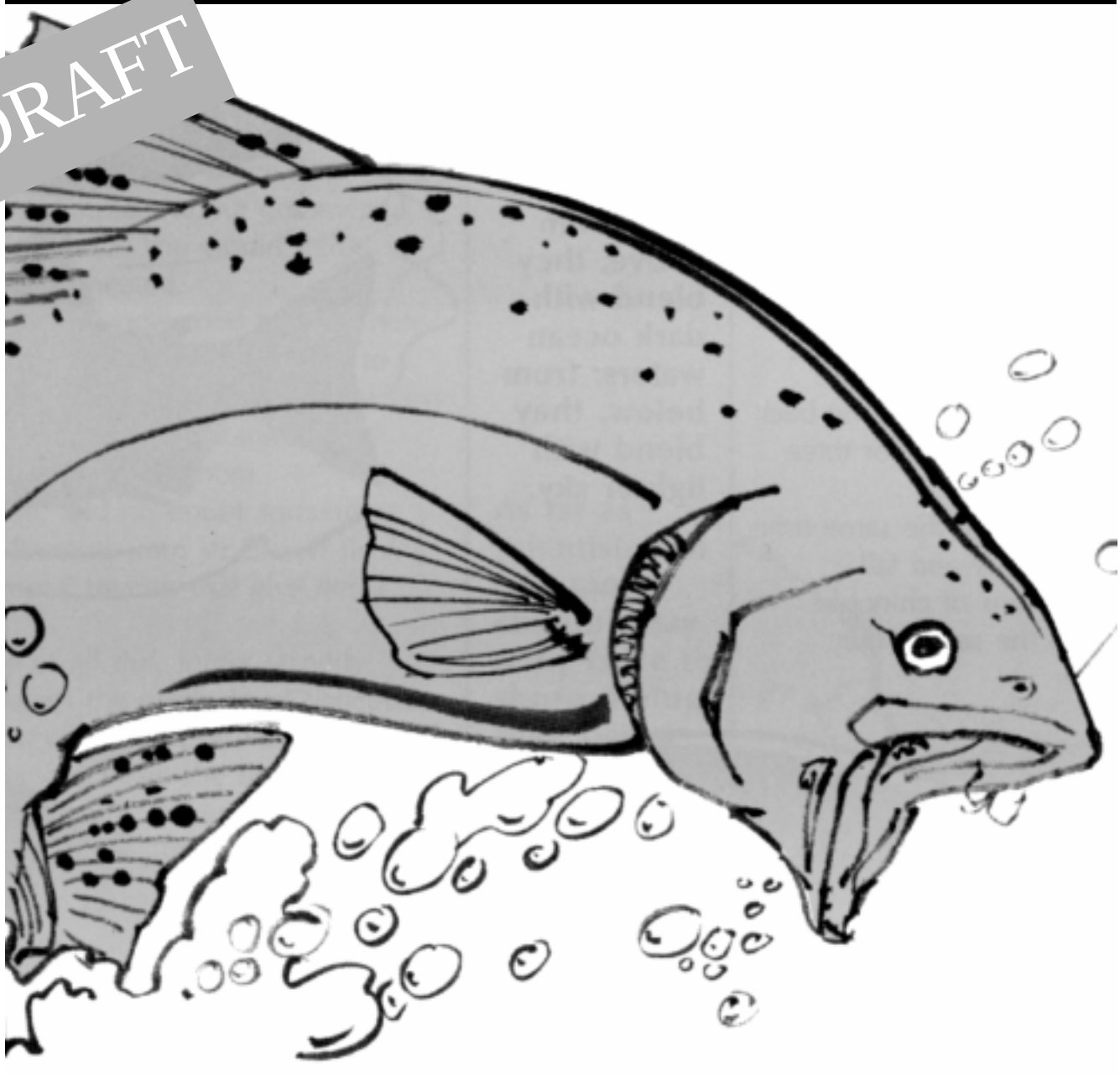
Conservation of Columbia Basin Fish

Harvest Appendix

A Publication of the Federal Caucus • December 1999

DRAFT



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Prepared by
The Federal Caucus

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A. OVERVIEW OF COLUMBIA RIVER FISHERIES MANAGEMENT

HISTORICAL CONTEXT

For generations, salmon fishing has been an identifying feature of Northwest tribal culture, religion and commerce. Columbia River Indians from many tribes participated in seasonal fisheries all along the rivers and their tributaries. Prior to European contact, tribal harvest of salmon from the Columbia Basin is estimated to have been approximately 4.5 to 5.6 million fish annually, although this estimate may be conservative because some aboriginal uses of fish were excluded (NPPC, 1986). Today the opportunities for tribal and non-Indian harvest are vastly diminished and conservation concerns have eliminated harvest for many species of fish.

HARVEST AND ITS CONSEQUENCES

The history of harvest of Columbia River Basin (basin) salmon parallels that of the entire region. With the arrival of European settlers and the advent of canning technologies in the late 1800s, commercial fishing developed rapidly. Development of non-Indian fisheries began in about 1830; by 1861; commercial fishing had developed into an important economic activity. The early commercial fishery used gill nets, seines hauled from shore, traps, and fish wheels. Later, purse seines and trolling (using hook and line) developed. Recreational (sport fishing) began in the late 1800s, occurring primarily in tributary locations (ODFW/WDFW, 1998).

Initially, the non-Indian fisheries targeted spring and summer chinook salmon. Those runs dominated commercial salmon harvest in the Columbia River during the 1800s. Eventually the combined ocean and freshwater harvest rates for Columbia River spring/summer chinook exceeded 80 and sometimes 90 percent, contributing to the species' decline (Ricker, 1959). From 1938 to 1955, the average harvest rate dropped to about 60 percent of the total spring chinook salmon run and appeared to have a minimal effect on subsequent returns (NMFS, 1991). The last commercial season for spring chinook occurred in 1977. Present Columbia River harvest rates are very low compared to those from the late 1930s through the 1960s (NMFS, 1991).

The summer chinook salmon run could not sustain an average harvest rate of 88 percent between 1938 to 1944, and produced lower returns between 1942 and 1949 (NMFS, 1991). Between 1945 and 1949, the Columbia River harvest rate on summer chinook salmon was reduced to about 47 percent, and subsequently, the run size increased. Construction of Grand Coulee Dam in 1941 and the associated inundation of summer chinook spawning areas were a primary factor influencing this species' declining abundance. In the 1950s and 1960s, harvest rates were further reduced to about

20 percent for summer chinook salmon (Raymond, 1988). Columbia River summer chinook has not been commercially harvested as a target species since 1963.

Following the sharp declines in spring and summer chinook in the late 1800s, fall chinook salmon became more important to the catch. Fall chinook has provided the greatest contribution to Columbia River salmon catch in most years between 1890 and the present. Through the first part of this century, the commercial catch was usually canned for marketing. The number of Columbia River salmon canneries peaked at 39 in 1886; the peak year of commercial sales was 1911, when 49.5 million pounds of fall chinook were landed. Columbia River chinook salmon catches were generally stable from the beginning of commercial exploitation until the late 1940s, when landings declined by about two-thirds to a level that remained stable from the 1950s through the mid-1980s (ODFW/WDFW, 1998). Since 1938, total salmonid landings (all species) have ranged from a high of about 2,112,500 fish in 1941 to a low of about 68,000 fish in 1995. See Figure A.1 (ODFW/WDFW, 1998).

While freshwater fisheries in the basin were declining during the first half of this century, ocean fisheries were growing, particularly after World War II. This trend occurred up and down the West Coast, as fisheries with new gear types leap-frogged over the others to gain first access to the migrating salmon runs. Large mixed-stock fisheries in the ocean gradually supplanted the freshwater fisheries, which were increasingly restricted or eliminated to protect spawning escapements. By 1949, the only freshwater commercial gear types remaining were gill net, dip and hoop nets (ODFW/WDFW, 1998).

This “leap-frogging” by various fisheries and gear types resulted in conflicts over harvest allocation, and the displacement of one fishery in favor of another. Ocean trolling peaked in the 1950s; recreational fishing peaked in the 1970s. The ocean harvest has declined since the early 1980s due to declining fish abundance and increasing harvest restrictions (ODFW/WDFW, 1998).

A major impact to tribal fisheries was the 1957 construction of The Dalles Dam, which flooded Celilo Falls and inundated the site of a major Indian fishery that had existed for millennia. Primarily using dip nets, commercial Indian landings at Celilo Falls from 1938-1956 ranged from 0.8 to 3.5 million pounds annually (ODFW/WDFW, 1998). With the elimination of Celilo Falls, salmon harvest in the area declined dramatically. In 1957, by the joint action of the states of Oregon and Washington, the tribal fishery above Bonneville Dam was closed to commercial fishing. Treaty Indian fisheries that did continue to occur during the 1957-68 period were conducted under tribal ordinances. In 1968, with the Supreme Court opinion on the appeal of the ***Puyallup v. Washington*** case, the states re-opened the area to commercial fishing by treaty Indians (ODFW/WDFW, 1998). For the next six years, until 1964, only a limited tribal harvest occurred above Bonneville Dam. By then, the tribal fishery developed alternative methods (set gillnets) suitable for catching salmon in the reservoirs created by the construction of the dams (ODFW/WDFW, 1998).

As run sizes permit, tribal members continue to catch salmon for ceremonial, subsistence and commercial purposes primarily with set gillnets in the mainstem Columbia River. Dip net fishing is also conducted from scaffolds that have been erected at Cascade Locks, Lone Pine (below The Dalles Dam), the mainstem below John Day Dam, and at other sites. Tribal tributary fisheries using dip nets and hook-and-line gear are conducted by members of the treaty tribes and also by other basin tribes, also as run sizes permit.

BIOLOGICAL CONTEXT

The various species of salmon vary widely in their oceanic migratory patterns and life history characteristics. As such, the extent to which changes in harvest regimes can benefit recovery varies widely across species, areas, and fisheries. For example, some species (such as the Endangered Species Act [ESA]-listed Snake River fall chinook or Hanford Reach bright chinook) are harvested at significant levels in ocean fisheries as far north as Alaska, and/or as far south as California. Others, such as coho and the stock of fall chinook known as tules, tend not to migrate so far: they are caught mostly in ocean fisheries off central and southern British Columbia, Washington and Oregon. Other evolutionarily significant units (ESUs) are apparently harvested very little in any ocean fisheries: spring chinook, steelhead, chum, and Columbia River sockeye are examples. Evidence indicates that juvenile steelhead tend to migrate directly to offshore areas, rather than along the coastline as do fall chinook and coho (Pearcy, et.al. 1990). Some ESUs, especially chinook (which has a longer life history), are vulnerable to harvest for several age classes, further complicating management. All salmonids are susceptible to harvest within the Columbia River and its tributaries, although harvest rates vary by species and by ESU. Figure A.1.a illustrates the aggregate run timing of various species that migrate above Bonneville Dam.

The capacity of salmonids to produce more adults than are needed for spawning offers the potential for sustainable harvest of naturally produced (vs. hatchery-produced) fish. This potential can be realized only if two basic management requirements are met:

(1) enough adults are allowed to escape the fisheries to spawn and perpetuate the run; and

(2) the productive capacity of the habitat is maintained.

Catches fluctuate in response to such variables as ocean productivity cycles, periods of drought, and natural disturbance events; and, as long as the two management requirements are met, fishing can be sustained indefinitely.

Unfortunately, both prerequisites for sustainable harvest have been routinely violated in the past. The lack of coordinated management across jurisdictions, coupled with competitive economic pressures to increase catches or to sustain them in periods of lower production, resulted in harvests that were too high and escapements that were too low. At the same time, habitat has been increasingly degraded, reducing the capacity of the salmon stocks to produce numbers in excess of their spawning escapement requirements.

For many years, the response to lost habitat productivity and declining catches was the construction of hatcheries to produce more fish. (Also see Hatcheries Appendix). Because hatcheries require fewer adults to sustain their production, harvest rates in the fisheries were allowed to remain high, or go even higher, further exacerbating the effects of overfishing on the natural (non-hatchery) runs mixed in the same fisheries.

JURISDICTIONAL CONTEXT

Freshwater Fisheries

Freshwater fisheries are divided into three distinct categories:

- Columbia River **commercial fisheries** include the non-Indian gillnet fishery operating in the zone from the estuary to Bonneville Dam and the treaty Indian gillnet fishery operating in the main Columbia River between Bonneville Dam and McNary Dam.
- **Recreational fisheries** that use hook-and-line gear occur in the mainstem, and in various tributaries in Idaho, Oregon, and Washington.
- **Tribal ceremonial and subsistence fisheries** that employ set nets, hoop nets, gillnets and other methods occur in the mainstem and tributaries. The individual tribes hold rights reserved by treaties (and by other rights), to fish specific areas of the mainstem and tributaries within the basin.

United States v. Oregon

The case of *United States v. Oregon*, originally filed in 1968, establishes certain legal requirements for the management of Columbia River salmon. A parallel case in *United States v. Washington* addresses the treaty fishing rights of the Puget Sound and coastal Washington tribes. The central issues in both of these long-standing cases deals with state regulation of treaty Indian fishing (primarily involving harvest allocation), and legal standards for conservation and management. The court maintains continuing jurisdiction in *U. S. v. Oregon*.

The original plaintiffs in the *U.S. v. Oregon* case were the United States, the Confederated Tribes of the Yakama Indian Nation, the Confederated Tribes of the Warm Springs Reservation of Oregon, the Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce Tribe. The original defendant was the State of Oregon. Additional parties in the case now include the States of Washington and Idaho, and the Shoshone-Bannock Tribe of Fort Hall.

Since 1968, two court-ordered management plans have been adopted by the parties and approved by the court in *U.S. v. Oregon.* Between 1988 and 1998 fisheries within the Basin were managed pursuant to the Columbia River Fish Management Plan (CRFMP). The CRFMP established production and harvest goals intended to rebuild weak runs to

full productivity, while fairly sharing the harvest of upriver runs between treaty Indian and non-Indian fisheries in the ocean and the Columbia River Basin. For a variety of reasons, many documented within this report, the runs have not been restored as originally envisioned.

In response to ESA listings, the CRFMP was amended by agreement of the parties in 1995. The three-year amendments imposed even greater restrictions on harvests. The restrictions that had already eliminated tribal commercial fisheries years earlier were continued, and the tribal ceremonial and subsistence (C&S) fisheries were constrained to conservation levels (harvest rates below 5-7 percent) for another three years. The fall season commercial fishery was also further restricted to limit impacts on the listed Snake River fall chinook, which arrive intermingled with the healthier upriver fall chinook and steelhead (e.g., Hanford reach fall chinook, hatchery steelhead).

Today, both the CRFMP and the 1995 amendments have expired. For over two years, the *U.S. v Oregon* parties have been engaged in difficult negotiations to develop a successor plan, largely without success. Those negotiations are severely hampered by the uncertainty associated with the many decisions framed throughout this paper. Meanwhile, in 1999 the fisheries have been managed under increasingly constraining conditions and only after very contentious negotiations triggered by the most recent ESA listings announced in March 1999. Because a substantial portion of the newly listed upriver steelhead ESUs also arrive intermingled with significant numbers of harvestable hatchery fall chinook and steelhead, another layer of constraint has been imposed on the tribes' fall season mainstem fishery. These ESA constraints threaten the tribes' last remaining commercial fishery in the Basin.

The parties to *U.S. v. Oregon* are presently negotiating harvest and hatchery programs in hopes of developing a new management plan that addresses conservation under the ESA while meeting trust obligations to the tribes. The negotiations in *U.S. v. Oregon* are ongoing, and the date for completion of a new plan is uncertain.

Ocean Fisheries

Salmon species that are harvested in the ocean are particularly difficult to manage; their migratory patterns involve multiple jurisdictions and the mixing of numerous fish populations from many geographic origins. Numerous, sometimes conflicting, legal mandates regarding catch allocation apply to the various stocks and fisheries.

This complex web of jurisdictions and legal obligations makes coordinated management particularly challenging. Federal, state, and tribal entities coordinate harvest regulations and share management authority while the fish are present in their respective jurisdictions. (See Harvest Appendix B for a description of each of the ocean and river harvest regulatory authorities.)

Because many Columbia Basin stocks migrate through Canadian waters, over which the United States has no direct control, international cooperation is critical. However, cooperation has been sadly lacking in many years. An important milestone, the recent agreements reached between the governments of Canada and the United States under the Pacific Salmon Treaty, greatly improve the prospect for new, biologically based harvest regimes in future years. Harvest Appendix C provides details on the new agreement.

CURRENT MANAGEMENT

A number of major and dramatic reforms in harvest management have been underway for a period of several years. In general, the trend of these reforms has been to reduce harvest rates in mixed stock areas in favor of harvests in more terminal areas, i.e., fisheries closer to the rivers of origin, where the stocks can be segregated and more selectively caught. This trend is the result of two major factors:

(1) federal court rulings that require harvestable fish be available to tribal fishing areas, which generally are located in or close to terminal areas; and

(2) a growing recognition among fishery managers, reflected in modernized management plans, that harvest rates in mixed stock fisheries must be better controlled (i.e., reduced) to meet the conservation needs of natural stocks present in those fisheries.

Large mixed-stock fisheries that once were managed to maximize catch are now managed to reflect the productive capability and conservation needs of naturally spawning fish present in those fisheries and to achieve allocation objectives to terminal fisheries.

ESA listing have accelerated this trend in recent years. For example, the NMFS has developed jeopardy standards for Snake River fall chinook, designed to ensure that the combined impacts from all ocean fisheries were significantly reduced even though there is no direct control over Canadian fisheries. During the 1996-1998 timeframe, ocean fishery impacts have been reduced by an average of 38 percent. Mainstem harvests in the Columbia River have been similarly constrained to achieve a 30 percent reduction in harvest rate for this species.

In practical terms, this evolution in harvest management is characterized by a trend away from mixed-stock fisheries that may apply high harvest rates to aggregates of stocks, toward fisheries in more terminal areas that are can be directed on discrete stocks. With the advent of the recent agreement with Canada, ocean fisheries coastwide are now managed to respond to the annually variable abundance of stocks present in the fisheries; the fixed, multi-year catch quotas of the past are completely gone, and with them the excessive impacts they caused on natural stocks.

Taken alone, these harvest management reforms do not account for all of the dramatic declines in catches in recent years, although they do account for much of the change in harvest distribution. Rather, the decline in total catch has resulted from the application of

these harvest management and hatchery reforms, coupled with the reduced production of salmon from this region (the Pacific Northwest, including southern British Columbia) due to natural and human-induced changes in survival. The combined effect on fisheries has been dramatic, as evidenced by the precipitous decline in catches in nearly every mixed-stock salmonid fishery in Washington, Oregon, and southern British Columbia.

Nowhere is this more evident than in Columbia River fisheries. The general decline of up-river spring and summer chinook runs in the 1960's and early 1970's led to increasingly restrictive harvest restrictions to protect spawning escapements. No commercial in-river fisheries directed at upper Columbia River spring chinook have occurred since 1977; impacts have been limited to tribal ceremonial and subsistence and very minimal incidental catch levels. As a result, the average harvest rate on that species presently averages less than 6 percent. For summer chinook, there have been no commercial fisheries since 1973; even taking into account the very limited tribal ceremonial and subsistence fisheries, the annual harvest rate for this run has averaged less than 3 percent since 1986.

Ocean fisheries also have been greatly curtailed. Increasingly restrictive regulations, shortened seasons, area closures, special gear regulations, license moratoria, and buyout of fishing fleets have all occurred to limit harvests. The reduction of the ocean commercial salmon fishing fleet in Oregon and Washington is illustrative: the fishery has declined from over 7,000 vessels in the early 1980s to approximately 1,600 vessels in the late 1990s (PFMC, 1999). The commercial and sport catch of chinook off Washington and northern Oregon coasts (where Columbia River chinook predominate in the catch) has declined from nearly 600,000 fish in 1974 to an average of about 15,000 fish since 1994 (PFMC, 1999). See Figure A.1.b.

Recent modifications in the harvest management approach under the Pacific Salmon Treaty will shift management toward an abundance-based, rather than quota-based approach. This change is expected to greatly improve the level of protection provided to naturally spawning salmon that are caught in northern fisheries off Alaska and off British Columbia. See Harvest Appendix C for a more detailed description regarding the effects of the new treaty agreement.

EFFECT OF HATCHERIES IN FISHERIES MANAGEMENT

Historically, spring, summer and fall chinook; sockeye; coho; steelhead; and chum salmon were harvested in various Columbia basin fisheries. However, as human development caused numerous wild fish runs in the basin to decline over the past century, many historic fisheries were phased out. Hatcheries were constructed under federal programs such as the Mitchell Act and Lower Snake River Compensation Program to mitigate for fisheries losses due to Federal Columbia River Power System (FCRPS) construction and operation, however, these programs do not mitigate for all lost species or fisheries losses.

Hatchery mitigation and compensation programs for fall chinook, spring chinook, coho, and steelhead play an important role in fisheries management, and now produce most of the fish that are harvested in the various marine and freshwater fisheries. With few exceptions, such as the naturally spawning Hanford Reach population of fall chinook ("upriver brights"), natural and wild spawning salmon populations make up a relatively minor proportion of most runs and the overall harvest. However, because individual wild populations are so diminished, even a small amount of harvest can have substantial negative impacts. The challenge for harvest management is therefore to structure fisheries to avoid weaker populations while permitting harvest on the more robust (typically hatchery) stocks. The Hatchery section of this document provides additional information on the role of hatcheries in fisheries mitigation, and the evolving role of hatcheries as tools for conservation.

MANAGEMENT GOALS

Harvest Appendix B Table 1 provides an example of interim management objectives for some key naturally produced and hatchery populations that are subject to harvest in ocean and in-river fisheries. ESA recovery and management goals have not been established and are presently under development by NMFS. As part of its recovery planning responsibilities under the ESA, the NMFS is developing a document that addresses "viable salmon populations and the recovery of ecologically significant units. The paper will identify the attributes of viable salmon populations and provide guidance on determining the status of listed populations. From a management perspective, this effort will help determine how salmon populations and population groupings will be defined for recovery planning and management purposes under the ESA. The information will be used as a foundation to guide decisions in all four "Hs," including harvest management. Present harvest management performance measures, such as harvest rates and escapement targets, will be updated through this effort.

RUN STATUS AND HARVEST

The traditional stock descriptions used in fishery management are referred to in this section. These terms have an extensive history and provide a useful frame of reference for anyone familiar with the Columbia basin fisheries. They are based on similarities in migration timing and do not necessarily correspond to ESU definitions.

Spring and Summer Chinook

The Columbia River spring chinook run includes ESA-listed species from the lower Columbia River tributaries, including upper Willamette spring chinook; upper Columbia River spring chinook; and Snake River Spring/summer chinook. Historically, most of the spring chinook spawned in the Salmon River, a tributary of the Snake River in Idaho (ODFW/WDFW, 1998).

Spring chinook adults return to freshwater primarily in the period March through May. Direct information on wild Snake River spring/summer chinook harvest is not available; however, coded wire tag (CWT)[1] information from hatchery chinook indicates that this species is presently subjected to low ocean and in-river harvest impacts. Due to their migration pattern and the present configuration of ocean fishing seasons, it is believed that spring/summer chinook are not susceptible to significant impact by ocean fisheries. CWT recoveries of spring chinook salmon from the Rapid River and Sawtooth Hatcheries, which are assumed to represent Snake River spring chinook salmon, indicate that survival through the life cycle is very low, and that harvest in all ocean fisheries accounts for only 0.03 percent of total mortality. Based upon CWT recoveries, fewer than one percent of spring chinook salmon surviving to harvest size are harvested in the ocean, with small numbers harvested in British Columbia troll and net fisheries (Berkson, 1991). For the Upper Columbia Basin spring chinook ESU, ocean harvest rates are also very low. The 1978-93 ocean harvest rate was estimated at 0.6 percent (NMFS, 1999). Based upon hatchery CWT information, some catch of upper Willamette Spring chinook occurs off the coasts of British Columbia and Alaska (NMFS, 1999).

The McCall Hatchery is assumed to represent Snake River summer chinook salmon. CWT recoveries for that stock indicate that summer chinook salmon survival is very low, and that harvest in all ocean fisheries accounts for only 0.0001 percent of the total mortality (Berkson, 1991). Of the population, 0.63 to 0.72 percent of that stock were harvested in the combined British Columbia, Washington and Oregon troll and Washington recreational fisheries (Berkson, 1991).

Most of the spring and summer chinook harvest that does occur takes place in the Columbia River tribal ceremonial and subsistence fisheries, where catch has averaged less than 6 percent and 3 percent, respectively, in recent years. Recreational fishing in the Columbia River is second in magnitude. Some harvest of spring/summer chinook during fisheries directed toward other species can also occur.

Harvest in the Columbia River mainstem is managed primarily to limit impacts on the upriver (above Bonneville Dam) stocks, including listed Snake River spring/summer chinook, and to meet management goals for Willamette spring chinook. Sport fishing and tribal fisheries designed to target hatchery stocks in the various tributaries may also occur, as run sizes permit. With the recent listing of Upper Willamette River spring chinook in 1999, harvest in freshwater fisheries is being modified to further restrict the harvest of this ESU.

Figures A.2 and A.3 display the total (hatchery and wild) upriver spring and summer chinook salmon run sizes into the Columbia River and escapement after mainstem

1 Beginning in the early 1970s, hatcheries began implanting coded-wire tags (CWT) into the nasal cartilage of juvenile salmonids to identify the fish stock and release site. Adult fish are sampled in the various ocean and freshwater fisheries, at hatcheries, and on the spawning grounds to gather the CWTs. This information is then used in harvest management to assess catch and for other scientific and management purposes.

fisheries for the years 1960-1998. Figure A.4 displays the Snake River wild spring/summer chinook salmon run size into the Columbia; mainstem harvest; upstream passage loss, and escapement index (dam counts) at Lower Granite Dam, 1979-98 (TAC, 1999). Figure A.5 displays upper Columbia River spring chinook salmon redd counts (an index of spawning escapement) for the Methow, Entiat and Wenatchee Rivers for the years 1975-98.

Fall Chinook Salmon

The fall chinook run has several management components:

- the lower river (below Bonneville) hatchery stocks (tules),
- the lower Columbia River wild stocks,
- the upper river tules (Spring Creek hatchery),
- upriver brights (Hanford Reach),
- listed Snake River fall chinook, and
- hatchery upriver bright fall chinook ("mid-Columbia brights"). (Mid-Columbia brights are fish that are being released in tributaries and other locations between Bonneville and McNary Dams.)

Columbia River tule-type fall chinook ocean migration pattern is characterized as north migrating; the bright type fall chinook is far-north migrating. Both tule and bright fall chinook are harvested at significant levels in ocean fisheries.

Columbia River mainstem fisheries that harvest fall chinook include the non-Indian gillnet fishery located from the estuary to Bonneville Dam, the treaty Indian fishery located between Bonneville and McNary Dams and the recreational fishery from the river mouth (Buoy 10) to the Priest Rapids Dam area. Relatively minor fall chinook catches occur in elsewhere in the basin (e.g., tributaries).

Snake River Fall Chinook Salmon

The ocean catch distribution of Snake River fall chinook ranges from Southeast Alaska to California, with the center of the distribution off the west coast of Vancouver Island, B.C. and the Washington coast. Snake River fall chinook is also significantly harvested in the Columbia River in Indian and non-Indian net and sport fisheries. NMFS has provided Biological Opinions on all fisheries that harvest Snake River fall chinook since this species was first listed. Impacts in Canadian fisheries are accounted for even though Canadian fisheries are not subject to the ESA.

Estimating the impacts of fisheries on listed stocks requires assumptions about the distribution and relative abundance of listed stocks within fisheries that are catching many different stocks. Because direct information is poor or absent, CWT information

from hatchery stocks believed to have the same distribution as the listed stocks is used to estimate harvest impacts. In the case of Snake River fall chinook, Lyons Ferry Hatchery fall chinook is used to estimate impacts on the listed ESU.

The standards developed by NMFS for fisheries were designed to assure that the sum of impacts from all fisheries, including Canadian fisheries, resulted in a significant reduction in the harvest of Snake River fall chinook. The Biological Opinion standard requires that 1996-98 was reduced by an average of 38 percent, relative to the base period. With the listing of Snake River Fall Chinook under the ESA, all in-river fisheries have also been managed to reduce harvest of this ESU. The average harvest rate in freshwater fisheries from 1988 through 1993 was 35 percent and was reduced to 20% between 1994 and 1998 (TAC, 1999).

Figure A.6 displays the catch distribution of Snake River fall chinook by percentage for each fishery (Dell Simmons, NMFS, pers. comm., 1999). Estimates of the number of fish killed are discussed in some detail in the 1998 supplementary report to the Biological Assessment for the southeast Alaska fishery (Sands and Koenings, 1998). Table 1 provides information regarding estimates of fish mortalities (harvest as well as inter-dam loss and escapement) during the 10-year period 1988-97 (Sands and Koenings, 1998).

Figure A.6 Distribution of Fishing Mortality (Snake River Wild Fall Chinook)

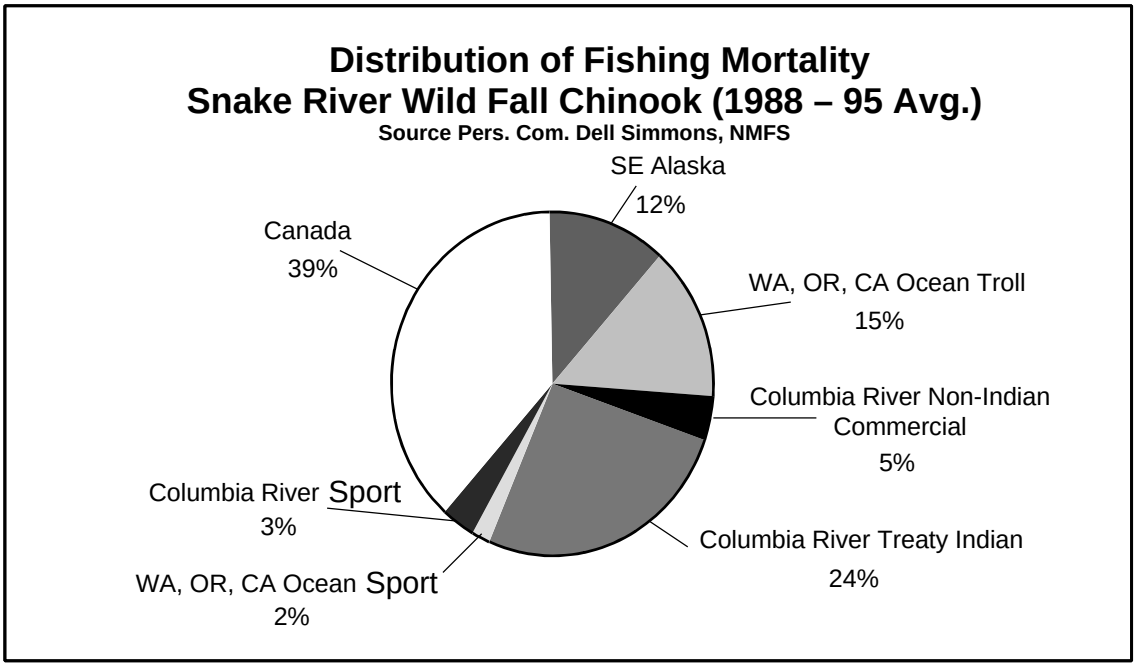

Table 1: Estimated total fishery mortalities, inter-dam loss, and escapement and total run (1988 – 97 average). Sands and Koenings, 1998

Fishery	Naturally Spawning Snake River Fall Chinook Salmon
Southeast Alaska	169
Canadian	413
Pacific Coast (WA, OR, CA)	165
Columbia River	429
Inter-dam loss	627
Escapement	454
Total	2,257

With respect to other potential ocean fisheries impacts, NMFS has concluded that listed spring/summer and Snake River fall chinook are caught in negligible numbers in the Bering Sea and Alaska groundfish fisheries (NPFMC/NMFS, 1994). The incidental catch (by-catch) of listed spring/summer chinook in the Pacific coast whiting groundfish fishery is also assumed to be negligible, although fall chinook may be somewhat more susceptible (NMFS, 1992). The incidental harvest rate in the whiting fisheries has been calculated to be 0.13 percent (Berkson, 1991).

Figure A.7 displays Snake River wild fall chinook adult run size into the Columbia River, mainstem harvest, passage loss, and escapement index (Lower Granite Dam count) for the years 1986-98. Figure A.8 displays commercial catch of Columbia River basin upriver fall chinook salmon (hatchery and wild) by treaty and non-treaty fisheries for the years 1938-1998.

Snake River Sockeye Salmon

The Columbia River sockeye run is comprised of fish that return almost entirely to two upper basin river/lake systems: the Wenatchee and Okanogan. The run is composed almost entirely of wild fish. The remnant Snake River sockeye run was listed as endangered under the ESA in 1991; since that time, the species has been maintained in a captive broodstock program.

The sockeye peak migration occurs in the Columbia River in late June through mid-July. Harvest of sockeye has been intermittent over the past two decades, with the majority of the harvest taken in tribal ceremonial and subsistence fisheries in recent years. There has been no commercial harvest since 1988. Columbia River sockeye are not known to be harvested in ocean fisheries. Figure A.9 shows run size, harvest, and Lower Granite Dam counts for Snake River sockeye salmon for the years 1979-88.

Columbia River Steelhead

Steelhead are difficult to characterize, as there are both summer and winter components, and differences in run timing of stocks reflected by their geographic origins within the basin. Five steelhead species are listed under the ESA: lower Columbia River steelhead, upper Willamette steelhead, mid-Columbia steelhead, upper Columbia steelhead, and Snake River steelhead.

The range of the Lower Columbia River ESU includes tributaries between the Cowlitz and Wind rivers (Washington), and between the Willamette and Hood rivers (Oregon), and the Willamette River up to Willamette Falls. Both winter and summer steelhead are included in the ESU, as are the Cowlitz hatchery winter run stock and Clackamas stock.

An estimated 150,000 winter steelhead and 80,000 summer steelhead from the major stocks in this ESU returned to the area below Bonneville Dam (including the upper Willamette) in the early 1980s (Light, 1987). Winter steelhead return to the Columbia

River from November through April (ODFW/WDFW, 1998). An estimated 75 percent of the run is destined for hatcheries downstream of The Dalles Dam. Recent run sizes of hatchery and wild fish for major streams are estimated to be greater than 16,000 adult fish, but this is an incomplete estimate. Of this total, recent 5-year average natural stock escapements range from less than 100 to 1,100 (NMFS, 1999).

Since 1953, the mainstem and tributary sport catch of winter steelhead in Oregon and Washington has ranged from 14,000 to 124,100 fish. Successful hatchery programs have boosted the catch of steelhead significantly since the mid-1960s (ODFW/WDFW, 1998). Selective fisheries that require the release of wild steelhead have been adopted by the states of Oregon, Washington and Idaho in recent years. The treaty Indian catch of winter steelhead in the Bonneville Pool fishery ranged from less than 100 to 1,500 fish annually between 1979 and 1997 (ODFW/WDFW, 1998).

Summer steelhead return to virtually all accessible tributaries of the Columbia River. The adult run, composed of many stocks, has a protracted timing that extends from March through October. Hatchery programs have substantially increased the harvestable numbers of steelhead throughout the basin over the past few decades: between the years 1984 through 1997, hatcheries have constituted 90 percent of the lower river returns and 75 percent of upriver returns (ODFW/WDFW, 1998). The non-Indian commercial catch ranged from 4,000 to 240,000 fish annually between 1938 and 1974 (the commercial sale of steelhead by non-Indians was banned after 1974). Tribal catches ranged from 25,000 to 66,000 fish annually at Celilo Falls between the years 1938 and 1956. The tribal fishery harvested 28,200 summer steelhead in 1997 (ODFW/WDFW, 1998).

Figure A.10 displays wild steelhead returns to Lower Granite Dam for the years 1985-1998. For management purposes, "A" and "B" components refer to differences in run timing and geographic area of origin rather than ESU designation. "B" steelhead spawn primarily in the Clearwater River (and to a lesser extent the Salmon River) in Idaho. With the listing of mid-Columbia steelhead, upper Columbia steelhead and Snake River steelhead harvest management for these species has become increasingly restrictive. See *U.S. v. Oregon* discussion, above. Figure A.11 displays upper Columbia River wild and hatchery steelhead counts at Priest Rapids Dam for the years 1986-1998.

Chum Salmon

Lower Columbia River chum salmon are an ESA-listed species. The Columbia River historically produced large runs of chum salmon that supported a substantial commercial fishery in the first half of this century (NMFS, 1999). Fishery landings totaled more than 500,000 fish in some years. The remaining chum populations are almost entirely of wild origin, and spawn in the Grays River and smaller tributaries below Bonneville Dam. Chum salmon return to freshwater primarily in October and November (ODFW/WDFW, 1998). Presently, there are no commercial or sport fisheries directed at this species, although chum are taken incidentally in gillnet fisheries for coho and chinook salmon, and a minor catch occurs in tributary recreational fisheries. Information indicates that the

total number of adult chum salmon returning to the Columbia River basin has been low and stable since the run collapsed in the mid-1950s. The total natural escapement is probably at least several thousand adult fish per year (NMFS, 1999).

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Figure 1. Commercial Landings of Salmon and Steelhead from the Columbia River in Pounds, (ODFW, WDFW, 1998)

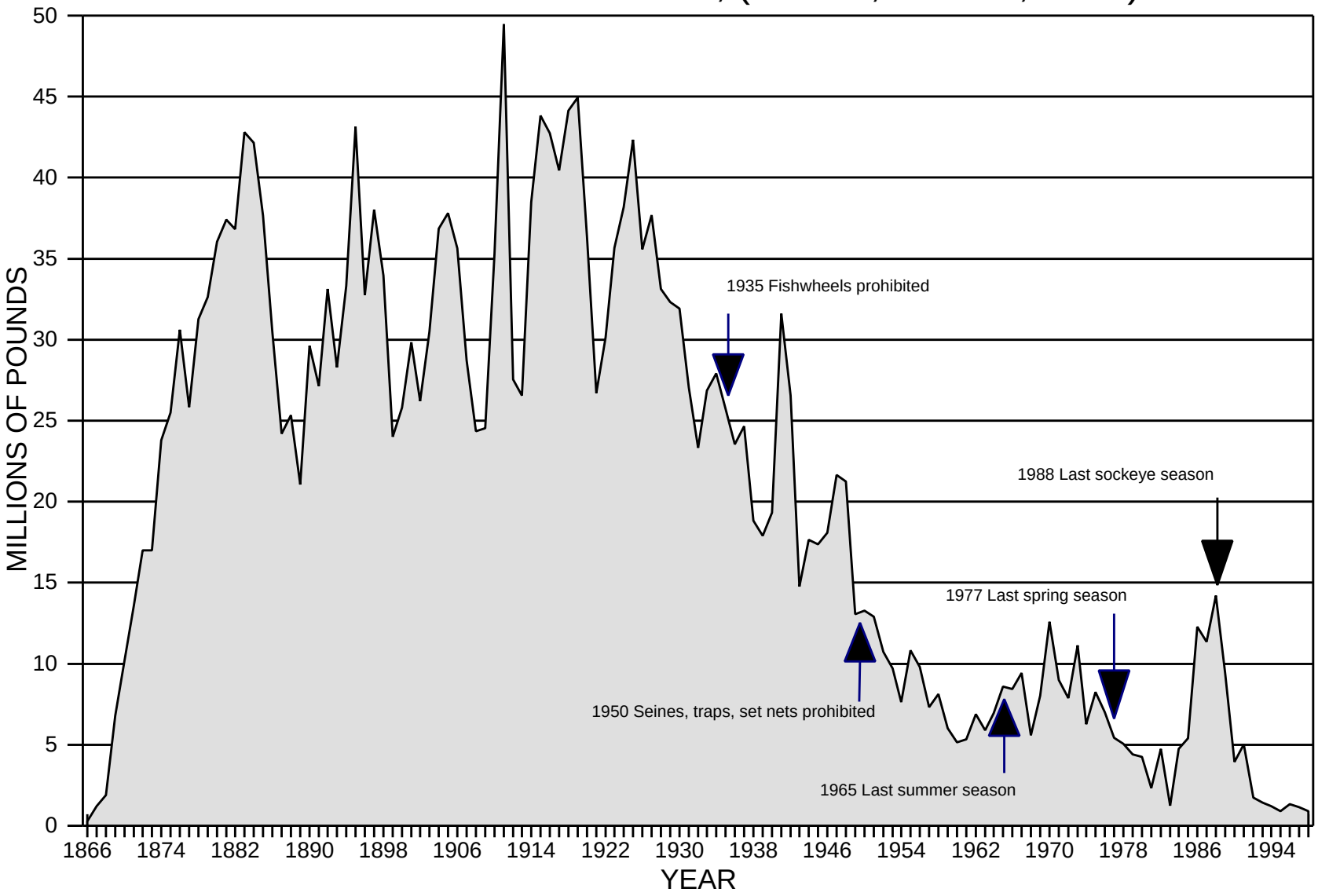


Fig. A.1a.
Daily Counts of Columbia River salmonids at Bonneville Dam, 1989-1998 average

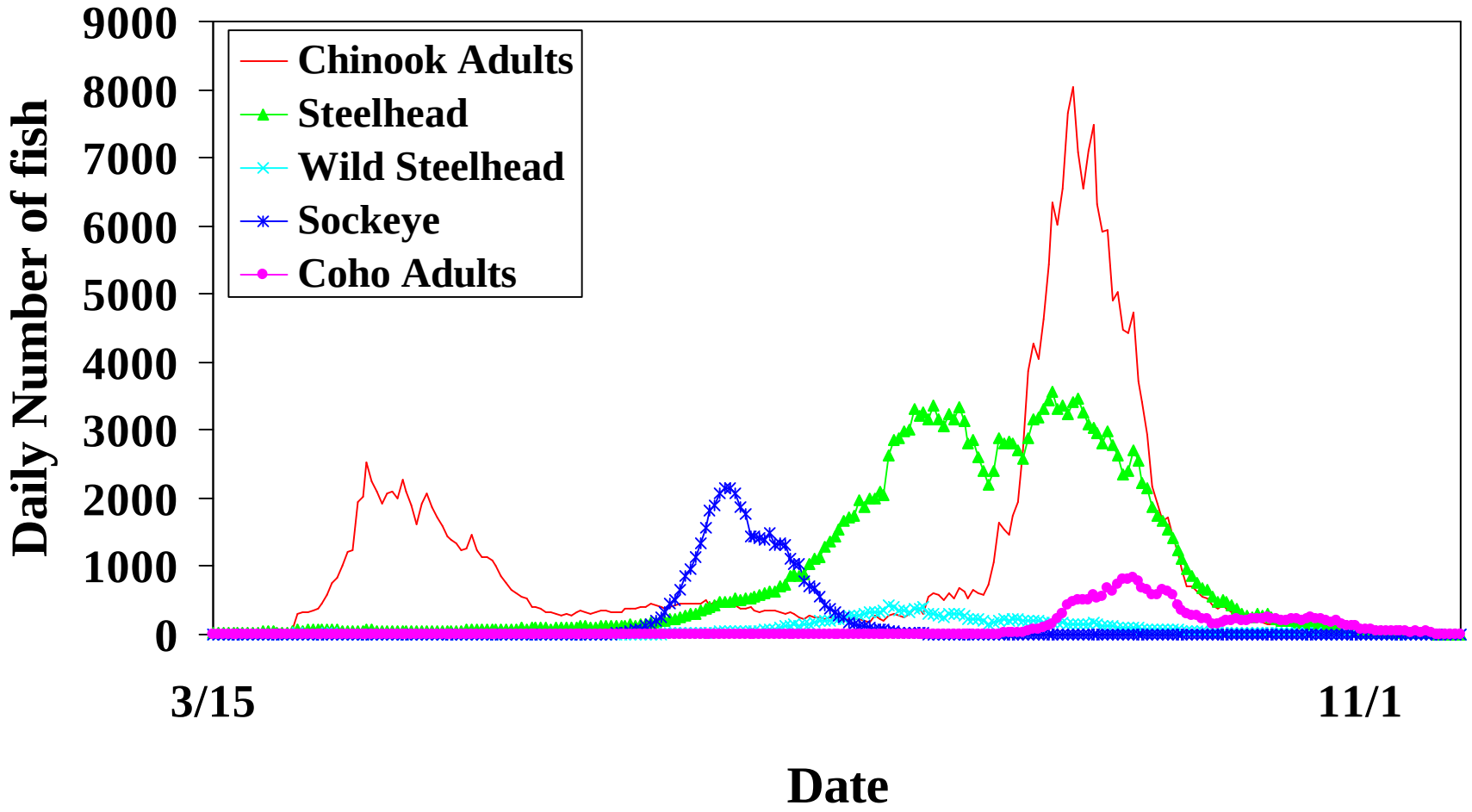


Fig. A.1.b U.S. Chinook Salmon Harvest in Ocean Waters North of Cape Falcon, Oregon to the Canadian border

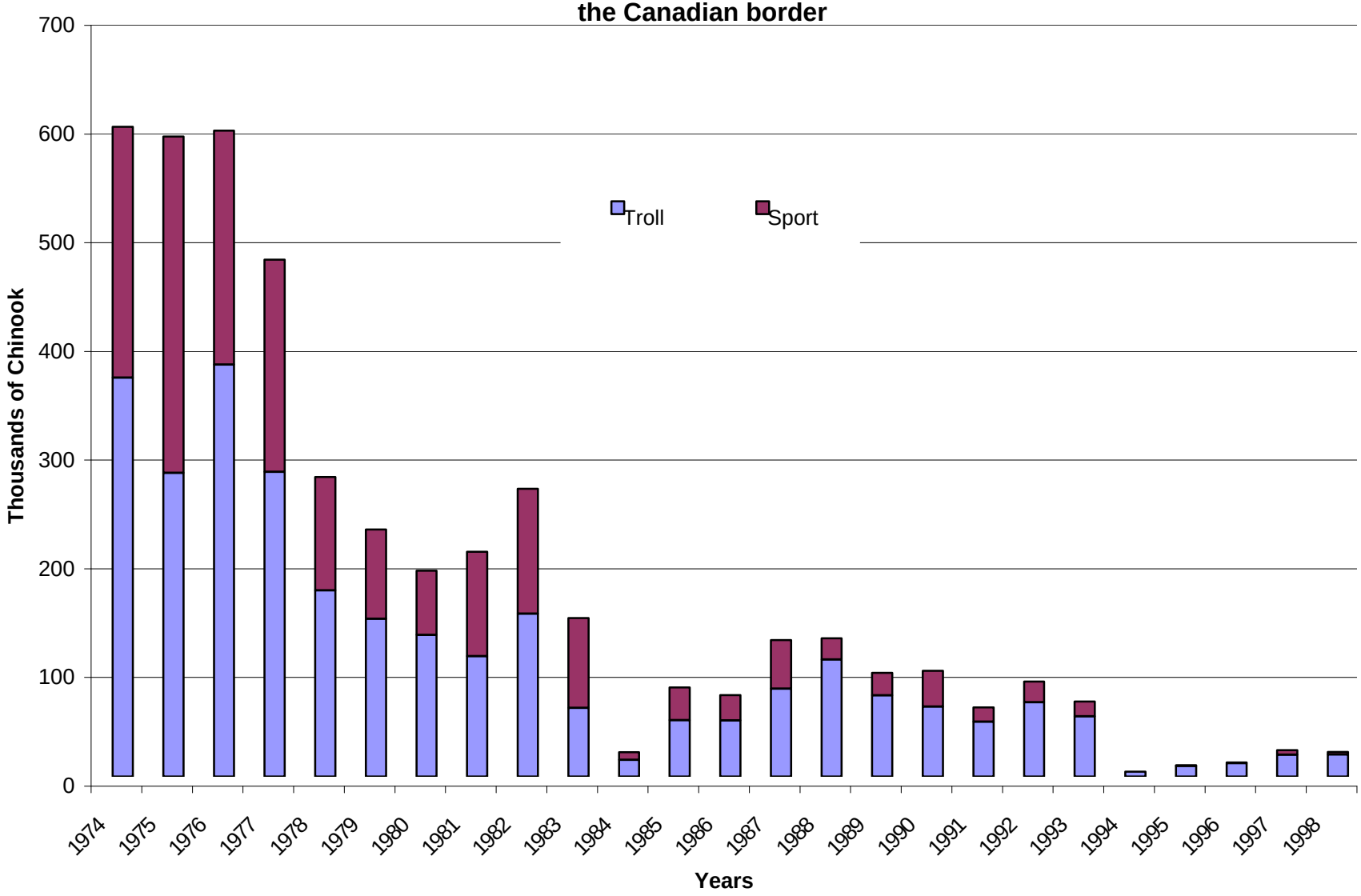


Fig.A.1.b.xlsChart101/11/2000

Figure A2

Upriver Spring chinook salmon run size into Columbia River and escapement after fisheries

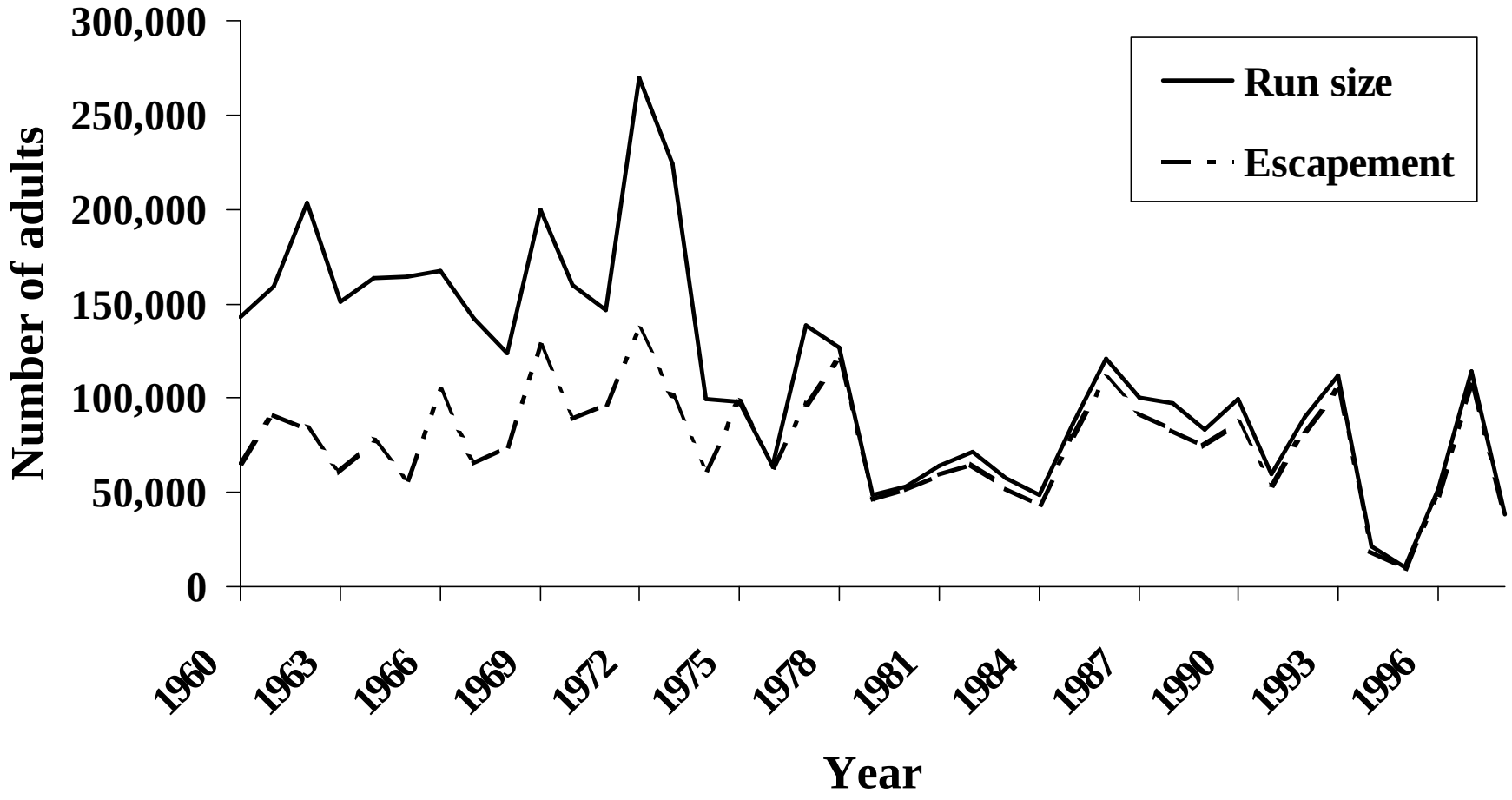


Figure A3

Upriver Summer chinook salmon run size into Columbia River and escapement after fisheries

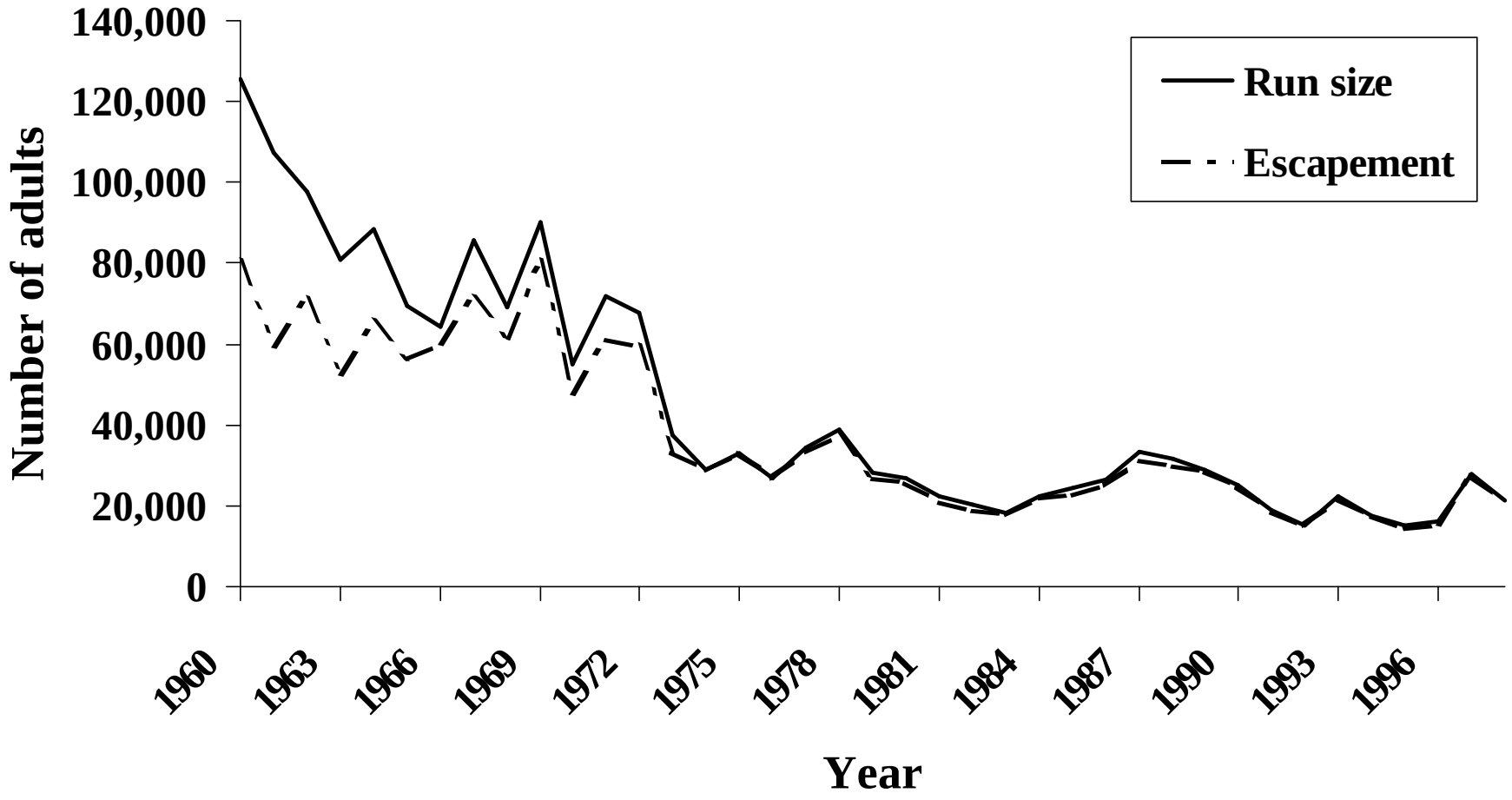


Figure A8

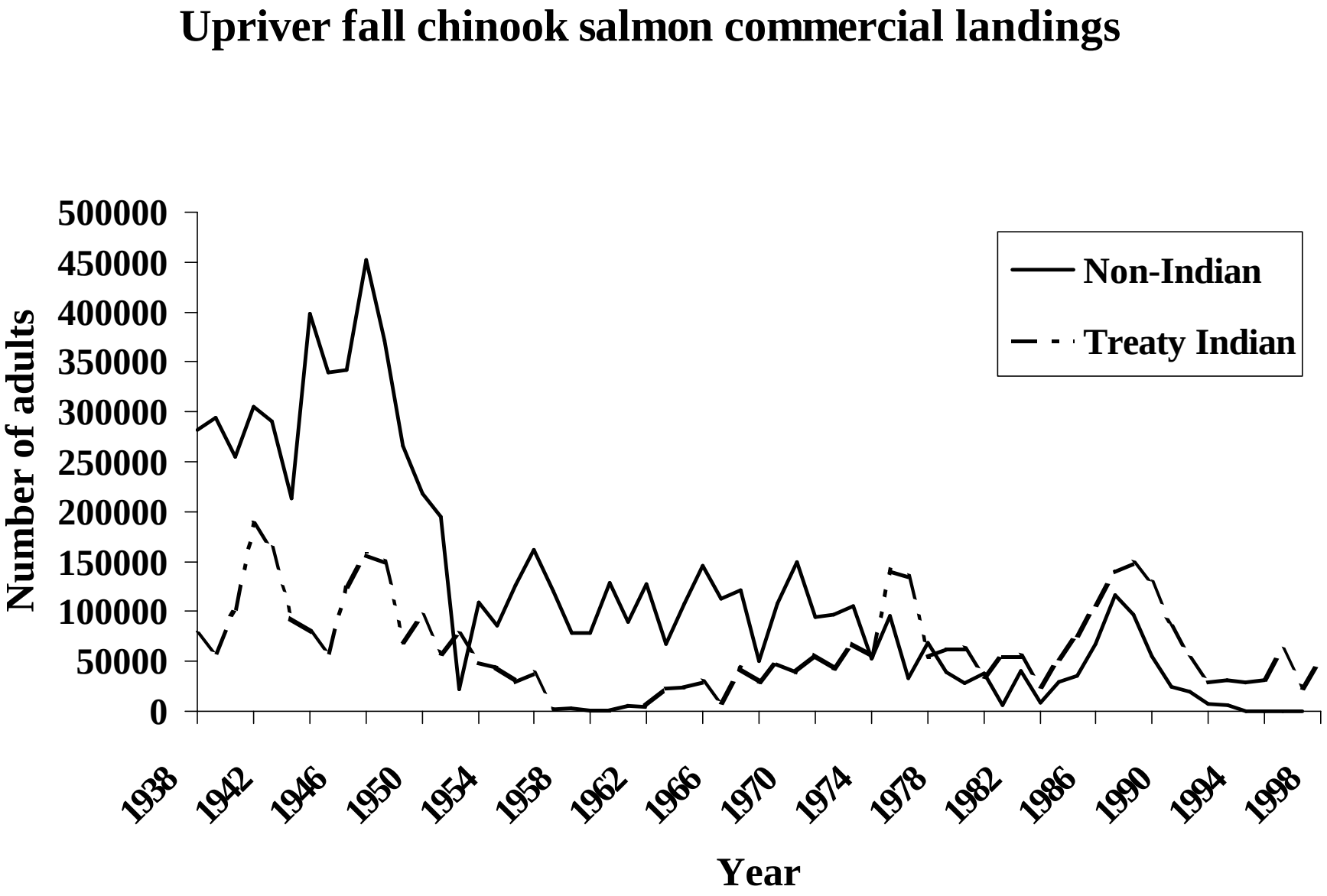

Upriver fall chinook salmon commercial landings
Number of adults
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
Non-Indian
Treaty Indian
1938
1942
1946
1950
1954
1958
1962
1966
1970
1974
1978
1982
1986
1990
1994
1998
Year

Figure A4

Snake River wild spring/summer chinook salmon run size into Columbia River, mainstem harvest, passage loss, and escapement over Lower Granite Dam, 1979-1998

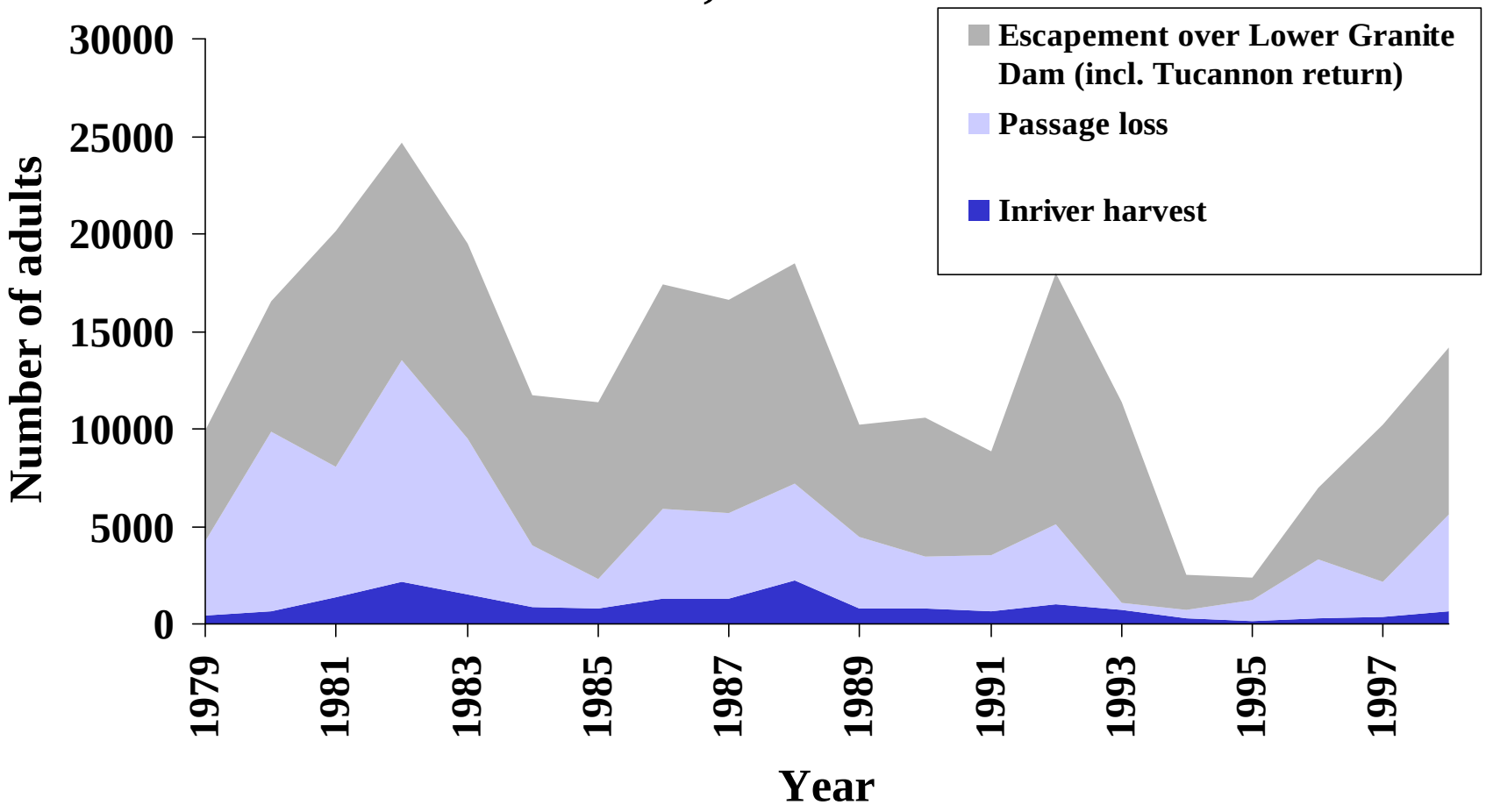


Figure A7

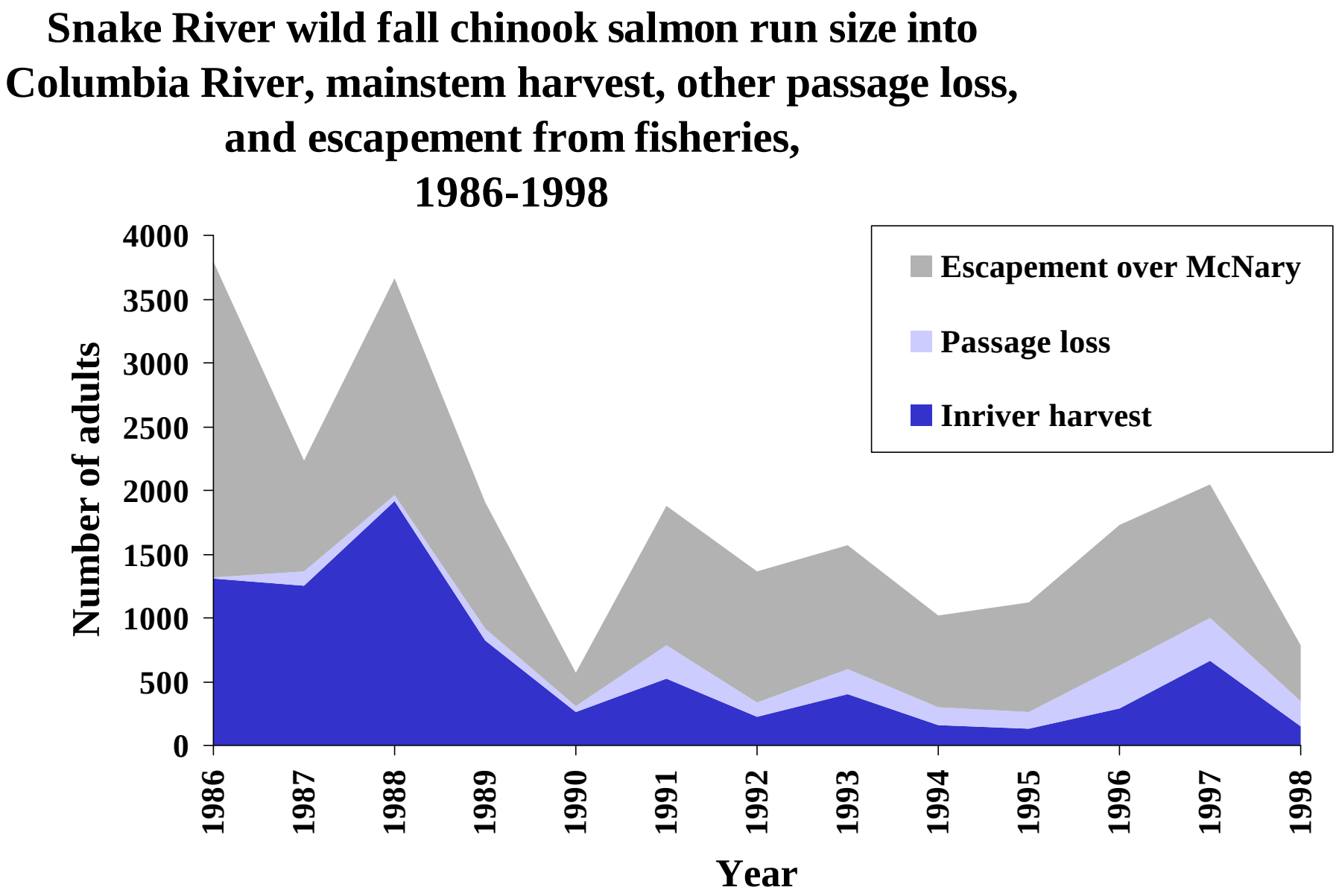

Snake River wild fall chinook salmon run size into Columbia River, mainstem harvest, other passage loss, and escapement from fisheries, 1986-1998
Escapement over McNary
Passage loss
Inriver harvest
Number of adults
4000
3500
3000
2500
2000
1500
1000
500
0
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
Year

Figure
A9

Snake River sockeye salmon run size into Columbia River, mainstem harvest, passage loss, and escapement over Lower Granite Dam, 1979-1998

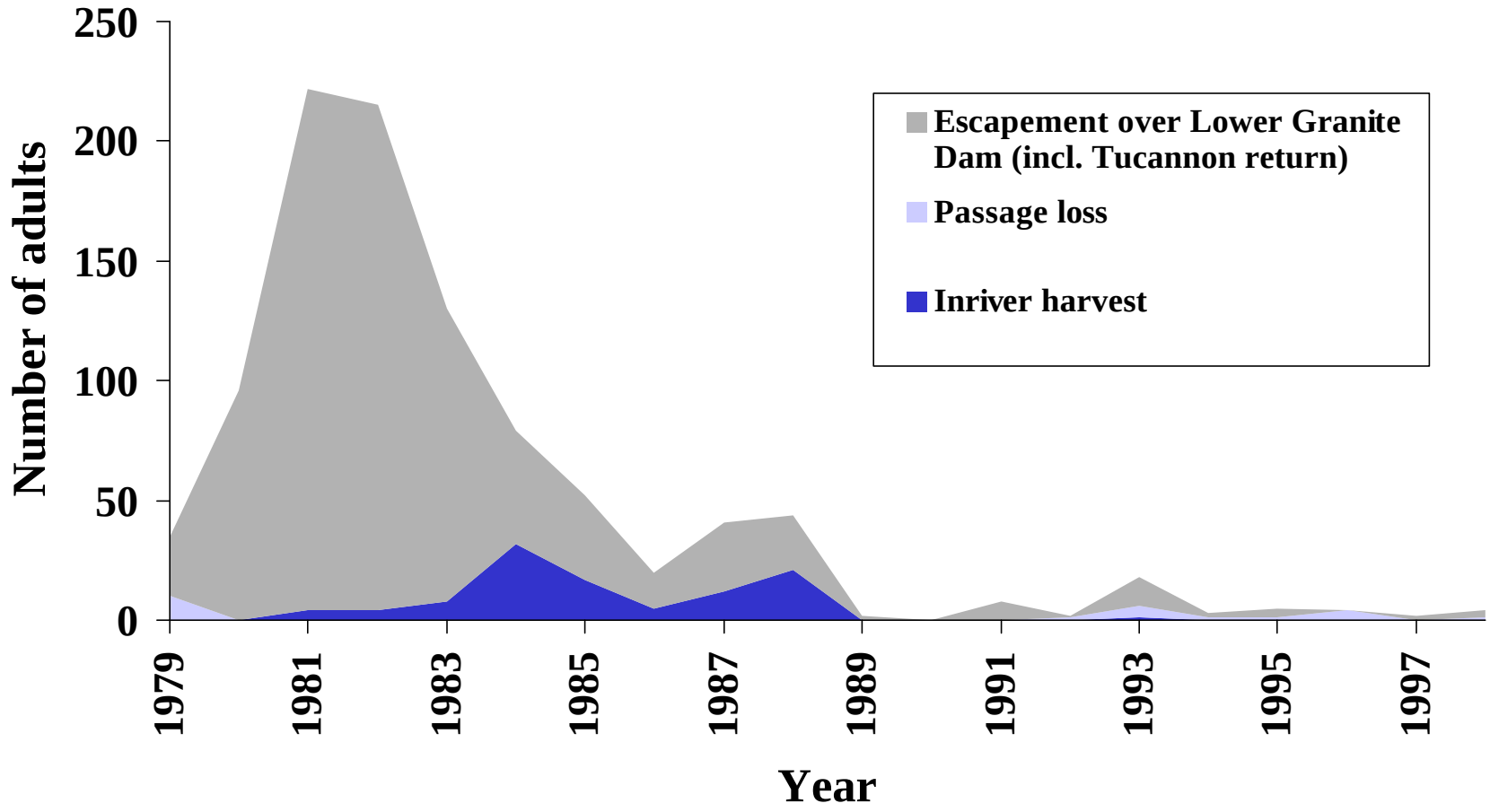


Figure
A10

Wild steelhead returns to Lower Granite Dam, 1985-1998

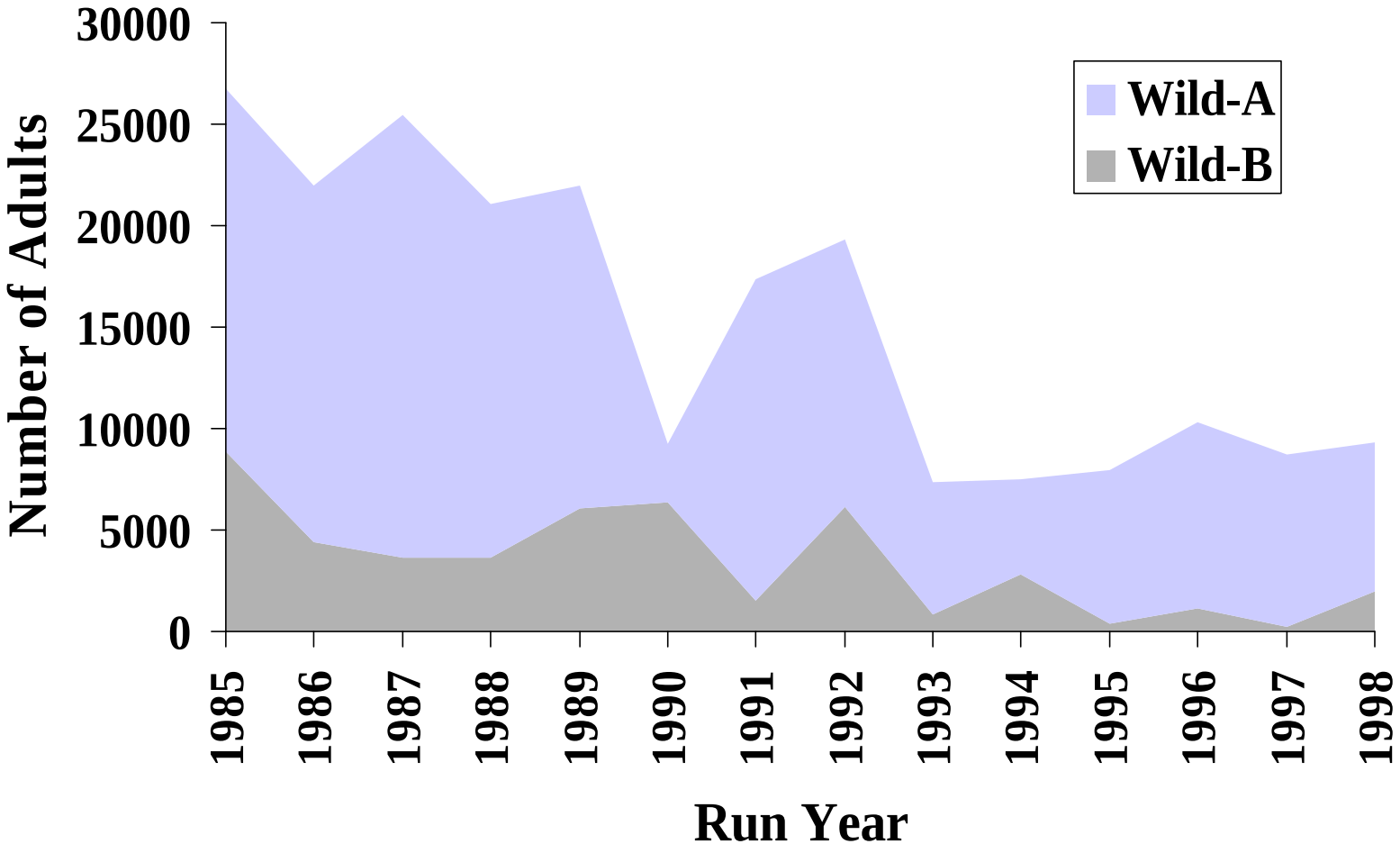


Figure A5

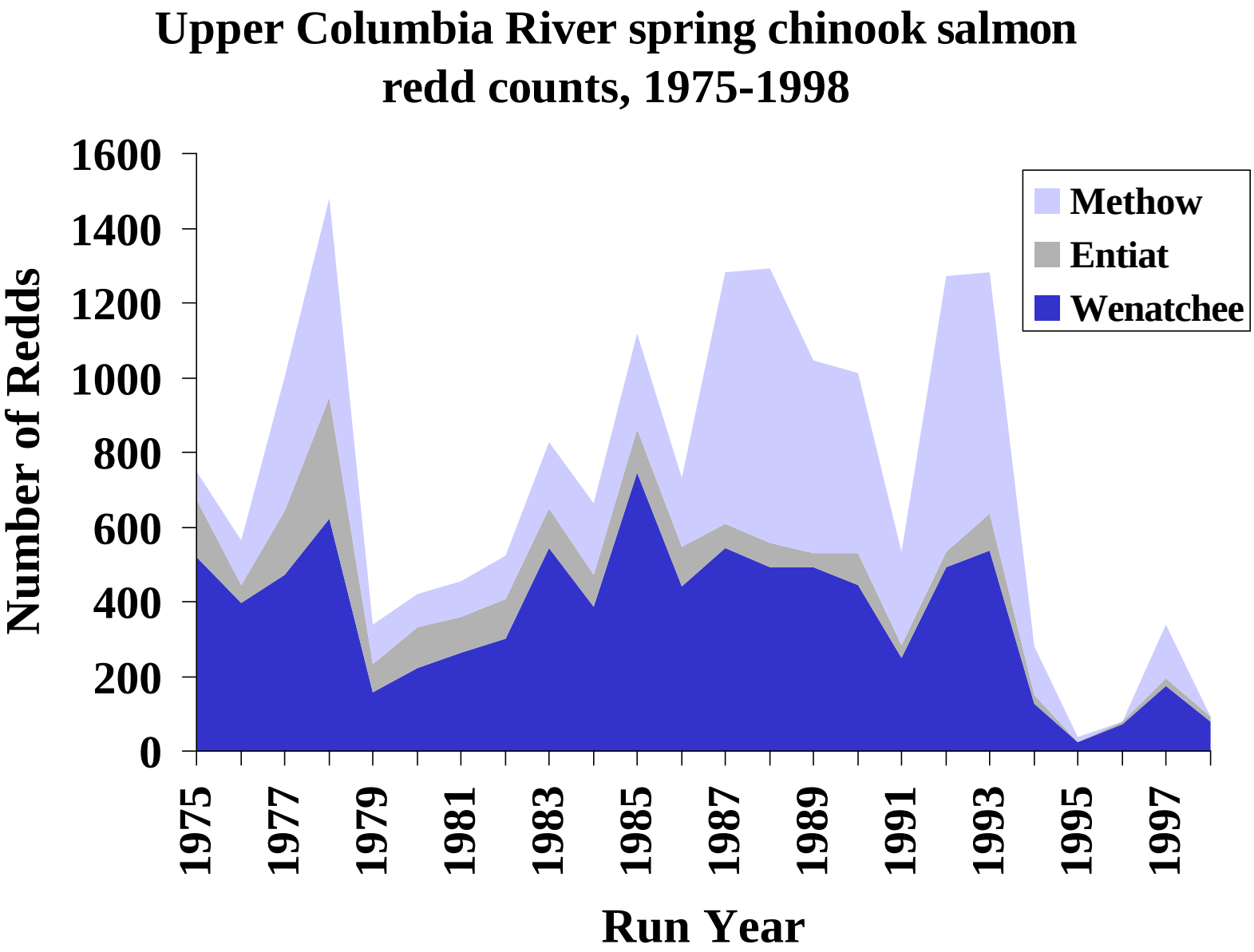
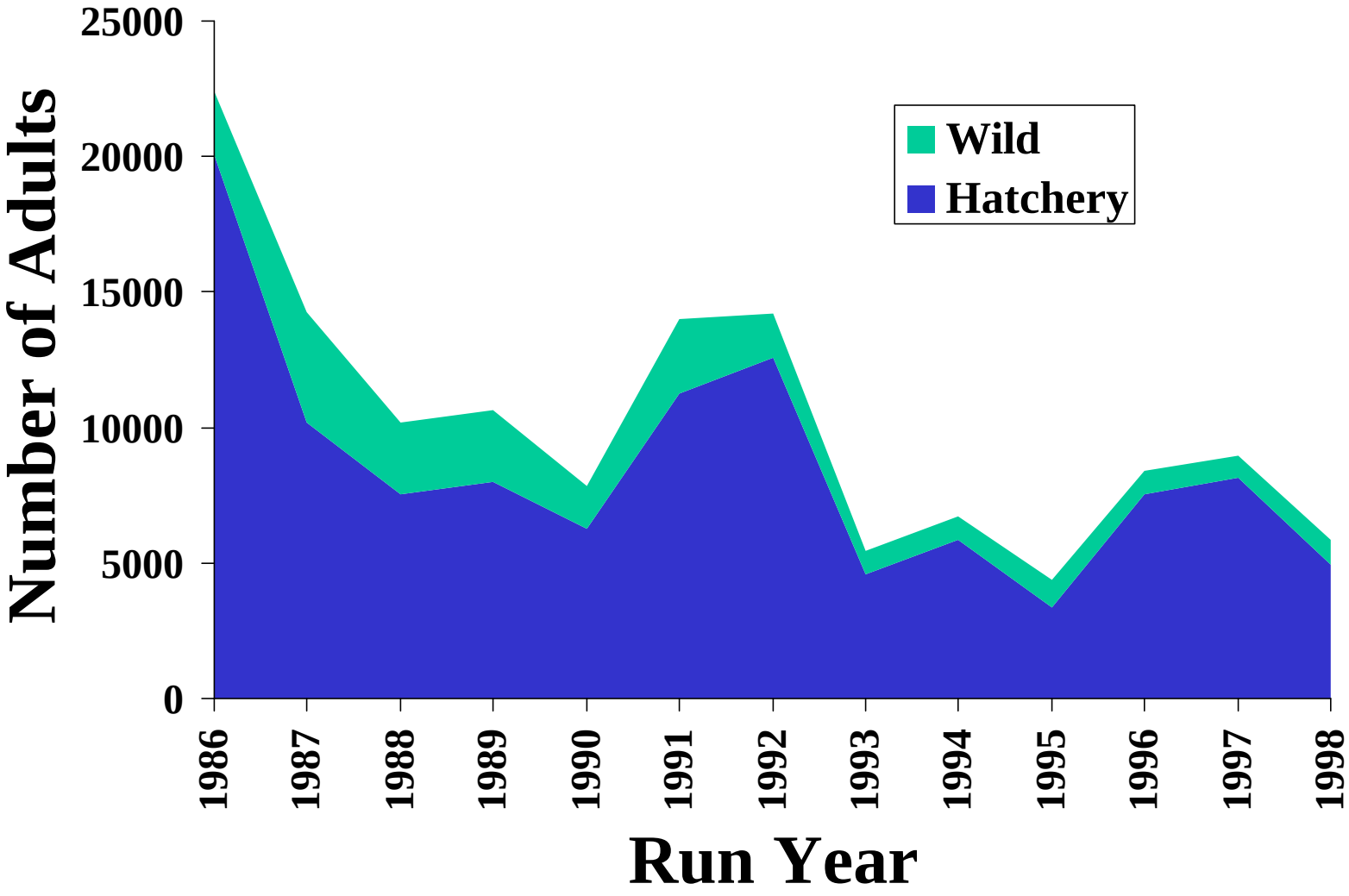

Upper Columbia River spring chinook salmon redd counts, 1975-1998
Number of Redds
1600
1400
1200
1000
800
600
400
200
0
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
Run Year
Methow
Entiat
Wenatchee

Figure
A11

Upper Columbia River steelhead counts at Priest Rapids Dam, 1986-1998



SALMON HARVEST REGULATORY AUTHORITIES

Ocean Management:
Two Pacific coast fisheries management councils regulate salmon fishing in federal marine waters. Funded by the Department of Commerce under the Magnuson-Stevens Fisheries Conservation and Management Act, the Councils develop Fisheries Management Plans (FMPs) as well as annual fishing regulations, which must be approved and implemented by the U.S. Dept. of Commerce. Various council technical committees and advisory panels support the Councils by developing annual information on stock abundance, escapements, fishing options and socio-economics. The U.S. Coast Guard implements enforcement of fishing regulations in federal marine waters.

Pacific Fishery Management Council: Responsible for developing salmon and several other species FMPs for fisheries in federal waters 3-200 miles off the coasts of California, Oregon, Washington

North Pacific Fishery Management Council: Responsible for developing salmon and several other species FMPs in the 3-200 mile federal waters off the state of Alaska.

Pacific Salmon Commission: Canadian and U.S. commission responsible for implementing harvest agreements under the U.S.-Canada Pacific Salmon Treaty of 1985, as modified by recent agreements in 1999. The two primary principles of the treaty are conservation and equity (harvest sharing). Several technical and advisory committees support the Commission by providing annual fisheries management information. See Harvest Appendix B for additional details regarding the recently concluded agreement.

State Territorial Marine Waters: State waters encompass marine coastal areas from 0-3 miles offshore. Alaska, Washington, Oregon and California are responsible for implementing marine fisheries regulations in their respective waters. State regulations for marine fisheries are generally adopted and enforced in concurrence with the federal FMP regulations.

Treaty Indian Tribes (marine waters): The Quinault, Queets, Quileute, Hoh and Makah tribes possess treaty rights to fish in marine waters. The respective tribal governments implement tribal marine fishing regulations and conduct law enforcement activities. Regulations are generally coordinated with those of the Pacific Fisheries Management Council.

Freshwater (Columbia River):

For many species of Columbia River salmon, harvest allocation between non-Indian and treaty Indians is subject to continuing jurisdiction of the federal courts under *United States v. Oregon*. Under that case, the Yakima, Warm Springs, Nez Perce and Umatilla tribes are entitled to a fair share (50%) of the harvestable fish. The parties to the case are the United States, the states of Oregon, Washington and Idaho, the four above mentioned treaty tribes and the Shoshone-Bannock Tribe. The Shoshone-Bannock Tribe does not exercise fishing rights on the mainstream Columbia River, but does conduct fisheries in Idaho, primarily within the Salmon River basin. Although the rights and the extent to which other tribes may fish for salmon has not been expressly adjudicated, other tribes such as the Colville Tribe also conduct limited subsistence fisheries for some species of salmon.

Commercial harvest of salmon is regulated by the Columbia River Compact, a bi-state compact established by the legislatures of Oregon and Washington in 1918. Compact fishing regulations are implemented under the state laws of Oregon and Washington and allow the sale and purchase of fish caught commercially in non-Indian and treaty Indian fisheries. The Compact is supported by the state staffs of Oregon and Washington, and the Technical Advisory Committee, composed of representatives of the state, tribal and U.S. agencies that are parties to *U.S. v. Oregon*. The tribal governing bodies of each of the tribes collaborate with the Compact agencies in establishing fishing regulations that affect tribal members.

Sport fishing for anadromous fish in state waters is regulated and administered by the respective departments of fish and wildlife in Idaho, Oregon and Washington.

Fisheries law enforcement in sport and commercial fisheries is conducted by the state police departments of Oregon; the fish and wildlife departments of Washington and Idaho; and, the United States acting through the Coast Guard, U.S. Fish and Wildlife Service, and National Marine Fisheries Service.

Tribal fisheries enforcement for the four lower river tribes is implemented by each of the respective tribes and also cooperatively through the Columbia River Inter-tribal Fisheries Enforcement Office.

HARVEST APPENDIX B. Table 1. Pacific Fishery Management Council Draft Final Pacific Coast Salmon Plan (January, 1999)

Conservation objectives and management information for natural and hatchery salmon stocks and stock complexes of significance to ocean salmon fisheries. Abundance information is generally based on the period 1994-1998.[a/]

Stock	Conservation Objective (to be met annually unless noted otherwise)	Subject to Council Actions to Prevent Overfishing	Other Management Information
	- - - CHINOOK - - -		
COLUMBIA RIVER BASIN - All pertinent fall, summer, and spring stocks of the Columbia River and its tributaries. Stocks within this complex are noted by area of origin: lower river (below Bonneville Dam), mid-river (Bonneville to McNary Dams), and upper river (above McNary Dam). Spawner escapement goals for these stocks are set through procedures of the U.S. District Court in U.S. v. Oregon and subsequent court orders. These goals are set forth in the Columbia River Fishery Management Plan and are recognized in the Council's conservation objectives. Annual inside fishery management planning activities are conducted within the Columbia River Compact and other state and tribal management forums. The Columbia River Compact, initially established by Oregon and Washington to jointly administer commercial fisheries within the Columbia River, takes into account the impacts from other state and tribal fisheries (e.g., recreational, ceremonial, subsistence, etc.) authorized under the Columbia River Fish Management Plan. The majority of ocean chinook harvest north of Cape Falcon is provided by Columbia River salmon stocks, primarily hatchery production of tule fall chinook from the Bonneville Pool (Spring Creek) and lower river hatcheries, smaller numbers of upper river bright hatchery and natural fall chinook, and some lower river hatchery spring chinook (Cowlitz). Hatchery objectives are based on long-range production programs and/or mitigation requirements associated with displaced natural stocks. Threatened Snake River fall chinook, which suffer from severe dam passage mortalities and extreme loss of freshwater habitat, are of prime concern in limiting ocean exploitation rates in all ocean fisheries north of Pigeon Pt., California. These limits act to provide considerable protection to other weak natural stocks subject to ocean fishery impacts.			
North Lewis River Fall Threatened (1999)	NMFS jeopardy standard/recovery plan (not established at time of printing). McIsaac (1990) stock-recruit analysis supports MSY objective of 5,700 natural adult spawners.	No. Listed stock. ESA jeopardy standard provides interim rebuilding program. Base period Council-area ocean fishery impacts around 7%.	Medium to low abundance. Present in ocean fisheries north of Cape Falcon to SE Alaska.
Lower River Hatchery Fall	14,400 adults to meet egg-take goal or as determined by management entities.	No (hatchery exception).	Medium to low abundance. Major contributor to ocean fisheries north of Cape Falcon to central British Columbia.
Lower River Hatchery (Spring)	2,700 adults to meet Cowlitz, Kalama, and Lewis Rivers broodstock needs.	No (hatchery exception).	Medium to low abundance. Present in ocean fisheries north of Cape Falcon to SE Alaska.
Upper Willamette (Spring) Threatened (1999)	NMFS jeopardy standard/recovery plan (not established at time of printing). Willamette River Management Plan provides an MSY proxy of 30,000 to 45,000 hatchery and natural adults over Willamette River falls, depending on run size.	No. Listed stock. ESA jeopardy standard provides interim rebuilding program. Base period Council-area ocean fishery exploitation rate of <1% prevents effective Council fishery management and rebuilding.	Low abundance. Present in fisheries north of Cape Falcon to SE Alaska.
Mid-River Bright Hatchery (Fall)	None for ocean fishery management.	No (hatchery exception).	Medium to high abundance. Contributor to ocean fisheries off Washington, British Columbia, and southeast Alaska. Primarily produced at Bonneville Hatchery.

HARVEST APPENDIX B. Table 1. Pacific Fishery Management Council Draft Final Pacific Coast Salmon Plan (January, 1999)

Conservation objectives and management information for natural and hatchery salmon stocks and stock complexes of significance to ocean salmon fisheries. Abundance information is generally based on the period 1994-1998.[a/]

Stock	Conservation Objective (to be met annually unless noted otherwise)	Subject to Council Actions to Prevent Overfishing	Other Management Information
		- - - CHINOOK - - -	
COLUMBIA RIVER BASIN (continued)			
Spring Creek Hatchery (Fall)	7,000 adults to meet hatchery egg-take goal.	No (hatchery exception).	Low abundance. Significant contributor to ocean fisheries north of Cape Falcon to southern British Columbia.
Klickitat, Warm Springs, John Day, and Yakima Rivers (Spring)	Hold ocean fishery impacts at or below base period (<1%) and recognize CRFMP objective - MSY proxy of 115,000 adults above Bonneville Dam, including upper and mid-Columbia and Snake River stocks (state and tribal management entities considering separate conservation objectives for these stocks).	Limited. Base period Council-area ocean fishery exploitation rate of <1% prevents effective Council fishery management and rebuilding. Major habitat restoration addressing water withdrawals and dam passage and blockages is necessary for rebuilding.	Long-term depressed abundance. No significance to ocean fisheries, infrequent occurrence in fisheries north of Cape Falcon to Alaska.
Snake River Fall Threatened (1992)	NMFS jeopardy/recovery standard. Since 1995, Council has met a standard of limiting its fisheries so that the total exploitation rate on age-3 and age-4 Lyons Ferry Hatchery fall chinook (representing Snake River fall chinook) for all ocean fisheries (including Canada) has been #70% of the 1988-1993 average adult equivalent exploitation rate. Prior to listing, managed within objectives for upper Columbia River bright fall chinook.	No. Listed stock, MSY criteria undefined. ESA jeopardy standard provides interim rebuilding program. Recovering historic abundance unlikely as dams block former primary spawning area.	Present in ocean fisheries from central California to southeast Alaska with greatest contribution to Canadian fisheries. Primary impacts in Council fisheries north of Cape Falcon, but also extending to Pigeon Pt., CA.
Snake River Spring/Summer Threatened (1992)	Not applicable for ocean fisheries.	No. Listed stock. Base period Council-area ocean fishery impacts rare (unmeasurable). Dam passage mortality must be reduced to allow stock recovery.	Depressed, recent trend downward. Rare occurrence in ocean fisheries from Washington to SE Alaska.
Upper River Bright (Fall)	40,000 natural bright adults above McNary Dam (MSY proxy adopted in 1984 based on CRFMP. The management goal has been increased to 45,000 by Columbia River managers in recent years.	Limited. Base period Council-area ocean fishery exploitation rate <4% prevents effective Council fishery management and rebuilding.	High to medium abundance. Significant contributor to ocean fisheries off Canada and to a lesser extent Washington and Oregon. Primary impact area north of Cape Falcon.
Upper River Summer	Hold ocean fishery impacts at or below base period (<2%); recognize CRFMP objective - MSY proxy of 80,000 to 90,000 adults above Bonneville Dam, including both Columbia and Snake River stocks (state and tribal management entities considering separate objectives for these stocks).	Limited. Base period Council-area ocean fishery exploitation rate <2% prevents effective Council fishery management and rebuilding. Dam passage mortalities must be reduced to allow rebuilding.	Long-term depressed abundance. Present in ocean fisheries north of Cape Falcon to southeast Alaska.

HARVEST APPENDIX B. Table 1. Pacific Fishery Management Council Draft Final Pacific Coast Salmon Plan (January, 1999)

Conservation objectives and management information for natural and hatchery salmon stocks and stock complexes of significance to ocean salmon fisheries. Abundance information is generally based on the period 1994-1998.[a/]

Stock	Conservation Objective (to be met annually unless noted otherwise)	Subject to Council Actions to Prevent Overfishing	Other Management Information
		- - - CHINOOK - - -	
COLUMBIA RIVER BASIN (continued)			
Upper River Spring Endangered (1999)	None applicable to ocean fisheries. Ensure ocean fishery impacts remain rare and recognize CRFMP objective - MSY proxy of 115,000 adults above Bonneville Dam, including upper and mid-Columbia and Snake River stocks (state/tribal management entities considering separate objectives for these stocks).	No. Listed stock. Base period Council-area ocean fishery impacts rare (not measurable), making Council management and rebuilding ineffective. Reduce dam passage mortalities to allow rebuilding.	Long-term depressed abundance. Captive broodstock programs started in 1997. No significance to ocean fisheries. Rare occurrence in ocean fisheries north of Cape Falcon to Canada.
		- - - COHO - - -	
Columbia River Late (Hatchery)	Hatchery rack return goal of 17,200 adults.	No (hatchery exception).	Major component of ocean fisheries north of Cape Falcon. When abundant, significant contributors to ocean fisheries off Oregon north into Canada and Columbia River fisheries.
Columbia River Early (Hatchery)	Hatchery rack return goal of 18,800 adults.	No (hatchery exception).	Major component of OPI area fisheries. When abundant, significant contributors to ocean fisheries off California and north to Leadbetter Pt., WA and to Columbia River fisheries. Current ocean fishery impacts from very limited retention fisheries north of Cape Falcon and incidental hook-and-release mortality in fisheries south of Cape Falcon.
Columbia River (Natural)	Undefined. Management is in a transitional phase pending completion of a critical review that may establish an explicit objective.	Not presently. See management information.	Extinct above the Dalles Dam, very rare below. Lower river coho are a candidate species under the ESA with an ongoing effort to determine if a reproducing population can be found and rebuilt.

a/ This table may be updated periodically by formal amendments to the FMP or comprehensive technical reviews which result in modified conservation objectives or the development of rebuilding programs in response to overfishing concerns. In addition, any stock listed under the ESA and its jeopardy standard or recovery plan will immediately be incorporated in the table.

HARVEST APPENDIX C

PACIFIC SALMON TREATY AGREEMENT: EFFECT ON COLUMBIA RIVER CHINOOK

Overview. The new Pacific Salmon Treaty agreement establishes abundance-based fishing regimes for the major salmon intercepting fisheries in the US and Canada. These regimes, which allow catches in fisheries to vary from year-to-year, are designed to implement the Treaty's conservation and harvest sharing principles better than previous regimes. In contrast to fixed catch ceilings, i.e., those that do not change from year to year, the abundance based regimes allow larger catches when abundance is higher and, importantly, significantly reduced catches in years when abundance is down. The new regimes will help to ensure the effectiveness of public and private investments in habitat restoration and other aspects of salmon recovery.

Chinook salmon. The new chinook regime encompasses marine and certain freshwater fisheries in Alaska, Canada, Washington, and Oregon. All chinook fisheries will be managed based on abundance, replacing the fixed catch quotas that applied in previous regimes. Two types of fisheries have been designated: (1) those that will be managed based on the aggregate abundance of chinook salmon present in the fishery, and (2) those that will be managed based on the status of individual stocks or stock groups in the fishery. The three that have been designated for aggregate abundance-based management (called "AABM" fisheries) are ocean fisheries that occur in large marine areas that affect a complex aggregation of many stocks. They are:

- The Southeast Alaska troll, net and sport fishery;
- The Northern British Columbia troll and Queen Charlotte Islands sport fishery; and
- The West Coast Vancouver Island troll and outside sport fishery.

All other ocean and freshwater fisheries impacting chinook salmon have been designated for individual stock-based management (called "ISBM" fisheries). Fisheries in this category include, but are not limited to:

- The central British Columbia troll, net, and sport fisheries;
- The southern B.C. marine net, troll and sport fisheries (other than the west coast Vancouver Island troll and outside sport fishery); and,
- All net, sport and troll marine and freshwater fisheries in Washington, Oregon and the Snake River basin in Idaho.

AABM fisheries. The three AABM fisheries will be managed to achieve a specific harvest rate that varies based on an index of abundance of salmon present in that

particular fishery for that particular year. Because each fishery is comprised of a different group of stocks that have different survival rates, the allowable catch will vary between fisheries and between years. Larger catches will be allowed when abundance is higher and, importantly, catches will be increasingly constrained when abundance is down. A schedule of harvest rates and abundances indices, and the resulting annual catch target, has been developed for each AABM fishery.

ISBM fisheries. These fisheries generally occur in marine waters closer to the rivers of origin, or directly in the rivers. These fisheries often are aimed at harvesting hatchery-produced salmon or species other than chinook. The catch in these fisheries is comprised of a relatively small number of chinook stocks, some of which are currently depressed. Accordingly, these fisheries will fall under a "general obligation" that specifies certain reductions in exploitation rates relative to a "base period."

The general obligation requires Canada to maintain at least a 36.5% reduction in *total* fishing mortality (i.e., not just landed catch) on identified depressed chinook stock groups relative to the base period of 1979-1982. This obligation applies to the sum of Canadian impacts across all of its ISBM fisheries that affect depressed US stock groups. The corresponding general obligation applicable across the US ISBM fisheries requires at least a 40% reduction relative to the same base period. Additionally, in those cases where the general obligation is insufficient to achieve escapement objectives for natural stocks, the agreement requires and specifies additional reductions. The reductions are expressed in terms of percentages, not fixed numbers of fish, on specifically identified natural stock groups, represented by a system of escapement and exploitation rate indicator stocks.

The agreement provides a degree of flexibility to allow management agencies within a region to decide how best to distribute the harvest impacts across their various ISBM fisheries to reflect domestic fishery priorities, provided the over-all reductions are achieved. For some depressed chinook stocks, the reductions will have to be much greater than required by the general obligation, and at least equal to the average of reductions that have been put in place in recent years (1991-96). The ISBM reductions do not apply to hatchery stocks or healthy natural stocks that are achieving escapement objectives and can support harvest.

In addition to predetermined harvest schedules, the agreement contains provisions that specify conditions under which even greater harvest reductions would apply in the future. These so-called "weak stock" provisions serve as a safety valve to afford additional protection to stocks that may fail to respond to the overall recovery program.

Columbia Basin chinook. Looking at the agreement from a Columbia Basin stock perspective, a number of key points should be made. First of all, the mere *existence* of the new agreement provides a great deal of certainty — certainty that has been notably lacking since 1992 — about how the ocean fisheries will be managed. This will allow US managers to make comprehensive fishery decisions that take into account total

impacts on stocks throughout their migratory range, rather than just in US fisheries. It also addresses the concern that the benefits of non-harvest measures designed to restore salmon stocks, such as habitat improvements, might be thwarted by an unconstrained harvest regime.

Second, the new regime is designed to manage fisheries based on the health (abundance) of the underlying stocks supporting that fishery. This is particularly pertinent to the Columbia Basin because the various chinook salmon types that originate in the Basin have vastly different migratory patterns; indeed, this phenomenon helps explain why the various fisheries under the new PST agreement will vary significantly in their allowed catch levels in any given year or between years. Some chinook stocks migrate as far north as Southeast Alaska and northern British Columbia; Hanford brights (a healthy stock) and Snake River falls and Willamette spring chinook (both ESA listed ESUs) are examples. Other Columbia Basin stocks do not migrate as far, and thus are impacted primarily in more southerly Canadian and southern US fisheries; Lower Columbia chinook, a listed ESU, is an example. The presence of small numbers of listed Snake fall chinook and Willamette spring chinook notwithstanding, the vast majority of the fish caught in the SEAK AABM fishery are from relatively healthy natural stocks and/or hatchery stocks. Compared to the SEAK AABM fishery, a much higher portion of the catch in the two Canadian AABM fisheries is comprised of depressed natural chinook stocks. In marked contrast to the previous fixed ceiling regime, the new agreement establishes catch levels in each of the AABM fisheries based solely on the abundance in that particular fishery, rather than a perceived balance of catches between fisheries operating on different stock mixtures.

As a result of this variation in migratory patterns, each fishery, whether AABM or ISBM, is linked to a specific list of stock groups and the spawning escapements of the stocks comprising those groups. For example, the SEAK fishery is linked to the status of the far-north migrating Columbia Basin fall chinook stock group, which is in turn comprised of the Up-river Brights, Deschutes, and Lewis River stocks, and to the Columbia River summers, which is comprised of mid-Columbia summer stocks. By way of contrast, SE Alaska is not linked to the status of Puget Sound chinook groups, as Puget Sound stocks tend not to migrate so far north.

The three AABM fisheries — the SEAK, Northern B.C., and West Coast Vancouver Island — are where the vast majority of the ocean impacts on many Columbia chinook stocks occur. Each of these will be constrained by specific catch/abundance schedules based on the stocks supporting it, rather than on the catch occurring in one of the other fisheries. Not surprisingly, given the different status of the various chinook stocks up and down the coast *at this point in time*, the catch/abundance schedule for the SEAK fishery will tend to provide for higher catches, and the regime for the Northern B.C. and West Coast Vancouver Island AABM fisheries will produce lower catches, due to their differing mixes of contributing stocks. This contrasts with the old system, which could actually raise ocean fishery harvest rates when stocks could least support it, as jurisdictions sought to fish up to their assigned quotas in order to maintain a perceived

fairness in catch balances. Note also that the regime will "self-adjust" if the current pattern of ocean abundances changes over time.

Third, another key feature of the new regime is that all chinook mortalities are to be accounted for, whether the fishery is targeting chinook salmon or some other species. Additionally, the harvest schedule for the major ocean fishery off the West Coast Vancouver Island now includes sport fisheries as well as the troll fishery, in notable improvement relative to the previous regime.

For the ISBM fisheries, which includes all the southern US fisheries and the Canadian fisheries other than the AABM fisheries noted above, the new agreement establishes caps on the overall impact of these fisheries on depressed stocks. As is the case with the AABM fisheries, the ISBM caps are rate-based, and thus will produce catches that can vary from year-to-year with abundance. Additionally, the catches in the various fisheries constrained by the ISBM limits may vary depending on how the jurisdictions choose to distribute (allocate) their allowed impacts.

As a practical matter, the new ISBM constraints will not greatly affect Columbia Basin stocks; due to their migratory habits, those stocks will benefit primarily from the improved management of the AABM fisheries, as described previously. Another reason the ISBM caps will not add a lot of additional new constraints for Columbia Basin stocks is that most southern US fisheries have already been under significant new abundance-based constraints in recent years due to recent declines in chinook production in the region and in response to ESA listings.

HARVEST APPENDIX D

Summary of the Effect of PATH Harvest Sensitivities

Spring/Summer Chinook:

The primary harvest of Snake River spring/summer chinook occurs within the Columbia River with little (or no) ocean harvest. In-river harvest levels have been significantly reduced since the late 1970's to levels less than 15%. Mainstem harvest of Columbia River spring and summer chinook stocks are currently managed using schedules that relate the annual allowable harvest to an estimated return. Harvest sensitivity analyses included two more conservative in-river harvest rate scenarios than the one based on current management. In the first sensitivity, called 'conservative', all harvest rates were reduced by 1/5 current value. In the second harvest sensitivity, called 'low harvest', all harvest rates were set to the lowest harvest rate in the current schedule. This extreme harvest sensitivity ('low harvest') is only hypothetical and equates to elimination of all mainstem commercial and sport fisheries and conservation level tribal ceremonial fisheries over the 100-year simulation period.

Harvest reductions for spring/summer chinook modeled in PATH had minor effects on projected probability of survival and recovery for spring/summer chinook and the ranking of management actions was unaffected by more conservative harvest schedules (PATH FY98). Under the 48-year recovery standard, neither of the PATH transportation based management actions (A1 & A2) were projected to meet the recovery standard, regardless of the harvest reductions implemented. In contrast, under the drawdown management action, the recovery standard is met regardless harvest. Given the existing low levels of harvest on spring/summer chinook and the insensitivity of PATH model projections to harvest reductions, it is unlikely that additional future reductions in harvest alone will significantly increase the survival of spring/summer chinook such that recovery standards will be meet.

Comparisons of the number of returning spawners (escapement) among two of the management actions modeled in PATH analyses under the existing harvest

schedule demonstrate, in part, the expected effect of current harvest regimes for spring/summer chinook. The PATH A2' action is meant to reflect the current hydrosystem configuration with transportation of fish maximized and implementation of all system improvements identified in the NMFS Biological Opinion. The PATH B1 management action represents drawdown of the lower four Snake River dams and John Day dam. Under the A2' action, mean spawners (averaged across 7 indicator stocks) are projected to increase by 39% over the next 10 years and by 77% over the next 25 years. In contrast, under the B2 drawdown management action, mean spawners are projected to increase by 115% over the next 10 years and by 185% over the next 25 years. The results from these two management actions show the maximum possible increase in spawner levels predicted under a no drawdown and a drawdown action.

The projected increase in spawners under the maximized transportation and system improvements action (A2') is not; however, enough to meet the recovery standards set by NMFS (see below) whereas the B2 action is predicted to lead to recovery. It is also important to note that the A2' action assumes that all system improvements are implemented and have a positive effect on fish survival. In addition, comparisons of PATH predicted to observed returning spawners for the most recent brood years indicate that PATH model predictions are optimistic (the models are generally over-predicting escapement compared to recent observed escapements). This positive bias suggests that model predictions are best suited for comparing among hydrosystem management actions (the relative rank etc…) and that predicted spawner levels must be considered with caution.

Fall chinook:

In contrast to spr/sum chinook, Snake River fall chinook are harvested at a much higher rate in both the ocean (by both the U.S. and Canada) and in-river. Both adult in-river harvest and cumulative ocean harvest rates have fluctuated around 30% from the late 70's to the present. In-river harvest of Snake River fall chinook is currently determined by river-mouth returns of both Snake River and Hanford Reach stocks (up-river bright chinook), while ocean harvest is

determined largely by overall abundance and management agreements between Canada and the US originally set by the Pacific Salmon Treaty in 1985. PATH included several different harvest reduction scenarios in model predictions: 15% reduction in ocean harvest combined with the existing in-river harvest schedule, and a 50 and 75% reduction in ocean harvest combined with an extremely low conservation level harvest schedule for in-river fisheries. The larger ocean reductions might be possible if Canada were to eliminate or drastically reduce one or more of their major West Coast salmon fisheries and/or if selective fisheries on hatchery fish were implemented coast wide. For the in-river fisheries, harvest rates under the conservation level scenario would be subsistence or treaty only and would be similar to the current harvest rates for spring/summer chinook. Neither scenario was meant to reflect any management action or current harvest policy and may be entirely unrealistic.

Because the purpose of the harvest sensitivity analyses was to explore the effects of different harvest scenarios on the response of Snake River fall chinook to hydrosystem actions, these analyses were focused on the 48-year recovery probability and the A2 management action (and under low D values --discussed elsewhere). The A2 management action reflects current hydrosystem management with transportation maximized. This action was the only case where reduced harvest rates had the potential to affect the ability of an action to achieve recovery as the probability of recovery under drawdown actions was far above critical levels (and for other actions when D is high).

The harvest sensitivities modeled in PATH demonstrated an increase in the probability of recovery under the current hydrosystem only when dramatic reductions in harvest were applied. The 15% reduction in ocean harvest rates resulted in only a minor change in the probability of recovery. When a 50% reduction in ocean harvest was combined with the current base schedule for in-river harvest, the probability of recovery increased (on average) from 0.31 to 0.46. Neither of these reductions (15 or 50%) in ocean harvest alone increased the probability of recovery enough to meet NMFS recovery standards (of 0.5). However, when a 50% reduction in ocean harvest was combined with a 50% reduction in in-river harvest rates (that also requires recovery to be met before

any non-subsistence level harvest can occur in-river), the probability of recovery increased to 0.56. And when a 75% reduction in ocean harvest was combined with a 50% reduction in in-river harvest rates (that also requires recovery to be met before any non-subsistence level harvest can occur), the probability of recovery increased to 0.60, on average. Both the 50% ocean/ 50% in-river reduction and the 50% ocean/ 75% in-river reductions increased the probability of recovery to levels that just meet the NMFS recovery standard (of 0.5). Again, this is in contrast to a drawdown management action, which has a 100% probability of meeting the recovery standard under current harvest schedules (no reduction) for fall chinook.

Comparisons of the number of returning spawners (escapement) among all the management actions modeled for fall chinook PATH analyses and under the three more dramatic harvest reductions described above are possible although not available at this time (under the 50% ocean reduction/ base in-river, the 50% ocean reduction/ 50% in-river reduction, and the 75% ocean reduction/ 50% in-river reduction).