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# Pacific Coast Salmon

## INTRODUCTION

Pacific salmon support important commercial and recreational fisheries in Washington, Oregon, and California. Salmon are part of the culture and heritage of the Pacific Northwest; having been harvested by Native Americans for millennia.

Pacific salmon are anadromous. They spawn in freshwater and migrate to the ocean where they may undergo extensive migrations. At maturity, they return to their home stream to spawn and complete their life cycle.

Pacific salmon include five species: chinook, coho, sockeye, pink, and chum salmon. Chinook and coho salmon are harvested recreationally and commercially in the Pacific Ocean, Puget Sound, and in freshwater rivers on their spawning migrations. All recreational fisheries use hook-and-line gear. Commercial fisheries use a variety of gear depending on location: in the Pacific Ocean all harvest is by trolling; in Puget Sound, gillnets and purse seines are also used; gillnets are used almost exclusively in freshwater and estuaries. Pink, chum, and sockeye salmon are not harvested in significant numbers recreationally nor outside of Puget Sound, although there are recreational fisheries directed at these species in a few locations. The majority of harvest is by commercial gillnet and purse-seine fisheries in Puget Sound and gillnet fisheries in estuaries. All species are also harvested by Native American tribes for subsistence and ceremonial purposes.

During 1995–97, the average annual commercial salmon catch was 13,100 metric tons (t) and provided revenues averaging almost \$22 million at dockside. Recreational catches are more difficult to value since the recreational experience associated with the catch cannot be easily measured. If recreationally caught fish are valued at a conser-

vative \$20/fish, the 1995–97 average catch of 661,000 fish would have been worth about \$13,000,000 annually.

The abundance of individual stocks of Pacific salmon and the mixture of stocks contributing to fisheries fluctuate considerably. Consequently, landings fluctuate. For all species, there is excess fishing power and overcapitalization of the fishing fleets. While harvest rates in recent years have been held near, or below, levels that would produce the long-term potential yield, environmental conditions have resulted in poor ocean survival of chinook and coho salmon in general and some individual stocks of other species. Because of the depressed status of many populations of chinook and coho salmon, these two species are considered overexploited while the other species are considered fully exploited (Table 12-1).

## Management Situation

The management of this resource is complex, involving many stocks originating from various rivers and jurisdictions. Ocean fisheries for chinook and coho salmon are managed under a fishery management plan by the Pacific Fishery Management Council (PFMC) with the cooperation of the states and tribal fishery agencies. Within Puget Sound and the Columbia River, fisheries for these two species are managed by the states and tribes. The other three species (pink, chum, and sockeye salmon) are managed primarily by the Pacific Salmon Commission (PSC), the State of Washington, and tribal fishery agencies.

Fisheries are managed using a variety of regulations. Ocean fisheries are managed primarily by gear restrictions, minimum size limits, and time and area closures; although harvest quotas have been placed on individual fisheries in recent years.

# Unit 12

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**Table 12-1**

Productivity in metric tons and status of Pacific Coast salmon resources.

| Species | Recent average yield (RAY) <sup>1</sup> | Current potential yield (CPY) <sup>2</sup> | Long-term potential yield (LTPY) <sup>2</sup> | Fishery utilization level | Stock level relative to LTPY |
|---------|---|--|---|---------------------------|------------------------------|
| Chinook | 7,444                                   | 11,460                                     | 11,460  | Over                      | Below                        |
| Coho    | 1,421                                   | 5,300                                      | 5,300   | Over                      | Below                        |
| Pink    | 3,931                                   | 7,270                                      | 7,270   | Full                      | Near                         |
| Sockeye | 1,740                                   | 4,646                                      | 4,646   | Full                      | Near                         |
| Chum    | 2,768                                   | 4,636                                      | 4,636   | Full                      | Near                         |
| Total   | 17,304                                  | 33,312                                     | 33,312  |                           |                              |

<sup>1</sup>RAY is for 1995–97, except pink salmon which is for the years 1993, 1995, and 1997.

<sup>2</sup>Potential yields include doubling of production for some stocks.

<sup>3</sup>Recreational harvest was converted from numbers of fish to approximate weight using average weights of salmon caught in commercial fisheries from 1993–97: Chinook=5.38 kg, coho=2.95 kg, pink=1.70 kg, sockeye=2.44 kg, and chum=4.16 kg.

The PSC has used harvest quotas, updated on the basis of inseason abundance forecasts, and cumulative impact quotas for weak stocks have been used to regulate some Columbia River commercial fisheries.

Pacific salmon depend on freshwater habitat for spawning and rearing of juveniles. Because the quality of freshwater habitat is largely a function of land management practices, salmon production is heavily influenced by entities not directly involved in the management of fisheries. Salmon management involves the cooperation of the U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service, Bureau of Reclamation, Army Corps of Engineers, Environmental Protection Agency, Bonneville Power Administration, state resource agencies, Indian tribes, municipal utility districts, agricultural water districts, private timber companies, and landowners.

On September 12, 1994, in response to an increasing number of petitions to list various populations of Pacific salmon and anadromous trout as endangered species, the National Marine Fisheries Service (NMFS) announced its intent to conduct comprehensive, coastwide status reviews of all species of Pacific salmon. These status reviews have been completed for most species and have resulted in listings of coho salmon from central California through coastal Oregon, chinook salmon in California's Central Valley and the upper Columbia and Snake River Basins, and sockeye salmon in the Snake River Basin. In March 1999, NMFS announced the most comprehensive

listing decision yet with final listings of nine evolutionarily significant units (ESU's) of salmon (chinook, chum, and sockeye) and steelhead trout ranging from the upper Columbia River through Puget Sound. These listings include the metropolitan areas of Portland, Ore., and Seattle, Wash., within the boundaries of the listed ESU's.

## RESOURCE STATUS

### Chinook Salmon

Chinook salmon are produced primarily by rivers and hatcheries in Puget Sound in Washington, the Columbia River, the Umpqua and Rogue Rivers in Oregon, and the Klamath and Sacramento Rivers in California. Chinook salmon stocks are named for the season in which they migrate from the ocean to freshwater to spawn, and include spring, summer, fall and winter runs. The proportion of chinook salmon production originating from hatcheries has been increasing.

Chinook salmon production tends to fluctuate considerably (Figure 12-1) depending on hatchery production, freshwater habitat conditions, and ocean productivity. In recent years, freshwater habitat loss and degradation have been exacerbated by drought in many areas in the west, and ocean conditions have been generally unfavorable for chinook salmon since the late 1970's. This has resulted in historically low levels of a number of stocks and reduced commercial and recreational catches in many areas. Currently, the

Snake River spring/summer run and Snake River fall run ESU's are listed as threatened, and the Sacramento River winter-run ESU has been listed as an endangered species by the NMFS. In addition, on 28 February 1998 NMFS proposed listing the Sacramento Central Valley spring run and the Upper Columbia spring run ESU's as endangered and six additional ESU's as threatened. Concern for the status of depressed stocks and biological opinions requiring reduced impacts on listed ESU's has led to increasingly restrictive ocean fishing seasons in recent years.

### Coho Salmon

Coho salmon are produced primarily by rivers and hatcheries in the Puget Sound area in Washington, hatcheries on the Columbia River, and coastal rivers and hatcheries in Oregon and California. Hatcheries play a larger role in the production of coho salmon than in the case of chinook salmon, in some areas accounting for over 80% of the catch. Recent reductions in landings have resulted from record low abundances of several stocks of coho salmon including Oregon coast natural and Columbia River hatchery stocks (Figure 12-2). To protect the spawning escapement of these stocks and to provide fish for the legally-mandated tribal allocation, severe restrictions have been placed on ocean fisheries since 1993. In May 1994, retention of coho salmon was prohibited in all ocean fisheries, and no retention of coho salmon has been permitted south of Cape Falcon in northern Oregon since then. To date, three coho salmon ESU's have been listed as threatened: central California in 1996, northern California-southern Oregon in 1997, and the Oregon coast in 1998.

### Sockeye, Pink, and Chum Salmon

Pink and chum salmon originate primarily from tributaries of Puget Sound, Washington. Chum salmon are also produced, in limited numbers, in the Columbia River and coastal streams as far south as the central Oregon coast. Sockeye salmon originate primarily from river systems connected to lakes. They are produced in a few rivers in the Puget Sound area, in limited numbers in a few coastal rivers on the Olympic Peninsula, and

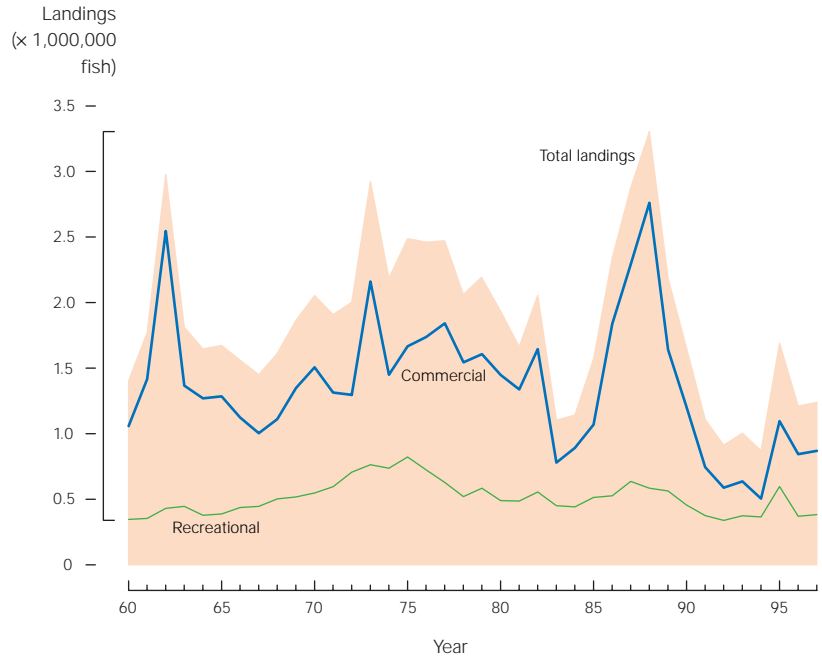


Figure 12-1  
Chinook salmon landings,  
1960-97.

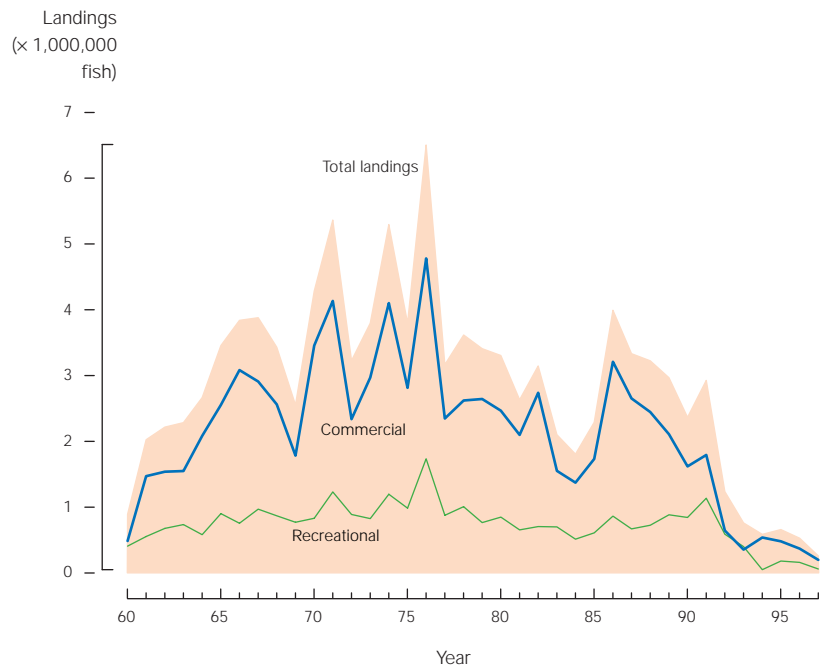
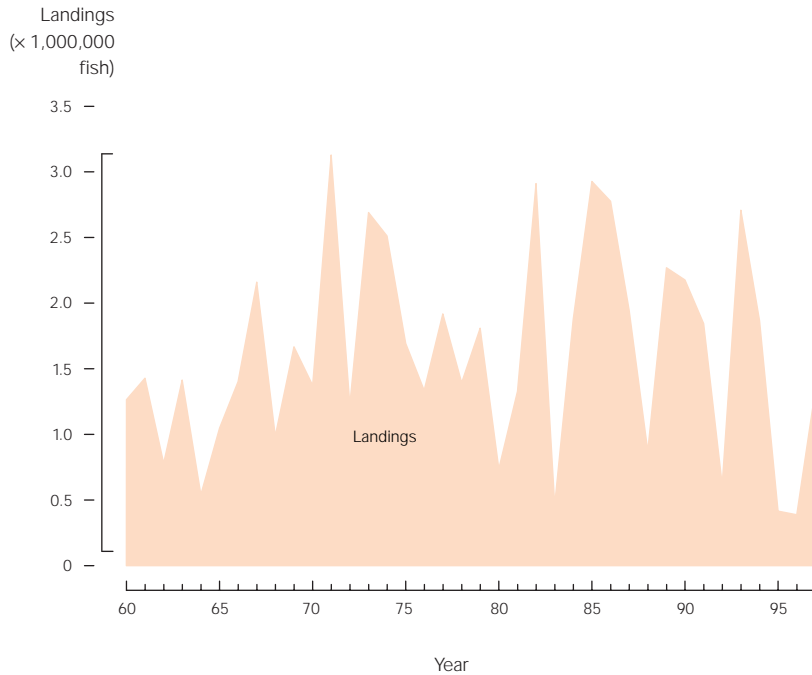
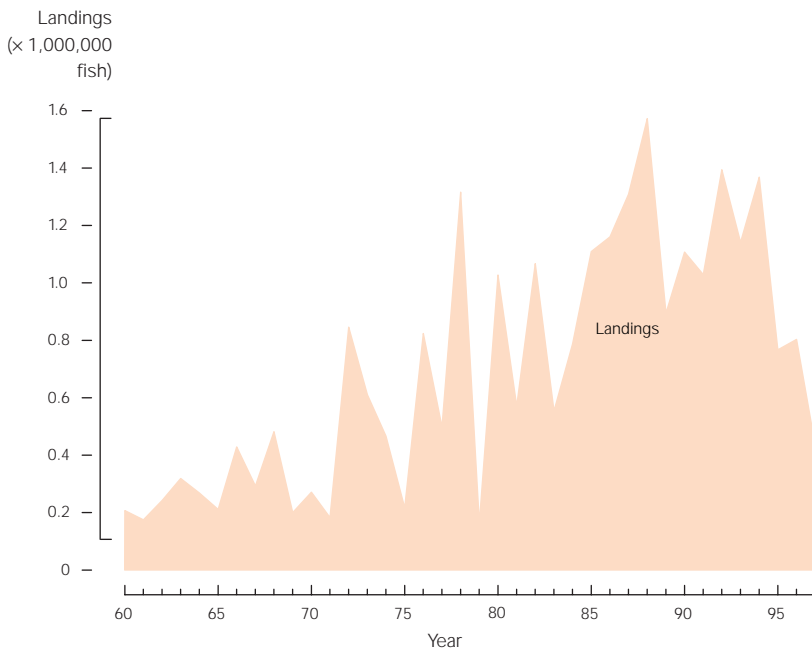


Figure 12-2  
Coho salmon landings,  
1960-97.



**Figure 12-3**  
Sockeye salmon landings,  
1960–97.



**Figure 12-4**  
Chum salmon landings,  
1960–97.

in the upper Columbia and Snake River basins. The majority of these species is caught commercially in the Puget Sound region of Washington. Much of the sockeye and pink salmon harvested in Puget Sound originates from the Fraser River in Canada. Though Fraser River runs have been large in recent years, the U.S. catch has been limited under Pacific Salmon Commission rules. Historical landings of the species are shown in Figures 12-3, 12-4, and 12-5.

### Recreational Fisheries

Pacific salmon support valuable recreational fisheries in saltwater, freshwater, and estuaries. Recreational landings of chinook salmon have averaged about 450,000 fish annually for the period 1995–97. During the same period, recreational landings of coho salmon have averaged about 133,000 salmon from hatchery and natural production combined. These represent substantial reductions from recreational landings in the recent past, especially for coho salmon which had annual recreational landings averaging 856,000 salmon as recently as the 1990–92 period.

While reduced recreational landings of chinook and coho salmon reflect lower abundance of these two species, declines in abundance are not as pronounced as the declines in landings. Much of the decrease in landings is the result of regulations intended to reduce impacts of both commercial and recreational fisheries on stocks listed under the ESA and to provide adequate spawning escapement for healthier stocks. Consequently, catch per unit of effort and angler success rates have remained high.

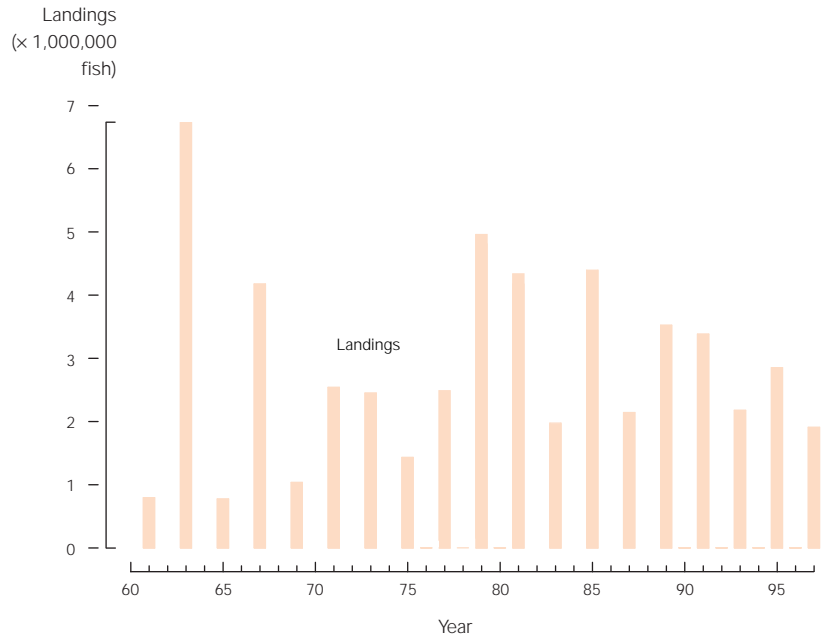
Recreational landings for sockeye, pink, and chum salmon combined have averaged about 78,000 fish. Recreational landings of these species are much lower than recreational catches of chinook and coho salmon, while commercial landings are substantially greater. The reason for this lies partly in the life histories and migration patterns of the individual species. Sockeye, pink and chum salmon migrate far offshore into the central North Pacific Ocean and the Gulf of Alaska. Thus they are only available to recreational fisheries briefly during their spawning migration. In addition, pink and chum salmon spawn and die shortly

after entering freshwater as adults. By the time they reach terminal areas where recreational fisheries are located, they have undergone physiological changes in preparation for spawning. Consequently, their flesh is of poorer quality, and they are not as highly prized as chinook, coho and sockeye salmon. While the recreational fisheries for sockeye, pink, and chum salmon are substantially smaller than recreational fisheries for chinook and coho salmon, they are still important.

### Commercial Landings

For 1995–97, the combined chinook salmon harvest from natural and hatchery production averaged about 936,000 fish. In the same period, the commercial catch of coho salmon averaged about 349,000 salmon. This represents a modest increase in chinook salmon landings over the 576,000 taken during 1992–94, and a further decline in coho landings which averaged about 512,000 during 1992–94 and produced annual landings of more than 2,000,000 fish as recently as 1989. As with recreational landings, the decline reflects restrictions placed on ocean fisheries beginning in 1993 to protect the spawning escapement of depressed and ESA listed stocks. The landings also reflect poor ocean conditions that coho and chinook salmon have been experiencing in recent years.

Sockeye, pink and chum salmon have not suffered the same recent declines as chinook and coho salmon. Trends in the recent landings have generally been stable or increasing, with downturns in landings of chum and sockeye salmon in the last 3 years. While the downturn in chum salmon reflects an actual decline in abundance in the Puget Sound region, sockeye salmon landed in Washington are primarily from the Fraser River in British Columbia. Fraser River sockeye salmon runs have been very strong recently, but ocean conditions have caused a large proportion of the fish to migrate north of Vancouver Island where they were unavailable to U.S. fisheries. Recent average annual catches of these species were roughly 700,000 sockeye salmon (1995–97), 660,000 chum salmon (1995–97), and 2.2 million pink salmon (1993, 1995, and 1997).



## ISSUES AND PROGRESS

Figure 12-5  
Pink salmon landings, 1960–97.

### Balancing Competing Users

The decline in chinook and coho salmon abundance has forced severe reductions and closures of ocean fisheries in recent years. These reductions, in some cases, follow earlier reductions legally mandated to allocate salmon to interior-water fisheries for harvest by Native American tribes. Ocean salmon fisheries cannot redirect their effort to take advantage of abundant sockeye, pink, and chum salmon stocks because the ocean distribution of these species keeps them outside the range of coastal fisheries. With the prospect of even further restrictions that may be required to protect threatened and endangered species, the future viability of these commercial fisheries is uncertain.

### Hatchery vs. Wild Salmon

The use of hatcheries to mitigate habitat loss and to enhance fisheries, especially for chinook and coho salmon, has raised concerns about the interactions of hatchery and natural fish. While hatchery fish can supplement natural production, they can also compete with naturally produced fish. In areas where fisheries are managed on the

basis of hatchery production, harvest rates may be higher than the natural stocks can sustain. In addition, some hatchery fish fail to return to the hatchery, spawning in natural areas with wild fish. Some hatchery brood stocks are of nonlocal origin, and the insertion of nonlocal genes into natural populations can compromise the genetic integrity of the native stocks and decrease their productivity. To address these concerns, NMFS has drafted an interim policy on artificial propagation in the listing and recovery of Pacific salmon under the Endangered Species Act.

#### **Bycatch and Multispecies Interactions**

Some salmon, primarily chinook, are caught incidentally in the Pacific whiting fishery. While the numbers are small, this is a sensitive issue given that directed salmon fisheries have been increasingly restricted. Interactions with marine mammals have also become a sensitive issue as populations of California sea lions have increased. Predation by sea lions tends to be localized, but it is also highly visible.

#### **Transboundary Stocks and Jurisdiction**

Because salmon migrate long distances, they are subject to interception by fisheries far from their region of origin. Issues of allocation have never been easy to resolve and have been addressed in a variety of forums. Much of the annual process of managing ocean salmon fisheries by the PFMC is concerned with the allocation of fish between different user groups: the United States and Canada, ocean and interior-water fisheries, commercial and recreational fisheries, and tribal and nontribal fisheries. The PSC oversees the allocation of salmon between the United States and Canada. In 1994, a breakdown of the U.S.-Canada negotiations led to aggressive harvesting that compounded forecasting errors and nearly destroyed one of the most productive runs of sockeye salmon from the Fraser River in British Columbia. The PSC has not reached an allocation agreement in any year since then. The allocation of salmon between Native American tribes and nontribal users continues to be defined in Federal courts.

#### **Ecosystem Considerations**

Coho salmon abundance reached a peak in 1976, and has declined ever since. Chinook salmon abundance has also generally declined since the mid 1970's, although there was a brief increase in chinook salmon abundance in the late 1980's. This decline has affected both hatchery and natural stocks and thus appears to indicate a decline in ocean survival. This decline is coincident with a change in the oceanographic regime off the west coast that occurred around 1978. Since then, the coastal waters off California, Oregon, and Washington, where many chinook and coho salmon stocks mature, have been warmer and less productive than they were in the period from roughly 1950 to 1978. The decline in ocean productivity off the Pacific Coast appears to be linked to increased productivity in the Gulf of Alaska. Sockeye, pink, and chum salmon, which migrate further offshore than chinook and coho salmon, have been relatively stable or increasing during the same period that chinook and coho salmon have declined.

Because Pacific salmon depend on freshwater habitat for spawning and juvenile rearing, they are particularly vulnerable to habitat degradation. Throughout their range, their freshwater habitat has been degraded by dam construction, logging, agriculture, grazing, urbanization, and pollution. Water extraction and flow manipulation for hydropower, irrigation, flood control, and municipal needs directly compete with salmon for the freshwater on which they depend. As the human population in the western United States continues to increase, so will the pressures on salmon habitat. The fact that we still have salmon in harvestable quantities is a tribute to the resilience of these fish.

### FOR FURTHER READING

Pacific Fishery Management Council. 1998. Review of 1997 ocean salmon fisheries. Pacific Fishery Management Council, 2130 SW Fifth Ave., Portland, OR 97201, 107 p.

Oregon Department of Fish and Wildlife (ODFW) and Washington Department of Fish and Wildlife (WDFW). 1998. Status report: Columbia River fish runs and fisheries 1938–97. ODFW, P.O. Box 59, Portland, OR 97207, 299 p.

Hare, S. R., N. J. Mantua, and R. C. Francis. 1999. Inverse production regimes: Alaska and West Coast Pacific salmon. *Fisheries* 24(1):6–14.