

# SELECT AREA FISHERY EVALUATION PROJECT

## FINAL PROJECT COMPLETION REPORT

October 1993 – July 2004



### Prepared for:

U.S. Department of Energy  
Bonneville Power Administration  
Environment, Fish and Wildlife  
P.O. Box 3621  
Portland, OR 97208-3621



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**Clatsop Economic Development Council  
Fisheries Project**



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October 2004

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The use of trade names throughout this report does not imply endorsement by the SAFE project.

## EXECUTIVE SUMMARY

The Select Area Fisheries Evaluation (SAFE) Project was initiated in late 1993 with funding by the Bonneville Power Administration based on a recommendation by the Northwest Power Planning Council. The goal of the project is to determine the feasibility of creating and expanding terminal known stock commercial and recreational fisheries in the Columbia River Basin to allow harvest of strong anadromous salmonid stocks while minimizing impacts to depressed salmonid stocks. This report summarizes activities and findings of the SAFE project during fall 1993-spring/summer 2004, except some earlier information is provided for background and to identify trends.

During 1993-1994, eight potential sites (five in Oregon and three in Washington) were identified as feasible locations for developing net-pen rearing facilities to establish commercial and recreational fisheries. The Youngs Bay net-pen project that was initiated in 1986 by Clatsop Economic Development Council's Fisheries Project (CEDC), served as the model for development of the SAFE project due to superior growth and survival rates documented for this rearing strategy. Each area was evaluated for rearing potential, site access, capacity for fishers, and potential for impacts on stocks listed under the Endangered Species Act (ESA). Physicochemical and aquatic bio-monitoring surveys were conducted from 1994-1996 at each site to establish baseline conditions and document differences between areas. Extensive test fishing was conducted during this same period to assess the harvest potential in each site by evaluating abundance and timing of non-target fish stocks, suitable gill-net mesh sizes, and fishing area boundaries. Based on this information and available funds, Tongue Point, Blind Slough, Deep River, and Steamboat Slough were selected for development of rearing sites and establishment of select area fisheries. Releases in Youngs Bay were increased and used as a standard for comparison with the new sites.

Experimental groups of coho (*Oncorhynchus kisutch*) were reared and released from the Tongue Point, Blind Slough, and Deep River sites in 1995 and Steamboat Slough in 1999 to determine each site's capability to successfully acclimate and imprint smolts based on recovery of coded-wire tags from returning adults. Coho were used during initial production years due to a surplus of juveniles and a shorter maturation cycle. Spring chinook (*O. tshawytscha*) were subsequently reared and released at Tongue Point, Blind Slough, and Deep River. Two stocks of fall chinook including upriver brights (URB) and select area brights (SAB; originally Rogue River stock) were evaluated at all Oregon sites. For all sites combined, annual SAFE-project smolt releases during 1993-2004 have ranged between 2.0-4.2 million coho, 0.4-1.8 million spring chinook, 0.1-0.6 million URB fall chinook, and 0.1-1.4 million SAB fall chinook.

Experimental fishing seasons were established in each site concurrent with initial adult returns of each species. Extensive sampling of the landed catch for each fishery has been and continues to be conducted to recover coded-wire tags applied previously to a representative component of each SAFE release and from any non-target stocks. Sampling of local hatchery returns, SAFE recreational fisheries, and spawning ground surveys in SAFE-site tributaries provides additional tag recovery data that is used to monitor survival, straying, and fishery contributions to determine if project objectives are

being met. Fishing periods, gear, and area boundaries have been refined over time to minimize impacts to listed species.

Adult survival of select area spring chinook (1994-1998 broods) averaged 0.63 percent, similar to average survival rates for releases from Willamette River Basin hatcheries (0.59 percent). Select area coho smolt-to-adult survival rates (1993-1999 broods) ranged from 1.20–3.60 percent annually as compared to lower Columbia River hatcheries, which averaged 0.40-2.0 percent. Adult survival rates for select area bright fall chinook averaged 1.05 percent for brood stock releases at Klaskanine Hatchery (1995-2000 broods) and 0.86 percent for releases from net pens in Youngs Bay (1991-2000 broods). Average survival of upriver bright fall chinook (1994-1997 broods) was 0.11 percent.

Average stray rates for select area spring chinook were 0.5 percent for Blind Slough (1994-1999 broods); 3.6 percent for Youngs Bay (1994-1999); 20.8 percent for Tongue Point (1994-1998), and 26.7 percent for Deep River (1996-1997, 1999). Escapement of 1993-1999 brood year select area coho averaged 0.4 percent for Youngs Bay, 0.8 for Blind Slough, 1.8 for Tongue Point, 2.9 for Deep River, and 33.1 for Steamboat Slough (1997-1999 broods). Average stray rates for select area bright fall chinook were 13.8 percent for Big Creek Hatchery (1991-1995 broods), 0.7 percent for Klaskanine Hatchery (1995-2000 broods), and 1.9 percent for Youngs Bay net pens (1991-2000 broods). The stray rate for upriver bright fall chinook (1994-1997 broods) averaged 8.1 percent.

Based on these results several modifications to the original release programs were required. Upriver bright fall chinook releases at Tongue Point were discontinued due to unacceptable stray rates, and releases at Youngs Bay were curtailed because of poor returns. Releases of select area bright fall chinook from Tongue Point and Blind Slough were discontinued after 1997 due to poor survival and high stray rates, primarily to lower Columbia River tributaries. Select area bright fall chinook production was continued in Youngs Bay; however, the brood stock release and collection site was moved from Big Creek Hatchery to Klaskanine Hatchery in 1996 to reduce straying and maximize harvest of surplus adult returns. Production-level releases of spring chinook from Tongue Point were discontinued in 2000; pending results of 2003-2005 release trials from a new rearing site established in this area. Releases of coho from Steamboat Slough will be discontinued, but the site may continue to be used as a production facility.

During this reporting period, spring fisheries (mid-April through mid-June) targeting spring chinook were expanded in Youngs Bay based on increased releases, with new seasons established in Tongue Point, Blind Slough, and Deep River select areas beginning in 1998. Winter seasons were established during late-February through mid-March in Youngs Bay (1998) and Blind Slough (1999) to target early-returning spring chinook. Summer seasons (mid-June-July) have been adopted in Youngs Bay since 1999 to harvest SAB fall chinook. Due to these expanded fishing opportunities and additional releases, chinook harvest has increased steadily throughout the reporting period ranging from 155 fish harvested in 1995 to 11,699 fish landed in 2002. Landings of spring chinook in 2004 were 6,849 fish in Youngs Bay, 3,531 in Blind Slough, and

113 in Deep River. During 1992-2004, incidental harvest of white sturgeon (*Acipenser transmontanus*) in spring fisheries did not exceed 644 fish annually.

Fall commercial fisheries were established and monitored from early August through the end of October in Youngs Bay (1993-2003), and September-October in Tongue Point, Blind Slough, Deep River (1996-2003), and Steamboat Slough (2000-2003). The August portion of the season in Youngs Bay targets SAB fall chinook with the fisheries shifting to coho beginning in September. During 1996-2003, Youngs Bay harvest ranged from 1,225 to 5,157 fall chinook, and 13,649 to 94,279 coho. At the other sites annual coho harvest ranged from 26 to 15,598 fish during this period. In 2003, a record 117,133 coho were harvested in SAFE fisheries. Fish of SAFE origin dominated fall SAFE coho harvest during 1996-2002: Youngs Bay (87.1 percent), Deep River (85.9 percent), Blind Slough (81.6 percent), and Tongue Point (79.8 percent). The largest fall harvest of sturgeon in 1996-2003 SAFE fall fisheries was 334 fish, predominantly at Youngs Bay and Tongue Point.

Fisheries adopted during this reporting period resulted in a significant increase in interest in select area fisheries by both commercial and recreational user groups. The number of participating commercial vessels increased from 57 to 218 in spring fisheries and 96 to 192 in fall fisheries. Since recreational surveys were initiated in 1998, sport harvest has increased significantly especially for spring chinook and SAB fall chinook. The economic value of the fishery, as measured in ex-vessel dollars for commercial fisheries, and the non-market user value per fish landed in sport fisheries, increased from approximately \$492,000 in 1996 to \$3.3 million in 2003. The economic impact of SAFE salmonid production on personal incomes of families in lower Columbia River communities totaled \$4.6 million in 2003.

One of the primary goals of this project was to maximize harvest of returning adults while minimizing catch of non-SAFE stocks. Coded-wire tag recoveries document extremely high harvest rates for all species: coho (98.3 percent), spring chinook (92.0 percent), select area bright fall chinook (96.4 percent), and upriver bright fall chinook (94.4 percent). As intended, the majority of the fish harvested in SAFE fisheries were of local origin although the contribution varied by site and year. For 1993-2003 winter-summer fisheries, SAFE releases comprised an average of 88.9 percent of the Blind Slough harvest (1998-2003), 80.1 percent of the Youngs Bay harvest (1993-2003), 74.6 percent of the Tongue Point harvest (1998-2003), and 69.2 percent of the Deep River harvest (2003). During 1996-2002, locally-produced coho contributed an average of 87.1 percent of the coho harvest in Youngs Bay, 85.9 percent in Deep River, 81.8 percent in Tongue Point, and 81.6 percent in Blind Slough. In Steamboat Slough, SAFE coho comprised an average of 57.8 percent of the landings during 2000-2002. Fall chinook harvest and stock composition varied considerably depending on the extent of releases at each site. During 1996-2002 Youngs Bay had an average annual harvest of over 1,934 fall chinook, with 97.0 percent originating from SAFE sites based on non-expanded CWT recoveries. Tongue Point and Blind Slough averaged 438 and 581 chinook, respectively, with SAFE stocks comprising 57.6 percent of the Tongue Point catch and 58.1 percent of the Blind Slough landings. In Deep River, 67.1 percent of the average annual harvest of 106 chinook were of SAFE origin.

The CEDC Fisheries portion of the SAFE project releases an average of 4.4 million smolts per year, which represents approximately 2.2 percent of the hatchery smolts produced in the Columbia River Basin. During 1993-2003, CEDC releases contributed an average of 38.3% of the total lower Columbia River non-indian commercial harvest with a range of 15.7-98.8%.

Another major goal of the SAFE project was to develop fisheries that provided greater protection for depressed and listed stocks. Impact rates in SAFE fisheries adopted during 1993-2000 were negligible. Impacts to upriver spring chinook increased during 2001-2003 (0.16 percent average) likely due to increased upriver run sizes but were maintained within management guidelines through in-season management. Annual landings of Snake River wild spring chinook in combined SAFE winter-summer fisheries during 1993-2003 ranged between 0-124 adults which represents a 0.00-0.20 percent impact rate. Impacts to wild Snake River fall chinook during 1997-2000 SAFE fall fisheries never exceeded 0.15 percent for all SAFE fisheries combined. Impacts during 2001-2003 fall fisheries are likely higher but final run sizes for this stock are not yet available.

In conjunction with rearing and releasing smolts into SAFE sites for the purpose of fishery development, many fish propagation studies were also initiated. Studies have focused on avian avoidance and predation, subsurface feeding, winter dormancy, rearing density, size at release, time of release, smolt condition and migration rates, and adult holding. Some study results have been incorporated into production strategies while others are incomplete pending final adult returns.

In addition to documenting results of net-pen released fish, all sites have been monitored for water quality to determine whether any change is occurring in local biochemical composition. Monthly measurements of water chemistry and macro invertebrate populations have been conducted before, during, and after each rearing period. To date the tendency has been for limited changes at some sites during the rearing period (November-April), with return to previous conditions during the recovery period (May-October).

# 1. INTRODUCTION AND PROJECT HISTORY

## BACKGROUND

In its 1993 Strategy for Salmon, the Northwest Power Planning Council (NPPC) recommended that terminal-fishing sites be identified and developed to harvest abundant fish stocks while minimizing the incidental harvest of weak stocks. The Council called on the Bonneville Power Administration (BPA) to "Fund a study to evaluate potential terminal fishery sites and opportunities. This study should include: general requirements for developing those sites (e.g., construction of acclimation/release facilities for hatchery smolts so that adult salmon would return to the area for harvest); the potential number of harvesters that might be accommodated; type of gear to be used; and other relevant information needed to determine the feasibility and magnitude of the program."

Beginning in 1993 BPA initiated the Columbia River Terminal Fisheries Project, a comprehensive program to investigate the feasibility of establishing and expanding terminal fisheries in Youngs Bay and other off-channel sites in the lower Columbia River (LCR) (Hirose et al. 1996). This project is an extension of the existing hatchery system that utilizes existing hatchery facilities to spawn, hatch, and conduct initial rearing of juvenile salmonids for subsequent outplanting to net-pen facilities at each of the SAFE sites. This strategy capitalizes on documented improvements to growth and survival provided by net-pen culture pioneered by the Clatsop Economic Development Council Fisheries Project (CEDC) (Hirose et al. 1998).

Now referred to as the Select area Fisheries Evaluation (SAFE) Project (effective 1997), the sponsors are the Washington Department of Fish and Wildlife (WDFW), Oregon Department of Fish and Wildlife (ODFW), and CEDC Fisheries Project. At present 55 percent of CEDC's funds are from BPA, while the remaining 45 percent are from local, state and others. The goal of the project is to determine the feasibility of creating and expanding known stock sport and commercial fisheries in the Columbia River Basin to allow harvest of strong anadromous salmonid stocks while providing greater protection to depressed stocks.

The project has been conducted in three distinct stages: an initial research phase to investigate potential sites, salmon stocks, and methodologies (Hirose et al. 1998); a second phase of expansion in Youngs Bay and introduction into areas of greatest potential as shown from the initial stage; and a final phase of establishment of terminal fisheries at full capacity at all acceptable sites (Miller et al. 2002). The final phase of the SAFE project is intended to establish select area fisheries at full capacity at all acceptable sites through adaptive management strategies. No site is currently rearing all species of fish at full capacity and several potential sites have not been thoroughly evaluated. Although expansion has been constrained somewhat by stock availability, limitations on funding will control progression into this third phase of the program.

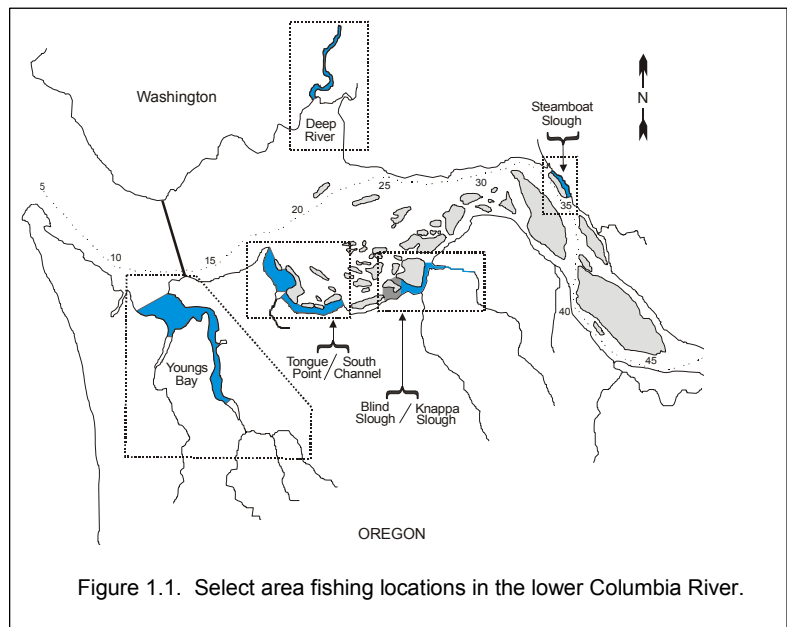
Impacts to listed stocks resulting from select area fisheries are covered under two separate Biological Opinions (BO) issued for mainstem Columbia River spring and fall fisheries (NMFS 2003a; NMFS 2003b). An updated Biological Assessment specific to harvest in SAFE fisheries was submitted to the National Oceanic and Atmospheric Administration (NOAA, formerly NMFS) in December 2003 and is currently under review. Hatchery production by the SAFE Project is currently covered in a separate BO issued in 1998 (NMFS 1998). The current BO is scheduled to be renewed in 2004 through the ongoing Hatchery Genetic Management Plan (HGMP) process. Existing and previous BO's have found the project does not likely jeopardize the continued existence of listed salmonid stocks in the Columbia River Basin.

The project was initially operated under the Final Environmental Assessment (EA) of Youngs Bay Salmon Rearing and Release Program (BPA 1993). In May 1994 BPA prepared a Categorical Exclusion to perform research activities to identify and evaluate potential sites for expansion of this program. In 1995, the BPA completed an EA for the SAFE Project and issued a Finding of No Significant Impacts (FONSI). An additional FONSI issued in 1998 by BPA was found to be adequate in 2002 when BPA reinitiated ESA consultation with NOAA regarding SAFE Project activities. This EA and FONSI remain valid as long as project activities remain unchanged. This report summarizes activities and results of the SAFE Project for the period Fall 1993-Spring 2004.

## SITE SELECTION

When the SAFE Project was initiated in 1993, eight potential sites were identified, surveyed, and classified with respect to rearing potential, access, capacity for fishers, and potential for impacts on stocks listed under the Endangered Species Act (ESA). Spring and fall test fishing programs were initiated to determine area, time, and gear parameters that would maximize harvest of targeted stocks. Physicochemical surveys and aquatic bio-monitoring were conducted from November 1994 through October 1996 at five sites in Oregon and three sites in Washington to establish baseline conditions and document differences between sites.

Based on this information four sites were selected in Oregon (Tongue Point, Blind Slough, Clifton Slough, and Wallace Slough), and three in Washington (Deep River, Steamboat Slough, and Cathlamet Channel), for consideration as terminal fishing areas. In addition the established Youngs Bay site was included for further expansion and Coal Creek Slough, Washington was given



further consideration. Based on available funds Youngs Bay, Tongue Point, Blind Slough, Deep River, and Steamboat Slough were selected for rearing and establishment of select area fisheries (Figure 1.1). Experimental releases of 1993 brood coho (*Oncorhynchus kisutch*) were conducted to determine each site's capability to successfully acclimate and imprint smolts based on recovery of coded-wire tags (CWT) from returning adults.

## FISHING SITES AND FACILITIES

The five SAFE net-pen rearing and fishing sites exist in the lower Columbia River (LCR) between river miles 10.0 and 35.0 (Figure 1.1). Currently, each site provides commercial and recreational fishing opportunities, although season structure and target species differ depending on current production goals and management objectives.

### Youngs Bay

Youngs Bay is located in Oregon waters adjacent to the city of Astoria and inland of the Highway 101 Bridge (Figure 1.2). The fishing area includes those waters of Youngs Bay from the new Highway 101 Bridge upstream to either the upper boundary markers at the confluence of the Klaskanine and Youngs rivers or Battle Creek Slough (depending on season): except for those waters which are closed southerly of the alternate Highway 101 Bridge (Lewis and Clark River). The upper fishing boundary is the confluence of Youngs and Klaskanine rivers for all fisheries except for the fall commercial fishery when the boundary is moved downstream to Battle Creek Slough to increase SAB fall chinook (*O. tshawytscha*) broodstock escapement. All waters in this site are under Oregon State jurisdiction with an Oregon landing permit required for participation.

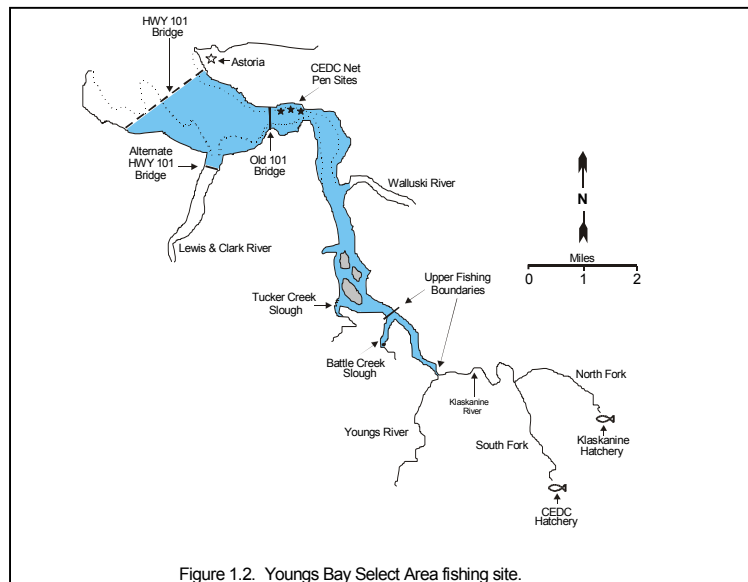


Figure 1.2. Youngs Bay Select Area fishing site.

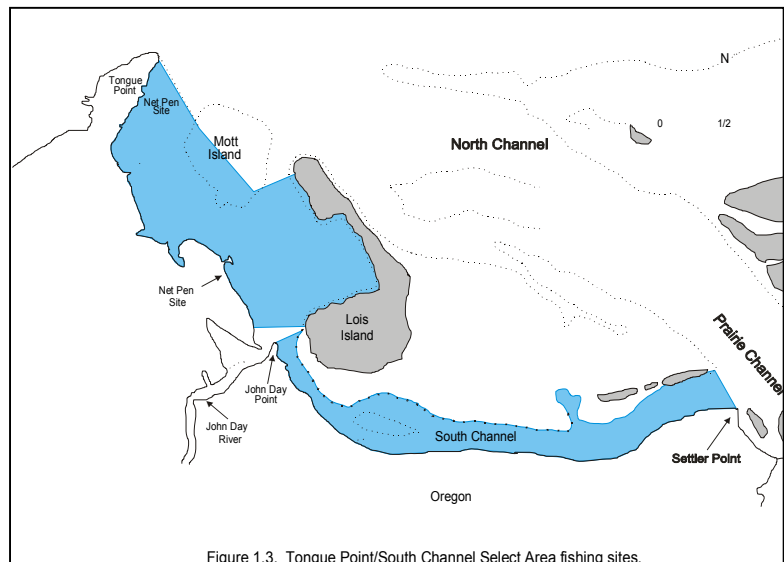


Figure 1.3. Tongue Point/South Channel Select Area fishing sites.

## Tongue Point/South Channel

Tongue Point Basin is located just east of Astoria, Oregon in the concurrent Columbia River waters bounded by the Oregon shore and Mott and Lois islands (Figure 1.3). The South Channel area extends easterly from the Tongue Point Basin along the Oregon shoreline to its confluence with Prairie Channel. The Tongue Point fishing area includes all waters bounded by a line from the red light at the tip of Tongue Point to the flashing green light “3” at the rock jetty on the northwesterly tip of Mott Island, a line from a marker at the south end of Mott Island easterly to a marker on the northwest bank on Lois Island, and a line from a marker on the southwest end of Lois Island due west to a marker on the Oregon shore at John Day Point. All waters are under concurrent jurisdiction and open to fishers from both states. The South Channel area includes all waters bounded by a line from a marker on John Day Point through the green navigation buoy “7” north to a marker on the southwest end of Lois Island, upstream to an upper boundary line from a marker on Settler Point northwesterly to the flashing red marker “10”, then northwest to a marker on Burnside Island defining the terminus of South Channel. All waters in this site are under concurrent state jurisdiction.

## Blind Slough/Knappa Slough

Blind Slough is located near Brownsmead, Oregon and encompasses the lower reaches of Gnat Creek to its confluence with Knappa Slough, which then extends downstream to its confluence with Prairie Channel at the west end of Minaker Island, including Big Creek and Calendar sloughs (Figure 1.4). The Blind Slough fishing area is approximately 2.5 miles long and includes all waters from markers at the mouth of Gnat Creek

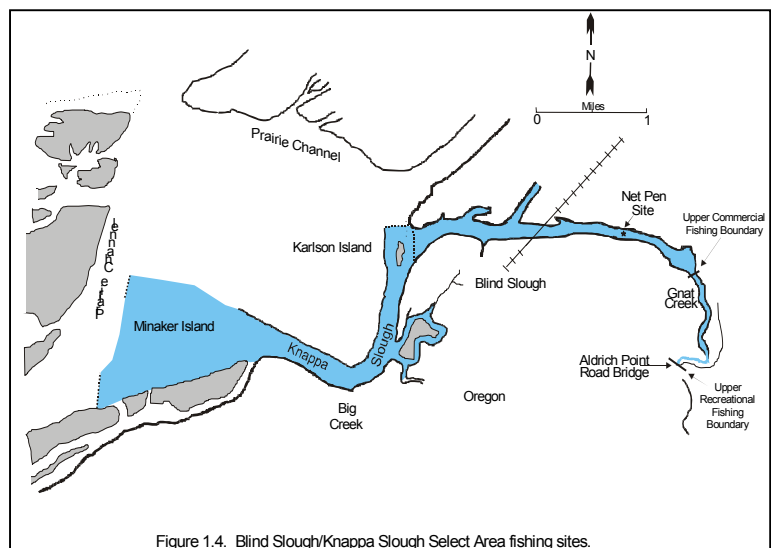


Figure 1.4. Blind Slough/Knappa Slough Select Area fishing sites.

located approximately ½ mile upstream of the county road bridge, downstream to markers at the mouth of Blind Slough. Concurrent waters extend downstream of the railroad bridge. Oregon State waters extend upstream of the railroad bridge. The Knappa Slough fishing area includes all waters bounded by a line from the northernmost marker at the mouth of Blind Slough, westerly to a marker on Karlson Island, downstream to boundary lines defined by markers on the western end of Minaker Island to markers on Karlson Island and the Oregon shore. An area closure of about 100' radius at the mouth of Big Creek is defined by markers. All waters in this site are under concurrent state jurisdiction.

## Deep River

The Deep River fishing site is located within the lower reaches of Deep River near the town of Deep River, Washington and extends downstream to its confluence with the Columbia River in Grays Bay (Figure 1.5). The fishing area includes all waters downstream of the town of Deep River to the mouth (a line from navigation marker "16" southwest to a marker on the Washington shore). Washington State waters extend upstream of the Highway 4 bridge and concurrent state waters extend downstream.

## Steamboat Slough

Steamboat Slough is a side-channel area just east of the town of Skamokawa, Washington and is bounded by the Washington shoreline and Price Island (Figure 1.6). The Steamboat Slough fishing area includes all waters bounded by markers located on Price Island and the Washington shore at both ends of Steamboat Slough. All waters in this site are under concurrent state jurisdiction.

Hatcheries providing production are for these sites are South Fork Klaskanine (CEDC); Big Creek, Bonneville, Cascade, Gnat Creek, Klaskanine, Oxbow, Sandy, and Willamette (all ODFW); Cowlitz, Elochoman, Lewis, and Gray's River (all WDFW); and Eagle Creek (U. S. Fish and Wildlife Service; USFWS). The SAFE project fully funds Gnat Creek and Grays River hatcheries and partially funds Klaskanine Hatchery. A summary of each facility's association with the SAFE project is provided in Table 1.1.

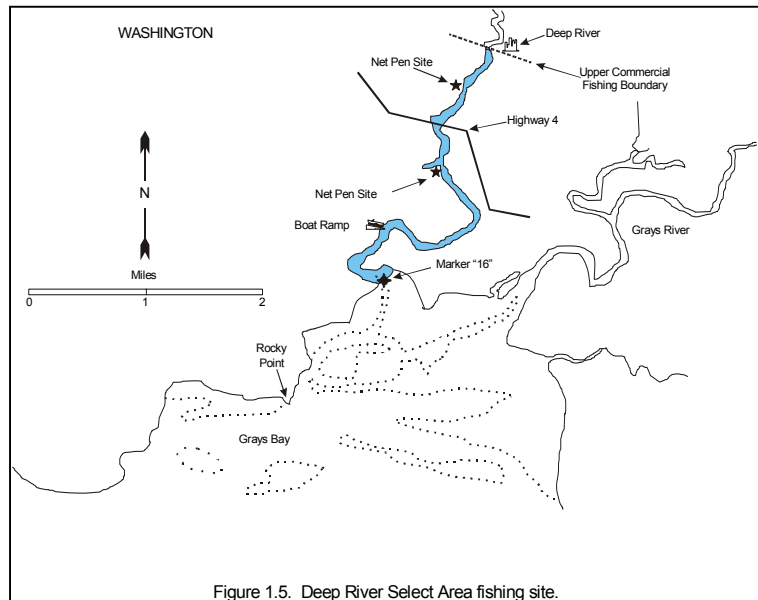


Figure 1.5. Deep River Select Area fishing site.

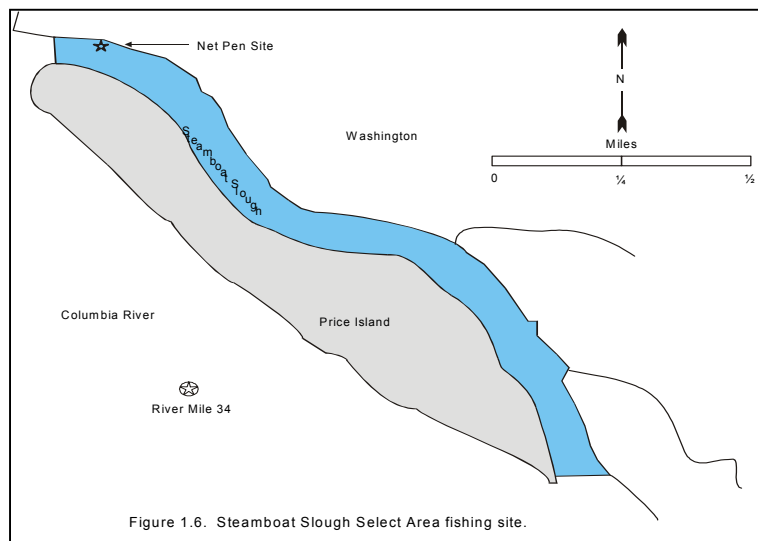


Figure 1.6. Steamboat Slough Select Area fishing site.

The net-pen rearing complex at each site consists of 2-4 individual 6.1-m<sup>2</sup> inside dimension frames of high-density polyethylene pipe (33 cm o.d.) filled with styrofoam

(Figure 1.7). A wooden walkway of 2" x 12" lumber is bolted to the plastic frame for access. A 3.1-m deep net hung within each frame confines the fish during rearing and acclimation. Mesh sizes of 3.2-19.0 mm (0.125-0.750") are utilized and adjusted depending on fish size. Vertical plastic standpipes are submerged around the perimeter of each pen to maintain the shape of the net. Actual rearing area of each net is approximately 91 m<sup>3</sup> (3,200 ft<sup>3</sup>).

There are currently 76 pens at Youngs Bay, 37 at Tongue Point, 15 at Blind Slough, 36 in Deep River, and 16 at Steamboat Slough. Fish are grown and released from these pens under varying management and grow-out regimes including two-week acclimation, over-winter, and full-term net-pen rearing.

## LISTED ANADROMOUS SPECIES

A total of 12 salmonid evolutionarily significant units (ESU's) listed under the federal ESA occur near, and occasionally in, the project area (Table 1.2). Lower Columbia River coho salmon were designated as a federal candidate species in 1995 and have recently been proposed for federal threatened species status (NOAA 2004). Naturally-produced coho salmon destined for tributaries downstream of Bonneville Dam are listed as a threatened species by the State of Oregon. Incidental take of listed stocks in select area



Figure 1.7. Net pens at the Youngs Bay Yacht Club site.

fisheries is included in biological assessments and opinions adopted for mainstem Columbia River fisheries. All winter, spring, and summer select area fisheries are established in accordance with the Willamette Fish Management and Evaluation Plan (ODFW 2000). The project has regularly been evaluated for its impact on endangered species resulting from juvenile production and harvest (NMFS 1998; NMFS 2003a; NMFS 2003b).

As a note of explanation, annual releases from Deep River net pens are generally the latest each year due to the need to minimize interactions of hatchery stocks with ESA-listed chum salmon (*Oncorhynchus keta*) that spawn in this system. Stream surveys are conducted each year to determine when chum juveniles have emigrated from the Deep River/Grays River system, at which time fish are released from both the net pens and Grays River Hatchery.

Table 1.1. Summary of salmonid<sup>a</sup> production facilities associated with the select area fisheries project, 1993-2003.

Hatchery	Agency	Early Rearing				Direct Release		
		COH	CHS	SAB	URB	COH	CHS	SAB
Oregon								
Big Creek	ODFW	X		X		X		X
Bonneville	ODFW	X			X			
Cascade	ODFW	X						
Eagle Creek	USFWS	X						
Gnat Creek	ODFW		X					
Klaskanine River	ODFW			X				X
Oxbow	ODFW	X						
Sandy River	ODFW	X						
S. Fork Klaskanine	CEDC	X				X	X	
Willamette	ODFW		X					
Washington								
Cowlitz River	WDFW		X					
Lewis River	WDFW		X					
Elochoman River	WDFW	X						
Grays River	WDFW	X				X		

<sup>a</sup> Coho (COH); spring chinook (CHS); select area bright (SAB) fall chinook (Rogue River stock); upriver bright fall chinook (URB)

<sup>b</sup> Discontinued in 2004

Table 1.2. Federally-listed salmonid evolutionarily significant units (ESU's) in the Columbia River Basin.

ESU	Designation	Effective Date
Sockeye		
Snake River	Endangered	December 20, 1991
Chinook		
Snake River fall	Threatened	May 22, 1992
Snake River spring/summer	Threatened	May 22, 1992
Upper Columbia River spring	Endangered	May 24, 1999
Lower Columbia River spring/fall	Threatened	May 24, 1999
Upper Willamette spring	Threatened	May 24, 1999
Chum		
Lower Columbia River	Threatened	May 24, 1999
Coho		
Lower Columbia River	Candidate <sup>a</sup>	July 25, 1995
Steelhead		
Snake River	Threatened	October 17, 1997
Upper Columbia River	Endangered	October 17, 1997
Middle Columbia River	Threatened	May 24, 1999
Lower Columbia River	Threatened	May 18, 1998
Upper Willamette River	Threatened	May 24, 1999

<sup>a</sup> Proposed for threatened status June 14, 2004

## **2. REARING AND RELEASE OF ANADROMOUS FISH STOCKS FROM SELECT AREA FACILITIES**

Selection of salmonid stocks used for select area fisheries has been based on flesh quality, availability of eggs, homing ability, and overall value to the economy. To date, stocks evaluated in SAFE rearing programs have included early stock coho; select area bright (SAB) fall chinook; upriver bright (URB) fall chinook, and lower river spring chinook. Annual releases of SAFE salmonids from 1993-2004 have ranged from 3.5-5.9 million fish, comprised of approximately 2.0-4.2 million coho, 0.1-1.4 million SAB fall chinook, 0.1-0.6 million URB fall chinook, and 0.4-1.8 million spring chinook (Figure 2.1).

Salmonid species currently being reared and released from select area sites include spring chinook, SAB fall chinook, and early stock coho. Currently source stocks of spring chinook are obtained from the Willamette River for Oregon select areas and the Cowlitz or Lewis rivers for Washington select areas. The SAB fall chinook stock originated from Rogue River stock egg transfers but is currently supported by a local broodstock program established at Klaskanine Hatchery in 1996. Early-stock coho released from Oregon select areas currently originate from Bonneville, Eagle Creek or Sandy hatcheries while Washington coho releases currently originate from either Grays or Elochoman hatcheries.

### **SPRING CHINOOK**

Willamette River stock spring chinook were first released from Youngs Bay in 1989 (1988 brood). Releases have continued annually at this site with the exception of 1993 when rearing strategies shifted from sub-yearling (0+) to yearling (1+) release patterns. Experimental releases from CEDC's South Fork Klaskanine facility ended with the 1995 brood, due to generally poor returns, most likely due to high levels of bacterial kidney disease (BKD). Initiation of the SAFE project provided opportunities to expand the program, and releases from Youngs Bay net pens were increased in 1995. Releases for site comparison at Tongue Point and Blind Slough began in 1996 (1994 brood), and beginning with the 1996 brood, WDFW started releasing Cowlitz River stock spring chinook from the Deep River site, adding Lewis River stock beginning with the 2001 brood.

Releases of spring chinook reared on an experimental winter dormancy feeding regime were added in 1997 through collaborative research with NOAA. Since 2002 (2000 brood) NOAA has conducted additional research of release timing/ocean entry at Blind Slough. Releases of spring chinook increased significantly in 2004 (2002 brood) with production at the South Fork Klaskanine Hatchery transitioning from coho to spring chinook. Beginning with the 1998 brood, all releases of spring chinook from select areas have been mass marked by removing the adipose fin (AD).

Similar to coho, net-pen rearing of spring chinook is generally limited to over-wintering and two-week acclimation strategies due to elevated summer water temperatures,

although some small-scale over-summer experiments are currently being conducted to determine if production can be increased in the net pens with that strategy. In Oregon, eggs are collected at Willamette Basin hatcheries and transferred to Gnat Creek Hatchery for incubation, early rearing, mass marking, and coded-wire tagging. Eggs for the Deep River site are collected at Cowlitz and Lewis Hatcheries and transferred to Grays River Hatchery for incubation, early rearing, mass marking, and coded-wire tagging. Fingerlings are transported from the hatcheries to the net pens in Youngs Bay, Tongue Point, Blind Slough, and Deep River during the fall. The fingerlings are generally fed BioDiet Grower™ three days per week at recommended levels during the rearing period. Target release size is 12 fish/pound, which is typically achieved in March or April, depending on feeding regimes and winter water temperatures. Winter dormancy feeding regimes, with little or no feeding from mid-December through January, have been conducted at Youngs Bay and Deep River (1999-2000 broods). Time of release has also been evaluated, with comparative February, March, and April releases (see Chapter 6). Two and four-week acclimation strategies have also been tested at both Blind Slough and Youngs Bay.

Due to straying of spring chinook reared at the Tongue Point site, releases there were discontinued after 2000 (1998 brood). However, an enhanced homing experiment using the chemical morpholine with small-scale releases has been conducted at that site, beginning with the 2001 brood (see Chapter 6)

It should be noted that the overall quality of the spring chinook released improved dramatically beginning with the 1996 brood, when hatcheries in the Willamette system began culling BKD-positive adults from the broodstock.

The following information details year-specific rearing activities for 1999-2001 brood years. Similar information is available for 1993-1995 broods in Hirose et al. (1998); and for 1996-1998 in Miller et al. (2002).

### **1999 Brood Spring Chinook**

The Oregon portion of the 1999 brood spring chinook was obtained from Willamette Hatchery, with about 850,000 eyed eggs transferred to Gnat Creek Hatchery. Early rearing, mass marking and coded-wire tagging occurred at Gnat Creek. Fingerlings were transferred to select area net pens in the fall of 2000. Due to homing concerns, the decision was made to discontinue releases from Tongue Point. However, when Gnat Creek Hatchery began to experience low flow conditions in September, 105,499 fish at 37 fish/pound were transferred to Tongue Point instead of Blind Slough as scheduled, because the Blind Slough water temperatures were considered too high. These fish were later transferred to Blind Slough in November when water temperatures decreased. Also, Youngs Bay received 131,242 fingerlings at 44 fish/pound in September, again to relieve concerns about low water flows at Gnat Creek. On October 30, 2000 the balance of the Youngs Bay fish were transferred (409,083 at 25 fish/pound). Blind Slough received 152,655 fish at 31 fish/pound on October 6, and the balance was transferred from Tongue Point, as stated above, in late November.

At Blind Slough there were three tag groups; one to be released March 1 at 12 fish/pound, one to be fed normally and released April 1 at 12 fish/pound, and the third to be put on a modified winter dormancy feeding regime and released April 1 at 12 fish/pound. The modified winter dormancy schedule included no feeding from mid-December until mid-January, then once per week until February 2 when the normal three days per week feeding resumed. At Youngs Bay there were four tag groups; two groups to be released March 1 at 12 fish/pound, one group to be fed on a normal schedule and released April 1 at 12 fish/pound, and one group to be put on the same modified winter dormancy feeding regime mentioned above and released April 1 at 12 fish/pound. In addition to the over-winter groups, two 2-week acclimation tag groups totaling 52,917 were transferred to the Blind Slough net pens on March 11, 2001; one normally fed and the other on winter dormancy feeding while at Gnat Creek Hatchery. Also, two acclimation tag groups totaling 54,772 were transferred to Youngs Bay from Gnat Creek on March 11; one was a 2-week acclimation group and the other was a 4-week acclimation group.

The Blind Slough over-winter fish that were temporarily reared at Tongue Point were treated for vibriosis with 1.7 percent Romet 30 for 15 days before transfer to Blind Slough. Losses to disease were minimal at Blind Slough, but some significant losses to otter predation were incurred. In Youngs Bay there was a significant outbreak of vibriosis in the fish that were received early, and they were treated with 1.7 percent Romet 30 for 15 days. The fish received on October 30 also received the same 15-day treatment for vibriosis. In February, the March 1 release group in Youngs Bay was treated for furunculosis with 1.7 percent Romet 30 for 10 days. Losses to disease in all groups were kept to a minimum with these treatments and no further outbreaks occurred. Dates, number, and fish size of each release are provided in Table 2.1.

In Washington spring chinook rearing was initiated with limited releases with the 1996 brood. Beginning with the 1999 brood full size releases were initiated, and experiments were conducted with winter dormancy and continued through two broods. Federal regulations restricted release of spring chinook to after May 1, causing considerable BKD problems for those fish being held in warm waters for that length of time.

### **2000 Brood Spring Chinook**

Gnat Creek Hatchery again received the Oregon portion of the 2000 brood spring chinook as eyed eggs from Willamette Hatchery (~850,000). Early rearing, mass marking and coded-wire tagging occurred at Gnat Creek. Because of the past problems of disease, these fish were vaccinated for vibriosis and enteric redmouth while at Gnat Creek, and in the fall of 2001 the fingerlings were transferred to the select area net pens. Blind Slough received 332,541 at 38 fish/pound on September 17; again early because of low water flow concerns at Gnat Creek. Youngs Bay received 427,872 at 31 fish/pound on October 1; also earlier than planned because of continued low water flows at Gnat Creek.

At Blind Slough there were two tag groups; one to be fed normally, and the other fed with the experimental subsurface feeding technique that had previously been tested on SAB fall chinook. The subsurface feeding began while the fish were at Gnat Creek, after coded-wire tagging was completed. In Youngs Bay there were two tag groups; one normally fed and released April 1 at 12 fish/pound, and the other put on a modified winter dormancy regime and released April 1 at 12 fish/pound. The modified winter dormancy schedule was one day each week feeding from December 17 until February 4, and then normal three days per week feeding resumed. In addition to the over-winter groups, two acclimation tag groups totaling 53,133 were transferred to Youngs Bay from Gnat Creek on March 12, 2002; a 2-week and 4-week acclimation.

Blind Slough fish suffered from a significant outbreak of columnaris, most likely a result of being transferred in September when water temperatures were still high (above 60°F). Both tag groups were treated with 2% TM-100 for 14 days. Losses were substantial (~20%), but diminished after treatment. The subsurface group was fed normally during treatment to make sure all fish received medication. In early March both tag groups were diagnosed with furunculosis and received a 10-day treatment with 1.7% Romet 30. Again, to treat more effectively, the subsurface group was fed normally, and because of observed size disparity in those fish, the decision was made to discontinue the subsurface feeding strategy. Both tag groups also experienced significant otter predation losses. In Youngs Bay both tag groups were treated for furunculosis with 1.7% Romet 30 for 10 days, after which losses were minimal. Dates, numbers, and fish sizes for each release group are provided in Table 2.1

### **2001 Brood Spring Chinook**

Because of 2001 spring chinook broodstock shortages at Willamette Hatchery, Gnat Creek Hatchery received ~850,000 eyed eggs from South Santiam and Clackamas Hatcheries. As a possible method to expand select area spring chinook production, the decision was made to experiment with over-summer net-pen rearing of fingerlings. On June 13, 2002 approximately 20,000 spring chinook fingerlings at 129 fish/pound were transferred to two sites; 10,000 to Youngs Bay and 10,000 to the new site in Tongue Point at the Marine and Environmental Research and Training Station (MERTS) dock. These fish were mass marked and vaccinated for vibriosis and furunculosis while at Gnat Creek Hatchery. The rest of the spring chinook fingerlings were transferred to select area net pens in the fall of 2002. In hopes of re-establishing spring chinook production at Tongue Point, the decision was made to evaluate the use of morpholine as a homing enhancer, and 26,300 fingerlings at 24 fish/pound were transferred to the MERTS site on October 21. Blind Slough received 306,589 fish at 23 fish/pound, and Youngs Bay received 447,091 fish at 27 fish/pound.

At Blind Slough there was one tag group fed normally and released April 1 at 12 fish/pound. At Tongue Point one tag group was added to the over-summer fish at the MERTS site to be exposed to a morpholine drip for a time prior to release on April 1 at 12 fish/pound. In Youngs Bay there were three tag groups; one fed normally and released April 1 at 12 fish/pound, one put on a modified winter dormancy feeding

regime (one day per week feeding from mid-December to February 1), and the third group to be fed subsurface for one month prior to release. In addition to the over-winter groups above one acclimation tag group was transferred to a new net-pen site on the John Day River, a tributary of the Columbia River near the MERTS site. Approximately 27,000 fish at 12.4 fish/pound were transferred from Gnat Creek Hatchery to the John Day site on March 10, 2003. All other acclimation groups were discontinued to avoid the cost of additional coded-wire tagging.

The over-summer spring chinook reared at the MERTS site had to be treated several times for columnaris, and also suffered severe losses to otter predation. The over-summer spring chinook at Youngs Bay fared better, but needed to be treated for vibriosis twice despite being vaccinated. Over-winter groups at all sites were treated for furunculosis with 1.7 percent Romet 30 for 10 days in February. The Blind Slough fish suffered chronic low-level losses to BKD, but overall losses to disease were minimal. Dates, numbers, and fish sizes of each release group are provided in Table 2.1.

In Washington at Deep River, 141,904 spring chinook were released. Winter dormancy experiments were discontinued and replaced with comparisons of releases from Cowlitz and Lewis River hatcheries. BKD problems continued and experiments were initiated to determine a release strategy that would allow for earlier liberations.

## **SELECT AREA BRIGHT FALL CHINOOK**

The SAB fall chinook stock used in the select areas originated from Rogue River stock egg transfers to Big Creek Hatchery in 1982, and to CEDC's South Fork Klaskanine Hatchery in 1983, with a goal of providing a higher quality fall chinook for harvest in LCR fisheries. The brood stock was maintained at Big Creek Hatchery through 1995. Fishery enhancement efforts in Youngs Bay began with releases from the South Fork Klaskanine Hatchery in 1983 and expanded to include net-pen releases in 1989. Releases from the South Fork Klaskanine were discontinued in 1988 due to generally poor survival, but net-pen releases have continued annually.

Beginning with the 1996 brood, the SAB brood stock program (funded by ODFW's Restoration and Enhancement program) was relocated to ODFW's Klaskanine Hatchery to address the problem of excessive straying (10-33 percent) from Big Creek Hatchery releases. Likewise, straying was documented from experimental releases at Tongue Point, so SAB net-pen releases have been restricted to Youngs Bay since 1998 (1997 brood). With the exception of the 1986-1989 broods, all SAB fall chinook released from select areas have been marked by removal of the left ventral (LV) fin to facilitate external identification. Time of release, rearing density, and sub-surface feeding experiments have been conducted in recent years, and results are being evaluated (see Chapter 6)

A variety of production strategies are currently utilized for SAB fall chinook to achieve a target production goal of 2.25 million smolts. To maintain the broodstock program, approximately 700,000 fish are reared to ~30 fish/pound at Big Creek Hatchery and

then transferred to Klaskanine Hatchery for acclimation prior to release at ~15-30 fish/pound with funding provided by ODFW's Restoration and Enhancement Program. An additional 800,000 fish are reared to 60 fish/pound at Big Creek Hatchery then transferred to the net pens in Youngs Bay for rearing to a target size of 20 fish/pound. If adult returns are sufficient, an additional 800,000 eggs (750,000 smolts) are collected at Klaskanine Hatchery and incubated at the South Fork Hatchery. These fish are then reared full-term in the net pens, from button-up fry through smoltification. Fry are usually transferred to the pens in February or March at about 1,000 fish/pound, vaccinated for vibriosis, mass marked (LV) and coded-wire tagged beginning in April, and reared until release in July or August at a target release size of 15 fish/pound. The fish are fed BioDiet Grower™ daily at recommended levels until release.

The following information details year-specific rearing activities for 2000-2002 brood years. Similar information is available for 1994-1995 broods in Hirose et al. (1998); and for 1996-1999 broods in Miller et al. (2002).

### 2000 Brood SAB Fall Chinook

2000 SAB fall chinook broodstock were collected at both Big Creek and Klaskanine Hatcheries. Some early returning adults were collected at Big Creek and Klaskanine and transferred to holding pens in Youngs Bay. Spawning took place in October, and enough eggs (~750,000) for Klaskanine broodstock releases were incubated at Big Creek Hatchery (Figure 2.2). Eggs in excess of the broodstock production goal were incubated at the CEDC South Fork Klaskanine Hatchery. Ponding of fry began February 11, 2001, and by the end of March about 240,000 fry were in the Youngs Bay net pens. Mass marking (LV clip) and coded-wire tagging occurred from May 8 to May 16 at Youngs Bay.

Approximately 100,000 fish were designated for funding by BPA, with the remaining production funded by ODFW's Restoration and Enhancement program (R&E). Four study groups of about 25,000 fish each were differentially coded-wire tagged to evaluate subsurface versus surface feeding in densities of 0.25 lbs/cu.ft. and 0.50 lbs/cu.ft.



Figure 2.2. Spawning select area bright fall chinook at ODFW's North Fork Klaskanine Hatchery.

Before and during tagging, the fish were treated for vibriosis with two percent TM 100 for 12 days. Losses dropped to near zero, and all study groups were vaccinated for vibriosis on May 22. Mortality increased shortly after vaccination, so another course of two percent and four percent TM 100 was administered from May 26 to June 4. From that time until release, losses were minimal. All groups were released on July 4 when water temperatures reached and stayed at 65°F and higher. Dates, numbers, and fish sizes for each study group at release are provided in Table 2.2.

### **2001 Brood SAB Fall Chinook**

Broodstock for the 2001 SAB fall chinook were again collected at Big Creek and Klaskanine Hatcheries. Some early returning adults were also held in net pens in Youngs Bay. Eggs were taken at all three sites, with about 750,000 eggs incubated at Big Creek for broodstock release needs, and an additional 500,000 incubated at the CEDC South Fork Klaskanine Hatchery. Ponding of fry into the Youngs Bay net pens occurred between February 12 and March 20. The fry were vaccinated for vibriosis prior to mass marking (LV clip) and coded-wire tagging, which took place from April 23 to May 13.

Approximately 300,000 fish were designated as BPA study fish, again with four tag groups. The 0.50 lbs/cu.ft. surface-fed group had about 125,000 fish; the 0.50 lbs/cu.ft. subsurface group had about 25,000 fish; the 0.25 lbs/cu.ft. surface-fed group had about 125,000 fish; and the 0.25 lbs/cu.ft. subsurface group had about 25,000 fish. The balance of the net-pen production (~165,000 fish) was funded by ODFW's R&E program.

During tagging, mortality in the pens increased, and the fish were treated for vibriosis with 0.86 percent Romet 30 for 10 days beginning May 7. After treatment all study groups had minimal losses to disease. All groups were released on July 2 when water temperatures reached or exceeded 65 °F. Dates, numbers, and fish sizes of each study groups at release are provided in Table 2.2.

### **2002 Brood SAB Fall Chinook**

Almost all of the broodstock for the 2002 SAB fall chinook production were collected at Klaskanine Hatchery. All eggs were incubated at Big Creek Hatchery, and on February 12, 2003 approximately 416,000 fry designated for the BPA study were transferred to the Youngs Bay net pens. An additional 400,000 fry were reared at Big Creek and transferred to the Youngs Bay net pens in June. These fish were funded by ODFW's R&E program.

On April 14 the fish were vaccinated for vibriosis at a size of about 200 fish/pound. Mass marking (LV clip) and coded-wire tagging began April 22 and concluded May 6. As a result of budget limitations and pending results of the density and subsurface feeding experiments, there was only one BPA-funded tag group. That group was fed normally and reared at a release density of 0.50 lbs/cu.ft.

Again, despite being vaccinated, the fish began to experience an outbreak of vibriosis during tagging and were treated with 0.86 percent Romet 30 for 5 days. After treatment losses were low to moderate. With adult return data suggesting higher survival for larger smolts, the decision was made to hold the BPA study fish as long as possible, until Youngs Bay water temperatures reached 70°F. The BPA study group was released on July 24, while the smaller R&E-funded fish were released on August 7. Dates, numbers, and fish sizes of each study group at release are provided on Table 2.2.

## **UPRIVER BRIGHT CHINOOK**

Beginning in 1995 the Pacific States Marine Fisheries Commission (PSMFC) provided funding to examine the suitability of URB fall chinook for use in the SAFE program. In brood years 1994-1997, approximately 200,000 fingerlings annually were transferred to select area sites (Youngs Bay and Tongue Point). Additionally, due to a shortfall of SAB fall chinook, about 400,000 (1997 brood) fingerlings were reared at Big Creek Hatchery and later transferred to the Youngs Bay net pens with funding from ODFW's Restoration and Enhancement program.

Warm water temperatures and disease problems, primarily bacterial gill disease (BGD) and furunculosis plagued these releases, and overall poor survival rates led to abandoning any further attempts at rearing this stock. Rearing information for 1996-1997 brood years is available in Miller et al. (2002). Annual releases are shown in Table 2.3.

## **COHO**

Releases of coho by CEDC have occurred in Youngs Bay since 1977 and were continued by the SAFE project since its inception in 1993. Releases were initiated in the new SAFE sites at Tongue Point, Blind Slough, and Deep River beginning with the 1993 brood. Steamboat Slough releases were initiated beginning with the 1997 brood. Approximately 1.5 million additional coho were released annually from the North Fork Klaskanine Hatchery until 1996 when production at this facility switched to SAB fall chinook.

Similar to spring chinook, coho are best suited for over-wintering or two-week acclimation. Rearing coho full term in the net pens is challenging because of elevated summer water temperatures in the estuary. Juveniles for over-winter rearing are generally transferred from Oxbow, Cascade, Elochoman, and Grays River hatcheries to the select area sites in October or November. Mass marking (AD) and coded-wire tagging are completed before transfer. The fish are received at approximately 25 fish/pound, fed recommended levels of BioDry 1000™ three days per week, and released in April-May at about 10 fish/pound. The two-week acclimation fish are transferred from ODFW's Sandy Hatchery to Blind Slough, and from Eagle Creek National Fish Hatchery to Youngs Bay and Tongue Point. The acclimation coho are

usually received in April at approximately 15 fish/pound and held for a minimum of 14 days prior to release to allow for imprinting.

For three years beginning with the 1999 brood, an avian avoidance experiment was conducted with SAFE coho in Youngs Bay. Each year one tag group was towed into the mainstem Columbia River and released in hopes of reducing losses to cormorant and tern predation. Results of this experiment are currently being evaluated and may influence future release strategies.

The following information details year-specific rearing activities for 1999-2001 brood years. Similar information is available for 1993-1995 broods in Hirose et al. (1998); and for 1996-1998 in Miller et al. (2002).

### **1999 Brood Coho**

In October of 2000 the Oregon select area sites received 1999 brood coho fingerlings from ODFW's Oxbow Hatchery. Tongue Point received 202,869 fish at 27 fish/pound (one tag group), and Youngs Bay received 473,426 at about 28 fish/pound (two tag groups). The extra tag code at Youngs Bay was applied to an experimental group of fish that was to be towed into the mainstem Columbia River at the time of release (see avian predation studies). Because of increased spring chinook production at Blind Slough, the over-winter group of BPA-funded coho at that site was replaced with acclimation coho from ODFW's Sandy Hatchery.

With all production of Grays River Hatchery dedicated to Washington SAFE sites, coho eggs were readily available. Hatchery goals of 150,000 broodstock and 200,000 coho for each net-pen site were established. As production needs increased, additional eggs were obtained from regional hatcheries. With the 1999 brood, increased spring chinook production at Deep River resulted in coho reductions by 150,000 fish. At Steamboat Slough 209,966 coho were released, and at Deep River 395,337 were released.

None of the BPA study groups received any treatment for disease, although some chronic low-level losses to BKD occurred. Dates, numbers, and fish sizes for each group are provided in Table 2.4.

### **2000 Brood Coho**

In November of 2001 the Oregon select area sites received 2000 brood coho fingerlings from ODFW's Oxbow Hatchery. Tongue Point received 180,258 fish at 34 fish/pound (one tag group), and Youngs Bay received 371,878 fish at 38 fish/pound (two tag groups). This was the second year of the avian predation study at Youngs Bay. All groups received were in the middle of a 28-day treatment for BKD with 4.5 percent Aquamycin, so the fish were given medicated feed daily for 15 days after transfer to the net pens. Losses to disease were minimal while in the net pens and no further treatments were necessary. Dates, numbers, and fish sizes of each release group are provided in Table 2.4.

In Washington a total of 354,557 coho were released at Deep River, and 158,598 at Steamboat Slough (Table 2.4).

### **2001 Brood Coho**

As in previous years, the Oregon select area sites received coho fingerlings from ODFW's Oxbow Hatchery in October of 2002. Tongue Point received 198,078 fish at 35 fish/pound (one tag group) and Youngs Bay received 408,918 fish at 37 fish/pound (two tag groups). This was the third year of the avian predation study at Youngs Bay (see Chapter 6).

The Youngs Bay study groups were treated for vibriosis with 1.7 percent Romet 30 for 10 days beginning October 23, after which losses were minimal. The Tongue Point fish received no treatments, and losses to disease were insignificant. Dates, numbers, and fish sizes of each release group are provided in Table 2.4

Coho were released at the following levels from Washington net pens: 236,890 at upper Deep River, 129,545 at lower Deep River and 239,635 at Steamboat Slough. Experiments continued relative to the addition of spring chinook at the lower Deep River site, and the possibility of releasing Deep River fish at an earlier time to reduce disease and predator mortality.

Table 2.1. Releases of spring chinook from lower Columbia River select area facilities, 1993-2002 brood years.

Brood Year	Release Date	Release Site <sup>a</sup>	Number Released	Number of CWT's	Tag Code <sup>b</sup>	Release Size #/lb	Funding Agency <sup>c</sup> and Study
1993	2/7/95	SFK	86,978	51,829	07-03-51	14.4	BPA
	2/9/95	YB	79,336	39,519	07-03-45	12.1	BPA / Feb release
	3/7/95	YB	156,519	52,446	07-03-43	8.1	BPA / Mar release
	3/30/95	YB	127,367	52,224	07-03-44	7.4	BPA / Apr release
			<b>450,200</b>	<b>196,018</b>			
1994	1/31/96	SFK	76,618	52,205	07-11-19	14.7	BPA
	2/5/96	TG	100,138	52,119	07-12-38	10.1	BPA / Feb release
	2/29/96	TG	142,181	48,281	07-12-36	10.8	BPA / Mar release
	2/29/96	BS	199,389	52,369	07-12-37	9.9	BPA / Mar release
	2/5/96	YB	142,976	53,685	07-11-21	11.9	BPA / Feb release
	2/29/96	YB	133,517	51,909	07-11-22	10.7	BPA / Mar release
	3/21/96	YB	97,945	41,085	07-11-20	10.0	BPA / Apr release
			<b>892,764</b>	<b>351,653</b>			
1995	2/1/97	YB	100,680	49,944	09-17-37	18.1	BPA / Feb release
	3/5/97	YB	96,540	49,341	09-17-38	15.2	BPA / Mar release
	4/4/97	YB	95,396	50,208	09-17-39	14.6	BPA / normal
	4/4/97	YB	94,612	50,139	09-17-40	12.7	BPA / dormancy
	3/4/97	SFK	76,821	25,149	07-13-37	15.9	BPA
	3/5/97	BS	171,229	58,002	09-17-16	15.2	BPA / Mar release
	3/5/97	TG	151,905	51,461	09-17-17	16.6	BPA / Mar release
	4/4/97	TG	149,889	50,309	09-17-18	14.6	BPA / Apr release
			<b>937,072</b>	<b>384,553</b>			
1996	3/3/98	YB	149,878	50,865	09-22-16	11.6	BPA / Mar release
	4/1/98	YB	153,265	47,147	09-22-14	12.0	BPA / dormancy
	4/1/98	YB	153,139	49,392	09-22-15	9.6	BPA / normal
	3/3/98	TG	128,314	46,710	09-22-18	13.8	BPA / Mar release
	4/1/98	TG	125,456	43,987	09-22-19	13.6	BPA / dormancy
	3/3/98	BS	198,034	44,452	09-22-17	12.6	BPA / Mar release
	4/1/98	BS	25,284	24,203	09-20-35	9.6	BPA / acc/normal
	4/1/98	BS	25,396	23,319	09-20-36	11.6	BPA / acc/dorm.
	4/22/98	DR	56,414	56,414	63-61-15	5.1	BPA
			<b>1,015,180</b>	<b>386,489</b>			
1997	3/4/99	YB	165,298	24,415	09-25-34	13.2	BPA / Mar release
	4/1/99	YB	158,574	24,253	09-25-33	11.9	BPA / dormancy
	4/1/99	YB	102,546	23,566	09-25-36	8.2	BPA / normal
	3/3/99	TG	118,291	23,782	09-25-32	10.0	BPA / Mar release
	4/1/99	TG	105,986	21,637	09-25-35	8.9	BPA / dormancy
	3/3/99	BS	148,881	24,644	09-25-30	14.0	BPA / Mar release
	4/1/99	BS	25,553	25,544	09-25-31	11.0	BPA / acc/dorm.

continued

Table 2.1. (continued). Releases of spring chinook from lower Columbia River select area facilities, 1993-2002 brood years.

Brood Year	Release Date	Release Site <sup>a</sup>	Number Released	Number of CWT's	Tag Code <sup>b</sup>	Release Size #/lb	Funding Agency <sup>c</sup> and Study
1997	4/1/99	BS	25,573	25,560	09-25-37	10.0	BPA /acc/normal
	5/13/99	DR	25,205	24,856	63-05-11	6.8	BPA
	5/13/99	DR	14,473	14,106	63-06-52	6.4	BPA
			<b>890,380</b>	<b>232,363</b>			
1998	3/1/00	YB	128,656	27,420	09-28-47	15.9	BPA / Mar release
	4/4/00	YB	180,695	24,689	09-28-46	18.7	BPA / dormancy
	4/4/00	YB	155,299	26,694	09-28-48	14.4	BPA / normal
	3/1/00	TG	132,484	29,028	09-28-50	12.6	BPA / Mar release
	4/4/00	TG	117,525	23,515	09-28-49	9.8	BPA / dormancy
	3/1/00	BS	143,507	25,656	09-28-45	17.7	BPA / Mar release
	4/4/00	BS	26,393	25,442	09-28-43	13.8	BPA / acc/dorm.
	4/4/00	BS	26,501	25,397	09-28-44	11.9	BPA /acc/normal
			<b>911,060</b>	<b>207,841</b>			
1999	3/2/01	YB	101,516	24,021	09-31-23	15.1	BPA / Mar release
	3/29/01	YB	27,310	25,773	09-31-33	13.8	BPA / 2-wk acc.
	3/29/01	YB	96,839	16,883	09-31-27	14.2	BPA / Mar release
	4/3/01	YB	146,346	25,371	09-31-26	16.2	BPA / dormancy
	4/3/01	YB	138,491	24,160	09-31-24	15.8	BPA / normal
	4/12/01	YB	27,396	23,576	09-31-29	12.3	BPA / 4-wk acc.
	3/2/01	BS	139,319	24,893	09-31-28	16.4	BPA / Mar release
	3/29/01	BS	25,384	23,967	09-31-25	12.8	BPA /acc/normal
	3/29/01	BS	27,467	22,945	09-31-32	14.4	BPA / acc/dorm.
	4/3/01	BS	27,897	13,235	09-31-31	13.4	BPA / normal
	4/3/01	BS	30,329	14,403	09-31-30	16.3	BPA / dormancy
	5/9/01	DR	119,533	25,109	63-13-10	12.0	BPA / normal
	5/9/01	DR	40,032	25,485	63-13-11	11.0	BPA / dormancy
			<b>947,859</b>	<b>289,821</b>			
2000	3/29/02	YB	212,214	24,508	09-33-30	10.4	BPA / normal
	3/29/02	YB	213,069	24,924	09-33-31	12.6	BPA / dormancy
	3/29/02	YB	26,973	25,416	09-33-32	13.4	BPA / 2-wk acc.
	4/12/02	YB	25,806	24,362	09-33-29	9.9	BPA / 4-wk acc.
	3/28/02	BS	67,981	20,612	09-33-33	12.3	BPA / subsurface
	3/28/02	BS	177,625	20,054	09-33-34	11.7	BPA / normal fed
	4/10/02	BS	24,887	21,197	09-01-20	14.8	NOAA / acclim.
	4/19/02	BS	23,871	20,074	09-01-19	13.6	NOAA / acclim.
	4/30/02	BS	24,164	20,002	09-01-21	13.7	NOAA / acclim.
	5/10/02	BS	24,441	20,992	09-01-22	13.0	NOAA / acclim.
	5/20/02	BS	23,536	19,646	09-01-23	15.7	NOAA / acclim.
	5/30/02	BS	24,403	20,798	09-01-24	13.0	NOAA / acclim.
	5/16/02	DR	12,361	12,361	63-10-87	9.0	BPA / dormancy
	5/16/02	DR	83,579	12,377	63-12-88	10.0	BPA / normal
			<b>964,910</b>	<b>287,323</b>			

continued

Table 2.1. (continued). Releases of spring chinook from lower Columbia River select area facilities, 1993-2002 brood years.

Brood Year	Release Date	Release Site <sup>a</sup>	Number Released	Number of CWT's	Tag Code <sup>b</sup>	Release Size #/lb	Funding Agency <sup>c</sup> and Study
2001	3/27/03	BS	302,934	17,431	09-36-01	11.5	BPA
	3/27/03	TGM	30,385	25,361	09-35-61	11.9	BPA/morpholine
	3/27/03	TGJ	27,412	26,277	09-36-02	11.4	BPA/JD acclim.
	3/28/03	YB	188,956	26,219	09-35-62	9.0	BPA / normal
	3/28/03	YB	187,097	24,733	09-35-63	12.7	BPA / dormancy
	3/28/03	YB	75,570	25,513	09-35-60	11.4	BPA / subsurface
	4/9/03	BS	18,508	17,764	09-36-19	16.6	NOAA / acclim.
	4/18/03	BS	22,353	21,782	09-36-22	15.5	NOAA / acclim.
	4/28/03	BS	21,236	20,982	09-36-20	15.6	NOAA / acclim.
	4/30/03	DR	33,113	20,052	63-15-72	10.0	BPA / Lewis
	4/30/03	DR	108,791	20,455	63-15-73	11.4	BPA / Cowlitz
	5/7/03	BS	20,801	20,273	09-36-23	16.5	NOAA / acclim.
	5/16/03	BS	20,158	19,726	09-36-21	16.6	NOAA / acclim.
	5/27/03	BS	20,319	19,767	09-36-24	14.7	NOAA / acclim.
				<b>1,077,633</b>	<b>306,335</b>		
2002	3/31/04	SFK	639,446	21,871	09-37-23	13.7	SFK production
	4/5/04	BS	261,840	26,465	09-39-01	12.1	BPA
	4/6/04	TGM	20,913	20,329	09-36-61	11.1	BPA
	4/6/04	TGJ	27,143	26,595	09-36-63	10.4	BPA/JD acclim.
	4/8/04	BS	16,185	15,138	09-39-06	12.8	NOAA / acclim.
	4/8/04	YB	455,825	25,886	09-36-62	12.8	BPA
	4/16/04	BS	27,359	26,346	09-39-03	12.5	NOAA / acclim.
	4/26/04	BS	27,644	26,412	09-39-07	11.7	NOAA / acclim.
	5/6/04	BS	27,471	26,699	09-39-04	13.1	NOAA / acclim.
	5/17/04	BS	24,488	23,849	09-39-08	11.4	NOAA / acclim.
	5/20/04	BS	23,508	22,811	09-39-05	12.5	NOAA / acclim.
	5/1/04	DR	31,095	24,088	63-21-76	12.0	BPA / Cowlitz
	5/1/04	DR	66,223	9,867	63-21-77	11.0	BPA / Lewis
			<b>1,649,150</b>	<b>296,356</b>			

<sup>a</sup> BS=Blind Slough, DR=Deep River, SFK=South Fork Klaskanine, SS=Steamboat Slough, TG=Tongue Pt., TGM=Tongue Pt. MERTS, TGJ=Tongue Pt. John Day, YB=Youngs Bay

<sup>b</sup> Tag codes funded by BPA representing production releases for each site that were used for year/site survival and straying analyses

<sup>c</sup> BPA-Bonneville Power Administration; NOAA-National Oceanic & Atmospheric Administration (10-day acclimation study)

Table 2.2. Releases of select area bright fall chinook from lower Columbia River select area facilities, 1994-2002 brood years.

Brood Year	Study Group	Site	Release Date	Number Released	Number of CWT's	Tag Code	Release Size (#/lb)	Funding Agency <sup>a</sup>
1994	July 15 or 65°	YB	6/27/95	107,892	49,826	07-07-42	18.2	BPA
	Aug 1 or 70°	YB	7/17/95	77,100	49,657	07-09-28	13.6	BPA
	0.25 #/ft <sup>3</sup> density	YB	7/17/95	116,030	43,518	07-09-29	10.9	BPA
	0.56 #/ft <sup>3</sup> density	YB	7/17/95	127,936	44,123	07-09-30	11.8	BPA
	0.66 #/ft <sup>3</sup> density	YB	7/17/95	115,702	42,854	07-09-31	13.8	BPA
	R&E	YB	7/17/95	707,127	19,514	07-14-21	36.5	R&E
	SFK Raceways	SF	8/15/95	15,758	LV only		37.0	OR/FPC
				<b>1,267,545</b>	<b>249,492</b>			
1995	0.25 #/ft <sup>3</sup> density	YB	7/16/96	64,679	57,523	07-13-42	13.1	BPA
	0.67 #/ft <sup>3</sup> density	YB	7/16/96	154,593	45,148	07-13-41	14.5	BPA
	R&E	TG	7/15/96	26,792	26,354	07-13-50	22.0	R&E
	PSMFC	YB	7/17/96	329,976	26,934	07-13-54	31.8	PSMFC
	R&E	BS	7/15/96	27,380	27,231	07-13-51	19.9	R&E
	R&E	YB	7/16/96	389,320	LV only		16.3	R&E
	PSMFC	YB	7/17/96	428,405	LV only		37.5	PSMFC
				<b>1,421,145</b>	<b>183,190</b>			
1996	July 15 or 65°	YB	6/17/97	53,442	52,956	07-13-39	38.0	BPA
	Aug 1 or 70°	YB	7/17/97	50,868	50,371	07-13-38	18.1	BPA
	0.14 #/ft <sup>3</sup> density	YB	7/17/97	116,680	52,468	09-21-36	21.4	BPA
	0.33 #/ft <sup>3</sup> density	YB	7/17/97	188,948	51,270	09-21-35	17.9	BPA
	0.46 #/ft <sup>3</sup> density	YB	7/17/97	53,765	52,618	07-13-40	18.4	BPA
	R&E	TG	7/17/97	27,482	27,427	09-21-46	24.1	R&E
	R&E	BS	7/17/97	27,413	27,413	09-21-45	31.6	R&E
				<b>518,598</b>	<b>314,523</b>			
1997	July 15 or 65°	YB	7/1/98	25,201	24,853	09-24-54	19.8	BPA
	Aug 1 or 70°	YB	7/20/98	25,019	24,896	09-24-53	16.0	BPA
	0.27 #/ft <sup>3</sup> density	YB	7/20/98	25,036	24,513	09-24-56	14.5	BPA
	0.34 #/ft <sup>3</sup> density	YB	7/20/98	17,303	16,850	09-24-57	15.8	BPA
	0.47 #/ft <sup>3</sup> density	YB	7/20/98	25,024	24,931	09-24-55	16.5	BPA
				<b>117,583</b>	<b>116,043</b>			
1998	July 15 or 65°	YB	7/12/99	25,811	25,369	09-27-54	17.1	BPA
	Aug 1 or 70°	YB	8/2/99	26,000	25,395	09-27-53	12.5	BPA
	0.24 #/ft <sup>3</sup> density	YB	7/12/99	25,992	25,697	09-27-57	16.6	BPA
	0.45 #/ft <sup>3</sup> density	YB	7/12/99	25,921	25,106	09-27-56	18.1	BPA

continued

Table 2.2. (continued). Releases of select area bright fall chinook from lower Columbia River select area facilities, 1994-2002 brood years.

Brood Year	Study Group	Site	Release Date	Number Released	Number of CWT's	Tag Code	Release Size (#/lb)	Funding Agency <sup>a</sup>
	0.57 #/ft <sup>3</sup> density	YB	7/12/99	32,410	25,570	09-27-55	17.8	BPA
	R&E	YB	7/12/99	85,838	25,851	09-27-58	30.6	R&E
				<b>221,972</b>	<b>152,988</b>			
1999	0.46#/ft <sup>3</sup> , surface	YB	7/5/00	24,944	24,075	09-30-39	17.1	BPA
	0.46#/ft <sup>3</sup> , subsurf.	YB	7/5/00	25,079	23,586	09-30-40	17.0	BPA
	0.23#/ft <sup>3</sup> , subsurf.	YB	7/5/00	24,909	24,167	09-30-41	16.7	BPA
	0.27#/ft <sup>3</sup> , surface	YB	7/5/00	24,983	24,344	09-30-42	14.3	BPA
	R&E	YB	7/5/00	24,738	22,269	09-30-43	15.7	R&E
	R&E	YB	7/5/00	29,275	LV only		15.7	R&E
				<b>153,928</b>	<b>118,441</b>			
2000	0.50#/ft <sup>3</sup> , surface	YB	7/4/01	25,263	24,342	09-32-58	26.9	BPA
	0.50#/ft <sup>3</sup> , subsurf.	YB	7/4/01	24,658	22,683	09-32-59	26.5	BPA
	0.25#/ft <sup>3</sup> , subsurf.	YB	7/4/01	25,235	23,059	09-32-60	22.2	BPA
	0.25#/ft <sup>3</sup> , surface	YB	7/4/01	25,221	23,026	09-32-61	20.2	BPA
	0.50#/ft <sup>3</sup> , density	YB	7/4/01	104,768	22,948	09-32-62	24.4	R&E
				<b>205,145</b>	<b>116,058</b>			
2001	0.50#/ft <sup>3</sup> , surface	YB	7/2/02	125,607	23,970	09-35-09	22.1	BPA
	0.50#/ft <sup>3</sup> , subsurf.	YB	7/2/02	25,065	24,329	09-35-10	26.2	BPA
	0.25#/ft <sup>3</sup> , subsurf.	YB	7/2/02	24,775	24,086	09-35-11	22.9	BPA
	0.25#/ft <sup>3</sup> , surface	YB	7/2/02	126,448	24,853	09-35-12	22.8	BPA
	R&E	YB	7/2/02	165,161	24,551	09-35-13	27.0	R&E
				<b>467,056</b>	<b>121,789</b>			
2002	SAFE	YB	7/24/03	370,942	23,529	09-38-09	17.4	BPA
	R&E	YB	8/7/03	409,372	27,679	09-38-19	22.3	R&E
				<b>780,314</b>	<b>51,208</b>			

<sup>a</sup> BPA-Bonneville Power Administration; OR/FPC-Oregon Department of Fish and Wildlife (ODFW) and Fishermen Poundage Contributions; R&E-ODFW Restoration and Enhancement Program; PSMFC-Pacific States Marine Fisheries Commission

Table 2.3. Releases of upriver bright fall chinook from lower Columbia River select area facilities, 1994-1997 brood years.

<u>Brood Year</u>	<u>Release Date</u>	<u>Release Site</u>	<u>Number Released</u>	<u>Number of CWT's</u>	<u>Tag Code</u>	<u>Release Size (#/lb)</u>	<u>Funding Agency<sup>a</sup></u>
1994	7/17/95	Youngs Bay	199,088	50,608	07-12-35	23.3	PSMFC
			<b>199,088</b>	<b>50,608</b>			
1995	7/15/96	Tongue Point	97,866	46,186	09-17-11	27.0	PSMFC
			<b>97,866</b>	<b>46,186</b>			
1996	7/15/97	Tongue Point	201,849	51,897	09-21-37	42.8	PSFMC
			<b>201,849</b>	<b>51,897</b>			
1997	7/1/98	Youngs Bay	205,544	27,305	09-25-15	37.0	PSFMC
	7/6/98	Youngs Bay	424,252	26,744	09-25-16	44.4	R&E
			<b>629,796</b>	<b>54,049</b>			

<sup>a</sup> R&E-ODFW Restoration and Enhancement Program; PSMFC-Pacific States Marine Fisheries Commission

Table 2.4. Releases of lower Columbia River early stock coho from select area facilities, 1993-2002 brood years.

Brood Year	Release Date	Release Site <sup>a</sup>	Number Released	Number of CWT's	Tag Code <sup>b</sup>	Release Size (#/lb)	Funding Agency <sup>c</sup> and Study
1993	5/11/95	YB	138,371	28,995	07-15-44	7.8	BPA / site comparison
	5/12/95	BS	140,267	26,258	07-15-45	8.9	BPA / site comparison
	5/12/95	TG	130,623	26,426	07-53-29	8.7	BPA / site comparison
	5/12/95	DR	201,200	30,751	63-54-44	8.1	BPA / site comparison
	4/10/95	SFK	433,674	23,160	07-03-56	10.5	OR/FPC
	4/17-18/95	YB	822,185	25,886	07-07-58	9.7	Mitchell
	5/1-8/95	YB	467,531	22,545	07-07-73	12.6	R&E / acclimation
	5/15/95	YB	280,412	22,057	07-07-44	12.6	R&E / acclimation
			<b>2,614,263</b>	<b>206,078</b>			
1994	5/7/96	YB	216,187	26,274	07-12-22	9.5	BPA / site comparison
	5/6/96	BS	209,761	24,942	07-59-01	9.0	BPA / site comparison
	5/6/96	TG	190,032	23,942	07-12-41	8.4	BPA / site comparison
	5/7/96	DR	200,100	28,406	63-57-39	9.7	BPA / site comparison
	4/14/96	SFK	443,183	25,979	07-09-25	10.7	OR/FPC
	4/15/96	YB	808,263	28,299	07-12-42	11.7	Mitchell
	4/26/96	YB	829,600	26,548	07-09-61	9.6	Mitchell
	5/20/96	YB	341,339	22,104	07-12-23	11.3	R&E / acclimation
	5/28/96	YB	295,512	26,418	07-11-36	11.2	Mitchell
			<b>3,533,977</b>	<b>232,912</b>			
1995	5/5/97	YB	146,818	27,198	07-09-42	13.2	BPA / site comparison
	5/5/97	BS	196,963	25,104	09-18-18	14.4	BPA / site comparison
	5/5/97	TG	430,221	26,174	07-13-36	13.9	BPA / site comparison
	5/12/97	YB	633,310	17,865	07-13-35	14.5	Mitchell
	5/12/97	SFK	621,932	28,284	09-18-24	12.7	OR/FPC
			<b>2,029,244</b>	<b>124,625</b>			
1996	5/1/98	YB	133,373	25,672	09-23-02	10.4	BPA / site comparison
	5/1/98	BS	144,958	24,607	09-23-05	11.4	BPA / site comparison
	5/1/98	TG	119,611	18,355	09-23-06	11.2	BPA / site comparison
	4/23/98	DR	208,350	29,717	63-62-47	10.6	BPA / site comparison
	4/29/98	SFK	550,427	26,787	09-23-21	16.8	OR/FPC
	5/1/98	YB	268,870	52,510	05-37-32	12.2	R&E / acclimation
	5/1/98	YB	261,654	50,604	05-37-33	12.2	R&E / acclimation
	5/26/98	YB	425,634	30,159	09-23-36	13.3	Mitchell / acclimation
	5/26/98	YB	30,101	29,990	09-23-38	13.3	Mitchell / acclim/d.index
			<b>2,142,978</b>	<b>288,401</b>			

continued

Table 2.4. (continued) Releases of lower Columbia River early stock coho from select area facilities, 1993-2002 brood years.

1997	4/28/99	YB	158,203	28,809	09-23-34	11.9	BPA / site comparison
	4/28/99	BS	197,089	26,072	09-25-28	11.3	BPA / site comparison
	4/28/99	TG	204,143	26,269	09-25-29	11.4	BPA / site comparison
	5/13/99	DR	203,284	25,003	63-05-30	11.4	BPA / site comparison
	5/13/99	DR	210,824	24,563	63-05-31	13.0	BPA / site comparison
	5/5/99	SS	210,530	24,248	63-05-32	10.4	BPA / site comparison
	4/21/99	SFK	429,652	19,622	09-24-28	13.3	OR/FPC
	5/5/99	YB	502,146	24,963	05-39-47	12.5	R&E / acclimation
	5/19/99	YB	479,662	24,874	05-39-46	11.8	R&E / acclim/d.index
	6/1/99	YB	272,656	26,215	09-26-43	13.4	Mitchell / acclimation
	6/1/99	YB	26,894	26,841	09-26-56	13.4	Mitchell /acclim/d.index
			<b>2,895,083</b>	<b>277,479</b>			
1998	5/4/00	YB	206,377	24,396	09-29-14	11.9	BPA / site comparison
	5/4/00	BS	195,645	24,624	09-29-12	11.5	BPA / site comparison
	5/4/00	TG	228,290	24,634	09-29-13	10.8	BPA / site comparison
	5/3/00	DR	217,732	25,774	63-12-01	11.8	BPA / site comparison
	5/4/00	DR	213,411	29,697	63-12-02	11.3	BPA / site comparison
	4/24/00	SS	191,543	29,937	63-11-17	11.2	BPA / site comparison
	4/12/00	YB	836,845	26,244	09-27-16	15.7	Mitchell
	5/1-8/00	SFK	610,658	25,414	09-27-30	12.8	OR/FPC
	5/11/00	TG	525,833	26,176	09-27-49	13.5	Mitchell
	5/25/00	YB	27,138	27,086	09-25-40	13.6	Mitchell /acclim/d.index
	5/25/00	YB	272,992	26,699	09-27-29	13.6	Mitchell / acclimation
	5/31/00	YB	476,148	21,743	05-39-48	15.9	R&E / acclimation
				<b>4,002,612</b>	<b>312,424</b>		
1999	5/14/01	YB	502,077	22,577	05-01-91	14.2	R&E / acclimation
	4/10/01	YB	808,735	26,075	09-30-06	15.6	Mitchell
	4/16/01	YB	234,032	26,011	09-31-61	14.0	BPA / control
	4/17/01	YB	179,187	26,494	09-31-59	14.7	BPA / towed
	5/07/01	SFK	344,738	26,231	09-30-13	12.5	OR/FPC
	5/24/01	BS	274,257	26,969	09-32-20	15.5	Mitchell / acclimation
	5/24/01	BS	25,154	25,104	09-32-22	15.5	Mitchell /acclim/d.index
	5/31/01	TG	482,414	25,055	05-49-08	15.3	R&E / acclimation
	4/16/01	TG	173,199	21,854	09-31-60	13.2	BPA / site comparison
	5/09/01	DR	166,087	22,468	63-03-75	12.0	BPA / site comparison
	5/09/01	DR	229,250	24,062	63-03-76	12.0	BPA / site comparison
	5/01/01	SS	208,966	29,800	63-03-69	12.0	BPA / site comparison
				<b>3,628,096</b>	<b>302,700</b>		

continued

Table 2.4. (continued) Releases of lower Columbia River early stock coho from select area facilities, 1993-2002 brood years.

2000	5/06/02	YB	482,657	24,632	05-42-50	14.1	R&E / acclimation
	4/12/02	YB	837,201	26,400	09-30-15	13.0	Mitchell
	5/05/02	YB	177,730	24,555	09-33-39	11.9	BPA / towed
	5/03/02	YB	191,108	22,937	09-33-40	12.0	BPA / control
	5/07/02	BS	315,988	26,896	09-33-52	13.8	Mitchell / acclimation
	5/07/02	BS	27,854	27,798	09-33-56	13.8	Mitchell /acclim/d.index
	5/07/02	SFK	583,248	24,144	09-33-57	11.4	OR/FPC
	5/16/02	TG	488,866	28,068	05-42-54	14.4	R&E / acclimation
	4/25/02	TG	178,892	23,639	09-33-41	14.6	BPA / site comparison
	5/16/02	DR	229,501	24,940	63-06-64	12.0	BPA / site comparison
	5/16/02	DR	125,056	25,359	63-10-82	9.4	BPA / site comparison
	5/01/02	SS	158,598	20,585	63-07-64	12.0	BPA / site comparison
				<b>3,796,699</b>	<b>299,953</b>		
2001	5/08/03	YB	512,549	23,482	05-47-60	12.6	R&E / acclimation
	4/10/03	YB	844,653	27,009	09-19-32	11.7	Mitchell
	5/09/03	YB	158,476	25,201	09-36-10	10.4	BPA / control
	5/10/03	YB	171,033	27,969	09-36-11	10.3	BPA / towed
	5/07/03	BS	161,222	26,940	09-34-61	13.0	Mitchell / acclimation
	5/07/03	BS	155,582	26,452	09-36-38	13.0	Mitchell /acclim/d.index
	4/28/03	SFK	641,555	24,698	09-34-60	12.0	OR/FPC
	5/22/03	TG	477,918	23,396	05-47-59	12.8	R&E / acclimation
	4/24/03	TG	197,794	25,439	09-36-12	10.0	BPA / site comparison
	4/30/03	DR	129,545	24,506	63-15-19	12.0	BPA / site comparison
	4/30/03	DR	236,890	25,652	63-15-20	12.0	BPA / site comparison
	5/05/03	SS	239,635	29,747	63-11-74	12.0	BPA / site comparison
			<b>3,926,852</b>	<b>310,491</b>			

continued

Table 2.4. (continued) Releases of lower Columbia River early stock coho from select area facilities, 1993-2002 brood years.

2002	4/6/04	TGM	186,520	24,770	09-38-62	13.0	BPA / site comparison
	4/9/04	YB	758,997	24,155	09-37-27	11.6	Mitchell
	4/28/04	YB	361,078	23,546	09-38-63	11.4	BPA / towed
	4/28/04	BS	298,748	26,760	09-37-32	14.4	Sandy acclimation
	4/28/04	TGM	511,002	24,150	05-37-25	13.7	R&E / acclimation
	4/29/04	YB	350,839	21,825	05-37-24	12.4	R&E / acclimation
	5/1/04	DR	152,780	24,900	63-20-72	14.0	BPA / site comparison
	5/1/04	DR	204,420	25,100	63-20-77	13.0	BPA / site comparison
	4/26/04	SS	204,600	30,000	63-02-67	13.0	BPA / site comparison
			<b>3,028,984</b>	<b>225,206</b>			

<sup>a</sup> BS=Blind Slough, DR=Deep River, SFK=South Fork Klaskanine, SS=Steamboat Slough, TG=Tongue Pt., TGM=Tongue Point MERTS, YB=Youngs Bay

<sup>b</sup> Tag codes funded by Bonneville Power Administration representing production releases for each site that were used for year/site survival and straying analyses

<sup>c</sup> BPA-Bonneville Power Administration; OR/FPC-Oregon Department of Fish and Wildlife (ODFW) and Fishermen Poundage Contributions; R&E-ODFW Restoration and Enhancement Program; Mitchell-Mitchell Act Funds. Double index (d.index)

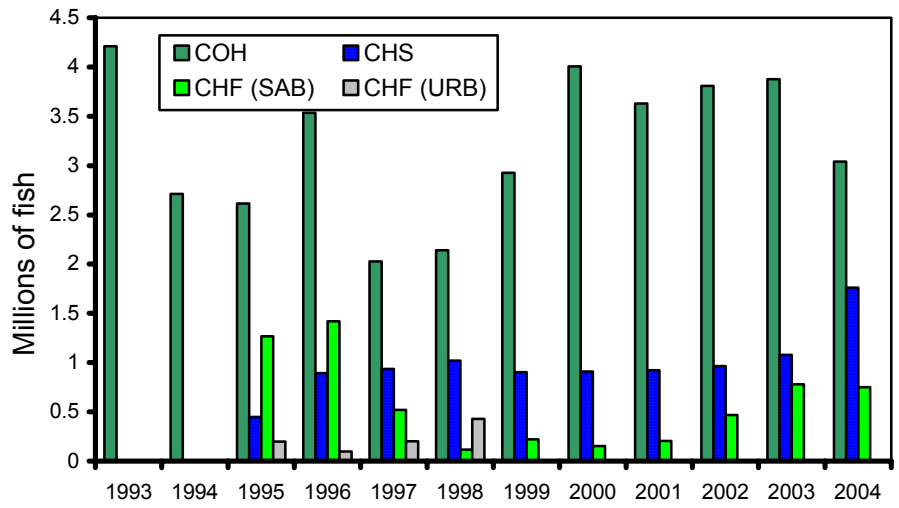


Figure 2.1. Annual releases of salmonids by the select area fisheries project, 1993-2004.

### 3. SUMMARY OF SELECT AREA FISHERIES

Select area fisheries have been developed to minimize impacts to listed and depressed stocks while providing expanded harvest opportunities for commercial and recreational fisheries. The goal of complete harvest of returning adults maximizes project benefits and reduces concerns of straying. Time and area regulations are the primary methods for minimizing impacts to listed species in commercial fisheries, while area and retention regulations are used to minimize impacts within sport fisheries. Gear restrictions in commercial fisheries are adopted annually to focus the fishery on target species and provide additional protection for depressed or listed stocks.

The five current select area fishing sites were selected primarily based on data indicating limited use by listed species for rearing, migration, or spawning purposes; therefore, impacts to listed species are inherently minimized by avoiding interaction with listed species through legal area restrictions that apply to both sport and commercial fisheries. Prior to development of each select area fishing site, test fishing was conducted to determine use of the area by Columbia River salmon stocks. Select area fishing sites were established based on test fishing results used to identify specific periods and boundaries of potential fishing sites where migrating listed species were unlikely to be encountered. Results of past fisheries have supported results of test fishing with impacts to listed species being limited for all species in most years.

The first commercial fisheries established in new SAFE areas beginning in 1996 were based on experimental releases in 1995 of 1993 brood coho, due to greater availability and a shorter life span of this species. Development of spring chinook seasons followed at several sites but was constrained initially due to a limited egg supply resulting from reduced run sizes and restricted stock usability, particularly in Washington. Ongoing releases of SAB fall chinook in Young Bay were increased to provide expanded harvest opportunities, including summer target seasons.

Select area fishing seasons are primarily designed to maximize effort during times of peak abundance of locally-produced stocks and low abundance of listed stocks. Since the majority of listed spring chinook stray into select areas during mid-March through mid-April, seasons are limited during this timeframe. Limited spring chinook fisheries are allowed in Youngs Bay and Blind Slough/Knappa Slough from mid-February through mid-March to target early-returning SAFE stock adult spring chinook and limit impacts to listed stocks. Liberal seasons are generally adopted in Youngs Bay, Blind Slough/Knappa Slough and Deep River from mid-April through mid-June to maximize harvest of SAFE stock spring chinook following departure of listed spring chinook stocks. Fisheries in June and July range between 1-3 days weekly and occur in Youngs Bay only, while fisheries occurring in August are limited to less than two days per week and occur primarily in Youngs Bay and occasionally in Knappa Slough. Fall fisheries targeting SAFE stock coho salmon are not initiated until early September when net-pen reared coho abundance is at its peak, and abundance of fall chinook is declining.

Gear restrictions are adopted for select area fisheries to focus harvest on target species. Winter fisheries have a 7¼-inch minimum mesh size restriction in effect to focus the

fishery on larger spring chinook and minimize handle of steelhead. Most spring and summer chinook fisheries have an 8-inch maximum mesh size restriction to target salmon. The majority of gear actually used during chinook salmon fisheries is 7½-8-inch mesh, which minimizes handle of steelhead. Fall season regulations include a 6-inch maximum mesh size restriction to target coho. Allowable sales for all select areas are restricted to salmon, sturgeon (*Acipenser* spp.), and shad (*Alosa sapidissima*).

## **SEASON SETTING PROCESS**

Annual public meetings to solicit community input regarding commercial and sport season recommendations are generally held in Astoria, Oregon around January of each year for spring fisheries, and June or July for fall fisheries. Based on input from these meetings and management objectives, a joint staff report is prepared outlining season recommendations for review by fishery managers and the Technical Advisory Committee (TAC). Seasons for concurrent waters are subsequently established by the Columbia River Compact, which is comprised of the agency directors (or their representatives) from the States of Washington and Oregon. Select area commercial seasons occurring in state waters, and all recreational seasons and regulations are established by the regulating state. All fisheries of the Columbia River are established within the guidelines and constraints of the Columbia River Fisheries Management Plan (CRFMP), the ESA, and management agreements negotiated between the parties to U.S. v. Oregon. Harvest impacts on federally-listed species by select area fisheries are addressed in “Biological Assessment” reports and submitted to the NOAA. (ODFW and WDFW 2003)

## **DATA COLLECTION**

Extensive monitoring and evaluation activities occur throughout the year to assess stock status of salmon and steelhead returns and to monitor fishery impacts. The landed catch from all select area fisheries is sampled for biological information, including scale samples and the recovery of CWT’s. Each select area site is monitored separately for catch estimation and collection of biological data from landed catch to account for variability in effort, catch rate and stock composition. Funding for fishery sampling is provided entirely by the BPA through two projects: the SAFE project in Oregon and Washington, and by the coded-wire tag recovery project (BPA Project # 82-01301) in Oregon only.

## **Commercial Fisheries**

Sampling of the commercial catch includes collecting representative weight and length data by species, examining the catch for any external tags and marks, collecting scales for age-structure, collecting CWT snouts, and collecting visual stock identification information (VSI; spring chinook only). Weekly average fish weight data of the sampled catch is applied to species-specific landings (in pounds) to determine the number of fish landed by species for each fishery. Coded-wire tag data is summarized to determine stock compositions of fish landed in each select area fishery. Stock compositions are then applied to total landing estimates to produce stock-specific catch estimates. Preliminary landings are summarized by statistical week based on phone surveys of

buyers and processors. These landings are later confirmed with actual point-of-sale fish tickets.

The minimum target-sampling rate for each season and site is 20 percent of the landed catch; however, significantly higher (30-60 percent) sampling rates have regularly been obtained. As a rule, more intensive sampling is conducted whenever a new site or season is established. For instance, In Deep River the sampling rate in 2003 was nearly 100 percent, since fish could not lawfully be removed from the area prior to inspection by WDFW staff.

## **Recreational Fisheries**

Prior to 2002, a modified creel census program was used to estimate sport catch in select areas. Since then, a more extensive program has been implemented in response to increased sport fishing effort. Recreational angler surveys are currently conducted in Youngs Bay, Knappa Slough, Blind Slough, Big Creek, and Gnat Creek during the spring, and in Klaskanine River during the fall. Fishing effort is estimated by counting trailers, boats, and/or anglers at each site. Aerial flight data obtained from mainstem Columbia River surveys are also used to estimate effort on days when creel surveys are not conducted. Catch rates are determined from angler interviews and voluntary harvest log books. Effort counts are expanded for non-survey days to estimate total effort for each fishing site. Total catch by species is estimated by applying observed catch rates to estimates of effort by fishing area. The landed catch is sampled to collect biological information, recover CWT's, and determine stock composition. Scales are collected to determine age structure of the landed catch. Coded-wire tag (or VSI) data are applied to the estimated landings for each site to estimate the impacts to listed species.

## **IN-SEASON MANAGEMENT**

To ensure impacts (lethal take) of listed stocks resulting from SAFE commercial fisheries remain within management guidelines, fish run sizes and harvest of individual stocks is tracked in-season based on visual stock identification (winter-spring seasons only) and CWT recoveries, with regulations and fishing periods adjusted in-season if necessary. In-season catch estimates are produced immediately following each fishing period. Stock-specific catch estimates for fisheries are monitored in conjunction with in-season run size updates to track stock-specific impact rates. If the data suggests that impacts will exceed management guidelines, adopted seasons are modified through the Compact Hearing process. Joint staff reports are prepared in advance and distributed for public review prior to each hearing. Adopted seasons and regulations are presented in a Compact Action Notice following each Compact Hearing.

## **WINTER, SPRING, AND SUMMER COMMERCIAL FISHERIES**

### **Season Structure**

Select area fishing seasons are established based on time of year (calendar week) to facilitate fishery management, with each season providing different harvest opportunities

for different species. Fishing periods include winter (early-February through mid-March), spring (mid-April through mid-June), summer (mid-June through July), and fall (August through October) seasons. Not all species are reared at all sites, so the number of fishing sites open during each season is variable (Table 3.1).

Season <sup>a</sup>	Youngs Bay	Tongue Point/ South Channel	Blind Slough/ Knappa Slough	Deep River	Steamboat Slough
Winter	X	<sup>b</sup>	X		
Spring	X	X <sup>c</sup>	X	X	
Summer	X				
Fall	X	X	X	X	X

<sup>a</sup> Winter=weeks 7-12; spring=weeks 16-24; summer=weeks 25-31; fall=weeks 32-44  
<sup>b</sup> Winter season closed since 2002 since area is open concurrent with mainstem Columbia River  
<sup>c</sup> 2003 marked the last year of significant adult returns from production-level releases that were discontinued in 2000 due to excessive straying. Did not reopen in 2004.

Winter Seasons

Winter season fishing periods in select areas occur during the mid-February through mid-March timeframe (statistical weeks 7-12) to target early-returning age-5 net-pen reared spring chinook prior to the time of any significant presence of non-local stocks. As production of SAFE spring chinook increased, winter seasons were adopted, beginning with Youngs Bay, followed by Blind Slough and Tongue Point, in an attempt to meet the project goal of 100 percent harvest of returning adults. The timeframes for winter seasons in each of the areas were established based on test fishing results and adjusted based on onboard monitoring during the initial years of full-fleet implementation in each of the areas. Currently Youngs Bay and Blind Slough are the only select area fishing sites that have winter seasons (Table 3.1). Although winter season landings are lower than during the spring fishery, this season is popular as it provides an opportunity to harvest some of the first spring chinook of the year, which command a high market value.

Youngs Bay

Winter seasons have been adopted in Youngs Bay since 1998. A season format consisting of one or two fishing periods weekly is intended to provide sufficient opportunity to harvest early returns of SAFE spring chinook that may buildup in the area without accruing excessive impacts on non-local stocks. Initially, fishing periods were scheduled during daylight hours to facilitate monitoring. From 2000-2003 fishing time consisted of 1-2 weekly fishing periods of 12-54 hours each for three weeks (Table 3.2). This season structure was effective in allowing some harvest (≤544 fish annually) of early local adult returns while minimizing impacts on listed stocks through 2002. In 2003, unanticipated high abundances of upriver stocks during the first three fishing periods prompted an emergency closure of the remaining three periods. In 2004 several brief additional fishing periods were adopted in upper Youngs Bay (above the old Youngs Bay

Bridge) and in Blind Slough to harvest significant early returns of local stock. Volunteer test fishing was utilized prior to adopting the season to verify stock composition in both areas. This option may be implemented in future years to provide access to increased returns projected in future seasons.

An 8-inch minimum mesh size restriction has been required since 1998 to target the larger 5-year old chinook, while minimizing the handle of steelhead. In 2003, an industry request for a minimum mesh size of 7¼-inches was adopted (no minimum in spring seasons). Previous monitoring data has shown that steelhead handle during the winter season is negligible. The maximum net length for all seasons in Youngs Bay is 250 fathoms (1,500 feet), and leadline weight may not exceed two pounds per fathom of length.

#### Blind Slough/Knappa Slough

The first winter season in Blind Slough was adopted in 2000, and seasons have continued annually. Knappa Slough is not open during the winter season to minimize interceptions of upriver spring chinook. Fishing periods have consisted of one nighttime opener each week. Night fishing maximizes catch and minimizes interactions with recreational fishermen and boaters using this area.

Net length is restricted to 100 fathoms (600 feet) due to the smaller size of this fishing site. No leadline weight restriction is in effect since this area cannot be effectively drift-fished due to weak tidal currents and an abundance of snags. Allowable sales include salmon, sturgeon, and shad.

Increased production of spring chinook at this site since 2000 may justify expanding fishing opportunity during future winter seasons; however, seasons will likely follow the format of one or two 12-hour nighttime fishing periods weekly for three weeks from mid-February to mid-March.

#### Tongue Point/South Channel

Winter seasons occurred at the Tongue Point fishing site in 2000 and 2001 with modest catches ( $\leq 124$  fish annually) but were discontinued in 2002 and 2003 because this area was open concurrent with the mainstem winter commercial fishery. In addition, 2003 marked the final year of significant adult returns from production-level releases of spring chinook that were discontinued at this site in 2000 due to excessive straying of returning adults from 1996-1998 releases. To resolve this issue, a new rearing site was established and experimental releases were implemented in 2003 (see Chapter 6). The South Channel area has not been open during any past winter seasons.

#### Spring Seasons

Select area spring seasons occur between mid-April and mid-June (statistical weeks 16-24) and account for the majority of the spring chinook harvest since the abundance of non-local stock decreases rapidly during this timeframe, allowing fishing time to be

liberalized. The goal of this fishery is to harvest 100 percent of the returning adults produced by the project since all spring chinook returning to select areas originate from transferred hatchery stock that are acclimated in net pens. The peak of the fishery traditionally occurs during mid-April through early-May but does extend into late-May in some years. Spring seasons have been established at Youngs Bay, Blind Slough, Tongue Point, and Deep River fishing sites concurrent with initial adult returns at each site (Table 3.2). As with all select area seasons, timeframes for spring seasons at each site were established based on test fishing results and fine-tuned with either onboard monitoring or commercial sampling data.

### Youngs Bay

Spring seasons in Youngs Bay have been established every year since originally adopted in 1992 to harvest returns from experimental releases of 1988-1991 broods from the South Fork Klaskanine Hatchery and net pens. A season format consisting of weekly fishing periods of progressively increasing length is intended to maximize harvest of local stocks while minimizing impacts on non-local stocks. Fishing opportunity was expanded gradually from 1992-2001 based on positive stock composition results in order to harvest increasing adult returns while maintaining low impacts to non-local stocks. Since 2000 fishing time has consisted of one weekly fishing period of 30-102 hours (Table 3.2).

Net weight and length regulations are the same as the winter fishery. An 8-inch maximum mesh size restriction is in place during spring seasons to target chinook, while minimizing sturgeon harvest.

As was the case in the 2003 winter seasons, unusually high mixing of non-local stocks in many of the select areas during the early part of the spring season, and inclusion of select area impacts within the mainstem non-Indian spring chinook impact limits prompted fishery managers to rescind several of the adopted seasons to remain within the spring chinook impact guideline for non-Indian fisheries. For this reason, spring seasons adopted for 2004 were modified to begin later in April with shortened, staggered openings to allow managers time to assess the abundance of non-local stocks in the area. This approach was warranted, as the upriver run did not meet preseason expectations, forcing managers to rescind several openings scheduled for SAFE areas in early-mid May due to combined commercial and recreational mainstem impacts increasing beyond management guidelines. To maximize harvest of increased adult returns anticipated in 2006, fishing periods may need to be liberalized during the mid to later part of the spring season when upriver spring chinook are no longer present.

### Tongue Point/South Channel

Spring seasons have been adopted in Tongue Point since 1998 to target initial returns of 4-year old adults. Season dates were established based on experience gained in Youngs Bay and through test fishing from 1995-2000. Nighttime weekday fishing periods (7pm-5am) were adopted consistently to minimize interactions with recreational boaters. Based on test fishing results, the Tongue Point site was expanded in 1999 to include the South Channel; an approximately 4.0-mile slough extending east along the Oregon shoreline to

Settler Point (river mile 23.0). The number of fishing periods allowed each year was expanded from 9 in 1998 to 15 in 2002.

Since 2003 marked the last year of adult returns to this site, no spring fishery is planned for Tongue Point/South Channel in 2004. Future spring fisheries in this area will depend on positive homing results of 2003-2005 experimental releases (see Chapter 6); therefore, full-fleet winter or spring commercial fisheries are not anticipated at this site until 2007 or beyond.

#### Blind Slough/Knappa Slough

Spring seasons have been established in Blind Slough since 1998. Open fishing area at Blind Slough was extended in 1999 to include Knappa Slough; a 3.4-mile channel extending downstream from the mouth of Blind Slough to a north-south line through the eastern tip of Minaker Island. Similar to Tongue Point, the season format has consisted of two, weekday 12-hour night fishing periods (7pm-7am) each week to minimize interactions with recreational boaters. Since 1998 the number of fishing periods allowed each year has remained fairly constant at 13-18 nights. As in Youngs Bay, an 8-inch maximum mesh size restriction is in place to target chinook and reduce sturgeon harvest. Other restrictions are the same as required in the winter season.

#### Deep River

The first experimental spring season in Deep River was adopted in 2003. Season structure was similar to that used in Tongue Point and Blind Slough consisting of 1-3, 12-hour nighttime fishing periods (7pm-7am) per week. Nets were restricted to a maximum length of 100-fathoms (600') with a 7-inch minimum and a 9¾-inch maximum mesh size. Weight of nets was not regulated. In order to obtain accurate biological data, fishers were required to have all harvested fish be sampled by WDFW staff prior to transportation from the fishing area. This rule will be in effect for the next several years, as occurred in other select area fisheries during their formative years, but will be eliminated concurrent with the fishery evolving from the experimental to the production phase.

#### Summer Seasons

Select area summer seasons occur from mid-June through July (statistical weeks 25-31) with a goal of harvesting early returning SAB fall chinook and late returning spring chinook. Summer seasons have been established annually in Youngs Bay since 1999, based on favorable results of test fishing conducted in 1997 and 1998. A trial summer season in Blind Slough landed only three fish; therefore, additional summer season fisheries were not adopted for this site. Gear regulations are the same as those in effect during spring seasons. Future summer seasons will be likely be limited to Youngs Bay since this is the only SAFE site releasing SAB fall chinook, which begin returning during the summer-season timeframe.

## Results of Winter, Spring, and Summer Fisheries

Harvest of chinook in select area winter-summer fisheries has increased substantially, from a low of 155 fish in 1994 to 11,699 fish in 2002 (Figures 3.1 and 3.2). Catches increased significantly beginning in 1997 with initial returns from increased SAFE project releases since 1995 (Table 3.2). Most fish were harvested during the spring season, especially during late-April and early-May with landings ranging between 155 fish in 1994 to 10,786 fish in 2002. Annual harvest during winter seasons has ranged from a low of 4 fish



Figure 3.2. Spring chinook salmon produced by the select area fisheries project.

in 1999 to 1,341 fish landed in 2004. Prior to 2004, harvest during winter seasons comprised  $\leq 7.4\%$  of the annual landings in winter-summer fisheries. Catches during 1999-2004 summer fisheries have ranged between 188 and 695 fish annually. For 1998-2003 winter-summer SAFE fisheries, landings of chinook salmon have been distributed 2.8 percent during the winter season, 91.8 percent during the spring season, and 5.4 percent for summer season. During 1992-2004, incidental harvest of white sturgeon in SAFE winter-summer fisheries ranged between 10 and 644 fish annually, with an average annual harvest of 314 fish.

In Youngs Bay, harvest of chinook has increased significantly since the first spring fishery in 1992. Annual landings in winter-summer fisheries have ranged from 155 fish landed in 1994 to 6,849 fish in 2004 (Table 3.2). Commercial landings in Blind Slough have increased from 60 fish harvested in 1998 to 3,531 for 2004. During 1998-2002 annual landings in Tongue Point during winter and spring fisheries increased from 31 to 3,003 fish. In 2003 high abundances of upriver spring chinook in this area resulted in the harvest of 348 fish during the one fishing period that occurred prior to the remainder of the season being rescinded. In Deep River the initial season in 2003 resulted in a commercial harvest of 117 spring chinook, partially due to low effort resulting from poor returns to this site and management constraints imposed on all SAFE sites due to unusually high mixing of upriver stocks. Landings for 2004 at this site totaled 113 spring chinook (Table 3.2).

The harvest of spring chinook in select area fisheries from 1996-2004 represented the majority (57.7 percent) of the combined annual LCR (Zones 1-5) of this stock due to significant restrictions on mainstem harvest through 2001 (ODFW and WDFW 2000). Even though adoption of live-capture harvest methods has allowed for increased harvest of spring chinook in the mainstem Columbia River non-indian commercial fishery since

2002, SAFE winter, spring, and summer fisheries have contributed 49.1 percent of the total spring chinook landings during 2002-2004 (Table 3.3).

The number of fishermen participating in SAFE winter-summer fisheries increased over 400 percent to 218 fishers during 1996-2001, but has decreased to 157-166 fishers in recent years (Table 3.4; Figure 3.3). A dramatic increase in effort occurred in 2000 in response to record returns. The number of fishers utilizing the Tongue Point and Blind Slough sites increased annually from 1998-2001 in response to implementation of spring fisheries in these new sites.



Figure 3.3. Commercial fishermen and a fish buyer in Youngs Bay, 2003.

### Stock Composition

The stock composition of chinook salmon harvested in all winter-summer select area fisheries consisted predominantly of local stocks, based on recovery of 6,187 CWT's from 1993-2003 (Table 3.5). For this period 83.6 percent of all CWT recoveries were from SAFE releases; 12.6 percent were from LCR stocks; 3.7 percent were from releases above Bonneville Dam; and 0.1 percent from fish originating from Oregon Coast tributaries. During this period 3,975 CWT recoveries from Youngs Bay winter-summer fisheries were comprised of 82.6 percent SAFE stocks, 13.3 percent LCR stocks, 4.0 percent upriver stocks, and 0.1 percent Oregon Coast stocks.

The composition of 1,609 CWT's recovered during 1998-2003 winter-spring fisheries in Blind Slough was weighted even more toward locally-produced fish with 90.6 percent from SAFE releases, 7.8 percent from LCR stocks, and 1.6 percent from upriver stocks. Based on recovery of 585 CWT's from 1998-2003 Tongue Point winter-spring fisheries, 70.4 percent were from locally-produced fish; 20.9 percent were from LCR stocks; 8.2 percent from releases above Bonneville Dam; and 0.5 percent from Oregon coastal stocks. Only 18 CWT's were recovered during the 2003 spring fishery in Deep River with 83.3 percent from SAFE releases, and the remainder (16.7 percent) from LCR stocks.

Expansion of visual stock classifications (corrected for coded-wire tag recoveries) by sampling rate and total landings indicates the chinook harvest in 1993-2003 select area winter-summer commercial fisheries consisted of 80.8 percent SAFE stocks, 14.9 percent LCR stocks, 3.5 percent upriver stocks, and ~0.4 percent each for summer chinook and Oregon coastal stocks (Table 3.6). During this period the estimated harvest of upriver spring chinook ranged from 0-562 fish annually, of which 0-124 fish were of Snake River

wild origin (Table 3.7). The estimated annual harvest of Willamette River wild spring chinook ranged from 0 fish during 1993-1996 to 194 fish in 2002. The estimated harvest of Columbia River summer chinook was  $\leq 24$  fish annually from 1999-2001, but increased to 55 and 65 fish in 2002 and 2003, respectively.

### Fishery Impacts

Estimated impact rates to ESA-listed stocks in winter-summer SAFE fisheries have been consistently low (Figure 3.4). From 1992-2003 combined harvest rates on upriver spring chinook in all winter-summer SAFE fisheries have averaged 0.06 percent (Table 3.7). The average impact rate for 2001-2003 increased to 0.16 percent, likely resulting from significant increases in the upriver spring chinook run size. Impacts to Willamette River wild spring chinook during 1996-2003 ranged from 0.28-1.62 percent, with an annual average impact of 0.79 percent. Impacts to upriver summer chinook have been very low, ranging from 0.03-0.06 percent during 1999-2003.

Fisheries in Youngs Bay have typically accounted for the majority of upriver spring and summer chinook impacts resulting from SAFE fisheries due to more fishing periods and higher effort for this site. From 1992-2003 combined harvest rates on upriver spring chinook in Youngs Bay winter-summer fisheries have averaged 0.04 percent, with a 2001-2003 average of 0.10 percent (Table 3.7). Impacts during winter seasons have typically been minor with the majority of upriver harvest occurring in April concurrent with increased fishing opportunities. Impacts to Willamette River wild spring chinook during 1996-2003 Youngs Bay fisheries have ranged from 0.26-1.15 percent. Harvest of upriver summer chinook in SAFE fisheries mainly occurs during the late-spring and summer fisheries in Youngs Bay, with impacts ranging from 0.02-0.06 percent during 1999-2003.

Impacts to listed stocks resulting from winter and spring fisheries in Blind Slough have been extremely low (Table 3.7), likely due to the isolated location of this site relative to the main Columbia River channel. From 1998-2003 the annual harvest of upriver spring chinook has ranged between 0-38 fish, with an annual harvest of 0-7 wild Snake River spring chinook (Table 3.6). During these six fishing seasons the annual impact for these two stocks has averaged  $< 0.006$  percent. Only one known upriver spring chinook has been landed since spring seasons were initially adopted at this site in 1998.

Since 1998, winter and spring fisheries in Tongue Point have accounted for 2.9-49.0 percent of the annual impacts to upriver spring chinook resulting from SAFE winter-summer fisheries. Actual harvest of this stock has ranged from 3-199 fish, representing 0.002-0.60 percent of the upriver run (Tables 3.6 and 3.7). Harvest of Snake River wild spring chinook has ranged between 0-35 fish. Impacts to summer chinook have been low ( $\leq 7$  fish or 0.008 percent) since summer fisheries have not been adopted at this site. Harvest of Willamette River wild spring chinook has ranged from 0-38 fish annually (0.007-0.315 percent impact rate).

During the 2003 spring fishery in Deep River an estimated 22 upriver spring chinook were harvested, representing a 0.01 percent impact to the upriver run (Table 3.7). The catch included few other listed stocks (one wild Willamette River spring chinook and zero summer chinook).

## FALL COMMERCIAL FISHERIES

### Season Structure

Select area fall fisheries occur between August 1 and October 31 (statistical weeks 32-44), and are managed to primarily harvest hatchery or net-pen reared coho and fall chinook salmon. As with other select area fisheries, the management goal is to achieve 100 percent harvest of SAFE stocks, while minimizing impacts to non-local stocks. Fall seasons have been adopted in Youngs Bay since 1962; in Tongue Point Basin, Blind Slough and Deep River since 1996; and in Steamboat Slough since 2000. Since 1996 the fall season format has consisted of weekly fishing periods in Youngs Bay during August to target SAB fall chinook, followed by liberal fishing opportunities in all sites from Labor Day (early September) through the end of October to maximize harvest of net-pen reared coho. The majority of the coho harvest occurs during the first three weeks of September, while SAB harvest is usually distributed throughout August and early September.

### Youngs Bay

Fall seasons in Youngs Bay typically begin during the second week of August and continue for four weeks through Labor Day weekend with 30-hour weekly fishing periods to provide a reasonable commercial harvest opportunity for SAB fall chinook, while minimizing interception of non-local salmonid stocks. This season framework has been used since 1996 to maximize commercial harvest, while maintaining an opportunity for recreational harvest and providing escapement of broodstock to Klaskanine Hatchery.

Following Labor Day weekend, a very liberal season running continuously (no closed periods) through the end of October is typically adopted to harvest net-pen coho, whose abundance peaks in mid-September, and late returning SAB fall chinook. This season structure has been effective at harvesting approximately 98 percent of the returning SAFE coho production annually (1993-1997 broods). Annual participation in this fishery has averaged 77 fishers from 1996-2002 (Table 3.4).

Net weight and length regulations are the same as all other commercial fisheries in Youngs Bay with a maximum net length of 250 fathoms and maximum net weight of two pounds of weight per fathom. An 8-inch maximum mesh size restriction is in place during most of the August component of the fall season to target chinook salmon. A 6-inch maximum mesh is required during September and October to target coho. During August the upper fishing deadline is generally moved downstream from the confluence of the Klaskanine and Youngs rivers to Battle Creek Slough to allow increased SAB fall chinook escapement to Klaskanine Hatchery. Allowable sales include salmon and sturgeon; however, weekly vessel sturgeon limits or sturgeon retention prohibitions have been imposed in recent years to maintain sturgeon harvest at historic levels and for consistency with mainstem regulations.

### Tongue Point/South Channel, Blind Slough/Knappa Slough, Deep River, and Steamboat Slough

The structure of fall seasons in Tongue Point/South Channel, Blind Slough/Knappa Slough, Deep River, and Steamboat Slough are similar and generally consist of three or four 12-hour nighttime fishing periods each week beginning immediately after Labor Day and continuing through September. Fishing periods are lengthened to 14 hours during October as available daylight and recreational fishing activity decrease. This season format provides reasonable commercial harvest opportunities with little interaction to, or negative effect on, recreational fisheries. Occasionally August fishing periods are adopted in Knappa Slough whenever large returns of “tule” fall chinook are predicted to return to Big Creek Hatchery. Fishing periods focusing on “tule” fall chinook in Knappa Slough typically occur during late August and early September, with length and number of fishing periods varying in response to expected surplus. Annual participation in these fisheries ranges from 7-54 fishers.

Regulations governing length and weight of nets and fishing boundaries for these select areas are generally the same as in their corresponding spring fisheries. In Steamboat Slough, net length cannot exceed 100 fathoms in length, but there are no net-weight restrictions. Except for the August Knappa Slough fishery, the maximum allowable mesh size is 6-inches during fall seasons in these select areas. Allowable sales include all salmon species and sturgeon, although specific sturgeon harvest rules may be adopted annually.

### **Results of Fall Fisheries**

Since the initiation of SAFE fisheries, harvest at Youngs Bay has ranged from 1,225 to 5,157 chinook and 13,644 to 94,279 coho (Table 3.8). The remaining sites have harvested a minimum of 0, to a maximum of 2,760 chinook per site, with a range of 26 to 15,598 coho. No more than three chum have been caught annually at any site. Commercial harvest in 2003 was the highest of the reporting period with 9,723 chinook and 117,133 coho landed for all sites combined (Table 3.8). Incidental harvest of white sturgeon in select area fall fisheries has not exceeded 334 fish annually, with most harvest occurring in Youngs Bay and Tongue Point.

For the period 1993-1998 coho minimum run levels were among the lowest in the past 30 years (ODFW and WDFW 2001). During many of those years the only unrestricted fisheries were select area fisheries. Since then run sizes have increased, allowing for larger mainstem commercial fisheries. The annual contribution of coho harvested in select areas to the total lower Columbia River commercial harvest during 1993-2003 averaged 40.9 percent (Table 3.3).

Fishermen participation in fall select area fisheries was influenced by strength of adult returns and market price. From 1996-2003 an average of 142 fishermen participated in fall select area fisheries, but ranged from a low of 96 fishers in 2001 to 192 in 2000. (Table 3.4). Youngs Bay consistently draws the most participants due to its size and significantly higher returns. Effort was influenced considerably in 2001 due to low coho prices.

## **Stock Composition**

In 1996 fishery monitoring was initiated at all of the new select area fishery sites. About 20 percent of the Youngs Bay harvest was sampled, but at Tongue Point, Blind Slough, and Deep River regulations were initiated that restricted transport of harvested fish from the fishing area prior to examination by an agency sampler. For the first three seasons this helped prevent mixing of select area catches with fish harvested in the mainstem Columbia River and facilitated a near 100 percent sampling rate. Since 1999 the sampling goal has been to sample at least 20 percent of the harvest in each select area.

### Coho

The results of the 1996-2002 CWT sampling of harvested coho are presented in Table 3.9. For the four SAFE sites releasing fish since 1995, fisheries were dominated by fish of net-pen origin; averaging 85.9 percent at Deep River, 81.6 percent at Blind Slough, 87.1 percent at Youngs Bay, and 79.8 percent at Tongue Point (Figure 3.5). Youngs Bay, Blind Slough and Deep River all had the majority of their catch of local origin. All of the sites had an average of less than one (1.0) percent contribution from above Bonneville Dam. The first years of the Steamboat Slough fishery were the exception, with 57.8 percent of SAFE origin (42.5 percent local), 41.2 percent below Bonneville, and 1.0 percent above Bonneville Dam. The reason for low harvest and few local origin contributors will be shown in Chapter 5.

### Fall Chinook

The stock composition from expanded CWT recoveries of fall chinook harvested in select area sites from 1996 through 2002 varied considerably, depending on whether and when SAB fall chinook had been released at that site. As described previously, SAB fall chinook had been released at Youngs Bay since the beginning of the project, while Blind Slough and Tongue Point had limited numbers released for only two brood years (1995-1996). No fall chinook have been released at Deep River.

At all sites, fall chinook harvest occurred predominantly before the first week of September. At Youngs Bay, with annual releases of 153,000 to 1.4 million smolts, the harvest showed predominant contributions of SAFE SAB chinook (Table 3.10; Figure 3.6). At Blind Slough and Tongue Point the SAFE segment of the catch was greatly reduced, however the proportion increased throughout the 1996-2000 study period as the 1995-1996 brood SAB fall chinook appeared in those fisheries. At Deep River, with the lowest fall chinook harvest and no local releases, all fall chinook were of non-local origin. The average harvest contribution of stocks originating above Bonneville Dam to each select area fishing site was 0.9 percent at Deep River, 1.8 percent at Youngs Bay, 2.5 percent at Blind Slough, and 21.5 percent at Tongue Point.

For all SAFE fall fisheries combined during 1993-2000, the impact rate to Snake River wild fall chinook has ranged from 0.00 percent-0.15 percent, and has averaged 0.04 percent. At the time this document was completed run size estimates were not available for 2001-2003; therefore, specific impacts cannot be estimated for these years. The

preliminary 2003 estimate for harvest and impacts to Snake River wild fall chinook is 510 fish and 0.13 percent impact rate. The impact rates on LRH fall chinook during 1993-2002 have ranged from 0.00 percent-3.89 percent, and have averaged 1.41 percent (Table 3.11). Impact rates on LRW fall chinook have been 0.0 percent since none of this stock has been observed in commercial landings or sport catches. Very few chum salmon are landed in select area fall fisheries, with impact rates not exceeding 0.24 percent in any year during 1996-2002 (Table 3.12).

## **RECREATIONAL**

The SAFE project benefits many different recreational fisheries in the region. Contributions of select area fish to Columbia River mainstem and ocean recreational fisheries have been significant (see Chapters 5 and 8) since these fisheries were already established. Recreational fisheries within SAFE fishing sites have evolved slowly due to these other angling opportunities in the lower Columbia River area and relatively low adult returns early in the program's history. Recently, both effort and harvest in SAFE sport fisheries has increased significantly, likely due to increasing adult returns and quality fishing opportunities. Presently all species produced by the SAFE project are targeted by recreational fisheries; however, the magnitude of the effort and catch differs greatly between sites and years. The most popular and productive fisheries occur in Blind Slough/Knappa Slough and Youngs Bay during March-May for spring chinook and in the Klaskanine River/Youngs Bay from July-October for SAB fall chinook. Angling for coho salmon occurs during August-October in Knappa Slough, Big Creek, Klaskanine River (both forks), Deep River, and directly from the Youngs Bay net pens during some years. Only limited coho angling occurs in the Tongue Point and Steamboat Slough areas.

Since 1998 year-round recreational seasons have been in effect for chinook and adipose fin-clipped coho in Youngs Bay, Tongue Point and Blind Slough. Similar regulations were adopted for South Channel and Knappa Slough in 1999 and for Deep River in 2000. In 2003 regulations to allow year-round angling for adipose fin-clipped steelhead were adopted in all select areas. To meet guidelines of the Willamette Fish Management Plan, select area recreational spring chinook fisheries will be managed for selective spring chinook harvest effective January 1, 2004, with retention restricted to adipose-fin clipped spring chinook only during January 1-July 31 in all Oregon SAFE sites. A similar regulation requiring release of unmarked chinook from January 1-July 31 is in effect for Deep River in Washington. These regulations will further minimize impacts to listed stocks of spring chinook. Angling for fall chinook is open in all areas from July-December. Effective January 1, 2004 salmon angling regulations were liberalized for tributaries entering Oregon SAFE fishing areas to allow nearly year-round recreational harvest opportunities. These changes were adopted to maximize angling opportunity and minimize effects of SAFE fish straying to these streams.

Recreational harvest in SAFE areas has increased significantly since creel surveys were initiated in 1998 (Figure 3.7). Harvest of spring chinook increased from only 25 fish harvested in 1999 to an estimated 1,400 in 2004 (Table 3.13). Most of this increase was due to growing effort in Knappa Slough, although an estimated 450 fish were landed in Gnat and Big creeks in 2003 due to restrictions imposed on the commercial fishery that resulted in increased escapement to these streams. From 1998-2003 landings of SAB fall chinook fluctuated between 50 and 637 fish annually. Sport effort for this stock has shifted from Knappa Slough to the tidewater sections of Youngs and Klaskanine rivers commensurate with transfer of the broodstock program to Klaskanine Hatchery. This fishery has grown rapidly in recent years and may require further restrictions to ensure adequate broodstock escapement.

Recreational harvest of coho within SAFE areas has increased steadily from 118 fish landed in 1998 to 772 fish in 2003. The most significant landings of coho in recent years have occurred in Youngs and Klaskanine rivers.

Although recreational harvest in select areas has increased since 1998, future seasons will

likely remain unchanged to maximize fishing opportunities unless impacts to listed stocks increase substantially. During 2001-2003 impact rates have been low, ranging from 0.002-0.014 percent for upper Columbia River and Snake River wild spring chinook, and 0.04-0.07 percent for Willamette River wild spring chinook (Table 3.14).



Figure 3.7. Select area recreational anglers with a select area bright fall chinook and coho.

Table 3.2. Select area winter, spring, and summer commercial seasons and harvest, 1992-2004.

Year	Fishery	Season	Days	Chinook	Coho	Chum	White Sturgeon
1992	Youngs Bay	Apr. 27 - May 26	9	296	0	0	10
		Total	9	296	0	0	10
1993	Youngs Bay	Apr. 26 - May 26	9	851	0	0	32
		Total	9	851	0	0	32
1994	Youngs Bay	Apr. 25 - May 25	9	155	0	0	31
		Total	9	155	0	0	31
1995	Youngs Bay	May 1 - Jun. 7	11	201	0	0	108
		Total	11	201	0	0	108
1996	Youngs Bay	Apr.29 - Jun. 14	15	789	0	0	581
		Total	15	789	0	0	581
1997	Youngs Bay	Apr. 28 - Jun. 13	22	1,821	0	0	351
		Total	22	1,821	0	0	351
1998	Youngs Bay	Feb. 25 - Mar. 4	2	74	0	0	6
	Youngs Bay	Apr. 23 - Jun. 12	23	2,093	0	0	251
	Tongue Point	Apr. 29 - May 27	9	31	0	0	79
	Blind Slough	Apr. 29 - Jun 12	13	60	0	0	19
	Total	47	2,258	0	0	355	
1999	Youngs Bay	Feb. 24 - Mar 11	3	4	0	0	1
	Youngs Bay	Apr. 22 - Jun. 11	26	936	0	0	84
	Youngs Bay	Jun. 14 - Jul. 28	10	358 <sup>a</sup>	0	0	85
	Tongue Point	Apr. 28 - Jun. 9	13	199	0	0	260
	Blind Slough	Apr. 28 - Jun. 11	13	450	0	0	94
	Blind Slough	Jun. 24 - Jul. 2	3	8	0	0	0
	Total	68	1,955	0	0	524	
2000	Youngs Bay	Feb. 23 - Mar. 8	3	33	0	0	6
	Youngs Bay	Apr. 19 - Jun. 5	23	4,494	0	0	189
	Youngs Bay	Jun. 12 - Jul. 26	11	204 <sup>b</sup>	0	0	78
	Tongue Point	Feb. 29 - Mar. 14	3	10	0	0	5
	Tongue Point	Apr. 24 - Jun. 14	15	937	0	0	220
	Blind Slough	Feb. 27 - Mar. 13	3	8	0	0	0
	Blind Slough	Apr. 23 - Jun. 13	15	810	0	0	44
	Total	73	6,497	0	0	542	
2001	Youngs Bay	Feb. 21 - Mar. 9	3	544	0	0	14
	Youngs Bay	Apr. 18 - Jun. 4	30	4,462	0	0	122
	Youngs Bay	Jun. 18 - Jul. 31	9	587	0	0	181
	Tongue Point	Feb. 20 - Mar. 7	3	124	0	0	2
	Tongue Point	Apr. 17 - Jun. 13	15	1,507	0	0	145
	Blind Slough	Feb. 19 - Mar. 6	3	14	0	0	0
	Blind Slough	Apr. 2 - Jun. 14	18	2,031	0	0	27
	Total	81	9,269	0	0	491	

continued

Table 3.2. (continued) Select area winter, spring, and summer commercial seasons and harvest, 1992-2004.

2002	Youngs Bay	Feb. 20 – Mar. 8	6	199	0	0	3
	Youngs Bay	Apr. 17 – Jun. 13	30	5,749	0	0	135
	Youngs Bay	Jun. 19 – Aug. 1	9	695	0	0	103
	Tongue Point	Apr. 18 – Jun. 12	15	3,003	0	0	354
	Blind Slough	Feb. 18 – Mar. 5	3	19	0	0	1
	Blind Slough	Apr. 18 – Jun. 12	15	2,034	0	0	48
	Total		78	11,699	0	0	644
2003 <sup>c</sup>	Youngs Bay	Feb. 18 – Feb. 25	3	74	0	0	1
	Youngs Bay	Apr. 16 – Jun. 12	21	4,963 <sup>d</sup>	0	0	81
	Youngs Bay	Jun. 18 – Jul. 31	9	279	0	0	102
	Tongue Point	Apr. 17-18	1	348	0	0	11
	Blind Slough	Feb. 18 – Mar. 2	3	12	0	0	0
	Blind Slough	Apr. 17 – Jun. 13	13	2,027	0	0	32
	Deep River	Apr. 17 – Jun. 13	20	117	0	0	28
		Total		70	7,820	0	0
2004	Youngs Bay	Feb. 14 – Mar. 21	9	1,050	0	0	8
	Youngs Bay	Apr. 12 – Jun. 18	22	5,611	0	0	92
	Youngs Bay	Jun. 23 – Jul. 29	8	188	0	0	12
	Blind Slough	Feb. 14 – Mar. 21	6	291	0	0	1
	Blind Slough	Apr. 12 – Jun. 18	13	3,240	0	0	59
	Deep River	Apr. 23 – Jun. 18	12	113	0	0	5
		Total		70	10,493	0	0

<sup>a</sup> Includes 196 select area bright fall chinook

<sup>b</sup> Includes 70 spring chinook and 134 select area bright fall chinook

<sup>c</sup> Anticipated seasons in 2003 were reduced significantly due to high abundance of non-local stocks

<sup>d</sup> Includes 108 select area bright fall chinook

Table 3.3. Harvest (thousands) of salmon in lower Columbia River mainstem and select area commercial fisheries, 1993-2004.

Species/Year	Minimum Adult Run	Mainstem Harvest	SAFE Harvest	SAFE %
<u>Spring chinook</u>				
1993	201.2	1.5	0.9	36.2
1994	81.5	1.9	0.2	7.5
1995	60.5	0.0	0.2	100.0
1996	93.9	0.1	0.8	87.7
1997	159.5	0.1	1.8	95.2
1998	91.4	0.01	2.3	99.5
1999	101.4	0.02	2.0	99.2
2000	250.8	0.5	6.5	92.9
2001	508.4	6.7	9.3	58.2
2002	431.6	14.4	11.7	44.9
2003	364.8	3.2	7.8	71.1
2004	nya	13.6	10.5	43.5
<u>Fall Chinook</u>				
1993	213.9	17.0	0.4	2.1
1994	255.3	1.7	0.1	6.7
1995	244.7	0.06	0.8	93.8
1996	331.8	12.0	1.6	11.8
1997	326.8	4.6	2.1	31.2
1998	255.3	2.4	1.7	42.2
1999	313.1	5.9	2.1	26.6
2000	255.8	10.9	2.3	17.5
2001	556.2	21.5	3.1	12.6
2002	737.0	35.0	8.6	19.7
2003	885.0	58.4	9.7	14.3
<u>Coho</u>				
1993	113.9	20.7	15.5	42.8
1994	168.6	6.0	57.8	90.5
1995	74.5	0.2	22.3	98.9
1996	113.8	5.6	22.3	79.8
1997	149.8	2.8	16.9	86.0
1998	165.1	0.3	24.1	98.8
1999	270.9	57.6	23.0	28.5
2000	553.5	112.4	61.7	35.5
2001	1,112.9	219.7	33.8	13.3
2002	514.8	94.9	69.3	42.2
2003	893.7	149.8	117.1	43.9

Table 3.4. Numbers of commercial fishers participating in select area fisheries, 1996-2003.

Year	Season	Youngs Bay	Tongue Point	Blind Slough	Deep River	Steamboat Slough	All Areas
1996	Spring	53	a	a	a	a	53
	Fall	87	31	24	17		159
1997	Spring	49	a	a	a	a	49
	Fall	78	22	24	18		142
1998	Spring	69	14	11	a	a	94
	Fall	68	28	19	--		115
1999	Spring	57	21	21	a	a	99
	Fall	81	41	21	7		150
2000	Spring	74	43	40	a	a	157
	Fall	83	54	21	26	13	192
2001	Spring	94	71	53	a	a	218
	Fall	70	8 <sup>b</sup>	12 <sup>b</sup>	6	0	96
2002	Spring	79	51	27	a	a	157
	Fall	73	34 <sup>b</sup>	16 <sup>b</sup>	4	2	129
2003	Spring	92	32	37	5	a	166
	Fall	80	48 <sup>b</sup>	16 <sup>b</sup>	6	4	154

<sup>a</sup> No season

<sup>b</sup> Mainstem Columbia River season open concurrently

Table 3.5. Stock composition of coded-wire tagged chinook salmon harvested in select area winter, spring, and summer commercial fisheries <sup>a</sup>, 1993-2003.

Fishery	Year	Harvest	Total Recoveries	Oregon Coast	Above Bonneville	Below Bonneville			Origins of above Bonneville Dam recoveries
						Non-SAFE	SAFE		
						Local <sup>b</sup>	Non-Local		
Youngs Bay	1993	851	230		3	41	186		2 - Deschutes R., 1 - Dworshak NFH
	1994	155	29			2	27		
	1995	201	107			2	105		
	1996	789	95		2	15	78		2 - Umatilla H.
	1997	1,821	479		8	21	450		2 - Dworshak NFH, 2 - Imnaha R., 2 - Similkameen R., 2 - S. Fk. Salmon R.
	1998	2,167	581	1	5	16	559		1 - S. Fk. Clearwater, 1 - Dworshak NFH, 2 - W. Fk. Hood R., 1 - Rapid R. H
	1999	1,298	338	1	14	36	287		2 - Col R. general, 3 - Col. R. @ Turtle Rock, 2 - Dworshak NFH, 1 - Methow R., 1 - Wind R., 1 - Similkameen H, 3 - Wenatchee R., 1 - Warm Springs NFH
	2000	4,731	752		15	87	592	58	2 - Turtle Rock Hatchery, 5 - Warm Springs NFH 1 - Lookingglass H, 1 - Round Butte H, 1 - Clearwater H 1 - Similkameen H, 4 - McCall H
	2001	5,593	424	1	18	55	320	30	4 - Warm Springs NFH, 3 - McCall H, 3 - Wells H, 1 - Clark Pnd 2 - Round Butte H, 1 - Lookingglass H, 1 - Winthrop NFH 1 - Clearwater NFH, 1 - Turtle Rock H, 1 - Chiwawa H 13 - Warm Springs NFH, 16 - Round Butte, 1 - Carson NFH,
	2002	6,643	470	1	59	172	181	57	4 - Little White Salmon NFH, 4 - Dryden Pond, 3 - Wells H 1 - Winthrop NFH, 1 - Leavenworth NFH, 2 - Klickitat H, 3 - Lookingglass H, 2 - Irrigon, 1 - Umatilla H, 2 - Similkameen H 2 - McCall H, 2 - Turtle R. H, 1 - Rapid R. H, 1 - Chiwawa H
	2003	5,316	470	1	34	80	325	30	8 - Warm Springs NFH, 7 - Round Butte H., 3 - McCall H 4 - Lookingglass H, 3 - Leavenworth NFH, 1 - Winthrop NFH
			3,975	5	158	527	3,111	175	1 - Entiat NFH, 2 - Umatilla H, 1 - Wells H, 2 - Methow H
				0.1%	4.0%	13.2%	78.3%	4.4%	1 - Dryden Pond, 1 - Little White Salmon NFH
								82.7%	

<sup>a</sup> Recoveries from February-July commercial fisheries

<sup>b</sup> Includes SAB fall chinook

continued

Table 3.5. (continued) Stock composition of coded-wire tagged chinook salmon harvested in select area winter, spring, and summer commercial fisheries<sup>a</sup>, 1993-2003.

Fishery	Year	Harvest	Total Recoveries	Oregon Coast	Above Bonneville	Below Bonneville			Origins of above Bonneville Dam recoveries
						Non-SAFE	SAFE		
						Local <sup>b</sup>	Non-Local		
Tongue Point	1998	31	5				5		
	1999	199	27	1	1	3	22		1 – Warm Springs NFH
	2000	937	195		4	15	121	55	2-Warm Springs NFH, 1-McCall H, 1-Wells H
	2001	1,507	158	1	17	46	37	57	4-Chiwawa H, 3-Lookingglass H, 3-Round B. H, 2-Warm S. H, 1-Leavenworth, 1-Clearwater, 1-Wells H, 1-Clark P., 1-Carson
	2002	3,003	182	1	20	51	46	64	5-Round B. H, 2-Umatilla, 2-Warm S., 2-Dworshak NFH, 2-Clearwater, 2-Similkameen, 1-McCall, 1-Lookingglass, 1-Winthrop, 1-Chiwawa, 1-Dryden Pond
	2003	348	18		6	7		5	3-Round B. H, 1-Carson H, 1-Warm S. NFH, 1-Lookingglass H
			585	3	48	122	231	181	
				0.5%	8.2%	20.9%	39.5%	30.9%	
								70.4%	
Blind Slough	1998	60	15			1	14		
	1999	458	92			8	84		
	2000	818	226			14	169	43	
	2001	2,045	329		16	44	143	126	3-Round B., 2-Winthrop, 2-Warm S., 2-Methow, 1-Little White S, 1-Dworshak, 1-Lookingglass, 1-Sawtooth, 1-Clearwater, 1-Tucannon, 1-Clark Flat Pond
	2002	2,053	490		5	49	403	33	1-Carson, 1-Leavenworth, 1-Warm S., 1-Umatilla, 1-Round B.
	2003	2,039	457		5	9	368	75	2-Carson NFH, 1-Lookingglass H, 1-Methow H, 1-Round Butte
			1,609		26	125	1,181	277	
				0.0%	1.6%	7.8%	73.4%	17.2%	
								90.6%	
Deep River	2003	117	18			3	13	2	None
			18			3	13	2	
				0.0%	0.0%	16.7%	72.2%	11.1%	
								83.3%	

<sup>a</sup> Recoveries from February-July commercial fisheries

<sup>b</sup> Includes SAB fall chinook

Table 3.6. Estimated stock composition of chinook salmon harvested in select area winter, spring, and summer commercial fisheries based on expanded coded-wire tag recoveries, 1992-2003.

Year	Fishery	Stock Component (%)					Total
		Local <sup>a</sup>	Lower River	Upriver	Coastal	Summer	
1992	Youngs Bay	245 (83%)	44 (15%)	7 (2%)			296
1993	Youngs Bay	496 (58%)	343 (40%)	12 (<2%)			851
1994	Youngs Bay	127 (82%)	26 (17%)	2 (1%)			155
1995	Youngs Bay	187 (93%)	14 (7%)	0 (0%)			201
1996	Youngs Bay	705 (89%)	71 (9%)	13 (<2%)			789
1997	Youngs Bay	1,613 (89%)	189 (10%)	19 (1%)			1,821
1998	Youngs Bay	1,954 (90%)	171 (8%)	24 (1%)	17 (<1%)	0	2,167
	Tongue Point	25 (80%)	3 (10%)	3 (10%)	0	0	31
	Blind Slough	57 (95%)	3 (5%)	0 (0%)	0	0	60
		2,036 (90%)	177 (8%)	27 (1%)	17	0 (0%)	2,258
1999	Youngs Bay	1,012 (78%)	265 (20%)	16 (1%)	5 (<1%)	0	1,298
	Tongue Point	168 (84%)	13 (7%)	7 (4%)	11 (5%)	0	199
	Blind Slough	351 (77%)	105 (23%)	2 (<1%)	0	0	458
		1,531 (78%)	383 (20%)	25 (1%)	16 (<1%)	0 (0%)	1,955
2000	Youngs Bay	3,984 (84%)	706 (15%)	20 (<1%)	0	21 (<1%)	4,731
	Tongue Point	803 (85%)	138 (15%)	3 (<1%)	0	3 (<1%)	947
	Blind Slough	726 (89%)	92 (11%)	0 (0%)	0	0	818
		5,513 (85%)	936 (14%)	23 (<1%)	0 (0%)	24 (<1%)	6,496
2001	Youngs Bay	5,128 (92%)	261 (5%)	172 (3%)	13 (<1%)	19 (<1%)	5,593
	Tongue Point	1,245 (76%)	152 (9%)	199 (12%)	31 (2%)	4 (<1%)	1,631
	Blind Slough	1,747 (85%)	259 (13%)	38 (2%)	0	1 (<1%)	2,045
		8,120 (88%)	672 (7%)	409 (4%)	44 (<1%)	24 (<1%)	9,269
2002	Youngs Bay	4,558 (69%)	1,651 (25%)	356 (5%)	30 (<1%)	48 (<1%)	6,643
	Tongue Point	2,262 (75%)	552 (18%)	173 (6%)	9 (<1%)	7 (<1%)	3,003
	Blind Slough	1,813 (88%)	207 (10%)	33 (2%)	0	0	2,053
		8,633 (74%)	2,410 (21%)	562 (5%)	39 (<1%)	55 (<1%)	11,699
2003	Youngs Bay	3,931 (74%)	971 (18%)	300 (6%)	49 (<1%)	65 (1%)	5,316
	Tongue Point	94 (27%)	188 (54%)	66 (19%)	0	0	348
	Blind Slough	1,948 (96%)	64 (3%)	27 (1%)	0	0	2,039
	Deep River	81 (69%)	14 (12%)	22 (19%)	0	0	117
		6,054 (77%)	1,237 (16%)	415 (5%)	49 (<1%)	65 (<1%)	7,820

<sup>a</sup> Includes SAB fall chinook

Table 3.7. Summary of spring chinook harvest impacts during winter-summer select area commercial fisheries, 1992-2003.

Year	Site	Upper Columbia River Spring Chinook						Willamette River Wild Spring Chinook					Sandy R. Wild Spring Chinook			Columbia River Summer Run				
		Total Adult Harvest	% Upriver VSI Group	Upriver Run Size	SAFE Upriver Harvest	% Upriver Impacts	Snake River Wild Run Size	SAFE Snake River Wild Harvest	% Snake River Wild Impacts	% Willamette River Stock	SAFE Willamette River Harvest	Willamette River Run Size	Willamette River Harvest Rate	Number Willamette River Wild	Sandy River Wild Run Size	SAFE Sandy River Harvest	% Sandy River Impacts	Columbia River Summer Run Size	SAFE Columbia River Summer Run Harvest <sup>a</sup>	% Columbia River Summer Run Impacts
1992	Youngs Bay	296	2.36%	89,969	7	0.008%	16,198	1	0.008%		0	75,000	0.000%	0	-	-	-	15,150	0	0.000%
1993	Youngs Bay	851	1.41%	111,758	12	0.011%	7,740	1	0.011%		0	65,900	0.000%	0	-	-	-	22,226	0	0.000%
1994	Youngs Bay	156	1.28%	21,075	2	0.009%	2,067	0	0.009%		0	49,600	0.000%	0	-	-	-	17,711	0	0.000%
1995	Youngs Bay	201	0.00%	10,197	0	0.000%	1,791	0	0.000%		0	42,600	0.000%	0	-	-	-	15,052	0	0.000%
1996	Youngs Bay	789	1.65%	51,530	13	0.025%	3,897	1	0.025%	21.67%	171	34,800	0.491%	17	-	-	-	16,102	0	0.000%
1997	Youngs Bay	1,806	1.05%	114,124	19	0.017%	4,750	1	0.017%	10.47%	189	35,300	0.535%	19	-	-	-	27,977	0	0.000%
1998	Youngs Bay	2,167	1.11%	38,376	24	0.063%	9,620	6	0.063%	5.49%	119	45,100	0.264%	12	-	-	-	21,468	0	0.000%
	Tongue Point	31	9.68%	38,376	3	0.008%	9,620	1	0.008%	9.68%	3	45,100	0.007%	0	-	-	-	21,468	0	0.000%
	Blind Slough	60	0.00%	38,376	0	0.000%	9,620	0	0.000%	5.00%	3	45,100	0.007%	0	-	-	-	21,468	0	0.000%
	<b>All SAFE</b>	<b>2,258</b>			<b>27</b>	<b>0.070%</b>		<b>7</b>	<b>0.070%</b>		<b>125</b>		<b>0.277%</b>	<b>13</b>					<b>0</b>	<b>0.000%</b>
1999	Youngs Bay	1,298	1.23%	38,700	16	0.041%	1,366	1	0.041%	13.25%	172	54,200	0.317%	17	3900	64	1.641%	26,299	0	0.000%
	Tongue Point	199	3.52%	38,700	7	0.018%	1,366	0	0.018%	5.03%	10	54,200	0.018%	1	3900	0	0.000%	26,299	0	0.000%
	Blind Slough	453	0.44%	38,700	2	0.005%	1,366	0	0.005%	14.57%	66	54,200	0.122%	7	3900	33	0.846%	26,299	0	0.000%
	<b>All SAFE</b>	<b>1,950</b>			<b>25</b>	<b>0.065%</b>		<b>1</b>	<b>0.065%</b>		<b>248</b>		<b>0.458%</b>	<b>25</b>		<b>97</b>	<b>2.487%</b>		<b>0</b>	<b>0.000%</b>
2000	Youngs Bay	4,731	0.42%	178,640	20	0.011%	5,741	1	0.011%	11.31%	535	57,500	0.930%	54	3800	114	3.000%	39,651	21	0.053%
	Tongue Point	947	0.32%	178,640	3	0.002%	5,741	0	0.002%	13.73%	130	57,500	0.226%	13	3800	0	0.000%	39,651	3	0.008%
	Blind Slough	818	0.00%	178,640	0	0.000%	5,741	0	0.000%	10.51%	86	57,500	0.150%	9	3800	0	0.000%	39,651	0	0.000%
	<b>All SAFE</b>	<b>6,496</b>			<b>23</b>	<b>0.013%</b>		<b>1</b>	<b>0.013%</b>		<b>751</b>		<b>1.306%</b>	<b>75</b>		<b>114</b>	<b>3.000%</b>		<b>24</b>	<b>0.061%</b>
2001	Youngs Bay	5,593	3.08%	416,418	172	0.041%	27,579	11	0.041%	4.40%	246	80,400	0.306%	25	5600	6	0.107%	76,377	19	0.025%
	Tongue Point	1,631	12.20%	416,418	199	0.048%	27,579	13	0.048%	7.60%	124	80,400	0.154%	12	5600	8	0.143%	76,377	4	0.005%
	Blind Slough	2,045	1.86%	416,418	38	0.009%	27,579	3	0.009%	8.17%	167	80,400	0.208%	17	5600	56	1.000%	76,377	1	0.001%
	<b>All SAFE</b>	<b>9,269</b>			<b>409</b>	<b>0.098%</b>		<b>27</b>	<b>0.098%</b>		<b>537</b>		<b>0.668%</b>	<b>54</b>		<b>70</b>	<b>1.250%</b>		<b>24</b>	<b>0.031%</b>
2002	Youngs Bay	6,643	5.25%	295,111	356	0.121%	60,233	73	0.121%	20.86%	1386	120,164	1.153%	139	7000	137	1.957%	129,012	48	0.037%
	Tongue Point	3,003	5.76%	295,111	173	0.059%	60,233	35	0.059%	12.59%	378	120,164	0.315%	38	7000	149	2.129%	129,012	7	0.005%
	Blind Slough	2,053	1.61%	295,111	33	0.011%	60,233	7	0.011%	8.67%	178	120,164	0.148%	18	7000	5	0.071%	129,012	0	0.000%
	<b>All SAFE</b>	<b>11,699</b>			<b>562</b>	<b>0.190%</b>		<b>115</b>	<b>0.190%</b>		<b>1,942</b>		<b>1.616%</b>	<b>194</b>		<b>291</b>	<b>4.157%</b>		<b>55</b>	<b>0.043%</b>
2003	Youngs Bay	5,316	5.70%	208,900	300	0.144%	62,300	89	0.144%	14.57%	775	126,600	0.612%	93	nya	56	nya	116,900	65	0.056%
	Tongue Point	348	19.00%	208,900	66	0.032%	62,300	20	0.032%	52.30%	182	126,600	0.144%	22	nya	0	nya	116,900	0	0.000%
	Blind Slough	2,039	1.30%	208,900	27	0.013%	62,300	8	0.013%	2.65%	54	126,600	0.043%	6	nya	0	nya	116,900	0	0.000%
	Deep River	117	18.64%	208,900	22	0.010%	62,300	7	0.010%	4.27%	5	126,600	0.004%	1	nya	0	nya	116,900	0	0.000%
	<b>All SAFE</b>	<b>7,820</b>			<b>415</b>	<b>0.199%</b>		<b>124</b>	<b>0.199%</b>		<b>1,011</b>		<b>0.798%</b>	<b>121</b>		<b>56</b>	<b>nya</b>		<b>65</b>	<b>0.056%</b>

<sup>a</sup> Data not available prior to 2000

nya=data not yet available

Table 3.8. Select area fall commercial seasons and harvest, 1996-2003.

Year	Fishery	Season	Days	Chinook	Coho	Chum	White Sturgeon <sup>a</sup>
1996	Youngs Bay	Aug. 12 - Sept. 6	10	1,439	15,783	3	85
		Sept. 9 - Oct. 31	52				
	Tongue Point	Sept. 17 - Oct. 31	14	50	1,955	0	--
	Blind Slough	Sept. 16 - Oct. 29	13	82	2,301	2	--
	Deep River	Sept. 16 - Oct. 29	13	35	2,240	0	--
	Total		102	1,606	22,279	5	85
1997	Youngs Bay	Aug. 11 - Aug. 28	7	1,726	13,644	2	76
		Sept. 3 - Oct. 31	59				
	Tongue Point	Sept. 3 - Oct. 24	16	180	861	1	--
	Blind Slough	Sept. 8 - Oct. 22	18	32	1,605	0	--
	Deep River	Sept. 8 - Oct. 22	18	149	821	1	--
	Total		118	2,087	16,936	4	76
1998	Youngs Bay	Aug. 10 - Sept. 4	11	1,225	20,121	2	102
		Sept. 8 - Oct. 31	53				
	Tongue Point	Sept. 10 - Oct. 23	13	421	3,398	1	68
	Blind Slough	Sept. 8 - Oct. 21	17	103	615	0	1
	Total		94	1,749	24,134	3	171
1999	Youngs Bay	Aug. 3 - Sept. 1	5	1,589	15,911	2	99
		Sept. 7 - Oct. 31	54				
	Tongue Point	Sept. 7 - Oct. 28	19	339	3,659	0	106
	Blind Slough	Sept. 9 - Oct. 28	19	167	1,958	0	4
	Deep River	Sept. 9 - Oct. 28	19	48	1,426	2	0
	Total		116	2,143	22,954	4	209
2000	Youngs Bay	Aug 1 - Aug. 30	5	1,744	33,214	1	88
		Sept. 5 - Oct. 31	56				
	Tongue Point	Sept. 5 - Oct. 31	32	252	10,731	0	59
	Blind Slough	Sept. 7 - Oct. 31	31	132	3,398	0	9
	Deep River	Sept. 5 - Oct. 31	32	109	13,392	1	0
	Steamboat Slough	Sept 7 - Oct. 28	30	78	362	0	1
	Total			2,315	61,745	2	157
2001	Youngs Bay	Aug. 6 - Aug. 28	4	2,040	25,469	1	21
		Sept. 4 - Oct. 31	57				
	Tongue Point	Sept. 4 - Oct. 31	33	116	2,021	0	0
	Blind Slough	Sept. 4 - Oct. 31	33	793	3,764	0	0
	Deep River	Sept. 4 - Oct. 31	33	149	2,491	0	0
	Steamboat Slough	Sept. 4 - Oct. 31	33	0	26	0	0
	Total			3,098	33,771	1	21
2002	Youngs Bay	Aug. 7 - Aug. 29	4	3,774	51,859	0	96
		Sept. 3 - Oct. 31	58				
	Tongue Point	Sept. 3 - Oct. 31	34	1,708	15,560	0	202
	Blind/Knappa Sloughs	Aug. 26 - Aug. 29	3				
		Sept 3 - Oct. 31	34	2,760	1,449	0	33
	Deep River	Sept. 3 - Oct. 31	34	145	303	1	3
	Steamboat Slough	Sept. 3 - Oct. 31	34	183	105	0	0
	Total			8,570	69,276	1	334
2003	Youngs Bay	Aug. 6 - Aug. 30	4	5,157	94,279	0	45
		Sept. 2 - Oct. 31	59				
	Tongue Point	Sept. 2 - Oct. 31	35	2,451	15,598	0	97
	Blind/Knappa Sloughs	Aug. 25 - Aug. 28	3				
		Sept. 2 - Oct. 31	35	1,903	3,816	0	28
	Deep River	Sept. 2 - Oct. 31	35	168	3,333	0	3
	Steamboat Slough	Sept. 2 - Oct. 31	35	44	107	0	0
	Total			9,723	117,133	0	173

Table 3.9. Stock composition of coho salmon harvested in select area fall<sup>a</sup> commercial fisheries based on coded-wire tag recoveries, 1996-2002.

Fishery	Year	Harvest	Total Recoveries	Below Bonneville				Origins of above Bonneville Dam recoveries
				Above Bonneville	SAFE		Non-Local	
					Non-SAFE	Local		
Youngs Bay	1996	15,783	1,594	0	220	1,207	167	
	1997	13,644	891	0	52	760	79	23-L. White Salmon Hat., 2-Ringold Pond, 4-Rosa Accl. Pond, 5-Umatilla R.
	1998	20,121	1,197	34	210	878	75	
	1999	15,911	1,614	4	51	1,467	92	2-L. Yakima R., 1-Umatilla R., 1-Wenatchee R.
	2000	33,214	2,857	3	348	2,309	197	3-Cascade Hatchery (Yakima R)
	2001	25,469	1,307	6	182	1,043	76	5-Umatilla R., 1-Little White Salmon
	2002	51,859	3,048	9	607	2,137	295	6-Willard NFH, 3-Cascade Hatchery
				0.6%	12.3%	79.4%	7.7%	
Tongue Point	1996	1,955	350	0	15	260	75	
	1997	861	62	0	3	37	22	
	1998	3,398	204	3	35	46	120	2-L. White Salmon, 1-Umatilla R.
	1999	3,659	459	1	33	255	170	1-Umatilla R.
	2000	10,731	589	0	155	199	235	
	2001	2,021	181	0	48	61	72	
	2002	15,560	1,057	7	555	309	188	4-Willard NFH, 3-Cascade Hatchery
				0.3%	19.8%	44.1%	35.7%	
Deep River	1996	2,240	393	0	6	374	13	
	1997	821	139	0	5	133	1	
	1998	0						
	1999	1,426	268	0	7	257	4	
	2000	13,392	2,120	0	83	2,027	10	
	2001	2,491	202	0	23	124	55	
	2002	303	73	3	42	23	5	3-Keta Creek Hatchery
				0.7%	13.4%	79.2%	6.7%	

continued

Table 3.9. (continued) Stock composition of coho salmon harvested in select area fall <sup>a</sup> commercial fisheries based on coded-wire tag recoveries, 1996-2002.

Blind Slough	1996	2,301	470	0	24	431	15	2-Cascade Hatchery
	1997	1,605	215	0	3	209	3	
	1998	615	52	0	6	22	24	
	1999	1,958	390	0	17	344	29	
	2000	3,398	436	0	47	381	8	
	2001	3,764	653	0	89	400	164	
	2002	1,449	192	2	155	2	33	
				0.1%	18.2%	67.0%	14.6%	
Steamboat Sl.	2000	362	32	1	8	19	4	1-Dworshak NFH
	2001	26	9	0	1	5	3	
	2002	105	16	0	14	2	0	
				1.0%	41.2%	42.5%	15.3%	

<sup>a</sup> Recoveries from August-October fisheries

Table 3.10. Stock composition of chinook salmon harvested in select area fall<sup>a</sup> commercial fisheries based on coded-wire tag recoveries, 1996-2002.

Fishery	Year	Harvest	Total Recoveries	Below Bonneville				Origins of above Bonneville Dam recoveries
				Above Bonneville	Non-SAFE	SAFE		
						Local	Non-Local	
Youngs Bay	1996	1,439	113		1	112		
	1997	1,726	317	1	1	315		1- Col. R. @ Turtle Rock
	1998	1,225	323	5	4	312	2	2- Clearwater R., 1- Col. R. general, 2-Snake R.
	1999	1,589	240	1	5	234		1-Lower Snake R.
	2000	1,744	431	14	6	407	4	2-Umatilla R., 6-Snake R., 3-Priest Rapids, 3-Columbia R. general
	2001	2,040	587	27	3	557		14-Lyons Ferry Hat., 6-Ringold Pond, 4-Spring Cr, NFH, 2-Turtle Rock Hat., 1-Umatilla R.
	2002	3,774	1,068	24	22	1,022		20-Lyons Ferry Hat., 2-Hanford Reach, 2-Spring Cr. NFH
				1.8%	1.2%	96.8%	0.2%	
Tongue Point	1996	50	4	1	3			1-Col. R. @ McNary
	1997	180	10	3	3		4	1-Clearwater R., 1-Col. R. near Wells, 1-Snake R.
	1998	421	47	14	6	4	23	2-Spring Cr. NFH, 8-L. Snake R., 2-Iron Gate Hatchery, 1-McNary, 1-Clearwater R.
	1999	339	62	12	2	40	8	3-Clearwater R., 1-Col. R. @ McNary, 1-Little White Salmon Hatchery, 6-Snake R., 1-Yakima R. @ Prosser
	2000	252	43	9	2	12	20	1-Col. R. general, 7-Snake R., 1-Spring Cr. NFH
	2001	116	52	2	2		48	2-Lyons Ferry Hatchery
	2002	1,708	139	30	23		86	15-Lyons Ferry Hat., 5-Spring Cr. NFH, 3-Hanford Reach, 3-Priest Rapids Hat., 3-Umatilla R @ Bonneville, 1-Umatilla Hat.,
				21.5%	20.9%	14.4%	43.2%	
Deep River	1996	35	6		5		1	
	1997	149	15		12		3	
	1998	0						
	1999	48	9				9	
	2000	109	18		5		13	
	2001	149	277		2		275	
	2002	145	53	3			50	3-Lyons Ferry Hatchery
				0.9%	32.0%	0.0%	67.1%	

continued

Table 3.10. (continued) Stock composition of chinook salmon harvested in select area fall<sup>a</sup> commercial fisheries based on coded-wire tag recoveries, 1996-2000.

Blind Slough	1996	82	6		6			
	1997	32	5		3	2		
	1998	103	30		4	24	2	
	1999	167	131	1	1	92	37	1-Lower Snake R.
	2000	132	13		2	3	8	
	2001	793	18	2			16	2-Priest Rapids Hatchery
	2002	2,760	92	5	80		7	2-Hanford Reach, 1-Lyons Ferry Hat., 2-Spring Cr. Hat.
				2.5%	39.5%	30.5%	27.6%	
Steamboat Slough	2000	78	4	1	3			1-Lower Snake R.
	2001	0						
	2002	183	11	1	5		5	1-Spring Cr. NFH
				17.0%	60.2%	0.0%	22.7%	

<sup>a</sup> Recoveries from August-October fisheries

Table 3.11. Summary of fall chinook harvest impacts during select area commercial fisheries, 1993-2003.

Year	Site	Upriver Bright Harvest	Upriver Bright Run Size	Snake River Wild (SRW) Run Size	SAFE SRW Harvest	% SRW Impacts	Lower River Hatchery (LRH) Run Size	SAFE LRH Harvest	% LRH Impacts	Lower River Wild (LRW) Run Size	SAFE LRW Harvest	% LRW Impacts
1993	Youngs Bay	46	102,908	1,620	1	0.045%	-	-	-	-	-	-
	Tongue Point	0	102,908	1,620	0	0.000%	-	-	-	-	-	-
	Blind Slough	0	102,908	1,620	0	0.000%	-	-	-	-	-	-
	<b>All SAFE</b>	<b>46</b>			<b>1</b>	<b>0.045%</b>	<b>52,300</b>	<b>0</b>	<b>0.000%</b>	<b>13,300</b>	<b>0</b>	<b>0.000%</b>
1994	Youngs Bay	0	132,839	1,055	0	0.000%	-	-	-	-	-	-
	Tongue Point	0	132,839	1,055	0	0.000%	-	-	-	-	-	-
	Blind Slough	0	132,839	1,055	0	0.000%	-	-	-	-	-	-
	<b>All SAFE</b>	<b>0</b>			<b>0</b>	<b>0.000%</b>	<b>53,600</b>	<b>0</b>	<b>0.000%</b>	<b>12,200</b>	<b>0</b>	<b>0.000%</b>
1995	Youngs Bay	44	106,459	1,223	1	0.041%	-	-	-	-	-	-
	Tongue Point	0	106,459	1,223	0	0.000%	-	-	-	-	-	-
	Blind Slough	0	106,459	1,223	0	0.000%	-	-	-	-	-	-
	<b>All SAFE</b>	<b>44</b>			<b>1</b>	<b>0.041%</b>	<b>46,400</b>	<b>0</b>	<b>0.000%</b>	<b>16,000</b>	<b>0</b>	<b>0.000%</b>
1996	Youngs Bay	0	143,193	1,957	0	0.000%	-	-	-	-	-	-
	Tongue Point	16	143,193	1,957	0	0.011%	-	-	-	-	-	-
	Blind Slough	0	143,193	1,957	0	0.000%	-	-	-	-	-	-
	Deep River	0	143,193	1,957	0	0.000%	-	-	-	-	-	-
	<b>All SAFE</b>	<b>16</b>			<b>0</b>	<b>0.011%</b>	<b>75,500</b>	<b>2,938</b>	<b>3.891%</b>	<b>14,600</b>	<b>0</b>	<b>0.000%</b>
1997	Youngs Bay	4	161,727	2,048	0	0.002%	-	-	-	-	-	-
	Tongue Point	0	161,727	2,048	0	0.000%	-	-	-	-	-	-
	Blind Slough	0	161,727	2,048	0	0.000%	-	-	-	-	-	-
	Deep River	0	161,727	2,048	0	0.000%	-	-	-	-	-	-
	<b>All SAFE</b>	<b>4</b>			<b>0</b>	<b>0.002%</b>	<b>57,400</b>	<b>2,220</b>	<b>3.868%</b>	<b>12,300</b>	<b>0</b>	<b>0.000%</b>
1998	Youngs Bay	22	142,301	864	0	0.015%	-	-	-	-	-	-
	Tongue Point	42	142,301	864	0	0.030%	-	-	-	-	-	-
	Blind Slough	0	142,301	864	0	0.000%	-	-	-	-	-	-
	Deep River	0	142,301	864	0	0.000%	-	-	-	-	-	-
	<b>All SAFE</b>	<b>64</b>			<b>0</b>	<b>0.045%</b>	<b>45,300</b>	<b>498</b>	<b>1.099%</b>	<b>7,300</b>	<b>0</b>	<b>0.000%</b>
1999	Youngs Bay	17	166,066	2,739	0	0.010%	-	-	-	-	-	-
	Tongue Point	80	166,066	2,739	1	0.048%	-	-	-	-	-	-
	Blind Slough	12	166,066	2,739	0	0.007%	-	-	-	-	-	-
	Deep River	0	166,066	2,739	0	0.000%	-	-	-	-	-	-
	<b>All SAFE</b>	<b>109</b>			<b>2</b>	<b>0.066%</b>	<b>40,000</b>	<b>380</b>	<b>0.950%</b>	<b>3,300</b>	<b>0</b>	<b>0.000%</b>
2000	Youngs Bay	86	155,744	1,977	1	0.055%	-	-	-	-	-	-
	Tongue Point	140	155,744	1,977	2	0.090%	-	-	-	-	-	-
	Blind Slough	0	155,744	1,977	0	0.000%	-	-	-	-	-	-
	Deep River <sup>a</sup>	1	155,744	1,977	0	0.001%	-	-	-	-	-	-
	<b>All SAFE</b>	<b>227</b>			<b>3</b>	<b>0.145%</b>	<b>27,000</b>	<b>135</b>	<b>0.500%</b>	<b>10,200</b>	<b>0</b>	<b>0.000%</b>
2001	Youngs Bay	22	232,446	nya	nya	nya	-	-	-	-	-	-
	Tongue Point	414	232,446	nya	nya	nya	-	-	-	-	-	-
	Blind Slough	387	232,446	nya	nya	nya	-	-	-	-	-	-
	Deep River <sup>a</sup>	0	232,446	nya	nya	nya	-	-	-	-	-	-
	<b>All SAFE</b>	<b>823</b>					<b>94,300</b>	<b>1,193</b>	<b>1.265%</b>	<b>15,700</b>	<b>0</b>	<b>0.000%</b>
2002	Youngs Bay	381	276,872	nya	nya	nya	-	-	-	-	-	-
	Tongue Point	350	276,872	nya	nya	nya	-	-	-	-	-	-
	Blind Slough	51	276,872	nya	nya	nya	-	-	-	-	-	-
	Deep River <sup>a</sup>	2	276,872	nya	nya	nya	-	-	-	-	-	-
	<b>All SAFE</b>	<b>784</b>					<b>156,400</b>	<b>3,887</b>	<b>2.485%</b>	<b>24,900</b>	<b>0</b>	<b>0.000%</b>
2003 <sup>b</sup>	Youngs Bay		380,000	nya			-	-	-	-	-	-
	Tongue Point		380,000	nya	510	0.130%	-	-	-	-	-	-
	Blind Slough		380,000	nya			-	-	-	-	-	-
	Deep River <sup>a</sup>		380,000	nya			-	-	-	-	-	-
	<b>All SAFE</b>	<b>0</b>			<b>510</b>	<b>0.130%</b>	<b>nya</b>	<b>nya</b>	<b>nya</b>	<b>nya</b>	<b>nya</b>	<b>nya</b>

<sup>a</sup> Includes landings for Steamboat Slough

<sup>b</sup> Upriver bright run size is estimate

Table 3.12. Summary of lower Columbia River chum and sockeye harvest impacts during select area commercial fisheries, 1996-2002.

Year	Site	Chum Impacts			Sockeye Impacts		
		SAFE Chum Harvest	Chum Run Size <sup>a</sup>	% Chum Impacts	SAFE Sockeye Harvest	Sockeye Run Size	% Sockeye Impacts
1996							
	Youngs Bay	3	3,300	0.091%	0	30,300	0.000%
	Tongue Point	0	3,300	0.000%	0	30,300	0.000%
	Blind Slough	2	3,300	0.061%	0	30,300	0.000%
	Deep River	0	3,300	0.000%	0	30,300	0.000%
	Steamboat Slough		3,300	0.000%		30,300	0.000%
	<b>All SAFE Areas</b>	<b>5</b>		<b>0.152%</b>	<b>0</b>		<b>0.000%</b>
1997							
	Youngs Bay	2	1,700	0.118%	0	46,900	0.000%
	Tongue Point	1	1,700	0.059%	0	46,900	0.000%
	Blind Slough	0	1,700	0.000%	0	46,900	0.000%
	Deep River	1	1,700	0.059%	0	46,900	0.000%
	Steamboat Slough		1,700	0.000%		46,900	0.000%
	<b>All SAFE Areas</b>	<b>4</b>		<b>0.235%</b>	<b>0</b>		<b>0.000%</b>
1998							
	Youngs Bay	2	1,900	0.105%	0	13,220	0.000%
	Tongue Point	2	1,900	0.105%	0	13,220	0.000%
	Blind Slough	0	1,900	0.000%	0	13,220	0.000%
	Deep River		1,900	0.000%	0	13,220	0.000%
	Steamboat Slough		1,900	0.000%		13,220	0.000%
	<b>All SAFE Areas</b>	<b>4</b>		<b>0.211%</b>	<b>0</b>		<b>0.000%</b>
1999							
	Youngs Bay	1	2,400	0.042%	0	17,878	0.000%
	Tongue Point	0	2,400	0.000%	0	17,878	0.000%
	Blind Slough	0	2,400	0.000%	0	17,878	0.000%
	Deep River	2	2,400	0.083%	0	17,878	0.000%
	Steamboat Slough		2,400	0.000%		17,878	0.000%
	<b>All SAFE Areas</b>	<b>3</b>		<b>0.125%</b>	<b>0</b>		<b>0.000%</b>
2000							
	Youngs Bay	1	2,500	0.040%	0	93,757	0.000%
	Tongue Point	0	2,500	0.000%	0	93,757	0.000%
	Blind Slough	0	2,500	0.000%	0	93,757	0.000%
	Deep River	1	2,500	0.040%	0	93,757	0.000%
	Steamboat Slough	0	2,500	0.000%	0	93,757	0.000%
	<b>All SAFE Areas</b>	<b>2</b>		<b>0.080%</b>	<b>0</b>		<b>0.000%</b>
2001							
	Youngs Bay	1	5,500	0.018%	1	116,623	0.001%
	Tongue Point	0	5,500	0.000%	0	116,623	0.000%
	Blind Slough	0	5,500	0.000%	0	116,623	0.000%
	Deep River	0	5,500	0.000%	0	116,623	0.000%
	Steamboat Slough	0	5,500	0.000%	0	116,623	0.000%
	<b>All SAFE Areas</b>	<b>1</b>		<b>0.018%</b>	<b>1</b>		<b>0.001%</b>
2002							
	Youngs Bay	0	11,900	0.000%	0	49,629	0.000%
	Tongue Point	0	11,900	0.000%	0	49,629	0.000%
	Blind Slough	0	11,900	0.000%	0	49,629	0.000%
	Deep River	1	11,900	0.008%	0	49,629	0.000%
	Steamboat Slough	0	11,900	0.000%	0	49,629	0.000%
	<b>All SAFE Areas</b>	<b>1</b>		<b>0.008%</b>	<b>0</b>		<b>0.000%</b>
2003							
	Youngs Bay	0	nya	nya	0	39,296	0.000%
	Tongue Point	0	nya	nya	0	39,296	0.000%
	Blind Slough	0	nya	nya	0	39,296	0.000%
	Deep River	0	nya	nya	0	39,296	0.000%
	Steamboat Slough	0	nya	nya	0	39,296	0.000%
	<b>All SAFE Areas</b>	<b>0</b>		<b>nya</b>	<b>0</b>		<b>0.000%</b>

<sup>a</sup> Estimated run size rounded to nearest hundred fish

Table 3.13. Minimum estimated harvest in select area recreational fisheries, 1998-2004.

Year	Species <sup>a</sup>	Youngs Bay	Tongue Point	Blind Slough	Deep River	Steamboat Slough	SAFE tributaries	Total
1998	CHS	55						55
	SAB CHF			300			100	400
	COH			18			100	118
	Total	55		318			200	573
1999	CHS	25						25
	SAB CHF			300				300
	COH	59					100	159
	Total	84		300			100	484
2000	CHS	14		121			120	255
	SAB CHF						50	50
	COH			102			100	202
	Total	14		223			270	507
2001	CHS	50		400			50	500
	SAB CHF						150	150
	COH	50		111			100	261
	Total	100		511			300	911
2002	CHS	121	1	430				552
	SAB CHF						500	500
	COH	200		44			100	344
	Total	321	1	474			600	1,396
2003	CHS	51		493			450	994
	SAB CHF						67	637
	COH	300		114	8		350	772
	Total	351		607	8		1,437	2,403
2004 <sup>b</sup>	CHS	100		200			1,100	1,400

<sup>a</sup> Species are: spring chinook (CHS); select area bright fall chinook (SAB CHF); coho (COH)

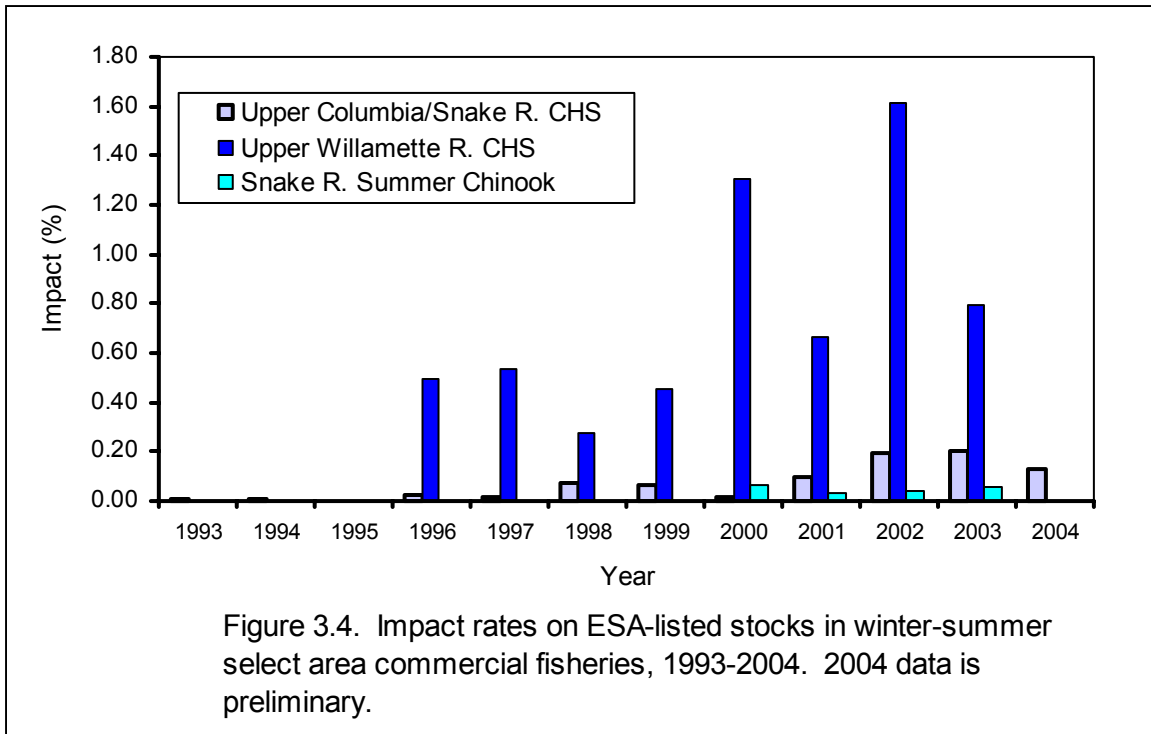
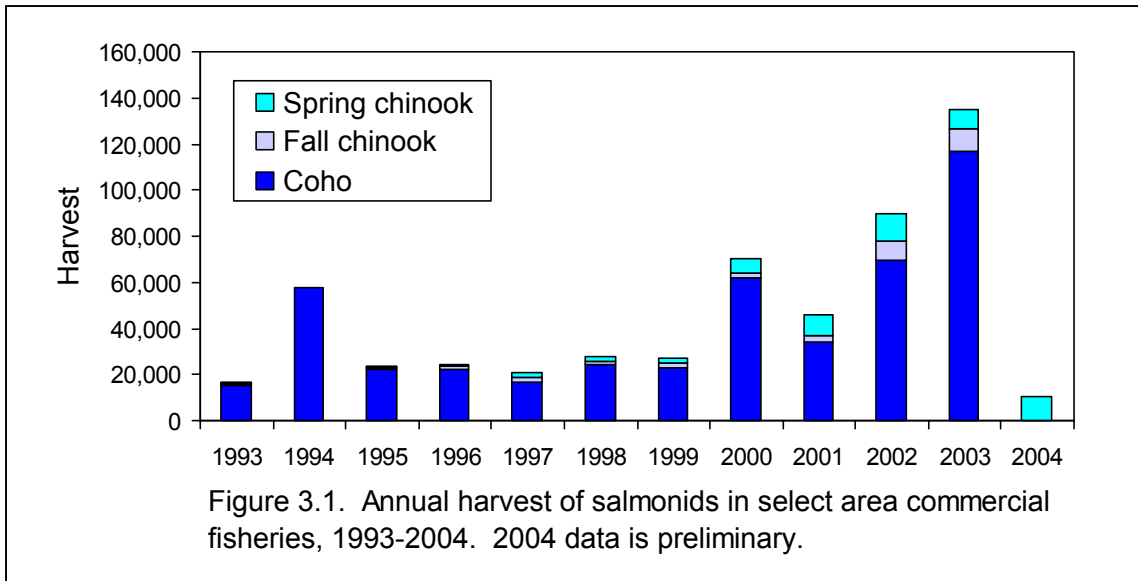
<sup>b</sup> Estimated harvest through 6/1/04

Table 3.14. Summary of spring chinook harvest impacts during select area recreational fisheries, 2001-2003.

Year	Site	Upper Columbia River Spring Chinook Impact Rate						Willamette River Wild Spring Chinook Impact Rate						
		Total Harvest	% Upriver <sup>a</sup> Stock	Upriver Run Size	Number Upriver	% Upriver Impacts	Snake River Wild Run Size	Number Snake River Wild	% Snake River Wild Impacts	% Willamette River Stock <sup>b</sup>	SAFE Willamette River Harvest	Willamette River Run Size <sup>c</sup>	Willamette River Harvest Rate	Number Willamette River Wild
2001	Youngs Bay	50	2.20%	416,418	1	0.000%	27,579	0	0.000%	4.54%	2	80,400	0.003%	0
	Tongue Point	0	0.00%	416,418	0	0.000%	27,579	0	0.000%	7.71%	0	80,400	0.000%	0
	Blind Slough	400	1.71%	416,418	7	0.002%	27,579	0	0.002%	8.18%	33	80,400	0.041%	3
	<b>All SAFE</b>	<b>450</b>			<b>8</b>	<b>0.002%</b>		<b>1</b>	<b>0.002%</b>		<b>35</b>		<b>0.044%</b>	<b>3</b>
2002	Youngs Bay	121	5.40%	295,111	7	0.002%	60,233	1	0.002%	21.24%	26	120,164	0.021%	3
	Tongue Point	1	1.20%	295,111	0	0.000%	60,233	0	0.000%	12.70%	0	120,164	0.000%	0
	Blind Slough	430	3.90%	295,111	17	0.006%	60,233	3	0.006%	8.68%	37	120,164	0.031%	4
	<b>All SAFE</b>	<b>552</b>			<b>23</b>	<b>0.008%</b>		<b>5</b>	<b>0.008%</b>		<b>63</b>		<b>0.053%</b>	<b>6</b>
2003	Youngs Bay	51	8.20%	208,900	4	0.002%		0	0.002%	12.19%	6	126,600	0.005%	1
	Tongue Point	0	0.00%	208,900	0	0.000%		0	0.000%	11.31%	0	126,600	0.000%	0
	Blind Slough	943	2.75%	208,900	26	0.012%		0	0.012%	9.12%	86	126,600	0.068%	9
	<b>All SAFE</b>	<b>994</b>			<b>30</b>	<b>0.014%</b>		<b>0</b>	<b>0.014%</b>		<b>92</b>		<b>0.073%</b>	<b>9</b>

<sup>a</sup> Percent upriver stock based on commercial VSI data

<sup>b</sup> Percent Willamette stock based on commercial CWT data. 2003 rates are 2000-2002 commercial averages.



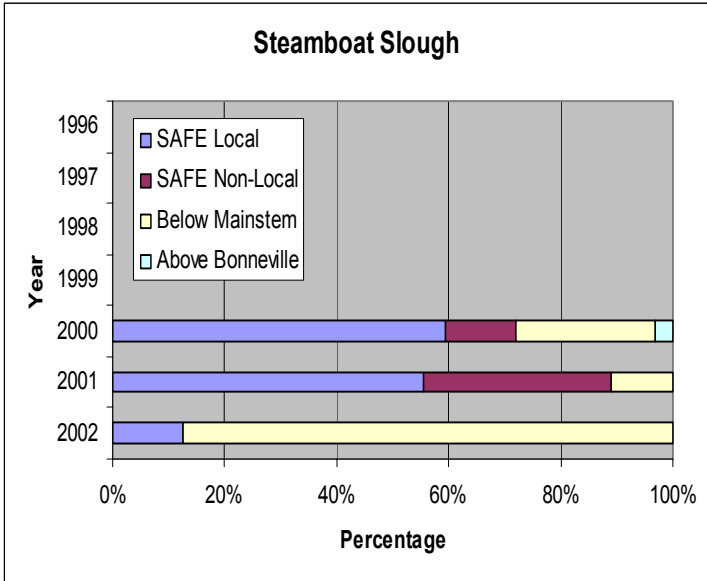
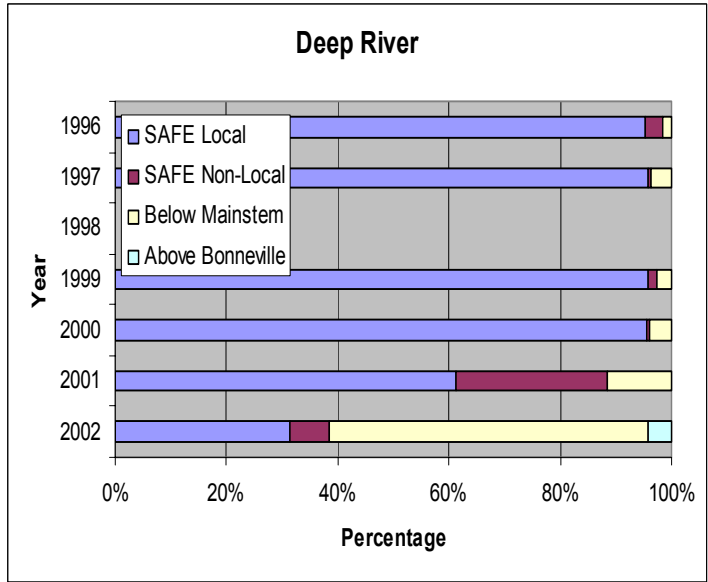
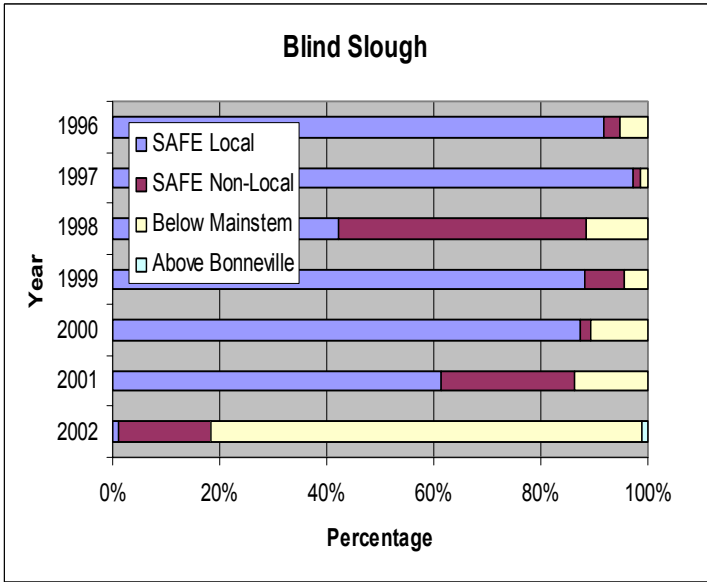
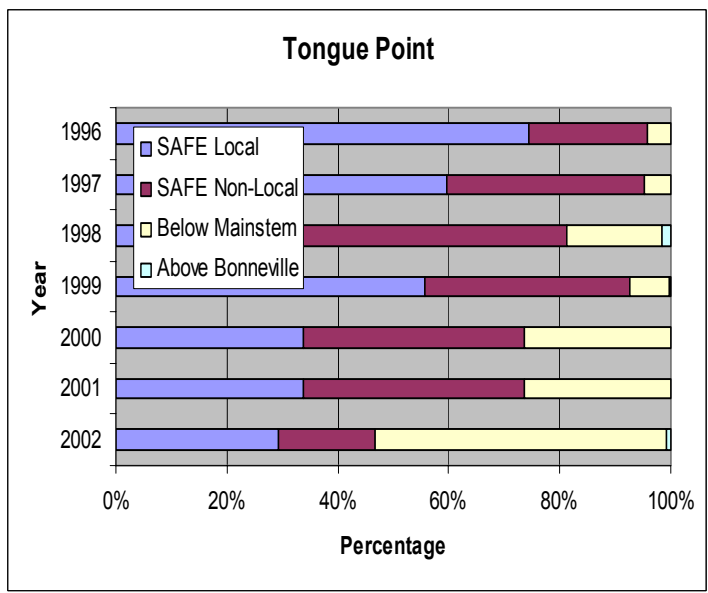
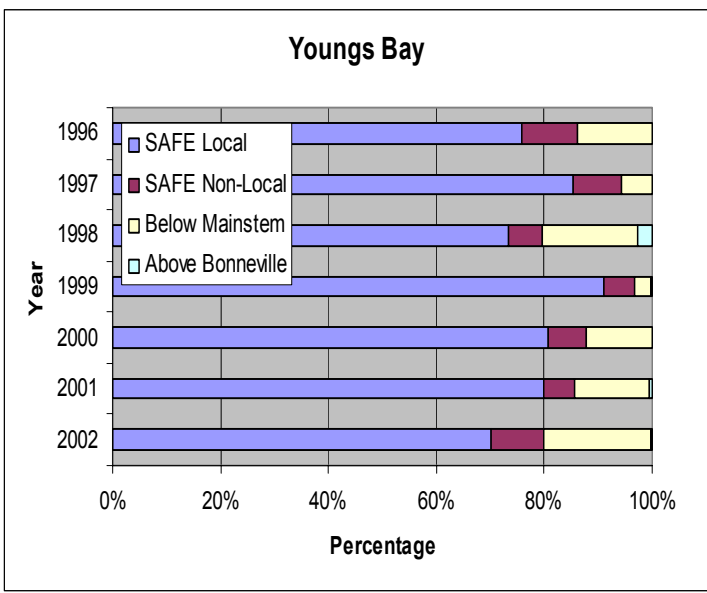


Figure 3.5. Stock composition of select area commercial coho harvest by site, 1996-2002.

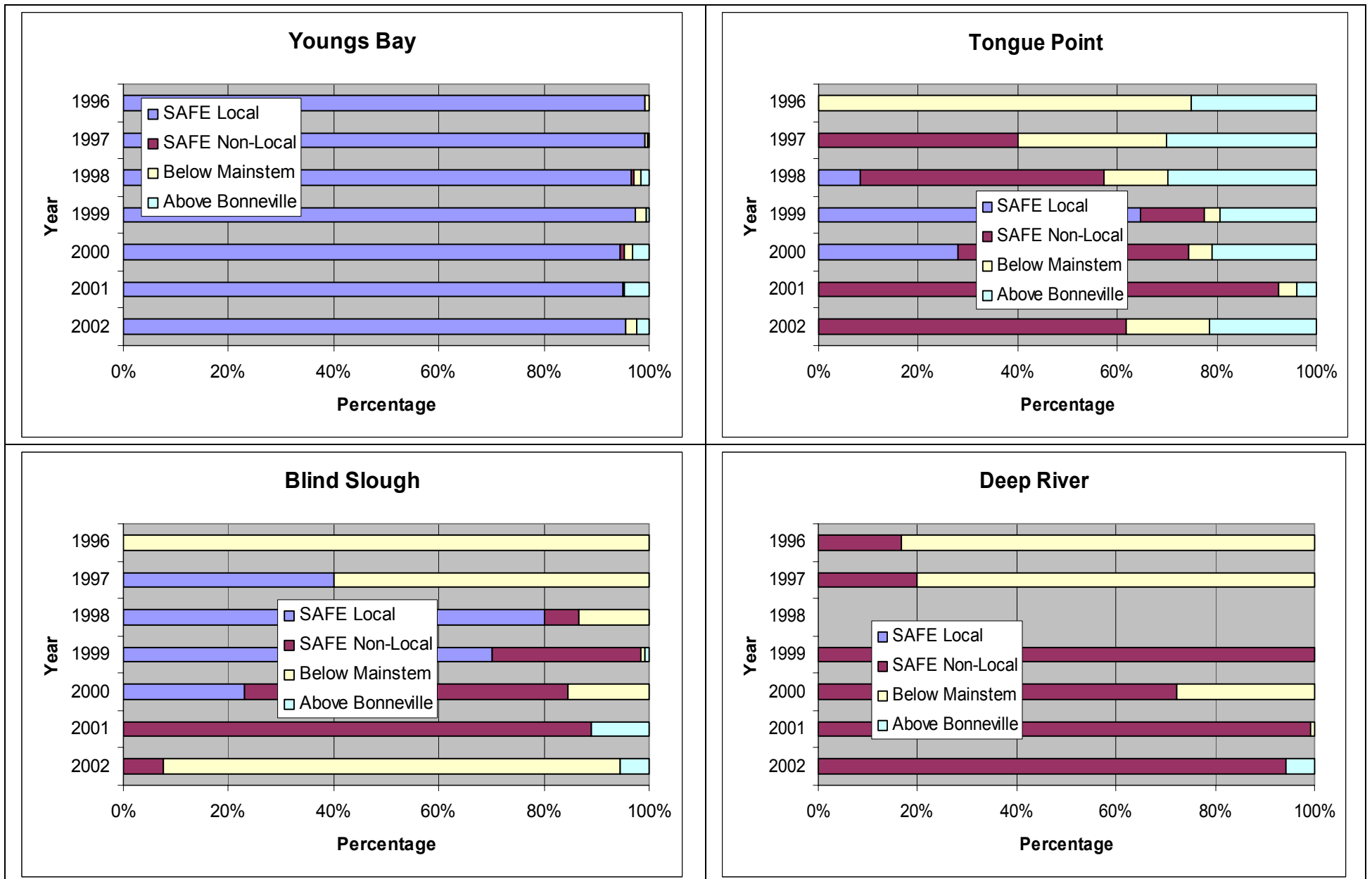


Figure 3.6. Stock composition of select area commercial fall chinook harvest by site, 1996-2002.

#### **4. TEST FISHING**

Gillnet test fishing serves an important role in SAFE fisheries management. Development of new fisheries and seasons in all select areas have consistently been based on test fishing prior to, and concurrent with, adoption of new programs. Test fishing has been conducted prior to adoption of fisheries to assess the harvest potential in selected sites by evaluating catch rates and timing of non-target fish stocks, variation in gear type, and fishing area boundaries. Recently, test fishing has been used as a tool to determine time-specific stock compositions in SAFE sites to ensure proposed seasons will not impart excessive impacts to listed species. All test fishing is conducted following ESA-mandated guidelines of allowable impacts to listed stocks.

Test fishing is conducted by both contracted and volunteer local fishermen, who are accompanied by agency staff. Data collected includes net type and configuration, set location, sampling effort, biological data of the catch (length, condition, marine mammal damage, mark type, VSI, and CWT recoveries from mortalities), and water conditions (temperature and clarity). Catch rates are converted to a standardized unit (catch per hour of 100 fathoms of net) for intra- and inter-site comparisons.

During the reporting period a variety of test fishing activities were conducted for multiple purposes, including establishing baseline stock composition data in potential new sites, monitoring stock composition concurrent with established fisheries, and evaluating new gears and harvest opportunities (Table 4.1).

Table 4.1. Summary of select area test fishing activities, 1994-2004.

Year	Season	Date	Area <sup>a</sup>	Effort (drifts)	Purpose
1994	Spring	4/20-6/2 4/25-5/31	TP, BS, CC, WS, DR/GB, SS, CCh	128	Assess harvest potential in selected sites; catch and timing of non-target stocks, variation in gear type, establish fishing area boundaries
1994	Fall	9/21-10/31	TP, BS, CC, WS, DR/GB, SS, CCh	124	Same as above
1995	Spring	4/25-5/1	TP, BS, CC, WS, DR, SS, CCh	129	Same as above
1995	Fall	9/20-10/26	TP, BS, CC, WS, DR, SS, CCh	126	Same as above
1996	Spring	4/24-5/31	TP, BS, SC, PC, CC, WS, DR/GB, SS, CCh	155	Same as above
1996	Fall	9/23-10/31	YB, TP, SC, PC, BS, CC, DR/GB, SS, WS	77	Same as above plus added smaller meshes to collect coho jacks from 1993 brood SAFE releases. Also used large-mesh nets to evaluate bycatch rate of sturgeon
1997	Summer	7/8-7/24	YB	19	-Determine SAB and non-local stock abundances -Evaluate ability to hold adults in net pens
1997	Fall	9/3-10/2	SC, PC	?	-Determine coho jack abundances -Adult coho fishing assessment
1997	Fall	9/23-11/1	YB, TP, BS, CC, WS, DR, SS	many	-Determine stock abundances and type by time and area
1998	Summer	6/17-7/8	YB	19	-Determine SAB and non-local stock abundances
1998	Fall	9/17-10/9	YB, TP, BS, DR	28	-Determine stock abundances and type by time and area
1999	Spring	3/18-4/23	YB (below 101 bridge), PC	59	-Determine the potential for development of spring chinook fisheries

continued

Table 4.1. (continued). Summary of select area test fishing activities, 1994-2004.

Year	Season	Date	Area <sup>a</sup>	Effort (drifts)	Purpose
1999	Fall	11/2-11/30	YB	30	-Determine the feasibility of establishing a late-run fall chinook fishery
1999	Fall	9/17-10/1	TP, BS	14	-Determine coho jack abundances -Adult coho fishing assessment
2000	Spring	3/20-5/30	YB, PC, DR	51	-Determine the potential for development of spring chinook fisheries
2003	Summer	9/6-18	YB (Youngs, Klaskanine river confluence)	37	-Determine the potential for collecting SAB broodstock to maximize egg production
2004	Spring	4/6-7	YB (above old Hwy 101, BS)	21	-Determine stock composition prior to adopting additional early-spring season fishing periods

<sup>a</sup> Areas include: Youngs Bay (YB), Blind Slough (BS), Tongue Point (TP), South Channel (SC), Prairie Channel (PC), Clifton Channel (CC), Cathlamet Channel (CCh), Wallace Slough (WS), Deep River (DR), Grays Bay (GB), and Steamboat Slough (SS).

## 5. RUN RECONSTRUCTION

Survival and homing/straying rates based on run reconstructions were calculated using the Regional Mark Information System (RMIS) coded-wire tag database ([www.rmis.org](http://www.rmis.org)) managed by the PSMFC ([www.psmfc.org](http://www.psmfc.org)). For each group all regional CWT recoveries, including hatchery and spawning ground escapement and harvest in fisheries, were combined to determine total smolt-to-adult survival rates (SARs). Escapement was categorized by area of recovery to separate detrimental straying from returns to natal streams. Survival rates of chinook salmon were calculated separately for sub-adults (jacks) and adults based on age-specific CWT recoveries.

It is important to note that determining survival and straying is a lengthy process. The life history pattern of salmon (up to six years for chinook) inherently delays this process. In addition, reporting agencies require a substantial amount of time to collect, process, and report CWT recovery data to RMIS. Therefore the RMIS database is continually updated as new information becomes available from the individual reporting agencies. For these reasons, final recoveries of all age classes of a study group may not be accessible for up to six years post-release.

### SPRING CHINOOK

Results for spring chinook included in this report are based on recoveries of up to 63 CWT study groups released between 1990 and 2001 (1988-1999 brood years) from SAFE production facilities; including 27 tag groups released from net pens in Youngs Bay, 16 tag groups from Blind Slough, 10 tag groups from Tongue Point, 5 groups from Deep River, and 5 CWT groups released from CEDC's South Fork Klaskanine facility. For comparison, recoveries of up to 64 spring chinook CWT tag groups (1993-1999 brood years) released from five ODFW Willamette Basin hatcheries (Clackamas, Marion Forks, McKenzie, Santiam, and Willamette) are also included. Since final recovery data is not yet available for some study groups (1999 brood primarily), survival comparisons are generally restricted to releases occurring from 1996-2000 (1994-1998 broods), when spring chinook were released from most SAFE facilities. Unless otherwise noted, survival rates represent smolt-adult rates (SARs) and do not include jack survival.

Average annual survival rates of select area spring chinook (1988-1999 brood years) based on CWT recoveries of 62 tag groups fluctuated widely within and between release locations (Table 5.1). During this period, annual site-specific survival rates for 1994-1998 broods ranged between 0.02-1.80 percent and averaged 0.63 percent. Releases from Blind Slough and Deep River had the highest average survival (0.81 and 0.80 percent) and returns from South Fork Klaskanine releases were the poorest (0.03 percent). However, releases from the South Fork Hatchery were discontinued after 1997, so the poor survival rates for this site are likely an artifact of poor ocean conditions in the mid 1990s. The average adult survival for Youngs Bay releases during this period was 0.73 percent based on recovery of 16 CWT groups. The average survival for 10 tag groups released from Tongue Point was 0.58 percent.

Survival of 1994-1998 brood spring chinook released from select area net pens averaged 0.72 percent survival based on recoveries of 40 CWT tag groups and 0.69 percent for 42 CWT groups released from net pens and the South Fork Hatchery (Figure 5.1). This compares favorably with the average survival rate of 0.59 percent for 51 tag groups released during the same time period from the aforementioned Willamette Basin hatcheries. During this timeframe, only releases from Clackamas Hatchery exhibited an average survival rate higher than SAFE net pen releases (Figure 5.2). Oceanic conditions appear to strongly influence survival of yearling spring chinook with good survival more apparent during years of a low 12-month post-release average Pacific Decadal Oscillation (PDO) index (Mantau 1997). Discrepancies to this trend were only apparent for fish released in 1991 and 1997 (Figure 5.3).

As intended, the majority (76.4 percent) of SAFE spring chinook are harvested in select area commercial fisheries (Table 5.2; Figure 5.4). Based on recoveries of 55 1994-1999 brood year CWT tag groups, 88.6 percent of all SAFE spring chinook were harvested in commercial fisheries; 3.4 percent are harvested in sport fisheries, with the balance (8.0 percent) escaping harvest. In comparison, spring chinook released from Willamette River Basin hatcheries were most likely to escape harvest (62.4 percent) with near equal contributions to commercial (16.4 percent) and recreational fisheries (21.2 percent), based on CWT recoveries of 54 CWT tag groups released from 1996-2001 (Table 5.2). Adult returns from Youngs Bay releases had the highest contribution to commercial fisheries (94.8 percent) followed by Blind Slough (90.0 percent), Tongue Point (73.4 percent), and Deep River (65.5 percent). Production from SAFE facilities contributed far less (3.1 percent) to inland recreational fisheries than did Willamette Basin hatchery releases (20.4 percent), most likely a result of SAFE adult returns leaving the mainstem Columbia River prior to being exposed to significant sport fisheries. The average escapement rate for SAFE spring chinook during 1998-2003 (1994-1999 broods) was 8.0 percent compared to 62.4 percent for spring chinook released from Willamette Basin hatcheries. This low escapement rate is desirable since a primary goal of the SAFE project is to maximize harvest of local stocks in order to achieve the greatest economic value of the project while minimizing impacts of the program.

Homing of spring chinook released from Youngs Bay and Blind Slough during 1996-2001 was quite favorable. Adults returning to Blind Slough exhibited the lowest straying rate with <0.5 percent returning to streams and hatcheries not associated with the release site. The average stray rate of adults destined for Youngs Bay was 3.6 percent of all returns stemming from releases at this site, which is about twice the rate observed for Willamette Basin releases during the same period (Table 5.2). The average stray rate of adults returning from Tongue Point releases was 20.8 percent; a rate which lead to discontinuation of production-level releases from this site after 2000. Fortunately, most (70.5 percent) of all SAFE spring chinook strays and the vast majority (89.0 percent) from Oregon sites were recovered in Big Creek (primarily Big Creek Hatchery) rather than in systems with endemic spring chinook stocks. The stray rate for Deep River releases was also high (26.7 percent) although this rate is highly variable due to fewer returning adults than at other sites. On average only 0.02 percent of adult spring chinook returning from 1996-2001 SAFE releases were recovered above Bonneville Dam.

The age structure of select area spring chinook recovered from 1992-2003 was comprised of nearly all age 4-5 fish based on scale samples collected during sampling of adults recovered from regional fisheries, hatcheries, and stream surveys (Table 5.3). Most fish returned at age-4 (55.4 percent), with 43.7 percent returning as 5-year olds. The age structure based on coded-wire tag recoveries from 20 CWT groups (1988-1995 broods) was weighted more heavily toward age-5 adults (53.7 percent) than to age-4 fish (41.5 percent). The reason for this difference probably stems from using different return periods. Results will be refined in future reports. Paired jack and adult survival rates of 49 CWT tag groups were not correlated ( $R^2=0.140$ ) (Figure 5.5).

## COHO

Each year throughout the study period a representative CWT group (usually 25,000-30,000) was included at each net-pen site, as was the practice at all hatcheries in the Columbia River Basin. Additional tag groups may have been applied to study groups at various times, but the fish reared utilizing a standard set of practices agreed to by all parties, were monitored through the representative CWT groups (Table 2.4). For 1993-1999 brood year coho, 35 tag groups were monitored; from single or double annual releases at Youngs Bay, Tongue Point, Blind Slough, Deep River and Steamboat Slough.

Percent survival (total expanded recoveries / total CWT releases) of the representative study groups provides a reference for relative success of each annual release. In general, the 1993-1999 mean survival ranged from a low of 1.2 percent at Blind Slough to a high of 3.6 percent at Steamboat Slough, where brood years 1997-1999 were observed. Total CWT accountability for all representative tag groups is shown in Table 5.4. Survival varied substantially among 1993-1999 brood releases with reduced returns occurring at all sites in 1994-1995 (Figure 5.6).

Relative success of SAFE releases compared to hatchery production groups (1993-1997 broods) is shown in Figure 5.7. For all Columbia River hatcheries releasing early-run coho salmon, survival rates were calculated for the same years as with SAFE sites (Table 5.5). Overall, SAFE sites averaged 2.1 percent survival while Columbia River hatcheries averaged 1.2 percent. Of the 10 hatcheries examined, average survival ranged from 0.4 percent at Elochoman River Hatchery to 2.0 percent at Green River Hatchery.

The contribution of 1993-1997 brood SAFE coho to regional fisheries is compared in Figure 5.8. Most apparent is the difference in escapement between SAFE sites and Columbia River hatcheries. Select area releases averaged 98.3 percent of returns harvested compared to a 20.4 percent harvest from Columbia River hatchery releases. The one exception among select areas where coho harvest was not overwhelmingly comprised of locally-released fish was Steamboat Slough, with 62.6 percent harvest for its first release. The majority of the unharvested fish escaped to the Elochoman Hatchery (Table 5.4). The Klaskanine Hatchery in Youngs Bay showed considerably more coho harvested than the Columbia River hatchery average because returning coho must pass through the Youngs Bay fishery.

In comparing the total accountability of release groups of the various SAFE net-pen sites, similarities between Youngs Bay, Blind Slough and Deep River are apparent. Numbers contributing to the local SAFE fishery from the local tag group were 74.9 percent for Youngs Bay, 77.4 percent for Blind Slough, and 70.5 percent for Deep River (Figure 5.8). In contrast, only 28.4 percent of Tongue Point fish were harvested in the Tongue Point SAFE fishery, with an additional 17.1 percent contributing to other SAFE fisheries and 44.6 percent to mainstem fisheries (sport and commercial). The most extreme exception was Steamboat Slough. After three years of returns, 13.8 percent of production was from ocean fisheries, 42.4 percent from mainstem fisheries, 10.8 percent from SAFE fisheries (0.8 percent local), and 33.1 percent from escapement.

The proportions of escapement to total coho run size were 0.4 percent for Youngs Bay, 0.8 percent for Blind Slough, 1.8 percent for Tongue Point, 2.9 percent for Deep River, and 33.1 percent for Steamboat Slough (Figure 5.9). By release site, the numbers of expanded recoveries at each escapement location for 1993-1999 broods are shown in Table 5.6.

### **FALL CHINOOK (SAB)**

Results for SAB fall chinook included in this report are based on recoveries for 41 CWT study groups released between 1992 and 2001 from SAFE net pens; 12 CWT groups released from 1992-1996 at Big Creek Hatchery, 11 CWT groups released from Klaskanine Hatchery between 1996 and 2001, and 4 CWT groups released from the South Fork Klaskanine Hatchery between 1986 and 1988. Recovery data for some study groups remains incomplete for all age classes but is included and will be updated in future reports.

Survival rates of 1985-2000 brood year SAB fall chinook varied substantially between release sites and year (Table 5.7; Figure 5.10). Many factors probably affect these results including completeness of CWT recoveries, river and ocean conditions, size at release, release timing and location, and health of released smolts. Due to programmatic changes, little opportunity exists to compare sites within years. Of the land-based facilities that have reared SAB fall chinook, releases from the South and North Fork Klaskanine hatcheries had the highest average survival rates (1.22 and 1.05 percent, respectively). The average survival of smolts released from Big Creek Hatchery was 0.58 percent but releases from this site occurred during years of poor ocean conditions. During 1996-2001 when SAB releases occurred at both the North Fork Klaskanine Hatchery and from Youngs Bay net pens, annual survival was comparable for both release locations with significant improvements observed beginning with the 1998 brood class (Figure 5.11). It is unclear what variable most significantly influences survival rates of SAB fall chinook, although it appears oceanic conditions may have a significant influence. Based on CWT recoveries for 1986-2001 SAB releases, survival rates were inversely related to the 12-month post-release PDO index with the highest survival rates occurring during periods of a low PDO and poorer survival occurring during high years with a high PDO index value (Figure 5.12).

Select area bright fall chinook contribute substantially to a variety of regional fisheries (Figure 5.13; Table 5.8). Based on run reconstructions of 41 CWT groups released from SAFE net pens (primarily Youngs Bay), an average of 82.0 percent of the returning SAB adults are harvested in commercial fisheries and 14.5 percent are harvested in recreational fisheries, with only 3.5 percent escaping harvest. When all SAB production facilities are considered, the percentage of returning adults harvested in commercial fisheries decreases to 65.8 percent, with recreational harvest and escapement percentages increasing to 21.1 and 13.1 percent, respectively (Figure 5.14). In either case, a surprisingly high percentage (23.1-25.2 percent) of the total adult SAB returns for this period were harvested in ocean troll fisheries; however, many user groups and fisheries benefit from select-area releases of this stock. For example, of the total SAB return in 2003, an estimated 3,045 fish were harvested in SAFE fisheries; 3,001 were landed in ocean troll fisheries; 2,338 in the Columbia River gillnet fishery, 1,838 in Columbia River sport fisheries, 933 in ocean recreational fisheries, and 637 in SAFE recreational fisheries.

Straying of SAB fall chinook has been an issue in the past, even jeopardizing compliance with ODFW's wild fish policy (Chilcote et al. 1992) and federal ESA recovery plans. Significant escapement of Big Creek Hatchery releases to natural fall chinook spawning areas in LCR Washington tributaries prompted relocation of the brood stock program to Klaskanine Hatchery. Stray rates of 33.0 percent and 25.9 percent; with 10.9 percent and 9.2 percent occurring in natural spawning areas, were documented in 1994 and 1995, respectively, when the brood stock program operated out of Big Creek Hatchery.

Based on adult tag recoveries from 60 CWT study groups, relocating Big Creek SAB releases and broodstock production to Youngs Bay net pens and the Klaskanine Hatchery, respectively, has been an overwhelming success (Table 5.8). The transfer resulted in a significant reduction in straying with only 0.7-1.9 percent of the adult returns from 1992-2000 brood releases straying, compared to 13.8 percent for 1992-1996 Big Creek releases. In addition, the economic value of these fish was greatly increased by shifting excess escapement to harvest in SAFE fisheries; an average of 46.0 percent of all Big Creek Hatchery SAB fall chinook were harvested, compared to 87.6 and 96.8 percent of Klaskanine Hatchery and Youngs Bay net-pen fish being caught in regional fisheries. Interestingly, local escapement (defined as unharvested returns to the Youngs Bay tributaries) for Youngs Bay net-pen releases was considerably lower (1.6 percent) than for Klaskanine Hatchery releases (11.7 percent), even though returning adults for both cohorts migrated through the Youngs Bay commercial fishery. This difference indicates net-pen fish hold within the fishing area longer than fish released farther upstream, thereby increasing their vulnerability to capture.

Straying above Bonneville Dam remained constant at 0.40 percent for releases from Big Creek and from for Youngs Bay net-pen releases, but dropped to 0.00 percent for releases from Klaskanine Hatchery. Straying within the LCR was also reduced significantly from an average rate of 13.8 percent for 1991-1995 brood Big Creek Hatchery releases to  $\leq 1.9$  percent for releases from both Youngs River basin sites.

The age structure of SAB fall chinook, based on scales collected from adults returning during 1994-2003, indicates age-3 (39.1 percent) and age-4 fish (47.0 percent) are the most abundant age classes (Table 5.3). Age-2 jacks comprised 9.8 percent of returning fish with smaller numbers of age-5 (3.9 percent) and age-6 (0.2 percent) also present. The age composition of returning SAB adults, based on 20 CWT tag groups (1993-1996 brood years), yielded similar results. The correlation between survival of “jack” and adult SAB’s was positive but weak ( $R^2=0.398$ ; Figure 5.15).

### **FALL CHINOOK (URB)**

A total of five CWT study groups of URB fall chinook were released from 1995-1998 at the Youngs Bay and Tongue Point net-pen sites. Adult survival rates were generally poor, ranging from 0.01 percent to 0.37 percent, and averaging 0.11 percent.

The vast majority (90.5 percent) of adult returns from SAFE URB fall chinook releases were harvested in commercial fisheries, primarily in the mainstem Columbia River gillnet fishery (53.7 percent). An additional 13.6 percent were harvested in ocean commercial fisheries with only 25.4 percent harvested in select area fall gillnet fisheries. The remaining 7.3 percent of returning adults were either harvested by sport fisheries (1.4 percent) or escaped harvest and were recovered at hatcheries (3.1 percent) and in tributaries (2.5 percent).

This stock did not appear to acclimate very well to the SAFE release sites, resulting in excessive straying. This may have been exacerbated since the only two tag groups that survived very well were both released at Tongue Point where homing for chinook stocks has been less than ideal. Approximately 2.8 percent of the combined adult returns for these tag groups were recovered above Bonneville Dam, a rate significantly higher than observed for other SAFE chinook releases. The SAFE project does not intend to use this stock in the future.

The age structure of URB fall chinook, based on freshwater recoveries of three CWT groups, consisted primarily (74.4 percent) of age-4 adults (Table 5.3). However, this data may be negatively biased since it includes recoveries from ocean fisheries that may harvest fish earlier than they would have normally returned to freshwater.

Table 5.1. Smolt-to-adult survival rates (%) of 62 spring chinook coded-wire tag (CWT) groups<sup>a</sup> released from select area production facilities, 1988-1999 brood years.

Brood Year	Production Site				
	S. Fork Klaskanine	Youngs Bay Net Pens	Tongue Point Net Pens	Blind Slough Net Pens	Deep River Net Pens
1988	1.15				
1989					
1990		0.82			
1991					
1992	0.02	0.37			
1993	0.06	0.69			
1994	0.02	0.17	0.07	0.11	
1995	0.04	0.11	0.22	0.26	
1996		1.57	0.80	0.43	0.02
1997		1.15	0.71	0.62	1.19
1998		0.85	1.12	1.80	
1999 <sup>b</sup>		0.42		0.28	0.19
1988-99 average <sup>c</sup>	0.26	0.65	0.58	0.58	0.56
1994-98 average <sup>c</sup>	0.03	0.73	0.58	0.81	0.80

<sup>a</sup> Excludes eight sub-yearling releases from the South Fork Klaskanine facility and Youngs Bay net pens during 1989-1992

<sup>b</sup> Incomplete CWT recovery data

<sup>c</sup> Weighted for all CWT release groups within years

Table 5.2. Summary of smolt-to-adult survival, contribution to fisheries, and straying rates of coded-wire tagged (CWT) spring chinook from select area and Willamette Basin release sites, 1994-1999 brood years.

	Release Site					
	Youngs Bay	Blind Slough	Tongue Point	Deep River <sup>a</sup>	All SAFE Facilities <sup>b</sup>	Willamette Basin Hatcheries
Brood Years	1994-99	1994-99	1994-98	1996,97,99	1994-99	1994-99
Number of CWT groups	22	16	10	5	55	54
Average survival rate (%) <sup>c</sup>						
Smolt-jack	0.01	0.01	0.01	0.15	0.02	0.03
Smolt-adult	<u>0.73</u>	<u>0.81</u>	<u>0.58</u>	<u>0.80</u>	<u>0.69</u>	<u>0.59</u>
Total	0.74	0.82	0.59	0.95	0.71	0.62
Fishery contributions (% of total adult return)						
Commercial						
SAFE	84.2%	80.8%	57.4%	23.9%	76.4%	1.9%
Ocean	6.0%	7.0%	7.4%	38.6%	7.2%	12.0%
Columbia River	<u>4.6%</u>	<u>2.2%</u>	<u>8.6%</u>	<u>3.0%</u>	<u>5.0%</u>	<u>2.5%</u>
Total	94.8%	90.0%	73.4%	65.5%	88.6%	16.4%
Recreational						
Ocean	0.2%	0.6%	0.0%	3.1%	0.3%	0.8%
Freshwater	<u>1.2%</u>	<u>6.2%</u>	<u>5.8%</u>	<u>1.7%</u>	<u>3.1%</u>	<u>20.4%</u>
Total	1.4%	6.8%	5.8%	4.8%	3.4%	21.2%
Escapement <sup>d</sup> (straying)	3.8% (3.60%)	3.2% (0.46%)	20.8% (20.83%)	29.7% (26.70%)	8.0% (7.40%)	62.4% (1.67%)
Straying						
Above Bonneville Dam <sup>e</sup>	0.02%	0.00%	0.03%	0.00%	0.02%	0.01%
Below Bonneville Dam <sup>f</sup>	3.58%	0.46%	20.80%	26.70%	7.38%	1.66%
Percent of Below Bonneville Dam escapement returning to Big Creek, Oregon (96-99 brood data)	89.9%	94.0%	87.8%	4.4%	70.5%	n/a

<sup>a</sup> Recovery data based on only one commercial season (2003) in Deep River

<sup>b</sup> Includes South Fork Klaskanine Hatchery releases

<sup>c</sup> Survival rates based on recoveries of 1994-1998 brood year releases including 16 CWT groups released from Youngs Bay, 11 released from Blind Slough, 10 from Tongue Point, 5 from Deep River, 2 from South Fork Hatchery, and 51 from Willamette River Basin hatcheries.

<sup>d</sup> Escapement includes recoveries from streams and hatcheries (natal & out-of-system)

<sup>e</sup> Includes escapement to hatcheries, streams, and fisheries above Bonneville Dam

<sup>f</sup> Includes non-natal straying to streams and hatcheries not associated with the release site

Table 5.3. Age composition of select area chinook salmon recovered from regional fisheries, hatcheries, and stream surveys, based on scale analysis 1994-2003; and by coded-wire tag recoveries, 1990-2001.

Select area stock (method)	Expanded fish numbers	Age at return (% of total)				
		2	3	4	5	6
Spring chinook						
(coded-wire tag recoveries)	1,977	2.3	1.1	41.5	53.7	1.4
(scales)	31,875	0.0	0.5	55.4	43.7	0.4
Rogue River fall chinook (SAB)						
(coded-wire tag recoveries)	2,033	6.3	47.4	43.4	2.9	0.0
(scales)	52,609	9.8	39.1	47.0	3.9	0.2
Upriver bright fall chinook (URB)						
(coded-wire tag recoveries)	203	1.0	22.2	74.3	2.5	0.0

Table 5.4. Accountability of coho from select area fishery evaluation (SAFE) project releases at all net-pen sites, 1993-1999 brood years.

SAFE Site	BY	CWT Releases	CWT Groups	Expanded CWT Recoveries					Percent Survival	Hatchery/Stream Location	
				Ocean	C o l u m b l a R i v e r			Total			
					Fisheries	(SAFE)	Hatcheries	Streams			
Youngs Bay	93	28,995	1	59	1,020	-955	0	0	1,079	3.72%	
	94	26,274	1	3	293	-259	3	0	299	1.14%	Big Cr. H. (1), Klaskanine H. (2)
	95	27,198	1	20	374	-349	3	0	397	1.46%	Big Cr. H. (3)
	96	25,672	1	36	640	-546	3	0	679	2.64%	Big Cr. H. (2), Elochoman H. (1)
	97	28,809	1	31	643	-589	3	0	677	2.35%	Big Cr. H. (3), Klaskanine H. (2)
	98	24,396	1	95	596	-346	4	1	696	2.85%	Big Cr. H. (4), Paradise Cr. (1), Klaskanine H. (4)
	99	52,505	2	49	913	-864	3		916	1.74%	Big Cr. H. (2), Elochoman H. (1), Klaskanine H. (4), Youngs R. (1)
		213,849		293	4,479	-3,908	19	1	4,743	2.22%	
Tongue Point	93	26,426	1	57	747	-432	14	0	818	3.10%	Big Cr. H. (13), Elochoman H. (1)
	94	23,942	1	5	202	-116	9	0	216	0.90%	Big Cr. H. (9)
	95	26,174	1	4	124	-117	11	1	140	0.50%	Big Cr. H. (7), Cowlitz H. (1), Elochoman H. (3)
	96	18,355	1	39	694	-310	3	0	736	4.00%	Big Cr. H. (3)
	97	26,269	1	34	376	-245	8	0	418	1.59%	Big Cr. H. (8)
	98	24,634	1	112	626	-98	10	0	748	3.04%	Big Cr. H. (10)
	99	21,854	1	57	600	-386	8	2	669	3.06%	Big Cr. H. (8), Bear Cr. (1), Umpqua R. (1), Klaskanine H. (2)
		167,654		308	3,369	-1,702	63	3	3,743	2.23%	
Blind Slough	93	26,258	1	41	468	-445	3	0	512	1.90%	Big Cr. H. (3)
	94	24,942	1	7	314	-246	3	1	325	1.30%	Big Cr. H. (3), Duck Cr. (1)
	95	25,104	1	0	18	-16	0	0	18	0.10%	
	96	24,607	1	10	396	-359	3	0	409	1.70%	Big Cr. H. (3)
	97	26,072	1	28	488	-456	8	0	524	2.01%	Big Cr. H. (8)
	98	24,624	1	43	524	-432	2	0	569	2.31%	Big Cr. H. (2)
	99	52,073	2	0	2	-2	0	0	2	0.00%	
		203,680		129	2,210	-1,956	19	1	2,359	1.16%	

continued

Table 5.4. (continued) Accountability of coho from select area fishery evaluation (SAFE) project releases at all net-pen sites, 1993-1999 brood years.

SAFE Site	BY	CWT Releases	CWT Groups	Expanded CWT Recoveries						Percent Survival	Hatchery/Stream Location
				Ocean	C o l u m b l a R i v e r			Total			
					Fisheries	(SAFE)	Hatcheries	Streams			
Deep River	93	30,535	1	52	426	-399	13	2	493	1.60%	Grays R. H. (13), Deep R. (1), Grays R. (1)
	94	28,320	1	7	176	-147	8	4	195	0.70%	Grays R. H. (7), Lewis R. H. (1), Grays R. (2)
	95	0	0						0		Deep R. (1), Duck Cr. (1)
	96	29,474	1	46	365	-304	7	8	426	1.40%	Big Cr. H. (2), Grays R. H. (5), Gorley Cr. (1), Grays R. (7)
	97	49,566	2	284	2,345	-2,118	63	0	2,692	5.43%	Big Cr. H. (2), Grays R. H. (61)
	98	55,471	2	65	249	-128	17	0	331	0.60%	Grays R. H. (16), Elk R. H. (1)
	99	46,530	2	0	24	-12	0	0	24	0.05%	
		<u>239,896</u>		454	3,585	-3,108	108	14	4,161	1.73%	
Steamboat Slough	97	24,248	1	92	268	-72	215	0	575	2.37%	Elochoman H. (209), Grays R. H. (5), Fallert Cr. H. (1)
	98	29,937	1	188	854	-55	525	0	1,567	5.23%	Elochoman H. (521), Big Cr. H. (4)
	99	<u>29,800</u>	1	132	480	-198	255	0	867	2.91%	Elochoman H. (248), Kalama F. H. (6), Big Cr. H. (1)
			<u>83,985</u>		412	1,602	-325	995	0	3,009	3.58%

Table 5.5. Accountability of early run coho from representative Columbia River hatchery releases, 1993-1997 broods.

Hatchery	BY	Expanded CWT Recoveries								Percent Survival
		CWT Releases	CWT Groups	Columbia River				Total		
				Ocean	Fisheries	Hatcheries	Streams			
Elochoman R.	93	31,149	1	3	5	12	1	21	0.1%	
	94	30,568	1	3	1	0	0	4	0.0%	
	95	0	0					0		
	96	30,215	1	36	26	172	0	234	0.8%	
	97	<u>29,723</u>	1	<u>22</u>	<u>61</u>	<u>89</u>	<u>0</u>	<u>172</u>	<u>0.6%</u>	
	121,655		64	93	273	1	431	0.4%		
Fallert Cr.	93	31,060	1	14	3	79	0	96	0.3%	
	94	30,760	2	4	37	92	0	133	0.4%	
	95	27,551	1	5	62	209	9	285	1.0%	
	96	28,176	1	48	46	255	3	352	1.2%	
	97	<u>29,080</u>	1	<u>27</u>	<u>39</u>	<u>164</u>	<u>0</u>	<u>230</u>	<u>0.8%</u>	
	146,627		98	187	799	12	1,096	0.7%		
Grays R.	93	29,547	1	17	45	107	2	171	0.6%	
	94	28,236	1	0	50	92	3	145	0.5%	
	95	0	0					0		
	96	29,907	1	25	37	79	7	148	0.5%	
	97	<u>29,339</u>	1	<u>181</u>	<u>352</u>	<u>1,148</u>	<u>0</u>	<u>1,681</u>	<u>5.7%</u>	
	117,029		223	484	1,426	12	2,145	1.8%		
Green R.	93	27,967	1	7	4	50	0	61	0.2%	
	94	29,734	1	46	35	81	2	164	0.6%	
	95	31,056	1	39	118	1,339	6	1,502	4.8%	
	96	30,221	1	66	83	276	1	426	1.4%	
	97	<u>31,625</u>	1	<u>91</u>	<u>133</u>	<u>689</u>	<u>0</u>	<u>913</u>	<u>2.9%</u>	
	150,603		249	373	2,435	9	3,066	2.0%		
Lewis R.	93	70,487	1	39	33	528	3	603	0.9%	
	94	73,767	1	27	65	281	1	374	0.5%	
	95	139,456	2	84	79	913	6	1,082	0.8%	
	96	146,588	2	166	151	2,772	13	3,102	2.1%	
	97	<u>147,303</u>	2	<u>301</u>	<u>207</u>	<u>3,403</u>	<u>0</u>	<u>3,911</u>	<u>2.7%</u>	
	577,601		617	535	7,897	23	9,072	1.6%		
Big Cr.	93	53,842	2	24	64	317	0	405	0.8%	
	94	56,067	2	9	69	329	0	407	0.7%	
	95	55,351	2	18	100	245	0	363	0.7%	
	96	51,133	2	11	90	219	0	320	0.6%	
	97	<u>62,827</u>	2	<u>81</u>	<u>320</u>	<u>430</u>	<u>0</u>	<u>831</u>	<u>1.3%</u>	
	279,220		143	643	1,540	0	2,326	0.8%		

continued

Table 5.5. (continued) Accountability of early run coho from representative Columbia River hatchery releases, 1993-1997 broods.

Hatchery	BY	Expanded CWT Recoveries							Percent Survival
		CWT Releases	CWT Groups	Columbia River				Total	
				Ocean	Fisheries	Hatcheries	Streams		
Bonneville NFH	93	51,936	2	30	19	426	0	475	0.9%
	94	48,695	2	8	101	385	2	496	1.0%
	95	56,689	2	24	44	341	0	409	0.7%
	96	44,037	2	30	49	267	0	346	0.8%
	97	<u>51,549</u>	2	<u>58</u>	<u>80</u>	<u>756</u>	<u>1</u>	<u>895</u>	<u>1.7%</u>
		252,906		150	293	2,175	3	2,621	1.0%
Klaskanine R	93	49,439	2	26	237	96	0	359	0.7%
	94	50,953	2	7	179	75	1	262	0.5%
	95	28,284	1	15	404	69	0	488	1.7%
	96	27,321	1	18	212	34	0	264	1.0%
	97	<u>19,730</u>	1	<u>10</u>	<u>79</u>	<u>11</u>	<u>0</u>	<u>100</u>	<u>0.5%</u>
		175,727		76	1,111	285	1	1,473	0.8%
Eagle Cr. NFH	93	58,383	4	15	11	104	0	130	0.2%
	94	45,517	1	4	11	65	0	80	0.2%
	95	72,101	2	42	104	1,383	0	1,529	2.1%
	96	98,259	2	118	98	1,310	0	1,526	1.6%
	97	<u>98,147</u>	2	<u>173</u>	<u>115</u>	<u>3,411</u>	<u>0</u>	<u>3,699</u>	<u>3.8%</u>
		372,407		352	339	6,273	0	6,964	1.9%
Sandy R.	93	107,472	2	30	20	300	0	350	0.3%
	94	222,754	8	22	106	495	1	624	0.3%
	95	159,152	6	52	68	973	1	1,094	0.7%
	96	87,781	3	37	67	172	0	276	0.3%
	97	<u>144,456</u>	4	<u>213</u>	<u>175</u>	<u>1,502</u>	<u>0</u>	<u>1,890</u>	<u>1.3%</u>
		721,615		354	436	3,442	2	4,234	0.6%

Table 5.6. Escapement number and recovery location of select area coho based on expanded coded-wire tag recoveries, 1993-1999 brood years.

Recovery Site	SAFE Net-Pen Site				
	Youngs Bay	Tongue Point	Blind Slough	Deep River	Steamboat Slough
Big Creek Hatchery	15	59	19	4	5
Klaskanine Hatchery	12	2			
Elochoman Hatchery	2	4			978
Fallert Creek Hatchery					1
Cowlitz Hatchery		1			
Grays River Hatchery				102	5
Lewis River Hatchery				1	
Elk River Hatchery				1	
Kalama Falls Hatchery					6
Paradise Creek	1				
Gorley Creek				1	
Grays River				10	
Youngs River	1				
Bear Creek		1			
Umpqua River		1			
Duck Creek			1	1	
Deep River				2	

Table 5.7. Smolt-to-adult survival rates (%) of select area bright fall chinook coded-wire tag (CWT) groups released in select area production facilities, 1985-2000 brood years.

Brood Year	Hatcheries			Net Pens		
	S. Fork Klaskanine	N. Fork Klaskanine	Big Creek	Youngs Bay	Tongue Point	Blind Slough
1985	0.81					
1986	0.36					
1987	2.90					
1988						
1989				1.32		
1990						
1991			0.48	0.11		
1992			1.48			
1993			0.55	1.06		
1994			0.32	0.33		
1995		0.20	0.17	0.35	0.26	0.77
1996		0.32		0.09	0.13	0.07
1997		0.58		0.28		
1998		0.91		1.70		
1999		3.09		2.04		
2000 <sup>a</sup>		0.75		1.16		
Average <sup>b</sup>	1.22	1.05	0.58	0.90	0.19	0.42

<sup>a</sup> Incomplete CWT recovery data

<sup>b</sup> Weighted for all CWT release groups within years

Table 5.8. Summary of smolt-to-adult survival, contribution to fisheries, and straying rates of coded-wire tagged (CWT) select area bright fall chinook from select area release sites, 1991-2000 brood years. 2000 recovery data is incomplete.

Brood Years	Release Site			
	Big Creek Hatchery 1991-1995	Klaskanine Hatchery 1995-2000	Youngs Bay Net Pens 1991-2000	Select area Net Pens <sup>a</sup> 1991-2000
Number of CWT groups	12	11	37	41
Average survival rate (%)				
Smolt-jack	0.04	0.05	0.07	0.07
Smolt-adult	<u>0.58</u>	<u>1.05</u>	<u>0.79</u>	<u>0.82</u>
Total	0.62	1.10	0.86	0.89
Fishery Contributions (% of total adult return)				
Commercial				
SAFE	0.7%	27.0%	42.2%	42.1%
Ocean	31.0%	26.0%	23.2%	23.0%
Columbia River	<u>4.2%</u>	<u>12.7%</u>	<u>16.9%</u>	<u>16.9%</u>
Total	35.9%	65.7%	82.3%	82.0%
Recreational				
Ocean	2.3%	7.5%	3.4%	3.4%
Freshwater	<u>7.8%</u>	<u>14.4%</u>	<u>11.1%</u>	<u>11.1%</u>
Total	10.1%	21.9%	14.5%	14.5%
Escapement <sup>b</sup> (Straying)	54.0% (13.8%)	12.4% (0.7%)	3.2% (1.9%)	3.5% (2.0%)
Straying				
Above Bonneville Dam (Includes recoveries from hatcheries, fisheries, and streams)	0.4%	0.0%	0.4%	0.4%
Escapement to streams and hatcheries other than location of release	13.4%	0.7%	1.5%	1.6%

<sup>a</sup> Includes two release each from Blind Slough and Tongue Point net pens in addition to Youngs Bay net pen production

<sup>b</sup> Escapement includes unharvested fish recovered in streams and hatcheries (natal and out-of-system)

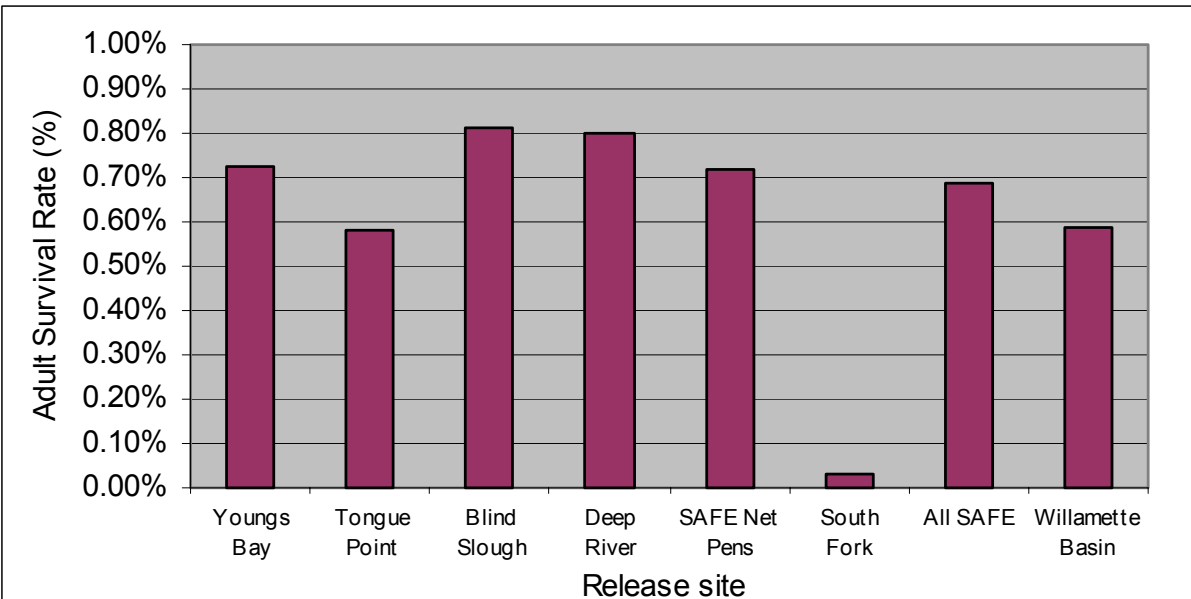


Figure 5.1. Average adult survival rates of spring chinook based on recoveries of coded-wire tag groups released from select area (SAFE) production facilities (42) and Willamette River Basin hatcheries (51), 1994-1998 brood years.

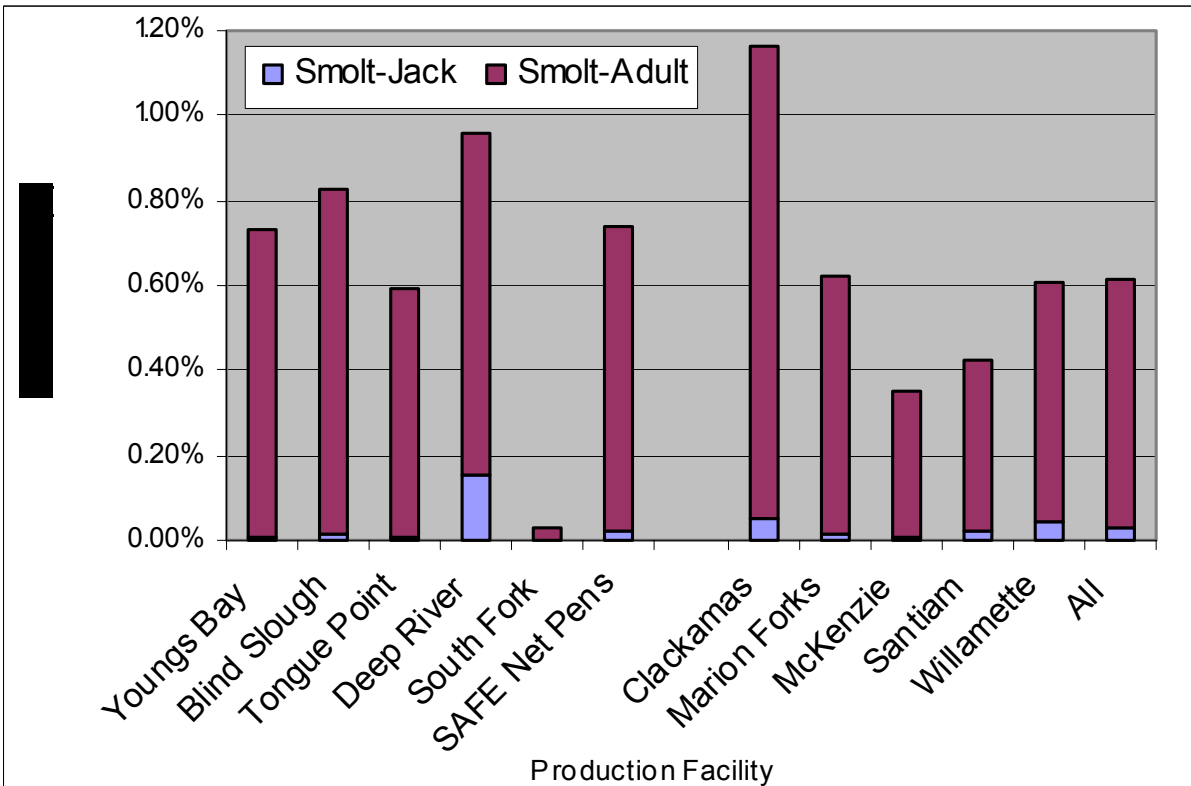


Figure 5.2. Smolt-to-adult survival rates of spring chinook based on recoveries of 93 coded-wire tag groups released from select area production facilities (42) and Willamette River Basin hatcheries (51), 1994-1998 brood years.

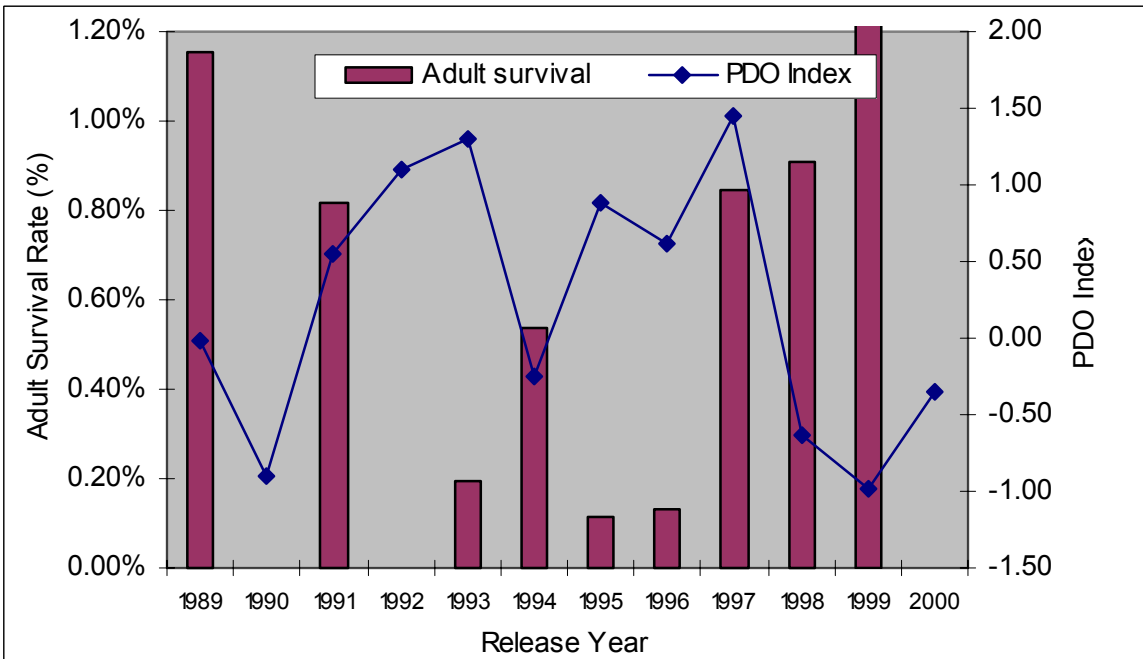


Figure 5.3. Relationship between smolt-to-adult survival rate and 12-month post-release Pacific Decadal Oscillation (PDO) Index (Mantua 1997) for 63 yearling spring chinook coded-wire tag groups released from SAFE facilities, 1988-1999 brood years.

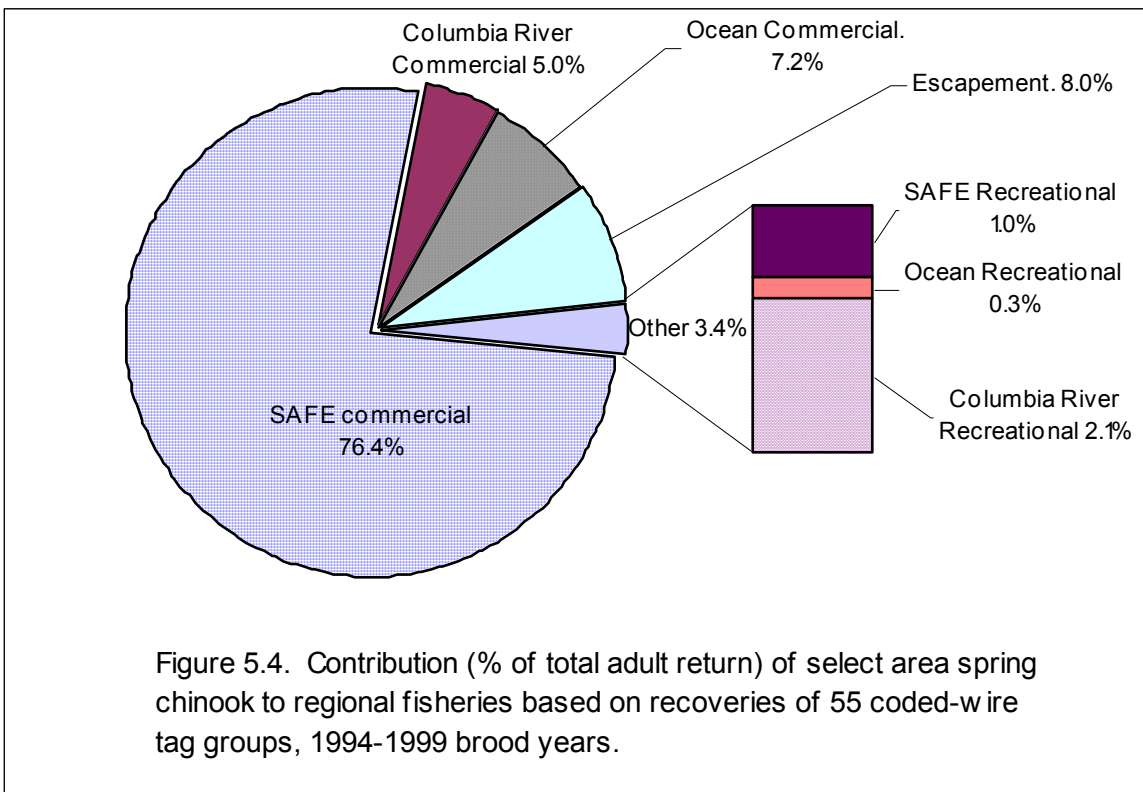


Figure 5.4. Contribution (%) of total adult return) of select area spring chinook to regional fisheries based on recoveries of 55 coded-wire tag groups, 1994-1999 brood years.

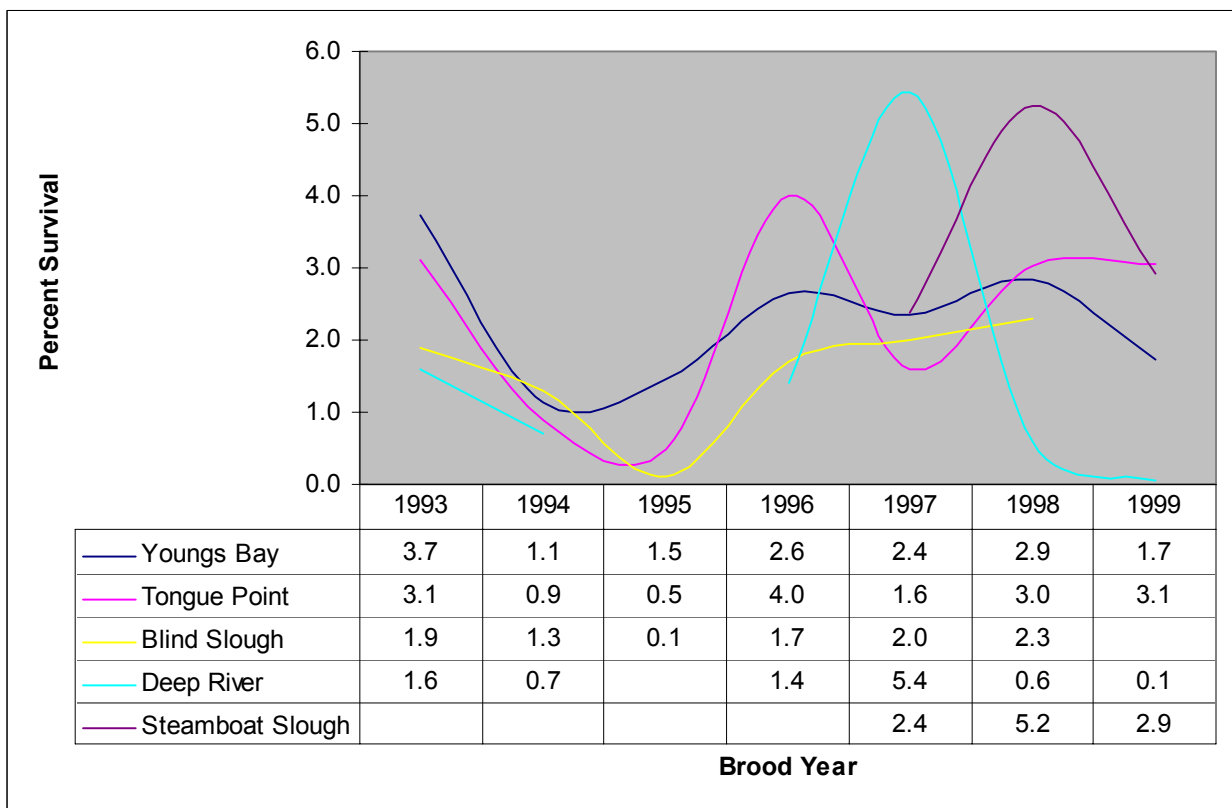
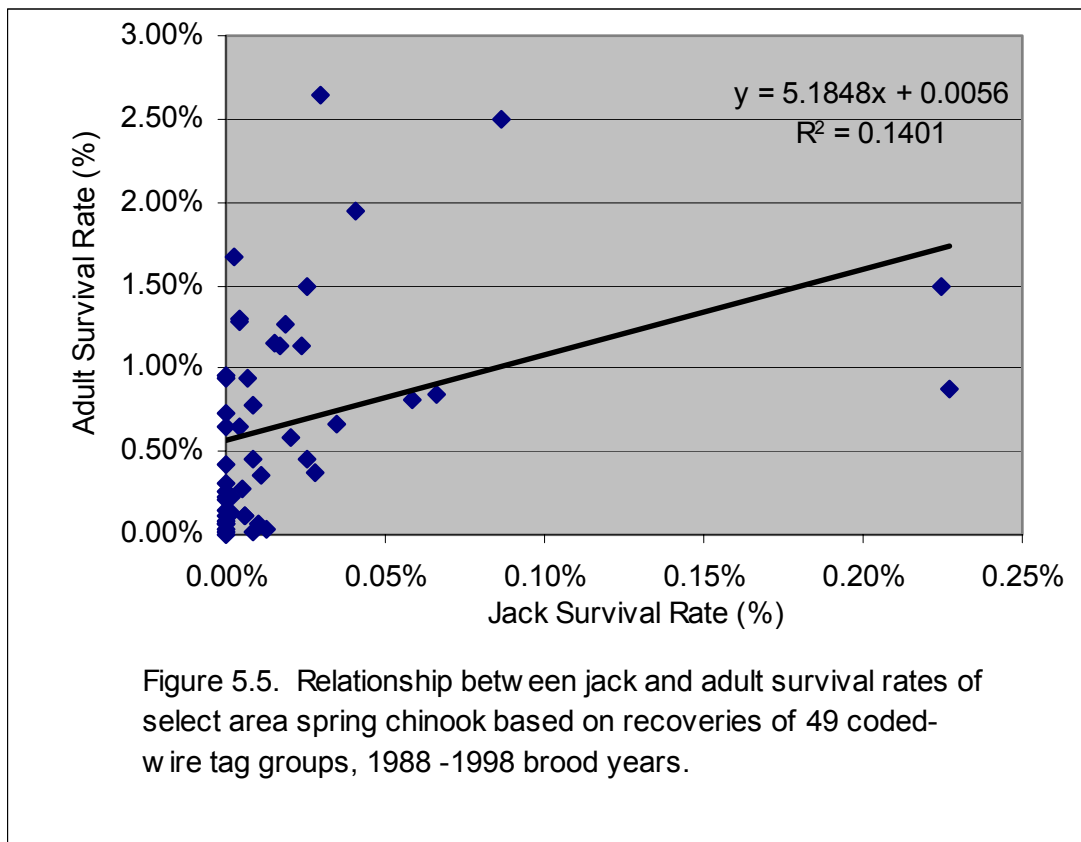
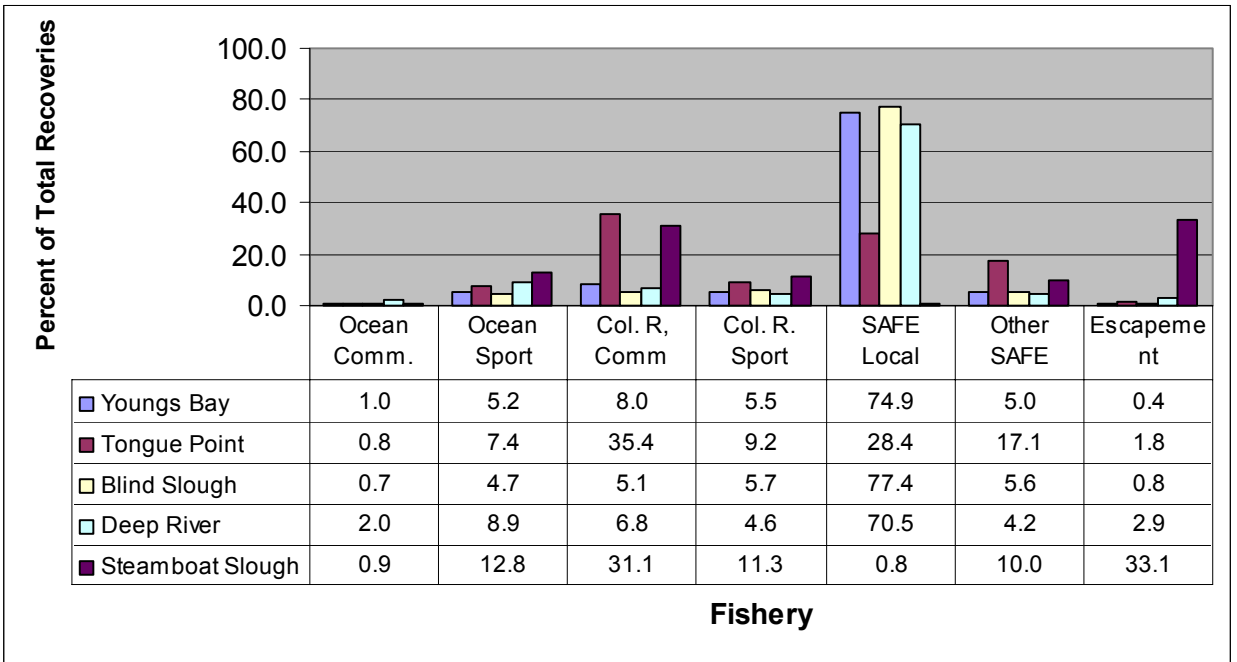
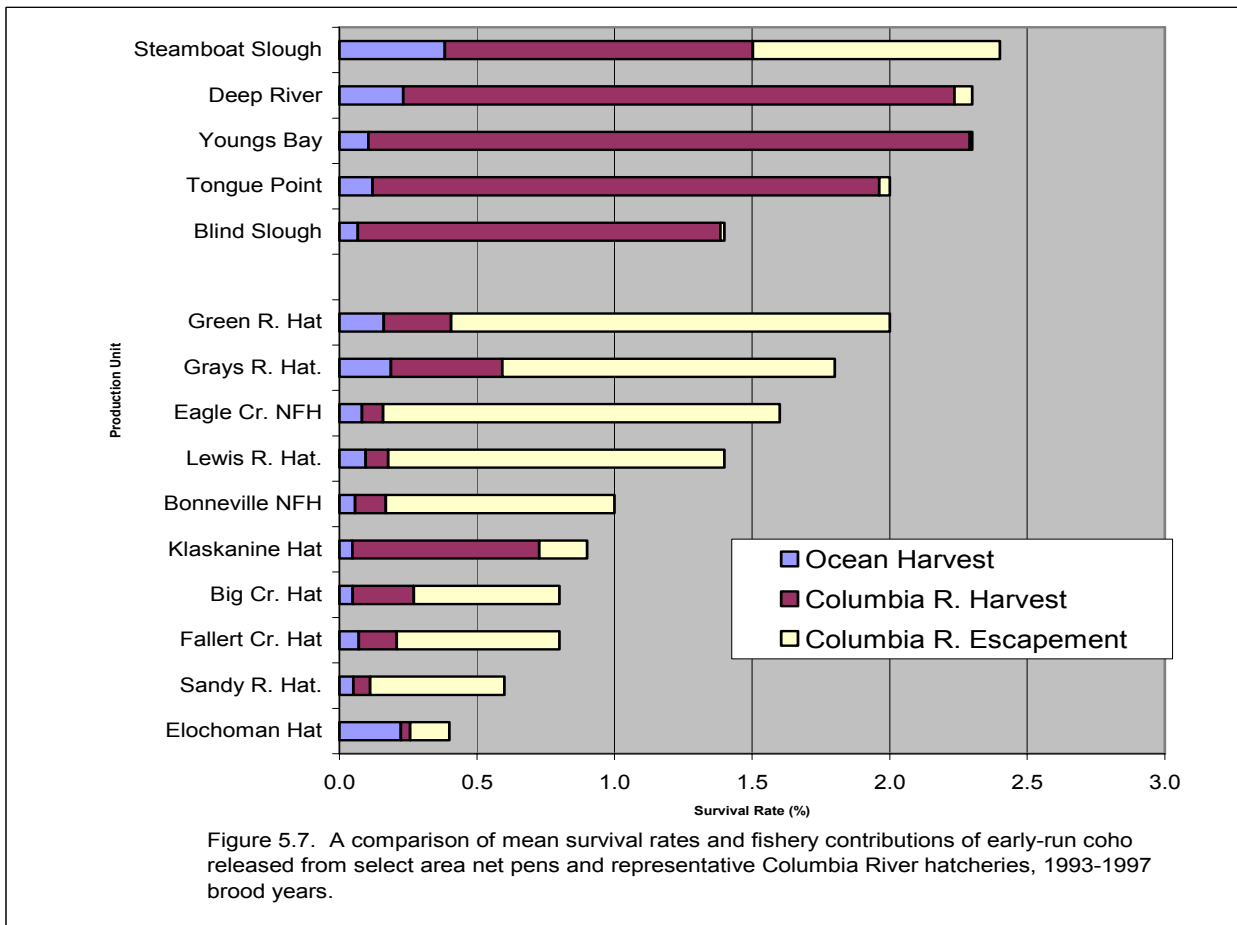


Figure 5.6. Survival rates (%) of coho released from select area net pens, 1993-1999 brood years.



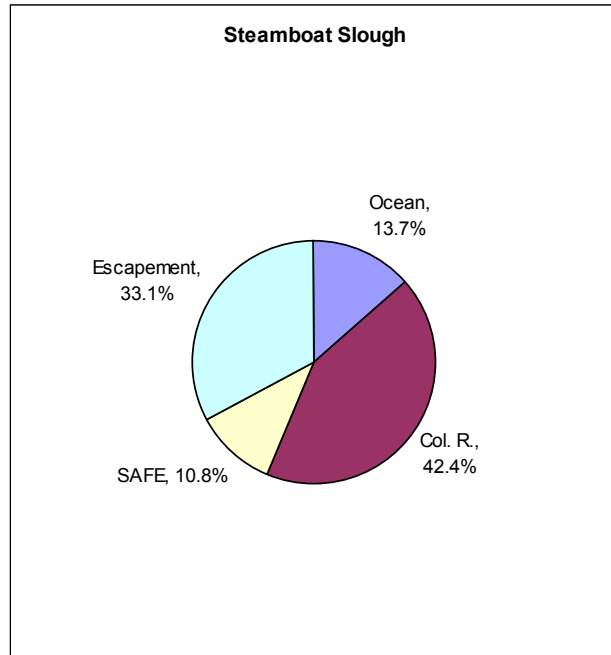
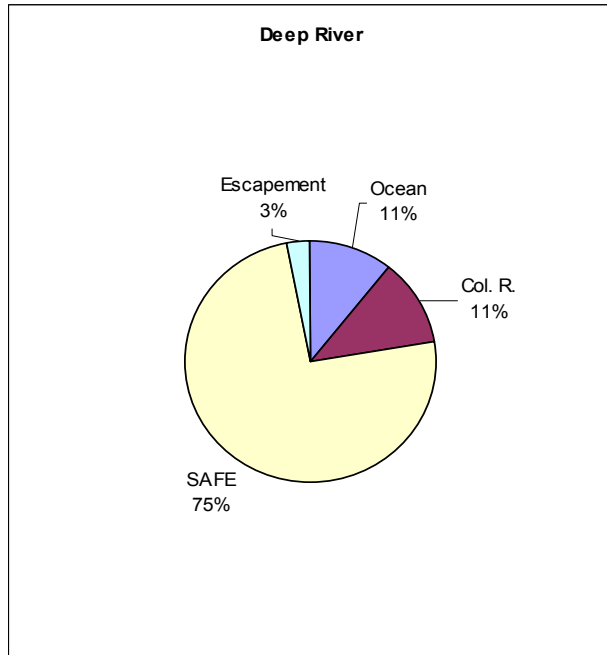
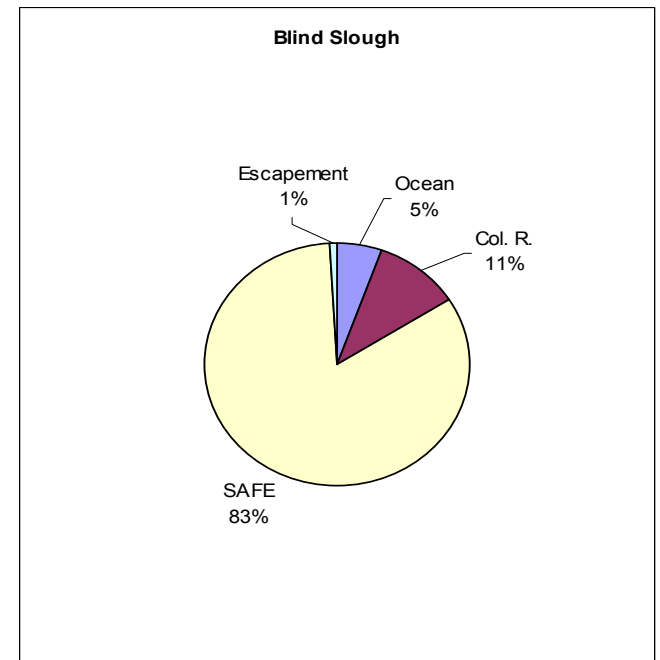
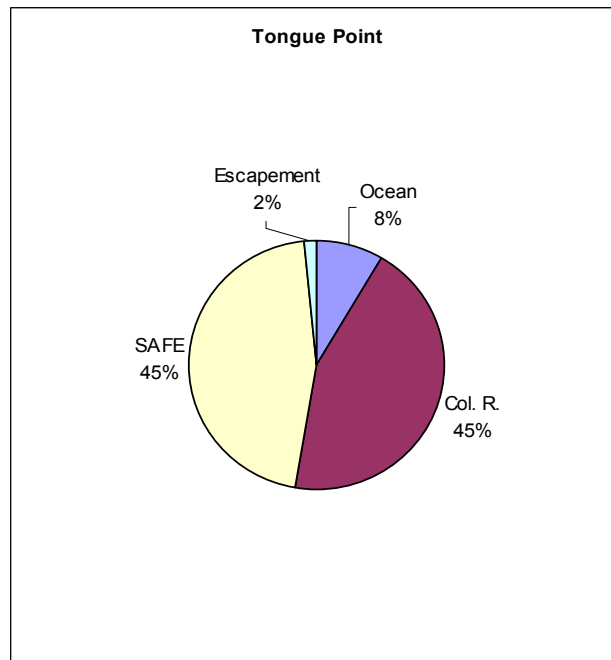
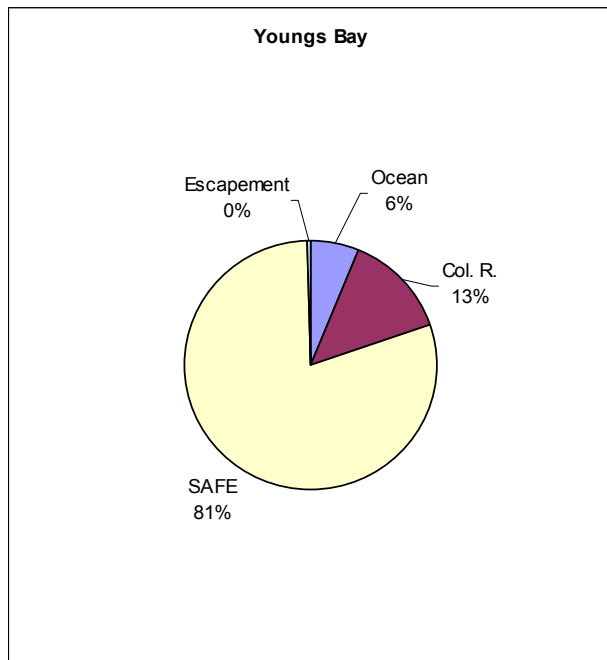


Figure 5.9. Contribution to fisheries and escapement of coho released from select area net-pen sites, 1993-1999 brood years.

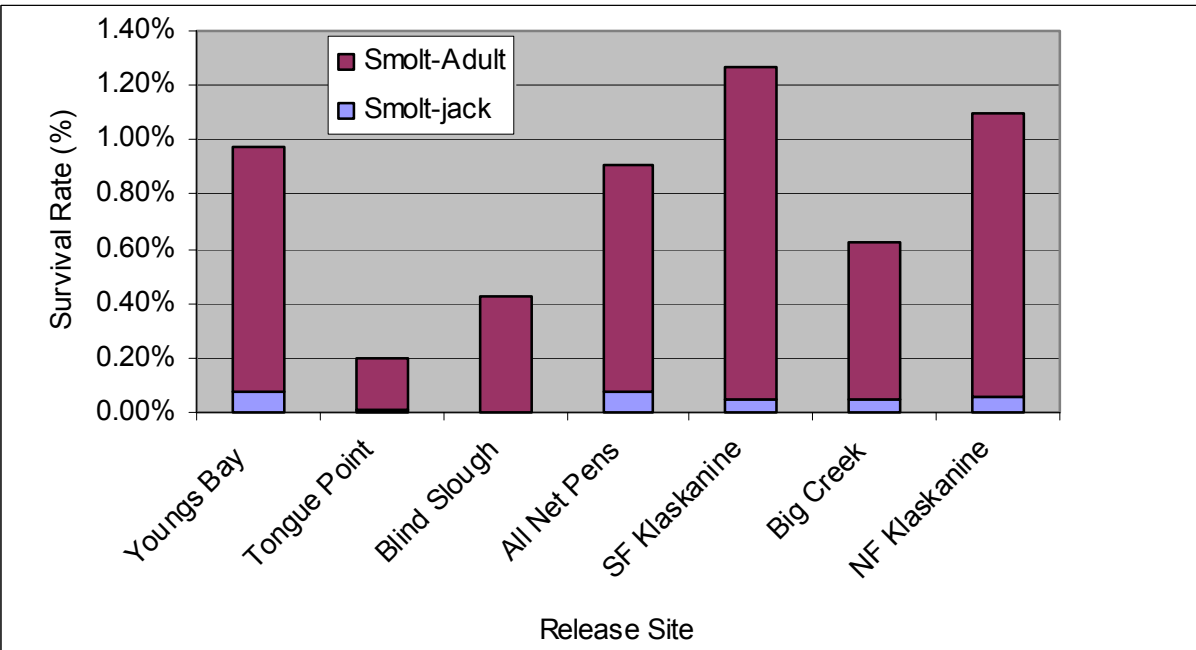


Figure 5.10. Average survival rates of select area bright fall chinook by release site, 1985-2000 brood years.

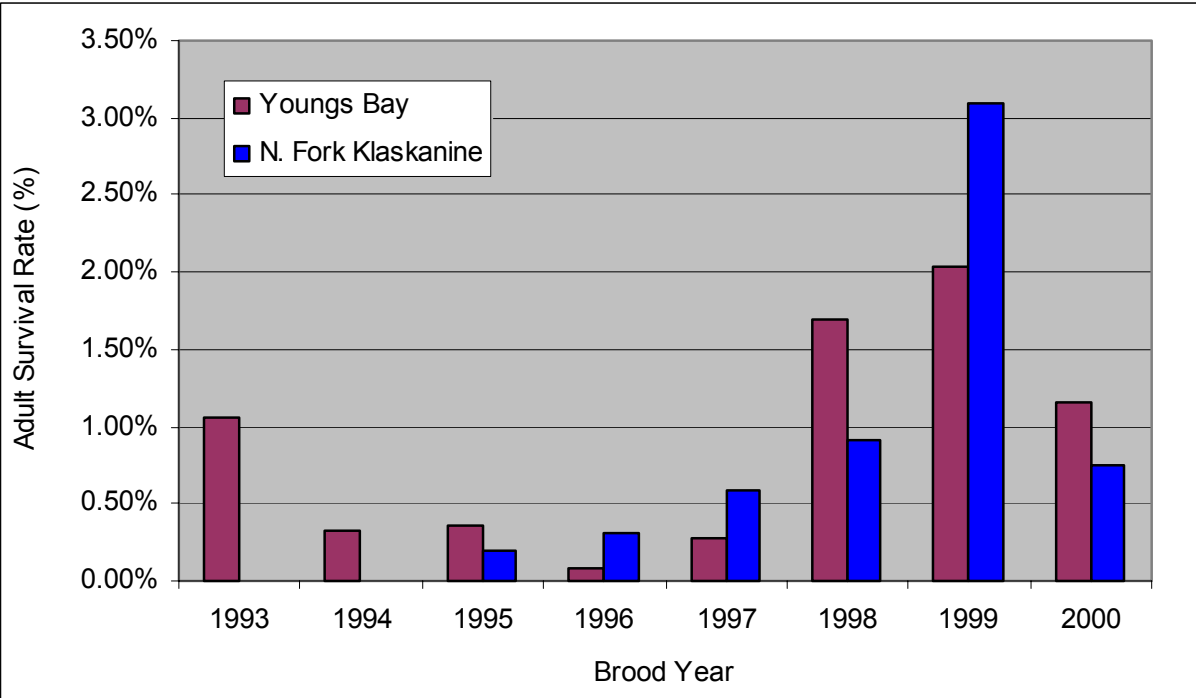
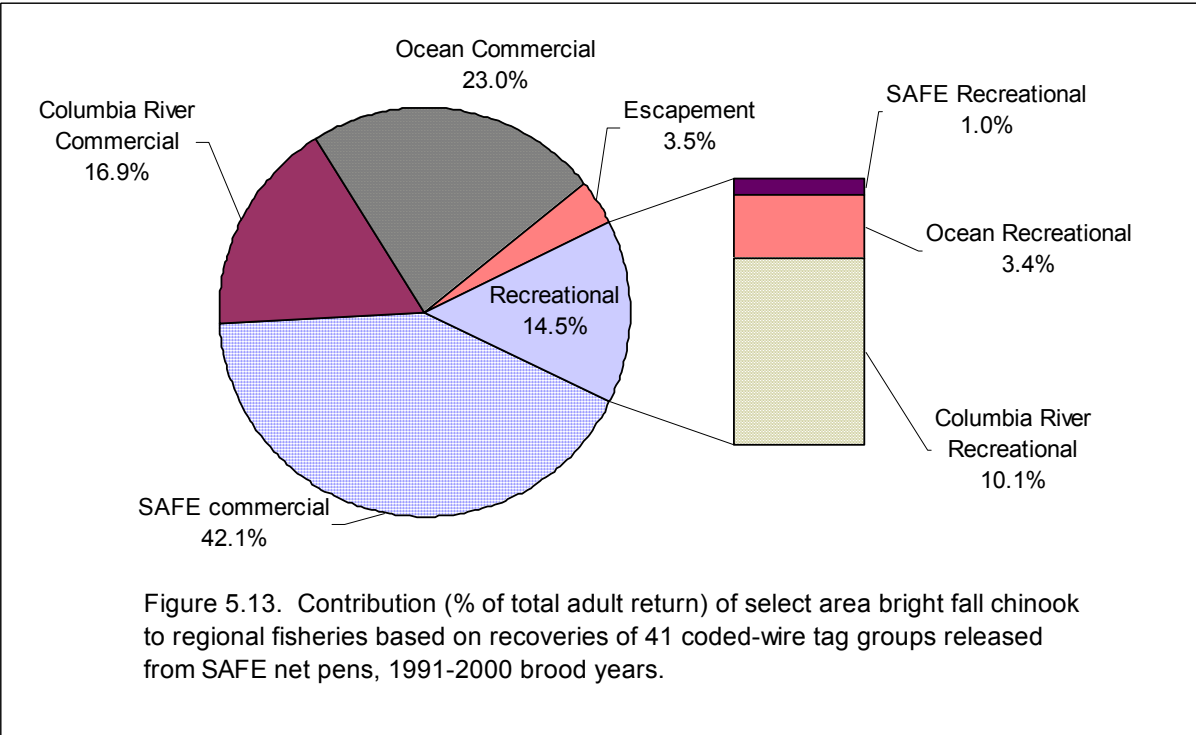
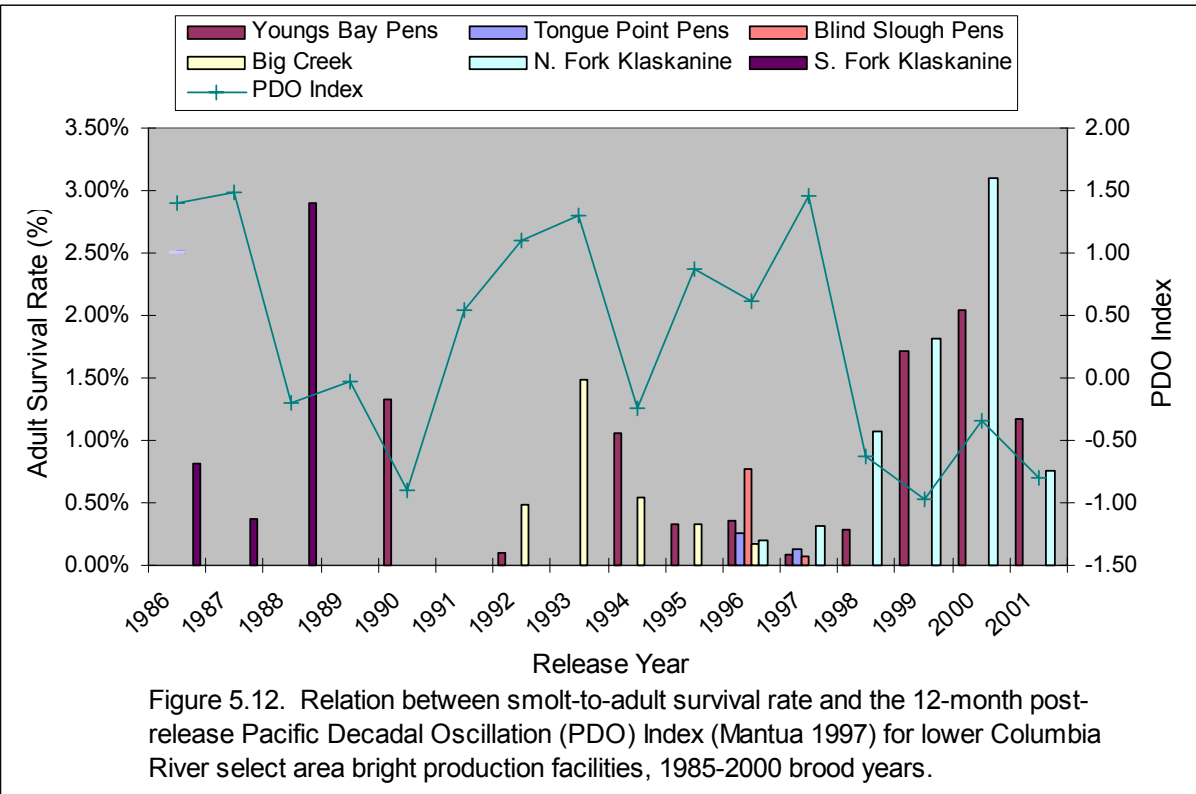
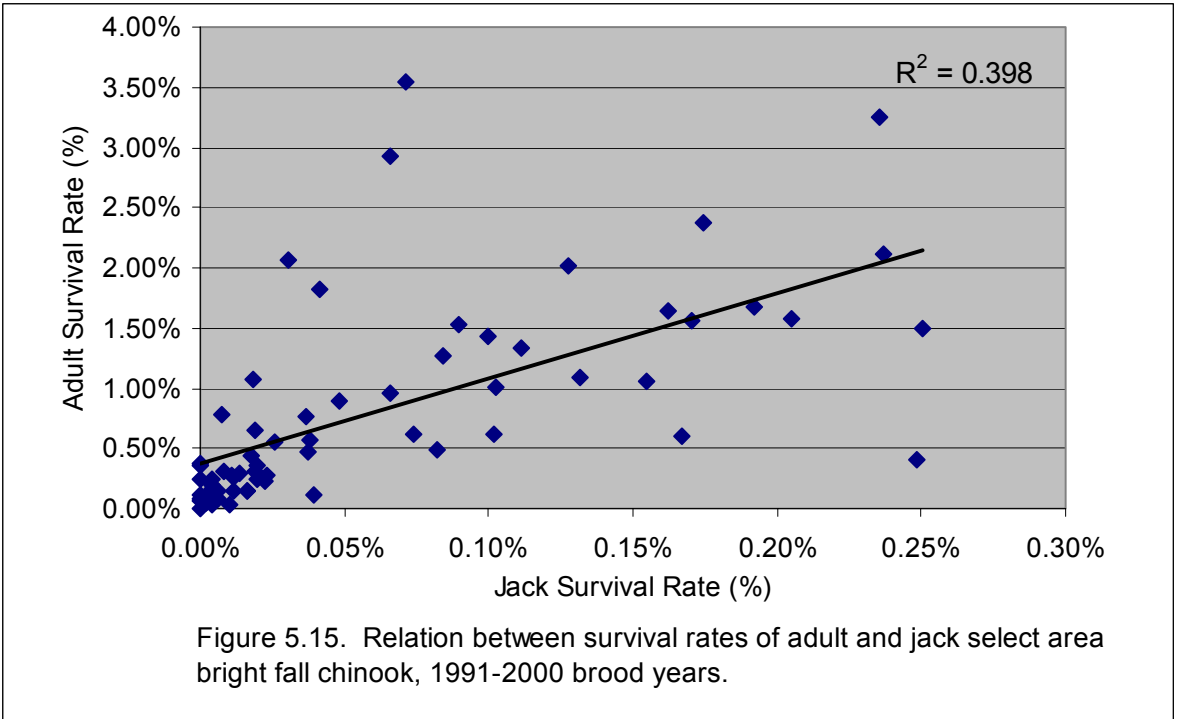
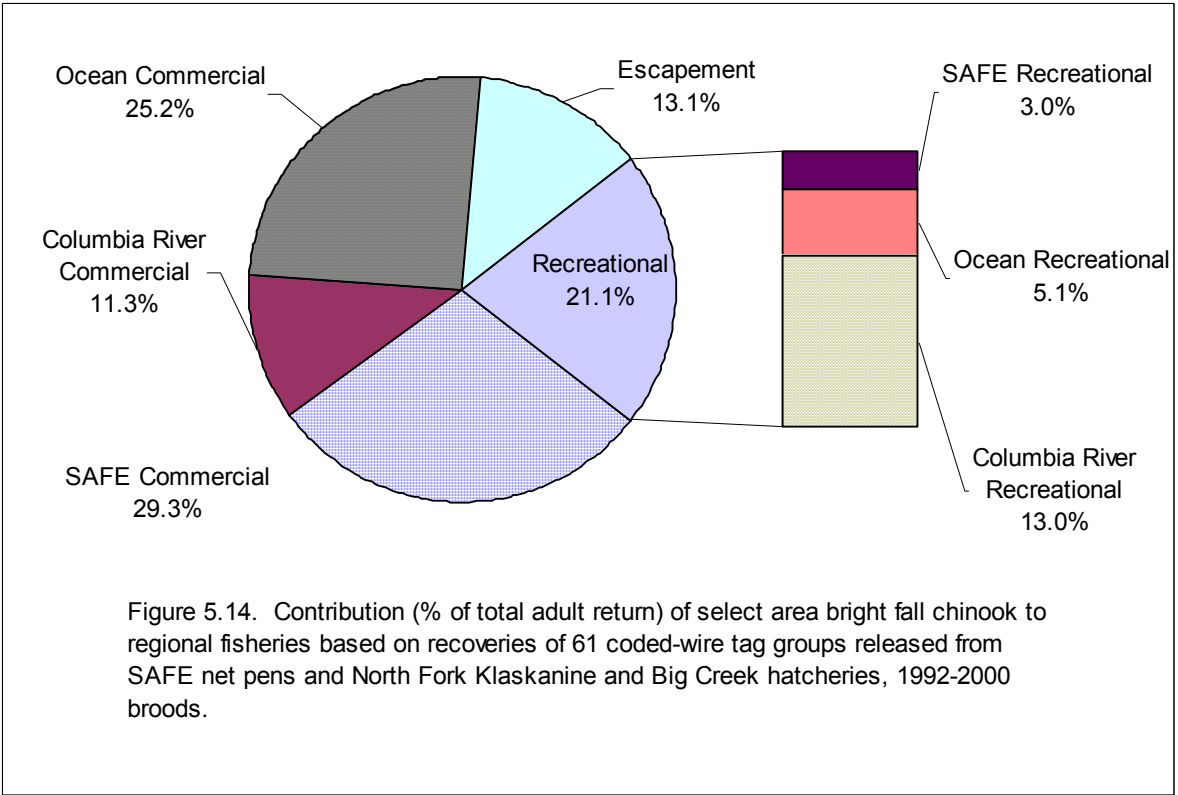


Figure 5.11. Average survival rates of select area bright fall chinook released from Youngs Bay net pens and the North Fork Klaskanine Hatchery, 1993-2000 brood years.





## 6. RESEARCH AND MONITORING

In addition to developing new fishing sites and establishing high value species, the SAFE project has conducted or been involved in many studies throughout its history with a goal of maximizing smolt survival, improving smolt quality, and minimizing impacts of the project on endangered salmonids and their habitat. Studies have included evaluations of avian predation avoidance, determining advantages of winter-fasting to simulate natural behavior of fish, evaluating escapement and natural production of SAFE stocks, documenting out-migration timing of smolts, and determining optimal rearing strategies including rearing density, release timing, and smolt size. Several of these studies were initiated or completed during the reporting period and are summarized herein.

### AVIAN AVOIDANCE AND PREDATION STUDIES

Avian predation of juvenile salmonids in the LCR estuary by piscivorous birds has been well documented by the scientific community (Emmett et al. 1997; Maynard et al. 2001). Artificial nesting areas created by channel dredging have dramatically increased the numbers of these predators. Their close proximity to the SAFE rearing sites creates opportunity for heavy losses of released smolts. Each year increasing numbers of cormorants (*Phalacrocorax* spp.), Caspian terns (*Sterna caspia*), great blue herons (*Ardea herodias*), and gulls (*Larus* spp.) are documented in Youngs Bay at times of chinook and coho releases. Predator control becomes ineffective when the numbers become overwhelming. To address this problem, the SAFE Project conducted release trials during 2001-2003 (1999-2001 broods) to evaluate differences in adult survival rates of coho smolts released from net pens within Youngs Bay (control) with experimental releases in the mainstem Columbia River (treatment). Each test group consisted of 200,000 smolts, of which approximately 25,000 were coded-wire tagged. Each year, treatment groups were drifted out of Youngs Bay during an ebb tide with navigation provided by 2-3 contracted commercial fishing vessels (Figure 6.1). Treatment fish were released near Hammond, Oregon at river mile 8.0, approximately ten miles downriver from the rearing site in Youngs Bay. Control fish were released within 1-2 days of treatment group releases during a nighttime ebb tide.

Based on preliminary recoveries of CWT's from adult fish returning in 2002-2003, the average survival of towed release groups was 280 percent greater than for control release groups (Table 6.1). Escapement and stray rates were minimal (0.8 and 0.2 percent) for the towed groups, and actually less than rates observed for the control fish (1.9 and 1.3 percent). However, several other release groups exhibited survival and straying rates comparable to the towed CWT groups, indicating towing may not improve survival dramatically over other release strategies, but it certainly does not reduce survival or contribute to increased straying. It is unclear why control fish survived at a lower rate than other CWT-release groups in both 2002 (poorest) and 2003 (2<sup>nd</sup> poorest). Results are likely influenced by incomplete tag recovery data for some fisheries, especially the 2003 Youngs Bay commercial fishery. The difference in harvest distribution of the various release groups was surprising given the fairly significant

number of recoveries. Towed release groups had the highest commercial harvest rate (72.2 percent) and the lowest recreational contribution (27.0 percent). This harvest distribution was similar to that for acclimation groups, whereas the harvest distribution for other releases was weighted toward recreational harvest (Table 6.1). Given these results, towing may be one means to minimize the potential for interaction and competition of SAFE hatchery production with wild juveniles in the Columbia River Estuary without compromising survival, homing, or contribution to fisheries.

In addition to efforts to understand the extent of avian predation on smolts released from the SAFE project, attention to limiting or eliminating losses in the net pens from avian and mammalian predation is an ongoing concern. Typically the net pens, regardless of location, are visited by several species of piscivorous birds and families of river otters (*Lutra canadensis*). A variety of approaches, from legal trapping to sewing bird covers to the nets, have been tried with some success. Incidences of otter predation continue to plague the project and new treatments are underway to address the problem. A solar-powered electric deterrent device similar to the kind used in agriculture to contain bovines has been evaluated at some sites. The Deep River pen complex has been successful in reducing otter predation using this technique, yet it was only marginally successful when tested at Youngs Bay net pens. Current net-pen covers need to be replaced with finer-mesh netting to prevent chronic predation by blue herons.

## **SUBSURFACE FEEDING**

Frequent criticism of hatchery methodologies includes that of teaching raceway-reared fingerlings to feed on the surface and to respond to human presence associated with surface feeding. It is speculated that this conditioning may result in higher than normal avian predation once fish are liberated. Other trials have concluded that salmon fed in captivity will become accustomed to human hand feeding and respond to human presence yet still maintain avoidance responses to avian shapes (Maynard et al. 1996; Olla et al. 1998; Maynard et al. 2001).

To determine if subsurface feeding would improve survival of juveniles released by the SAFE project, a multi-year release trial was conducted using 1999-2001 brood SAB fall chinook ponded into net pens in Youngs Bay. Each year, two groups of approximately 25,000 fish each were fed using six-inch diameter polyvinyl chloride (PVC) pipes, three per net pen extending 1.0 meters below the surface as a delivery system for feeding (Figure 6.2). Target release densities for the two groups were 0.25 and 0.50 pound/ft<sup>3</sup>. As a control, two additional groups of fall chinook were reared at similar densities in nearby pens and surface fed on an identical schedule. All fish received an LV fin clip for stock identification, and each study group was uniquely coded-wire tagged prior to release.

Based on CWT recoveries for 1999-2000 brood year release groups, adult survival does not appear to be greatly influenced by feed delivery practices employed for SAFE juveniles (Figure 6.3). Survival was higher for surface-fed fish reared at low densities,

but lower than fish fed subsurface at medium densities. Average survival for the two feeding regimes was nearly identical when data for two rearing densities were combined. Pending additional CWT recovery data, sub-surface feeding strategies are not likely to be adopted for SAFE net pen rearing.

Brood year 1999 spring chinook reared at Gnat Creek Hatchery were also subjected to subsurface feeding in one of fifteen raceways. An engineered subsurface complex of PVC tubes linked to a water-driven system distributed feed into the raceway at six locations one meter below the surface.

After just a few days of feeding, the subsurface fed fish showed decreased surface activity, and eventually it became more difficult to capture weight samples because the fish would not come to the surface when "chummed" with feed. The subsurface groups showed comparable growth rates to the traditional surface-fed groups. However, fish reared under these conditions exhibited significant size divergence; half the fish grew rapidly while the remaining fish were less than 50 percent the size of their cohorts. After transferring these fish to net pens the size divergence continued to the extent that many of the "runts" never grew. While this may not be inherent to underwater feeding systems, review of the program resulted in the conclusion that subsurface feeding would be best applied once the fish were transferred to net pens. No further fresh water subsurface feeding is planned.

## **WINTER DORMANCY**

Metabolism of feed and the subsequent feeding response of hatchery fish is directly related to the rearing water temperature. Hatchery operators frequently report that fish naturally reduce their feed intake during cold-water periods but feed heavily as water temperatures increase in the spring resulting in rapid growth prior to smolting; a pattern typical of wild pre-smolts (Beckman et al. 1999). To evaluate how a winter-dormancy feeding regime would affect fish health and resulting survival of net-pen reared fish, release trials were initiated with SAFE Willamette stock spring chinook (1995-2003 brood years). Dormancy (treatment) and winter-feeding (control) groups were reared and released from net pens in Youngs Bay during 1997-2003, Blind Slough during 1998-2001, and Tongue Point from 1998-2000. Each year a sub-sample of approximately 25,000 fish of each group was tagged with uniquely coded CWT tags. During the first year of the study, the dormancy group was not fed for up to 60 days during the coldest water months; however, this resulted in fish that developed near lethal low-lipid levels after three weeks. The trial design was modified to incorporate low-level feeding once per week in subsequent years rather than total fasting, and the dormancy period was reduced to six weeks from mid-December through January.

Fingerlings subjected to reduced winter feeding regimes followed by a satiation diet in early spring can still reach targeted release weights of 13 fish/pound (Figure 6.4); however, anticipated savings in winter feed costs were offset by the increased rations required in the spring to achieve target release sizes.

No clear trend was apparent in adult survival of these two feeding regimes based on recoveries of 14 CWT release groups (1995-1998 brood years) from Youngs Bay and Blind Slough (Figure 6.5). Data for Tongue Point test groups was not evaluated since dormancy groups at this site were consistently released one month prior to the winter-feeding group, thereby imparting bias. For the other two sites, each group's survival fluctuated annually with SAR's for the dormancy groups ranging from 0.22-1.94 percent, and winter-feeding groups fluctuating from 0.14-2.65 percent. Average site-specific adult survival rates were higher for fish fed throughout the winter (Figure 6.6). Additional data from 1999-2003 release groups may aid in determining if this observed difference is actual, and results may determine future feeding strategies.

## **REARING DENSITY**

Artificial rearing of salmonids is constrained by various factors, one of which is the total biomass that can be produced in a given space. Water flows are needed to provide adequate oxygen for respiration and flushing of metabolites. Research has shown that there is a direct correlation between the total biomass in rearing situations and eventual survival of liberated smolts to adults (Banks 1989; Ewing and Ewing 1995). Each species and stock of fish may have unique tolerances to the known environmental constraints, and this study addresses one of three species reared and released by the SAFE project.

To determine the optimal net-pen rearing density for SAB fall chinook, juveniles of the 1994-2000 broods were reared in floating net pens in Youngs Bay using three loading levels that would yield target biomass densities of approximately 0.25 pound/ft<sup>3</sup>, 0.50 pound/ft<sup>3</sup>, and 0.75 pound/ft<sup>3</sup> at a release size of 15 fish/pound (Hirose et al. 1998). Approximately 25,000 fish from each study group were coded-wire tagged prior to release. Due to differential growth rates, annual variance in actual rearing densities occurred between years.

Fish grown at lower densities grew rapidly and generally exceeded the target release weight. Fish grown at medium densities grew at a rate sufficient to meet the target weight at time of release. Fish grown at higher densities grew slower and did not always meet the growth target. Adult survivals based on expanded CWT recoveries were almost always poorer for fish reared at high densities than for fish reared at medium and low densities (Figures 6.7 and 6.8). Given the trade-off of vastly increasing the number of pens and nets to achieve low density rearing and the relatively small advantage over medium density rearing, the program has adopted medium density rearing as its strategy for rearing SAB fall chinook. This study was not able to differentiate whether the density of rearing, size of release, or state of smoltification was the actual causative factor in total ocean survival. Trials that use strategies to differentiate these factors and use different stocks may be evaluated in the future.

## RELEASE TIMING AND SMOLT SIZE

Fish propagation programs in the Columbia River Basin are generally driven by an underlying goal to grow fish to a predetermined target release size during a specific timeframe to mimic natural fish behavior. A wealth of propagation information is available from years of species-specific research conducted relative to the extensive land-based hatchery system that has evolved in the system (Senn et al. 1984). In comparison, net-pen culture in the Columbia River system is a recent development, often requiring verification or fine-tuning of long-standing hatchery practices.

To evaluate the effects of release timing on adult survival, two paired CWT groups of SAB fall chinook smolts were released from Youngs Bay net pens annually during 1995 and 1997-1999 (four paired releases). One test group represented fish to be released on or near July 15 of each year or when water temperatures reached 65° F. The second CWT group represented fish to be released on or near August 1 of each year or when water temperatures reached 70° F. Release timing was generally driven by water temperature criteria rather than target release date. During all four years the average size of fish in the early release group (17.1-31.0 fish/pound) was smaller than the later release (12.5-18.1 fish/pound); however, adult survival rates were very similar (Figure 6.9). Given these results, and data from other SAB release trials, the SAFE project has adopted 65° as the target SAB release temperature whenever possible.

Annual variations in timing of egg collection, incubation, and rearing water temperature often influence the subsequent size and timing of smolt releases. Adult survival rates of 1988-1996 brood spring chinook released from SAFE net-pen facilities were consistently poor for five CWT test groups released late in the year (calendar days 150-201); however, these fish were all sub-yearlings (0<sup>+</sup> life stage). For yearling fish released during the normal spring period, a weak positive trend ( $R^2=0.161$ ) indicates liberating fish in or after March may result in higher survival than fish released in or prior to February, but this may be an artifact of larger smolt size rather than timing (Figure 6.10). Interestingly, the trend of improved survival with a later release date occurred regardless of release location (Figure 6.11). Based on these results, the SAFE project has adopted a target release period of late-March to early-April for spring chinook beginning with the 2000 brood year. Coded-wire tag recovery data from these recent releases will be evaluated in the future to determine if this is an effective strategy for this species.

Based on CWT recoveries of 47 CWT groups of 1992-1998 brood spring chinook released from select area net pens, survival was positively correlated with release size for all release years (Figure 6.12). The relation between release size of 1988-1999 brood spring chinook smolts and subsequent jack survival was positive but very weak ( $R^2=0.089$ ; Figure 6.13). Recoveries of 51 SAB fall chinook (1995-2000 broods) CWT groups released from the North Fork Klaskanine Hatchery and Youngs Bay net pens also showed a weak correlation between adult survival and size at release ( $R^2=0.064$ ), indicating it may not be critical to achieve a specific release size for these fish (Figure 6.14). However, survival of 1995-2000 brood SAB smolts released from Youngs Bay

net pens was generally higher for larger smolts during each year of release (Figure 6.15). Based on these results, the SAFE project will maintain a target release size of 12.0 fish/pound for spring chinook and an April 1 release date. The release target for SAB fall chinook will be 15-20 fish/pound and 65° F water temperature when possible.

## **SELECT AREA BRIGHT BROODSTOCK COLLECTION AND ADULT HOLDING**

A common problem throughout the evolution of the SAFE SAB fall chinook program has been how to hold early-returning adults in the hatchery facilities. These fish enter freshwater over a protracted period from June through September with returns to hatcheries occurring from July through October. Most of these early returnees are not ripe when they reach the hatcheries. Even if they could be spawned, protracted egg collections complicate subsequent rearing. Utilizing all returning broodstock has been an important goal of the SAB program since full capacity (2.4 million eggs) has not yet been accomplished (Figure 6.16). Unfortunately these fish do not hold well due to a preponderance to jump, resulting in injury. Early returns are especially vulnerable due to warmer water temperatures.

In 1999 and 2000, SAB fall chinook that returned early to Big Creek, North Fork Klaskanine and CEDC's South Fork Klaskanine hatcheries were transferred to net pens in Youngs Bay to evaluate the potential for holding adults to maturity. In 1999, 107 adults (62 females, 45 males) were held from 93 to 121 days, with 64 percent of the females surviving to be spawned. In 2000, 75 adult SAB's were held up to 42 days with 84 percent of the females spawned successfully. Overall, ripening adult SAB adults in the net pens was successful. The nets cause little abrasion and the brackish water seemed to deter fungus growth. Interestingly, it appears one side effect of net-pen holding is that maturation may be delayed one or two weeks.

During September 2003, additional broodstock collection activities were conducted using tangle nets and a Merwin fish trap in the tidewater sections of the Klaskanine and Youngs Rivers to determine whether offsite broodstock collection is a feasible alternative for obtaining additional SAB eggs. Tangle nets (4½" stretched mesh) were deployed across the confluence hole and weighted heavily to avoid drifting. Fish were removed from the net, revived in a live box, and held in a 67-gallon insulated tote prior to being transported to net pens (6) stationed onsite. Both the live box and holding tote were plumbed to deliver raw river water. The Merwin trap was fished across the mouth (~85 percent coverage) of the Klaskanine River overnight for ~26.5 hours.

Overall, the tangle-net component of the experiment was successful, with 155 SAB fall chinook captured yielding 174,573 eggs. The capture to spawning survival rate was 81.6 percent. Both catch (4.2 fish/set) and holding survival (88.9 percent) rates were sufficiently high to warrant future work. The holding survival rate compared favorably with the holding evaluations conducted in 1999 and 2000. Only limited fungus was observed on some fish late in the holding period. Several coho were captured in the Merwin trap but no SAB fall chinook were collected. Based on results of this study, off-

site broodstock capture should be conducted during late-August through early-September with tangle nets in future years to maximize SAB egg collections.

### **SPAWNING GROUND, JUVENILE SURVEYS, AND HATCHERY SAMPLING**

In addition to systematic stream surveys conducted each fall in LCR tributaries by various state agencies, SAFE project staff also conduct local stream surveys for a variety of reasons. Spawning ground surveys are conducted each fall in the Lewis and Clark, North and South Fork Klaskanine, and the Youngs rivers (all Youngs Bay tributaries) to estimate straying and escapement of adult SAB fall chinook. Each river is surveyed up to five times annually from late-September through October. Data collected includes redd counts and estimates of live and dead fish numbers. Carcasses are examined for sex, spawning success, fin marks, and also measured for length. Scales are collected to determine age composition. Snouts are collected from carcasses with appropriate fin-mark combinations with data incorporated into the RMIS system for estimating survival and stray rates. These surveys have documented the majority (90.0 percent) of fall chinook present in SAFE tributary streams in recent years were SAB stock, which occur at fairly high levels and exhibit spawning activity in area streams (Table 6.2).

Additional spawning ground surveys have been conducted each winter in the South Fork Klaskanine since 1998 to determine the stock origin of a late run of fall chinook known to exist in the Klaskanine River drainage. It is possible this run is a remnant of Chetco and/or Trask stock releases from the North Fork Klaskanine Hatchery in 1975. Data collected during these surveys includes redd counts, live fish abundance, scale samples, and sex of adult mortalities. Muscle and organ tissues are also collected for ongoing genetic analysis.

To determine if either of these chinook stocks are successfully spawning, juvenile abundance surveys were conducted during July of 1999-2002 and the fall of 1999 in Youngs Bay tributaries. Surveys were not completed in 2003 due to unexpected staffing vacancies but will be resumed in 2004. Sampling was conducted within several pools in each of three sections of the Lewis and Clark and Klaskanine rivers (North Fork, South Fork, and mainstem) using multiple passes with a stick seine. Fish were identified to species, counted, examined for fin marks, and measured. Results indicate that abundances of juvenile chinook and cutthroat trout in survey sections of these streams are low, while juvenile coho and steelhead are more common, especially in the Lewis and Clark River (Figure 6.17). Given the low juvenile chinook abundances, it appears the adult chinook spawning activity observed during fall surveys may not be very successful. More extensive surveys during other months are probably warranted to verify this hypothesis.

Sampling of returning adults is conducted annually at several local hatcheries to collect biological data and recover coded-wire tags to determine adult escapement levels. Sampling of spring chinook occurs annually during April-June at Big Creek Hatchery concurrent with recycling of stray spring chinook back to the Blind Slough fishing site for

additional harvest opportunities. Select area bright fall chinook are sampled at the North Fork Klaskanine Hatchery during October and November of each year concurrent with spawning activities. Coho and any stray spring chinook or SAB fall chinook returning to the South Fork Hatchery are sampled annually in October and November. Data collected includes sex, length, examination for external marks, and recovery of snouts containing coded-wire tags. All data is incorporated into the RMIS system for estimation of survival and stray rates.

## **CONDITION AND OUTMIGRATION OF SAFE SMOLTS**

The issue of whether hatchery-reared salmon have a negative effect on wild stocks through competition, predation, disease transmission, and other mechanisms is a topic of continual debate (Myers and Horton 1982; Levings et al. 1986; Williams et al. 1998). Since SAFE project releases are significant, the project has received some criticism for not evaluating potential project effects. Although it would be very difficult to quantify any adverse effects of SAFE production on wild salmonids, several actions have been undertaken to evaluate the potential for impacts and minimize the effects of SAFE project releases on wild juvenile salmon.

Currently, the SAFE project is coordinating with Sea Resources, Salmon for All, ODFW, Oregon State University, and USFWS on an ODFW R&E funded project initiated in 2003 to determine the migration rate and residency time of SAFE net-pen spring chinook and the correlation with gill  $\text{Na}^+, \text{K}^+$ -ATPase. Fieldwork was initiated in April 2004 using 20 fish fitted with surgically-implanted Vemco acoustic transmitters (Figure 6.18) and both fixed sites and mobile tracking for tag recoveries. Understanding residency time of SAFE smolts in the lower Columbia River estuary will help determine the potential for impacts of SAFE releases on listed salmonids. If residency times of SAFE smolts are minimal, the potential for significant negative impacts on other salmonids is reduced. Correlation of out-migration rates with ATPase levels will hopefully provide a tool that can be used to time releases when smolts are most likely to migrate directly to the ocean environment; thus minimizing potential impacts on native stocks during their early life history stages. Preliminary results of this study corroborate findings of Ledgerwood (1997) who found that SAFE juveniles migrated rapidly through the lower estuary, with most fish departing Youngs Bay within six hours or one tidal series. Recoveries from fixed sites stationed at the mouth of the Columbia River have not yet been summarized. Results of this work will be presented in a project summary report to the R&E Board following completion of additional fieldwork scheduled for spring 2005.

Beginning in 2002, project staff began a longer-term project of collecting representative tissue samples for gill  $\text{Na}^+, \text{K}^+$ -ATPase analysis from one annual release of coho and spring chinook to determine levels of smoltification and the effect on adult survival based on CWT recoveries. This data, combined with the telemetry results mentioned above, will help refine release guidelines that optimize survival of SAFE production and minimize impacts with other salmonids.

## HOMING

Throughout the research phase, the SAFE project has monitored recoveries of coded-wire tagged returning adults to evaluate homing for each stock and release site. This effort has led to discontinuation of several release programs to minimize effects of the project on other systems in the Columbia River Basin. Spring chinook production at the original Tongue Point rearing site was discontinued in 2001 due to excessive straying of the 1996-1998 releases. Because this site has excellent production and fishing potential, several actions were undertaken in hopes of re-establishing a spring chinook fishery at this location. The current rearing site has been relocated approximately 1.2 miles upstream (east) to the MERTS dock to distance the production area from the mainstem Columbia River. In addition, experimental releases were initiated in 2003 consisting of ~35,000 spring chinook smolts artificially imprinted with a low concentration ( $\sim 5.0 \times 10^{-5}$  mg/L) drip of the synthetic chemo-attractant (morpholine) and released onsite. As a control, approximately 25,000 additional smolts were acclimated and released from a temporary net-pen site in the John Day River (river mile 3.0), a tributary that enters Cathlamet Bay (Tongue Point fishing site) approximately 0.6 miles east of the MERTS site. Paired releases occurred in 2003 and 2004, with a final release scheduled for 2005. All release groups have been uniquely marked with coded-wire tags to evaluate homing of returning adults. Test fishing or limited participation fisheries are anticipated in 2005-2008 to recover CWT's from returning adults to determine if homing is sufficient to reinstate production-level releases at this site.

Table 6.1. Summary of average smolt-to-adult survival, contribution to fisheries, and straying rates of avian-predation and comparative coded-wire tag groups released by the select area fisheries project, 1999-2000 brood years.

	Release Strategy/Location				
	Towed	Control	South Fork	Over-winter	2-week acclimation
Number of CWT groups	2	2	2	2	2
Expanded adult returns <sup>a</sup>	1,347	464	1,344	1,031	1,167
Average survival rate (%)					
Smolt-jack	0.04	0.03	0.14	0.04	0.07
Smolt-adult	<u>2.66</u>	<u>0.95</u>	<u>2.68</u>	<u>1.94</u>	<u>2.63</u>
Total	2.70	0.98	2.82	1.98	2.70
Fishery Contributions (% of total adult return)					
Commercial					
SAFE	44.7	26.7	31.4	21.5	62.0
Ocean	0.0	0.6	0.1	0.3	0.4
Columbia River	<u>27.5</u>	<u>5.3</u>	<u>2.2</u>	<u>2.0</u>	<u>7.1</u>
Total	72.2	32.6	33.7	23.8	69.5
Recreational					
Ocean	21.0	51.4	45.2	16.1	24.5
Freshwater	<u>6.0</u>	<u>14.1</u>	<u>7.4</u>	<u>60.0</u>	<u>5.1</u>
Total	27.0	65.5	52.6	76.1	29.6
Escapement <sup>b</sup> (Straying)	0.8 (0.22)	1.9 (1.26)	13.7 (0.15)	0.1 (0.00)	0.9 (0.52)
Straying					
Above Bonneville Dam (Includes recoveries from hatcheries, fisheries, and streams)	0.00%	0.00%	0.00%	0.00%	0.00%
Escapement to streams and hatcheries other than location of release	0.22%	1.26%	0.15%	0.00%	0.52%

<sup>a</sup> Coded-wire tag recovery data for the 2000 brood year is preliminary

<sup>b</sup> Escapement includes unharvested fish recovered in streams and hatcheries (natal and out-of-system)

Table 6.2. Summary of Youngs Bay tributary fall chinook spawning ground surveys, 1997-2003.

Year	Stream	Observed adults	Estimated escapement <sup>a</sup>	Mark sample	Marks observed	Redds <sup>b</sup>
1997	SFK Klaskanine	na	54	13	2 AdLV; 7 LV; 4 no mark	na
	NFK Klaskanine	na	53	10	4 AdLV; 6 LV	na
	Youngs River Lewis and Clark <sup>c</sup>	na	25	1	1 no mark	na
1998	SFK Klaskanine	na	7	0		7
	NFK Klaskanine	na	7	1	1 Ad	7
	Youngs River	na	9	3	3 no-mark	5
	Lewis and Clark	na	10	0		4
1999	SFK Klaskanine	na	7	0		3
	NFK Klaskanine	na	80	14	1 Ad; 1 AdLV; 12 no-mark	16
	Youngs River	na	15	1	1 no-mark	10
	Lewis and Clark	na	7	0		na
2000	SFK Klaskanine	na	2	1	1 no-mark	6
	NFK Klaskanine	na	347	57	2 AdLV; 53 LV; 2 no-mark	62
	Youngs River	na	71	4	3 LV; 1 no-mark	21
	Lewis and Clark	na	0	0	0	0
2001	SFK Klaskanine	8	14	3	1 AdLV; 1LV; 1 no-mark	57
	NFK Klaskanine	102	173	37	3 AdLV; 34LV	32
	Youngs River	53	90	15	1 AdLV; 14 LV	32
	Lewis and Clark	3	5	1	1 no-mark	14
2002	SFK Klaskanine	0	0	0	0	
	NFK Klaskanine	403	685	14	1 AdLV, 8 LV; 5 no-mark	2
	Youngs River <sup>c</sup> Lewis and Clark	8	14	0	0	2
2003	SFK Klaskanine	132	206	44	6 AdLV; 35 LV; 1 Ad; 2 no-mark	132
	NFK Klaskanine	297	505	115	17 AdLV; 94 LV; 4 no-mark	297
	Youngs River	33	56	0	0	36
	Lewis and Clark	121	206	18	4 LV; 14 no- mark	48

<sup>a</sup> Escapement expanded from single-pass peak fish counts

<sup>b</sup> Peak survey count

<sup>c</sup> No survey conducted

na=data not available



Figure 6.1. Local gillnetters towing net pens containing coho smolts during an avian-predation avoidance experiment, 2001.



Figure 6.2. Subsurface feed delivery system at Youngs Bay Yacht Club net pens.

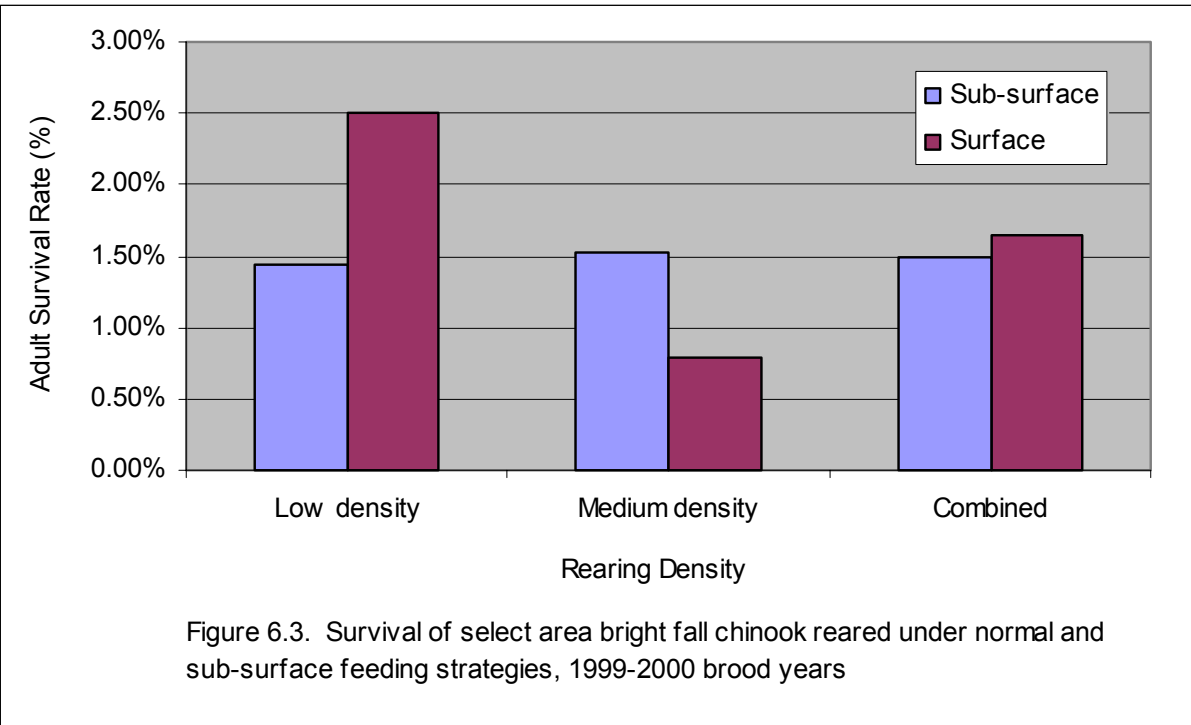


Figure 6.4. Feeding winter dormancy spring chinook smolts at Blind Slough net pens.

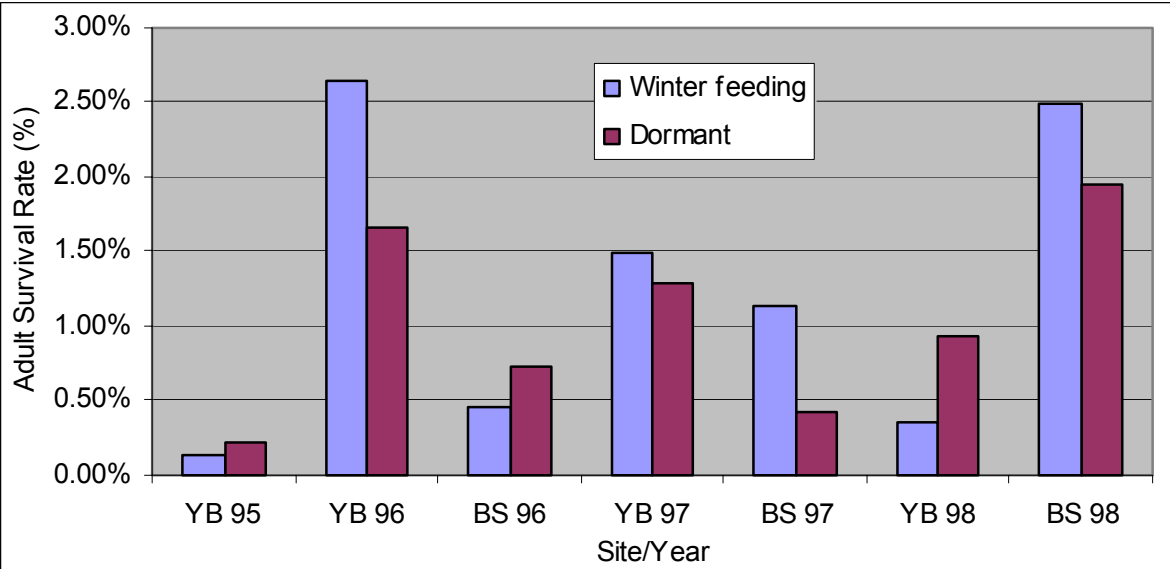


Figure 6.5. Comparison of adult survival rates for select area spring chinook w inter feeding and dormancy test groups by site and year, 1995-1998 brood years.

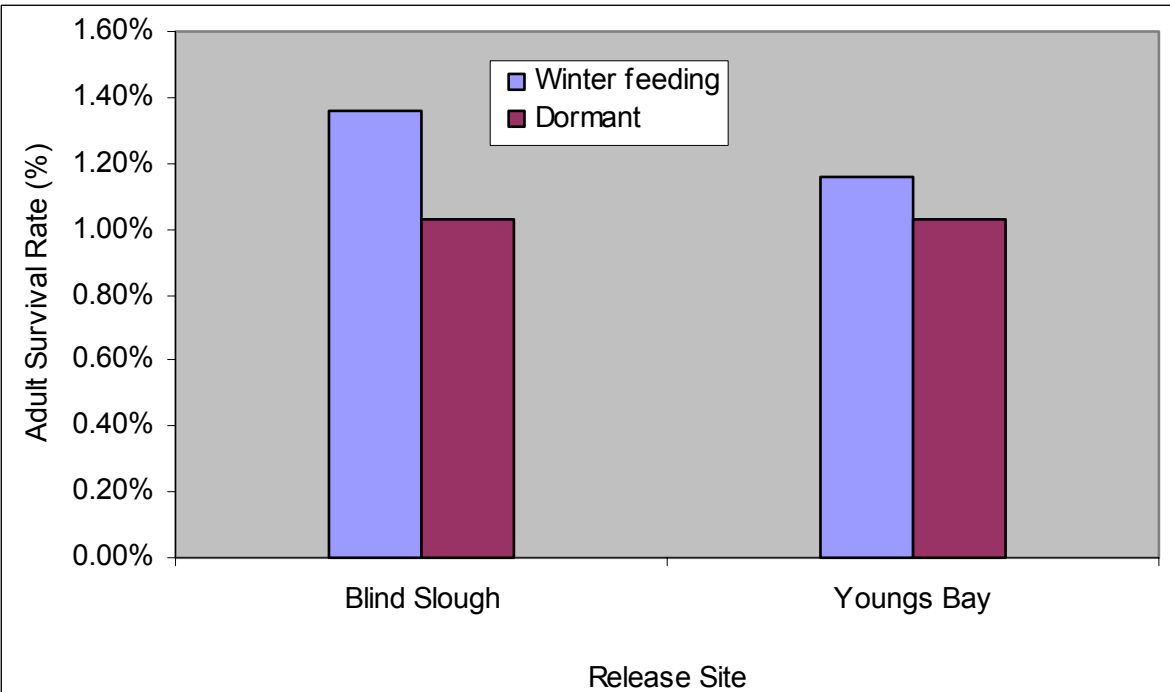
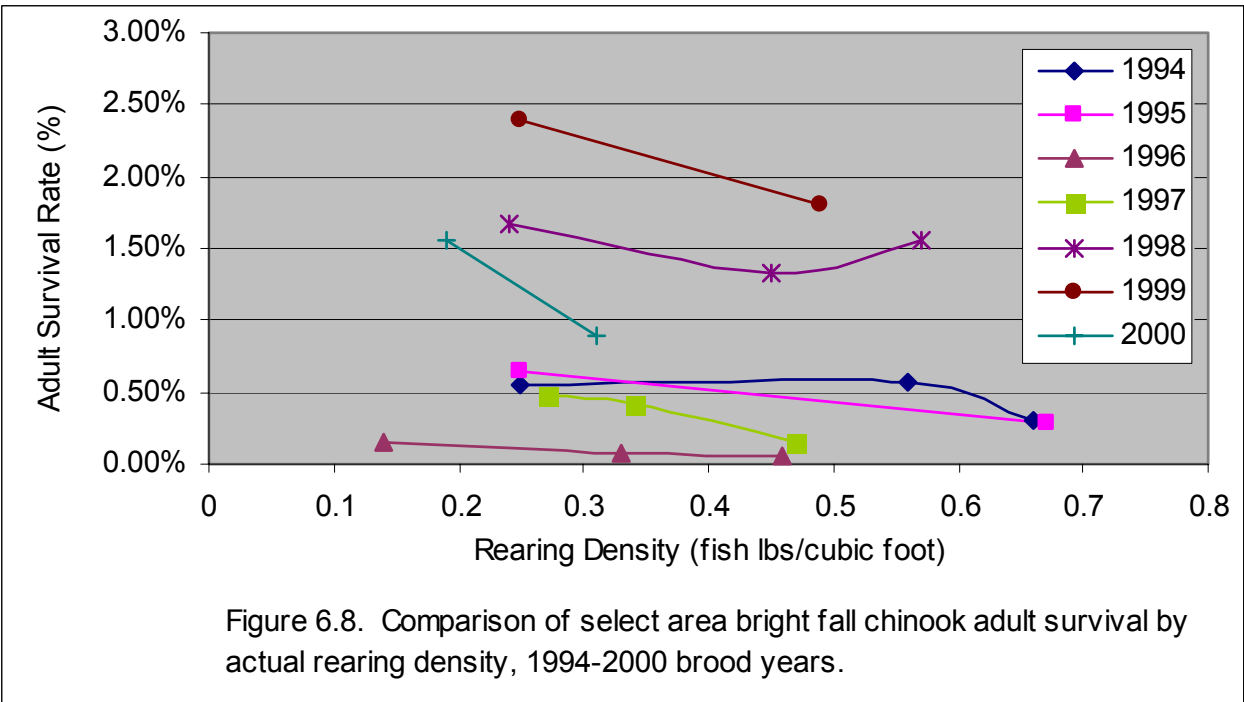
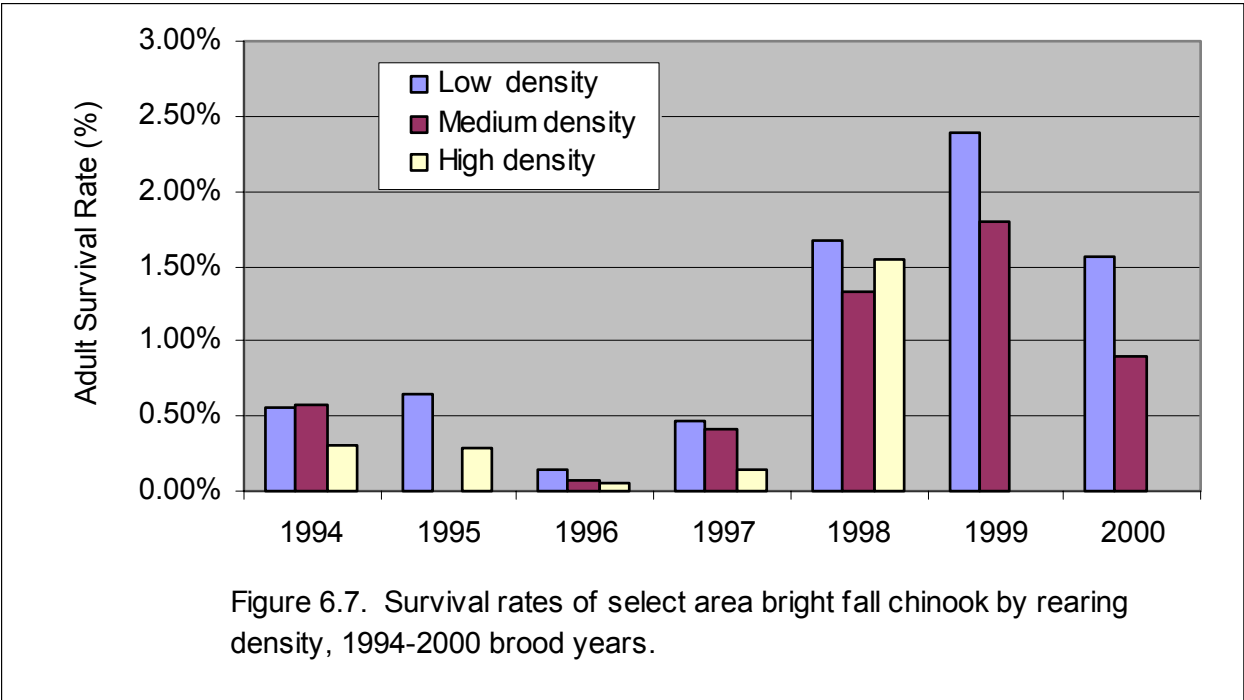
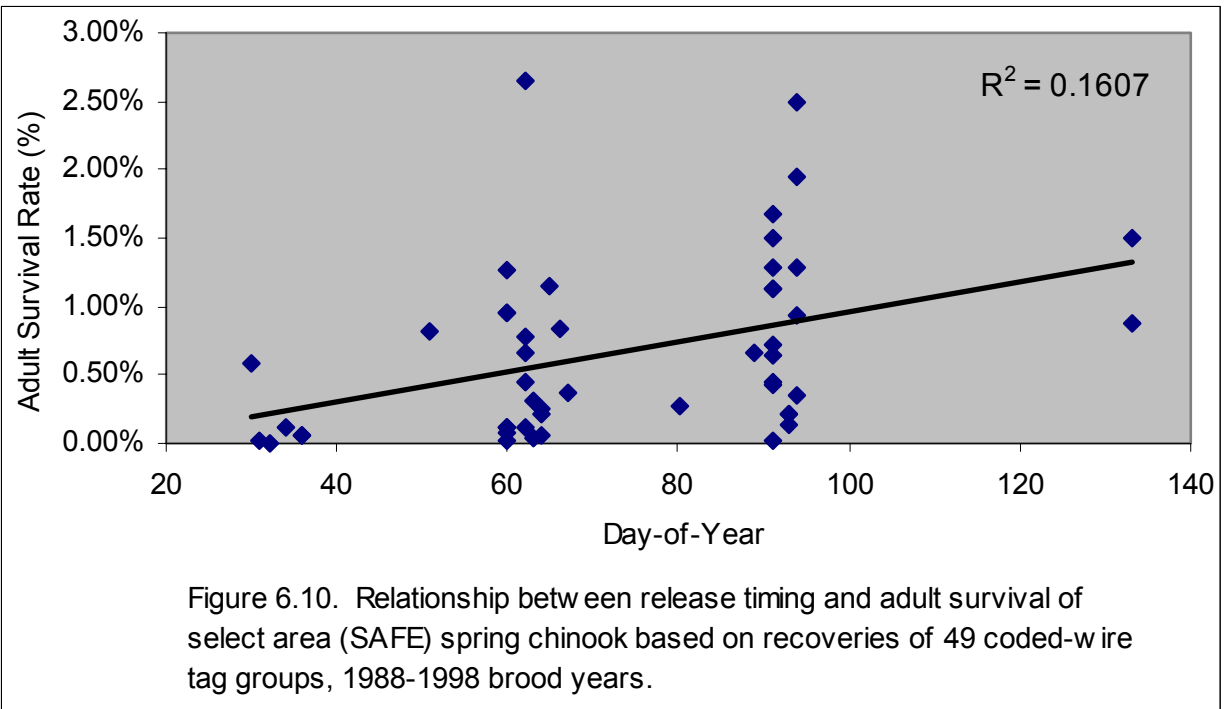
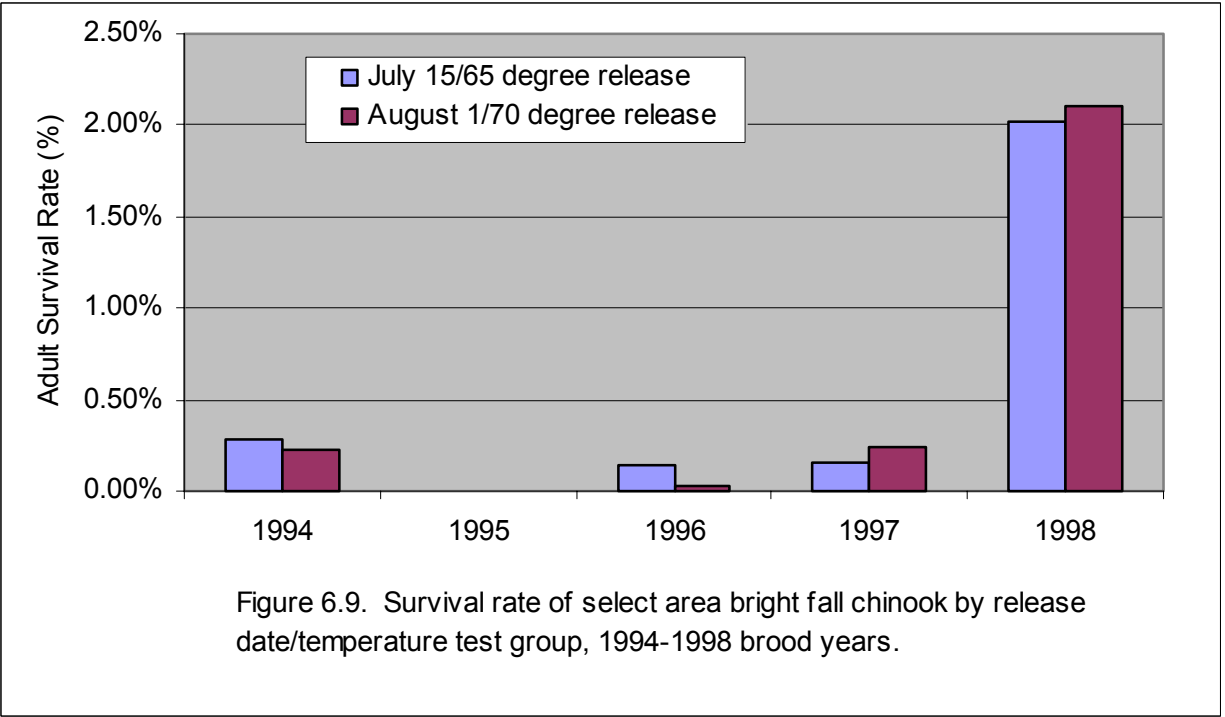
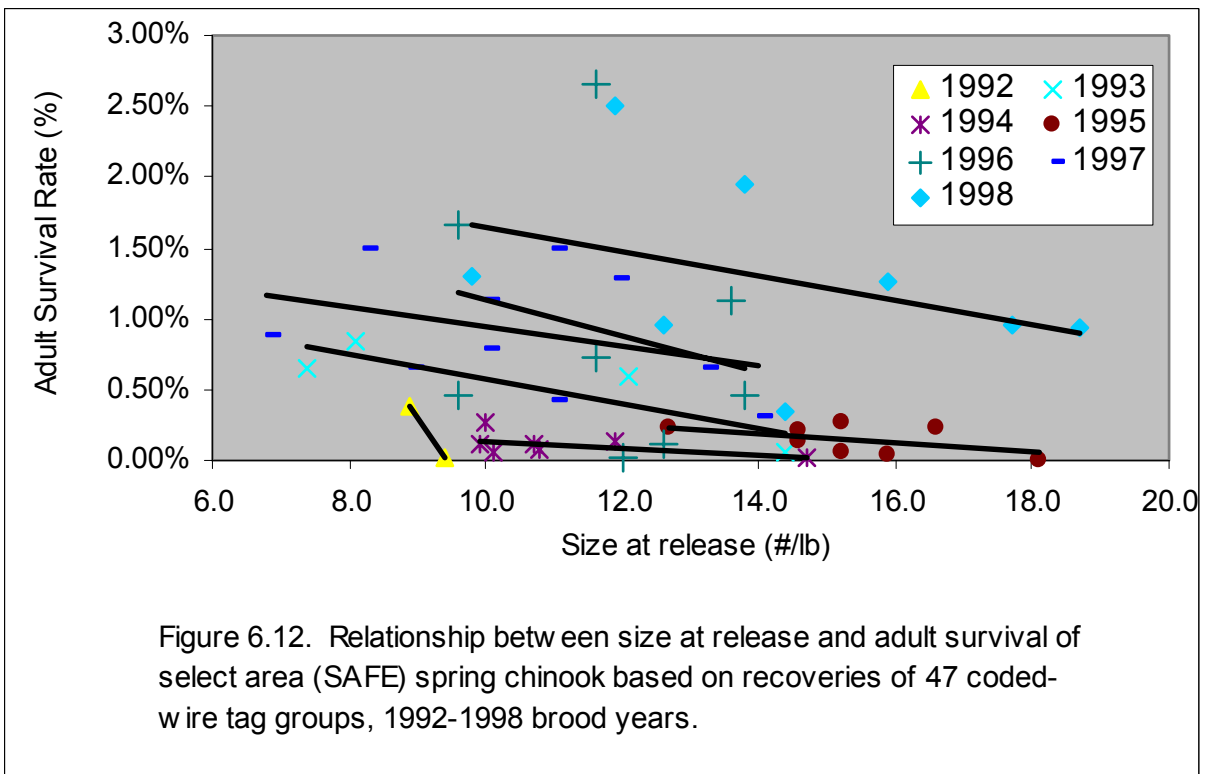
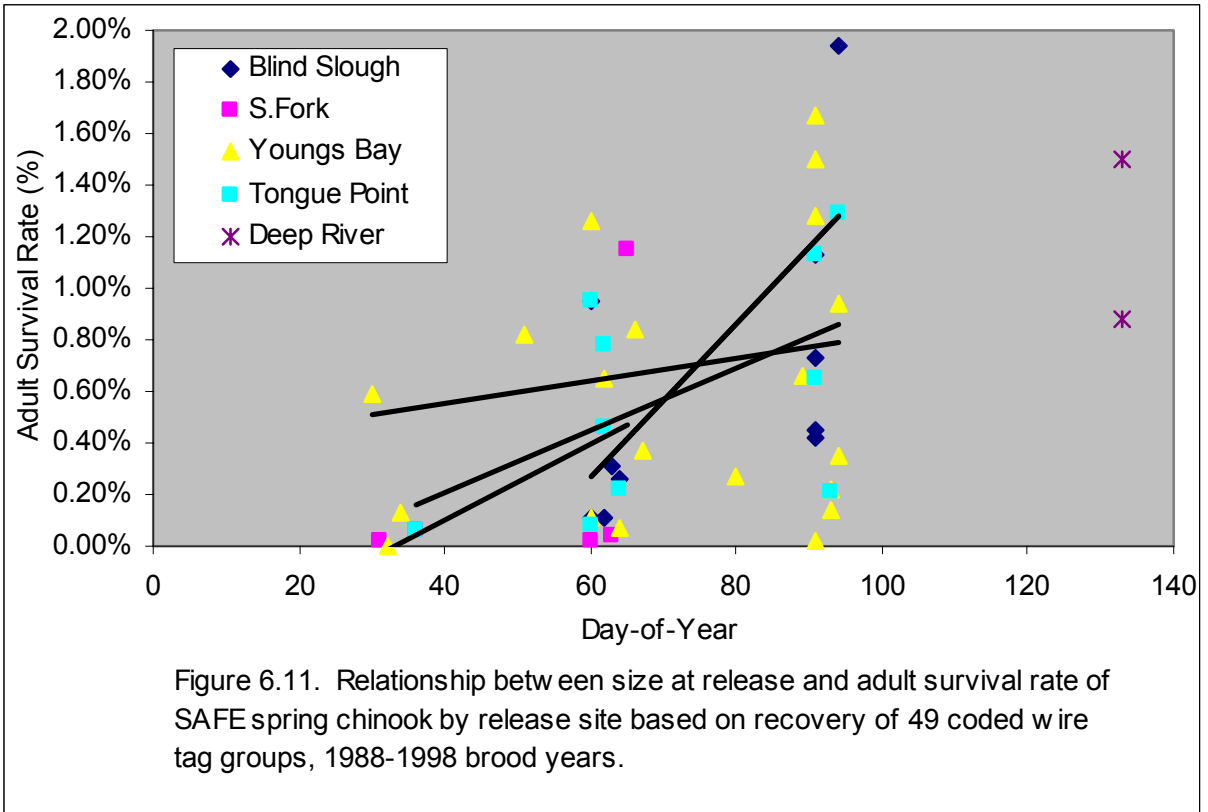
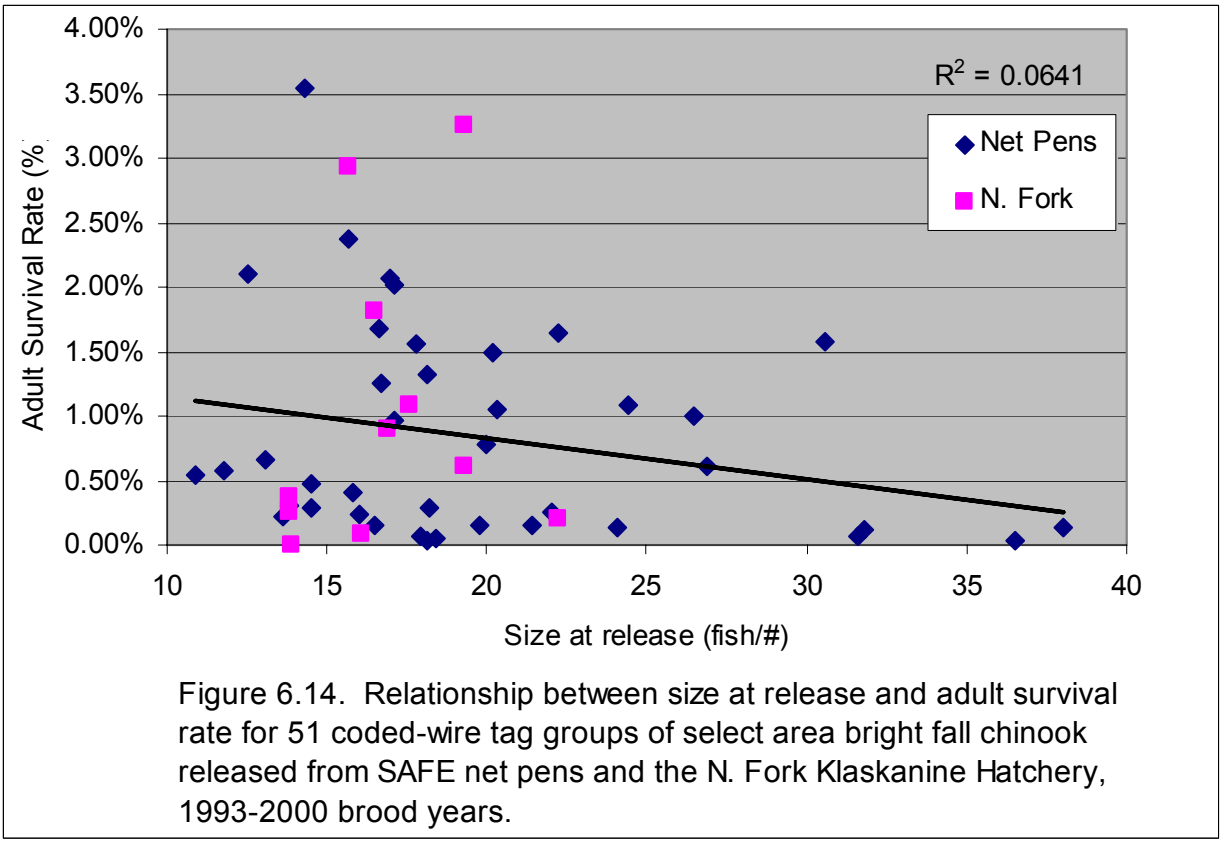
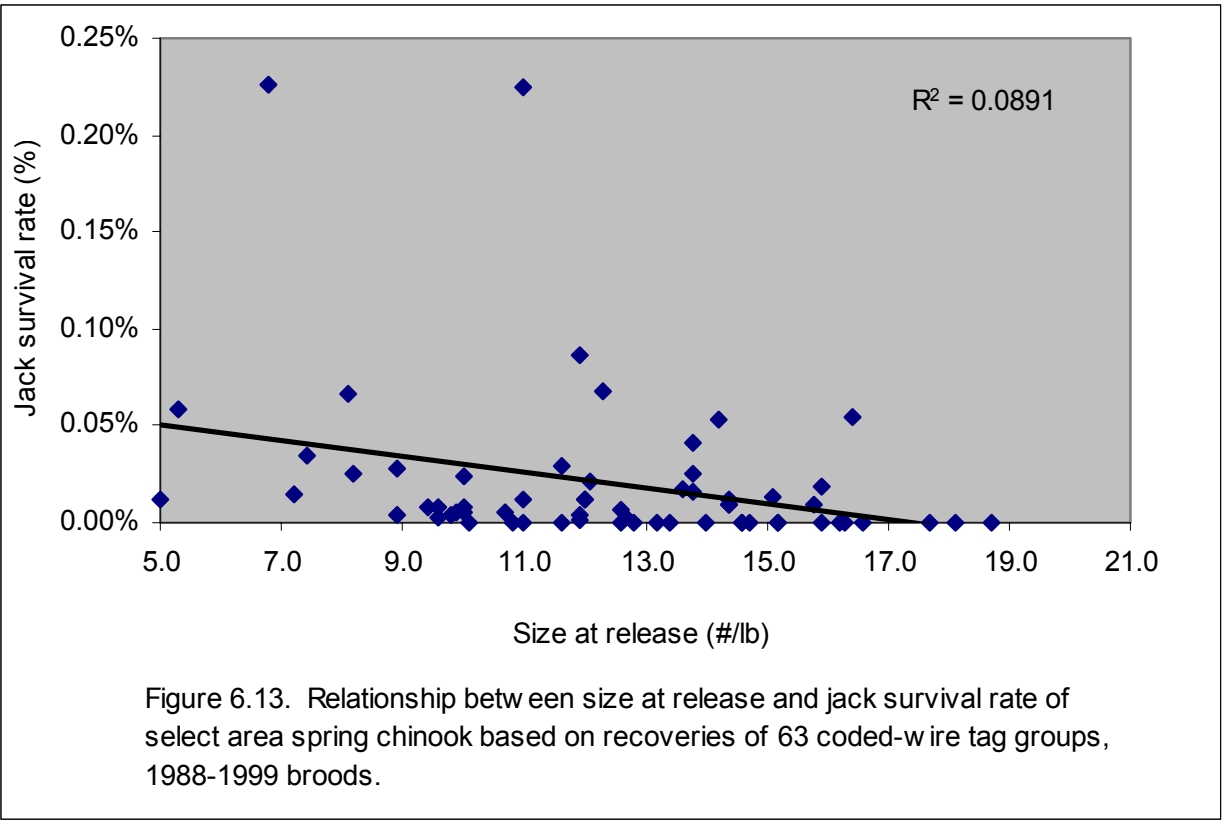


Figure 6.6. Comparison of adult survival rates for select area spring chinook w inter-feeding and dormancy test groups based on recovery of 14 coded-wire tag groups, 1995-1998 brood years.









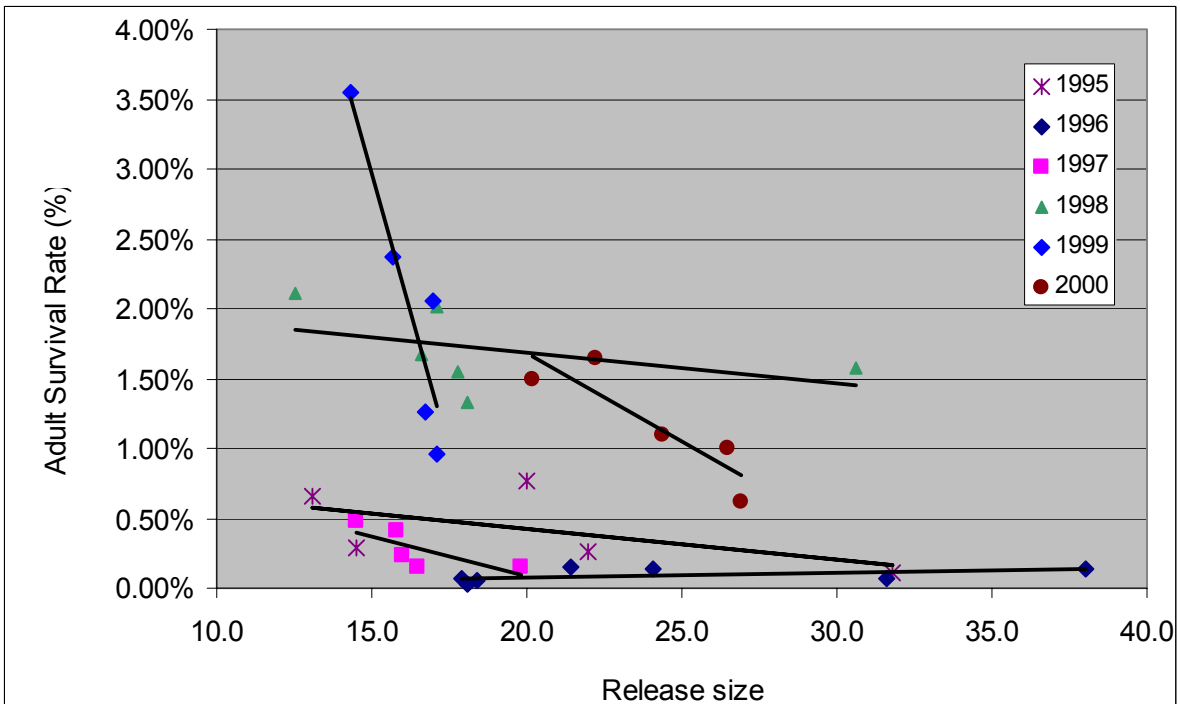


Figure 6.15. Relationship between release size and adult survival rate by brood year for 32 select area bright fall chinook coded-wire tag groups released from select area net pens, 1995-2000 broods.

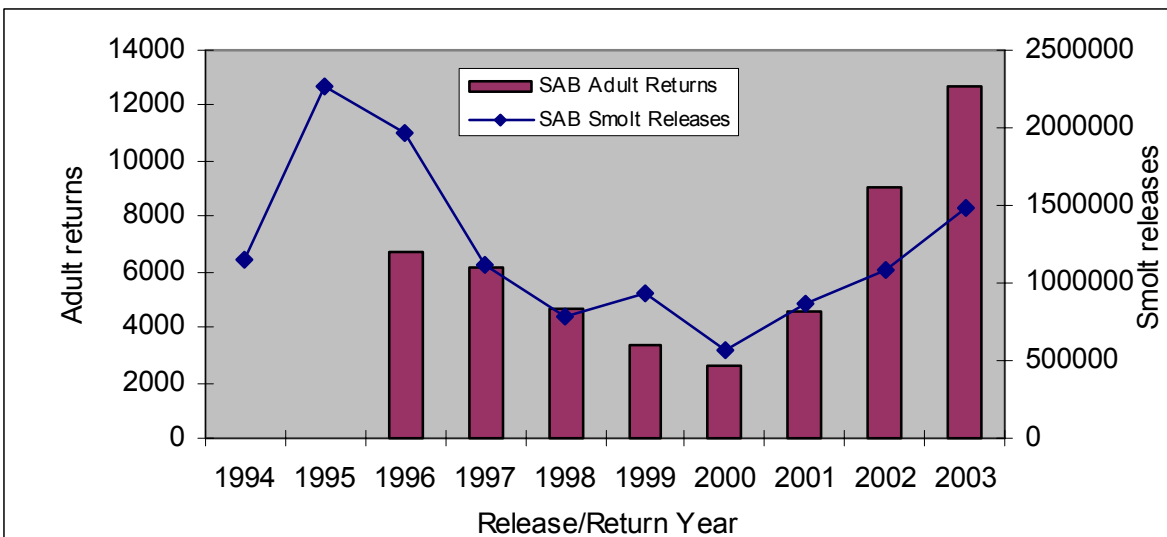
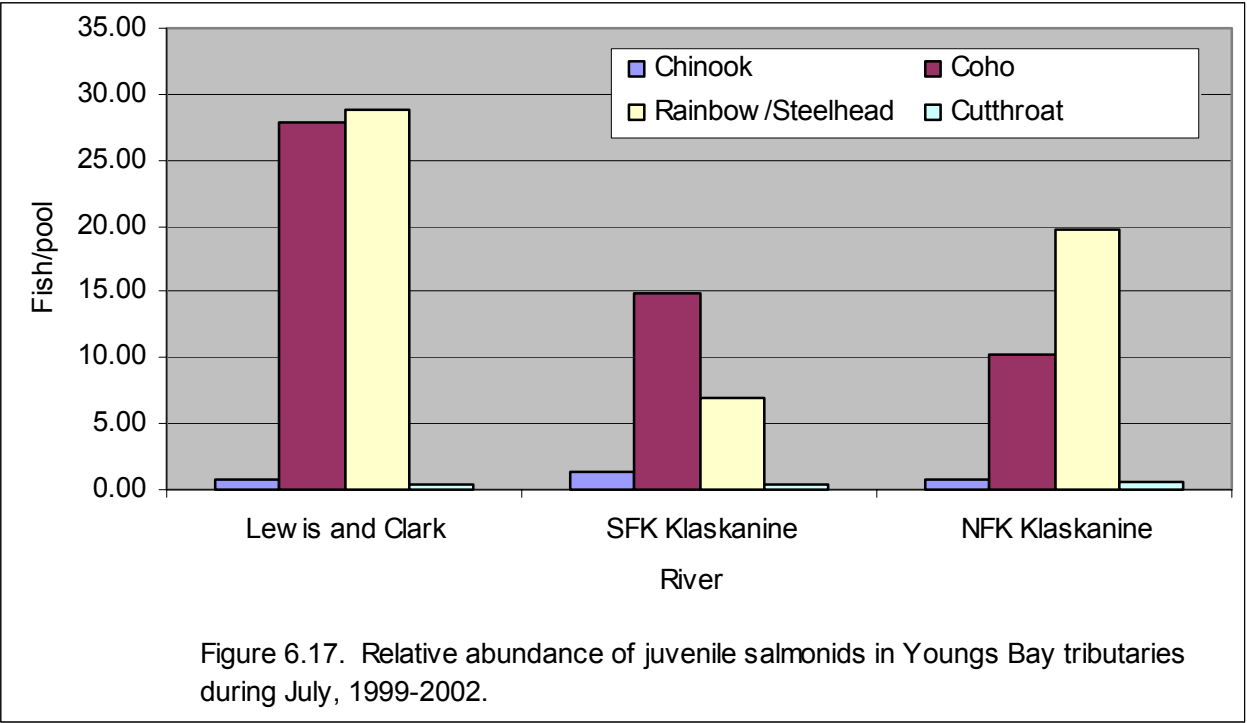


Figure 6.16. Select area bright fall chinook (SAB) smolt releases and adult returns, 1993-2002 brood years. Releases include production from ODFW's North Fork Klaskanie Hatchery funded by ODFW's Restoration and Enhancement Program.



## **7. ENVIRONMENTAL MONITORING**

With the initiation of the SAFE project came the need to monitor impacts of net-pen rearing at net-pen sites. Limited water quality monitoring was conducted in Columbia River pen rearing sites in the past (Hirose et al. 1998), leaving the project with few guides for designing a monitoring program. Beginning in 1994 environmental monitoring was initiated at all existing and planned net-pen sites. The design exceeded all known state and federal requirements at the time. Details of project findings to date are included in Appendix 1, with a summarization as follows:

The SAFE Project Environmental Monitoring Program has two objectives. The first is to assess the environmental suitability of water bodies being considered for fish rearing and to monitor water quality parameters annually during each production cycle to document their continued suitability.

The second objective of the program is to monitor the effects of the fish rearing activities on the environmental health of the water bodies where the net-pen operations are located. This is done with input from the state regulatory bodies that have jurisdiction over environmental issues.

### **ASSESSING SITE SUITABILITY FOR FISH REARING**

The following steps are taken to identify a water body suitable for net-pen operations:

- Identify water bodies with suitable depth and access to fishing vessels
- Measure physicochemical parameters
- Investigate the history of the site for the possible presence of toxic materials
- Sample sediment for benthic population structure and sediment chemistry
- Investigate ownership and residents' interest
- Determine if natural fish runs exist that would be in conflict with a net-pen fisheries
- Conduct a test fishery to determine if a conflict with threatened or endangered species exists

### **Water Quality Parameters**

In order to monitor the ongoing suitability of the environment for the rearing of salmon at the various SAFE facilities, instruments are deployed at each site every month for a 24-hour period. These instruments record temperature, dissolved oxygen, pH, turbidity and specific conductance. The instrument probes are placed about two meters below the water surface between the net pens. The water bodies that have multiple net-pen facilities such as Youngs Bay and Deep River, are only monitored at one location.

All of the physicochemical parameters measured have been within the healthy tolerance range of the salmon being reared in the net pens by this project. Only the summer temperatures occasionally reach levels that may be stressful to salmon, but these occur during months when fish are usually not being held.

## ASSESSING THE ENVIRONMENTAL IMPACT OF THE FISH REARING ACTIVITIES

The net-pen facilities at Youngs Bay and Tongue Point have production levels that require National Pollutant Discharge Elimination System (NPDES) permits issued by the Oregon Department of Environmental Quality (DEQ). Under these permits the net pens at Youngs Bay and Tongue Point are allowed a 15-meter mixing zone extending in all directions from the net-pen structure. No environmental impact is permitted outside of the mixing zone as compared with reference conditions, and no impact that adversely affects aquatic life or any beneficial use is permitted within the mixing zone. The purpose of the monitoring effort at these locations is to determine if these criteria are at risk of being violated, so that corrective measures can be taken.

The production levels at the Steamboat Slough and the two Deep River sites as well as the Blind Slough and MERTS sites are below the level that would require discharge permits. These five locations incur minimum impact, and the purpose of the monitoring effort at these sites is to document any environmental changes that may occur under the net pens as compared to a reference condition.

Raising fish in net pens has been practiced in various parts of the world for decades. The following environmental issues have been raised in different places and situations where net pens have been employed for fish farming. Each issue is addressed as it pertains to the SAFE net-pen operations.

- Introduction of non-native fish  
With the exception of the SAB fall chinook, only fish stocks native to the Columbia River basin are reared in the SAFE net-pen operations.
- Introduction of non-native disease from non-native fish  
The one-time transfer of non-native SAB fall chinook did not result in the introduction of non-indigenous disease, and all other stocks are native.
- Concentration of parasitic sea lice (*Lepeophtheirus salmonis*) in the net pens that can infect wild fish  
The SAFE net pens are located in fresh water, so sea lice are not a problem.
- Aesthetic impact on the surroundings  
Part of the site-selection process for net pens is to meet with people in the area to make sure that the net pens will be welcome. There have been no complaints.
- Predator control (birds, otters, seals, etc)  
With the exception of permitted trapping of otters at Oregon sites, non-lethal methods of predator control are employed at the SAFE net pens.
- The quality of farmed fish for human consumption has been questioned as a result of the fish's diet, which consists of manufactured fish food usually containing dye.  
Fish raised by the SAFE project are raised to smolt size only in the net pens. During this time they are fed manufactured fish food pellets that do not contain dye. When the fish reach smolt stage they are released to migrate out to the ocean where they spend their adult life feeding on natural food sources.

- Impact of therapeutic compounds (pharmaceutical and pesticides) on non-target species  
The principal use of therapeutic compounds at other net-pen sites has been to control sea lice. Since sea lice are not an issue for the SAFE project net pens, this is a minor issue. Erythromycin and Oxytetracycline are the only therapeutic compounds used by the SAFE project when the fish are in the net pens. They are not expected to produce any environmental impact; however, the monitoring program is designed to detect such an impact should it occur.
- Sediment chemistry (nitrogen, phosphorus, zinc, copper, ammonia, hydrogen sulfide, Eh)  
Since antifouling agents are not used on the net-pen structures and production during the course of a year is lighter than at commercial production facilities where sediment chemistry parameters have been adversely affected, it is not anticipated that these parameters would be affected enough to produce an unacceptable impact. However, the monitoring program is designed to detect impacts from changes in sediment chemistry.
- Relationship of sediment total organic content (TOC) to grain size  
This relationship may be affected by the generation of organic materials from the net pens and is monitored by laboratory analysis and by visual observation.
- Impact of released smolts on threatened or endangered species  
Studies are being conducted to determine the impact on listed species (see Chapter 6), and preliminary results indicate that current release strategies minimize the interaction of SAFE smolts with listed species.
- Impact of returning fish and fishing activity on threatened or endangered species  
Fisheries are managed to minimize impact on threatened or endangered species, and stream surveys have likewise indicated no significant impact.
- Accumulation of organic matter (fouling organisms, uneaten fish food, fish feces, fish carcasses)  
This is the principle environmental impact of concern for the SAFE project net-pen operations. The input of organic matter creates a localized impact. It is unlikely to spread and produce systemic effects in the water bodies where the net pens are located. The focus of the monitoring program is to determine that the impact is small in intensity and limited to the mixing zone under and around the net pens.

There are four sources of organic matter from the net-pen operations. The first source results from the presence of the net-pen structures themselves. When these structures are disturbed, such as when work is done on the nets or when the fish are released, fouling organisms and associated organic debris fall to the surface of the underlying sediment. The second source of impact is from uneaten fish food that passes through the bottom of the nets and can accumulate on the bottom beneath the net pens. The third source of impact is from the waste produced by the fish. Much of this waste is in the form of ammonia in solution and is quickly diluted and carried away by the current. It is not likely to have any measurable impact on the large water bodies where the net pens are located. However, the solid waste produced by the fish can also accumulate under the net pens adding to the other sources of organic material. The fourth source

of organic input results when fish die and are not removed from the net pens, but instead sink to the bottom of the pens and decay.

When there is an input of organic matter to a particular location it settles to the bottom sediments where it produces a range of effects on the benthic communities as the input increases. At low levels the first effect is an increase in the population density of those species that can utilize the organic matter. As the input increases, the species that can utilize the organic matter increase in numbers at the expense of species that cannot utilize the organic input or are not tolerant of high levels of organic material. As the input increases further other species disappear from the area leaving only one or two hardy species. Finally, as the input exceeds the ability of the environment to absorb it, it begins to decay bacterially and deplete the dissolved oxygen at the surface of the sediment, creating an anoxic layer. This last stage represents an unacceptable impact.

In order to monitor the impact of the fish rearing activities on the benthic macro invertebrate populations at the impact station under the net pens and at the perimeter stations at the boundaries of the mixing zones, sediment samples are collected from these areas and from reference stations well outside of the area influenced by the fish rearing activities. Animals are picked from these samples, preserved, identified and counted. Characteristics of the benthic populations at the impact stations and the perimeter stations are compared with those at the reference stations to look for differences that could be attributed to the fish rearing activities.

Sediment chemistry samples are collected from each station for TOC and grain size analysis to monitor for the possible accumulation of organic matter and to detect an unacceptable TOC/Grain size relationship.

In addition, a core sample is collected from under each net pen at the facilities that operate under a discharge permit. Each core sample is inspected for the presence of live animals, the thickness of the oxidized surface layer, and any indication of an unacceptable impact.

There are four net-pen facilities where the production is below the level that would require a discharge permit. These facilities are Steamboat Slough and two Deep River facilities, as well as Blind Slough. These sites are all upriver where there is limited salt-water influence.

Steamboat Slough is open to the mainstem of the Columbia River at both ends and it is extremely well flushed. There is little opportunity for organic material to accumulate. There has been no measurable environmental impact detected at this facility.

The two net pen facilities in Deep River are physically removed from the influence of the mainstem Columbia River. Both sites are located over organically rich sediments. *Oligochaeta* worms dominate the other taxonomic groups in number in this type of sediment. The input of organic material to these sediments during the growing season produces an increase in the population of *Oligochaeta* worms. This is often a significant

increase over the population at the reference station, especially in recent years. This increase is usually gone by the time the next growing season begins the following fall. There is no indication that any environmental impact that could be considered unacceptable is likely to occur at these facilities at the current production levels.

The Blind Slough facility is similar to the Deep River facilities. It is located over organically rich bottom sediments upriver from the mainstem of the Columbia River and the benthic macro invertebrate population is dominated by *Oligochaeta* worms. The *Oligochaeta* population is consistently more concentrated at the impact station than at the reference station at the end of the growing season, but it returns to the density levels of the reference station by the beginning of the next growing season in the fall after laying dormant for a few months. There is no indication that an unacceptable environmental condition will develop at this facility at the current production levels.

The MERTS facility began operations recently and is expected to replace the Tongue Point facility. The production level at this facility is still below that which requires a discharge permit. There is no indication of a measurable impact at this facility at this time.

The remaining facilities all have production levels that require discharge permits. These sites are Tongue Point, Youngs Bay-Yacht Club, and the Youngs Bay-TidePoint/Bornstein facility. These sites are all influenced by salt water, and the impact of organic enrichment from the net pens has a more complex influence on the benthic communities.

The Tongue Point facility is in the process of being vacated and replaced by the MERTS facility beginning early in 2004. The population density is greater at the impact station under the net pens than at the reference station. This increase in population density is driven by the increase in *Oligochaeta* at this site, as is the case at the facilities previously discussed. This situation persists through the months of inactivity to the beginning of the following growing season. A mixing zone extends out from the net pens for 15 meters in all directions. Samples have been collected at the perimeter of this mixing zone for only the last two years. Data from the Perimeter stations have shown no significant impact from the fish rearing activities. There has not been any evidence of the development of an unacceptable environmental impact at this site. There will be minimal monitoring here in the future to document recovery.

The facility at the Yacht Club in Youngs Bay has the highest production, and some fish are held in pens here into the summer months. Organic enrichment of the sediments under the net pens is evident. The population density is consistently greater and with more species present at the impact station under the net pens than at the reference station. This situation persists through to the start of the next growing season in the fall. The benthic community structure at this site is more complex than at the facilities previously discussed. These waters have been invaded by a non-indigenous species, the New Zealand Mud snail (*Potamopyrgus antipodarum*). Densities of this species have been measured at over 100,000 animals per square meter. Other species that

benefit from organic enrichment and are found in dense numbers are *Oligochaeta* worms and *amphipods* of the genus *Americorophium*. While benthic community analysis and visual inspection of sediment cores show indications of heavy organic enrichment, the environment under the net pens has been able to absorb it without the development of anaerobic conditions on the sediment surface. An oxidized layer of one to three centimeters exists.

A mixing zone extends out from the net pens for 15 meters in all directions. No impact is permitted outside of this mixing zone. Samples have been collected at the perimeter of this mixing zone for only the last two years. One perimeter station is located out from the net pens in a direction such that currents do not carry organic material to it from the net pens. No indication of an impact has been seen at this station and none would be expected. The other two stations are downstream of the net pens on either the incoming or outgoing tide. These two stations could receive organic enrichment from the net pens. One of these stations is located under a bridge, which makes it difficult to distinguish the impact of the bridge and bridge-related activity from an impact of the net pens. However, no indications of organic enrichment that can be attributed to the net-pen activities have been found at this station. The other perimeter station in the direction of current flow has shown some indication of low-level organic enrichment. *Oligochaeta* populations are more dense here than at the reference stations. If this situation persists it may be necessary to take steps to reduce the migration of organic material out of the mixing zone in this direction.

The Tide Point/Bornstein net-pen facilities in Youngs Bay consist of two sets of net pens located close enough together that, for the purpose of environmental monitoring, are treated as a single facility. These net pens are very well flushed. The sediments under these net pens consist of mudstone, woody debris and some mud. Sampling these sediments is very difficult. Even with the good flushing action, organic enrichment is detected under the net pens. Both impact stations at the Bornstein and Tide Point net pens show a consistent increase in the population densities over the densities of the reference station of species that can utilize the organic material from the net pens. The species that usually dominate this increase are the *Oligochaeta* worms, the New Zealand Mud snail and *Americorophium* spp. However, there is no indication that the environment under the net pens is not able to absorb this material. Benthic invertebrate analysis and visual inspections of core samples taken from under each net pen show no indication of the development of an anoxic condition.

A mixing zone extends out from the net pens for 15 meters in all directions. Samples have been collected at the perimeter of this mixing zone for only the last two years. There is no indication of organic enrichment at the perimeter stations in the direction of current flow from the net pens at this facility.

## 8. ECONOMIC BENEFIT OF THE SAFE PROJECT

The SAFE project provides significant economic benefit to lower Columbia River communities through commercial harvest in select area fisheries. A combination of factors including expanded production, improved fish culture practices, favorable ocean conditions, and recent renewed consumer interest in wild-caught salmon have all contributed to a marked increase in value of SAFE commercial harvest since the project was initiated. With the exception of the 2001 season, which was marred by a fisherman strike over poor coho prices, combined ex-vessel values of SAFE commercial fisheries have increased steadily since 1996 (Figure 8.1). The 2003 SAFE commercial fishery set a single-season record dockside value of \$824,000; nearly 25 percent higher than 2002. Given the \$509,000 ex-vessel value of the 2004 season to date, 2004 will likely establish a new record ex-vessel harvest value for SAFE fisheries.

The contribution of the spring chinook fishery has shown the most significant increase in value since initiation of the SAFE project due to increased releases, and because this species possesses a unique flavor and richness that provides for a niche market that is relatively isolated from competition. Results of recent studies detailing risks associated with consumption of farmed salmon, and the media attention these reports have received, have increased demand for wild-caught salmon, which has resulted in the highest ex-vessel price (\$3.67/pound) observed for any SAFE commercial fishery to date. The high public demand for this product in 2004, coupled with good adult returns, has yielded a record value for this year's fishery. If market demand continues in the future this component of the fishery could nearly double in value beginning in 2006-2007 with adult returns from production increases initiated in 2002.

Coho salmon continue to be a key contributor to the value of SAFE commercial fisheries. High survival rates of net-pen reared coho produce large adult returns that support extended fall seasons and offset the lower price-per-pound paid to commercial fishermen. Since 1996, coho salmon have contributed 20-64 percent of the combined annual ex-vessel value of SAFE commercial fisheries. Unfortunately, the market for coho can be volatile. This was especially true in 2001 when poor prices prompted a strike, resulting in a reduced coho harvest with a dockside value of approximately \$80,000. In contrast, the 2003 SAFE commercial harvest of over 117,000 coho coupled with increased market demand yielded approximately \$524,000 in ex-vessel value (Figure 8.1).

The value of SAFE fall chinook component of the fishery during 1996-2003 ranged from approximately \$22,000-\$111,000 with 21-77 percent of the value resulting from harvest of SAB fall chinook. The SAB stock is a high quality fall chinook but has also been subject to recent market conditions and fluctuating production levels. Target annual production levels of 2.2 million released smolts have not yet been met due to limited availability of broodstock. Returns since 2002 have increased substantially and should help boost future releases and subsequent fisheries.

Salmonid production from SAFE facilities also provides significant contributions to other regional fisheries, both commercial and recreational (Figure 8.2). Fisheries benefiting from the SAFE project include ocean sport and commercial troll fisheries, Columbia River mainstem commercial and recreational fisheries (especially the “Buoy 10” fishery), and recreational fisheries occurring within select areas. Based on species-specific CWT recovery data for 1996-2003 return years, an average of 33.3 percent of the combined salmonid production from the SAFE project was harvested in fisheries other than the select area commercial segment.

The economic benefit of the SAFE project to these other fisheries is substantial. Applying ex-vessel values to the estimated catch of SAFE-produced salmonids harvested in other commercial fisheries and an approximate net economic value per fish (Carter 1999) to the recreational harvest provides a minimal estimate of the regional economic significance of the SAFE project (Table 8.1). Due to the increased non-market value of sport-caught fish (\$50-\$100 per fish) and a high price-per-pound value of salmon caught in ocean troll fisheries, the economic value of the SAFE project is significantly increased. This is especially apparent for coho and SAB fall chinook, which are frequently harvested at high rates in several non-SAFE fisheries. Considering all regional fisheries, the economic value (2001 inflation adjusted dollars) of SAFE salmonid production has ranged from approximately \$443,000-\$3,291,000 during 1996-2003 (Figure 8.3). This represents a combined regional value for SAFE-produced fish that is 200-400 percent higher than for SAFE commercial fisheries alone.

In addition to direct income to commercial fishermen, many local jobs are provided by the activities related to commercial harvest of salmon produced by the SAFE project including processing, retailing, fishing supplies, and boat repair. For example, Fishhawk Fisheries in Astoria employs up to ten people to buy and process salmon harvested in winter and spring SAFE fisheries (personal communication with Steve Fick of Fishhawk Fisheries, 6/3/04). An additional 20 people are employed for three months each year to process the fall select area commercial harvest. Bornstein Seafoods employs 8-10 people each year to purchase and process fish from SAFE commercial fisheries (personal communication with Doug Heater of Bornstein Seafoods, 6/3/04).

A more complete representation of the total economic contribution of SAFE Project salmon production to coastal economies can be estimated by applying impacts on personal income per fish harvested (Tables 8.2 and 8.3). This exercise recognizes the net effect on personal income, most of which occurs in coastal communities resulting from trip expenditures (motels, food, etc.) of recreational anglers, purchases of gear for commercial harvest, and wages associated with processing of commercially harvested fish. Because of the significant employment associated with processing commercially harvested fish, the total regional economic contributions of SAFE-produced fish harvested in commercial fisheries increases substantially (Figure 8.4). During 1996-2003, the estimated impact on personal income resulting from the SAFE project ranged from \$816,000-\$4,603,000 based on 2001 inflation adjusted values. The impacts on personal income differ by stock and fishery (Figure 8.5). Recreational fisheries harvest a smaller percentage of each SAFE stock, but contribute a disproportionately higher

percentage of the total personal income impacts due to higher expenditures per harvested fish. Even though per fish values are less, commercial fisheries account for the majority of the personal income impacts for each SAFE stock due to higher harvest rates and significant employment associated with processing.

The results presented herein describe the economic value (user value) and economic impact (financial activity) associated with salmonid production by the SAFE project. A more robust benefit:cost analysis has not been completed since this will require determination of the costs associated with harvest of salmonids produced by the SAFE project. Harvest costs of SAFE commercial fisheries are fairly low so total ex-vessel revenue provides a reasonable assessment of net economic value for this fishery. However, due to the variety of fisheries that harvest select area fish and different harvest costs associated with each, additional time will be required to complete a benefit-cost framework. We also did not attempt to identify alternatives to the project such as investing in habitat restoration to increase adult returns because of the host of unknown variables involved in such an exercise. Fortunately, other reports have included the SAFE project in cost-effective analysis. The Independent Economic Analysis Board (IEAB) included the SAFE project, specifically CEDC Fisheries, in their economic review of eight Columbia River Basin hatchery programs (IEAB 2002). This review found CEDC costs per released smolt were reasonable for both fall chinook (\$0.37/smolt) and spring chinook (\$0.42/smolt) and low for coho (\$0.18/smolt). Costs-per returning adult and per harvested adult were also considerably lower than for most other Columbia Basin facilities (coho \$13/\$14; fall chinook \$66/\$66; spring chinook \$233/\$233) even though the project is in a developmental stage and has not yet achieved full production. These production costs compare favorably with average costs-per-harvested-adult for coho (\$461), fall chinook (\$61), and spring chinook (\$310) reared by other ODFW hatcheries (Bradbury and Pollino 2002).

In conclusion, key considerations regarding the economic value of the SAFE project are:

- Full-scale production at all SAFE sites has not been an objective during the research phase, thereby increasing the cost-per-returning adult.
- Producing additional smolts above current production would be cost effective since the program's infrastructure has been developed. The costs per-smolt-released and per-returning-adult would decrease with expanded production since limited additional equipment and staff would be needed to maximize releases.
- The true economic potential of the fishery would increase rapidly with advancement to full capacity for all species at each select area site.
- Select area fisheries provide stable fisheries with very limited impacts to ESA-listed stocks. Because SAFE fisheries have limited impacts on depressed stocks, fishing opportunity is maximized and high harvest rates are obtained.
- The regional economic contributions of full-scale SAFE releases would be multiplied many-fold due to high survival, exceptional harvest rates, and significant contributions to other high-value fisheries.
- The SAFE project has been designed to investigate the feasibility of net-pen production and fishery development, not to maximize economic benefits. Even

so, this project can quantify significant benefits to the regional economy in addition to meeting research objectives.

- Aside from economic values, the SAFE project provides public access to high quality, wild-caught salmon, which are both reared and harvested in local waters.

Table 8.1. Total select area fishery (SAFE) project landings and values, and estimated contributions to other regional commercial and recreational fisheries, 1996-2004.

Year	Spp <sup>a</sup>	Commercial Harvest						Recreational Harvest						Total SAFE Contribution	
		SAFE		Columbia River		Ocean		SAFE		Columbia River		Ocean		Number	Value
		Number <sup>b</sup>	Value <sup>c</sup>	Number	Value <sup>de</sup>	Number <sup>f</sup>	Value <sup>def</sup>	Number	Value <sup>g</sup>	Number	Value <sup>g</sup>	Number	Value <sup>g</sup>		
1996	CHS	789	\$17,711	7	\$320	13	\$265	15	\$1,500	4	\$400	0	\$0	828	\$20,196
	SAB	1,469	\$12,492	309	\$4,437	2048	\$33,090	400	\$30,000	606	\$45,450	198	\$9,900	5030	\$135,369
	CHF	3526	\$54,241											3526	\$54,241
	ALL CHF	4,995	66,733	309	\$4,437	2,048	33,090	400	\$30,000	606	\$45,450	198	\$9,900	8,556	\$189,610
	COH	22422	\$113,294	2318	\$14,924	361	\$2,766	69	\$3,450	1482	\$74,100	1478	\$73,900	28130	\$282,434
		28206	\$197,738	2,634	\$19,681	2,422	\$36,121	484	\$34,950	2,092	\$119,950	1,676	\$83,800	37,514	<b>\$492,240</b>
1997	CHS	1821	\$57,438	18	\$1,210	98	\$2,253	40	\$4,000	15	\$1,500	0	\$0	1992	\$66,401
	SAB	1,570	\$18,341	248	\$2,734	1964	\$44,341	400	\$30,000	699	\$52,425	139	\$6,950	5020	\$154,791
	CHF	2,429	\$40,001											2429	\$40,001
	ALL CHF	3,999	58,342	248	2734	1964	44341	400	30000	699	\$52,425	139	\$6,950	7449	\$194,792
	COH	16991	\$100,046	231	\$1,472	0		48	\$2,400	4253	\$212,650	309	\$15,450	21832	\$332,018
		22811	\$215,826	497	5416	2062	46594	488	36400	4967	\$266,575	448	\$22,400	31273	<b>\$593,211</b>
1998	CHS	2258	\$90,156	8	\$549	167	\$4,532	55	\$5,500	23	\$2,300	0	\$0	2511	\$103,037
	SAB	1,385	\$16,744	281	\$3,803	1294	\$29,587	400	\$30,000	713	\$53,475	81	\$4,050	4154	\$137,659
	CHF	364	\$4,953											364	\$4,953
	ALL CHF	1,749	\$21,697	281	\$3,803	1294	\$29,587	400	\$30,000	713	\$53,475	81	\$4,050	4518	\$142,612
	COH	24134	\$120,425	0		0		118	\$5,900	389	\$19,450	1026	\$51,300	25667	\$197,075
		28141	\$232,278	289	\$4,352	1461	\$34,119	573	\$41,400	1125	\$75,225	1107	\$55,350	32696	<b>\$442,724</b>
1999	CHS	1955	\$78,347	27	\$1,990	131	\$3,806	25	\$2,500	36	\$3,600	3	\$150	2177	\$90,393
	SAB	1,375	\$33,261	327	\$6,147	573	\$16,950	300	\$22,500	453	\$33,975	73	\$3,650	3101	\$116,483
	CHF	768	\$15,671											768	\$15,671
	ALL CHF	2143	\$48,932	327	\$6,147	573	\$16,950	300	\$22,500	453	\$33,975	73	\$3,650	3869	\$132,154
	COH	22954	\$166,438	5922	\$44,985	108	\$858	159	\$7,950	1210	\$60,500	2415	\$120,750	32768	\$401,481
		27052	\$293,717	6276	\$53,122	812	\$21,614	484	\$32,950	1699	\$98,075	2491	\$124,550	38814	<b>\$624,028</b>
2000	CHS	6496	\$197,828	249	\$15,045	378	\$9,494	255	\$25,500	139	\$13,900	28	\$1,400	7545	\$263,167
	SAB	1,130	\$20,824	177	\$2,667	450	\$12,530	50	\$3,750	221	\$16,575	80	\$4,000	2108	\$60,346
	CHF	1,185	\$21,141											1185	\$21,141
	ALL CHF	2,315	\$41,965	177	\$2,667	450	\$12,530	50	\$3,750	221	\$16,575	80	\$4,000	3293	\$81,487
	COH	61745	\$303,991	6076	\$29,370	1241	\$12,442	202	\$10,100	2544	\$127,200	5915	\$295,750	77723	\$778,853
		70556	\$543,784	6502	\$47,082	2069	\$34,466	507	\$39,350	2904	\$157,675	6023	\$301,150	88561	<b>\$1,123,507</b>
2001	CHS	9269	\$289,442	709	\$43,420	369	\$9,006	500	\$50,000	174	\$17,400	32	\$1,600	11053	\$410,868
	SAB	1,557	\$18,888	384	\$4,016	1207	\$27,734	150	\$11,250	475	\$35,625	248	\$12,400	4021	\$109,913
	CHF	1,541	\$17,115											1541	\$17,115
	ALL CHF	3,098	\$36,003	384	\$4,016	1,207	\$27,734	150	\$11,250	475	\$35,625	248	\$12,400	5562	\$127,028
	COH	33771	\$79,783	38617	\$94,611	679	\$4,099	263	\$13,150	17848	\$892,400	13346	\$667,300	104524	\$1,751,343
		46138	\$405,228	39710	\$142,047	2255	\$40,839	913	\$74,400	18497	\$945,425	13626	\$681,300	121139	<b>\$2,289,239</b>

(Cont'd.)

Table 8.1 (continued). Total select area fishery (SAFE) project landings and values, and estimated contributions to other regional commercial and recreational fisheries, 1996-2004.

Year	Spp <sup>a</sup>	Commercial Harvest						Recreational Harvest						Total SAFE Contribution	
		SAFE		Columbia River		Ocean		SAFE		Columbia River		Ocean		Number	Value
		Number <sup>b</sup>	Value <sup>c</sup>	Number	Value <sup>de</sup>	Number <sup>f</sup>	Value <sup>def</sup>	Number	Value <sup>g</sup>	Number	Value <sup>g</sup>	Number	Value <sup>g</sup>		
2002	CHS	11699	\$279,767	581	\$33,927	780	\$16,592	552	\$55,200	409	\$40,900	26	\$1,300	14047	\$427,686
	SAB	2,450	\$29,422	1105	\$8,100	2347	\$56,004	500	\$37,500	1173	\$87,975	627	\$31,350	8202	\$250,351
	CHF	6,120	\$67,182											6120	\$67,182
	ALL CHF	8,570	\$96,604	1,105	\$8,100	2,347	\$56,004	500	\$37,500	1,173	\$87,975	627	\$31,350	14322	\$317,533
	COH	69281	\$237,430	11321	\$35,271	111	\$876	344	\$17,200	1171	\$58,550	6000	\$300,000	88228	\$649,327
		89550	\$613,801	13007	\$77,298	3238	\$73,472	1396	\$109,900	2753	\$187,425	6653	\$332,650	116,597	<b>\$1,394,546</b>
2003	CHS	7,820	\$188,999	380	\$27,333	544	\$16,311	994	\$99,400	286	\$28,600	18	\$900	10042	\$361,543
	SAB	3,043	\$42,547	2335	\$29,624	2999	\$107,991	637	\$47,775	1837	\$137,775	627	\$31,350	11478	\$397,062
	CHF	6,680	\$68,548											6680	\$68,548
	ALL CHF	9,723	\$111,095	2,335	\$29,624	2,999	\$107,991	637	\$47,775	1,837	\$137,775	627	\$31,350	18158	\$465,610
	COH	117,133	\$523,901	23427	\$133,834	1171	\$10,154	772	\$38,600	21084	\$1,054,200	14056	\$702,800	177643	\$2,463,489
		134,676	\$823,995	26142	\$190,791	4714	\$134,456	2403	\$185,775	23207	\$1,220,575	14701	\$735,050	205,843	<b>\$3,290,642</b>
2004	CHS	9,844	\$508,728	489	\$26,648	656	\$39,074	1400	\$140,000	344	\$34,400	22	\$1,100	12755	\$749,950
	SAB	0	\$0		\$0		\$0		\$0		\$0		\$0	0	\$0
	CHF	0	\$0											0	\$0
	ALL CHF	0	\$0		\$0		\$0	0	\$0	0	\$0	0	\$0	0	\$0
	COH	0	\$0	0	\$0	0	\$0		\$0	0	\$0	0	\$0	0	\$0
		9,844	\$508,728	489	\$26,648	656	\$39,074	1400	\$140,000	344	\$34,400	22	\$1,100	12,755	<b>\$749,950</b>

<sup>a</sup> Species are spring chinook (CHS); select area bright fall chinook (SAB); fall chinook (CHF); and coho (COH)

<sup>b</sup> SAB values are based on year-specific expansions of smolt releases and survival for individual coded-wire tag release groups. SAB landings during winter-summer SAFE fisheries are included in spring chinook totals

<sup>c</sup> Ex-vessel value (pounds landed \* price per pound)

<sup>d</sup> Ex-vessel value. Prices are 2001 inflation adjusted dollars per pound as landed based on Oregon data

<sup>e</sup> Ex-vessel prices are used as a proxy for net economic value of the additional catch associated with SAFE production

<sup>f</sup> No ocean commercial coho seasons in 1997 and 1998

<sup>g</sup> Recreational values are from the Economics Appendix of the ODFW 1999 Draft Hatchery Program Review (by Chris Carter) and are approximate dollars per fish

<sup>h</sup> 2004 data complete through 6/4/04

Tabel 8.2. Estimated impact<sup>a</sup> per pound of salmon produced by the Select Area Fisheries Project (SAFE) harvested in regional commercial and recreational fisheries, 1996-2004.

Year	Spp	Commercial Harvest			Recreational Harvest					
		SAFE	River	Ocean	SAFE		Columbia River		Ocean	
		Estimated coastal area impact on total personal income <sup>a</sup> per pound of harvested fish			Average coastal area impact on personal income <sup>a</sup> (IPI) per fish harvested					
				CPUE	IPI <sup>b</sup>	CPUE <sup>c</sup>	IPI <sup>b</sup>	CPUE <sup>d</sup>	IPI <sup>b</sup>	
1996	CHS	\$3.20	\$3.20	\$2.95	0.20	\$152.10	No season		1.00	\$64.69
	CHF	\$1.85	\$1.85	\$2.95	0.60	\$50.70	0.33	\$92.18	1.00	\$64.69
	COH	\$1.47	\$1.47	\$1.89	0.50	\$60.84	0.33	\$92.18	1.00	\$64.69
1997	CHS	\$3.87	\$3.87	\$2.98	0.20	\$152.10	No season		1.00	\$64.69
	CHF	\$1.84	\$1.84	\$2.98	0.60	\$50.70	0.60	\$50.70	1.00	\$64.69
	COH	\$1.62	\$1.62	\$2.98	0.50	\$60.84	0.60	\$50.70	1.00	\$64.69
1998	CHS	\$4.13	\$4.13	\$3.00	0.30	\$101.40	No season		1.00	\$64.69
	CHF	\$1.84	\$1.84	\$3.00	0.60	\$50.70	0.38	\$80.05	1.00	\$64.69
	COH	\$1.49	\$1.49	\$3.00	0.50	\$60.84	0.38	\$80.05	1.00	\$64.69
1999	CHS	\$4.46	\$4.46	\$3.39	0.30	\$101.40	No season		1.00	\$64.69
	CHF	\$2.53	\$2.53	\$3.39	0.40	\$76.05	0.38	\$80.05	1.00	\$64.69
	COH	\$1.53	\$1.53	\$1.86	0.33	\$92.18	0.38	\$80.05	1.00	\$64.69
2000	CHS	\$4.07	\$4.07	\$3.45	0.30	\$101.40	0.15	\$202.80	1.00	\$64.69
	CHF	\$2.33	\$2.33	\$3.45	0.33	\$92.18	0.38	\$80.05	1.00	\$64.69
	COH	\$1.41	\$1.41	\$2.13	0.33	\$92.18	0.38	\$80.05	1.00	\$64.69
2001	CHS	\$3.45	\$3.45	\$2.82	0.40	\$76.05	0.12	\$253.50	1.00	\$64.69
	CHF	\$1.58	\$1.58	\$2.82	0.33	\$92.18	1.13	\$26.92	1.00	\$64.69
	COH	\$1.04	\$1.04	\$1.55	0.33	\$92.18	1.13	\$26.92	1.00	\$64.69
2002	CHS	\$3.45	\$4.05	\$2.71	0.40	\$76.05	0.15	\$202.80	1.00	\$64.69
	CHF	\$1.58	\$1.31	\$2.71	0.33	\$92.18	0.34	\$89.47	1.00	\$64.69
	COH	\$1.14	\$1.10	\$1.65	0.33	\$92.18	0.34	\$89.47	1.00	\$64.69
2003 <sup>d</sup>	CHS	\$3.45	\$4.05	\$2.71	0.50	\$60.84	0.17	\$178.94	1.00	\$64.69
	CHF	\$1.58	\$1.31	\$2.71	0.40	\$76.05	0.61	\$49.87	1.00	\$64.69
	COH	\$1.14	\$1.10	\$1.65	0.33	\$92.18	0.61	\$49.87	1.00	\$64.69
2004 <sup>d</sup>	CHS	\$3.45	\$4.05	\$2.71	0.60	\$50.70	0.26	\$117.00	1.00	\$64.69

<sup>a</sup> Impact on total personal income (per harvested fish) at the state level based on the 1999 FEAM model for Oregon with listed prices adjusted to 2001 dollars.

<sup>b</sup> Calculated as the product of average angler days per harvested fish (1/CPUE) and coastal area impact on personal income per angler day. Impacts are \$30.42 per angler day in SAFE areas, \$30.42 per angler day in the lower Columbia River, and \$64.69 per angler day in the ocean.

<sup>c</sup> Columbia River recreational spring chinook catch rates based on March-May averages. Annual catch rates for fall chinook and coho based on Bouy 10 fishery data and set at higher CPUE of the two species (usually coho).

<sup>d</sup> Impacts on personal income per pound of harvested fish in 2003 and 2004 (spring chinook) set at 2002 values pending updated information.

Notes:

- Estimates from Oregon Angler Survey are adjusted for inflation using the implicit GDP deflator for 1989 and 2001
- Data on anglers' variable trip expenses and associated impact on personal income collected in 1988 and 1989
- Implicit GDP deflator= 1989=83.45; 2001=108.65
- Adjustment factor= 108.65/83.45= 1.30
- Estimates are for all modes of fishing (charterboat, private boat, etc.)
- Columbia River and SAFE estimates based on Columbia River area model for Oregon resident anglers
- Ocean fishing impacts based on coastal counties model

Table 8.3. Total Select Area Fisheries Project (SAFE) contributions to regional commercial and recreational fisheries by landings and total personal income impact<sup>a</sup>, 1996-2004.

Year	Spp <sup>a</sup>	Commercial Harvest						Recreational Harvest						Total SAFE Contribution	
		SAFE		Columbia River		Ocean		SAFE		Columbia River		Ocean		Number	Personal Income <sup>b</sup>
		Number	Total Personal Income <sup>b</sup>	Number	Total Personal Income <sup>b</sup>	Number <sup>c</sup>	Total Personal Income <sup>bd</sup>	Number	Total Personal Income <sup>b</sup>	Number	Total Personal Income <sup>b</sup>	Number	Total Personal Income <sup>b</sup>		
1996	CHS	789	\$30,147	7	\$336	13	\$384	15	\$2,282	4	\$0	0	\$0	828	\$33,149
	SAB	1,469	\$25,678	309	\$8,575	2,048	\$60,416	400	\$20,280	606	\$55,861	198	\$12,809	5030	\$183,619
	CHF	3526	\$111,496											3526	\$111,496
	All CHF	4,995	\$137,174	309	\$8,575	2,048	\$60,416	400	\$20,280	606	\$55,861	198	\$12,809	8,556	\$295,115
	COH	22422	\$391,462	2318	\$27,260	361	\$3,411	69	\$4,198	1482	\$136,611	1478	\$95,612	28130	\$658,554
		28206	\$558,783	2634	\$36,171	2422	\$64,211	484	\$26,760	2092	\$192,472	1676	\$108,421	37514	<b>\$986,818</b>
1997	CHS	1821	\$94,188	18	\$1,045	98	\$0	40	\$6,084	15	\$0	0	\$0	1992	\$101,317
	SAB	1,570	\$37,919	248	\$6,845	1,964	\$58,920	400	\$20,280	699	\$35,439	139	\$8,992	5020	\$168,395
	CHF	2429	\$82,699											2429	\$82,699
	All CHF	3,999	\$120,618	248	\$6,845	1,964	\$58,920	400	\$20,280	699	\$35,439	139	\$8,992	7,449	\$251,094
	COH	16991	\$222,019	231	\$2,994	0	\$0	48	\$2,920	4253	\$215,627	309	\$19,989	21832	\$463,549
		22811	\$436,825	497	\$10,884	2062	\$58,920	488	\$29,284	4967	\$251,066	448	\$28,981	31273	<b>\$815,960</b>
1998	CHS	2258	\$75,166	8	\$496	167	\$5,010	55	\$5,577	23	\$0	0	\$0	2511	\$86,249
	SAB	1,385	\$9,907	281	\$7,756	1,294	\$38,820	400	\$20,280	713	\$57,076	81	\$5,240	4154	\$139,079
	CHF	364	\$351,718											364	\$351,718
	All CHF	1,749	\$361,625	281	\$7,756	1,294	\$38,820	400	\$20,280	713	\$57,076	81	\$5,240	4,518	\$490,797
	COH	24134	\$372,428	0	\$0	0	\$0	118	\$7,179	389	\$31,139	1026	\$66,372	25667	\$477,118
		28141	\$809,219	289	\$8,252	1461	\$43,830	573	\$33,036	1125	\$88,215	1107	\$71,612	32696	<b>\$1,054,164</b>
1999	CHS	1955	\$124,795	27	\$1,806	131	\$4,441	25	\$2,535	36	\$0	3	\$194	2177	\$133,771
	SAB	1,375	\$50,694	327	\$12,410	573	\$19,425	300	\$22,815	453	\$36,263	73	\$4,722	3101	\$146,329
	CHF	768	\$28,523											768	\$28,523
	All CHF	2,143	\$79,217	327	\$12,410	573	\$19,425	300	\$22,815	453	\$36,263	73	\$4,722	3,869	\$174,852
	COH	22954	\$303,154	5922	\$72,485	108	\$1,004	159	\$14,657	1210	\$96,861	2415	\$156,226	32768	\$644,387
		27052	\$507,166	6276	\$86,701	812	\$24,870	484	\$40,007	1699	\$133,124	2491	\$161,142	38814	<b>\$953,010</b>
2000	CHS	6496	\$320,781	249	\$15,201	378	\$13,041	255	\$25,857	139	\$28,189	28	\$1,811	7545	\$404,880
	SAB	1,130	\$35,416	177	\$6,186	450	\$15,525	50	\$4,609	221	\$17,691	80	\$5,175	2108	\$84,602
	CHF	1185	\$39,407											1185	\$39,407
	All CHF	2,315	\$74,823	177	\$6,186	450	\$15,525	50	\$4,609	221	\$17,691	80	\$5,175	3,293	\$124,009
	COH	61745	\$779,323	6076	\$68,537	1241	\$13,217	202	\$18,620	2544	\$203,647	5915	\$382,641	77723	\$1,465,985
		70556	\$1,174,927	6502	\$89,924	2069	\$41,783	507	\$49,086	2904	\$249,527	6023	\$389,627	88561	<b>\$1,994,874</b>

(Cont'd)

Table 8.3 (continued). Total Select Area Fisheries Project (SAFE) contributions to regional commercial and recreational fisheries by landings and total personal income impact<sup>a</sup>, 1996-2004.

Year	Spp <sup>a</sup>	Commercial Harvest						Recreational Harvest						Total SAFE Contribution	
		SAFE		Columbia River		Ocean		SAFE		Columbia River		Ocean		Number	Total
		Number	Total	Number	Total	Number <sup>c</sup>	Total	Number	Total	Number	Total	Number	Total		
2001	CHS	9269	\$484,746	709	\$36,691	369	\$10,406	500	\$38,025	174	\$44,109	32	\$2,070	11053	\$616,047
	SAB	1,557	\$35,109	384	\$9,101	1,207	\$34,037	150	\$13,827	475	\$12,787	248	\$16,043	4021	\$120,904
	CHF	1541	\$38,631											1541	\$38,631
All	CHF	3,098	\$73,740	384	\$9,101	1,207	\$34,037	150	\$13,827	475	\$12,787	248	\$16,043	5,562	\$159,535
	COH	33771	\$307,314	38617	\$321,293	679	\$5,262	263	\$24,243	17848	\$480,468	13346	\$863,353	104524	\$2,001,933
		46138	\$865,800	39710	\$367,085	2255	\$49,705	913	\$76,095	18497	\$537,364	13626	\$881,466	121139	\$2,777,515
2002	CHS	11699	\$561,160	581	\$35,296	780	\$21,138	552	\$41,980	409	\$82,945	26	\$1,682	14047	\$744,201
	SAB	2,450	\$60,372	1,105	\$21,713	2,347	\$63,604	500	\$46,090	1173	\$104,948	627	\$40,561	8202	\$337,288
	CHF	6120	\$179,910											6120	\$179,910
All	CHF	8,570	\$240,282	1,105	\$21,713	2,347	\$63,604	500	\$46,090	1,173	\$104,948	627	\$40,561	14,322	\$517,198
	COH	69281	\$820,214	11321	\$99,625	111	\$916	344	\$31,710	1171	\$104,769	6000	\$388,140	88228	\$1,445,374
		89550	\$1,621,656	13007	\$156,634	3238	\$85,658	1396	\$119,780	2753	\$292,662	6653	\$430,383	116597	\$2,706,773
2003	CHS	7820	\$381,315	380	\$23,085	544	\$14,742	994	\$60,475	286	\$51,177	18	\$1,164	10042	\$531,958
	SAB	3,043	\$74,693	2,335	\$45,883	2,999	\$81,273	637	\$48,444	1837	\$91,611	627	\$40,561	11478	\$382,465
	CHF	6680	\$196,919											6680	\$196,919
All	CHF	9,723	\$271,612	2,335	\$45,883	2,999	\$81,273	637	\$48,444	1,837	\$91,611	627	\$40,561	18,158	\$579,384
	COH	117133	\$1,244,264	23427	\$206,158	1171	\$9,661	772	\$71,163	21084	\$1,051,459	14056	\$909,283	177643	\$3,491,988
		134676	\$1,897,191	26142	\$275,126	4714	\$105,676	2403	\$180,082	23207	\$1,194,247	14701	\$951,008	205843	\$4,603,330
2004 <sup>e</sup>	CHS	9844	\$478,232	489	\$29,707	656	\$17,778	1400	\$70,980	344	\$40,248	22	\$1,423	12755	\$638,368
	SAB	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
	CHF	0	\$0											0	\$0
All	CHF	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
	COH	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
		9844	\$478,232	489	\$29,707	656	\$17,778	1400	\$70,980	344	\$40,248	22	\$1,423	12755	\$638,368

<sup>a</sup> Species are spring chinook (CHS); select area bright fall chinook (SAB); fall chinook (CHF); and coho (COH)

<sup>b</sup> Total impact on state level personal income (direct, indirect and induced based on Oregon FEAM model) and prices in 2001 dollars

<sup>c</sup> No ocean commercial coho seasons in 1997 and 1998

<sup>d</sup> Based on average dressed weight of 5#/s/coho and 10#/s/chinook

<sup>e</sup> 2004 data complete through 6/4/04

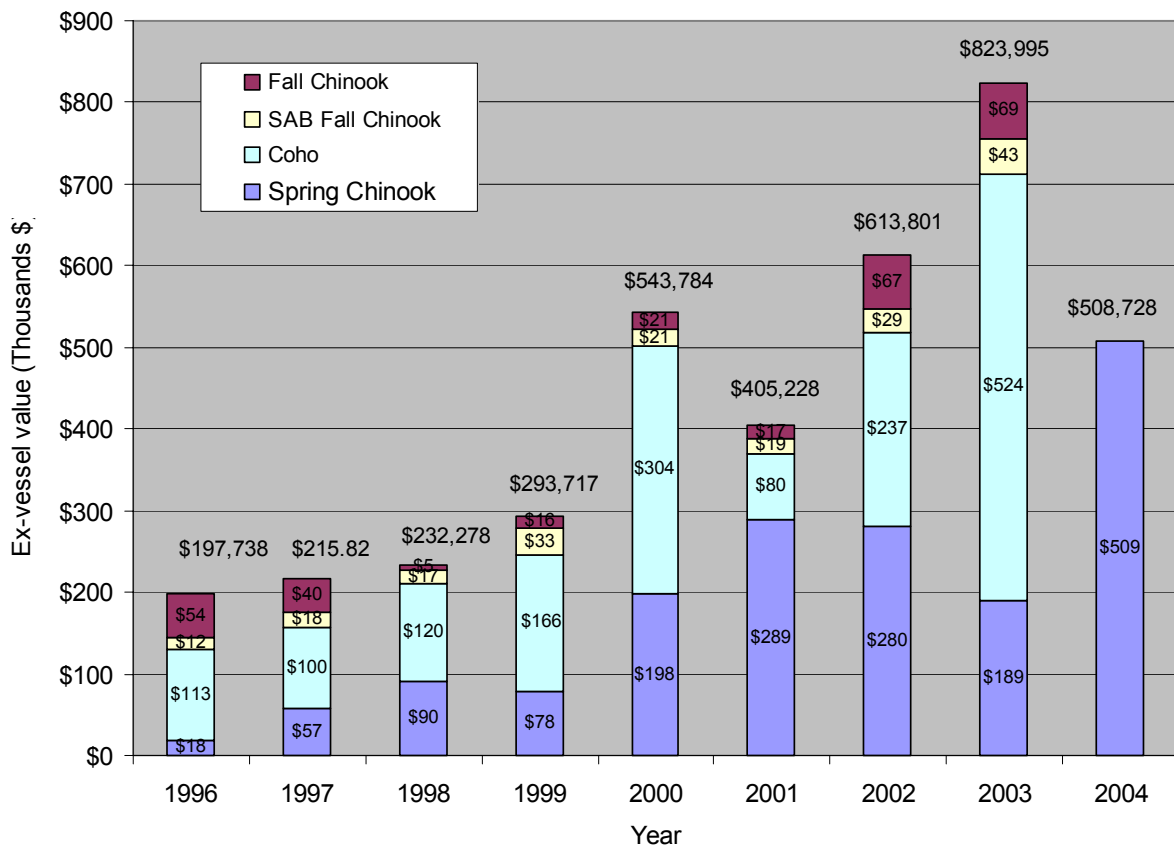


Figure 8.1. Estimated annual ex-vessel value of Select Area commercial fisheries by species, 1996-2004. Select area bright (SAB) fall chinook landed during winter-summer SAFE fisheries are included in spring chinook totals. (2004 data is incomplete).

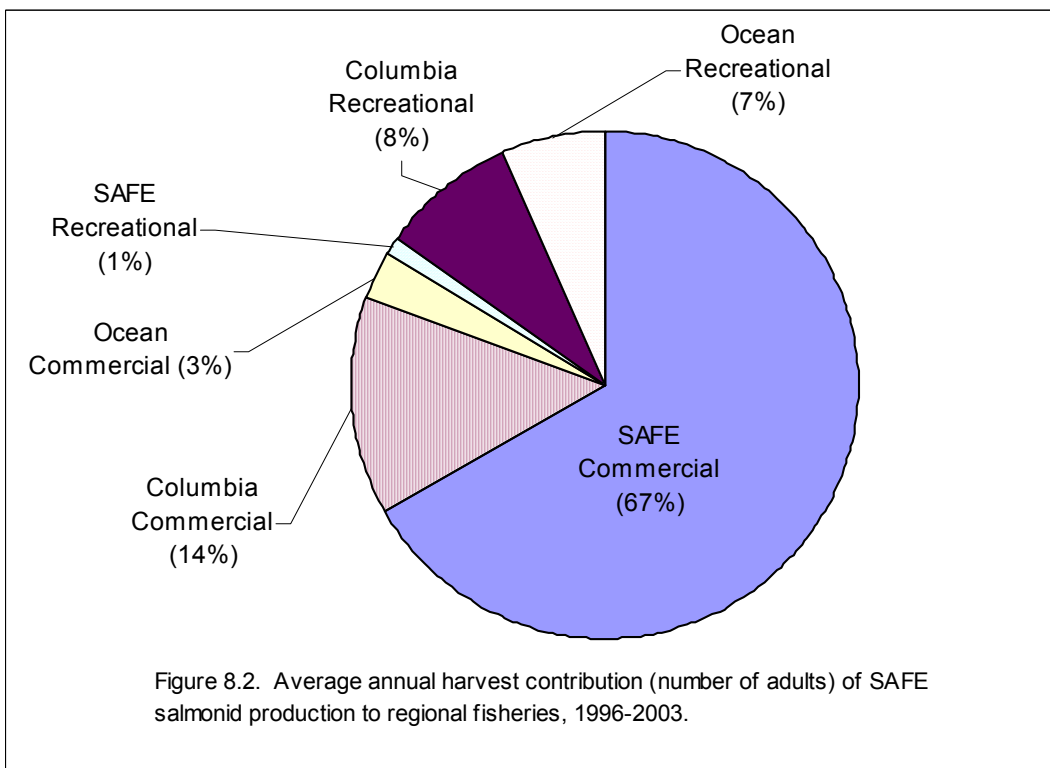


Figure 8.2. Average annual harvest contribution (number of adults) of SAFE salmonid production to regional fisheries, 1996-2003.

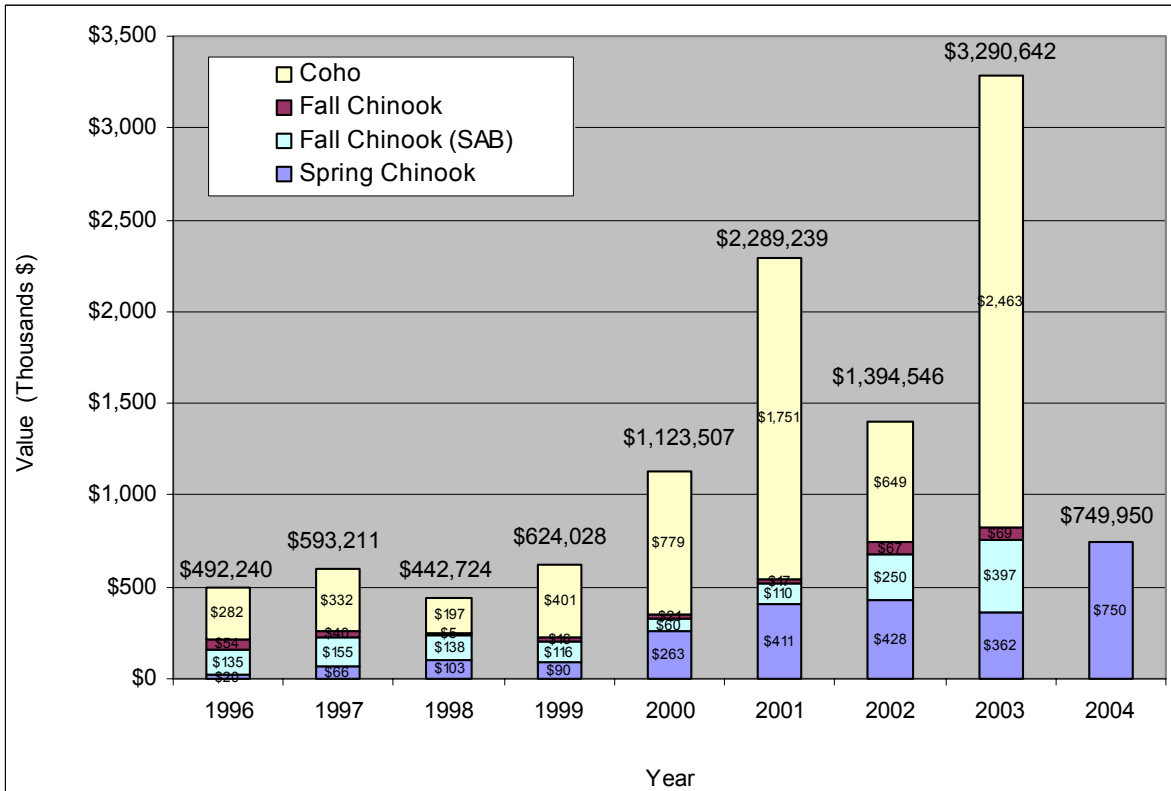


Figure 8.3. Estimated annual economic value of Select Area Fisheries Project production to regional fisheries, 1996-2004 (2004 data is incomplete).

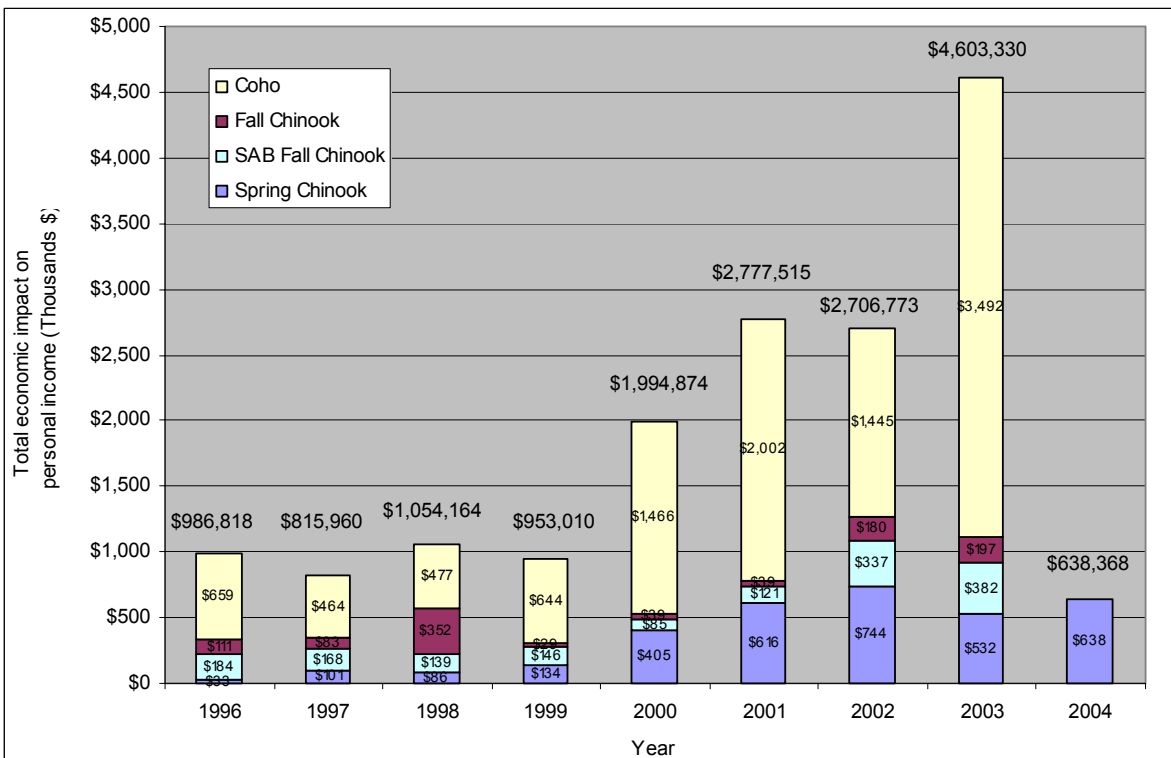
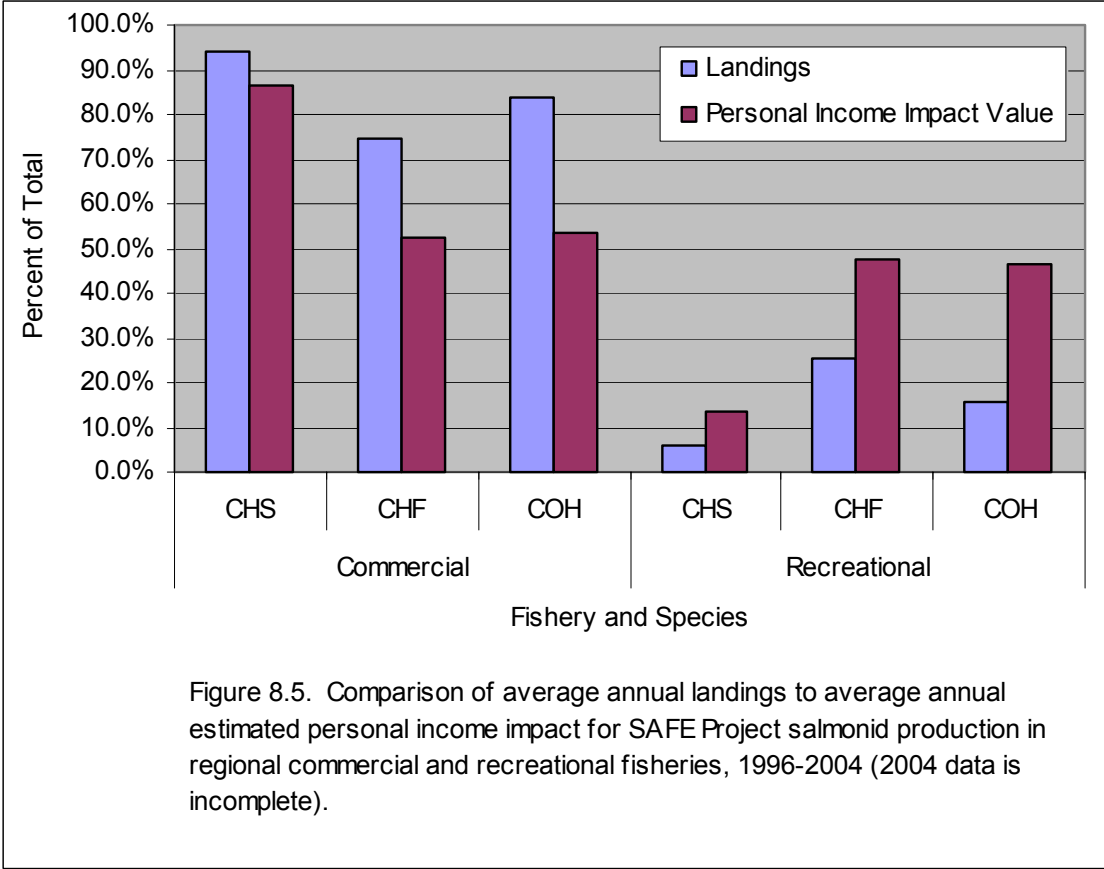


Figure 8.4. Estimated annual personal income impacts of Select Area Fisheries Project production to all regional fisheries, 1996-2004 (2004 data is incomplete).



## 9. FUTURE PLANS

Since its inception in 1993, the SAFE fisheries project has grown steadily and now contributes significant numbers of fish for harvest in Columbia River commercial and recreational fisheries. The project has successfully reared, acclimated and released fish from select area production facilities for harvest in select area fisheries, as well as commercial and recreational fisheries occurring in the mainstem Columbia River and the Pacific Ocean. Select area commercial fisheries provide stable and predictable commercial fishing opportunities that produce a consistent income for commercial fishers that can be reinvested into equipment necessary for other less stable mainstem fisheries.

Progress of the project, including site selection and development, juvenile production, and subsequent increased adult returns, has been slow to ensure that the goal of protecting depressed and listed stocks is accomplished. A monitoring program has been in place to document stray rates and impacts to non-target species, primarily listed stocks. Results during the early years of this project were positive, which allowed project managers to expand juvenile production and fisheries. In recent years, increased juvenile production and improved ocean rearing conditions have resulted in significant harvest in select area fisheries.

The SAFE project has been reviewed as part of the Estuary Subbasin Plan that is supported by the Northwest Power and Conservation Council (NPCC) and funded by BPA (Zenn et al. 2004). The review of the SAFE project is positive, hypothesizing that the program will support productive sport and commercial fisheries on harvestable stocks without negatively affecting rebuilding efforts directed at weak stocks. Additionally, the review provides justification for this hypothesis by stating that harvesters are generally agreeable to targeting specific hatchery stocks, and the technology exists to manage fisheries with selectivity in the estuary without negatively impacting biological diversity and genetic integrity of wild stocks. In analyzing the potential for success of the SAFE project the Subbasin Plan states that this project has a high potential to contribute to biological objectives of the plan and that the barriers to success are very low.

Commercial and sport fisheries in select areas have been effectively managed to harvest the majority of the returning adults with minimal impacts to listed species. The goals of this project are to participate in the recovery of listed or depressed stocks through alternative harvest opportunities and to increase the value of regional fisheries. Aiding in recovery efforts for listed stocks has been accomplished by careful site selection and implementation of conservative fishery management strategies. Increasing the value of the fisheries can be accomplished in two ways: 1) increasing production or 2) increasing the value of the fish harvested.

Increasing the value of SAFE and other regional fisheries can occur by increasing smolt releases or by improving SARs. With respect to increased smolt production, the long-term goal of the SAFE project would be to achieve full production for all species at all locations; however, in the short-term this project will focus primarily on increasing SARs in concert with modest increases in juvenile production. Increasing the value of fish

harvested primarily focuses on commercial fisheries. Methods of accomplishing this task include shifting production to more high value species, developing stable predictable fisheries, improving quality of harvested fish, and improving marketing techniques. The SAFE project will primarily focus on production shifts and developing stable and predictable fisheries. Other methods of increasing the value of fish caught in commercial fisheries are generally outside the scope of this project and therefore require that the commercial fishing industry implement those changes.

## **INCREASE SMOLT TO ADULT SURVIVAL RATES**

Increasing SARs would be the most efficient method of increasing adult returns. Although SARs are greatly affected by factors outside the scope of this project, there are several project modifications that may improve survival rates including, 1) net-pen towing, 2) release time modifications, 3) reduced fin clipping requirements, and 4) reducing predation in net pens. These modifications are generally cost neutral with some options actually reducing operating expenses of this project. These project modifications are expected to increase adult returns, which would in turn improve the cost:benefit ratio of this project.

### **Net Pen Towing**

Towing net pens outside the rearing area for smolt releases is a liberation strategy currently being evaluated by this project (see Chapter 6). The hypothesis is that towing fish to the mainstem Columbia River for release will increase SARs because current releases likely suffer significant bird predation during their migration through the tidewater bays and sloughs where net-pen rearing sites are located. By towing the pens through areas of highest avian predation this source of mortality would be reduced and adult returns would increase correspondingly. Release trials conducted to date using coho from Youngs Bay have shown positive results, although data is preliminary since CWT recoveries are incomplete. Survival rates for towed releases have generally been equal to or greater than rates for non-towed releases during the first two years of this study, with no negative effect on straying. This release technique shows significant promise, and project staff are planning to expand the current experiment to a larger scale involving additional species. If results are positive, this technique could be applied to all species in all locations.

In addition to increasing survival rates, this release technique will likely reduce the potential for interaction between smolts released by the SAFE project and local wild juvenile salmonids because the estuarine residency time of towed SAFE smolts is likely less than rates for smolts released directly from the select area rearing locations. An ongoing telemetry study will help evaluate this hypothesis (see Chapter 6). Costs associated with this release strategy include contracting vessels to tow the pens, which could be provided by commercial fishers. The cost of net-pen towing is relatively low and could be reduced to zero depending upon voluntary participation levels.

## **Release Time Modifications**

Conducting smolt releases at the proper time can have a significant effect on both SARs and migration patterns. Typically, spring chinook smolts are released in the late-February through early-April timeframe, depending on the program. In Oregon SAFE sites, February releases of spring chinook have been discontinued in favor of early-April releases due to poor SARs, as documented by CWT release trials. Currently in Deep River, release of spring chinook is not allowed prior to May 1 to eliminate interactions with listed chum salmon. Staff hypothesize that delaying the release of Deep River spring chinook results in lower condition factors because they are held past the optimum release time, which results in reduced SARs. Additionally, the late release time likely results in a protracted outmigration time and increased residualism. The WDFW staff will investigate the feasibility of modifying the current release date to early spring. Additionally, staff are considering towing pens in conjunction with this modified release date to further increase survival rate and eliminate possible interactions with listed chum salmon.

One method of determining appropriate release time is to monitor ATPase levels in smolts prior to release. ATPase can be used as an indicator of smoltification, which can in turn assist in determining the proper timing for release. Currently ODFW and CEDC are collecting ATPase samples from one CWT tag group of spring chinook and coho each year prior to release to determine if this data is useful for determining optimum release timing for smolts released by the SAFE project.

In addition to increasing survival rates, releasing smolts at the optimum time can further reduce interactions between SAFE project smolt releases and wild juvenile salmonids utilizing select areas for rearing and migration purposes. Releasing smolts at the proper time will reduce seaward migration time and residualism, both of which will in turn reduce interactions with local wild salmonids. Costs associated with this evaluation are limited to sample analysis, since project staff can collect the samples concurrent with production activities. Overall cost of ATPase testing would be low, while costs of collecting ATPase samples would be zero. Implementation of towing for Deep River spring chinook may actually reduce project costs if the release date can be moved forward by several months as proposed by staff.

## **Reduced Fin Clipping Requirements**

Currently SAB fall chinook releases are 100 percent marked with a LV fin clip to facilitate positive identification of broodstock and to document strays upon their return as adults to the lower Columbia River basin (see Chapter 1). This marking program helped document high stray rates of this stock when releases occurred at Big Creek Hatchery. In 1996 the brood stock program was moved from Big Creek Hatchery to Klaskanine Hatchery in an effort to reduce straying. The move has proven to be successful with current stray rates for SAB fall chinook being minor (see Chapter 5). Project staff believe that the left ventral fin clip for SAB stock fall chinook is no longer required and will pursue elimination of this marking program. Past studies indicate that a ventral fin clip produces a 40 percent decrease in SARs (Whale and Vreeland 1978;

Blankenship 1998); therefore, elimination of this fin clip would nearly double adult returns while reducing project costs.

Eliminating the LV clip would reduce costs of the project associated with contracting fin-clipping operations. Cost savings produced by this change in marking could be re-invested into increased CWT marking and continued hatchery and spawning ground monitoring to ensure that stray rates remain low for this stock. This project modification would be neutral with respect to interactions between SAFE project smolt releases and wild juvenile salmonids. Since the occurrence of other non-SAB adult fall chinook in Youngs Bay tributaries is low and SAB straying is minor, the consequence of eliminating the LV clip on SAB fall chinook brood stock would be minimal.

### **Predation in Net Pens**

Rearing juvenile salmonids in net pens congregates the fish and makes them an attractive target for predation by birds and otters. Bird netting has been installed at all net-pen sites to prevent bird predation; however, the mesh of the net was not always small enough to eliminate predation by blue herons, which can extend their long neck through the netting to prey on the fish. Existing pen covers are currently being replaced with a smaller mesh net that will completely eliminate all avian predation. Predation by river otters that inhabit select area rearing sites has been especially difficult to prevent because these animals are very adept at circumventing barriers. Staff have tested various netting configurations and electrified wire in an attempt to control this source of fish loss. While these steps have reduced the level of otter predation somewhat they have not eliminated the problem. Staff will continue to investigate methods of reducing otter predation.

These project modifications would also be neutral with respect to interaction between SAFE project smolt releases and wild juvenile salmonids. Costs associated with these modifications would consist of purchasing inexpensive smaller mesh bird netting. Costs of reducing otter predation is unknown at this time but are not expected to be significant. These minor expenses could yield significant economic value to the project if predation is as significant as staff believe.

### **Increased Juvenile Production**

Adult production could be significantly increased by combining the aforementioned methods for increasing SARs with increased numbers of smolts released. Increasing smolt production could be accomplished by either increasing efficiency of current rearing facilities or by increasing capacity of the facilities. Improved adult returns associated with increased juvenile production would likely improve the cost:benefit ratio of this project, depending on implementation costs. Except for additional feed and marking costs, efficiency improvements would generally be cost neutral with some methods requiring small additional monetary investments. Increasing the capacity of current rearing and/or net-pen acclimation facilities would require significant capital expenditures and additional operating costs. Costs of expanding current facilities and associated smolt releases may or may not result in an improved cost:benefit ratio depending on the cost of the expansion, adult returns, and fishery performance.

Methods of increasing juvenile production currently being considered include; 1) oxygen supplementation, 2) improved brood stock collection, 3) re-establishing lost production, 4) over-summer rearing, 5) expanding to additional sites, and 6) expanding current facilities and associated smolt releases.

### **Oxygen Supplementation**

Oxygen supplementation has been used in fish propagation programs throughout the world to increase rearing capacity through higher pond loading densities and to reduce disease outbreaks. Increased loading densities would allow the project to increase production through more efficient use of existing facilities without requiring significant construction costs. Reducing disease outbreaks would reduce rearing mortalities and increase juvenile production, while reducing project costs associated with disease prevention. This rearing strategy has proven to be effective in other hatcheries and is currently being planned for evaluation with 2003 brood spring chinook at Gnat Creek Hatchery. If the results of this proposed study are positive then project staff will recommend full-scale implementation of oxygen supplementation for rearing spring chinook at Gnat Creek and Deep River hatcheries.

This rearing strategy could be used to increase SAFE spring chinook smolt production approximately 30 percent and would therefore result in some increase in interaction between SAFE project smolt releases and wild salmonid smolts. Potential interactions could be minimized through net-pen towing and monitoring of gill ATPase. The primary outcome of this rearing strategy will be to increase production modestly, while producing a healthier smolt that will survive at a higher rate. The costs associated with this modification would include installation of an oxygen distribution system, compressed oxygen, and additional feed costs. The cost of disease treatments should be reduced. Additional staffing will not be required because staff can accomplish tasks associated with this modification concurrent with other production activities. Overall this modification would involve modest additional cost to the project but increased production would improve the projects cost:benefit ratio.

### **Improved Brood Stock Collection**

Early rearing of SAB fall chinook is primarily conducted at Big Creek Hatchery, with releases occurring from Klaskanine Hatchery for perpetuation of the broodstock program and from Youngs Bay net pens to maximize harvest opportunity. To date this stock has yet to achieve full production due to insufficient adult returns to the Klaskanine Hatchery located on the North Fork Klaskanine River. This stream is prone to low flows during the SAB migration timeframe of August-October, which makes it difficult for fish to migrate upstream. Achieving full production for SAB fall chinook will likely require a multi-faceted strategy.

One alternative is to actively collect and hold adult SAB fall chinook in upper Youngs Bay prior to their entry into the Klaskanine River. Project staff successfully initiated this project in 2003 (see Chapter 6). Additional effort is planned for 2004 and beyond if needed to achieve full production levels of SAB fall chinook.

Some SAB fall chinook also return to South Fork Hatchery on the South Fork Klaskanine River. The South Fork Klaskanine River maintains higher flow levels than the North Fork Klaskanine during August-September, which allows for increased conversion of brood stock SAB fall chinook from Youngs Bay to the South Fork Hatchery. Beginning in 2004 project staff intend to release a portion of the brood stock release at South Fork Hatchery to increase brood stock returns for SAB fall chinook. Installation of an improved adult weir is also being considered to facilitate adult collections and prevent undesirable straying in this system.

Increased production of SAB fall chinook will increase the potential for interaction between wild juvenile salmonids and SAFE project SAB fall chinook smolts. The release time for SAB fall chinook smolts is July and August and very few, if any, wild salmonids are present in the lower Klaskanine River basin (downstream of North and South Fork hatcheries) due to low flows and high water temperatures; therefore, tributary interaction between project and wild production is negligible for this stock. Costs associated with these project modifications are minimal since existing staff and equipment are sufficient to implement this work. These modifications would increase the cost:benefit ratio of the project by producing more smolts (two-fold increase) with little to no increase in costs.

### **Re-establish Lost Production**

For many years, the SAFE project has received up to 1,000,000 full-term coho salmon smolts for acclimation from Eagle Creek National Fish Hatchery through the Mitchell Act; however, this program will be temporarily discontinued in 2004 due to federal budget shortfalls. This production loss will represent approximately a 70 percent reduction in coho releases at Tongue Point and a 22 percent reduction at Youngs Bay. Based on results for the 1993-1999 brood years, these lost releases would produce a combined catch of 22,000 adult coho in regional fisheries, of which 16,000 would be harvested in SAFE commercial fisheries. Due to the importance of this production to regional fisheries, the SAFE project staff intend on re-establishing this or an equivalent program since it has worked so effectively since implementation.

Another production program that could yield significant economic value if reinstated is releases of spring chinook from the Tongue Point SAFE site. Previous production level releases from this site were voluntarily discontinued in 2001 due to excessive straying of previous broods (see Chapter 1). A new rearing site and use of artificial imprinting are currently being evaluated in an attempt to re-establish significant releases at this site (see Chapter 6). If results of this study are positive then project staff would propose that the spring chinook releases at Tongue Point be restored to their previous level (250,000 smolts annually).

With respect to interaction between smolts produced by the SAFE project and wild juvenile salmonids, the impact of these production sites could be considered neutral because they would replace programs that have been in effect for several years already. For adult interactions the Tongue Point re-establishment could actually reduce interactions between SAFE and wild production by eliminating the aforementioned straying problem. Costs of re-establishing both these programs would be neutral to low

because, 1) coho are received as acclimation fish and only require limited feeding prior to release, and 2) spring chinook production for the Tongue Point site would occur through the proposed oxygen supplementation increases at Gnat Creek Hatchery, which has a relatively low implementation cost. The infrastructure for acclimation of these smolts is already in place and would not require additional investment; therefore, these re-establishments would increase the cost:benefit ratio of this project

### **Over-summer Rearing**

Currently, production levels for this project are limited to some extent by the number of smolts that are provided by state and federal hatcheries. The limitations are generally driven by lack of freshwater rearing space rather than lack of brood stock or incubation facilities. By receiving fish as fry in the spring and rearing fish in net pens over the summer the project could increase the number of smolts produced. Over-summer rearing feasibility has been tested at the Tongue Point and Youngs Bay sites with good success in Youngs Bay but poor results due to disease in Tongue Point. Additional studies concerning the locations and species that would benefit from this rearing strategy are being considered. Results of future studies will determine how to proceed with over-summer rearing.

Implementation of over-summer rearing would allow for production increases at all three Oregon sites by shifting more over-winter fish to Blind Slough and MERTS from Youngs Bay and replacing the Youngs Bay portion with over-summer fish. Additional net pens would be required to facilitate this strategy. Annual costs of the modification would be moderate and would consist of fish food and medication necessary to rear fish from fry to smolt. Additionally, a one-time purchase of a net-pen washer would be needed because net fouling by algal growth increases with warmer water temperatures. Increased production would occur at a moderate cost; therefore it is likely that this project modification would have a positive effect on the cost:benefit ratio.

### **Expand to Additional Sites**

During the initial research phase of this project, 20 different sites were evaluated with the 5 current sites being selected because they were best suited for net-pen rearing, harvest of returning adults, and minimizing interactions with wild salmonids. Although the sites currently in use showed the most promise, other attractive sites still exist in the lower Columbia River. Project staff will continue to evaluate these possible sites to include in the SAFE project. As with the sites currently in use, evaluation of potential sites will follow a three-phase process that begins with site investigation and is completed with full-scale production. The three-phase process typically exceeds ten years in duration. In the short-term, project staff propose to conduct investigations into other possible locations. Investigations will include site evaluations for access and rearing potential, water quality testing, and discussions with affected fishing communities and landowners.

At its ultimate conclusion this process would increase the potential for interaction between SAFE and wild production; however, as with other SAFE locations, interactions with wild salmonids will be minimized through the site selection process. Costs of

expansion in the short-term will consist of water quality analysis and test fishing. Short-term costs will include construction of net pens and acclimation of small test groups for species being considered. Over the long-term, costs would include full-term rearing (fry to smolt) costs or could be limited to acclimation costs only. Establishment of new sites will be evaluated in part based on its impact on the project's cost:benefit ratio.

### **Expand Facilities and Associated Smolt Production**

Although some sites are nearing full production for some species, no site is at full production for all species. Full production can be affected by a variety of influences including salmon market conditions, public support, current economic climate, access issues, juvenile production capacity, and availability of acceptable access sites. Expansion to full production would require significant capital construction costs for additional net pens, establishment of new net-pen sites, and/or major modifications of existing hatchery facilities. In some cases only construction of additional net pens is required, whereas in other situations all three investments are required. For this document we have assumed that full production represents what would be reasonable expectations based on current market conditions and existing infrastructure (Table 9.1).

Expansion to full production must be approached cautiously; therefore, full production will probably not be reached for another 10-20 years. A critical element in determining full production is market conditions. Physically, production can be increased to levels where supply (returning adults) exceeds demand and the additional production actually reduces value of the fishery to its participants and the region as a whole. For this reason expansion to full production should occur over a protracted period of time and in several steps to ensure that each increase in production results in increased benefit to the fishery and the region. Based on current economic conditions the project staff does not expect to make significant progress toward full production in the next five years, which is why staff will focus on increasing SARs in the short-term. In the interim, project staff will continue to define full production for each species at each site and expand production wherever feasible.

### **INCREASE VALUE OF FISH HARVESTED**

The ultimate goal of fish produced by the SAFE project is for harvest; therefore, maximizing the value of the harvest is a logical objective of this project. Methods of increasing the value of fish harvested in select area fisheries include, 1) shifting production to species that have a higher commercial value, and 2) developing stable predictable fisheries. These actions are generally cost neutral and would result in increased cost:benefit ratio for the project due to the increase value of the catch.

#### **Shifting Production**

Shifting production to a more commercially valuable species of fish can result in increased income to the commercial fishing industry for similar production levels. Shifting some production from coho to spring chinook would accomplish that goal. In fact the SAFE project has already taken that step in two separate locations. Beginning with the 2002 brood, annual production at the South Fork Klaskanine Hatchery was

shifted from a release of approximately 600,000 coho smolts to 625,000 spring chinook smolts. Additionally, in 2003 coho production for Deep River was reduced from 300,000 to 200,000 smolts, and spring chinook production was increased from 200,000 to 350,000 smolts (see Chapter 1).

Other production shifts may be considered in the future, but the impacts to the project as a whole must be evaluated. It is important to note that a goal of the commercial fishery is to maintain product on the market during as much of the year as possible, and this cannot be accomplished if this project becomes focused on producing a single species. As mentioned earlier in this section, it is important to consider the law of diminishing returns. For instance, if the SAFE project produced only spring chinook then the total value to the commercial fishery may be less because supply could exceed demand. Even though price per pound is consistently higher for spring chinook than coho, this can be compensated for by increased number of fish landed. In fact, in some years coho produce more income for the commercial fishing industry than do spring chinook. Finally, the effect on sport fisheries should also be considered. Production of coho from the SAFE project contributes significantly to Columbia River, select area, and ocean sport fisheries. Elimination of coho salmon from the SAFE project would have a negative impact on both Columbia River and ocean fisheries targeting hatchery coho salmon. Ultimately the critical issue is to maintain the proper balance between all species being produced by the SAFE project to ensure that a variety of stable and profitable fishing opportunities are available to commercial and sport fisheries in the region.

Shifting production between species should have limited effect on interactions between SAFE and wild production. In general, species and areas were chosen due to their lack of interaction with wild stock adults; therefore, effects of shifting production will be minor. Shifts between species is cost neutral because both species smolt as yearlings and therefore incur similar rearing costs.

### **Maintain Stable Predictable Fisheries**

Commercial fisheries are strongly impacted by the stability of fishing opportunities over time. Stable predictable fisheries allow the commercial fishing industry to effectively develop and maintain markets for harvested fish. Conversely, unexpected closures or wide variations in fishing seasons from year to year can eliminate market opportunities and reduce the value of the fishery as a whole. Except for 2003 winter and spring, and 2004 spring seasons, the SAFE project has effectively managed fisheries to ensure stability and predictability. Fishery actions taken in select areas in 2003 and 2004 were the result of shared impacts between mainstem and select area commercial fisheries. In both years impacts in the mainstem exceeded expectations and resulted in unexpected closures of select area commercial fisheries to remain within ESA-related impact guidelines. These closures resulted in lost commercial catch in both years and reduced ex-vessel prices in 2003 when the fishery re-opened.

Project staff recognized the shortcomings of this situation and in 2003 completed a Biological Assessment for salmon harvested in select area commercial and sport fisheries. This document clearly describes past fishery impacts to listed species and

planned fisheries for future years in addition to proposing revised impact rates for select area fisheries that are consistent with the Columbia River Fish Management Plan. The purpose of this document is to establish impact rates for select area fisheries that would allow stable predictable commercial fishing opportunities in SAFE sites independent of other fisheries. The Biological Assessment for select area fisheries was submitted to NOAA Fisheries in December 2003 for their review. The document is currently being updated and will be resubmitted in late-Fall 2004.

## **MONITORING**

Monitoring of interactions of SAFE-produced fish with wild stocks is an integral part of the SAFE project. The SAFE project actively monitors interactions during two distinct life history stages: 1) juveniles migrating to the ocean, and 2) adults returning to spawning grounds or select area fishing sites.

### **Juvenile Monitoring**

Smolts released from net-pen rearing and acclimation sites in select area locations may interact with wild juveniles using the same area for rearing or migratory purposes. It is important to note that the select area net-pen sites were originally established based in part on a lack of presence of adult wild salmonids. Additionally, fish released from net pens have completed smoltification and therefore move quickly through freshwater areas to reach the Columbia River estuary (see Chapter 6). Based on a review of the SAFE Biological Assessment regarding SAFE juvenile production plans, the NOAA fisheries issued a Biological Opinion concluding that current smolt production conducted by the SAFE project has little impact on wild smolts utilizing the Columbia River estuary for short-term rearing and migration purposes (NMFS 1998). The current Biological Opinion is scheduled for renewal in 2004 through the ongoing Hatchery Genetic Management Plan (HGMP) process. Existing and previous Biological Opinions have found the project does not likely jeopardize the continued existence of listed salmonid stocks in the Columbia River Basin.

In 1996, the NMFS conducted an acoustic-tagging study to determine the outmigration rate of SAFE spring chinook released from Youngs Bay. Their results indicate SAFE spring chinook migrate rapidly from Youngs Bay and the lower Columbia River estuary. This rapid migration should minimize any possible interaction between SAFE-produced smolts and wild juvenile salmonids. In spite of this information there continues to be concern over possible interactions between SAFE smolts and wild juvenile salmonids. In response to these concerns Salmon for All, in conjunction with ODFW and CEDC, is conducting an additional study during 2004-2005 to document residency time and outmigration rate of SAFE spring chinook smolts within Youngs Bay and the lower Columbia River estuary. Preliminary results corroborate findings of the previous NMFS study (see Chapter 6). In conjunction with this study ATPase data is being collected and analyzed for the purpose of determining optimum release size and timing.

## **Adult Monitoring**

SAFE project staff, in conjunction with other WDFW and ODFW programs, annually conduct stream surveys to estimate total abundance and stock composition of adult coho and fall chinook returning to streams located near SAFE net-pen sites. Data collected on these surveys is used to document stray rates for coho, fall chinook and spring chinook produced by the SAFE project (see Chapter 6). Project staff will continue to conduct these surveys in future years to ensure that stray rates for SAFE releases remain at the low levels observed to date.

SAFE project staff also work closely with staff of WDFW and ODFW to monitor SAFE fisheries to collect biological data, recover CWT's, estimate fishery landings by species, and perform stock composition analyses. Ultimately this data is used to estimate impacts to listed species in select area fisheries. Additionally, data collected in select area fisheries is combined with data collected in mainstem Columbia River and ocean fisheries to estimate total production and fisheries contribution for fish produced by the SAFE project. Project staff will continue to conduct these duties in the future to document production of SAFE stock fish and to monitor impacts to listed species in SAFE fisheries.

Table 9.1. Summary of current and proposed select area fisheries project production.

Species	Site	Current	Short-term (1-9 years)	Long-term (≥10 years)
Spring Chinook	Youngs Bay	1,100,000 <sup>a</sup>	1,550,000	2,000,000
	Blind Slough	450,000 <sup>b</sup>	450,000	500,000
	Tongue Point	60,000 <sup>c</sup>	250,000	1,500,000
	Deep River	200,000	300,000	300,000
	Steamboat Sl.	0	0	0
		1,810,000	2,550,000	4,300,000
Coho	Youngs Bay	1,250,000 <sup>d</sup>	1,750,000	1,750,000
	Blind Slough	300,000	300,000	300,000
	Tongue Point	200,000 <sup>d</sup>	700,000	1,500,000
	Deep River	350,000	200,000	200,000
	Steamboat Sl.	200,000	200,000	200,000
		2,300,000	3,150,000	3,950,000
Fall Chinook	Youngs Bay	~1,250,000 <sup>e</sup>	2,250,000	3,250,000
	Blind Slough	0	0	0
	Tongue Point	0	0	0
	Deep River	0	0	0
	Steamboat Sl.	0	0	0
		~1,250,000	2,250,000	3,250,000
<b>All Species</b>	<b>All Sites</b>	<b>5,360,000</b>	<b>7,950,000</b>	<b>11,500,000</b>

<sup>a</sup> Includes ~650,000 smolt production at the South Fork Klaskanine Hatchery

<sup>b</sup> Includes 150,000 smolt production funded by NOAA Fisheries

<sup>c</sup> Experimental releases to evaluate homing of imprinted smolts at new MERTS site

<sup>d</sup> Does not include 500,000 Eagle Creek Hatchery smolt production at each site funded by Mitchell Act and scheduled to be discontinued after 2004

<sup>e</sup> Includes 700,000 Klaskanine Hatchery smolt production funded by ODFW's Restoration and Enhancement Program

## BIBLIOGRAPHY

- Banks, J. L. 1989. A Review of Rearing Density Experiments: Can Hatchery Effectiveness Be Improved? Paper presented, Session III: Hatchery Management Strategies and Supplementation, Spring Chinook Salmon Workshop sponsored by the Coastal Zone and Estuarine Studies Division, November 1989. Available at [www.nwfsc.gov/pubs/tm/tm187/Banks](http://www.nwfsc.gov/pubs/tm/tm187/Banks).
- Blankenship, H. L, D. A. Thompson, and S. Olhausen. 1998. Differential survival of ventral fin clip and adipose fin clips in fall chinook salmon (*Oncorhynchus tshawytscha*). Paper presented to the Mark Committee, Lewiston, Idaho, September, 1998.
- BPA (Bonneville Power Administration). 1993. Youngs Bay Salmon Rearing and Release Program, Final Environmental Assessment. DOE/EA-0852. U.S. Department of Energy, Bonneville Power Administration. Portland, Oregon. 25 pp.
- BPA (Bonneville Power Administration). 1995. Lower Columbia River Terminal Fisheries Research Project, Final Environmental Assessment. DOE/EA-1040. U.S. Department of Energy, Bonneville Power Administration. Portland, Oregon. 56 pp.
- Bradbury, B. and C. Pollino. 2002. Department of Fish and Wildlife: Hatchery cost effectiveness-state fiscal years 1994-1997. Secretary of State Audit Report No. 2002-39. (Revised issued September 3, 2003). Available at: [www.sos.state.or.us/audits/audreports/fullreports/2002-39.pdf](http://www.sos.state.or.us/audits/audreports/fullreports/2002-39.pdf)
- Carter, C. N., PhD. 1999. Draft Hatchery Program Review. Oregon Department of Fish and Wildlife, Portland, Oregon.
- Chilcote, M., C. Dale, K. Kostow, H. Schaller, and H. Weeks. 1992. Wild fish management policy. Oregon Department of Fish and Wildlife, Biennial Progress Report, Portland, Oregon. 31 pp.
- Beckman, B. R, W. W. Dickhoff, W. S. Zaug, et al. 1999. Growth, smoltification, and smolt-to-adult return of spring chinook salmon from hatcheries on the Deschutes River, Oregon. *Trans. Am. Fish. Soc.* 128:1125-1150.
- Emmett, R. L. and Oregon State University. Estuarine survival of salmonids: the importance of interspecific and intraspecific predation and competition. *In* Emmett, R.L., and M.H. Schiewe (editors). Estuarine and ocean survival of Northeastern Pacific salmon: Proceedings of the workshop. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NWFSC-29, 313 p.
- Ewing, R. D. and S. K. Ewing. 1995. Review of the effects of rearing density on survival to adulthood for pacific salmon. *Progressive Fish-Culturist* 57(1):1-25.
- Flagg T.A., B.A. Berejikian, J.E. Colt, W.W. Dickhoff, L.W. Harrell, D.J. Maynard, C.E. Nash, M.S. Strom, R.N. Iwamoto, and C.V.W. Mahnken. 2000. Ecological and behavioral impacts of artificial production strategies on the abundance of wild

- salmon populations. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-41, 92 p.
- Hirose, P., M. Miller, and J. Hill. 1996. Columbia River: Terminal Fisheries Research Report; 1994 annual report. Project 93-060 Annual Completion Report for the Bonneville Power Administration, Portland, Oregon. 151 pp.
- Hirose, P., M. Miller, and J. Hill. 1998. Columbia River: Select Area Fishery Evaluation Project; 1995-1996 annual reports. Project 93-060 Annual Completion Report for the Bonneville Power Administration, Portland, Oregon. 194 pp.
- IEAB (Independent Economic Analysis Board). 2002. Artificial production review – economic analysis Phase 1. Summary report on IEAB task 56 prepared for the Northwest Power Conservation Council, July 9, 2002. Available at: <http://www.nwcouncil.org/library/ieab/ieab2002-1.htm>
- Ledgerwood, R. D., B. A. Ryan, and R. N. Iwamoto. 2000. Estuarine and nearshore-ocean acoustic tracking of juvenile spring chinook salmon smolts from the Columbia River. Proceedings of the 3<sup>rd</sup> conference on fish telemetry in Europe, June 20-25, 1999, Norwich, UK, Centre for Environment, Fisheries, and Aquaculture Science, Lowestoft, UK.
- Levings, C. D., C. D. McAllister, and B. D. Chang. 1986. Differential use of the Campbell River estuary, British Columbia, by wild and hatchery-reared juvenile chinook salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences 43:1386-1397.
- Mantua, N. J., S. R. Hare, Y. Zhang, J. M. Wallace, and R. C. Francis. 1997. A Pacific interdecadal climate oscillation with impacts on salmon production. Bulletin of the American Meteorological Society 78:1069-1079.
- Maynard, D. J., T. A. Flagg, C. V. W. Mahnken, and S. L. Schroder. 1996. Natural rearing technologies for increasing post-release survival of hatchery-reared salmon. Bull. Natl. Res. Inst. Aquacult., Supplement 2:71-77.
- Maynard, D. J., J. L. Hackett, M. Wastel, A. L. LaRae, G. C. McDowell, T. A. Flagg, and C. V. W. Mahnken. 2001. The effect of automated sub-surface feeders on the behavior and predator vulnerability of fall chinook salmon. Proceedings of the 52<sup>nd</sup> Annual Pacific Northwest Fish Culture Conference 2001. Available at [www.nwr.noaa.gov/1habcon/habweb/caspiantern\\_references](http://www.nwr.noaa.gov/1habcon/habweb/caspiantern_references) .
- Miller, M., J. North, P. Frazier, T. Jones, A. Dietrichs, and T. Mieth. 2002. Select Area Fishery Evaluation Project. 1997-2000 Annual Completion Report for Project #199206000 prepared for the Bonneville Power Administration, Portland, Oregon. 94 pp.
- Myers, K. W., and H. F. Horton. 1982. Temporal use of an estuary by hatchery and wild juvenile salmon. Pages 377-392 in V. S. Kennedy (editor), Estuarine Comparisons. Academic Press. New York, NY.
- NMFS (National Marine Fisheries Service). 1998. Endangered Species Act – Section 7 consultation biological opinion. Impacts of select area fisheries enhancement project (SAFE) on salmon and steelhead species in the Columbia River Basin

- listed under the Endangered Species Act. NMFS, Northwest Region, Seattle, WA, 15 pp.
- NMFS (National Marine Fisheries Service). 2003a. Endangered Species Act (ESA) Section 7 consultation – Supplemental Biological Opinion. Supplemental Biological Opinion to the 2001 U.S. v. Oregon “Interim management agreement for upriver spring chinook, summer chinook, and sockeye on salmon and steelhead listed under the Endangered Species Act”, covering winter, spring, summer season treaty and ono-indian Columbia River Basin fisheries for 2003-2005. Consultation Number F/NWR/2003/00357. Issued July 11, 2003. NMFS, Northwest Region, Seattle, WA. 21 pp.
- NMFS (National Marine Fisheries Service). 2003b. Biological Opinion on impacts of treaty indian and non-indian fall season fisheries in the Columbia River Basin in year 2003, on salmon and steelhead listed under the Endangered Species Act. Consultation Number F/NWR/2003/00865. Issued July 30, 2003. NMFS, Northwest Region, Seattle, WA. 70 pp.
- NMFS (National Marine Fisheries Service). 2004. Endangered and threatened species: Proposed listing determinations for 27 ESU’s of West Coast salmonids; proposed rules. Federal Register Volume 69, Number 113. 79 pp. Available at <http://www.nwr.noaa.gov/reference/frn/2004/69FR33101.pdf>
- ODFW (Oregon Department of Fish and Wildlife). 2000. Fishery management and evaluation plan: upper Willamette River spring chinook in freshwater fisheries of the Willamette Basin and lower Columbia River mainstem. Oregon Department of Fish and Wildlife, Portland, Oregon.
- ODFW and WDFW. 2000. Status Report: Columbia River fish runs and fisheries, 1938-1999. Joint staff report of the Oregon Department of Fish & Wildlife (ODFW) and the Washington Department of Fish & Wildlife (WDFW), Clackamas, OR; Vancouver, WA.
- ODFW and WDFW. 2001. Joint staff report concerning the 2001 in-river commercial harvest of Columbia River fall chinook, summer steelhead, coho salmon and sturgeon. Oregon Department of Fish & Wildlife (ODFW) and Washington Department of Fish & Wildlife (WDFW), Clackamas, OR; Vancouver, WA. August 2, 2001.
- ODFW and WDFW 2003. ESA Section 7/10 application for the incidental take of listed species in Washington and Oregon select area fisheries of the lower Columbia River. Draft Biological Assessment report submitted to NOAA Fisheries, December 2003.
- Olla, B. L. and M. W. Davis. 1989. The role of learning and stress in predator avoidance of hatchery-reared coho salmon (*Oncorhynchus kisutch*) juveniles. *Aquaculture* 76:209-214.
- Senn, H., J. Mack, and L. Rothfus. 1984. Compendium of low-cost Pacific salmon and steelhead trout production facilities and practices in the Pacific Northwest. Project 83-353 Final Completion Report for the Bonneville Power Administration, Portland, Oregon. 488 pp.

- Whale, R. J. and R. R. Vreeland. 1978. Bioeconomic contribution of Columbia River hatchery fall chinok salmon, 1961 through 1964 broods, to the Pacific salmon fisheries. Fishery Bulletin 76(1):179-208.
- Williams, J., G. Matthews, J. Meyers, S. G. Smith, T. Cooney, and C. Toole. 1988. Hatchery extra mortality hypothesis. WOE Appendix Submission 1. June 30, 1998.
- Zenn, D., F. Anderson, M. Dahlstrom, M. Mock, P. Trask, J. Marsh, and M. Daigneault. 2004. Mainstem lower Columbia River and Columbia River estuary subbasin plan: Management Plan Supplement. Report prepared for the Northwest Power Conservation Council, May 2004. Available at:  
[http://www.nwcouncil.org/fw/subbasinplanning/lowerColumbia/plan/BiState/Chapter/205\\_CRE-LCR\\_Management/20Plan/20Supplement.pdf](http://www.nwcouncil.org/fw/subbasinplanning/lowerColumbia/plan/BiState/Chapter/205_CRE-LCR_Management/20Plan/20Supplement.pdf))