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PRIVATE SALMON HATCHERIES
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; US 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 US 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 data. 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 recent developments, progress in 1981, with summaries of 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 permits have been issued for pink salmon. ODFW has authorized Oregon State University (OSU) to test the feasibility of producing pink salmon in Oregon with a cooperative study funded by Oregon Aqua-Foods.

In early 1982 Oregon Aqua-Foods and Anadromous came to us with a request for help in resolving a problem they have at Coos Bay. Their sites are located about 3.8 miles apart, on the same side of the bay, and both draw water from

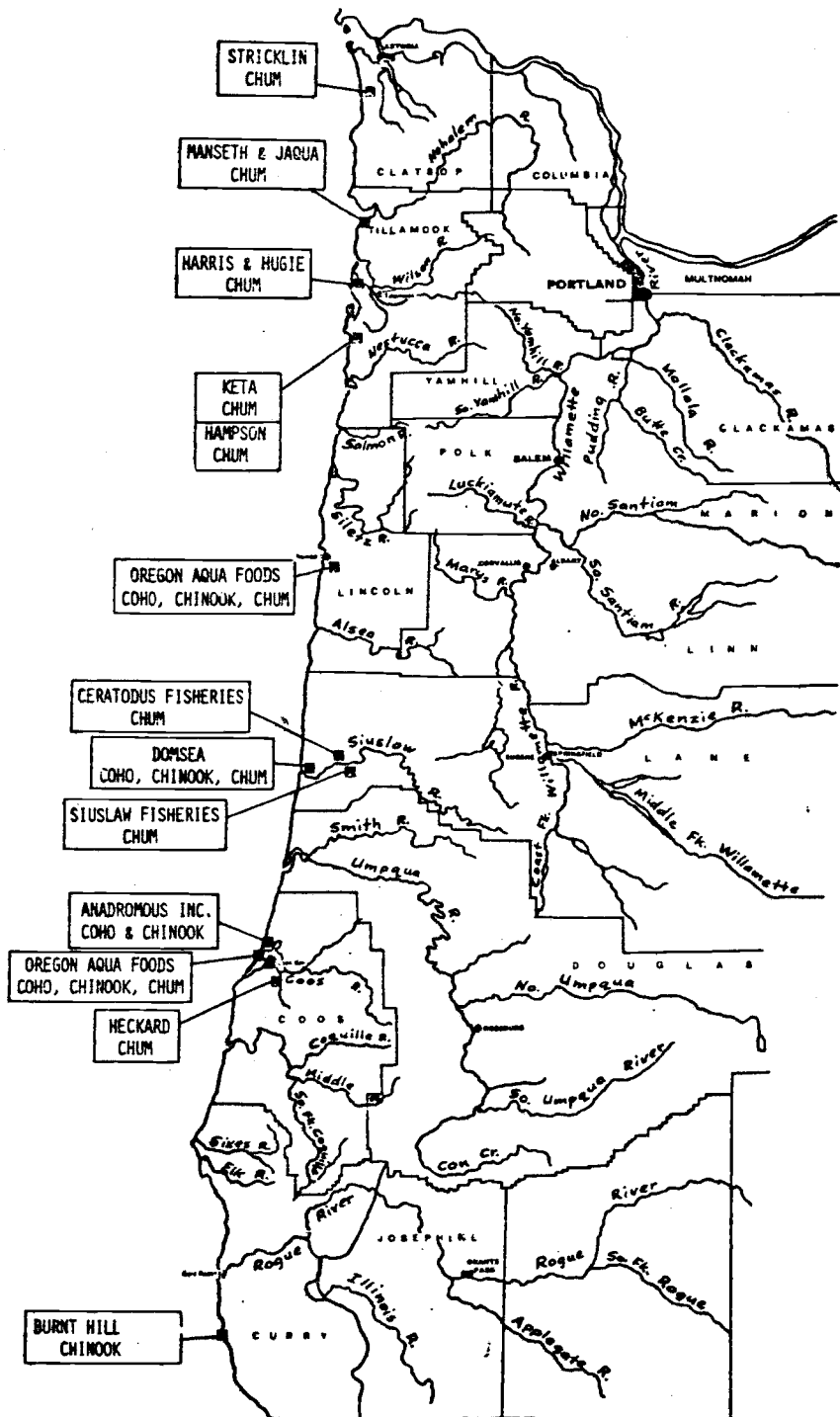


Figure 1. Location of Authorized Private Salmon Hatcheries in Oregon

Table 1. Oregon Private Salmon Hatcheries, March 1, 1982.

Name	Location	Permit Date	Release Limit by Brood and Species (Millions)				Priority ^{1/} for Chum
			Coho	Chinook	Chum	Pink	
Keta, Inc. 22930 Sandlake Rd. Cloverdale, OR 97112	Sand Cr., Sand Lake	12/01/71			5.0		0 ^{2/}
Siuslaw Fisheries, Inc. 31766 Freedom Lane Eugene, OR 97401	Sweet Cr., Siuslaw R.	3/19/72			5.0		0 ^{2/}
Alfred Hampson 505 Pacific Bldg. 520 SW Yamhill St. Portland, OR 97204	Sand Cr., Sand Lake	10/31/73			5.0		1
Cecil Harris and Don Hugie 3460 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.	12/28/73			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. 203 S. Columbia River Hwy. St. Helens, OR 97051	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 Stricklin Rt. 1, Box 538 Warrenton, OR 97146	Unnamed Trib., Skipanon Rd.	3/4/76			5.0		9
Domsea Farms, Inc. 510 Washington Ave. Bremerton, WA 98310	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		

- 1/ Priority for Oregon chum salmon eggs based on date of application or permit issue.
2/ Priority for chum salmon eggs expired with 1979 brood.
3/ No limits. Assume 5 million and review if they reach that point.
4/ Permit authorized at Keta's site and combined with Keta for records.

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 in the normal cycle of the tide. In 1981, Oregon Aqua-Foods reported some 17,000 coho adults returned from a release of 5.4 million smolts, while Anadromous had nearly 28,000 coho adults enter their facility and they had released only 1.5 million smolts. Tagged fish in these returns showed them to be of mixed origin. The companies for 2 years 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 Fish and Wildlife Commission discussed this proposal and authorized Anadromous to operate the Oregon Aqua-Foods site at Coos Bay during an evaluation period 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 (21 million total permitted) at their Yaquina site. The companies will be operating within their existing permit numbers for species 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 would come to the Department with a request to change their permits and sites as appropriate for continued operation.

Domsea Farms has notified the Department that they are considering sale of their experimental site on the Siuslaw. This site is permitted for 12 million each coho and chinook, and 25 million chum salmon per brood year. However Domsea has released fewer than 2 million salmon, in total of all species, since they began operations in 1978. In 1981 they released 33,000 fall chinook, 158,000 coho, and 176,000 chum salmon.

The chum salmon released by Domsea in 1981 were reared from eggs collected at Siuslaw Fisheries site on Sweet Creek, Siuslaw River, and represent all seed available from adults returning to this site in 1980. Siuslaw Fisheries has closed their freshwater rearing facility in the Willamette Valley where they formerly reared their own chum with coho and chinook, under contract, for other operators. Sale of their seed stock suggests that Siuslaw Fisheries is continuing to reduce their operations.

Brood Stock

Operators are responsible for obtaining their own eggs to meet production needs. Transfer of eggs and stocks is controlled by ODFW through review of production proposals; then, import, fish transport, and individual release permits. 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 we (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.

ODFW operates traps to collect eggs for the state salmon production programs and, in some cases, 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. However even these can be expensive with annual cost to the private operator approaching \$10,000 for ODFW to construct, operate, and supervise an individual facility.

We have attempted to collect chinook and chum eggs through these projects. If trapping is successful, i.e., the operator is able to obtain eggs, they must raise a designated portion of the fish for return to ODFW and planting back into the stream. In several years most of the eggs collected were returned to meet this requirement. We have used some of these facilities to trap wild coho for the Salmon Trout Enhancement Program (STEP) but no wild coho have been provided to private salmon hatchery operators for their use.

Eggs surplus to ODFW programs can be sold. Our programs include egg collection for hatchery smolt production, fingerings for supplementing stream production, and eyed eggs for our STEP program. 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 our annual program. If our program needs are met and additional eggs are available, they become surplus and we sell them in accordance with egg sale guidelines adopted by the FWC. A comparison of eggs taken at our coastal hatcheries and those sold to private salmon hatchery operators is shown in Table 2. We have not been able to fill all requests for eggs in any year.

We allowed operators to import coho eggs from Puget Sound through the 1980 season. This practice was not allowed in 1981. Future imports will be allowed 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 stock.

Operations

Chum salmon

The first private hatchery permits issued were for chum salmon. The incentive here is the comparatively small size at which chum migrate to the ocean and a limited requirement for rearing prior to release. 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 would be 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.

Table 2. Salmon Eggs Taken at ODFW Coastal Stations and Numbers Sold to Private Operators, 1973-80 Broods

Species	Fall Chinook	Spring Chinook	Coho
Brood Year			
1973	4,366,800 ^{1/} (11.7) ^{2/} (510,915) ^{3/} ^{4/}	2,068,900 (0) (0)	9,613,100 (5.3) (509,495)
1974	2,422,400 (0) (0)	1,984,883 (6.3) (125,050)	8,347,882 (9.0) (751,310)
1975	3,488,100 (20.8) (725,525)	2,610,300 (11.8) (308,015)	5,667,600 (5.6) (317,385)
1976	436,536 (0) (0)	2,592,078 (10.1) (261,800)	9,167,383 (25.2) (2,310,180)
1977	3,832,348 (14.1) (540,360)	2,948,986 (7.1) (209,380)	7,394,065 (1.1) (81,335)
1978	3,214,348 (0) (0)	4,845,104 (44.4) (2,151,230)	6,223,090 (0.2) (12,445)
1979	2,992,506 (13.2) (395,010)	4,809,160 (40.2) (1,933,280)	22,747,394 (25.8) (5,868,825)
1980	3,135,009 (12.9) (404,415)	6,587,306 (39.1) (2,575,635)	19,741,631 (14.4) (2,842,795)
1981 ^{5/}	(2,780,428) (0) (0)	(3,251,847) (12.6) (411,786)	(12,184,136) (0) (0)
Total	(26,668,475) (9.7) (2,576,225)	(31,698,564) (25.2) (7,976,176)	(101,086,281) (12.6) (12,693,770)

^{1/} Number of eggs taken.

^{2/} Percentage sold: Percentages are misleading in some cases because additional eggs were taken specifically for sale as viable eggs as opposed to selling unspawned carcasses.

^{3/} Number of eggs sold.

^{4/} 27,000 released as smolts with the remainder harvested for sale as pan-size juveniles.

^{5/} Preliminary data

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 stocks of chum, and imports are allowed. Most of the chum salmon released (Table 3) by private operators have come from 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 the last 10 years from release of unfed fry to rearing and release of fingerlings. Rearing, prior to release, is now thought to be the better practice but this cannot be validated by most recent returns. Perhaps return of chum now at sea will give us a better insight to practices necessary to produce viable hatchery chum runs on the Oregon Coast.

Chum salmon have been released by 7 operators (Table 5). Three of these releases should be considered tests. Operators have reported variable rates of return with at least 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 to develop and improve chum runs 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. Large numbers of surplus eggs have not been consistently available, however.

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 eggs and rear up to 1 million chum for 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.

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 with only 272,500 eggs collected (1 million goal) in 1981. A portion of the resultant fingerlings are released into Coal Creek and adults are released upstream during trapping

Table 3. A Summary of Salmon Releases By Private Salmon Hatchery Operators in Oregon, 1972-81.

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 ^{1/}	23,852,408	1,755,892	499,828	5,528,589	31,636,717
Total	59,069,707	4,646,412	2,866,797	20,760,346	87,343,262

^{1/} Preliminary data.

Table 4. Return of Salmon to Private Facilities, Sites Combined, 1978-81.

	1978	1979	1980	1981
Chinook Adults	213 ^{1/} (3,952) ^{2/}	271 (2,872)	752 (9,386)	2,588 (35,860)
Chinook Jacks	31 (23)	145 (519)	2,642 (7,179)	2,499 (6,046)
Coho Adults	8,069 (38,903)	47,726 (225,105)	27,856 (146,263)	98,681 (631,619)
Coho Jacks	6,557 (15,736)	1,445 (2,224)	15,639 (31,922)	19,681 (42,070)
Chum	539 (4,841)	14 (110)	545 (4,815)	477 (4,053)

^{1/} Number.

^{2/} Pounds.

Table 5. Salmon Releases by Individual Private Salmon Hatchery Operators, 1972-81.

	Year of Release											
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	Total	
Harris & Hupie (Tillamook Bay)												
Chum		8,000	9,600	9,000								26,600
Total		8,000	9,600	9,000								26,600
Keta Corporation 1/ (Sand Lake)												
Chum	51,150	251,875	311,300	1,160,000		98,000	403,000	1,005,000		1,413,000	4,693,325	
Total	51,150	251,875	311,300	1,160,000		98,000	403,000	1,005,000		1,413,000	4,693,325	
Oregon Aqua Foods, Inc. (Yaquina Bay)												
Spring Chinook				5,551	161,251	42,079	15,790	886,588		89,026	1,200,285	
Fall Chinook			27,000	17,982	147,662		393,202	141,034	151,915	249,254	1,128,049	
Coho			87,782	142,032	1,170,875	1,376,048	8,898,287	3,894,344	7,584,916	11,925,359	35,079,643	
Chum	7,000	33,182	33,182	323,930	2,447	14,900	2,174	684,245		3,179,589	4,247,467	
Total	7,000	147,964	147,964	489,495	1,482,235	1,433,027	9,309,453	5,606,211	7,736,831	15,443,228	41,655,444	
Siuslaw Fisheries, Inc. (Sweet Cr, Siuslaw R)												
Chum	9,500	221,000	221,000	800,000		7,500	60,000	1,038,600	8,000	110,000	2,254,600	
Total	9,500	221,000	221,000	800,000		7,500	60,000	1,038,600	8,000	110,000	2,254,600	
Ceratodus Fisheries (Divide Cr, Siuslaw R)												
Chum				500,000							500,000	
Total				500,000							500,000	
Domesa Farms, Inc. (Siuslaw Bay)												
Fall Chinook							399,858	738,211	91,206	33,662	187,326	
Coho									240,920	157,680	1,536,689	
Chum							399,858	800,669	332,126	367,342	1,899,995	
Total							399,858	800,669	332,126	367,342	1,899,995	
Oregon Aqua Foods, Inc. (Coos Bay)												
Spring Chinook								312,907		112,199	425,106	
Fall Chinook						86,237		241,826	5,445,791	10,870,247	16,644,101	
Coho								8,212,354	8,212,354	8,212,354	24,637,062	
Chum						86,237		8,767,087	5,445,791	11,025,097	25,324,212	
Total						86,237		8,767,087	5,445,791	11,025,097	25,324,212	
Anadromous, Inc. (Coos Bay 2/)												
Spring Chinook								197,636	633,998	616,067	1,447,701	
Fall Chinook				991,277			128,899	19,319	95,983	174,261	1,409,739	
Coho					908,959	908,405	609,729	937,360	1,545,719	899,122	5,809,294	
Chum					908,559	908,405	738,628	1,154,315	2,275,700	1,689,450	8,666,734	
Total					908,559	908,405	738,628	1,154,315	2,275,700	1,689,450	8,666,734	
Burnt Hill Salmon, Ltd. (Burnt Hill Cr)												
Spring Chinook								634,720		938,600	1,573,320	
Fall Chinook								99,032			99,032	
Total								733,752		938,600	1,672,352	
Manseth and Jacque (Nehalem Bay)												
Chum										650,000	650,000	
Total										650,000	650,000	
Total												
Spring Chinook				5,551	161,251	42,079	15,790	1,397,131	1,268,718	1,755,892	4,646,412	
Fall Chinook			27,000	1,009,259 ^{2/}	147,662		522,101	222,811	438,136	499,828	2,866,797	
Coho			87,782	142,032	2,079,834 ^{2/}	2,370,690	9,907,874	5,811,741	14,817,346	23,852,408	59,069,707	
Chum	51,150	276,375	575,082	2,792,930	2,447	14,900	465,174	10,940,199	8,000	5,528,589	20,760,346	
Total	51,150	276,375	689,864	3,949,772	2,391,194	2,533,169	10,910,939	18,371,882	16,532,200	31,636,717	87,343,262	

1/ Includes releases made on permit issued to Alfred Hamson.
2/ 1975 and part of 1976 releases were made at Columbia River location prior to Columbia River permit being terminated.

to maintain natural production. 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.

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. A total of 2.87 million fall chinook have been released at 5 sites, mostly since 1978 (Table 5). Earlier releases included 0.99 million smolts by Anadromous at their Columbia River site in 1975, prior to termination of this permit and development of their present Coos Bay site. This leaves a total of 1,875,520 fall chinook smolts released at the 5 coastal sites since 1974.

In 1977 we began to collect eggs from wild fall chinook under projects financed by private operators. Individual operators have provided funds for ODFW to collect a total of 1,467,027 fall chinook eggs over a period of 5 years and at 4 separate sites (Table 6). We have received a total of 296,000 chinook smolts, for release back into the stream where eggs were taken, as replacement for natural production. This is some 20% of the eggs collected and probably closer to 30% of the smolts surviving after incubation and rearing loss. It is normal to experience a higher loss in handling eggs from wild stocks than is the case when eggs are taken at a hatchery where they are incubated.

ODFW has sold a total of some 2.0 million surplus hatchery fall chinook eggs to private operators for release along the coast. Table 2 shows a larger total, but this includes eggs used by Oregon Aqua-Foods in their pond rearing program prior to 1976. Diversion of these eggs to another program and poor success in handling eggs and fingerlings, initially, preclude use of these data to determine production success. All operators have improved their husbandry practices in recent years to better handle fall chinook and returns appear to be improved over those from earlier releases.

Recovery of CWT from fall chinook caught in ocean fisheries show an increasing contribution to these fisheries as chinook production is increased by private operators. Future production of 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.

Table 6. Eggs Taken from Wild Fall Chinook
for Stock Assessment and Brood Stock Development
Program in Cooperation with Private Operators, 1977-81

Cooperating Company	Anadromous	Oregon Aqua Foods	Burnt Hill	Domsea	Total
Brood Year					
1977	--	62,040 (18,810) ^{1/} Yaquina River	--	--	62,040 (18,810)
1978	185,402 (25,476) Coos River	169,725 (26,343) Yaquina River	--	288,000 (26,343) Stuslaw River	643,127 (78,162)
1979	--	--	150,000 (24,296) Lobster Creek	188,000 (24,739) Stuslaw River	338,000 (49,035)
1980	--	69,000 (25,000) Tioga Creek	30,000 (25,000) Lobster Creek	80,000 (25,000) Stuslaw River	179,000 (75,000)
1981	--	90,900 (25,000) ^{2/} Tioga Creek	31,000 (25,000) Lobster Creek	122,960 (25,000) Stuslaw River	244,860 (75,000)
Total	185,402 (25,476)	391,665 (95,153)	211,000 (74,296)	678,960 (101,082)	1,467,027 (296,007)

^{1/} Smolts returned to ODFW for release in stream of origin to replace eggs taken.

^{2/} Due back to ODFW as smolts in the fall of 1982.

Oregon Aqua-Foods sold fall chinook eggs taken from adults returning to their Yaquina facility in 1981. We would not allow transfer of this stock to other Oregon sites and the company told us they must put available funds into coho production. The company retained and is rearing over 100,000 fall chinook for release at Yaquina in 1982. This should be an adequate seed base upon which the company can expand if they choose to do so in the future.

Spring chinook. To date, private operators have released a total of some 4.6 million spring chinook, mostly in the last 3 years. Early returns of Rogue stock spring chinook indicate these could contribute well to Oregon ocean fisheries and to private operators (Garrison, personal communication). Most of these spring chinook will be contributing to the fisheries and returns in 1982 and thereafter as age-3 and 4 adults.

Releases of spring chinook have been authorized at 4 sites. These have been smolts from eggs surplus to ODFW hatchery needs. 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 Oregon Aqua-Foods have successfully matured spring chinook. Burnt Hill realized a good return of spring chinook jacks in 1981 and expects to hold adults, in 1982, for spawning. The companies should be able to develop their own brood stocks if necessary.

Coho

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. Releases total 87.3 million coho, from the 4 permitted sites, since 1974.

Operators have released both yearling (reared about 15 months) and zero coho (released within the first year of life). 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 is shifting to only zero coho as they identify husbandry practices necessary to obtain improved return rates. Overall returns to the four sites have improved each year to about 0.7% average in 1981. Survival of some treatment groups have been higher and most operators report they are encouraged by continued improvements.

Evaluation

Most of our evaluation effort has been with coho. Operators have contributed funds for a variety of studies including adult straying, estuary residence of juveniles, and ocean contribution by salmon released from private hatcheries.

Coho survival rates. The following analysis is primarily from a review of private and state hatchery returns by Bob Garrison of ODFW's research staff (Personal Communication). Private operators are required to submit release and return data to ODFW. Data have been selected from among many release groups for illustration.

As a result of a shortage of locally adapted coho brood fish to provide the initial production lots of seed, eggs were imported on an experimental basis from Puget Sound prior to 1981. A variety of stocks, fish sizes, and times of release were identified with coded wire tags (CWT) prior to release. The average and range of adult returns shown in Table 7 included coho released as yearlings but were mainly zero-age smolts when released (yearling coho are normally released at public hatcheries). During the same period of time tagged coho returned to Fall Creek Hatchery, Alsea River, at a higher but also increasing rate (Table 8). The wide variation which occurred in the return rates of tagged coho to the Oregon coastal public hatcheries during 1980 (Table 9) is typical of the variation in most years. Comparison of 1977 brood ODFW coastal yearling coho release data (May 1979) and return data in 1980 gives an apparent positive relationship showing release of larger fish improves survival. Returns of coho released at zero age shows similar results and suggest improved return of fish reared longer at the release site (Table 10). Comparison of returns for tagged private hatchery coho in 1979 and 1980 gives a comparable relationship regardless of age (zero or yearling) at release.

Survival of locally adapted brood stocks has generally been better than from imported eggs. The average return and observed catch during 1980 of the 1978 brood coho from multiple tag groups of Siletz (local) stock was 1.76% compared to only 0.29% for progeny from brood stock imported from Puget Sound, in the CWT Groups examined (Table 11). Part of this disparity in survival may have been caused by poor quality eggs purchased for import in 1978 and the use of 'adapted' Siletz stock for comparison.

The general practice of rearing smolts at a freshwater hatchery some distance inland and then transporting them to the private saltwater recapture facility shortly before release may also be contributing to low survival. Limited ocean survival data from marked public hatchery coho transported for release away from the hatchery suggest they did not survive like fish released at the rearing station. Groups of marked Alsea River coho released off-station in Alsea tidewater and Floras Lake were caught in the ocean fisheries at a rate of 3.09% and 2.10%, compared to a similar marked group released on-station at the Fall Creek Hatchery that contributed 5.01% to the ocean catch. Fish transferred for extended rearing and release at another hatchery exhibit survival similar to that of fish released on-station. More work is needed to overcome this apparent problem related to transporting fish just prior to release.

As progeny from the initial coho releases become better adapted to the environment and husbandry practices, an increase in survival rate is occurring (Table 12). The operators are 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 rate to private hatcheries around 0.70%. This turned out to be an accurate prediction with a return of 0.77%.

Table 7. Percentage return of adult coho released from private hatcheries, sites combined, 1978-1981.

	Year of Return				
	1977	1978	1979	1980	1981
Average return to private hatcheries	0.28	0.49	0.47	0.51	0.77 ^{1/}
Return of individual marked groups ranged from 0.00 up to -		1.61	2.06	1.93	1.90

^{1/} Preliminary

Table 8. Percentage return of coho to Fall Creek Hatchery in 1978-1980.

Release period	Year of Return		
	1978	1979	1980
March	0.42	0.86	0.82
May	---	---	1.00

Table 9. Percentage return of CWT coho to Oregon coastal public hatcheries, 1980.

	Nehalem	Trask	Salmon	Siletz	Fall Cr.	Cole R.
Date Released, 1977						
March 15	0.27	0.29	1.02	0.75	0.82	1.64
May 1	0.11	0.72	1.33	0.59	1.01	2.18

Table 10. Catch rates in the 1981 Oregon ocean fisheries of 1979 brood zero age tagged coho released by Oregon Aqua-Foods, Inc., in 1980.

Smolt group	Release date	Mean wt. gms		Estimated % catch in ocean fisheries
		Transferred to salt water	Mean wt. gms. when released	
Presmolt	6-28-80	14.3	18.9	0.53
Small smolt	6-28-80	15.2	18.9	0.97
Large smolt	6-28-80	16.1	18.9	0.98
Presmolt	8-05-80	11.2	25.9	0.14
Small smolt	8-05-80	13.9	25.9	0.44
Large smolt	8-05-80	18.6	25.9	1.09
Presmolt	8-25-80	20.8	30.8	0.39
Small smolt	8-25-80	23.2	30.8	0.87
Large smolt	8-25-80	26.9	30.8	2.26

Table 11. The 1980 return and observed ocean catch of marked 1978 brood "0" age coho smolts released during 1979.

Stock	Number Released	Returned to hatchery		Observed in ocean catch ^{1/}		Total observed recovery	
		#	%	#	%	#	%
Puget Sound (6 tag groups)	41,627	78	0.19	41	0.10	119	0.29
Siletz (76 tag groups)	101,484	922	0.91	860	0.85	1,782	1.76

^{1/} Observed tag recoveries are not expanded for sampling rate.

Table 12. Coho released by private salmon hatchery operators, estimated ocean catch, return, and total survival, all sites combined, 1978-81.

Year(N) ^{1/} Released	Number Released ^{2/}	Ocean Catch (N+1) ^{1/}	Hatchery Return Jacks (N)	Return Adults (N+1) ^{1/}	% Survival 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	98,573	0.77	1.73
1981	23,852,408	-	19,030	-	-	-

^{1/} N is year released (including summer and fall); N+1 is 2nd summer and fall after release.

^{2/} Includes yearling and zero age coho released that year.

The early low survival rates of coho released from private hatcheries in comparison to coho released from public hatcheries was probably the result of a combination of: 1) the use of non-native brood stocks, 2) release of under-sized smolts, and 3) stress from transportation due to release away from the primary station of rearing. In recent years the survival of coho released from private hatcheries has improved and is now more comparable to releases from public hatcheries. A limited supply of local coho eggs and sperm have been incorporated into the private hatchery brood stock. Adaptation of the private hatcheries' coho brood stock over succeeding generations has also helped and should continue to improve survivals. 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 released.

Straying of adult salmon. In 1980 ODFW research personnel examined spawning salmon in the Yaquina Watershed to determine the extent to which straying of hatchery fish occurred. Analysis of tagged fish and scale samples indicated that slightly less than half of the natural spawning population originated from release of smolts at Oregon Aqua-Foods near the mouth of Yaquina Bay. These fish spawned throughout the Yaquina System with peak abundance occurring in November. Wild spawners were present from November through January with peak abundance in December. A few marked strays were also found at ODFW hatcheries on Salmon River and on the Alsea System (Jay Nicholas, report in progress).

Spawning fish were again examined in 1981. These data have not been fully analyzed but suggest that some three-fourths of the coho found on the Yaquina System were strays. The actual rate of straying past the hatchery in 1981 may have been lower than it was in 1980 however (Jay Nicholas, personal communication). Returns of coho adults and jacks to Oregon Aqua-Foods in 1981 were nearly double those of 1980 while numbers of natural spawning coho in coastal stream survey areas declined by about one-third from 1980 to 1981 (Alan McGie, personal communication).

Scales were collected from unmarked coho entering Oregon Aqua-Foods facility in 1981. These were examined to determine if naturally reared coho entered the hatchery. The analysis showed 4% of these unmarked fish may have originated outside the hatchery. The 95% confidence interval for this estimate is 4 ± 3.2 (Lisa Van Dyke, personal communication).

~~We have not been able to make finite estimates of coho straying 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. Few salmon are attracted into a hatchery when the species considered is not reared at that site.~~

Stray adult chinook have also been found on the spawning grounds above both state and private hatcheries and in streams other than hatchery streams. The use of local or nearby hatchery adults continues to be important in developing hatchery brood stocks.

Hatcheries, both public and private, are contributing to natural spawning stocks even when all smolts are released at the hatchery. It also 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.

We will continue to examine fish carcasses during routine 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. We do not intend to continue an attempt to quantify the proportion of strays. Instead, we will work toward use of more local and localized stocks for seed at hatcheries 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.

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 their facilities. 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 did 298 sampled at Bonneville, Big Creek, and Cole Rivers hatcheries.

Ocean contribution. ODFW has estimated ocean harvest of coho for several years. Private hatchery operators have tagged large numbers of salmon and contributed funds toward our program to recover and process tags from fish landed by fishermen along the coast. We estimated contribution of coho, originating from private operators, to the ocean fisheries to be 63,000 in 1979, 53,600 in 1980, and 142,000, or 13% of the harvest in 1981 (Table 12). This was about 1.4 fish caught for each coho returning to the private hatcheries in 1981.

The 1982 contribution is predicted to be 193,000 coho or about 24% of the harvest. This estimate will be revised, with early tag recovery data, during the 1982 season. The evolving husbandry practices and release strategies, used by private operators, preclude making exact pre-season estimates of contribution. However, our estimate for 1981 was very good and with more experience, based on stabilized procedures, stocks, and returns, we should be better able to predict contribution before the ocean fishing season starts.

Over-all survival, including ocean contribution, of coho released by private operators remains below that of state hatcheries where yearling coho programs are followed. However, each year improved success in rearing and returns are reported. Most operators continue to be optimistic as they develop their respective programs.

Some private salmon hatchery operators continue to develop mainly coho programs. They tell us that they must reach projected release levels soon in order to determine economic feasibility of their operations. Other operators say they are awaiting eggs, better financial position of backers, or success by someone else before they begin or increase production. Several report that funding is becoming more difficult to obtain. However, if inquiries are an indication, there are still people interested in entering the private hatchery business. A moratorium prohibits new operations beyond existing permitted sites but this does not preclude more people becoming involved within existing permits and sites.

SUMMARY

Coho production increased during 1981 but will probably remain about the same in 1982. Chinook production is increasing overall, but the desire to raise chinook at this time is not consistent among the operators. Most chum permittees are attempting to increase production but poor egg availability continues to control development.

1981 has shown improved husbandry, better survival of coho and chinook, and an apparent improvement in availability of their own seed stock for some operators. Others are not actively attempting to obtain eggs or increase production. Although gains were made in several areas during 1981, funding and egg supplies are still reported to be the main factors controlling development or expansion.

ODFW evaluation of private operations continues to use survival of fish to adults as the basic indicator of success. Survival estimates include both fish caught in the ocean (mainly coho, now) and those returning to the recapture facilities. The operators, however look to returns to their facilities for evaluation and seed for further development. None of the private operators have indicated their returns to be at a profitable level.