STATUS OF CHEHALIS RIVER SALMON AND STEELHEAD FISHERIES AND PROBLEMS AFFECTING THE CHEHALIS TRIBE

A Report by the Fisheries Assistance Office , U.S. Fish and Wildlife Service , Olympia, to the Confederated Tribes of the Chehalis Reservation, Oakville, Washington

by
Joe Hiss, Fishery Management Biologist
John Meyer, Fishery Management Biologist
Ralph Boomer, Project Leader

April, 1982

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

Special thanks are due to Ms. Della McCrowell for typing many drafts of this report, to Ms. Chris Gurnard for assisting with the graphics, and to Ms. Michelle LaGory for designing the cover.

STATUS OF CHEHALIS RIVER SALMON AND STEELHEAD FISHERIES AND PROBLEMS AFFECTING THE CHEHALIS TRIBE

INTRODUCTION

The Chehalis Tribe has traditionally fished the Chehalis River for salmon and steelhead on their reservation near Oakville, Washington. In the summer of 1981 the Washington Department of Fisheries (WDF) recommended a closure of the tribe's fall chinook fishery. The tribe, having no biological staff, asked the Bureau of Indian Affairs (BIA) for assistance in evaluating the closure. The BIA requested the United States Fish and Wildlife Service (USFWS) to advise the tribe on the status of the salmon and steelhead stocks and to examine the reasons for the WDF management recommendations.

This report: (1) briefly describes the history and present condition of the salmon and steelhead stocks now fished by the Chehalis Tribe, (2) examines WDF salmon management techniques for Grays Harbor, (3) evaluates the potential for artificial enhancement in the upper Chehalis River watershed, and (4) gives a brief outline of the most obvious environmental conditions affecting these runs. References to the "terminal area" include all Grays Harbor rivers and open waters, references to "Chehalis system" include all Grays Harbor rivers and open waters except the Humptulips and WDF Management Area 2C; "upper Chehalis" refers to all waters at or above the Chehalis Reservation, and "lower Chehalis" refers to the rest of the Chehalis system below the reservation (Figure 1).

STOCK STATUS

The Chehalis Tribe harvests chinook, chum and coho salmon plus steelhead trout, all of which migrate past the reservation. Normal-timed coho and winter steelhead yield the largest part of the tribal catch, followed by chum and fall chinook (Table 1). Catches of spring chinook and late coho are much lower than the other species. The tribal fishery is presently confined to the reservation boundaries, upstream from the most productive tributary streams.

Trends in the Chehalis tribal catch and Chehalis tribal catch-per-landing were examined as possible indicators of long-term changes in run size and escapement. Catch-per-landing was considered only when more than 40 landings were made. (The run size is the number of fish available to a fishery. The percent actually caught is the exploitation or harvest rate, and the number escaping upstream to spawn is the escapement). It was assumed that the size of the tribal catch was proportional to run size into the upper

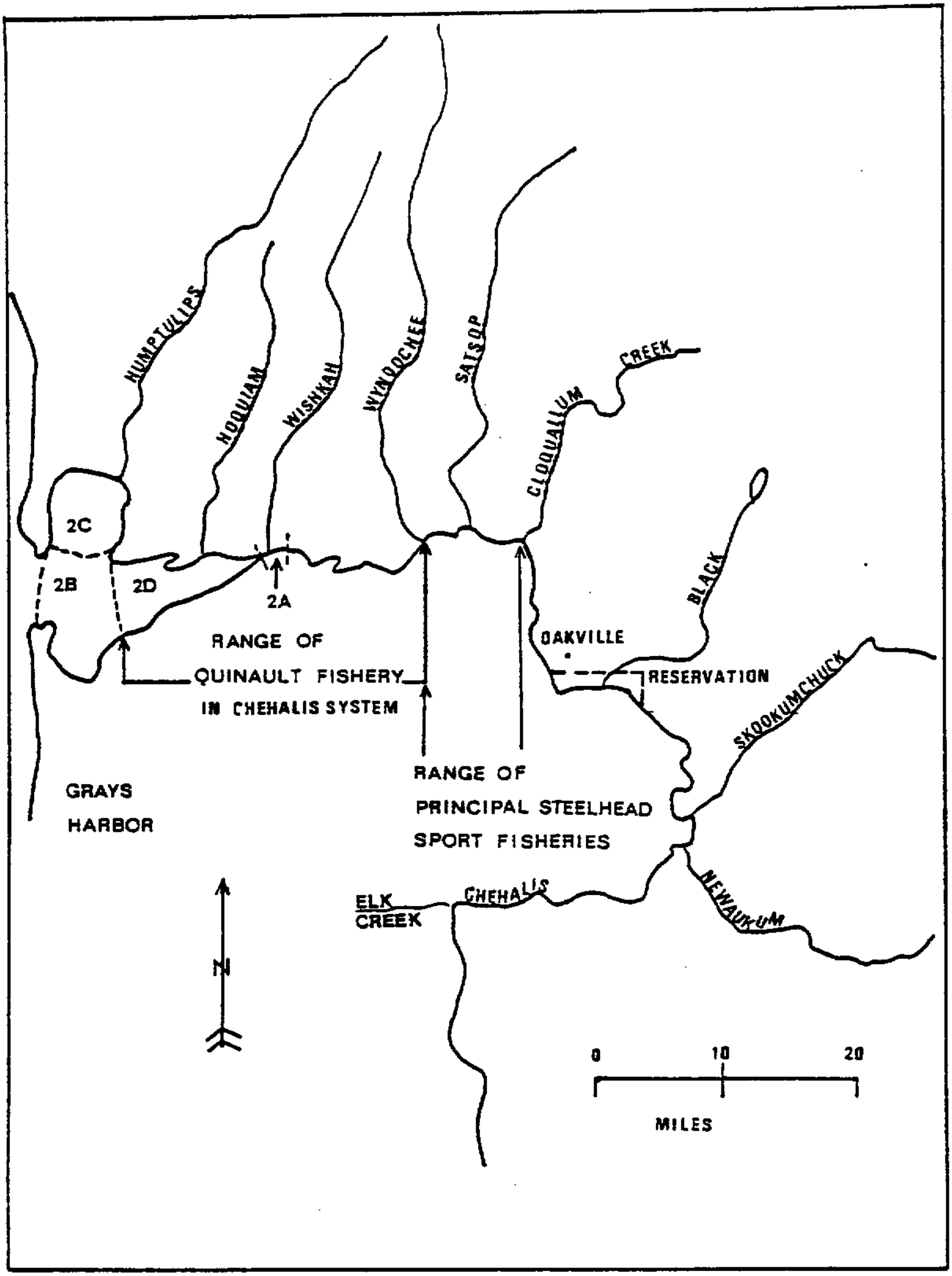


FIGURE 1. Grays Harbor fishing areas and major tributaries.

Table 1. Chehalis tribal average catch 1972-81.

Run	Number	Percent
Winter steelhead	3,100	35.5
Normal-timed coho	2,786	31.9
Fall chinook	1,071	12.3
Chum	906	10.4
Spring chinook	526	6.0
Late coho	335	3.8

Source: Salmon-1972-79: WDF hard data; 1980-81: WDF soft data.
Steelhead-WDG unpublished data.

Chehalis. However, exploitation rates of the tribal fishery are unknown. Significant changes over time could create a false picture of trends in abundance.

Trends were seldom clear and sometimes contradictory, but generally suggested that the stocks were somewhat depressed. This was usually confirmed by juvenile abundance studies or by total terminal area catch and escapement data.

Chinook

Hopley (1979) indicates that the upper Chehalis has 28% of the chinook-producing habitat in the Grays Harbor system. There are both spring and summer/fall runs returning to the upper watershed. WDF defines the spring run as chinook caught by the Chehalis Tribe on or before August 31, and the summer/fall run as fish caught later. The spring run enters the river from March to June and returns mainly to the upper Chehalis. The summer/fall run has two segments. The summer run is relatively small, enters the Chehalis mainly in August, and spawns mostly in the Satsop River. The fall run is larger and enters the upper Chehalis from September to November.

Spring chinook in the Chehalis system are reported to be depressed, as adult returns are below the escapement goal (WDF 1981[a], Table 2). (The escapement goal is the number thought necessary to maintain the run and catch at some desired level.)

Catch and catch-per-landing at Oakville have fluctuated but, surprisingly, show no real trend since 1935 (Figure 2). The 1981 catch and catch-per-landing are low, because the fishery was closed before the peak of the run. Total catch appears to be closely related to run size as estimated by WDF spawner surveys but catch-per-landing does not (Table 2). Exploitation rates as estimated by WDF are higher than usual for naturally reproducing stocks.

Fall chinook catch and catch-per-landing figures do not clearly indicate the status of the stock, but total Grays Harbor catch suggests an early decline and current underescapement.

The upper Chehalis catch has increased since the 1950's (Figure 3) but the catch-per-landing has not changed enough to suggest a change in run size or the effect of increased fishing. Total catch peaked in 1942 and then declined until 1952, after which both catch and catch-per-landing have tended to gradually increase (although catch-per-landing has been relatively low since 1972).

This stock may have declined before 1935, as suggested by the total Grays Harbor non-treaty catch since 1921 (Table 3). Moreover, recent total Grays Harbor escapement has always been below the escapement goal (Appendix Table 1).

WDF has studied the changes in abundance of juvenile salmon in Chehalis system rivers, Grays Harbor, and the Humptulips River. Abundance of juvenile chinook in the Chehalis River near Oakville has increased in annual beach

Table 2. Chehalis spring chinook catch and run size.

Year	Run size	Catch	Harvest rate	Escapement[a]	Catch per Landing
1970	1,202	924	0.77	278	2.52
1971	859	609	0.71	250	3.01
1972	1,105	855	0.77	250	2.54
1973	1,059	797	0.75	262	3.01
1974	625	275	0.44	350	2.04
1975	609	155	0.25	454	2.98
1976	1,038	390	0.38	648	3.42
1977	1,704	850	0.50	854	3.46
1978	1,646	623	0.38	1,023	2.39
1979	1,109	756	0.68	350	2.20
1980	629	379	0.69	250	2.23
Average	1,053	594	0.57	452	2.70

Correlation between run size and catch:

$r = 0.707$ $df = 10$ $P < 0.05$

Correlation between run size and catch per landing

$r = 0.314$ $df = 10$ $P > 0.05$

[a]Escapement goal is 1,400 fish.

Source: WDF unpublished records.

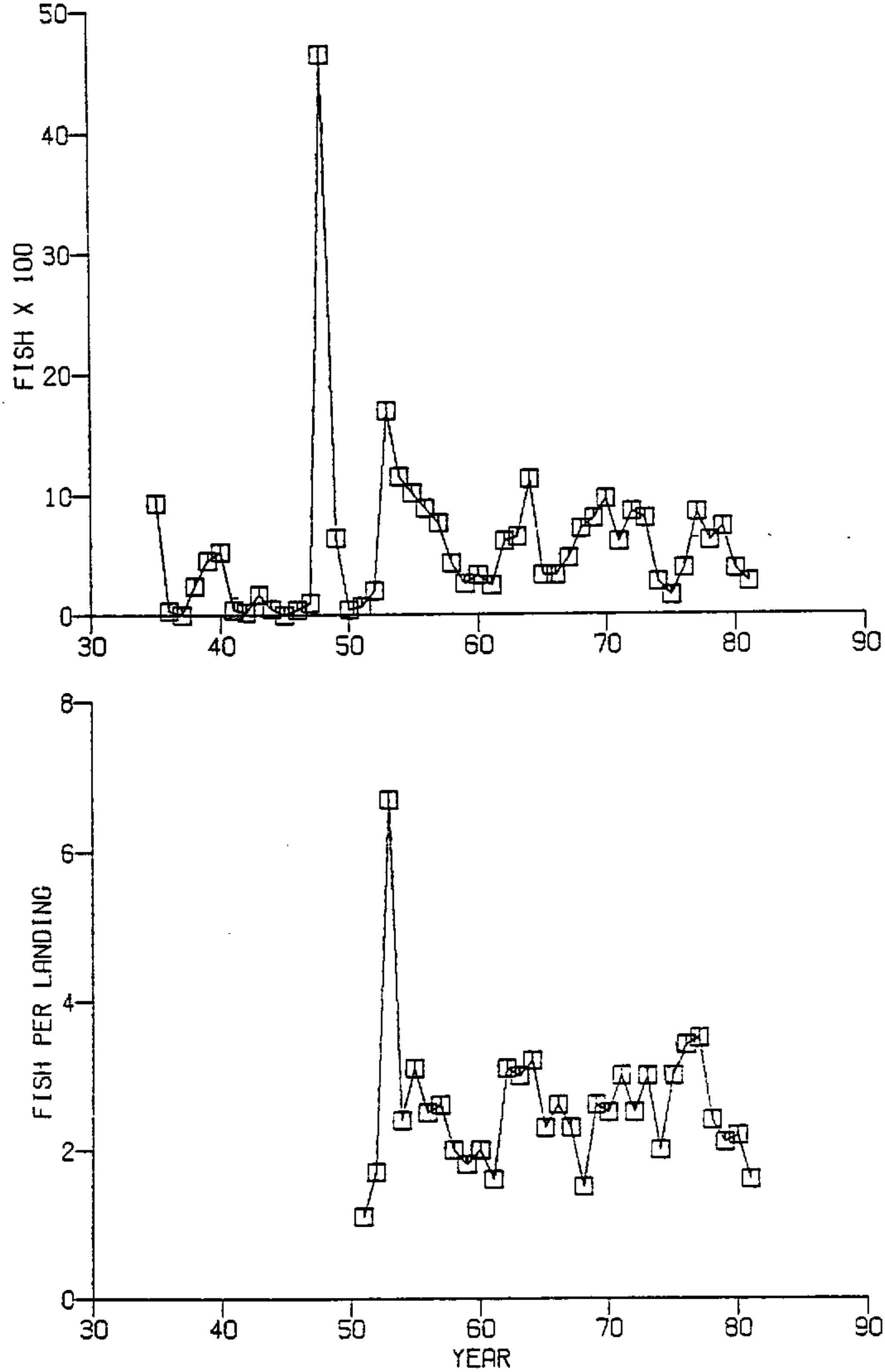


FIGURE 2. Upper Chehalis spring chinook tribal catch and catch-per-landing. Source: Chehalis Tribe unpublished data; WDF hard data, soft data and unpublished records.

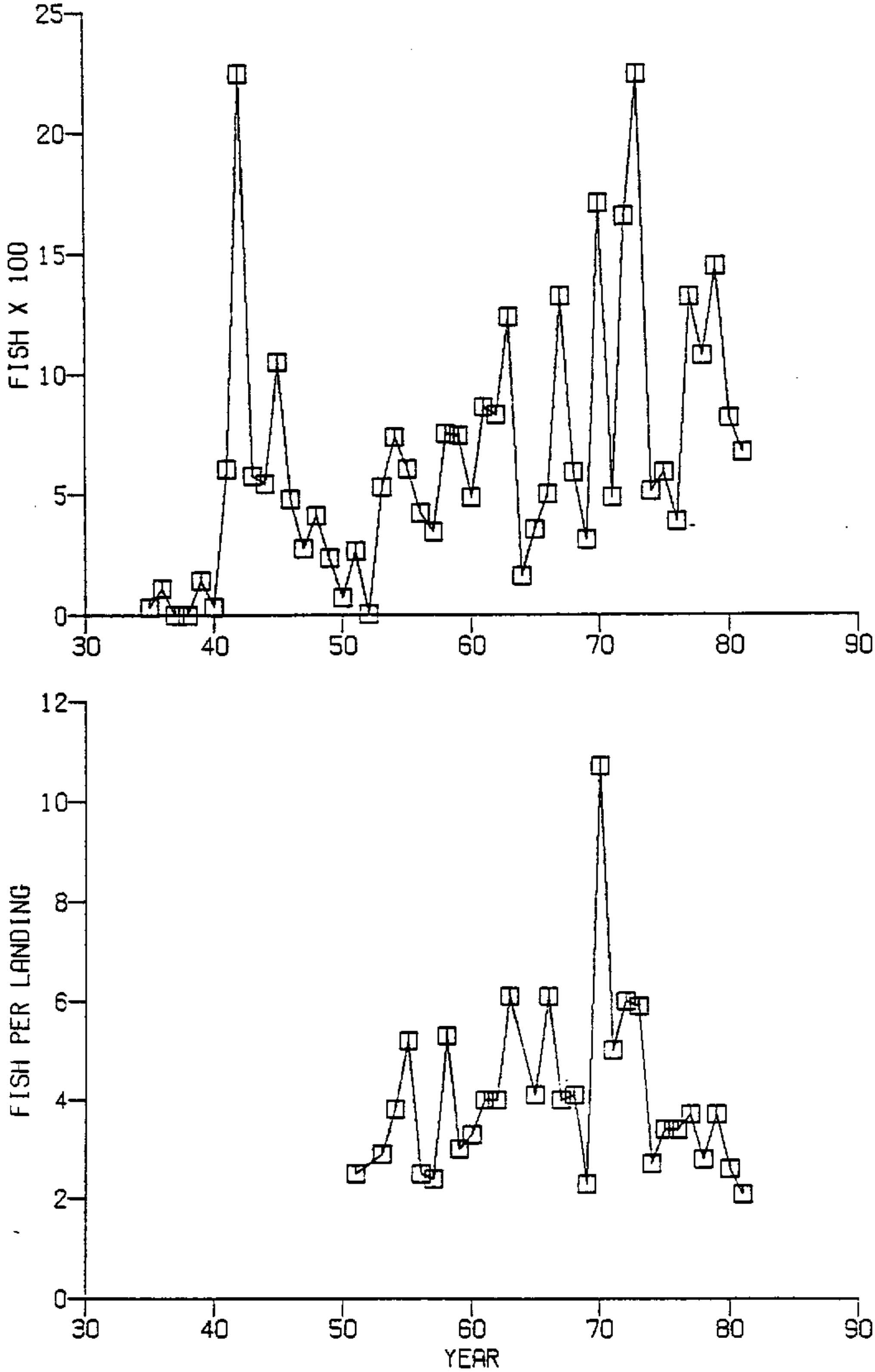


FIGURE 3. Upper Chehalis fall chinook tribal catch and catch-per-landing. Sources: WDF hard data, soft data, and unpublished records.

Table 3. Grays Harbor gill net landings (1921-1975)(excluding treaty Indian catches). Source : Zook,1976.

Year	Chinook	Chum	Coho
1921	35,951	18,668	76,971
1922	29,601	71,147	100,656
1923	32,508	145,278	144,605
1924	14,833	115,808	88,224
1925	12,661	127,509	59,657
1926	13,828	35,817	65,554
1927	15,403	58,865	54,318
1928	10,837	87,107	72,412
1929	8,005	122,344	33,546
1930	11,751	39,604	80,833
1931	15,960	103,590	59,922
1932	18,011	130,076	53,642
1933	26,067	26,523	68,084
1934	18,678	33,242	62,103
1935	17,470	21,584	60,454
1936	7,395	39,087	31,828
1937	8,661	39,920	16,721
1938	9,042	36,356	30,919
1939	9,878	15,191	40,560
1940	8,052	23,862	34,258
1941	6,751	124,428	20,133
1942	5,545	85,574	23,867
1943	5,438	21,299	15,637
1944	5,288	15,450	43,607
1945	12,688	24,424	54,082
1946	5,939	71,425	36,650
1947	3,982	22,040	70,357
1948	5,852	26,919	46,773
1949	6,430	17,608	26,925
1950	7,665	41,488	55,276
1951	7,987	60,171	61,219
1952	8,744	46,761	74,051
1953	5,589	35,762	38,304
1954	4,762	145,120	15,523
1955	4,881	60,421	37,100
1956	3,595	26,074	54,607
1957	1,572	37,235	12,327
1958	6,197	60,938	16,381
1959	4,486	73,478	16,177
1960	4,217	19,728	15,265
1961	7,339	11,086	42,242
1962	7,531	21,070	28,862
1963	9,373	7,079	12,535
1964	9,627	13,601	27,142
1965	8,900	4,541	25,196
1966	7,831	11,412	26,755
1967	9,984	10,565	21,804
1968	14,056	5,801	36,444
1969	13,678	22,571	25,426
1970	14,773	28,388	64,800
1971	9,329	12,567	58,652
1972	10,528	45,980	46,437
1973	16,530	35,350	40,161
1974 1/	9,680	28,841	49,515
1975 1/	7,362	9,967	20,842

seine catches since 1972 although juvenile catch at Hoquiam does not show this trend (Figure 4). It is difficult to relate this to adult returns.

Hatchery plants of fall chinook fingerlings were released above Oakville in the early 'Sixties and again in 1970 (Appendix Table 2) but the contribution to the tribal catch was not apparent. Hatchery fish form a very small part of the upper Chehalis escapement.

Chum

Upper Chehalis chum catch and catch-per-landing appear to have declined during the 1950's (Figure 5), although the trend is not entirely clear because the year-to-year changes before then were very large. The total Grays Harbor escapement goal has been reached only twice since 1967 (Appendix Table 3).

No hatchery plants of chum have been made in the upper Chehalis.

Coho

The upper Chehalis is capable of producing 19% of Grays Harbor coho (Hopley 1979). The run has both normal and late-timed segments. WDF defines the normal run as those coho caught before November 10 in the lower Chehalis system and December 1 at Oakville. Coho caught after these dates are considered to be part of the late run.

Coho catch and catch-per-landing does not indicate a trend in run size but juvenile trapping studies and total Grays Harbor catch data suggest that the upper Chehalis escapement is far below its potential.

Chehalis tribal catch of normal coho declined from the 1940's through the 1960's but greatly increased in the 1970's (Figure 6). Catch-per-landing has not shown a definite trend over the years recorded.

Catch-per-landing was relatively stable in the 1950's but became more erratic in recent years (Figure 6). This stock may have declined before 1935, however, as suggested by the total Grays Harbor non-treaty catch (Table 3). Total Grays Harbor escapement has tended to decline since estimates began in 1967 (Appendix Table 4).

The late coho catch has greatly increased in the last decade (Figure 7). Catch-per-landing has been too erratic to establish any trends.

The WDF has estimated the production of coho smolts in the upper Chehalis by trapping at Oakville, and concluded that the production was very low in comparison to other Northwest streams (Brix, 1977; 1978). If spawning occurred in all available habitat as shown in the stream catalog (Phinney *et al.* 1975) and if survival from egg to smolt were normal, then Brix estimated the river should produce about 1.8 million natural smolts. Smolt production,

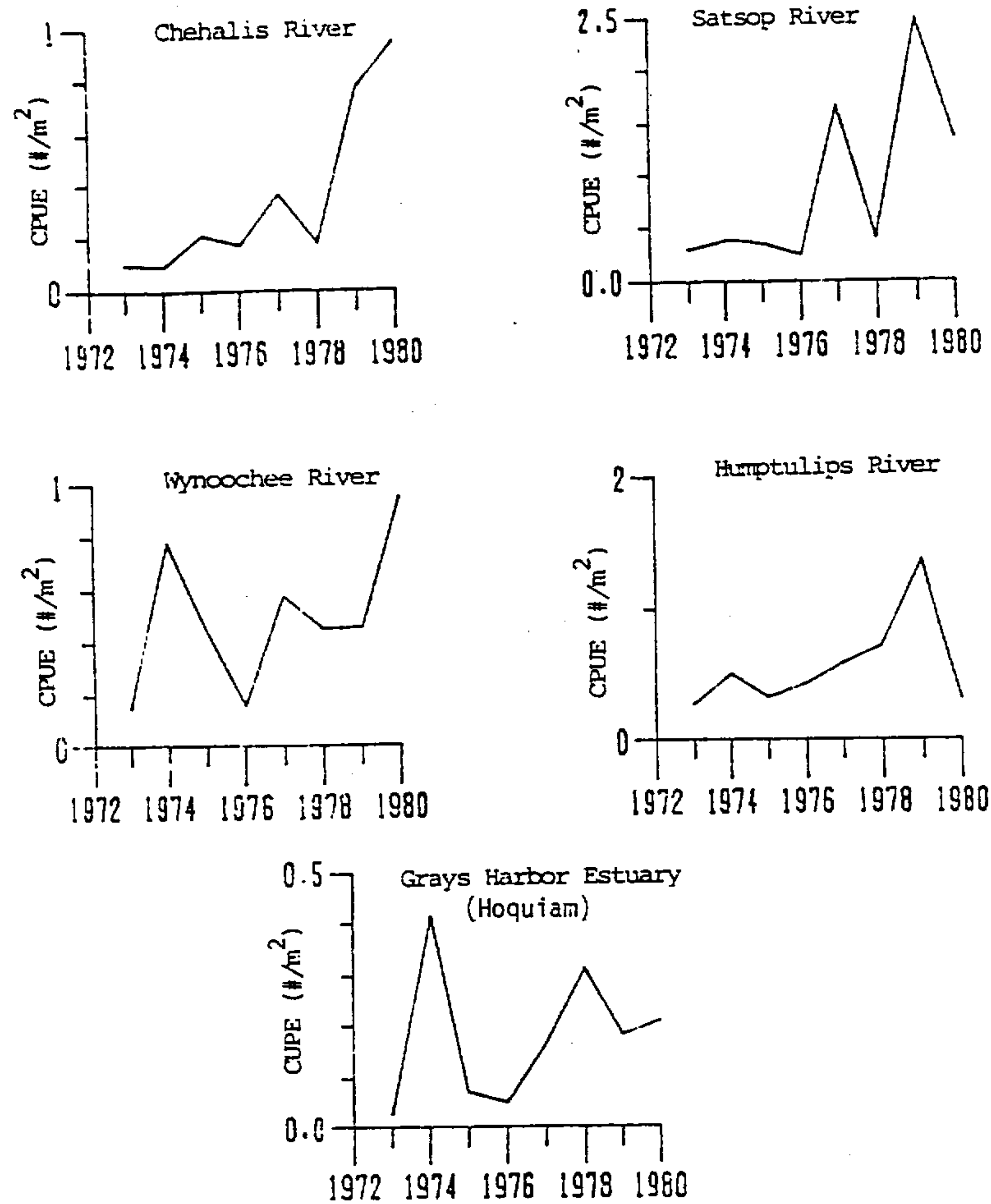


Figure 4. Peak chinook catch per unit effort (CPUE) by year for the Chehalis, Satsop, Wynoochee, and Humptulips Rivers, and the Grays Harbor Estuary. Source: Brix, 1981.

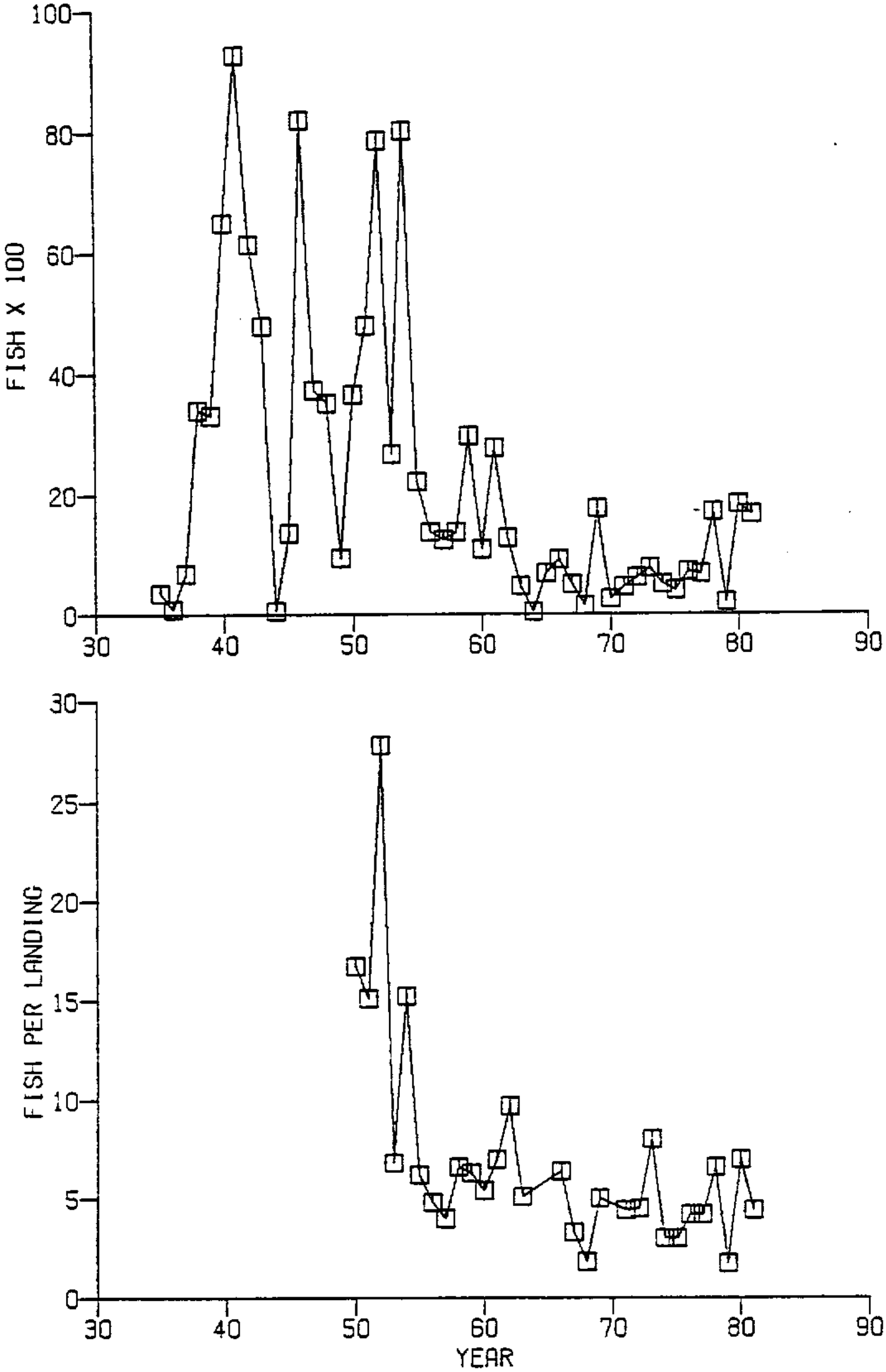


FIGURE 5. Upper Chehalis chum Tribal catch and catch-per-landing. Source: WDF hard data, soft data and unpublished data.

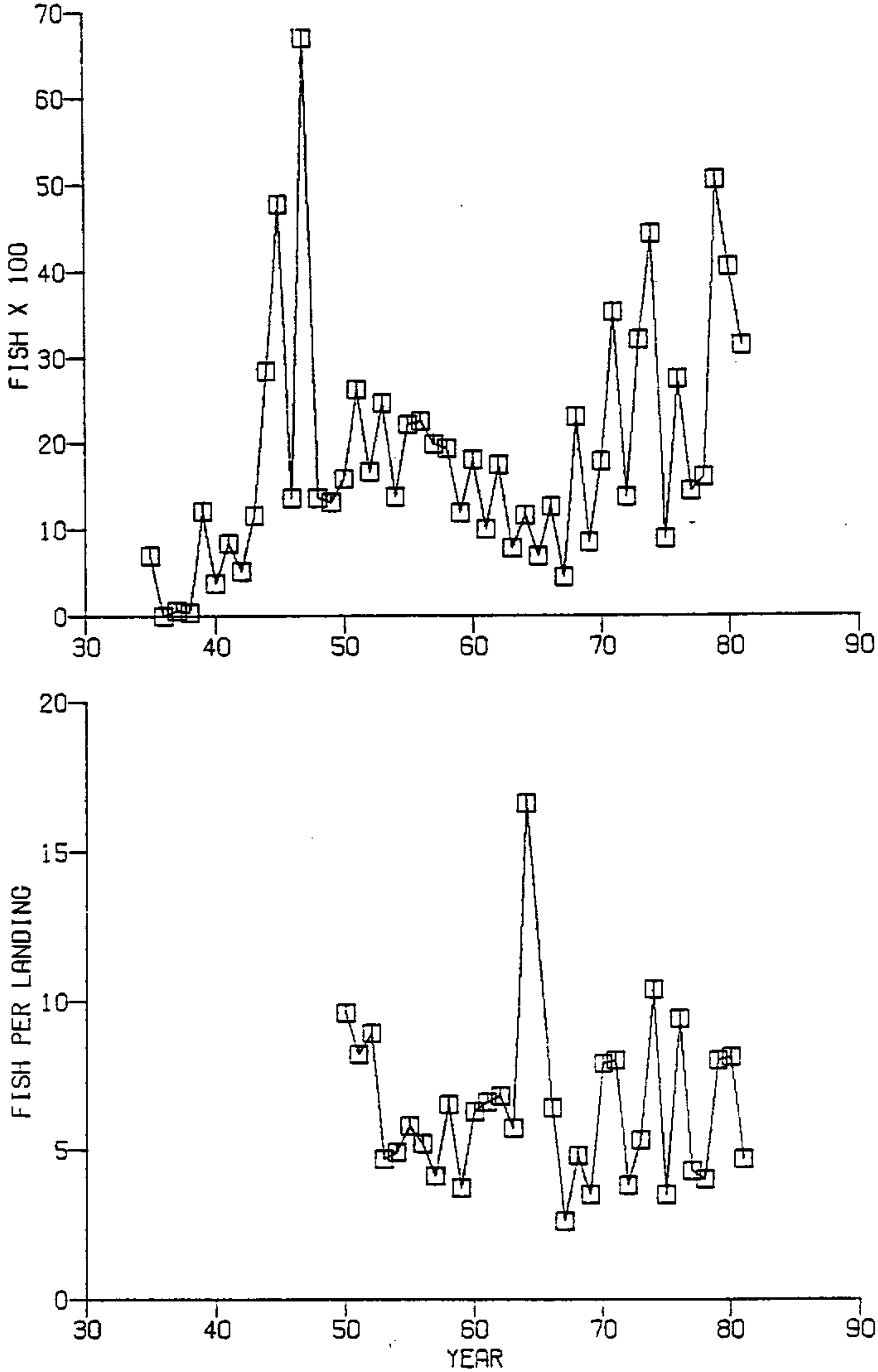


FIGURE 6. Upper Chehalis normal-timed coho tribal catch and catch-per-landing. Source : WDF hard data, soft data and unpublished records.

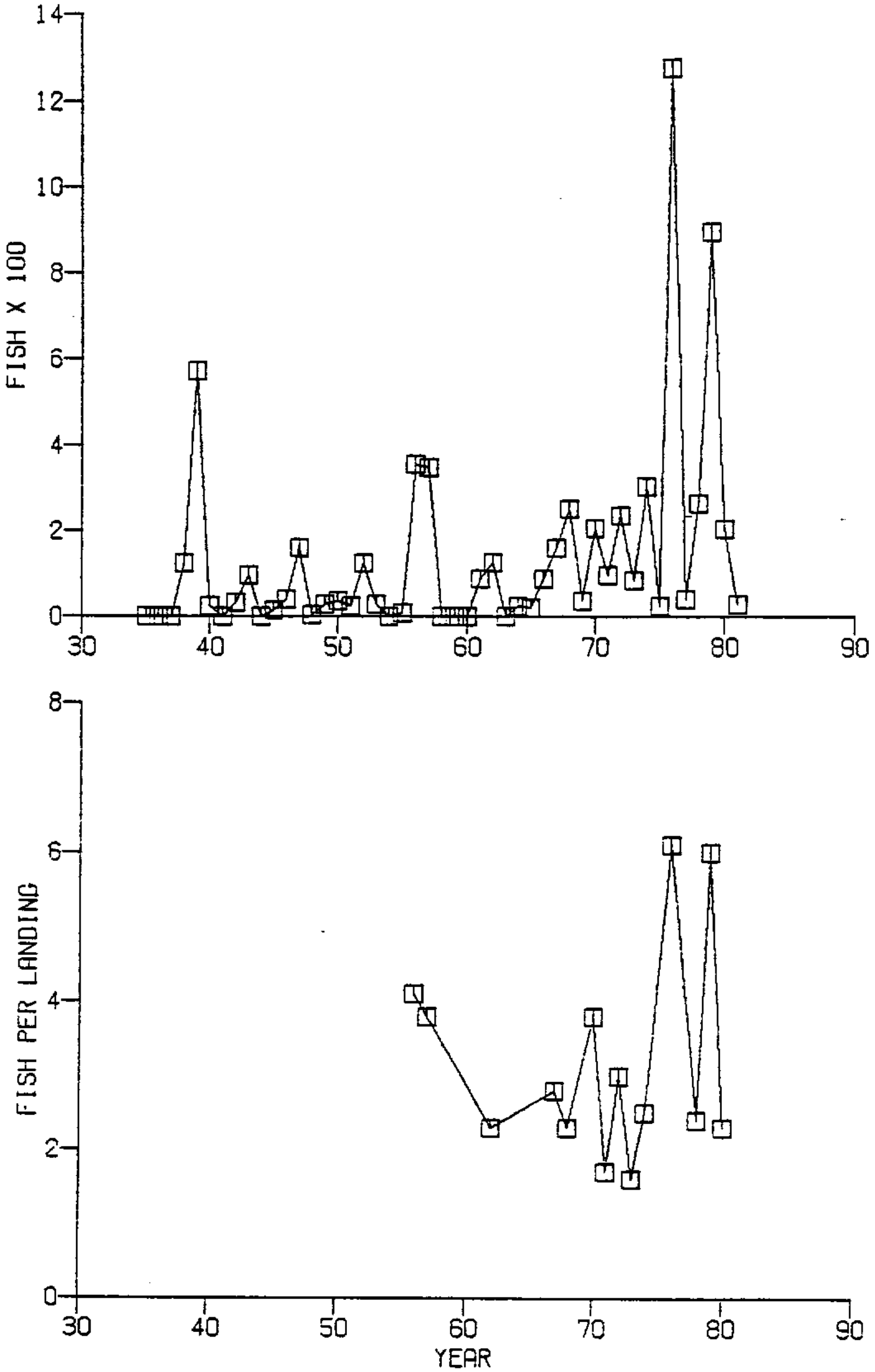


FIGURE 7. Upper Chehalis late coho tribal catch and catch-per-landing. Source: WDF hard data, soft data, and unpublished records.

as estimated by the 1976 trapping study, was 116,000 and, in 1977, 50,000. Both are far below potential. Brix concluded that low escapement was largely responsible for the observed low production. Assuming a Chehalis tribal exploitation rate of 30% of the 1975 run and 1% survival from egg to smolt, he anticipated a 1977 smolt run of 45,000, which was very close to the trapping estimate. Brix concluded that the upper Chehalis was chronically underseeded and recommended regulation to achieve a much higher natural escapement if coho were to be managed for natural production.

Hatchery plants of coho smolts and fingerlings above Oakville have generally increased over the years (Appendix Figure 1) and may be responsible for maintaining the catch at present levels, although large year-to-year changes cannot be attributed to varying numbers released.

Steelhead

Steelhead catch does not indicate a clear trend in run size but low and declining upper Chehalis sport catch coupled with comparatively low juvenile abundance at Oakville indicate low natural escapement to the upper watershed.

Commercial tribal steelhead catch increased from the 1940's to the 1950's and has remained about the same since then (Figure 8). Catch-per-landing does not show any obvious trend in recent years, but there are too few data points to draw conclusions regarding possible long-term changes in abundance Peak catches occurred in 1962 and 1975, but since 1972, catch and catch-per-landing have tended to decrease.

The numbers of steelhead taken in the upper Chehalis sport fishery are much less than the numbers taken in the lower river (Table 4). Lower Chehalis sport catch has declined rather steadily since 1961 (Appendix Figure 2), and upper Chehalis sport catch declined until recently. Catches in the Newaukum River have significantly decreased, while Skookumchuck River catch has fluctuated rather widely (Table 5). The relatively large catch on the Skookumchuck in 1979-80 may be due to enhancement efforts.

Crawford et al. (1979) compared the number of steelhead smolts estimated to be migrating out of the Kalama with the number Brix and Seiler (1977) calculated for the upper Chehalis. They found that the Kalama produced 301 smolts per mile while the Chehalis produced only 48 and 24 smolts per mile in 1976 and 1977, respectively. They attributed the difference to environmental degradation of the Chehalis watershed.

Hatchery plants of steelhead fingerlings were made above Oakville from 1936 to 1944 with Chambers Creek steelhead, a Puget Sound stock, but was discontinued due to apparent poor survival. It is now known that fingerlings have a much lower expected survival than smolts. Enhancement efforts resumed in 1971 with Skookumchuck stock. Since 1975, substantial numbers of smolts have been planted into the Skookumchuck River (Appendix Figure 3). Survival of the native Skookumchuck stock appears to be better than Chambers Creek transfers, although benefits to the tribal catch are not obvious.

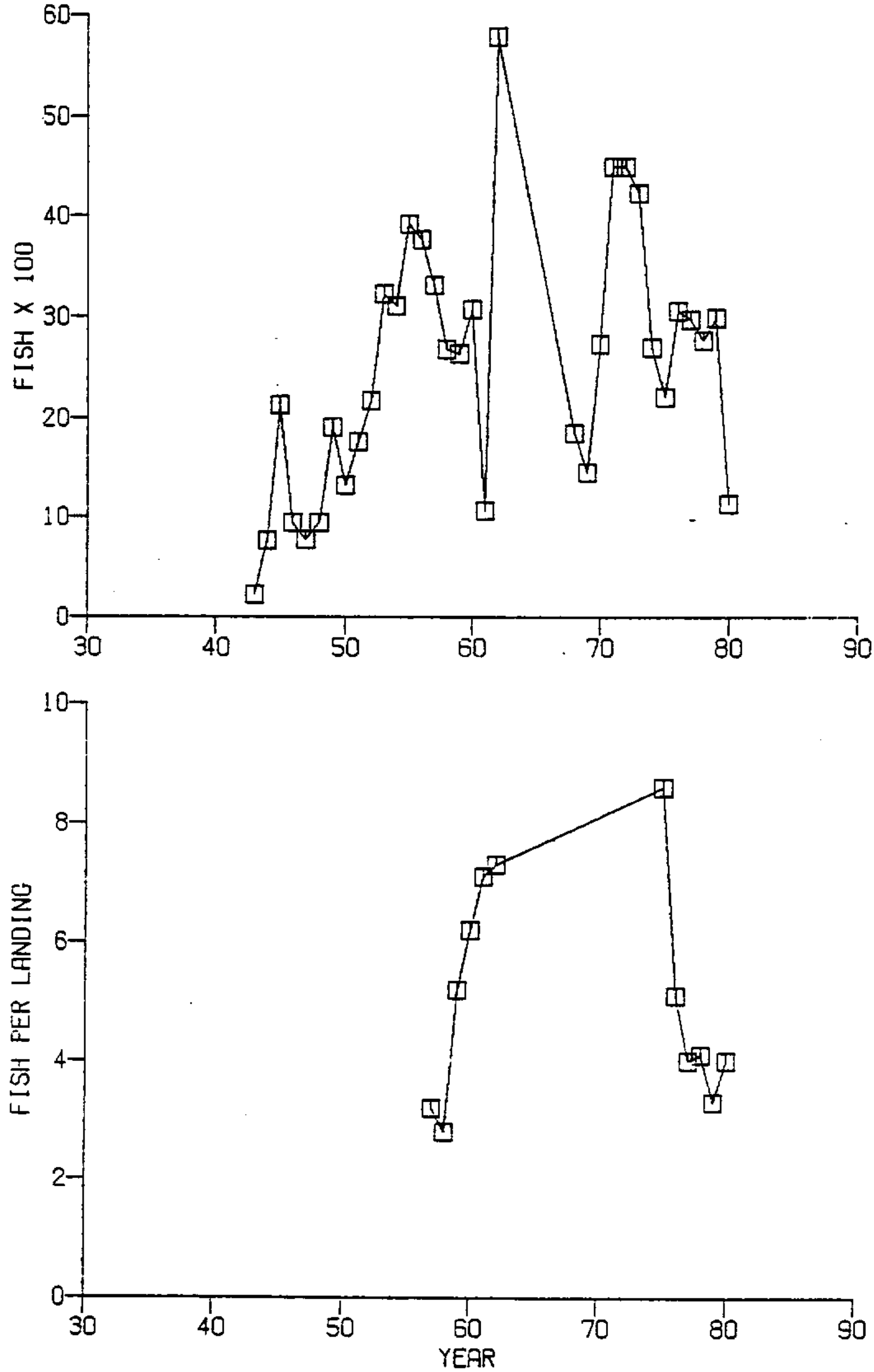


FIGURE 8. Upper Chehalis winter steelhead tribal catch and catch-per-landing. Source: Chehalis Tribe and WDG unpublished data.

Table 4. Distribution of Chehalis system steelhead catch from 1975-76 to 1979-80. Source: WDG unpublished data.

Fishery	Number	Percent
Wishkah sport	94	1.8
Quinault commercial	1,060	20.5
Mainstem Chehalis sport below Oakville	486	9.4
Cloquallum, Satsop, and Wynoochee sport	429	8.3
Chehalis commercial	2,984	57.8
Newaukum and Skookumchuck sport	113	2.2

Table 5. Newaukum and Skookumchuck River Steelhead Sport Catch. Source: WDG Unpublished Data.

Year	Newaukum	Skook.	Year	Newaukum	Skook.
61-62	157	120	71-72	60	73
62-63	219	132	72-73	62	362
63-64	215	166	73-74	24	194
64-65	121	57	74-75	38	151
65-66	157	15	75-76	30	32
66-67	106	77	76-77	7	22
67-68	69	166	77-78	15	21
68-69	95	53	78-79	4	48
69-70	49	30	79-80	48	336
70-71	62	10	80-81	9	117

FISHERIES MANAGEMENT

Grays Harbor salmon stocks are presently managed for natural production despite the existence of several hatcheries within the watershed. Grays Harbor steelhead are managed for either hatchery or wild production, depending upon the tributary. Hatchery escapements have apparently not exceeded allowable levels or are fully utilized in off-station plants.

Proper fisheries management is dependent upon accurate predictions of the runs, setting escapement goals, and allocating the allowable catch. Management depends on a data base consisting of annual information on run size, age composition, catch per landing, and spawner counts.

Grays harbor run size predictions and escapement goals have made the best possible use of a data base that is inadequate for most species. Allocation of the catch since 1974 remains largely unsettled.

Preseason Predictions

WDF annually projects the expected number of fall chinook, chum and coho salmon returning to Grays Harbor. An inadequate data base for spring chinook only allows gross predictions of whether the run will be above or below the escapement goal. More data is needed before preseason predictions of spring chinook run size can be made.

Estimates of returning wild fall chinook are based upon average returns per spawner by age group (WDF, 1981). Predictions are not as accurate as desired because there are gaps in the data on escapement, age composition, and resulting run sizes. This type of information is generally lacking or inaccurate for Pacific Coast chinook stocks. Predicted returns of some other north coastal fall chinook have been refined somewhat by utilizing more accurate escapement estimates and age composition.

Returns of wild chum to the Chehalis drainage are also based upon average return per spawner by age group. This technique has been utilized in predicting returns of Puget Sound chum stocks and probably is the best method for preseason predictions of this species. No returns of hatchery-propagated chums are expected to the upper Chehalis River system in 1981.

Predictions of returning wild coho are again developed using the average return per spawner from 1970-1978, adjusted to account for changes in management of the ocean fisheries. However, it is usually believed that above some minimum level, factors other than spawning escapement are most influential in determining resulting coho run sizes. Environmental factors, particularly minimum flows, are thought to limit freshwater production. Puget Sound coho run sizes are projected using the minimum low flow during the summer rearing period. For some north coastal watersheds, coho predictions are made using the prior year jack return. Prior year jack returns have also been successfully utilized with Oregon coho stocks. Unfortunately, predictions based upon minimum flows or jack returns have not proved useful with Grays Harbor stocks.

A return of 14,000 hatchery-produced coho was expected for the upper Chehalis in 1981. These fish were reared in the Skookumchuck rearing ponds and the prediction was based upon expected returns per release for other Grays Harbor hatcheries. Survival for 1981 was less than expected.

Steelhead data is inadequate to project returns. WDG uses average return rates at Chambers Creek Hatchery to predict returns of hatchery-produced steelhead in the Grays Harbor drainage. Because of the inadequate data for wild steelhead, WDG sets an allowable harvest which is the average of previous years' harvests. The inadequacy of the steelhead data base is not unique to the Chehalis drainage but is a coast-wide problem.

In-Season Updates

WDF adjusts their preseason run-size estimates with in-season updates. These updates generally rely upon test fishing catch-per-unit of effort data. Because of the low predicted return of Grays Harbor fall chinook in 1981, no commercial fishery occurred and, therefore, no update is available for this species.

Adjustments in the Grays Harbor chum run size are made using the Willapa Bay chum update. The Willapa chum run precedes the Grays Harbor run by about ten days. The update is usually made by examining the relationship between catch-per-landing in Area 2G of Willapa Harbor, the level in feet of the maximum high tide on the Pacific Ocean beaches during October 4-9, and run size. Statistically this relationship appears to be fairly reliable, but the method must be modified if storms prevent fishing during this period, as occurred in 1981.

The 1981 coho in-season update was to be made utilizing the relationship established in previous years between catch-per-landing for the non-Indian gill net fleet and run size. However, because of an allocation imbalance in favor of the non-treaty fleet in 1981, the Quinault Tribe proposed an alternate update method using the treaty gill net fleet. This method has not been used previously and no assessment of its reliability is possible.

Escapement Goals

Considerable debate is occurring as to optimum escapement and methods for determining escapement goals. Escapement goals for upper Chehalis River spring chinook were established by a combination of "past observations of available area, recent observations on present utilization, and knowledge of the variety of environmental conditions encountered"(Dick Stone, WDF, personal communication). Numbers of spawners desired, by tributary stream, are:

Upper Chehalis Mainstem	200
Elk Creek	150
South Fork Chehalis River	50
Newaukum River	300
Skookumchuck River	700
TOTAL	1400

This is probably within an expected range of desired escapement. The Nooksack and Skagit rivers in Puget Sound have spring chinook escapement goals of 500 and 3,000 respectively. The upper Chehalis is intermediate in size between these two rivers, and its escapement goal is likewise between the goals of the two Puget Sound rivers.

Much more work is needed before refined escapement goals can be developed for the Chehalis or any other coastal or Puget Sound spring chinook stock. Run size and escapement data is lacking for most of these populations, as well as an understanding of the critical factors limiting production.

The desired fall chinook escapement into the upper Chehalis has been set at 4,800. Coastal fall chinook escapement goals are based upon historic counts and observed utilization of the spawning grounds. The overall goal is to seed the natural habitat to its capacity, which is generally thought to be accomplished with 36 fish per mile of spawning habitat, although this number varies by area. There is much more escapement and run size information for fall chinook than there is for spring chinook, but limiting facors are not understood and again additional work is needed to refine fall chinook escapement goals.

Factors limiting chum production are not well understood and, again, escapement goals are designed to fully utilize the available spawning habitat. WDF assumed that the catch-production relationship in Grays Harbor was similar to that of Willapa Bay. WDF then determined the five highest escapements into one Willapa Bay tributary when there was good utilization of the spawning grounds. The estimate was expanded to represent the Willapa Bay system, then scaled down for Grays Harbor in proportion to the relative catch in the two terminal areas.

Coho escapement goals are also intended to fill the natural habitat to capacity. In the case of coho, rearing habitat during the summer low flow period is believed to be the factor limiting smolt production. Therefore, Grays Harbor coho escapement goals are calculated from the number of miles of rearing habitat during the low flow period and the smolt production potential of this amount of habitat. Using average egg to smolt survival estimates, the number of adult coho needed to produce the desired number of smolts is determined and fixed as the escapement goal. WDF estimates that the upper Chehalis River (except possibly the Skookumchuck River) is chronically underseeded, as described earlier. Enhancement effort at the Skookumchuck rearing ponds has emphasized coho with off-station plants designed to utilize this habitat.

Steelhead escapement goals have not been determined. Escapement estimates have not been made and much more work needs to be done in this area and on juvenile production.

Catch Allocation and Interception

Upper Chehalis runs are intercepted both in the Grays Harbor system and in the ocean. Catch in Grays Harbor is distributed between the non-Indian commercial fishery, the sport fishery, and the Quinault Tribal fishery. Ocean interceptions are made by commercial and sport fisheries. Each run contributes to these fisheries in a different proportion.

Spring chinook have not been fished commercially in Grays Harbor for a number of years, although heavy ocean interception is likely. The percent contribution of the stock caught in each of the various fisheries has not been studied but may be similar to that of the Cowlitz River, which is

Oregon and California Ocean sport and troll	2%
Washington ocean sport and troll	14%
British Columbia sport and troll	45%
Alaska ocean sport and troll	19%
Terminal fisheries - Indian and non-Indian net, river sport	20%

Chehalis fall chinook are intercepted in Grays Harbor by the Quinault tribal and non-Indian gill net fisheries and, in the river, by the sport fishery. In the Chehalis system the Indian share of the catch has averaged 44% and the non-Indian share, 56% since 1974 (Table 6). The Indian share has become much more significant since 1976, while the non-Indian commercial share decreased. The Chehalis Tribe had virtually the only commercial harvest in 1979 because the other commercial fisheries were closed.

Grays Harbor chinook are heavily intercepted in ocean fisheries with the British Columbia troll fishery being most significant as shown by microtagging studies (Table 7). This tag information is for fall chinook reared at Satsop, but wild Chehalis River stocks probably have a similar survival and contribution pattern. In the early 1970's there was a large Canadian troll fishery off Washington, and the increased British Columbia catch coincided with a decreased Grays Harbor gill net catch (Appendix Figure 4; Wright 1976). In more recent years, Canadian fisheries off Washington have been tightly restricted, although British Columbia trollers have continued to take large numbers of Washington chinook off Vancouver Island. The Alaskan commercial and Washington coastal gill net fisheries accounted for a smaller but significant portion of the catch, according to microtagging data.

Chum are intercepted within the Chehalis system both by the Quinault Tribe (which made up 23% of the Chehalis system catch since 1974) and the non-Indian fishery (which made up 51%). The Chehalis Tribe has taken an average of 26%. The Chehalis share was larger in 1977 and 1979 because the other fisheries were closed for conservation, while the Quinault and non-Indian catches predominated in 1980 (Table 8). These two fisheries also harvest stocks produced below Oakville. Ocean interceptions are quite low.

Table 6. Allocation of fall chinook in Areas 2A, 2B, 2D, and streams entering them. Area 2B catch was adjusted by the Chehalis system's share of Grays Harbor escapement.

Year	Chehalis Tribe	Quinault Tribe	Total Indian	Non-Indian Gillnet	Sport	Total Non-Indian
1974	10.4	0.0	10.4	75.4	14.1	89.6
1975	9.9	.2	10.1	83.5	6.4	89.9
1976	9.2	29.6	38.8	46.2	15.1	61.2
1977	20.0	46.1	66.1	25.9	8.1	33.9
1978	24.0	40.5	64.5	8.8	26.7	35.5
1979	59.8	.9	60.7	0.0	39.3	39.3
1980	11.5	46.3	57.8	35.4	6.8	42.2
Mean	20.7	23.4	44.1	39.3	16.6	55.9

Sources: WDF hard data, Quinault Tribal records, and WDF Washington Salmon Sport Catch Reports.

Table 7. Percent contribution of fall chinook released at Satsop Hatchery to various fisheries, as shown by WDF microtag returns. Source: WDF unpublished data.

Brood year Stock	1974 Nemah	1973 Trask	1973 Nemah	1971 Nemah X Deschutes	Unweighted mean percent
Releases	45,568	30,305	26,190	41,972	
Recoveries	83	35	172	183	
Oregon troll	1.2	0	0	0	0.3
Alaska commercial	11.1	21.2	22.7	1.6	14.1
BC troll	48.2	60.6	36.2	47.1	48.0
BC net	7.0	0	15.5	2.6	6.3
BC sport	4.9	0	2.0	1.8	2.2
Wash. ocean sport	4.9	0	2.9	19.3	6.8
Wash. troll	9.0	2.2	3.1	9.3	5.9
Puget Sound sport[a]	7.8	0	7.2	8.8	6.0
Wash. coastal net[b]	4.1	15.9	10.0	9.6	9.9
Columbia R. net	1.7	0	0.4	0	0.5

a. Includes Straits of Juan de Fuca
b. Grays Harbor, Willapa Bay, and Indian net fisheries.

Table 8. Allocation of chum in Areas 2A, 2B, 2D, and streams entering them. Area 2B catch was divided by two to approximate the Chehalis system's share of the Grays Harbor run.

Year	Chehalis Tribe	Quinault Tribe	Total Indian	Non-Indian Gillnet	Sport	Total Non-Indian
1974	2.7	0.0	2.7	97.3	0.0	97.3
1975	5.9	.9	6.8	93.2	0.0	93.2
1976	6.0	31.1	37.1	62.9	0.0	62.9
1977	43.7	27.7	71.4	28.6	0.0	28.6
1978	19.0	36.2	55.2	44.8	0.0	44.8
1979	91.3	8.7	100.0	0.0	0.0	0.0
1980	15.4	56.5	71.9	28.1	0.0	28.1
Mean	26.3	23.0	49.3	50.7	0.0	50.7

Sources: WDF hard data, Quinault Tribal records, and WDF Washington Salmon Sport Catch Reports.

Both normal and late coho runs are taken by the Quinault and non-Indian gill net fisheries in Grays Harbor (Table 9). These fisheries take coho bound for all Grays Harbor tributaries. In the Chehalis system the Indian share of the catch has averaged 47% and the non-Indian, 53% since 1974. The Indian share has become much more significant since 1976, while the commercial share decreased. On the average the Chehalis catch is slightly more than the Quinault. The Chehalis share was the larger of the two from 1974 to 1979, but the Quinault share was much larger than the Chehalis share in 1980. The high Chehalis share of the 1979 catch was due to closure of these other fisheries. WDF has set the allowable Chehalis tribal catch at 5,000 coho, which is somewhat greater than the ten-year average catch of 3,555 for combined normal and late runs. The heavy enhancement of 1978 brood year coho was expected to increase the catch beginning in 1981, but the tribal allowance was not readjusted to account for this. The actual catch was below the initial estimate.

Chehalis River coho are also intercepted in the ocean fisheries (Wright 1976). Coho tagged and released from Satsop Hatchery were taken by the British Columbia and Washington troll fisheries in considerable numbers. A large portion was also harvested, however, in Grays Harbor (Table 10). A few are harvested in the Oregon troll and Washington ocean sport fisheries. A group of late coho behaved about the same as the normal run except that more were taken in the Oregon sport fishery and none were reported caught by Oregon trollers. No upper Chehalis coho tag data was available for review but catch distribution patterns are probably similar.

Upper Chehalis steelhead are also harvested by the Quinault Tribe and by the river sport fishery (Table 11). Since 1974 the Chehalis Tribe has caught an average of 58% of Chehalis system steelhead. The Quinault Tribe has caught 20% and the sport fishery, 27%. Ocean interceptions are quite low.

ENHANCEMENT

Current Enhancement Effort

Salmon enhancement efforts in the Grays Harbor system have been concentrated in lower river tributaries, primarily on the Humptulips and Satsop rivers. In 1980, WDF made substantial coho plants into the upper Chehalis watershed in an attempt to augment the depressed natural stocks. Major salmon hatchery facilities in the Grays Harbor system are the Humptulips and Simpson hatcheries and the Skookumchuck ponds (Appendix Table 5). Minor facilities include the Satsop Springs spawning channel, the Westport pens, various other small rearing facilities, and egg boxes on the Wishkah, Hoquiam, Humptulips and Newaukum rivers. Those facilities which receive stock from a hatchery are called satellite stations. Coho production predominates, and the main producers are Humptulips, Simpson and Skookumchuck. The main fall chinook producers are Humptulips and Simpson. Most chum are produced in egg boxes on the Wishkah River and East Fork Hoquiam.

Table 9. Allocation of normal-timed and late coho combined, in Areas 2A, 2B, 2D, and streams entering them. Area 2B catch was adjusted by the Chehalis system's share of the Grays Harbor estimated total run.

Year	Chehalis Tribe	Quinault Tribe	Total Indian	Non-Indian Gillnet	Sport	Total Non-Indian
1974	10.6	0.0	10.6	82.0	7.4	89.4
1975	4.3	2.0	6.3	89.5	4.2	93.7
1976	14.7	33.4	48.1	43.1	8.5	51.9
1977	29.3	36.0	65.3	21.6	13.1	34.7
1978	29.4	37.7	67.1	8.5	24.5	32.9
1979	49.7	13.6	63.3	.2	36.4	36.7
1980	13.7	56.8	70.6	25.5	4.0	29.4
Mean	21.7	25.6	47.3	38.7	14.0	52.7

Sources: WDF hard data, Quinault Tribal records, and WDF Washington Salmon Sport Catch Reports.

Table 10. Percent contribution of Satsop coho to various fisheries as shown by WDF microtag returns. Source: WDF unpublished records.

Brood year Timing Releases Recoveries	1971 Normal 40,676 510	1974 Normal 33,920 92	1974 Normal 35,889 55	Unweighted Normal mean percent	1971 Late 41,739 368	1973 Late 39,632 335	Unweighted Late mean percent
California troll	0	0	0	0	0.3	0	0.2
Oregon troll	8.0	3.3	1.8	4.4	5.1	0	2.6
Oregon sport	0	0	4.2	1.4	0	11.0	5.5
Alaska commercial	0	0	0	0	0	0.8	0.4
BC troll	30.5	31.5	64.4	42.1	38.0	41.6	39.8
BC net	0.1	2.6	0	0.9	0.5	0.3	0.4
BC sport	0.1	1.1	0	0.4	0	0	0
Wash. ocean sport	13.1	2.2	4.8	6.7	4.4	7.7	6.1
Wash. troll		19.9	39.9	18.0	25.9	12.0	19.4
Puget Sound sport[a]	0.4	0	0	0.1	0	0.2	0.1
Wash. coastal net[b]	28.6	19.4	3.0	17.0	39.7	19.0	29.4
Puget Sound net[a]	0	0	4.2	1.4	0	0	0

a. Includes Straits of Juan de Fuca.

b. Grays Harbor, Willapa, and Indian net.

Table 11. Allocation of steelhead in Areas 2A and 2D including streams entering them.

Year	Chehalis Tribe	Quinault Tribe	Total Indian	Non-Indian Gillnet	Sport	Total Non-Indian
1974	50.1	0.0	50.1	0.0	49.9	49.9
1975	41.0	39.8	80.8	0.0	19.2	19.2
1976	60.7	21.4	82.2	0.0	17.8	17.8
1977	67.1	15.2	82.3	0.0	17.7	17.7
1978	60.6	13.6	74.2	0.0	25.8	25.8
1979	56.1	11.5	67.6	0.0	32.4	32.4
1980	32.5	40.1	72.6	0.0	27.4	27.4
Mean	52.6	20.2	72.8	0.0	27.2	27.2

Sources: WDG and Quinault Tribal records.

There are no steelhead hatcheries in the system but hatching and some rearing of Skookumchuck stocks occurs at South Tacoma Hatchery. There are also rearing pens in the Skookumchuck Reservoir and at Lake Aberdeen.

Salmon and steelhead broodstock have been taken from both inside and outside the Grays Harbor system (Table 12). Coho planted in 1980 were mainly from Willapa Bay and Humptulips, with a few from Simpson. Fall chinook were also from Simpson and Humptulips, but nearly a quarter were from Willapa Bay. Most of the chum were from Hood Canal, but some crosses with Satsop stock were used. Winter steelhead were from Skookumchuck, Wynoochee, Quinault, Humptulips, and Chambers Creek stock.

Previous Recommendations

This office had advised the Chehalis Tribe of the potential for on-reservation aquaculture projects (USFWS, 1974), contingent on water quality and availability. We recommended hatching and rearing chum in egg boxes using either pumped water from the Black River or well water. We also recommended rearing coho in the Indian Beach, side channel of the Chehalis. Other projects were later recommended by the Small Tribes Organization of Western Washington (Weller, 1976). All of these recommendatios should be reconsidered in light of the tribe's experience with chum enhancement and WDF enhancement activities.

Enhancement Potential

The magnitude of enhancement in Grays Harbor will be limited by the goal of managing for natural production. Harvest rates of hatchery stocks are substantially higher than those appropriate for wild stocks. Full harvest of large numbers of hatchery fish will result in overharvest of wild stocks and lower production from the natural stream habitat. Despite this, if hatchery releases are made on a fishable stream with no significant natural run, returns can be efficiently harvested without affecting the natural run.

Hatching and rearing need not be limited to the reservation. Best locations would be near a tributary stream descending steeply enough to provide gravity-feed water to eliminate the expense of pumping. The site should be upstream of potential pollution sources and should not be susceptible to winter flooding. Rearing could also occur in additional floating pens in the Skookumchuck Reservoir, but high summer temperatures limit rearing to the period from October through April (Roger Palmer, Pacific Power and Light (PP&L), personal communication). The tribe should also consider identifying underseeded streams for planting to augment or rebuild wild stocks.

Native broodstock are preferred whenever available, because they are naturally well-adapted to local conditions. Introducing exotic strains may result in less fitness in the natural run, as hatchery strays cross with native fish.

Table 12. Numbers of salmon and steelhead stocks released into Grays Harbor system in 1980.

Species	Stock	Above Oakville	Below Oakville	Total
Fall chinook	Humptulips	0	305,000	305,000
	Simpson	0	98,100	98,100
	Willapa	0	850,000	850,000
Chum	Hood Canal[c]	0	1,890,000	1,890,000
	Humptulips	0	24,500	24,500
Coho	Humptulips	2,470,000	6,880,000	9,350,000
	Willapa	0	254,000	254,000
	Simpson	1,730,000	3,060,000	4,790,000
Winter Steelhead	Chambers Creek	250,000[a]	174,500	174,500
	Quinault	0	74,473	74,473
	Skookumchuck	51,067	0	51,067
	Humptulips	0	18,200	18,200
	Wynoochee	0	7,500	7,500
Summer Steelhead	Skamania[b]	0	87,600	87,600

Source: Coleman and Rasch, 1981; WDG unpublished data.

[a]Fry only. Not included in total

[b]Subsequent plants will be Soleduck stock.

[c]Including crosses with Satsoop stock.

Chum is the best candidate for further immediate effort. The natural run above Oakville is probably depleted but no plants have been made in the upper river. Percent return to Grays Harbor would not be affected by marine interception, the rearing period is short, and facilities are relatively inexpensive. Two to three million fed fry would be compatible with natural harvest plans (D. Stone, personal communication). This would be about half the number reared on the lower Chehalis in 1979, the year of highest plants.

Native broodstock are preferred and might be collected at Satsop, but WDF suggests Willapa hatchery stock. Any stock chosen must be adapted to ascending a considerable distance from saltwater before spawning. For this reason, Quilcene National Fish Hatchery stock is not recommended. Rearing might occur in egg boxes in the upper Chehalis system or at the Naselle Hatchery.

A second candidate is fall chinook. Recent closures of the fishery imply that the run is depleted, but there has been no enhancement of this species above Oakville in recent years. It must be realized that marine interception may result in a low percent return. The goal of any new enhancement should be the augmenting of the existing wild run. WDF (D. Stone, personal communication) suggests off-reservation hatching, followed by pen-rearing in sloughs on-reservation. Fish could be planted in the Black River, which is not considered an important spawning area (Phinney et al., 1975), although the importance of the Black River as a fall chinook spawning and rearing area should be assessed before initiating enhancement efforts.

Based upon their apparent depressed status, spring chinook are also candidates for enhancement. The estimated escapement has consistently fallen short of the WDF goal but there has been no enhancement. This species has the advantages of (1) high commercial value, and (2) returning when there are no other competing Grays Harbor fisheries. Artificial enhancement of spring chinook, however, presents a number of technical difficulties. It may be difficult to acquire adequate numbers of broodstock and, once captured, they must be held until maturity. It will be necessary to build up a brood run for several years before harvest begins.

WDF has tried to capture spring chinook broodstock (at the former Skookumchuck weir site) but annual returns are not reliable there. If not captured immediately prior to spawning, there will be a need for cool water to hold these fish until they are ready to be spawned. The Skookumchuck ponds might be investigated for this purpose. Hatching at a federal facility could be considered because of USFWS interest in this species.

There is also probably room for additional steelhead enhancement because of the apparent underescapement mentioned earlier. Sites for enhancement effort might be the north, middle, and south forks of the Newaukum, and the South Fork Chehalis (Jay Hunter, WDG, personal communication). Broodstock may be available on the Wynoochee, Satsop and Skookumchuck rivers. WDG would like to enhance these areas but is waiting until the question of catch allocation between tribal and sport fisheries has been legally resolved.

Coho programs are well-developed and there is probably little opportunity for further enhancement. The Skookumchuck and Satsop facilities made outplants in 1979 and 1980 in an attempt to fully utilize the upper watershed. Most of these juveniles were smolts which should survive at relatively high rates. However, early indications from the 1981 commercial fisheries are that the upper Chehalis coho plants may have survived at a disappointingly low rate.

The Army Corps of Engineers has proposed a large hatchery below the Wynoochee Dam, although the final decision to construct it has not been made. Principal species would be spring/summer chinook and winter steelhead. Enhancement of a summer-timing chinook would avoid harvest conflict with the native spring and fall natural runs. As presently envisioned, this facility would include off-station rearing ponds. Location of ponds in the upper Chehalis could be very valuable in building up the native spring chinook and steelhead stocks. If no satellite facilities are located in the upper Chehalis, runs returning to the Wynoochee or to other lower Chehalis tributaries will probably be harvested at a rate that could only be supported by a hatchery. This would result in rapid and severe depletion of upper Chehalis natural stocks.

ENVIRONMENT

Habitat Requirements

Management of all Chehalis salmon and most steelhead stocks is directed toward achieving highest natural production using existing stream habitat. Spawning, rearing and adult holding habitat requirements vary between salmonid (salmon and trout) species but generally include areas of clean gravel with moderate flows of clean, cool, well-oxygenated water. Most species will survive water temperatures up to 65-70°F, but temperatures below 60°F are preferred for normal growth and survival. Oxygen levels should not fall below 6 parts per million (ppm).

Chinook spawn in the mainstem and major tributaries. Spring chinook spawning is heaviest in the Skookumchuck River, but there is also considerable use of the South Fork Newaukum and probably some use of the South Fork mainstem and the mainstem near Pe Ell (Figure 9). The North Fork Newaukum as well as other parts of the mainstem may also be suitable (Phinney, 1969; Phinney et al., 1975). Spring chinook rest several months in pools and deep runs, known as holding areas, before ascending to the spawning grounds. More information on location of spring chinook holding areas, spawning grounds, and migration timing would be useful for management.

According to Phinney (1969), juvenile spring chinook are present in certain areas throughout the year and the seaward migration commences in the second spring of their life, peaking in May. Some spring chinook, however, migrate to sea in their first year of life. Juvenile fall chinook begin their migration to the ocean following an initial freshwater rearing period of one to five months. This is most pronounced in May, June and July. Chum salmon spawn

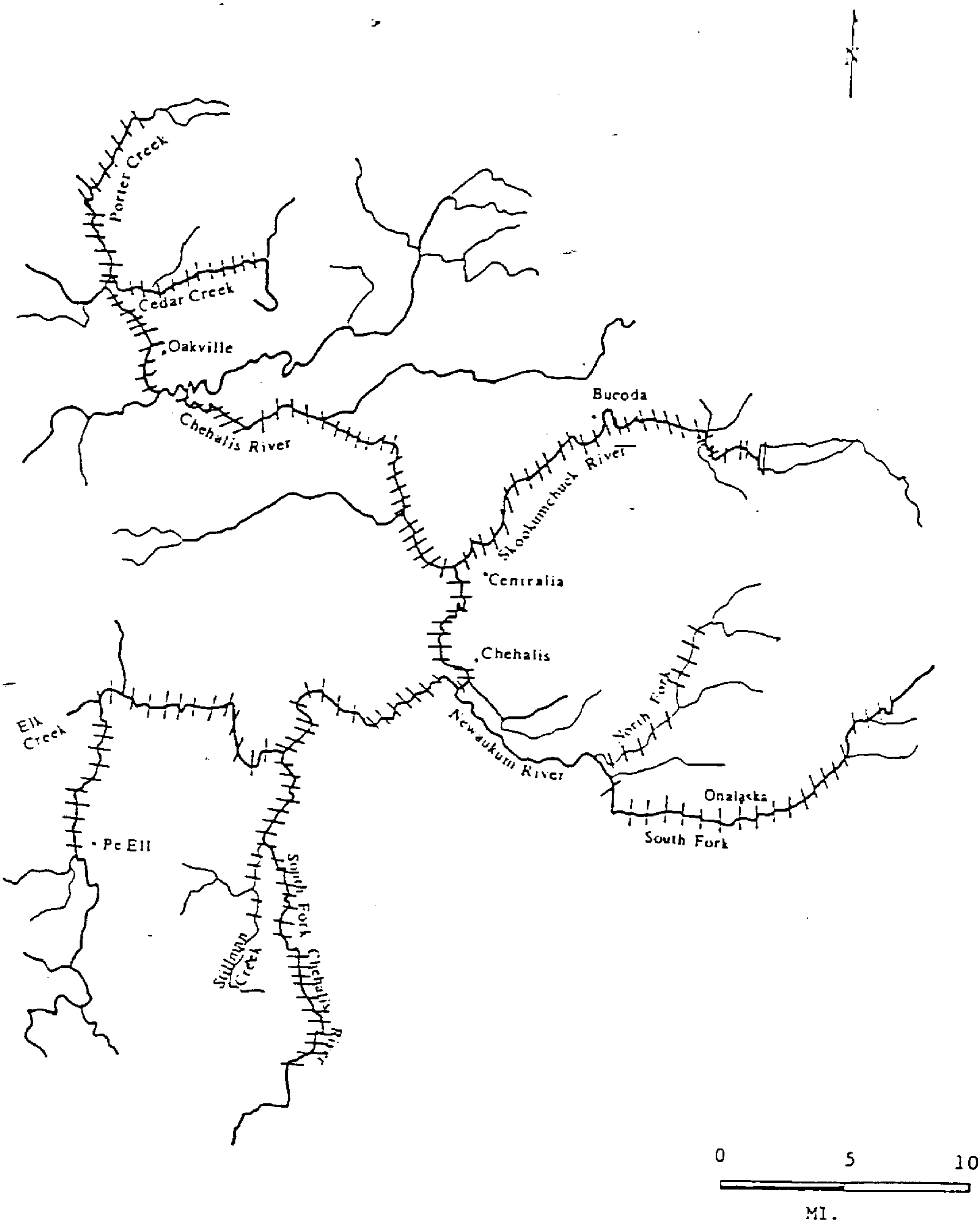


FIGURE 9. Potential chinook spawning areas. Sources: Phinney, 1969; Phinney et al., 1975.

in November and December with principal upper Chehalis spawning grounds on the mainstem up to Scatter Creek (Phinney, 1969), and possibly in the Black River. The young begin moving to salt water almost immediately, with the peak of outmigration occurring mainly in March and April.

Coho spawning occurs from November through January in the upper reaches of many tributary streams (Figure 10; Phinney 1969), as well as the areas suitable for steelhead spawning (Figure 11). The young normally rear one year before descending to salt water mainly in April and May.

Winter-run steelhead spawn and rear in the middle to upper reaches of tributary streams in the Chehalis watershed (Figure 11). Upper Chehalis River stocks return primarily to the Skookumchuck Dam trap, the Newaukum River, and the upper mainstem in the general vicinity of Adna (G. Fenton, WDG, personal communication).

Environmental Problems

The upper Chehalis contains a large amount of salmonid-producing habitat although much of the area has been degraded. Some of the most serious problems have been siltation, diminished summer flow, elevated temperatures, pollution, gravel removal, and blockage of fish migration. Problems downstream that affect returns to the upper Chehalis are pulp mill waste and channel dredging in Grays Harbor.

Silting-in of the spawning grounds and rearing areas is connected with logging, gravel removal, and agriculture. Logging roads are often susceptible to erosion, especially where loose earth is sidecast to build up the roadbed. Rain washes this material and that of the roadbed itself into the streams, and the resulting silt tends to smother eggs and fry in the gravel. The affected area may remain unusable for many years. After logging is completed, the roads are abandoned and continue to erode thus prolonging the siltation problem.

Examples of past logging damage are Mima Creek, parts of the Skookumchuck River, Bernier Creek, and Elk Creek (Phinney et al., 1975). Recent damage has probably occurred from extensive clearcutting down to the streambank on the South Fork Newaukum above Pigeon Springs Road. Another example is the mainstem above Pe Ell and its tributaries, especially Thrash and Cinnabar creeks (Jim Fraser, WDF, personal communication). Timber removal has resulted in landslides, both directly and through failure of logging roads. The upper South Fork Chehalis is also being logged.

Agriculture also contributes to siltation. Grazing cattle close to the streams increases erosion, as does removal of bank vegetation.

Coal mining in the Hanaford Creek system is another adverse activity. The mining, exposing about 900 acres at any time, increases siltation, especially in the Packwood Creek system. This system has supported coho and chum salmon (Phinney et al., 1975; Quinault Department of Natural Resources (QDNR, 1978).

Gravel mining is also detrimental because removal and washing of gravel adds to siltation. Water quality and quantity problems affect rearing habitat

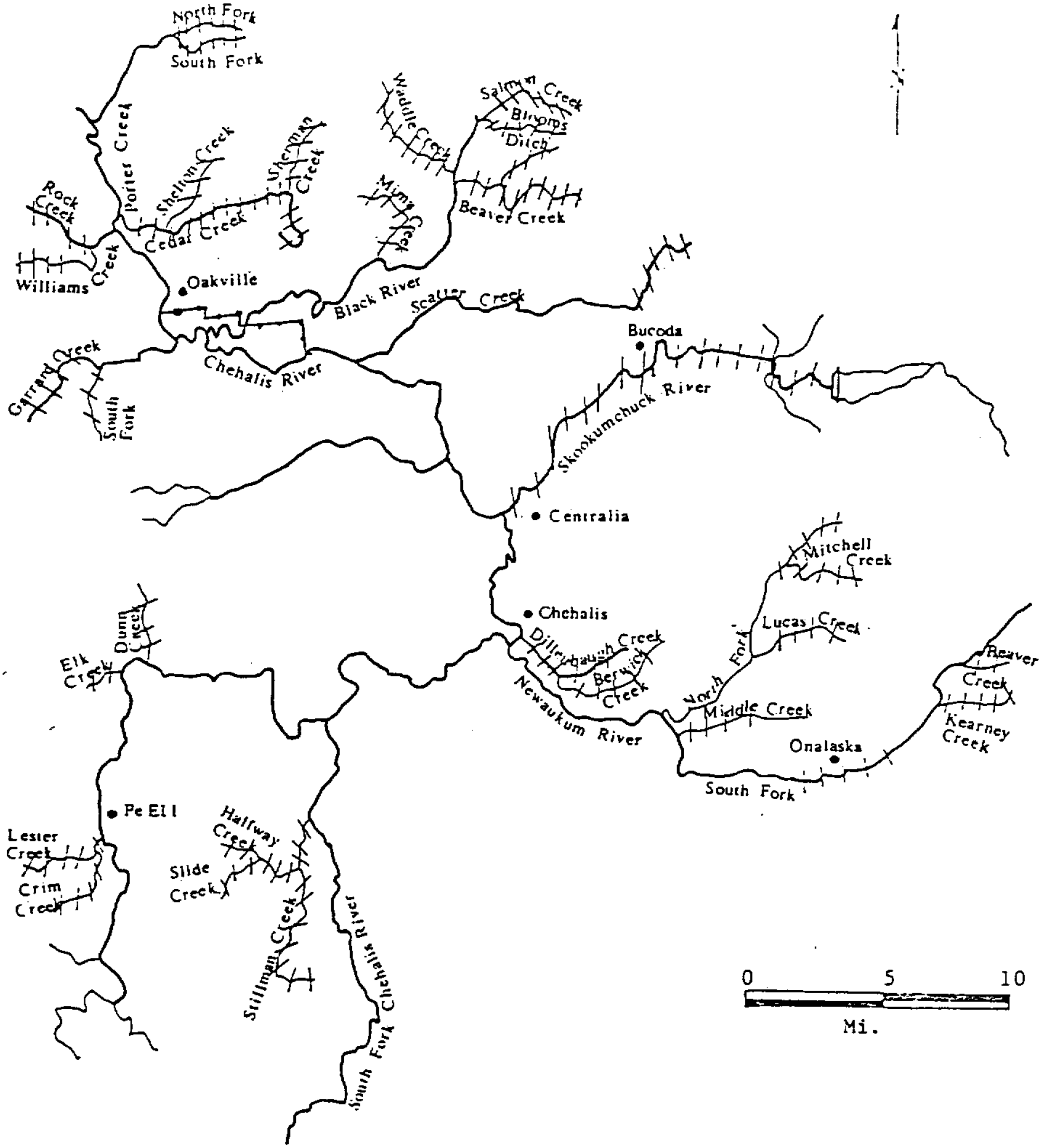


FIGURE 10. Potential coho spawning areas. Sources: Phinney, 1969; Phinney *et al.*, 1975.

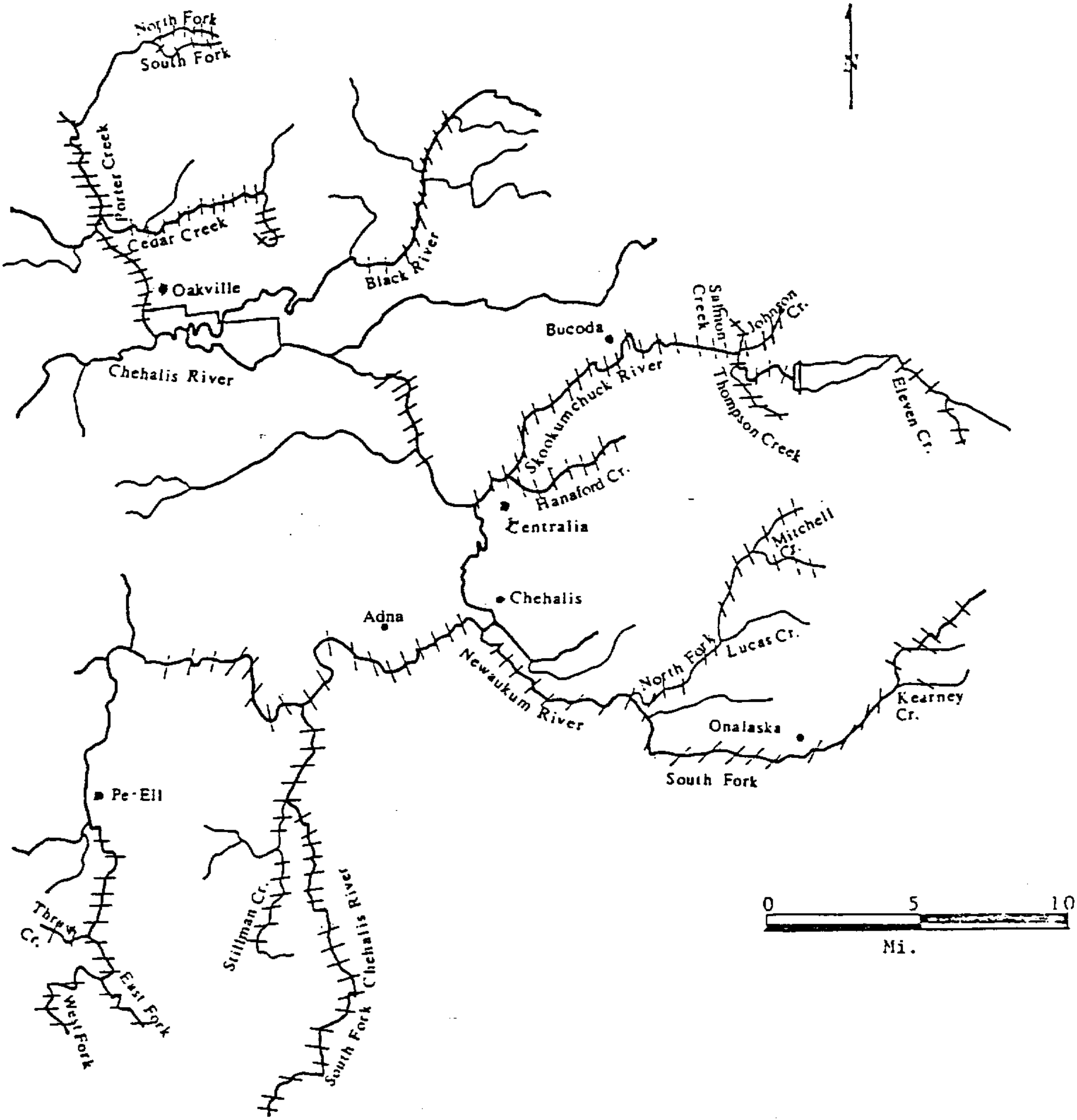


FIGURE 11. Potential steelhead spawning areas. Source: WDG, 1970.

of all species, spawning activity of chinook, and holding areas for spring chinook. Logging, agriculture, municipal diversion, and sewage all contribute to the problem. Removal of trees through logging lessens the capacity of the watershed to retain water resulting in low summer flows. This in turn can result in less rearing area and higher temperatures. Examples are the Stillman Creek, the south, east and west forks of the Chehalis (WDG, 1970), the mainstem above Fisk Falls, and Elk Creek (Phinney, 1969).

Agricultural diversion also contributes to low flow. Examples are Independence, Lincoln and Bunker creeks (Phinney et al., 1975), the upper mainstem tributaries, and Stillman Creek (Phinney, 1969). Municipal diversion also contributes to low flow. The City of Chehalis operates a diversion dam on the North Fork Newaukum which has been cited for causing low summer flows (WDF, 1969).

Low flow is often associated with excessively high water temperatures. A high of 82°F has been recorded at Grand Mound (Phinney, 1969). Temperatures frequently remain in the low 70's for some time, and may seriously affect juvenile rearing, spring chinook maturation and spawning, and fall chinook spawning.

Pollution is another aspect of poor water quality. One problem is agricultural runoff containing manure, pesticides, or fertilizers; fish kills have occurred near farms on Dillenbaugh and Berwick creeks (Phinney et al., 1975). Another is discharge of sewage in the Chehalis and Centralia area, with resulting oxygen depletion (WDG, 1970). Both cities now have secondary treatment. Primary treatment removes most solid materials from the water. Secondary treatment is designed to remove the remaining oxygen-demanding materials. Cannery wastes in Chehalis have also been a problem. Smaller towns, including Onalaska, Napavine, Tenino and Oakville, have also been mentioned in the past for unsatisfactory sewage systems (Phinney, 1969).

Gravel removal is another significant detriment to fish production because potential spawning grounds are disturbed. The remaining gravel tends to be less stable, and more likely to be washed into areas unsuitable for spawning. Gravel has been mined on the lower South Fork Newaukum (Phinney et al., 1975; QDNR, 1978), lower Stillman Creek, and the North Fork Newaukum below river mile (RM) 8 (Phinney, 1969).

The Skookumchuck Dam, built in 1970 and managed by Pacific Power and Light (PP&L) , has had both negative and beneficial impacts on Skookumchuck salmon and steelhead. The project provides water for two coal-fired power plants south of Bucoda. The dam maintains summer flows, of which up to 30 cfs (cubic feet per second) have been diverted at RM (River Mile) 7.8 and pumped to the power plants (Figure 12).

Before construction, the area above the dam provided holding, spawning, and rearing area for spring chinook, fall chinook, coho and steelhead. Salmon and steelhead had access 14 miles above the dam to RM 36. Half the potential coho rearing area (Finn, 1973) and 90% of the potential steelhead spawning grounds on the Skookumchuck (PP&L, 1979) were above the dam. The dam completely blocked migration upstream, resulting in an estimated loss of 500 spring chinook, 311 fall chinook, 1,800 coho (Finn, 1973) and about 700 steelhead (WDG, 1970) spawners.

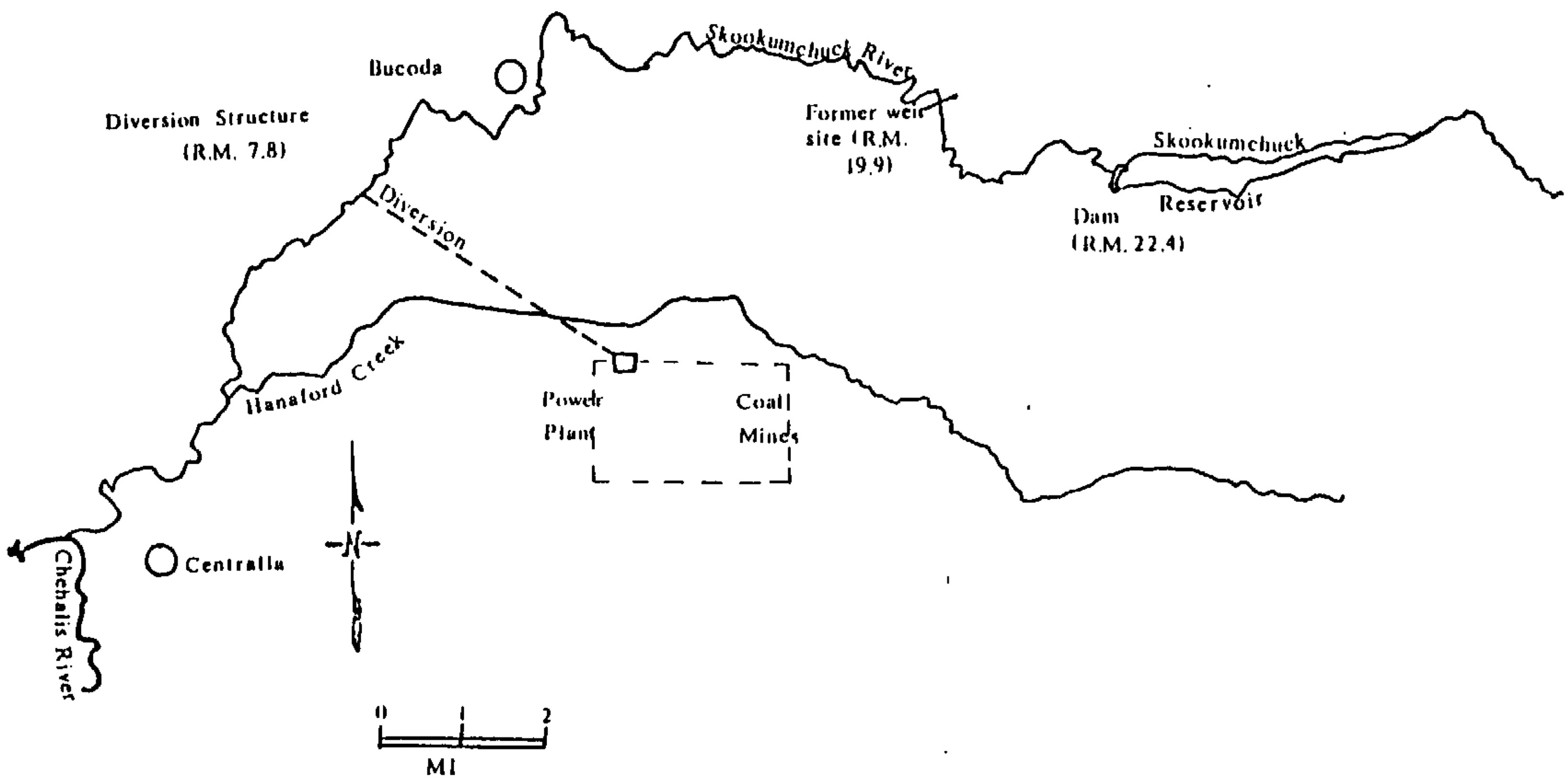


FIGURE 12. Pacific Power and Light Skookumchuck reservoir and power plant.

The power company agreed to mitigate by guaranteeing adequate spawning and rearing flow, making efforts to protect spring chinook, and enhancing coho and steelhead (PP&L, 1979). For adequate spawning flow, 140 cfs is provided below the dam, with some exceptions, from September 10 to the end of the spawning period. Flow during the rest of the year is set at a minimum of either 95 cfs or the reservoir inflows plus 50 cfs, whichever is less, to provide rearing flows below the diversion. The dam has provided higher summer flows, both above and below the diversion, and lower temperatures for three to five miles below the dam (Ed Weiss, PP&L, personal communication). This was expected to result in higher rearing capacity in these areas for spring chinook, coho and steelhead.

The dam was designed to mitigate spring chinook by providing cool outlet water. Outlets at various elevations allow outlet water temperature to be controlled and kept below 60°F all year. Also, an area immediately downstream of the dam was set aside for spring chinook spawning. To keep fall chinook from digging up spring chinook redds, a weir was built several miles below the dam and only spring chinook were allowed upstream. After five years the weir was removed because it was assumed that the two runs had established separate spawning grounds (R. Palmer, PP&L, personal communication).

Pacific Power and Light financially supported WDF in mitigating for the loss of coho by expanding the Simpson Hatchery to accommodate an additional 17,000 pounds of smolts. About 80% of the mitigation fish were to be planted in the upper Chehalis. These made up about 20% of the total 1980 upper Chehalis coho plants. To further enhance coho, WDF operates rearing ponds below the dam, using some of the outlet water.

The power company also agreed to provide passage for steelhead migrating both upstream and downstream past the dam, and to support WDG enhancement efforts. The company collects steelhead at a trap at the foot of the dam and transports them upstream. Smolts are effectively transported downstream by allowing dam waters over the spillway from March 15 to June 1. The spillway is designed to avoid injuring fish physically or by excessive aeration. Support is also provided to WDG in transporting a portion of the steelhead captured at the dam to the South Tacoma Hatchery for spawning. The rest are transported above the dam and released to spawn naturally. WDG rears about 30,000 offspring to smolt size at South Tacoma and 20,000 in floating pens on the reservoir, and releases them at various points in the upper Chehalis. WDG has set a goal of 1,000 returning adults; the last two years' returns have been about 800 and 900 fish, respectively (G. Fenton, personal communication).

The diversion structure at RM 7.8 was designed to avoid pinning fish against the intake screen during pumping and sucking fish through the pipeline. Neither problem has been observed (E. Weiss, personal communication).

Recently PP&L (1979) proposed that a hydroelectric generator be installed at the dam. The flow regime would not be altered, but some flow would come from the powerhouse outlet instead of the dam, thus attracting steelhead away from the trap at the foot of the dam. PP&L proposes to build a barrier for directing fish away from the powerhouse, and to provide enough flow at the dam outlet to attract adult steelhead in March and April when they are most abundant. This addition is under the jurisdiction of the Federal Energy Regulatory Commission (FERC); USFWS, Ecological Services, Olympia is studying the proposal.

As part of the Centralia Flood Control Project, the Army Corps of Engineers (COE) has proposed to spread out release of peak winter flows from the present twelve-hour period to a three-day interval. No flood control dikes or storage ponds are now being considered. Small dams and culverts when improperly built or when closed with debris, can also block fish migration to potential habitat upstream. Several examples in the Chehalis were cited in the Boldt Phase II proceedings.

Certain conditions on the lower river may also affect returns to the upper Chehalis. A pollution block was described by Deschamps and Senn (1969). This was a section of Grays Harbor from Cosmopolis to Hoquiam where dissolved oxygen fell below 6 ppm during the summer months. Poor survival of both adult and juvenile salmon and steelhead in their migration through the area was evident. The principal cause was pulp mill waste discharged by the ITT Rayonier and Weyerhaeuser mills. In 1971 and 1973, however, the Skookumchuck and Wyonoochee dams, respectively, contributed to higher summer flows which increased the flushing effect in the critical months. In 1976 Weyerhaeuser began secondary treatment of certain wastes and in 1977 Rayonier began such treatment for all wastes (Loehr and Collias 1981). However, concern for water quality remains (QDNR, 1978).

Another downriver action with possible effects is harbor dredging. The Army Corps of Engineers has been planning to widen and deepen the navigation channel up to Cosmopolis. The project is not expected to have a long-term effect on water quality (Loehr and Collias 1981). Disposal of spoils, however, will eliminate four acres of tidal flats, which contribute to production of fish food organisms. The annual short-term resuspension of sediments in initial and maintenance dredging may result in acute toxicity to fish, and will disrupt productivity of fish food organisms (WDNR, 1978). The USFWS, Ecological Services, Olympia is preparing a report on the biological effects of the project. The COE has prepared feasibility and environmental impact statements which are available at their Seattle District Office.

Tribal Opportunities for Environmental Protection Activity

The tribe can comment officially on many environmental issues by requesting to be placed on the mailing lists of various federal, state and local agencies (Appendix Table 6). Should the tribe not comment on every notice they request, this absence can be interpreted as consent.

The principal federal agencies are the Corps, the USFWS and the BIA (Table 13). The Corps has a Project Planning Division, which solicits comment at various steps in the complex process of planning large federal projects. It also

Table 13. Agencies with environmental responsibilities.

Agency	Division	Responsibilities
U.S. Army Corps of Engineers	Project Planning: Environmental Branch	Large federal projects
	Regulatory Functions	Public notice on state, local, and private projects
USFWS	Ecological Services	Corps project planning, FERC, and projects of other federal agencies
BIA		FERC, others
WDF		Hydraulic permits
WDG		Hydraulic permits
DOE		SEPA projects and certain logging operations
DNR		All logging operations
NWIFC		FERC, other projects

has a Regulatory Functions Branch, which distributes public notices for smaller projects proposed by individuals, businesses, and state and local agencies.

The USFWS, Ecological Services, Olympia provides information to the tribes on projects under consideration in the COE planning process and public notices, the Federal Register, and the FERC. The BIA also is available to provide information relating to FERC and other projects. The USFWS can advise on activities of other federal agencies, such as the Department of Transportation, in the area.

The principal state agencies are WDF, WDG, the Department of Ecology (DOE) and the Department of Natural Resources (DNR). WDF and WDG each process Hydraulic Permit Applications (HPAs) on which the tribe may comment. These are required for projects that could affect stream flow or water quality. The DOE administers the State Environmental Policy Act (SEPA) and can inform the tribe of major state, county and city activities via its weekly SEPA Register.

The DNR enforces regulations on all logging activities on both public and private lands. Logging operations proposed for state lands are listed and distributed monthly. The tribe may request this information. Operations on private lands are not publicized, but the tribe can get details of individual operations by providing a legal description of the property in question to the DNR Central Area Office in Chehalis. The WDF also provides information on logging practices. If logging involves subdivision, spraying of persistent chemicals, or endangered species, then the DOE, WDF, and WDG must inspect the operation. The Non-game Program of the WDG is responsible for protecting endangered species.

Locally, the Northwest Indian Fisheries Commission (NWIFC) passes on to the tribes information on FERC proceedings and other issues. The planning divisions of Lewis County, Centralia, Chehalis and the Port of Grays Harbor could also be consulted.

CONCLUSIONS

Salmon and steelhead stocks in the upper Chehalis watershed above Oakville are believed by many to be producing below capacity. Chehalis tribal catch was examined in an attempt to determine trends in run size and spawner escapement to the upper Chehalis. There is considerable fluctuation and variability in annual catch and few obvious trends were apparent. However, Grays Harbor fall chinook and coho stocks may have declined prior to 1935 when no information relative to the upper Chehalis was available. While tribal catches of coho do not appear to be declining, the size of the upper Chehalis watershed relative to the catch and apparent low juvenile and smolt abundance indicate the system may be producing below capacity. Heavy ocean interceptions and environmental problems, coupled with present terminal harvest, were undoubtedely key factors in depressing these stocks. Chum catches declined in the 1950's, as did other west coast chum stocks, but appear to be returning to a pattern of wide year-to-year fluctuations.

It appears that upper and lower Chehalis River steelhead catches have declined overall, although harvest in some tributaries has increased, probably due to enhancement. Sport catch in the Newaukum River appears to be particularly poor.

The Chehalis Tribe's share of the terminal area catch has decreased as the Quinault share has increased, particularly with fall chinook and coho. A sharing formula between the Chehalis Tribe, Quinault Tribe and non-treaty fishermen needs to be developed before the fisheries can be managed properly.

Management of Grays Harbor salmon stocks generally utilize techniques successfully employed in other north coastal and Puget Sound fisheries. However, the data upon which these techniques rely appears to be lacking in some respects for Grays Harbor stocks, and particularly for spring chinook. Pre-season prediction methodologies are based upon relationships which may not provide accurate estimates of expected run strength. Despite this fact, the present techniques are probably the best available although additional effort should be directed toward improving the data base and determining limiting factors.

In particular, a radio-tagging study for spring chinook could provide information on timing, holding areas and distribution on the spawning grounds. This would make run size estimates more reliable and useful for management and would also identify areas most in need of environmental protection.

The data base relating to steelhead is much more limited. No run size or spawning escapement estimates are available nor are spawning escapement goals. Much more data is needed before steelhead can be managed on the basis of an optimum spawning escapement. Again, the limited available data is being used to manage Grays Harbor stocks. Until additional information becomes available, a conservative approach should be taken in harvest strategies.

Further enhancement is possible for chum, spring and fall chinook, and steelhead. The tribe might first consider raising chum and fall chinook because of their shorter freshwater rearing period. Spring chinook and steelhead warrant consideration if resources permit, because they have the most need for enhancement. The tribe should also encourage the rearing of native spring chinook and steelhead if a hatchery is constructed at Wynoochee, with satellite stations and releases in the upper Chehalis.

Locating enhancement facilities off the reservation would take advantage of better water supplies and less flooding. Programs could both build up hatchery runs and re-stock streams that are now underseeded. Enhancement of upper Chehalis salmon must not conflict with the goal of managing Grays Harbor stocks for natural reproduction. Harvest of enhanced stocks should be separated in time or location in order to achieve full harvest.

The upper Chehalis watershed suffers from a number of environmental disturbances which impact its fishery resources. Most notable are probably water quality problems which result from or are aggravated by most of the previously mentioned environmental problems. A list of agencies and contacts with responsibilities relating to these problems is included in this report. The tribe should pursue these opportunities for involvement. At the present low level of enhancement of salmonids, other than coho, stocks in the upper Chehalis are dependent upon suitable natural spawning and rearing habitat.

In this report we have identified a few of the many fishery resource problems affecting the Chehalis Tribe and upper Chehalis River salmonid stocks. This system, one of the state's larger watersheds with numerous tributaries and important fish resources, presents complex problems requiring the full-time attention of a fisheries biologist. Most Puget Sound and coastal tribes employ two or more biologists. Considering the importance of this watershed, a Chehalis tribal biologist is needed to insure the tribe's interests are represented in management decisions.

REFERENCES

Brix, R. 1981. Data report of Grays Harbor juvenile salmon seining program, 1973-1980. State of Washington, Department of Fisheries. Prog. Rept. 141: 1-78

_____ and D. Seiler, 1977, Upper Chehalis River smolt trapping study, 1976, State of Washington, Department of Fisheries, Prog. Rept. 25: 1-14.

_____ and _____. 1978. Upper Chehalis River smolt trapping study, 1977. State of Washington Department of Fisheries, Prog. Rept. 48 1-15.

Coleman, P. and T. Rasch. 1981. A detailed listing of the liberations of salmon into the open waters of the State of Washington during 1980. State of Washington, Department of Fisheries Statistical Rept. 132: 1-360.

Crawford, B. A., S. A. Leider and M.W. Chilcote. 1979. Kalama River steelhead investigations,Washington Dept. of Game. 89p.

Deschamps, G. and H. Senn. 1969. Investigation of the effects of Grays Harbor waters on coho emigration. State of Washington, Department of Fisheries, Research Division. 17p.

Finn, E.L. 1973. Final report: Skookumchuck-Hanaford Creek fisheries investigations. State of Washington, Department of Fisheries, Management and Research Division. 83p.

Hopley, W. 1979. Salmon spawning objectives for Grays Harbor tributaries. Washington Department of Fisheries, Harvest Management Division. 6p.

Loehr, L.C. and E.E. Collias. 1981. A review of water characteristics of Grays Harbor 1938-1979 and an evaluation of possible effects of the Widening and Deepening Project upon present water characteristics. University of Washington, Department of Oceanography. 97p.

Mathews, S.B. 1981. Biological report for Wynoochee Hatchery management planning. Department of the Army, Seattle District, Corps of Engineers, DF-NPSEN-PL-ER. 76p.

Pacific Power and Light Company. 1979. Environmental statement for a proposed Skookumchuck Dam hydroelectric unit. 6p.

Phinney, L. 1969. Chehalis basin study: final report. State of Washington, Department of Fisheries, Research Division. 40p.

_____, P. Bucknell, and R.W. Williams. 1975. A catalog of Washington streams and salmon utilization. Vol 2: coastal region Washington Department of Fisheries. 1000p.

Quinault Department of Natural Resources and Economic Development. 1978. A survey of fish habitat alterations within WRIA 21, 22, 23 of Washington State. 69p.

U.S. Fish and Wildlife Service. 1974. Special report: fishery development potential on the Chehalis Indian Reservation. Northwest Fisheries Program. 9p.

Ward, W.D., R.S. Robinson, and G.D. Nye. 1976. 1975 fisheries statistical report. Department of Fisheries, State of Washington. 116p.

_____, L. J. Hoines, and G.D. Nye. 1979. 1978 fisheries statistical report. Department of Fisheries, State of Washington. 41p.

Washington Department of Fisheries. 1969. Summary of salmon resources of the upper Chehalis basin as related to certain dam proposals. State of Washington, Department of Fisheries. 19p.

_____. 1981 a. Stock status report and management proposals for Chehalis River spring/summer chinook. Harvest Management Division. 2p.

_____. 1981 b. Stock status report and management objectives for Grays Harbor and north coastal Washington fall chinook, coho, and chum salmon in 1981. Harvest Management Division. 22p.

Washington Department of Game. 1970. Chehalis basin study: fish and wildlife appendix. Washington Game Department, Environmental Management Division. 90p.

Weller, C. 1976. Progress report to the Chehalis Tribe number 5: fishery enhancement. Small Tribes of western Washington. 19p.

Wright, S.G. 1976. Status of Washington's commercial troll salmon fishery in the mid-1970's. Washington Department of Fisheries Tech. Rep. 21: 1-50.

Zook, W. J. 1976. Coastal gillnet management. State of Washington, Department of Fisheries Prog. Rept. 6: 1-60.

Appendix 1. Fall chinook salmon catches, escapements, and terminal harvest rate in the Grays Harbor drainage.

Year	Grays Harbor catch: Chehalis Indian	Non-Indian[1] gillnet	G.H. Indian[2] gillnet	River sport	Total[4] catch	Escapement[3]	Total terminal run	Harvest[4] rate
1967	1,320	9,187	-	-	10,507	-	-	-
1968	590	12,997	-	-	13,587	-	-	-
1969	310	12,534	-	-	12,844	7,039	19,883	.64
1970	1,705	13,756	-	-	15,461	9,738	25,199	.61
1971	487	8,880	-	-	9,367	8,032	17,399	.54
1972	1,652	10,113	-	-	11,765	7,477	19,242	.61
1973	2,236	10,476	-	-	12,712	7,262	19,974	.64
1974	511	7,941	70	1,107	9,629	4,248	13,877	.69
1975	578	7,013	1,294	705	9,590	4,283	13,873	.69
1976	386	2,874	3,086	809	7,155	1,847	9,002	.79
1977	1,317	1,840	4,006	898	8,061	5,409	13,470	.60
1978	1,069	703	2,874	1,941	6,587	4,785	11,372	.60
1979	1,413	0	95	1,094	2,602	9,486	12,088	.22
1980	1,229	3,508	5,650	-	10,387	12,730	23,117	.45
$\bar{x}$	1,057	7,273	2,439	1,092	10,018	6,861	16,541	.59

[1] Excludes catches prior to Aug 16 which are considered to be nonlocal stocks, i.e., stocks destined for the Columbia or other systems.
[2] Includes a small number of spring chinook from the Chehalis River.
[3] Desired escapement 14,586.
[4] Excludes unknown river sport catch prior to 1974.

Source: Mathews,1981.

Appendix Table 2. Upper Chehalis fall chinook fingerling plants.

Year	Number fish
1961	100,000
1962	100,000
1963	100,000
1964	99,000
1970	1,106,000

Source: WDF Hatcheries Statistical Reports.

Appendix 3. Chum salmon catches, escapements, and terminal harvest rates in the Grays Harbor drainage.

Year	Grays Harbor catch				Escapement[1]	Total terminal run	Harvest rate
	Chehalis Indian	Non-Indian gillnet	G.H. Indian gillnet	Total catch			
1967	618	10,565	-	11,183	-	-	-
1968	2,545	5,815	-	8,360	-	-	-
1969	887	22,571	-	23,458	11,502	34,960	.67
1970	1,984	28,391	-	10,375	17,171	27,546	.38
1971	3,607	12,467	-	16,074	10,757	26,831	.60
1972	1,604	46,287	-	49,495	8,791	58,286	.85
1973	3,288	34,269	-	37,557	12,279	49,836	.75
1974	4,715	28,841	-	33,556	8,142	41,698	.80
1975	1,131	9,986	2,802	13,919	12,389	26,308	.53
1976	3,988	12,775	10,220	26,983	12,856	39,839	.68
1977	1,609	645	1,038	3,289	21,283	24,572	.13
1978	1,831	7,567	7,853	17,251	12,875	30,126	.57
1979	5,443	0	47	5,490	-	-	-
1980	2,810	6,329	14,297	23,436	27,856	51,292	.46
$\bar{x}$	2,576	16,179	6,042	20,030	14,173	37,390	.58

[1] Desired escapement 21,000.

Source: Mathews, 1981.

Appendix 4. Coho salmon catches, escapements, and terminal harvest rates in the Grays Harbor drainage.

Year	Grays Harbor catch: Chehalis Indian	Non-Indian gillnet	G.H. Indian gillnet	River sport	Total catch	Escapement[1]	Total[4] terminal run	Harvest[4] rate
1967	618	21,804	-	-	22,422	105,012	127,434	.18
1968	2,545	36,489	-	-	39,034	91,191	130,225	.30
1969	887	25,426	-	-	26,313	55,706	82,019	.32
1970	1,984	64,827	-	-	66,811	103,786	170,597	.39
1971	3,607	58,698	-	-	62,305	77,452	139,757	.44
1972	1,604	46,552	-	-	48,156	26,928	75,084	.64
1973	3,288	40,162	-	-	43,450	19,233	62,683	.69
1974	4,715	49,515	218	4,154	62,429	98,660	161,089	.39
1975	1,131	20,985	3,507	1,272	26,895	11,971	38,866	.69
1976	3,988	13,863	14,718	2,633	35,202	33,462	68,664	.51
1977	1,609	1,455	2,581	689	41,536	30,512	72,048	.58
1978	1,831	837	4,282	2,265	9,215	16,177	25,392	.36
1979	5,443	0	3,289	3,827	12,559	*[2]	-	-
1980	2,810	9,935	23,804	-	36,549	*[3]	-	-
$\bar{x}$	2,576	27,896	7,486	2,473	38,064	55,841	96,155	.46

[1] Desired escapement 37,501

[2] Qualitatively excellent although no precise estimate available.

[3] Less than adequate.

[4] Excludes unknown river sport catch prior to 1974.

Source: Mathews, 1981.

Appendix Table 5. Salmon and steelhead facilities and production for Grays Harbor system, 1980. Sources: Coleman and Rasch 1981; WDG unpublished data; T. Buzzell, Mayr Brothers, personal communication.

Facility or Organization	Fall Chinook	Coho	Chum	Steelhead
WDF Humptulips Hatchery	1,155,690	7,335,277	24,480	
WDF Simpson Hatchery	98,118	4,096,450		
WDF Satsop Springs	202,350			
WDF Skookumchuck Ponds		1,681,800		
Kelpers Association[a]		250,000		
Grays Harbor Gillnetters[b]		51,625		
Grays Harbor 4-H Club[b]		90,000		
Mayr Brothers Logging[c]		5,000		135,000
WDF Westport Pens		29,000		
Grays Harbor College[b]		141,000	90,000	
Egg Boxes				
Humptulips		250,000		
East Fork Hoquiam			400,000	
Wishkah		250,000	1,400,000	
North Fork Newaukum		250,000		
WDG Skookumchuck Pens				16,080
WDG Puyallup Ponds				19,987
WDG Aberdeen Hatchery				87,600
WDG South Tacoma Hatchery				15,000

[a]Released on North Fork Newaukum

[b]Released at various locations.

[c]Released on Wishkah.

Appendix Table 6. Addresses of agencies involved in environmental procedures.

District Engineer
U.S. Army Corps of Engineers
4735-E. Marginal Way S.
Seattle, WA 98134
Attn: Gerald A. Keller
For Wynoochee Dam comments: Jack Thompson

Ecological Services
U.S. Fish and Wildlife Service
2625 Parkmont Ln. #B
Olympia, WA 98502
For FERC - Attn: Tom Payne
For Corps Permits - Attn: Dave Stout
For Grays Harbor projects - Attn: Jeff Opdycke
For Upper Chehalis projects - Attn: Jim Lykes

Bureau of Indian Affairs
P.O. Box 3785
Portland, OR 97208
Attn: Bob Taylor

Region 1
U.S. Fish and Wildlife Service
500 N.E. Multnomah St.
Portland, OR 97232
Attn: Chuck Polityka

For hydraulic permit applications:
Washington Department of Fisheries
Rm. 115 General Administration Bldg.
Olympia, WA 98504
Attn: Ray Johnson

For information on logging practices:
Washington Department of Fisheries
3039 Cleveland Ave.
Tumwater, WA 98501
Attn: Steve Keller

Washington Department of Game
600 Capitol Way N.
Olympia, Wa 98504
Attn: Fred Maybee

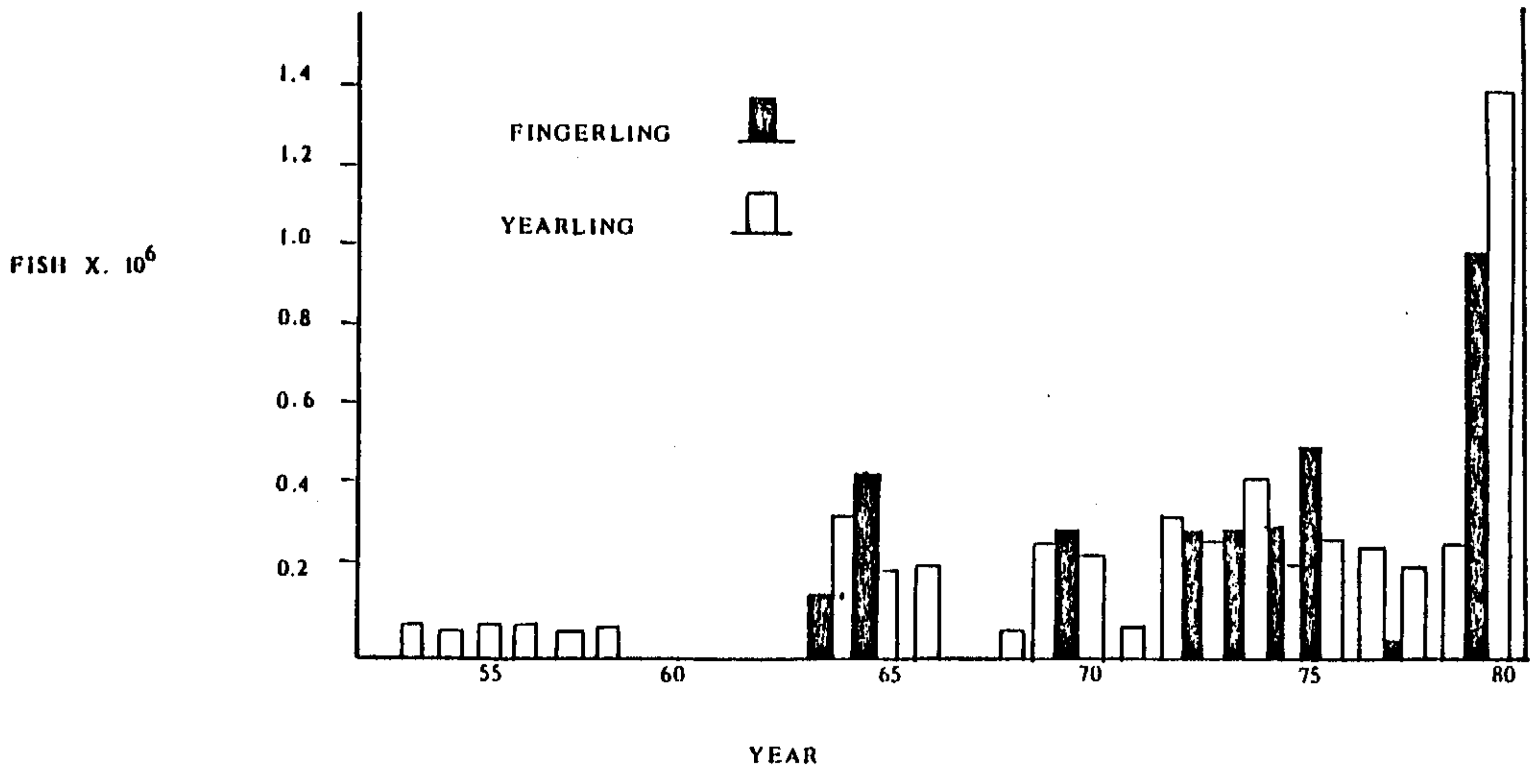
Washington Department of Ecology
Environmental Review Section
Mail Stop PV-11
Olympia, WA 98504
Logging issues-Attn: Jim Sachet
Other concerns - Attn: Shara Stelling

Appendix Table 6. (continued)

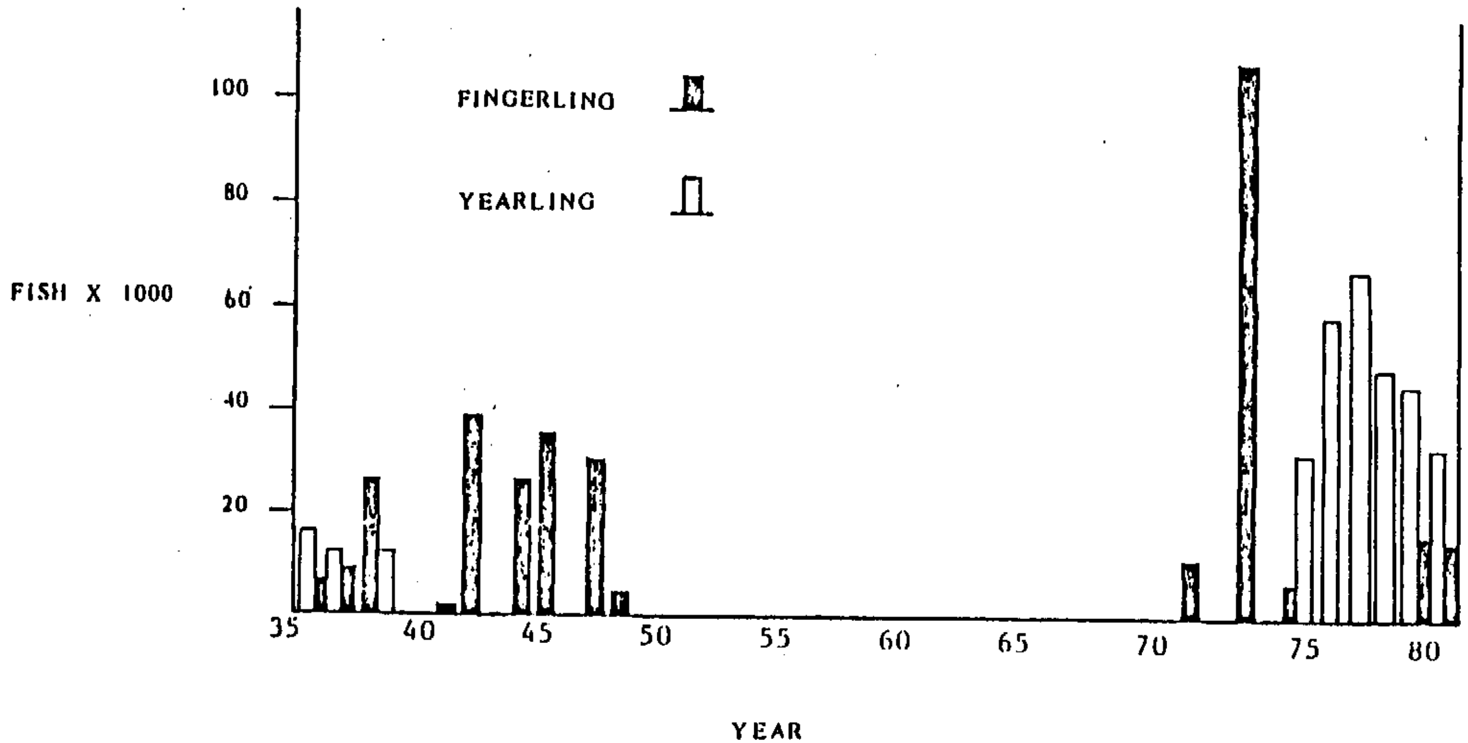
Northwest Indian Fish Commission
2625 Parkmont Ln # C
Olympia, WA 98502
Attn: Dennis McDonald

For timber sales on state lands-
Washington Department of Natural Resources
Public Lands Bldg.
Olympia, WA 98504
Attn: Glen Hawley

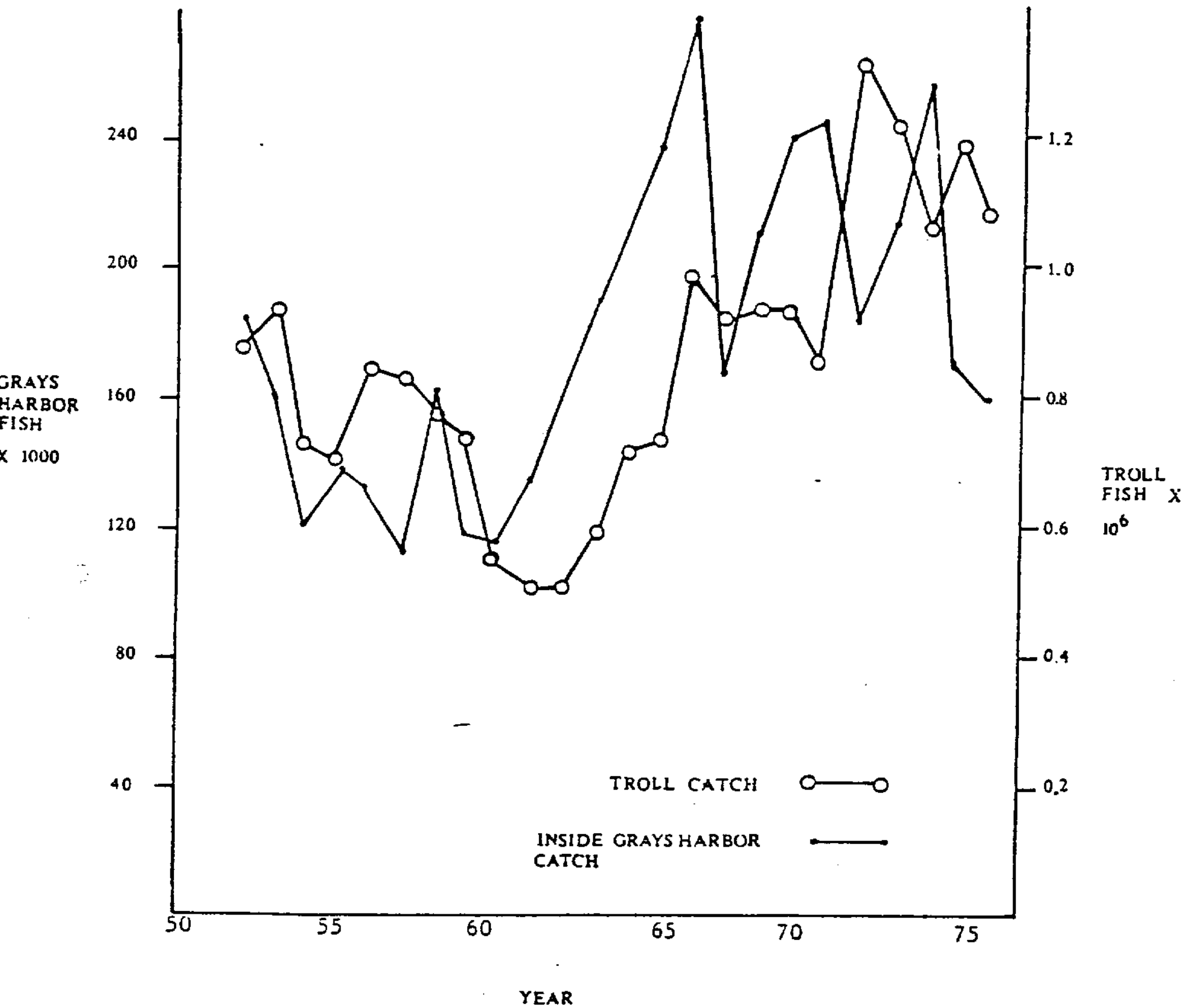
To report questionable logging practices:
Central Area Office
Washington Department of Natural Resources
P.O. Box 1004
Chehalis, WA 98532
Attn: Jan Reynolds



APPENDIX FIGURE 1. Upper Chehalis coho plants, 1953-80. Source:WDF Hatchery Statistical Reports.



APPENDIX FIGURE 3. Upper Chehalis steelhead plants, 1936-80. Source; WDG unpublished data.



APPENDIX FIGURE 4. Grays Harbor gillnet catch versus British Columbia troll catch. Sources: B.C. troll: British Columbia catch reports. Grays Harbor gillnet: Ward et al 1976.