

**PRIVATE SALMON HATCHERIES**  

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**IN OREGON**

**OREGON DEPARTMENT OF FISH AND WILDLIFE**  
**FISH DIVISION**

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## INTRODUCTION

In 1971, the Oregon Legislature passed Oregon Revised Statutes which authorized a program for private rearing, release, and recapture of chum salmon. Coho and chinook were added in 1973, and pink salmon were included in the statutes during the 1979 legislative session. The Oregon Fish and Wildlife Commission (FWC) has adopted Oregon Administrative Rules to guide conduct of the program. These OAR's include a moratorium on issue of new permits for chum, coho, and chinook salmon through 1985. Copies of these regulations can be supplied, upon request, by the Oregon Department of Fish and Wildlife (ODFW).

Regulations administered by other state agencies and the Federal Government are also applicable to private salmon ranching operations. Together the regulations give a rigid set of standards which must be met by private salmon ranchers as they select a site, construct facilities, and then conduct operations. They must meet the requirements of local and state zoning regulations; U.S. Army Corps of Engineers and Division of State Lands requirements for work in waterways; Health or Food and Drug restrictions for disease treatment or food processing; and discharge permits as required by the Oregon Department of Environmental Quality or the U.S. Environmental Protection Agency.

An ODFW coordinator monitors private hatchery operations, inspects facilities, and generally coordinates, with the private operators, needs of the Department for specific evaluations or information about private operations. This person is also responsible for processing applications through the review procedure and coordinating staff input to be presented at public hearings which are required before an operation permit can be authorized.

Once permits are issued, the coordinator handles review of each operator's annual production proposal to include rearing and release regimes along with marking requirements necessary to evaluation of ocean contribution and return information including biological data and tax reports. Compliance with regulations is maintained through requirements for fish transport permits for shipment of live fish or eggs; individual permits for each release of salmon through the year; routine reports of operations required by ODFW; and periodic visits to the rearing and recapture sites. This report provides information on developments, shows progress in 1982, and summarizes production and return information.

## DEVELOPMENT

### Permits

Current permits authorize release and recapture operations at 12 sites along the coast (Figure 1). Separate permits are required for each species of salmon even when releases are made at the same site. We have issued 11 chum, 5 chinook, and 4 coho operation permits (Table 1). No private hatchery permits have been issued for pink salmon. ODFW has

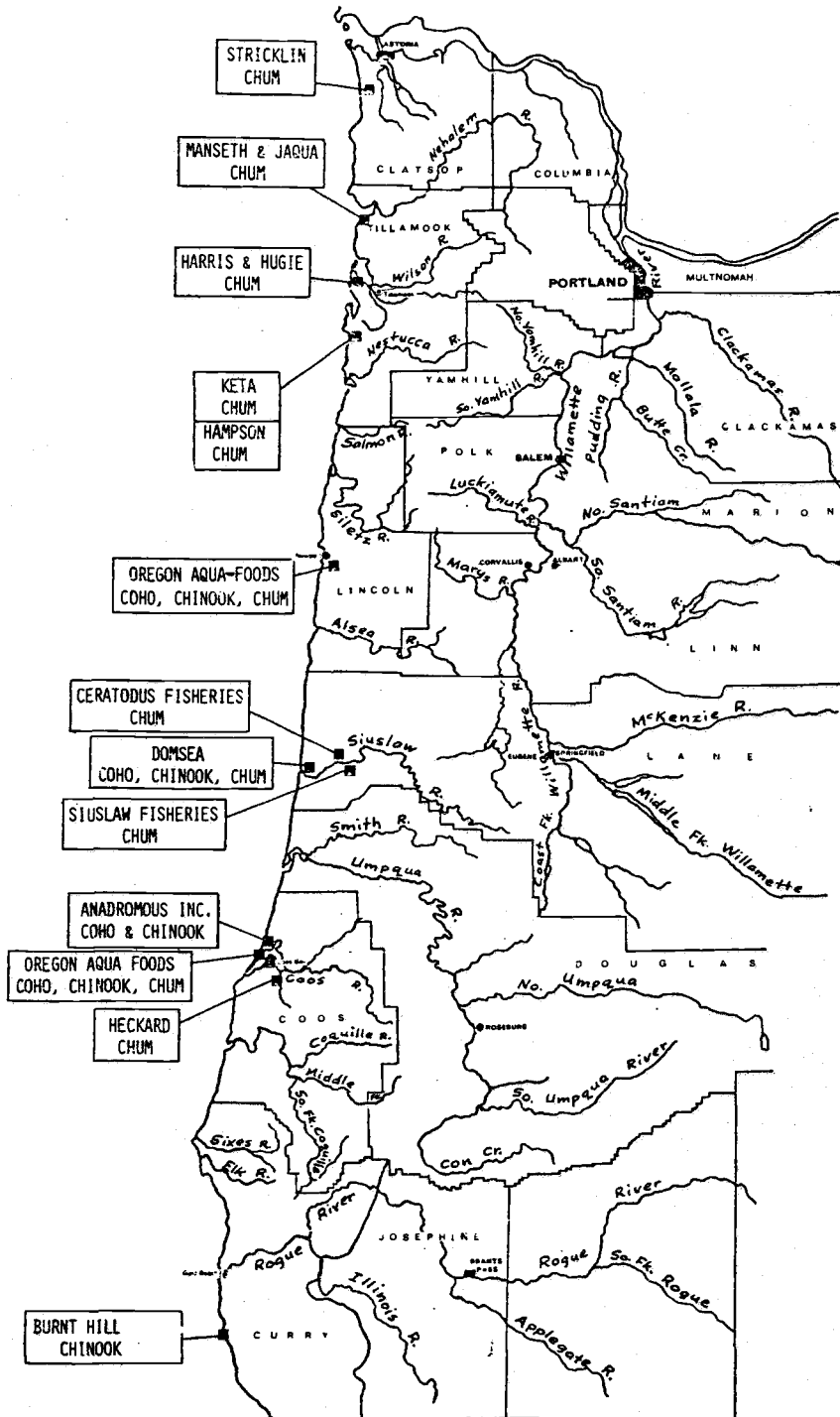


Figure 1. Location of authorized private salmon hatcheries in Oregon.

Table 1. Oregon private salmon hatcheries, March 1, 1983.

Name	Location	Permit Date	Release Limit by Brood and Species (Millions)				Priority a for Chum
			Coho	Chinook	Chum	Pink	
Keta, Inc. 22930 Sandlake Rd. Cloverdale, OR 97112	Sand Cr., Sand Lake	12/01/71			5.0		0 b
Siuslaw Fisheries, Inc. 32047 Coburg Bottom Loop Rd. Eugene, OR 97401	Sweet Cr., Siuslaw R.	3/19/72			5.0		0 b
Alfred Hampson 430 Pacific Bldg. 520 SW Yamhill St. Portland, OR 97204	Sand Cr., Sand Lake	10/31/73			5.0		1 c
Cecil Harris and Don Hugie 1985 Bayocean Rd., NW Tillamook, OR 97141	Dick Cr., Tillamook Bay	8/23/72			0.1		2
Ceratodus Fisheries 6523 E. Street Springfield, OR 97477	Divide Cr., Siuslaw R.	12/18/73			5.0		4
Oregon Aqua-Foods, Inc. 88700 Marcola Rd. Springfield, OR 97477	Manmade Trib., Yaquina Bay	11/1/72 3/19/74	9.5	10.6	20.0		5
	Manmade Trib., Coos Bay	7/30/76	11.3	9.4	20.4		10
Anadromous, Inc. 500 SW Madison St. Corvallis, OR 97333	Manmade Trib., Coos Bay (Prior permit on Columbia R. terminated)	10/24/74	5.0	5.0			
A. Manseth and J. Jaqua 34320 McKenzie View Dr. Eugene, OR 97401	Vosberg Cr., Nehalem Bay	3/4/76			5.0		3
Calvin Heckard 1281 West Catching Slough Rd. Coos Bay, OR 97420	Unnamed Trib., Coos Bay	3/4/76			5.0		7
Robert Sticklin Rt. 1, Box 538 Warrenton, OR 97146	Unnamed Trib., Skipanon R.	3/4/76			5.0		9
Domsea Farms, Inc. PO Box 1656 Florence, OR 97439	Manmade Trib., Siuslaw Bay	5/5/78	12.0	12.0	25.0		11
Burnt Hill Salmon Ranch, Ltd. 2300 SW First Portland, OR 97201	Burnt Hill Cr. (Direct ocean tributary)	4/25/78		5.0			
Total			37.8	42.0	100.5		

a Priority for Oregon chum salmon eggs based on date of application or permit issue.

b Priority for chum salmon eggs expired with 1979 brood.

c Permit authorized at Keta's site and combined with Keta for records.

authorized Oregon State University (OSU) to test the feasibility of producing pink salmon in Oregon with a cooperative study funded by Oregon Aqua-Foods. No new private hatchery permits have been issued since 1978.

In early 1982, Oregon Aqua-Foods and Anadromous requested help in resolving a problem at Coos Bay. Their sites are located about 3.8 miles apart, on the same side of the bay, and both draw water from the bay. Attraction water from one site becomes attraction water at the other site as the tide carries hatchery effluent from one intake to the other. Tagged fish in returns at both sites showed fish to be of mixed origin. For 2 years the companies separated returns by applying the proportion of tagged fish or specific scale characteristics occurring in the returns. This was not satisfactory and the companies requested a change in their release authorizations for coho. The FWC discussed this proposal and authorized Anadromous to operate the Oregon Aqua-Foods site at Coos Bay until December 1983 to determine if this site meets company needs for future operations. During this time, Oregon Aqua-Foods will be allowed to release all of their coho smolts (up to 21 million per brood year) at their Yaquina site. The companies are operating within their existing permit numbers for species at each site other than coho with releases by Anadromous at the Oregon Aqua-Foods Coos Bay site and Oregon Aqua-Foods releasing salmon only at their Yaquina site. Should the companies decide this method of operation meets their needs, they will have to come to the Department with a request to change their permits and sites as appropriate for continued operation.

Domsea continues to operate at a research level and is attempting to build a seed base for coho, fall chinook, and chum. Burnt Hill Salmon Ranch is concentrating on Rogue stock spring chinook, using seed from fish returning to their site and surplus when available from public hatcheries.

#### Brood Stock

Transfer of eggs and stocks is controlled by ODFW through agency review of company production proposals and also by individual import, fish transport, and release permits through the year. Our goal is development of an individual brood stock for each hatchery and species. We believe the use of local stream stocks to develop a hatchery stock is the best way to minimize impacting local stocks with a hatchery program. The next alternative is the use of hatchery stocks that ODFW would use to enhance the local stream. Developing local stocks continues to be a slow process because we are not willing to take a large proportion of a wild run for eggs even when smolts are returned to the stream in larger numbers than would have survived from natural spawning, and there have not been surplus eggs available from most ODFW coastal hatcheries in the last 2 years.

ODFW has operated traps to collect eggs for the state salmon production program and, in some cases, contract to provide seed stock for private salmon operators to begin developing their brood stock. Collection of adults on local streams for private operators is a short-term operation

using temporary weirs and traps. ODFW bills the private operator for expenses of such operation. If trapping is successful and the operator is able to obtain eggs, they must raise and return enough of the fish for ODFW to plant back into the stream to replace the number of fish which would have survived had eggs not been collected from the stream. In several years most of the fish from eggs collected were returned to meet this requirement. Some of these privately-funded facilities have been used to trap wild coho for the Salmon and Trout Enhancement Program (STEP) but no wild coho have been provided to private salmon hatchery operators for their use. No chinook were collected for private seed stock in 1982.

Eggs at state hatcheries surplus to ODFW programs can be sold. ODFW programs include egg collection for hatchery smolt production, fingerlings (presmolts) for supplementing stream production, and eyed eggs for our STEP program. Surplus adults are also used to seed or supplement streams where additional natural spawning is needed. Department budgets, numbers of adults returning (available eggs), and capacity of facilities control the development of ODFW's annual program. If state program needs are met and additional eggs are available, they become surplus and are sold or distributed in accordance with egg disposition guidelines adopted by the FWC. A comparison of eggs taken at coastal state hatcheries and those sold to private salmon hatchery operators is shown in Table 2. ODFW has not been able to fill all requests for eggs in any year.

Table 2. Salmon eggs taken at ODFW coastal stations and numbers sold to private operators, 1973-82 broods.

Species Brood Year	Fall Chinook			Spring Chinook			Coho		
	Eggs Taken	Eggs Sold	(%) <sup>a</sup>	Eggs Taken	Eggs Sold	(%)	Eggs Taken	Eggs Sold	(%)
1973	4,366,800	510,915 <sup>b</sup>	(11.7)	2,068,900	0	(0)	9,613,100	509,495	(5.3)
1974	2,422,400	0	(0)	1,984,883	125,050	(6.3)	8,347,882	751,310	(9.0)
1975	3,488,100	725,525	(20.8)	2,610,300	308,015	(11.8)	5,667,600	317,385	(5.6)
1976	436,536	0	(0)	2,592,078	261,800	(10.1)	9,167,383	2,310,180	(25.2)
1977	3,832,348	540,360	(14.1)	2,948,986	209,380	(7.1)	7,394,065	81,335	(1.1)
1978	3,214,348	0	(0)	4,845,104	2,151,230	(44.4)	6,223,090	12,445	(0.2)
1979	2,992,506	395,010	(13.2)	4,809,160	1,933,280	(40.2)	22,747,394	5,868,825	(25.8)
1980	3,135,009	404,415	(12.9)	6,587,306	2,575,635	(39.1)	19,741,631	2,842,795	(14.4)
1981	2,780,428	0	(0)	3,251,847	411,786	(12.6)	12,184,136	0	(0)
1982 <sup>c</sup>	3,663,205	0	(0)	6,088,528	3,685,256	(60.5)	10,482,324	0	(0)
TOTAL	30,331,680	2,576,225	(8.5)	37,787,092	11,661,432	(30.9)	111,568,605	12,693,770	(11.4)

<sup>a</sup> Percentages sold: Percentages are misleading in some cases because additional eggs were taken specifically for sale as viable eggs as opposed to selling unspawned carcasses.

<sup>b</sup> 27,000 released as smolts with the remainder harvested for sale as pan-size juveniles.

<sup>c</sup> Preliminary data.

ODFW allowed operators to import eggs from coho hatchery stocks returning to Puget Sound, Washington, hatcheries through the 1980 season, but none have been imported since then. Future imports, if allowed, will be only to meet the goals of accepted stock selection studies or to provide a



specific stock based on results of such studies. Coho and chinook operators are capable of building their own production stocks of both coho and chinook, in time, using returns from smolts released in past years.

Chum imports may be continued on a case-by-case basis. However, local (Oregon) stocks appear to be a better source of brood and we will continue to work with private operators to develop these stocks whenever possible.

## Operations

### Chum salmon

The first private hatchery permits issued were for chum salmon. The incentive for rearing chum is the comparatively small size at which they migrate to the ocean and a limited requirement for rearing prior to release. In theory, successful chum operations could be maintained at relatively low cost or inexpensively superimposed on programs for chinook and coho. Chum can be reared for 60 to 90 days in ponds which are needed later for coho or chinook as these juveniles increase in size. Use of pond space for rearing is limited by the pounds of fish reared at a particular time not by numbers alone, so a large number of small chum can be reared in ponds suitable for a smaller number of coho or chinook.

North of Salmon River, local stocks or eggs surplus to an experimental chum facility at Whiskey Creek, Netarts Bay, must be used. South of Salmon River (Cascade Head) there are few local chum, and imports are allowed. Chum salmon releases (Table 3) by private operators have included imported eggs. The relatively poor returns of chum adults (Table 4) have probably been due to small numbers released annually at each site, small fish size at release, the difficulty of acclimating fish through short rearing periods, and inherent differences in life history patterns between imports and chum from local stocks. Hatchery practices have been changed during recent years from release of unfed fry to rearing and release of fingerlings.

Chum salmon have been released by seven operators (Table 5). Three of the releases should be considered tests. Operators have reported variable rates of return with some eggs collected at 4 of the 11 permitted sites. All operators are still looking for enough eggs to develop brood stocks from their own returns or an outside source.

OSU experimental facility. In 1969, OSU began a cooperative program with ODFW to develop an inexpensive streamside incubator for chum salmon at Whiskey Creek on Netarts Bay. Successful production of chum salmon through this project was expected to provide methodology and seed stock for private hatcheries along the Oregon coast. Hatchery practices have been developed and improved through this experiment and returns to the Whiskey Creek facility have consistently been higher than those found in nearby streams supported only by natural production. In some years there have been eggs surplus to OSU's needs which were turned over to ODFW for sale to private operators.

Table 3. Salmon released by private salmon hatchery operators in Oregon, 1972-82.

Year	Species				Total
	Coho	Spring Chinook	Fall Chinook	Chum	
1972	--	--	--	51,150	51,150
1973	--	--	--	276,375	276,375
1974	87,782	--	27,000	575,082	689,864
1975	142,032	5,551	1,009,259	2,792,930	3,949,772
1976	2,079,834	161,251	147,662	2,447	2,391,194
1977	2,370,690	42,079	--	120,400	2,533,169
1978	9,907,874	15,790	522,101	465,174	10,910,939
1979	5,811,741	1,397,131	222,811	10,940,199	18,371,882
1980	14,817,346	1,268,718	438,136	8,000	16,532,200
1981	23,852,408	1,755,892	499,728	5,528,589	31,636,617
1982 <sup>a</sup>	23,107,316	351,416	630,951	1,649,406	25,739,089
Total	82,177,023	4,997,828	3,497,748	22,409,752	113,082,251

<sup>a</sup> Preliminary data.

Table 4. Return of salmon to private hatcheries, sites combined, 1978-82.

	1978	1979	1980	1981	1982 <sup>c</sup>
Chinook Adults	213 <sup>a</sup> (3,952) <sup>b</sup>	271 (2,872)	752 (9,386)	2,588 (35,860)	7,456 (85,238)
Chinook Jacks	31 (23)	145 (519)	2,642 (7,179)	2,499 (6,046)	4,426 (13,620)
Coho Adults	8,069 (38,903)	47,726 (225,105)	27,856 (146,263)	98,681 (631,619)	164,614 (930,638)
Coho Jacks	6,557 (15,736)	1,445 (2,224)	15,639 (31,922)	19,098 (42,070)	19,592 (48,211)
Chum	539 (4,841)	14 (110)	545 (4,815)	477 (4,053)	1,132 (9,133)

<sup>a</sup> Number.

<sup>b</sup> Pounds.

<sup>c</sup> Preliminary data.

Table 5. Salmon releases by individual private salmon hatchery operators, 1972-82.

	Year of Release							Total
	1972-76	1977	1978	1979	1980	1981	1982	
<b>Harris &amp; Hugie (Tillamook Bay)</b>								
Chum	26,600							26,600
Total	26,600							26,600
<b>Keta Corp. <sup>a</sup> (Sand Lake)</b>								
Chum	1,774,325	98,000	403,000	1,005,000		1,413,000	770,000	5,463,325
Total	1,774,325	98,000	403,000	1,005,000		1,413,000	770,000	5,463,325
<b>Oregon Aqua-Foods, Inc. (Yaquina Bay)</b>								
Spring Chinook	166,802	42,079	15,790	886,588		89,026		1,200,285
Fall Chinook	192,644		393,202	141,034	151,915	249,254	338,449	1,466,498
Coho	1,400,689	1,376,048	8,898,287	3,894,344	7,584,916	11,925,359	20,588,602	55,668,245
Chum	366,559	14,900	2,174	684,245		3,179,589	243,706	4,491,173
Total	2,126,694	1,433,027	9,309,453	5,606,211	7,736,831	15,443,228	21,170,757	62,826,201
<b>Siuslaw Fisheries, Inc. (Sweet Cr., Siuslaw R.)</b>								
Chum	1,030,500	7,500	60,000	1,038,600	8,000	110,000		2,254,600
Total	1,030,500	7,500	60,000	1,038,600	8,000	110,000		2,254,600
<b>Ceratodus Fisheries (Divide Cr., Siuslaw R.)</b>								
Chum	500,000							500,000
Total	500,000							500,000
<b>Domsea Farms, Inc. (Siuslaw Bay)</b>								
Fall Chinook				62,458	91,206	33,662	74,100	261,426
Coho			399,858	738,211	240,920	157,680	61,000	1,597,669
Chum						176,000	58,000	234,000
Total			399,858	800,669	332,126	367,342	193,100	2,093,095
<b>Oregon Aqua-Foods, Inc. (Coos Bay)</b>								
Spring Chinook				312,907		112,199		425,106
Fall Chinook						42,551		42,551
Coho		86,237		241,826	5,445,791	10,870,247	802,672	17,446,773
Chum				8,212,354				8,212,354
Total		86,237		8,767,087	5,445,791	11,024,997	802,672	26,126,784
<b>Anadromous, Inc. (Coos Bay) <sup>b</sup></b>								
Spring Chinook				197,636	633,998	616,067	93,474	1,541,175
Fall Chinook	991,277		128,899	19,319	95,983	174,261	159,346	1,569,085
Coho	908,959	908,405	609,729	937,360	1,545,719	899,122	1,655,042	7,464,336
Total	1,900,236	908,405	738,628	1,154,315	2,275,700	1,689,450	1,907,862	10,574,596
<b>Burnt Hill Salmon Ranch, Ltd. (Burnt Hill Cr.)</b>								
Spring Chinook					634,720	938,600	257,942	1,831,262
Fall Chinook					99,032		59,056	158,088
Total					733,752	938,600	316,998	1,989,350
<b>Manseth &amp; Jaqua (Nehalem Bay)</b>								
Chum						650,000	577,700	1,227,700
Total						650,000	577,700	1,227,700
<b>Total</b>								
Spring Chinook	166,802	42,079	15,790	1,397,131	1,268,718	1,755,892	351,416	4,997,828
Fall Chinook	1,183,921		522,101	222,811	438,136	499,728	630,951	3,497,648
Coho	2,309,648	2,370,690	9,907,874	5,811,741	14,817,346	23,852,408	23,107,316	82,177,023
Chum	3,697,984	120,400	465,174	10,940,199	8,000	5,528,589	1,649,406	22,409,752
Total	7,358,355	2,533,169	10,910,939	18,371,882	16,532,200	31,636,617	25,739,089	113,082,251

<sup>a</sup> Includes releases made on permit issued to Alfred Hampson.

<sup>b</sup> 1975 and part of 1976 releases were made at Columbia River location prior to Columbia River permit being terminated.

In 1980, we were notified that OSU could no longer fund this experiment. ODFW did not have the funds for continuation either. Private operators were apprised of the possible closure of the facility and chum permittees formed a non-profit group, Fish Development Corporation (FDC), to operate the Whiskey Creek facility for ODFW under contract. They also negotiated an agreement with OSU, the landowner, for use of the site. The contract with ODFW requires FDC to pay for the operation; collect up to 1.0 million chum eggs for incubation and release back to Whiskey Creek; release a number of adults upstream for natural spawning; and provide any surplus eggs to ODFW for sale to private operators in accordance with our priority for such sales. We sold 1.6 million eggs surplus to the ODFW-FDC Whiskey Creek program in 1981, and FDC incubated 1.0 million eggs to release 775,000 fry. In 1982, ODFW sold 5.3 million surplus eggs to six chum permittees and FDC released 700,000 fry into Whiskey Creek in March 1983.

Use of natural chum stocks. We have attempted to collect eggs at a trap on Coal Creek, Kilchis River, for several years, to be used for seed at other sites. Success of this effort to supplement the supply of chum eggs has varied, but has generally been below expectations. However, 970,000 eggs were collected (1.1 million goal) in 1982. Some 100,000 of the resultant fingerlings were returned to Coal Creek to replace eggs collected. Adults are also released upstream during trapping to maintain natural production in addition to the fingerlings.

We have not collected chum eggs from other streams for transfer to private operators although one operator, Keta, Inc., was permitted to take a portion of the Sand Creek chum run for seed stock from 1971 through 1973. They are required to release at least 80 pair of chum above their trap in Jewel Creek each year for natural spawning.

### Chinook salmon

Few chinook smolts were released prior to 1978 and not many eggs were collected from returning adults until 1981. Availability of eggs, reported company budget restrictions, and emphasis of coho releases at some sites have all contributed to slow development of chinook salmon programs.

Private operators are using release and size criteria similar to that used at ODFW's coastal hatcheries. Smolts are large when released and appear to have patterns of growth and movement similar to other local stocks. Size of fish at return appear to be comparable to that at State hatcheries for the same age classes.

Fall chinook. ODFW maintains the goal of developing local fall chinook stocks from the watershed in which a hatchery is located or from the hatchery stock that we would use for planting in that system. Availability of hatchery surplus and our ability to successfully collect wild seed stock has not been consistent from year to year. Fall chinook have been released at five coastal sites.

In 1977, we began to collect eggs from wild fall chinook under projects financed by private operators (Table 6). Individual operators have provided funds for ODFW to collect a total of 1,467,027 fall chinook eggs from wild stocks over a period of 5 years and at four separate sites. We have received a total of 291,000 chinook smolts, for release back into the stream where eggs were taken, as replacement for natural production. We did not conduct these operations in 1982, and no natural chinook spawners were collected for private seed stock.

Table 6. Eggs taken from wild fall chinook for stock assessment and brood stock development program in cooperation with private operators, 1977-82.

Cooperating Company	Anadromous	Oregon Aqua-Foods	Burnt Hill	Domsea	Total
Brood Year					
1977	--	62,040 (18,810) <sup>a</sup> Yaquina River	--	--	62,040 (18,810)
1978	185,402 (25,476) Coos River	169,725 (26,343) Yaquina River	--	288,000 (26,343) Siuslaw River	643,127 (78,162)
1979	--	--	150,000 (24,945) Lobster Creek	188,000 (24,739) Siuslaw River	338,000 (49,035)
1980	--	69,000 (25,000) Tioga Creek	30,000 (24,582) Lobster Creek	80,000 (25,000) Siuslaw River	179,000 (75,000)
1981	--	90,900 (25,000) Tioga Creek	31,000 (19,800) Lobster Creek	122,960 (25,000) Siuslaw River	244,860 (75,000)
1982	None taken	--	--	--	--
Total	185,402 (25,476)	391,665 (95,153)	211,000 (69,327)	678,960 (101,082)	1,467,027 (291,038)

<sup>a</sup> Smolts returned to ODFW for release in stream of origin to replace eggs taken.

Recovery of coded-wire tags (CWT) from fall chinook caught in ocean fisheries shows an encouraging contribution to these fisheries as chinook production is increased by private operators. Future production of fall chinook will depend on the availability of eggs, emphasis placed on rearing of other species, and company evaluations of the economic feasibility for use of chinook in their programs.

Spring chinook. Private operators have released a total of some 5.0 million spring chinook, mostly in the last 3 years. Early returns of spring chinook indicate they contribute well to Oregon ocean fisheries and to the private operators. This stock also returns well to our Cole Rivers Hatchery where excess eggs are often available.

Initially, the operators intended to use spring chinook as a "cash crop," harvesting all returns, because they were not certain about being able to hold returning adults through the extended freshwater maturation period necessary for spring return adults. Both Anadromous and Burnt Hill are now rearing spring chinook from eggs collected at their facilities (in addition to those from ODFW surplus).

## Coho salmon

Coho releases began in 1974 with comparatively small numbers of fish but increased to a level of 23.8 million coho smolts released in 1981. Operators released 23.1 million coho in 1982 from the four permitted sites (Table 3).

Both yearling (reared about 15 months) and zero coho (released within the first year of life) have been released. Anadromous and Domsea experimented with zero coho releases then used full-term, yearling, releases to evaluate various size and time of release strategies. These companies continue to release only yearling coho. Oregon Aqua-Foods has produced both yearling and zero coho but now program only zero coho for release. Overall adult returns to the four sites have improved each year to about 0.7% in 1982. Survival of some treatment groups has been higher and most operators report they are encouraged by continued improvements. Returns to the two operators combined at Coos Bay reached the 1.0% level in 1982.

## Evaluation

Most of our evaluation effort has been with coho which are released in production lots. Operators have contributed funds for a variety of studies including juvenile and adult straying, estuary residence of juveniles, and contribution to fisheries in the ocean of salmon released from private hatcheries.

## Coho survival and contribution

The following analysis of return and contribution is primarily from a review of private and state hatchery returns by the Department's Research and Development Section (R. L. Garrison, Personal Communication). Private operators are required to submit release and return data to ODFW.

A variety of stocks, fish sizes, and times of release have been identified with CWT's prior to release of the fish as juveniles from both public and private hatcheries. Survival, including ocean catch and return, for particular groups of fish can be estimated by comparison of the number of tags recovered and numbers of nonmarked fish released by the respective hatcheries. Tag recoveries also provide information about straying; i.e., adults returning to sites other than where they were released as juveniles. The average range of returns and total adult survival shown in Table 7 include coho released as yearlings and zero-age smolts (yearling coho are normally released at public hatcheries). During the same period of time, coho tagged by ODFW returned to Fall Creek Hatchery, Alsea River (Table 8). The wide variation which occurred in the return rates of ODFW tagged coho to the individual Oregon coastal public hatcheries during 1982 (Table 9) is typical of the variation in most recent years. Returns to ODFW hatcheries appear to be generally comparable to private hatcheries depending on the experimental treatment represented by individual tag groups. However, ODFW hatcheries show consistently higher total survival, i.e., catch plus return, than do

private hatcheries (Tables 7-9). Total survival of coho released from Fall Creek Hatchery was 2.7% in 1982 which compares favorably with past coastal averages but is probably the highest rate for a coastal hatchery in 1982.

Table 7. Average return to facilities and total survival (catch + return) of adult coho originating from private hatcheries, sites combined, based on expansion of CWT recoveries from fisheries and returns at the hatcheries, 1978-82.

	Year of Return <sup>a</sup>				
	1978	1979	1980	1981	1982 <sup>b</sup>
% Return to facilities	0.49	0.48	0.48	0.66	0.69
Catch + Return	<sup>c</sup>	1.11	1.40	1.60	1.20
Return of individual marked groups ranged from 0.00 up to -	1.61	2.06	1.93	1.90	5.08

<sup>a</sup> Year of release plus 1 year.

<sup>b</sup> Preliminary.

<sup>c</sup> No ocean contribution estimate was made for 1978.

Table 8. Percentage return to facilities and total survival (catch + return) of CWT adult coho to the Department's Fall Creek Hatchery in 1978-82.

	Year of Return <sup>a</sup>				
	1978	1979	1980	1981	1982
March Release					
Return	0.42	0.86	0.82	1.15	0.27
Catch + Return	1.64	3.04	2.80	6.12	1.80
May Release					
Return	--	--	1.00	0.90	0.50
Catch + Return			3.56	5.26	3.20
All releases <sup>b</sup>	0.40	1.81	1.18	1.68	1.43

<sup>a</sup> Year of release plus 1 year.

<sup>b</sup> Including non-marked coho.

Table 9. Percentage return to facilities and total survival (catch + return) of CWT adult coho originating from Oregon coastal public hatcheries, 1982.

	Nehalem	Trask	Salmon	Siletz	Fall Cr.	Cole Rivers
March 15 Release						
Return	0.04	0.14	0.29	0.31	0.29	--
Catch + Return	0.61	0.44	1.38	1.33	1.88	
May 1 Release						
Return	0.07	0.22	0.57	0.53	0.50	0.77
Catch + Return	0.43	0.74	2.62	2.36	3.20	4.20
Total returns <i>a</i>	0.16	0.30	0.85	0.98	1.43 <i>b</i>	1.01

*a* Includes non-marked adult coho.

*b* Estimated C+R for Fall Creek coho in 1982 is 2.71% of those released with C/R of 1.6 to 1.

As progeny from the initial coho releases become better adapted to the environment and Oregon stocks become more dominant through outcrossing and substitution, an increase in survival is expected. The operators are also improving their ability to control fish quality in the hatchery. A more consistent product at release and experience gained in estimating survival allow us to better predict return and contribution. Preliminary projections for 1981 placed the mean adult coho return to private hatcheries around 0.70%. This turned out to be an accurate prediction with a return of 0.78% (Table 10). Our pre-season estimate was well over the post-season or actual catch shown in Table 10 for 1982, however. Factors affecting the preseason estimate were an unusually low survival from one release site and probably the short fishing season which terminated early in the normal fishing year.

Survival of coho released from private hatcheries has probably been affected by a combination of: 1) the use of non-native brood stocks; 2) release of small smolts; and 3) stress from transportation due to release away from the primary station of rearing. In recent years, the overall survival of coho released from private hatcheries has generally improved until 1982. An apparent low survival to adults in the 1982 fishery is related to apparent problems at one release site.

A limited supply of local coho eggs and sperm has been incorporated into the private hatchery brood stock. Adaptation of the private hatcheries' coho brood stock over succeeding generations should continue to improve survival. Accelerated rearing of zero-age smolts and yearlings to a larger size is providing encouraging improvements in the survival of tagged experimental groups of coho.



Table 10. Coho released by private salmon hatchery operators, estimated catch in the ocean, return, and total survival, all sites combined, 1978-82.

Year (N) <i>a</i> Released	Number Released <i>b</i>	Catch in the Ocean (N+1) <i>a</i>	Returns to Hatchery		% Survival <i>c</i>	
			Jacks(N)	Adults(N+1) <i>a</i>	Hatchery	Total
1978	9,907,874	63,000	6,557	47,726	0.55	1.18
1979	5,811,741	53,600	1,445	27,856	0.50	1.43
1980	14,817,346	142,000	15,639	98,681	0.77	1.73
1981	23,852,408	122,100 <i>d</i>	19,098	164,614	0.78	1.29
1982 <i>d</i>	23,107,316	-	19,592	-	-	-

*a* N is year released (including summer and fall); N+1 is 2nd summer and fall after release.

*b* Includes yearling and zero-age coho released that year.

*c* Includes jacks.

*d* Preliminary data.

### Straying

Salmon show a remarkable ability to return to the site or stream where they reared as juveniles or were released as smolts. As salmon have been tagged and thereby are identifiable through their life we have found that some also stray to other streams. Information about straying is still being collected as more fish are tagged, released, and recovered as adults on the spawning ground or in hatcheries. Here we have reviewed some of the available information about straying at private hatcheries, ODFW hatcheries, to streams in Oregon, and in other areas.

Adult strays are represented by marked fish released as juveniles from public hatcheries, and from private hatcheries, but which return to other sites as adults. Some examples of adult strays captured at Department hatcheries and collection facilities are shown in Table 11 and Table 12. Prior to 1983, public hatcheries released comparatively few marked salmon, individually, relative to releases by private operators. Oregon Aqua-Foods at Yaquina has released more marked coho than ODFW coastal hatcheries so is used as an example of the occurrence of strays. Coho strays based on the occurrence of hatchery fish in the spawning population of sample sections within the Yaquina system are shown in Table 13. Strays found at various sites and streams along the coast are shown in Table 14. The proportion of strays to other capture locations and to the Yaquina system above the Oregon Aqua-Foods hatchery may not be necessarily large in comparison to the total number of coho they release relative to other hatcheries but are large in the proportion of the natural returns to the Yaquina system. We have used Oregon Aqua-Foods as an example here but the accompanying tables show that fish also stray from other hatcheries as well.

Table 11. Examples of stray salmon captured at ODFW capture sites in 1982.

Capture Location	Species	Number Caught	Release Location
<u>Columbia System</u>			
Deschutes	ChF	3	Klickitat, WA
	"	1	Trinity R., CA
	"	1	Cole Rivers, OR
	ChS	1	" " "
Bonneville	"	3	Below Bonneville
	"	1	Trinity R., CA
	ChF	1	Willamette R.
	"	3	Below Bonneville
	"	537	Other Columbia sites (OR & WA)
Bonneville Ladder	ChS	1	Snake R., ID
	"	1	N. Santiam
	ChF	1	Trinity R., CA
	"	1	" " "
	Willamette Falls	"	1
Big Creek	"	1	Bonneville
	"	1	Elk R., OR
	"	1	Trinity R., CA
	"	1	Other Columbia R.
	"	40	release sites in OR & WA
<u>Coastal</u>			
Cedar Cr.	ChS	1	Trask R., OR
	ChF	1	OAF Yaquina, OR
	Coho	1	Anad Coos Bay, OR
	Coho	3	Salmon R., OR
Salmon R.	ChF	1	Trinity R., CA
	"	1	OAF Yaquina, OR
	ChS	1	Willamette R., OR
	Coho	20	OAF Yaquina, OR
Siletz	"	1	" " "
Fall Cr.	ChS	1	Trask R., OR
	Coho	1	OAF Yaquina, OR
	"	1	OAF Coos Bay, OR
Rock Cr. (Umpqua)	ChF	1	Trinity R., CA
	Coho	1	OAF Yaquina, OR
Sixes R. (Sp. Surveys)	ChF	(see Table 12)	
Elk R.	Coho	2	Trinity R., CA
	"	1	Anad Coos Bay, OR
Cole Rivers	ChF	13	Trinity R., CA
	ChS	14	" " "
	Coho	7	" " "

Table 12. Number of fall chinook salmon from Elk River Hatchery found in Sixes River, 1970-82.

Spawning Year	Chinook Salmon Sampled	No. of Strays	Occurrence
1970-71 <i>a</i>	444	2	0.4
1971-72	135	3	2.2
1972-73	298	51	17.1
1973-74	371	16	4.3
1974-75	137	20	14.6
1975-76	165	14	8.5
1976-77	234	10	4.3
1977-78 <i>b</i>	370	14	3.8
1978-79	659	19	2.9
1979-80	1,089	81	7.4
1980-81	397	17	4.3
1981-82	136	13	9.6
1982-83	257	53	20.1

*a* 1970-1977 data from ODFW Info. Rpt. #77-6.

*b* 1977-1983 data from ODFW files.

Table 13. Oregon Aqua-Foods (Yaquina) adult coho salmon estimated to be present in the spawning population of the Yaquina River above the release site based on recovery of CWT and analysis of scale patterns, 1979-82.

Return Year	Estimated Occurrence
1979	--- <i>a</i>
1980	44% <i>b</i>
1981	75%
1982	62% <i>c</i>

*a* Few scales or tags were collected and no estimate could be made.

*b* Scale examination showed an estimated 43% of the spawners were of hatchery origin (Nicholas, et. al. 1982).

*c* Based on analysis of "0-age scales" and expanded to include yearlings (Jay Nicholas, personal communication). Few tags were found so no estimate could be made based on tags alone.

Table 14. Oregon Aqua-Foods (Yaquina) marked adult coho found at various locations in Oregon, 1980-82.

Recapture Facility or Location	Number Identified		
	1980	1981	1982 <i>a</i>
Cedar Creek Hatchery	0	0	1
Salmon River Hatchery	13	11	20
Siletz Hatchery	1	0	1
Yaquina Tributaries	23	12	10
Drift Creek (Alsea)	1	0	0
Fall Creek Hatchery (Alsea)	3	0	1
N.F. Alsea Hatchery	0	1	0
OAF, Coos Bay	3	1	0
Rock Creek (Umpqua)	0	0	1
	<u>44</u>	<u>25</u>	<u>34</u>

*a* Tags are still being processed; preliminary data.

A study of straying into private hatcheries of natural coho spawners was directed by the 61st Legislative Assembly. We examined returns to Oregon Aqua-Foods at Yaquina Bay because of the production releases made there. We found that naturally reared or wild coho do stray into private hatcheries (Table 15). More hatchery coho are found as strays on the spawning grounds than stray into the hatchery from natural runs destined for upstream spawning areas. Thus, more coho are added to the natural spawning population than are removed from it. Success of this supplementation depends on the ability of the hatchery stocks to survive in the wild. Generally, local stocks are thought to survive better than other stocks when spawning naturally.

Table 15. Estimated numbers of natural spawners entering Oregon Aqua-Foods (Yaquina), based on analysis of scale patterns, 1981-82.

Year	Number Examined	Point Estimate	Range of Estimate
1981-82	1,205	2,022	444 to 3,600
1982-83 <i>a</i>	1,204	1,129	564 to 1,693

*a* Analysis by Fisheries Research Institute in 1982, Report FRI-UW-8312, University of Washington, August 1983.

ODFW found adult coho, released at Coos Bay as juveniles, straying into Eel Lake on the mid-coast in 1982 where a hatchery stock is being developed from natural spawners. Scales were examined to separate strays and natural spawners. Strays were killed and natural stock adults were used for the egg take. Changes in release strategies at Coos Bay in 1982 should reduce the occurrence of strays in Eel Creek in 1983.

Juvenile strays. In the fall of 1982, large numbers of juvenile coho salmon were observed in tributaries of the lower Yaquina system. Examination of CWT's from 100 fish captured in Simpson Creek in November identified these fish as Oregon Aqua-Foods accelerated coho released between July 30 and September 22, 1982, at the release site in Yaquina Bay. Approximately 92% of the fish examined were released on or after August 25.

ODFW began a monitoring program to estimate the densities of these juvenile coho in four sections of Simpson Creek. The estimated density (numbers of fish found) gradually declined from a high value in November of 52 fish/m<sup>2</sup> pool area until June 1 when all of these fish had left the streams. Initially the fish were found in the lower 0.2 mile of the stream, but invaded the upper sections after increases in streamflow to where the majority of the fish were found between RM 1.2 and 2.0 of Simpson Creek by February.

In January 1983, the monitoring program was expanded to include weekly observations of fish distribution, notes on the occurrence of predation on salmon fry, periodic calculations of condition factors, and an estimate of the sex ratio of the stray juvenile coho. Fish were killed and stomachs removed to check for predation on salmon fry. Only one fry was found in each of seven stomachs (total of seven) from 845 fish examined.

ODFW district and research personnel found juvenile stray coho in 10 tributaries of the Yaquina River below RM 25 and in 3 tributaries of Big Elk Creek below RM 6 in November 1982. These fish were identified by CWT's, size, appearance, and scale pattern analysis as to origin. By March 1983, the stray coho were found only in four of the tributaries of the Yaquina River and were not found in any of the Big Elk Creek tributaries. The fish apparently left most of the streams after freshets in December and January. A more detailed account of the monitoring program and its conclusions will be available in an Information Report from the Research and Development Section of ODFW.

As a consequence of the upstream movement at Yaquina, Oregon Aqua-Foods production releases of coho in 1983 have been restricted to a period before August 20 because the majority of the upstream migrants were found to be from later releases in 1982. Return of adults and tagged fish caught in the ocean showed that survival of experimental groups released after August 20 in 1978, '79, and '80 was excellent and we intend to allow further experiments with small marked groups. The restriction of the 1983 releases of coho by Oregon Aqua-Foods will mean some

five million fewer smolts will be released than were produced in 1982 and could therefore mean fewer adult coho available to ocean fisheries in 1984.

General. Recent observations have increased awareness of the extent of straying and show that hatchery and natural stream populations are continually mixing to some degree when they return as adults. Finite estimates of all salmon straying have not been made, but it appears that hatchery coho in upstream spawning areas more than replace those that may be strays into the hatchery on their way to the spawning grounds. In future years as hatchery fish continue to move upstream and spawn naturally in the stream, the wild fish may resemble hatchery fish; i.e., these stocks may show genetic similarity. ODFW staff believes it is desirable to have new hatchery populations genetically similar to the fish in the stream where the hatchery is located. This means that new hatcheries (public and private) should be developed with local or acceptable hatchery stocks. Hatchery managers must also continue to take seed from throughout the return cycle rather than from only one segment or size of fish in the run to maintain diversity and preclude changing age regimes of returning fish. This will help in maintaining a high rate of survival of hatchery and wild stocks.

Stray adult chinook have also been found on the spawning grounds above both state and private hatcheries and in streams other than hatchery streams. Hatcheries, both public and private, are contributing to natural spawning stocks even when all smolts are released at the hatchery. It appears that we must manage a stream system on which a hatchery is located as a management unit for both hatchery and wild (natural spawning) fish of the species released by the hatchery rather than for wild stocks alone. ODFW intends to manage hatchery transfers on a stock (or stock group) basis, as outlined in the coho plan, for all species in the future.

ODFW personnel will continue to examine salmon carcasses in 1983 during routine and special spawning fish surveys to look for tagged fish. Scales will be collected from some nontagged fish in hatchery and adjacent streams in an effort to detect hatchery strays. ODFW will work toward use of more local and localized stocks for developing brood stock at both state and private hatcheries. The practice of developing separate stocks along the coast is consistent with the recently adopted coho plan and other species plans being developed by ODFW and should reduce the concern for straying in the hatchery stream system. Use of local stocks increases the value of strays to supplement the natural runs. Survivability of local stocks is thought to be better in run timing and other genetic characteristics than are other stocks. For instance, the imported stock at Yaquina returned earlier than Oregon stocks.

#### Size at return

Coho operators have experimented with size and time of release in an attempt to determine optimum sizes at which to release smolts during the

year to improve the size of returning adults. The operators report larger coho returning as they define and improve release strategies. We have good number and weight data from reports which must be submitted with tax payments by private operators for all salmon returning to private hatcheries. Adult coho size, at return to private hatcheries, averaged 4.8 pounds in 1978; 4.7 pounds in 1979; 5.2 pounds in 1980; and 6.4 pounds in 1981. The size of coho adults returning to private operators in 1981 averaged 1.98 pounds smaller than a combined sample of 298 adults sampled at Bonneville, Big Creek, and Cole Rivers hatcheries.

Returns, averaging 5.6 pounds each, in 1982 continued to be smaller than were coho adults returning to public hatcheries. Chinook adults returning to private operators are comparable to those of the same age group returning to public hatcheries, however.

### SUMMARY

Coho production increased during 1982 but will decline below the 1981 level in 1983. Chinook production is increasing overall, but the effort to raise chinook at this time is not consistent among all operators. Most chum permittees are still attempting to increase production but poor egg availability limits development.

ODFW evaluation of private operations continues to use survival of fish to adults as the basic indicator of success. Survival estimates for coho include both fish caught in the ocean and those returning to the recapture facilities. The operators, however, look more to returns to their facilities for evaluation of their success and seed for further development. ODFW must also rely on private hatchery returns to evaluate chum production and to some extent to evaluate success of chinook at this time. None of the private operators have indicated their returns to be at a profitable level, although return rate and overall survival is improving to some extent each year.

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