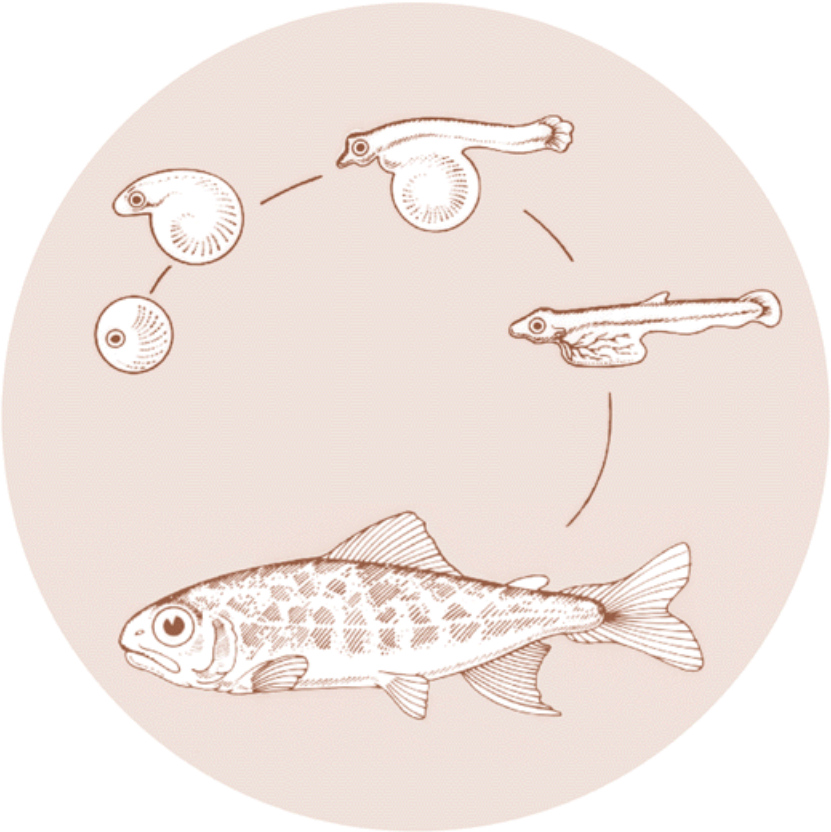
January 1997

EVALUATION OF 1991 - 1992 BROOD OVER WINTER-REARED COHO RELEASED FROM NET PENS IN YOUNGS BAY, OREGON

Youngs Bay Terminal Fishery Project

Final Completion Report



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EVALUATION OF 1991 – 1992 BROOD OVER WINTER-REARED COHO RELEASED FROM NET PENS IN YOUNGS BAY, OREGON

Youngs Bay Terminal Fishery Project

Final Completion Report

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ABSTRACT

The Youngs Bay Terminal Fisheries Project responds to amendment measures IV(B)(S)(b) and 5.3.C. in the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program. Funding from Bonneville Power Administration was provided to the Oregon Department of Fish and Wildlife and the Clatsop County Economic Development Council's Fisheries Project to identify and develop terminal fishing opportunities.

The 1991 and 1992 brood fingerling coho from Oregon Department of Fish and Wildlife hatcheries were successfully reared during the winter period to smolt stage in Youngs Bay utilizing floating net pens. Rearing mortality was extremely low for both broods. Attainment of 10 fish per pound target release size was nearly met for the 1991 brood and met for a similar timed release for the 1992 brood. The target release size was not attained for an earlier timed release.

Based on coded-wire-tag recoveries during 1991-93 from 2-week net-pen acclimation releases, total accountability of coho adult; averaged 40,540 fish, with the Youngs Bay commercial harvest accounting for 39%. With reduced ocean harvest impacts during 1994 and 1995, 92% of 51,640 coho in 1994 and 68% of 23,599 coho in 1995 (based on coded-wire-tag recoveries) were accounted for in the Youngs Bay commercial fishery for combined 2-week and overwinter acclimation net-pen releases. Overwinter net-pen acclimation coho accounted for 35,063 and 15,775 coho adults in 1994 and 1995 with 93% and 68% accountable in the Youngs Bay commercial harvest.

Based on coded-wire-tag recoveries, less than 1% of the adults resulting from releases at Youngs Bay net pens strayed to hatcheries, while none were recovered on spawning ground surveys during 1991-95.

The highest survival rates were observed for 1991 and 1992 brood overwinter coho released in early May. Time of release, not rearing strategy, appears to be the determining factor affecting survival in Youngs Bay. Low survival rates were observed for 1992 brood early April releases of overwinter, 2-week, and hatchery coho released into Youngs Bay. Bird predation during the spring smolt release period is a significant factor affecting survival. Disruption of bird foraging activity by the commercial fleet during early May spring fisheries in 1993-94 could have improved survival rates for overwintered coho during May.

Survival rate comparison of over-winter, 2-week, and source-hatchery-released coho show that; (1) for 2-week acclimation coho survival rates are consistently better than source-hatchery coho; (2) overwinter and 2-week acclimation strategies show no distinct differences; (3) it is premature to quantify differences in survival rates between overwinter and source-hatchery releases; and (4) a survival advantage is apparent for Youngs Bay net-pen-released coho compared to traditional hatchery releases.

For net-pen coho released into Youngs Bay, extremely low rates of straying are observed for returning adults, with no differences in straying rates between 2-week and overwinter-acclimation groups. Extensive spawning ground surveys conducted during October-December in 1994 and 1995 in the Necanicum River, Ecola Creek, and Youngs Bay tributaries resulted in an absence of fin-marked coho observed and no coded-wire tags recovered.

INTRODUCTION

Columbia River terminal fisheries have been conducted in Youngs Bay, Oregon, since the early 1960s, targeting coho salmon returning to the Oregon Department of Fish and Wildlife's (ODFW) Klaskanine Hatchery on the North Fork Klaskanine River. Beginning in 1977, the Clatsop County Economic Development Council's (CEDC) Fisheries Project has augmentad juvenile coho releases, and in recent years, has been the major contributor of coho returns to Youngs Bay. In 1987, CEDC first introduced the use of net pens for rearing juvenile salmon at Tide Point in Youngs Bay (Figure 1). In the initial year of the program, three pens were used, with 32 pens in place during 1990-92.

The successful 2-week acclimation program for 1988-90 brood coho (1991-93 adult return years) has been the impetus for accelerating further research efforts in the Youngs Bay net-pen program. The Youngs Bay Terminal Fishery Project (YBTFP) began with meetings between Bonneville Power Administration (BPA), ODFW, CEDC, Salmon for All (SFA), and local fishing industry representatives. The YBTFP responds to amendment measures IV(B)(S)(b) and 5.3.c. in the Northwest Power Planning Council's (NPPC) amended Fish and Wildlife Program, which call for the creation of terminal fishing opportunities to reduce main-stem Columbia River harvest pressure on depressed Columbia River basin salmon stocks (NPPC 1991 ,1992).

The specific scope of the YBTFP was to evaluate the effects of overwinter rearing of coho salmon in net pens, with comparisons to the 2-week acclimation program presently in place, and releases from selected hatchery facilities. Upon return as adults, survival, catch contribution and distribution, and, straying information were the most important findings of this project. This pilot study is the initial component in another longer term study to evaluate potential methods and sites that could lead to substantial terminal harvest opportunities and afford protection to depressed upriver salmon stocks.

METHODS AND MATERIALS

Study Area

Youngs Bay, Oregon, is located west of Astoria and south of the Columbia River ship channel near river mile 12. Water surface area for the harvest area, which extends from the Highway 101 bridge up to markers at Battle Creek Slough, is estimated to be about 4.46 sq. mi. (Bruce Fisher, United States Geological Survey, Water Resources Division) using Global Information System technology. At extreme low tidal stage, extensive tidelands are exposed. Flushing action is quite strong in Youngs Bay. Maximum water velocities of 1.20 knots at flood tide and 0.91 knots at ebb tide were measured at the Tide Point net-pen site. Since water quality monitoring is not a requirement of the net-pen permitting process, very limited water quality information is available for Youngs Bay (Hirose, Miller, Hill, 1996). Plans to monitor waterquality in Youngs Bay is in progress as part of the current Lower Columbia River Terminal Fisheries Research Project funded by BPA. Physiochemical data is being collected using a multiparameter water testing device and benthic biomonitoring is being conducted using a ponar grab sampler.

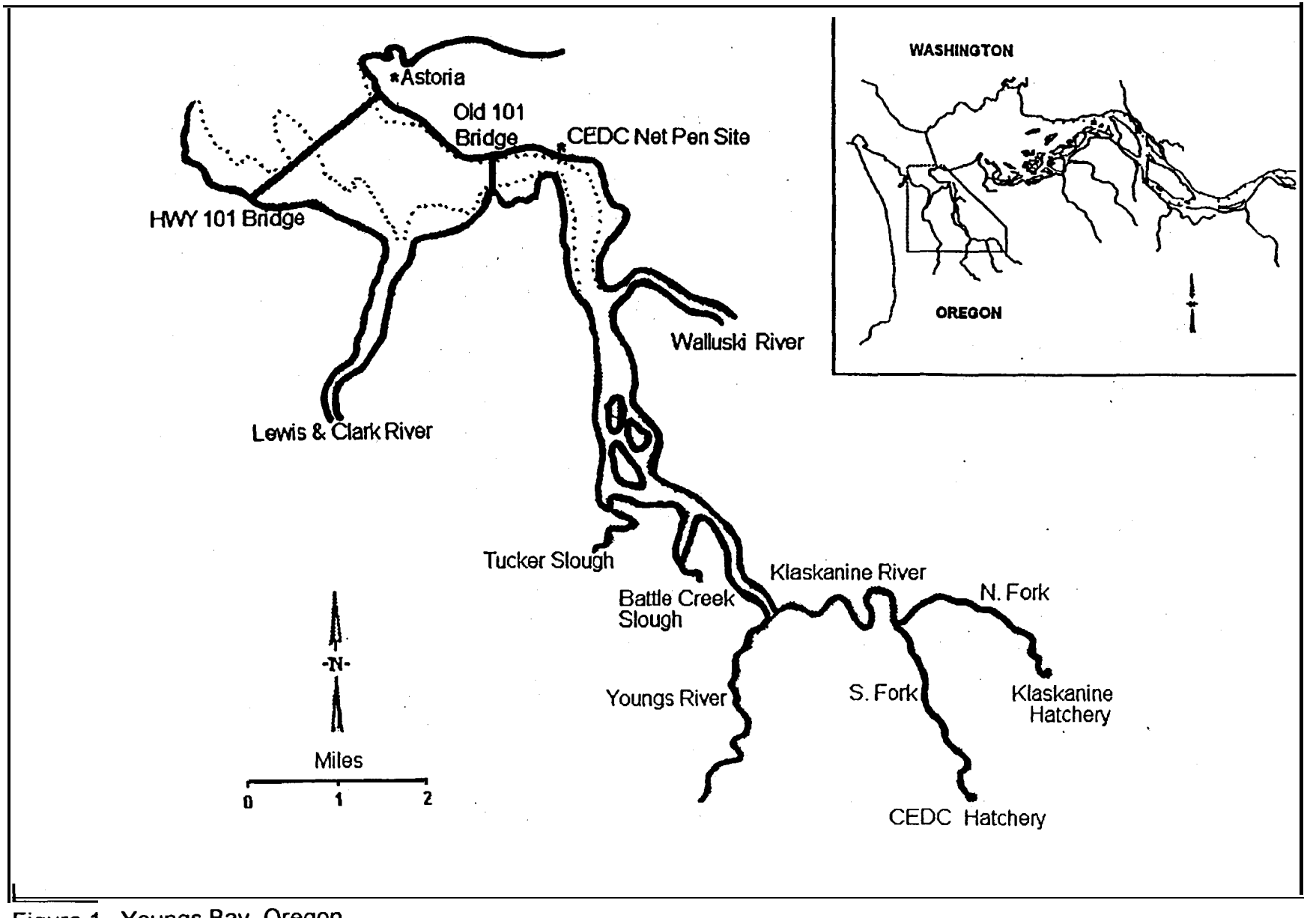


Figure 1 Youngs Bay, Oregon

Net-Pen Description

The design of the net pens has evolved from ideas gained from an initial visit by CEDC fisheries project staff to the National Marine Fisheries Service's research project at Manchester, Washington, on the Puget Sound. The present net pen uses a frame of plastic pipe of 13 inches in diameter, filled with Styrofoam for floatation. The inside dimension of the frame is 20 feet square. A wooden walkway is bolted to the outside perimeter of the frame. Within the frame, a IO-foot deep net is secured, which is held in place by 14-18 plastic standpipes that maintain the structural integrity of the net during periods of tidal currents (Figure 2). The rearing volume is about 3,200 cu ft. As of spring 1993, a total of 72 net pens was in place at Tide Point, which includes an additional 40 pens installed specifically for the overwintering experiments. The CEDC project is located on state-owned submerged lands adjacent to a privately owned grocery-marine supply business. The pens are attached to pilings along the adjacent shoreline on the edge of a deep area of the estuary leading out through a channel to the Columbia River.

Experimental Design

Early stock coho for this study were obtained from ODFW hatcheries. The 1991 -brood coho transfers consisted of two planned groups; (1) 560,000 who @ 90 fish/lb transferred from Oxbow Hatchery to McKenzie Hatchery, then transferred to Youngs Bay in November 1992 at a size of 30 fish/lb and (2) 825,000 coho transferred from Oxbow Hatchery @ 30 fish/lb to Youngs Bay in November 1992. The first group was scheduled for release in April 1993 at a target size of 10 fish/lb. The second group was also scheduled to be released in April 1993; however, at 12 fish/lb. Both groups were to be coded-wire tagged (CWT) with 25,000 for each group.

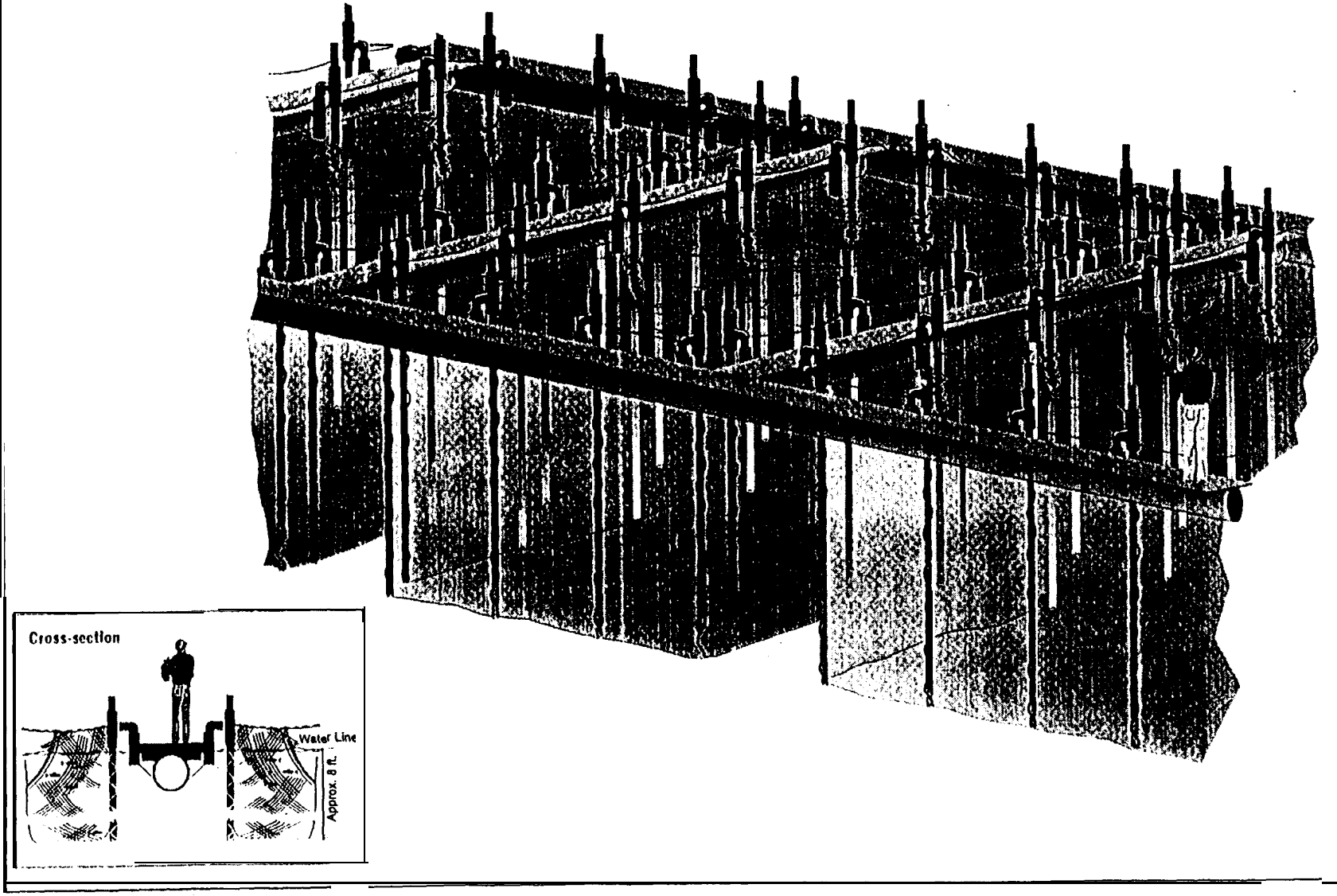
The 1992 brood coho, reserved for this study, also consisted of two planned groups; (1) 300,000 coho from Oxbow Hatchery transferred to Youngs Bay net pens @ 26 fish/lb. in November 1993, reared to a size of 10 fish/lb, and released in the spring 1994 and (2) 825,000 coho from Oxbow Hatchery transferred to Youngs Bay net pens @ 34 fish/lb. in December 1993, reared to 10 fish/lb, and released in spring 1994.

Rearing density of 0.75 pounds of fish per cubic feet of rearing space selected for this study is based on experience gained from previous experiments with coho in Youngs Bay. Anticipating a target release of 10 fish per pound, and given a rearing volume of 3,200 cubic feet, and a rearing density of 0.75 pounds per cubic foot, the rearing capacity for a single net pen would be 24,000 smolts.

Adult survival rates were to be calculated by accumulating all CWT recoveries in fisheries and escapement areas coastwide using the Pacific States Marine Fisheries Commission (PSMFC) Mark Recovery computerized CWT database. Expanded CWT recoveries are calculated based on systematic random sampling of fisheries. Survival rate comparisons of overwinter-reared coho to short-term, 2-week acclimation coho released from net pens in Youngs Bay could be evaluated since all releases of 2-week acclimation coho are represented by CWT groups. Further comparisons will be made to releases from production groups at selected facilities.

To evaluate the possibility of straying of adults resulting from 1991 and 1992 brood coho overwintered and released from Youngs Bay net pens, stream surveys during October-December were scheduled in the Necanicum River and Ecola (Elk) Creek drainages. Viable wild coho populations exist in these Oregon north coast streams and maintaining genetic integrity of these populations is high priority.

Figure 2
Isometric illustration of a net pen.



To assure thorough coverage of the spawning areas for coho, a stream surveyor was employed in 1994 and 1995 to supplement the work routinely done during annual spawning surveys in the Necanicum and Ecola drainages to estimate Oregon coastal natural coho spawning populations.' In addition, surveys in Youngs Bay tributaries were conducted by the project surveyor as time permitted. Specific instructions for the project surveyor were to enumerate spawners, collect biological information from carcasses, and examine all fish for fin clips and presence of CWTs. Estimates and origin of strays were to be based on recoveries of CWTs.

Evaluation of straying rates of YBTFP coho releases with 2-week acclimation and traditionally released coho from facilities in Youngs Bay at North Fork Klaskanine Hatchery (NFKH) and South Fork Klaskanine Hatchery (SFKH) are to be accomplished using recoveries of CWTs from all known escapement areas.

RESULTS

Rearina and Release of 1991 Brood Coho

During the period November 4, 1992 to January 25, 1993, approximately 1,334,400 coho fingerings were received from ODFW's McKenzie and Oxbow hatcheries. Approximately 506,500 fingerlings were transferred from McKenzie Hatchery at a size of 28 fish per pound during November 4-5, 1992. The first group of 414,500 fingerlings from Oxbow arrived on November 5-6, 1992 at 36 fish per pound followed by a second group of 413,400 fingerlings transferred on January 12-25, 1993 at 29 fish per pound. The fingerlings were distributed equally among 48 net pens with a target size of 10 fish per pound at release.

Scheduled release during April was delayed until early May after issuance of the final environmental assessment for the Youngs Bay Salmon Rearing and Release Program required by the National Environmental Policy Act (NEPA) and a resulting Finding of No Significant Impact (FONSI) on April 30, 1993 (BPA, 1993). The Oxbow group was released on May 3, 1993, and the McKenzie group was released on May 4, 1993, (Table 1). The target release size of 10 fish per pound was nearly met. No major problems were encountered during the rearing period and only 0.4% mortality was observed during the winter rearing period. During May, after the release dates, thousands of cormorants were observed feeding in the Youngs Bay estuary (Jim Hilt, personal communication, 1993). Beginning in June cormorant forages diminished.

Table 1. Releases of Overwinter-Reared Coho from Youngs Bay Net Pens, 1991 and 1992 Broods.

Brood	Release Date	Group	Number Released	Number CWTS	Size <Fish/Lb.)	Rearing Density (Lbs. /Ft^3)	Taa Code
1991	5/3/93	Oxbow	825,810	25,642	11.7	0.75	7-61-28
1991	5/4/93	McKenzie	502,918	19,776	11.3	0.75	7-59-52
1992	4/4/94	Oxbow	827,864	50,745	13.87	0.67	7-61-42
1992	5/2/94	Cascade	300,907	27,869	9.85	0.95	7-01-24

Rearina and Release of 1992 Brood Coho

During the period November 18 through December 2, 1993, 301,164 coho fingerlings were transferred from the ODFW's Cascade Hatchery to 10 net pens in Youngs Bay at about 26 fish per pound. During November IO-I 7, 1993, 828,239 coho fingerlings were transferred from ODFW's Oxbow Hatchery to 28 Youngs Bay net pens at about 34 fish per pound.

Target release size for both groups of 1992 brood who was 10 fish per pound. The Cascade group released on May 2, 1994, attained a size of 9.85 fish per pound, however the Oxbow group was released at 13.87 fish per pound. The fingerlings were received at a small size of 34 fish per pound and could not attain the target size by early May. A release date of April 4, 1994, was chosen with the intent of providing a comparison of the Oxbow overwinter group with 2-week net-pen acclimation using Eagle Creek stock and a normal hatchery release from SFKH all with a common April 4, 1994 release date.

As with the 1991 brood, no problems were noted during the winter rearing'period and minimal mortality of 0.03% was realized. Cormorants again were present in large numbers, especially in May (Jim Hill, personal communication 1994).

Contribution and Distribution

Total accountable coho adults resulting from net-pen releases have averaged 40,540 fish during 1991-93 with 2-week acclimation releases, and 51,640 fish and 23,599 fish in 1994 and 1995 with over-winter and 2-week acclimation strategies (Figure 3). During the same period the aggregate ocean harvest rate for early-stock coho in the Oregon Production Index Area (Leadbetter Point, WA to Mexico) averaged 40% during 1991-93 when limited ocean fisheries were allowed, 2% in 1994 with no ocean target coho fishing allowed, and 17% with only minor ocean harvest allowed in the area adjacent to the mouth of the Columbia River.

Youngs Bay commercial harvest has accounted for only 39% of the total adult production from net-pen releases during 1991-93. When ocean and Columbia River mainstem harvests have been restricted, the majority of the adult production has been accountable in the Youngs Bay terminal fishery with 92% in 1994 and 68% in 1995.

Total adult production from overwinter-rearedcoho resulted in 35,063 coho in 1994 and 15,775 coho in 1995 (Table 2). The Youngs Bay terminal gill-net fishery accounted for the majority of the production with 32,597 coho (93%) in 1994 and 10,775 coho (68%) in 1995.

Very few adults from net-pen releases are accountable in escapement areas. Based on CWT recoveries hatcheries have accounted for less than 1% of the Youngs Bay net-pen adult production annually. Spawning ground accountability during 1991-95 for both 2-week and overwinter acclimation releases has been zero based on CWT recoveries. Over 99% of the adult coho accountable from the Youngs Bay net-pen program annually during 1991-95 were harvested in mixed-stock ocean fisheries from California to British Columbia, Columbia River main-stem fisheries, and Youngs Bay terminal fisheries.

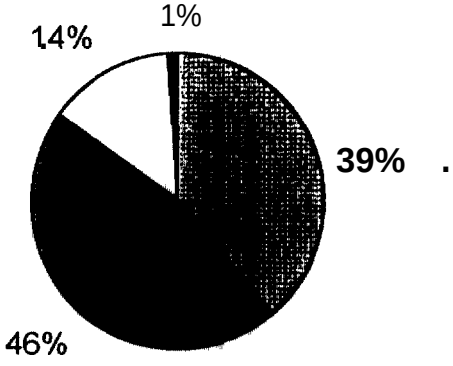
FIGURE 3. TOTAL ACCOUNTABILITY OF YOUNGS BAY NET-PEN-REARED COHO, 1991-95

Ocean Harvest Rate

Youngs Bay Adult Production

1991-93 TWO-WEEK ACCLIMATION

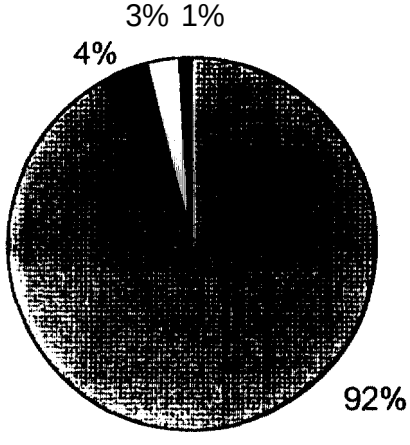
40%



40,540

1994 TWO-WEEK AND OVERWINTER ACCLIMATION

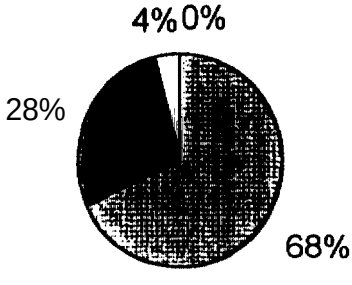
2%



51,640

1995 TWO-WEEK AND OVERWINTER ACCLIMATION

17%



23,599

- Youngs Bay Harvest
- Ocean Harvest
- Col. R. Mainstem Harvest
- Hatchery Escapement

Table 2. Estimated Numbers of Coho Adults Accountable in Fisheries and Escapement from Youngs Bay 2-Week and Overwinter Acclimation Net-Pen Releases by Adult Recovery Year, 1991-95.

	Adult Recovery Year						
	2-Week			1994		1995	
Recovery Area	1991	1992	1993	2-Wk.	Overwinter	2-Wk.	Over-winter
Ocean Fisheries							
California	6,525	238	898	789	822	0	72
Oregon	16,119	10,605	1,816	0	0	609	1,007
Washington	12,772	2,678	3,127	32	192	1,635	2,906
British Columbia	1,109	583	568	0	0	0	345
Subtotal	36,525	14,104	6,409	821	1,014	2,244	4,330
Columbia River							
Buoy 10	4,435	3,866	1,775	258	602	288	647
Gill Net	3,646	778	898	64	466	0	43
River Sport	0	0	0	0	137	0	0
Subtotal	8,081	4,644	2,673	322	1,205	288	690
Terminal							
Youngs Bay Net	33,148	8,631	7,057	15,273	32,597	5,292	10,755
Youngs Bay Sport	0	0	0	48	55	0	0
Hatcheries	128	108	114	113	192	0	0
Spawning Ground	0	0	0	0	0	0	0
Subtotal	33,276	8,739	7,171	15,434	32,844	5,292	10,755
GRAND TOTAL	77,882	27,487	16,253	16,577	35,063	7,824	15,775

Survival Rates of Youngs Bay Releases

Survival rates of 3.11% and 2.44% for 1991 brood coho were observed for age 3 adults that were over-winter-reared in net pens and released on May 3 and 4, 1993 (Table 3). All other releases of coho in 1993 into Youngs Bay produced adult survival rates less than 1%, except for a release on May 5, 1993, of a 2-week acclimation group that produced an adult survival rate of 2.29%. Although the overwinter-reared groups' survival rates ware the highest observed for all other releases into Youngs Bay, there may have been a narrow window of release timing in early May that was conducive to optimal smolt survival.

For the 1992 brood, adult survival rates of 0.37% for an April 4, 1994, release and 3.27% for the release on May 2, 1994, ware observed for overwinter-reared coho. All other adult survival rates for Youngs Bay releases were less than 1%. On April 4, 1994, a group of 2-week acclimation coho and the SFKH production group were released and their adult survival rates upon return were nearly identical to the over-wintered group released on April 4, 1994. Size at release for the April 4, 1994, net-pen-released coho was similar at 33 and 31 grams, while SFKH coho were slightly larger at 38 grams. The relatively high survival rate observed for the May 2, 1994, release of overwintered coho from net pens is similar to results observed for the 1991 brood. Again, a narrow window of optimal smolt survival may have been a factor. Also, a contributing factor to the high survival of this group was attaining the goal for size at release of 46 grams, which was the largest size for all releases in Youngs Bay.

The narrow time of release window for optimum smolt survival may be related to a reduction in bird predation during early May resulting from the activity of the fishing fleet during the spring gill-net season in Youngs Bay. Thousands of comorants have been observed on early morning foraging flights in Youngs Bay, especially in the proximity of the net pens and coinciding with periods when coho smolts have been released from the north and south forks of the Klaskanine River. Open commercial fishing periods of May 3-5, 1993, and May 24, 1994, resulted in about 70 gillnetters and 30 gillnetters on the bay. Highest survival rates for 1991 and 1992 brood coho have been observed for those releases in early May.

Table 3. Adult Survival Rates for Coho Released into Voungs Bay, 1988-92 Brood Years.

Brood	Production Component	Taa Code	Survival (%)	Release Date	Size (gm)	Stock
1988	Net Pen (2-wk accl.)	7-43-07	7.83	5/14-18/90	35	Eagle Cr.
	Net Pen " "	7-43-08	7.49	5/14-18/90	35	Eagle Cr.
	S.F. Klaskanine	7-51-28	5.20	5/13/90	39	Sandy/Tanner Cr. /Klask.
	N.F. Klaskanine	7-42-19	4.56	5/16-23/90	35	Klaskanine
	N.F. Klaskanine	7-42-20	4.90	5/19-23/90	35	Klaskanine
	N.F. Klaskaniue	7-42-21	4.73	5/16-23/90	35	Klaskanine
1989	Net Pen (2-wk accl .)	7-55-59	0.87	4/18/91	29	Eagle Cr.
	Net Pen " "	7-55-54	0.81	5/6/91	29	Eagle Cr.
	Net Pen " "	7-55-58	1.06	5/16/91	30	Eagle Cr.
	Net Pen " "	7-55-55	1.84	5/31/91	34	Eagle Cr.
	S.F. Klaskanine	7-55-48	0.52	5/8/91	35	Sandy
	N.F. Klaskanine	7-45-17	1.54	5/7/91	40	Klaskanine
	N.F. Klaskanine	7-45-18	1.48	5/7/91	40	Klaskanine
	N.F. Klaskanine	7-42-22	1.39	5/7/91	40	Klaskanine

Table 3. Continued

Brood	Production Component	Taa Code	Survival (%)	Release Date	Size (gm)	Stock
1990	Net Pen (2-wk accl.)	7-57-12	1.90	4/13/92	33	Klaskanine/Eagle Cr.
	Net Pen " "	7-54-55	2.77	4/15/92	69	Klaskanine
	Net Pen " "	7-57-14	1.07	5/12/92	30	Big Cr./Eagle Cr.
	Net Pen " "	7-57-13	0.13	5/27/92	20	Kalama/Eagle Cr.
	Net Pen " "	7-44-11	0.04	6/2/92	33	Sandy
	Net Pen " "	7-57-15	0.03	6/10/92	29	Sandy/Eagle Cr.
	S.F. Klaskanine	7-57-21	2.89	4/16/92	40	Klaskanine
	N.F. Klaskanine	7-45-20	0.44	5/11/92	33	Klaskanine
	N.F. Klaskanine	7-46-44	0.33	5/11/92	33	Klaskanine
	N.F. Klaskanine	7-46-45	0.33	5/11/92	33	Klaskanine
1991	Net Pen (overwinter)	7-59-52	2.44	5/4/93	40	Tanner Cr.
	Net Pen "	7-61-28	3.11	5/3/93	39	Tanner Cr.
	Net Pen (2-wk accl.)	7-61-11	0.67	4/8/93	41	Klaskanine
	Net Pen " "	7-60-14	2.29	5/5/93	36	Eagle Cr.
	Net Pen " "	7-60-15	0.42	5/24/93	29	Eagle Cr.
	Net Pen " "	7-61-29	0.79	6/1/93	30	Eagle Cr.
	Net Pen " "	7-61-30	0.23	6/8/93	31	Eagle Cr.
	S.F. Klaskanine	7-14-28	0.63	4/16-30/93	32	Klaskanine
	N.F. Klaskanine	7-48-32	0.32	5/10-16/93	33	Klaskanine
1992	Net Pen (overwinter)	7-61-42	0.37	4/4/94	33	Tanner Cr.
	Net Pen "	7-01-24	3.27	5/2/94	46	Tanner Cr.
	Net Pen (2-wk accl.)	7-01-35	0.39	4/4/w	31	Eagle Cr.
	Net Pen " "	7-01-36	0.61	5/9-6/15/94	33	Eagle Cr.
	S.F. Klaskanine	7-61-45	0.53	4/4/94	38	Klaskanine
	N.F. Klaskanine	7-03-62	0.32	4/15/94	37	Klaskanine

Survival Rates of Overwinter vs. 2-Week Acclimation vs. Source Hatchery

For the 1988-92 broods, comparisons of 2-week acclimation releases in Youngs Bay with on-station releases at Eagle Creek National Fish Hatchery (ECNFH) are displayed in Table 4. Although, a direct comparison of survival rates is not possible with differences in general release location, dates, size, and stock, it can be said that survival rates observed for 2-week acclimation coho have at least equaled and on average exceeded survival rates observed for coho at ECNFH.

For the 1991 and 1992 broods, survival rate comparisons are displayed for over-winter acclimation with on-station releases at Bonneville Hatchery and 2-week acclimation. For 1991 brood overwinter-acclimation coho (Tanner Creek stock) averaged 2.78% adult survival, while the on-station releases at Bonneville Hatchery averaged 2.33%. Average adult survival for 2-week acclimation (Eagle Creek stock) was only 0.88%, slightly better than the average adult survival rate of 0.33% for ECNFH.

The 1992 brood ovewinter-acclimation coho averaged 1.82%; however, very dissimilar survivals were observed for the April (0.37%) and May (3.27%) groups. Observed survival rates at Bonneville Hatchery averaged 0.62%. The 1992 brood, 2-week acclimation who averaged only 0.50%, very similar to control releases at ECNFH (0.44%).

To address the question of differences in survival rates for overwinter vs. 2-week acclimation coho, the early May release groups for the 1991 brood and the April 4 release groups for the 1992 brood were selected. Similar survival rates were observed for both brood comparisons, with no distinct advantage apparent for either rearing strategy.

To address the question of differences in overwinter acclimation vs. on-station, source-hatchery survival rates are more difficult and will not be attempted. As with survival comparisons of 2-week acclimation with source-hatchery releases, differing location, release timing, and size at release are factors that prohibit direct comparisons. General comparisons of survival rates may be possible with inclusion of more years in the data set.

Average survival rates for either net-pen rearing strategy have exceeded those observed at source hatcheries for all brood years, 1988-92. Although quantifying the difference would require several caveats, a survival advantage was consistently observed for both Youngs Bay net-pen rearing and release strategies.

Table 4. Comparison of Adult Survival Rates for Coho Released from Eagle Creek National Fish Hatchery and Bonneville Hatchery to Net-Pen Acclimated Coho Released into Young Bay, 1988-92 Broods.

Brood	Rearing Program	Release Site	Date	Size (gm)	Stock	Adult Survival Rates: By Release Group (%)	Adult Survival Rates: Average (%)
1988	2-wk acclimation	Youngs Bay Net Pen	5/14-18/90	35	Eagle Cr.	7.66	7.66
	Hatchery	Eagle Creek NFH	4/27/90	34	Sandy	5.22	
		" " "	5/1/90	32	Eagle Cr.	2.40	3.81
1989	2-wk acclimation	Youngs Bay Net Pen	4/18/91	29	Eagle Cr.	0.87	
		" " " "	5/6/91	29	" "	0.81	
		" " " "	5/16/91	30	" "	1.06	
		" " " "	5/31/91	34	" "	1.84	1.15
	Hatchery	Eagle Cr. NFH[1]	4/23/91	31	Eagle Cr.	0.85	
		" " " [1]	4/25/91	31	" "	0.96	0.91
1990	2-wk acclimation	Youngs Bay Net Pen	4/13/92	33	Klask./Eagle Cr.	1.90	
		" " " "	5/12/92	30	Big Cr./Eagle Cr	1.07	
		" " " "	5/27/92	20	Kalama/Eagle Cr.	0.13	
		" " " "	6/2/92	33	Sandy	0.04	
		" " " "	6/10/92	29	Sandy/Eagle Cr.	0.03	0.63
	Hatchery	Eagle Creek NFH	4/10/92	21	Sandy	0.06	
		" " "	4/10/92	30	Eagle Cr.	0.17	0.12
1991	Overwinter	Youngs Bay Net Pen	5/3/93	39	Tanner Cr.	3.11	
		" " " "	5/4/93	40	" "	2.44	2.78
	Hatchery	Bonneville Hatchery	5/17/93	32	Tanner Cr.	2.58	
		" "	6/8/93	33	" "	2.09	2.33
	2-wk acclimation	Youngs Bay Net Pen	4/8/93	41	Klaskanine	0.67	
		" " " "	5/5/93	36	Eagle Cr.	2.29	
		" " " "	5/24/93	29	" "	0.42	
		" " " "	6/1/93	30	" "	0.79	
		" " " "	6/8/93	31	" "	0.23	0.88
	Hatchery	Eagle Creek NFH	4/22/93	29	Eagle Cr.	0.34	
		" " "	4/30/93	32	" "	0.33	0.33

Table 4. Continued.

Brood	Rearing Program	Release Site	Date	Size (gm)	Stock	Adult Survival Rates: By Release Group (%)	Adult Survival Rates: Average (%)
1992	Ovetwinter	Youngs Bay Net Pen	4/4/94	33	Tanner Cr.	0.37	
		" " " "	5/2/94	46	" "	3.27	1.82
	Hatchery	Bonneville Hatchery	4/19/94	29	Tanner Cr.	0.30	
			s/31/94	38	" "	0.93	0.62
	2-wk Acclimation	Youngs Bay Net Pen	4/4/94	31	Eagle Cr.	0.39	
		" " " "	5/9-6/15/94	33	" "	0.61	0.50
	Hatchery	Eagle Creek NFH	4/22-29/94	37	Eagle Cr.	0.46	
		" " "	5/9/94	32	" "	0.42	0.44

[1] 1989 brood Eagle Creek survival rate estimates include releases of 3,712 and 3,711 Ad+CWT coho at a size of 46 gm released on 5/16/91 for tag retention check. Since the releases on 5/16/91 represent 13% of the total Ad+CWT releases and since both size and time differ significantly from the production release, survival rate comparison to net pen fish needs to account for this "difference."

Straying of Net-Pan and Younas Bav Hatchery Coho

Youngs Bay coho have shown extremely high homing instincts. For 1988-92 broods, CWT recoveries accountable in escapement areas are documented for adult coho destined for SFKH, NFKH, and Tide Point net-pen facilities (Table 5). For purposes of this analysis., Youngs Bey gill-net recoveries are included as escapement with potential for intercepting coho straying to escapement areas within the bay, The recoveries to escapement areas outside of Youngs Bay are not affected by the harvest in the bay.

A straying rate of 1.7% is calculated for adult coho destined for SFKH, with the majority of stray recoveries from NFKH. Recoveries outside of Youngs Bay vvere from Big Creek Hatchery (6) and Grays River spawning grounds (1).

An identical straying rate of 1.7% is calculated for NFKH, with recoveries from SFKH (2) and Lewis and Clark spawning ground survey (2) within Youngs Bay, nine recoveries from Big Creek Hatchery, and a single recovery from a spawning ground survey on the Rogue River on the south coast of Oregon.

Stray recoveries from net-pen production have resulted in the lowest rate (0.6%) of all production components in the bay calculated with the largest number (5,731) of escapement recoveries. No significant differences in straying rates are apparent between 2-week and overwinter acclimation programs, All recoveries of strays were from hatcheries: NFKH (15) and SFKH (2) in Youngs Bay; Big Creek (14), Grays River (I), Kalama (1, and Lewis River (1) in the lower Columbia River; and Fall Creek (1) and Salmon River (1) on the Oregon coast.

Table 5. Escapement Accountability of Adult Coho Resulting from Releases at S.F. Klaskanine Hatchery, N.F. Kleskanine Hatchery, and Youngs Bay Net Pen Site, 1988-92 Broods.

Brood	Site of Release	CWT Escapement Recoveries Total	Y.B. Net + Hatch.	Strays	Location of Strays
1988	S.F. Klaskanine H.	453	447 (98.7%)	6 (1.3%)	(1) N.F. Klaskanine Hatch. (4) Big Cr. Hatchery (1) Grays R. spawn. grd.
1989	S.F. Klaskanine H.	41	38 (92.7%)	3 (7.3%)	(2) N.F. Klaskanine Hatch. (1) Big Cr. Hatchery
1990	S.F. Klaskanine H.	344	33s (97.4%)	9 (2.6%)	(8) N.F. Klaskanine Hatch. (1) Big Cr. hatchery
1991	S.F. Klaskanine H.	169	169 (100.0%)	0	
1992	S.F. Klaskanine H.	100	99 (99.0%)	1 (1.0%)	(1) Lewis & Clark spawn. grd.
1988-92	S.F. Total	1,107	1,088 (98.3%)	19 (1.7%)	(11) N.F. Klaskanine Hatch. (6) Big Cr. Hatchery (1) Grays R. spawn. grd. (1) Lewis & Clark spawn. grd.
1988	N.F. Klaskanine H.	494	490 (99.2%)	4 (0.8%)	(2) Lewis & Clark spawn. grd. (1) Big Cr. Hatchery (1) Rogue R. spawn. grd.
1989	N.F. Klaskanine II.	170	163 (95.9%)	7 (4.1%)	(2) S.F. Klaskanine Hatch. (5) Big Cr. Hatchery
1990	N.F. Klaskanine H.	48	47 (97.9%)	1 (2.1%)	(1) Big Cr. Hatchery
1991	N.F. Klaskanine H.	73	71 (97.3%)	2 (2.7%)	(2) Big Cr. Hatchery
1992	N.F. Klaskanine H.	62	62 (100%)	0	
1988-92	N.F. Total	a47	a33 (98.3%)	14 (1.7%)	(2) S.F. Klaskanine Hatch. (9) Big Cr. Hatchery (2) Lewis & Clark spawn. grd. (1) Rogue R. spawn. grd.

Table 5. Continued.

Brood	Site of Release	CWT Escapement Recoveries Total	Y.B. Net t Hatch.	Stravs	Location of Stravs
1968	Net Pen (2-wk acclimation)	1,560	1,554 (99.6%)	6 (0.4%)	(1) N.F. Klaskanine Hatch. (4) gig Cr. Hatchery (1) Fall Cr. Hatchery
1989	Net Pen (2-wk acclimation)	405	400 (98.8%)	5 (1.2%)	(1) S.F. Klaskanint Hatch. (1) N.F. Klaskanint Hatch. (2) Big Cr. Hatchery (1) Salmon R. Hatchery
1990	Net Pen (2-wk accl imation)	695	684 (98.4%)	11 (1.6%)	(9) N.F. Klaskanine Hatch. (2) Big Cr. Hatchery
1991	Net Pen (2-wk acclimation)	959	952 (99.3%)	7 (0.7%)	(4) N.F. Klaskanine Hatch. (3) Big Creek Hatch.
1991	Net Pen (Over-winter accl imation)	1,200	1,193 (99.4%)	7 (0.6%)	(1) S.F. Klaskanine Hatch. (3) Big Creek Hatch. (1) Grays R. Hatch. (1) Fallcrt Cr. (Kalama) Hatch. (1) Lewis R. Hatch.
1992	Net Pen (2-wk acclimation)	165	165 (100%)	0	
1992	Net Pen (Overwinter acclimation)	747	747 (100%)	0	
1988-92	Net Pen Total	5,731	5,695 (99.4%)	36 (0.6%)	(15) N.F. Klaskanint Hatch. (2) S.F. Klaskanine Hatch. (14) Big Cr. Hatchery (1) Fall Cr. Hatchery (1) Salmon R. Hatchery (1) Grays R. Hatchery (1) Fallert Cr. (Kalama) Hatch. (1) Lewis R. Hatchery

Evaluation of Stray Spawners

Spawning ground surveys were conducted during October-December of 1994 and 1995 in the Necanicum River and Ecola (Elk) Creek drainages, tributaries of the Pacific Ocean (Figure 4). Concern that strays from net-pen releases could spawn and possibly interbreed with indigenous native populations necessitated intensifying the spawning fish survey effort in the closest adjacent Pacific Ocean tributaries with significant populations of natural spawning coho.

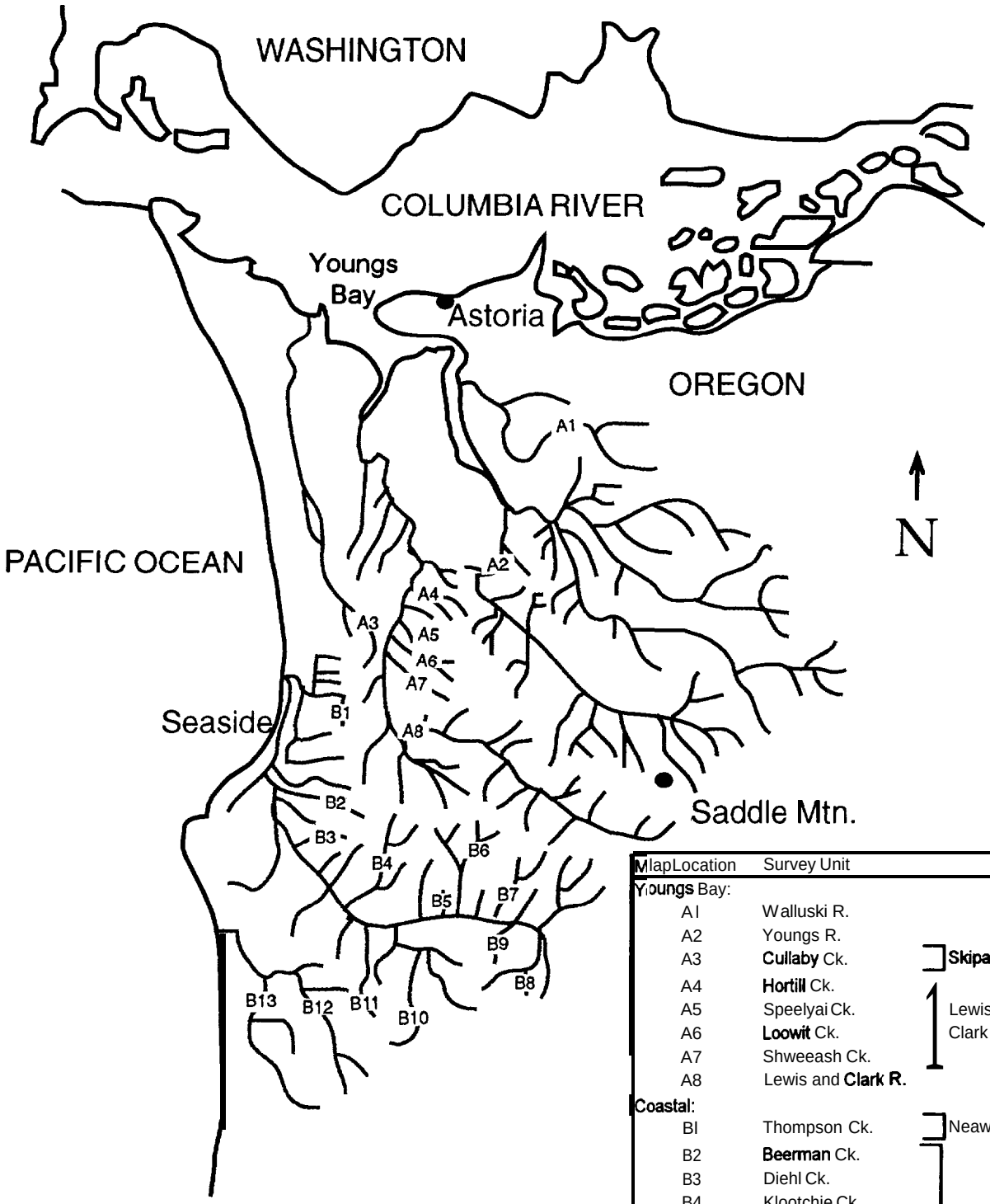
ODFW conducts coho spawning surveys for the purpose of annually assessing the status of naturally spawning coastal coho populations. In 1994-95, a total of 85 coho was observed in seven units in the Necanicum River system and one unit in the Ecola Creek drainage (Table 6). A total of 7.21 stream miles was surveyed during October-January.

During the 1995-96 spawning season, the ODFW surveyor observed a total of 67 coho that included four dead adults and four jacks (Table 7). A total of 8.83 stream miles was surveyed in eight Necanicum River units and two Ecola Creek units during October-January.

Additional spawning fish surveys conducted by the project surveyor were selected by the ODFW district fish biologist from those units in the Necanicum River and Ecola Creek that were not randomly chosen by ODFW for population assessment and held the best potential for observing coho spawners. In 1994, the project surveyor observed 35 coho, which included 11 dead spawners and two jacks (Table 8). A total of 6.8 stream miles was surveyed in five Necanicum units and one Ecola unit. Additional spawning fish surveys in Youngs Bay tributaries of the Lewis and Clark, and Walluski rivers produced a total of 85 coho observed in 5.8 stream miles.

In 1995, the project surveyor observed a total of 63 coho in five Necanicum River units and single units in Ecola and Neawanna creeks totaling 6.8 stream miles (Table 9). As in 1994, additional spawning fish surveys were conducted in three Youngs Bay tributaries and a single survey of Cullaby Creek, a tributary of the Skipanon River. A total of 61 coho was observed in 6.6 stream miles.

To document straying of Youngs Bay net-pen coho, all dead fish were examined for a missing adipose fin, indicating presence of a CWT. A total of 63 dead coho in 1994 and 44 dead coho in 1995 was examined, with no marked coho observed and no CWTs recovered (Table 10).



MlapLocation	Survey Unit	
Youngs Bay:		
A l	Walluski R.	
A2	Youngs R.	
A3	Cullaby Ck.	Skipanon R.
A4	Hortill Ck.	
A5	Speelyai Ck.	Lewis and Clark R.
A6	Loowit Ck.	
A7	Shweeash Ck.	
A8	Lewis and Clark R.	
Coastal:		
BI	Thompson Ck.	Neawanna Ck.
B2	Beerman Ck.	
B3	Diehl Ck.	
B4	Klootchie Ck.	
B5	Alder Ck.	
B6	N. Fk. Necsnicum R.	Necsnicum R.
B7	Little Humbug Ck.	
B8	Bergsvik Ck.	
B9	Warner Ck.	
B10	Trib. "A"	
B11	Mail Ck.	
B12	N. Fk. Ecola Ck.	Ecola Ck.
B13	W. Fk. Ecola Ck.	

Figure 4. Coho Spawning Ground Survey Units in Oregon North Coast Streams.

Table 6. Coho Salmon Spawning Ground Surveys in Oregon North Coast District Streams Conducted by ODFW for Oregon Coastal Natural Population Estimates, 1994-95.

Survey Unit	Distance in Miles	Times Surveyed	Total Coho Observed[1] Adults	Jacks	Total
Necanicum R.					
Beerman Cr.	1.63	11	19		21
Main Stem	1.53	11	18 (4)	0	18 (4)
Diehl Cr.	0.72	12	16 (4)	0	16 (4)
Warner Cr.	1.00	11	8 (3)	1	9 (3)
Klootchie Cr.	0.92		9	0	9
Alder Cr.	0.46	12	4	0	4
Unnamed Trib "A"	1.08	11	0	0	0
Subtotal	6.71	78	74 (11)	3	77 (11)
Ecola Cr.					
W. Fk. Ecola Cr.	0.50	12	8 (1)	0	8
Total	7.21	90	82 (12)	3	85 (12)

[1] *Dead in parentheses included in counts.*

Table 7. Coho Salmon Spawning Ground Surveys in Oregon North Coast District Streams Conducted by ODFW for Oregon Coastal Natural Population Estimates, 1995-96.

Survey Unit	Distance in Miles	Times Surveyed	Total Coho Observed[1] Adults	Jacks	Total
Necanicum R.					
Upper Main Stem	1.50	14	20	2	22
South Fork	1.26	10	12	0	12
Bergsvik Cr. (Upper)	1.06	11	9	2	11
Bergsvik Cr. (Lower)	0.49	12	2	0	2
Warner Cr.	1.00	13	10 (2)	0	10 (2)
Kloochie Cr.	0.37	8	0	0	0
Kloochie Cr. (Trib. "A")	0.61	12	1	0	
Unnamed Trib. "A"	1.08	9	0	0	A - -
Subtotal	7.37	89	54 (2)	4	58 (2)
Ecola Cr.					
W. Fk. Ecola Cr.	0.50	14	4 (1)	0	4 (1)
Ecola Cr., W. Fk.	0.96	12	5	0	5
Subtotal	1.46	26	9 (2)	0	9 (2)
Total	8.83	115	63 (4)	4	67 (4)

[1] *Dead in parentheses included in counts.*

Table 8. Coho Salmon Spawning Ground Surveys Conducted by Project Surveyor in Oregon North Coast District Streams, October-December 1994.

Survey Unit	Distance in Miles	Times Surveyed	Total Coho Observed[1] Adults	Jacks	Total
Pacific Ocean Tributaries					
Necanicum R.					
Bergsvik Cr. (Upper)	1.1	4	6	1	7
L. Humbug Cr.	1.2	5	1 (1)	0	1 (1)
Mail Cr.	1.0	6	8 (6)	1	9 (6)
Necanicum R.	1.0	2	7 (1)	0	7 (1)
N.F. Necanicum R.	1.2	2	1 (1)	0	1 (1)
Subtotal	5.5	19	23 (9)	2	25 (9)
Ecola Cr.					
N.F. Ecola Cr.	1.3	3	10 (2)	0	10 (2)
Total	6.8	22	33 (11)	2	35 (11)
Younas Bay Tributaries					
Lewis & Clark R.					
Hartill Cr.	0.3	5	23 (16)	4 (2)	27 (18)
Lewis & Clark R.	1.0	3	4 (2)	1 (1)	5 (3)
Loowit Cr.	1.0	5	31 (11)	7 (1)	38 (12)
Shweeash Cr.	1.0	4	1 (1)	0	1 (1)
Speelyai Cr.	1.0	5	12 (6)	2	14 (6)
Subtotal	4.3	22	71 (36)	14 (4)	85 (40)
Walluski R.	1.5	4	0	0	0
Total	5.8	26	71 (36)	14 (4)	85 (40)

[1] *Dead in parentheses included in counts.*

Table 9. Coho Salmon Spawning Ground Surveys Conducted by Project Surveyor in Oregon North Coast District Streams, October-December 1995.

Survey Unit	Distance in Miles	Times Surveved	Total Coho Observed[1] Adults	Jacks	Total
Pacific Ocean Tributaries					
Necanicum R.					
Beaver Cr. (Lower)	0.2	5	3 (1)	0	3 (1)
Mail Cr.	1.0	8	14 (3)	1	15 (3)
Necanicum R.	1.0	1	4	0	4
N.F. Necanicum R.	1.2	5	1 (1)		3 (1)
Subtotal	4.8	21	27 (5)	3	30 (5)
Ecola Cr.					
N.F. Ecola Cr.	1.3	5	16 (7)	3	19 (7)
Neawanna Cr.					
Thompson Cr.	0.7	6	14 (6)	0	14 (6)
Total	6.8	32	57 (18)	6	63 (18)
Columbia River Tributaries					
Youngs Bay					
Youngs R.	0.3	6	3	0	3
Walluski R.	1.5	5	8 (2)	1	9 (2)
Subtotal	1.8	11	11 (2)	1	12 (2)
Lewis & Clark					
Shweeash Cr.	1.0	3	2 (2)	0	2 (2)
Loowit Cr.	1.0	6	25 (12)	1	26 (12)
Speel yai Cr.	1.0	6	12 (3)	2	14 (3)
Hartill Cr.	0.3	6	5 (2)	2 (1)	7 (3)
Subtotal	3.3	21	44 (19)	5 (1)	49 (20)
Skipanon R.					
Cullaby Cr.	1.5	1	0	0	0
Total	6.6	33	55 (21)	6 (1)	61 (22)

[1] Dead in parentheses *included in counts.*

Table 10. Summary of 1994 and 1995 Spawning Season Results for Coho in Selected Oregon North Coast District Streams.

Spawning Year	Drai naae	Su rvevo r	Coho Observed Live	Dead	Total	Marked Coho Observed
1994	Necani cum R.	ODFW	66	11	77	0
		Project	16	9	25	0
			82	20	102	0
	Ecola Cr.	ODFW	7	1	8	0
		Project	8	2	10	0
			15	3	18	0
	Youngs Bay	Project	45	40	85	0
Total			142	63	205	0
1995	Necani cum R.	ODFW	56	2	58	0
		Project	25	5	30	0
			81	7	88	0
	Ecola Cr.	ODFW	7	2	9	0
		Project	12	7	19	0
			19	9	28	0
	Neawanna Cr.	Project	8	6	14	0
	Youngs Bay/Ski panon R.	Project	39	22	61	0
Total			147	44	191	0

SUMMARY AND CONCLUSIONS

Coho were successfully reared during the winter period to smolt stage in floating net pens in Youngs Bay. Low mortality rates were experienced during the rearing period and target size at release of IO fish per pound was attainable.

Nearly all (99%) of the adult production resulting from Youngs Bay' coho net-pen releases is accountable in fishery harvest with the distribution of harvest shifting to terminal Youngs Bay fisheries with reduced ocean harvest. A harvest rate of 100% for all net-pen released coho is desired and has been nearly attained annually.

Highest survival rates were observed for 1991 and 1992 brood overwinter coho released in early May. Disruption of bird foraging activity during the Youngs Bay spring commercial fishery appears to have a positive effect on survival after release.

Survival rates for 2-week acclimation coho have been consistently higher than for the source hatchery for 1988-92 broods. Survival rates for overwinter and 2-week acclimation coho are similar for groups with the same time of release for 1991-92 broods. Conclusions concerning survival rates for over-winter-acclimated coho and source-hatchery releases will be deferred until future brood year data is available.

Youngs Bay coho exhibit extremely high homing instincts. Stray rates calculated for net-pen releases of 0.6% for 1988-92 broods compare favorably with stray rates of 1.7% at both SFKH and NFKH for the same broods. Differences between 2-week and ovefwinter acclimation are not apparent.

Recovery of Youngs Bay net-pen coho in escapement areas has been documented only at hatcheries with no known recoveries from spawning grounds. Adult coho from SFKH and NFKH, however, have been noted at other hatcheries and on spawning grounds.

Based on results of 1994 and 1995 spawning ground surveys designed to specifically document and recover strays in the Necanicum River and Ecola Creek drainages, we conclude that Youngs Bay net-pen released coho did not spawn and interbreed with indigenous native populations.

ACKNOWLEDGMENTS

The following people were instrumental in successfully executing the first overwinter rearing study using coho salmon in the lower Columbia River:

The staff of the Clatsop Economic Development Council's Fisheries Project whose director, James M. Hill first pioneered the concept of net-pen acclimation in Youngs Bay, Rod Litton, Chris Ketcham, Keith Warren, Alan Dietrichs, and Toni Miethe are credited with producing high quality coho smolts meeting both time and release size goals.

Coded-wire-tag recovery information is the basis for study findings. Alan Dietrichs' performance as the Youngs Bay fall season sampler during 1994 and 1995 was exceptional. Matthew Hunter, the project stream surveyor with ODFW, thoroughly searched Oregon north coast streams for coho carcasses during 1994 and 1995 when, at times, weather conditions were extreme.

ODFW staff, Joanne Hirose, Kobi Hendrix, and Lisa Burner are acknowledged for their skillful contribution in word processing and creating the figures in the report. Estimates of surface area in Youngs Bay were from Bruce Fisher of the Water Resources Division of the United States Geological Survey.

The fishers and fish buyers of Youngs Bay deserve special recognition. Without their support and cooperation, high sample rates for the commercial fishery would not have been attained. Monetarily, a voluntary assessment of 5% of catch value by fishers and' matched by fish buyers has contributed to the maintenance and future of the Youngs Bay fisheries. Participation is nearly 100%. Fishers have been key volunteers when called upon for help in constructing net-pen frames and towing the units to specific sites.

Don "Ole" Johnson fished his final fall season this past year. He passed away in early December. Ole was a quiet, yet strong, supporter of the Youngs Bay terminal fishery program and a test fisherman during 1990-92. Ole will be missed.

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PROJECT EXPENDITURES

Salaries and Benefits	$ 44,501.22
Travel (Mileage and Rental)	$ 3,755.08
Fish Food	$ 21,033.51
Field Supplies	$ 5,424.28
Contact Services (CEDC Subcontract)	$454,942.13*
Expendable Property	
1. 30 HP Outboard Motor	$ 2,251.36
2. Pump and Accessories	$ 1,372.82
Capital Outlay	
Barge	$ 5,875.42
TOTAL	$539,155.82

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*CEDC Detail Spending:

a) Salaries and Benefits	$ 74,098.27	
b) Fish Food	$ 33,290.00	
c) Field Supplies & Lease	$ 16,639.30	
d) Expendable Property	$ 2,500.00	(Pressure washer)
e) Capital Outlay	$ 5,000.00	(Feed trailer)
	$264,032.56	(40 pen frames, 4 net cleaning decks, 53 nets, and 40 pen covers)
f) Overhead	$ 59,382.00	
	$454,942.13	

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