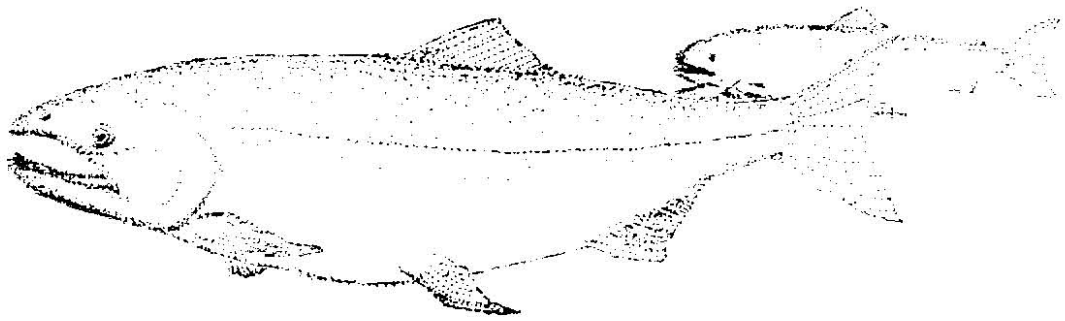
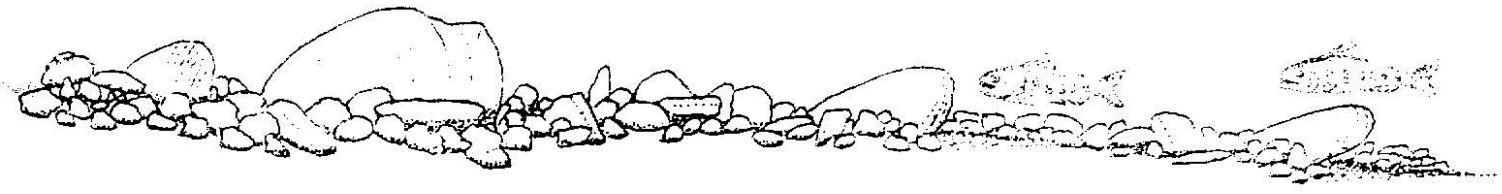
Fisheries Assistance Office
Olympia, Washington

PROGRESS REPORT OF NATIONAL FISH HATCHERY PROGRAMMING AND EVALUATION ACTIVITIES PUGET SOUND AND COASTAL WASHINGTON, 1984-85





PROGRESS REPORT OF NATIONAL FISH HATCHERY PROGRAMMING AND EVALUATION ACTIVITIES PUGET SOUND AND COASTAL WASHINGTON, 1984-85

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

This report describes the U.S. Fish and Wildlife Service's (FWS) programming and evaluation activities at Quilcene and Makah National Fish Hatcheries (NFH) for the period August 1, 1984 - July 31, 1985. The information presented has been summarized by the Olympia Fisheries Assistance Office (FAO) for use by the FWS, other federal resource agencies, state, and tribal fishery managers. Basic programming information for Quinault NFH is also presented.

QUILCENE NATIONAL FISH HATCHERY

During 1985 the revised Hood Canal Management Plan was adopted as the basis for management of hatchery and wild salmon stocks in Hood Canal. During the year, FWS, Point-No-Point Treaty Council (PNPTC), and the Washington Department of Fisheries (WDF) completed negotiations to revise the Plan. The purpose of the Plan, as stated in its preamble, "...is to establish guidelines for the harvest, protection, rehabilitation and enhancement of salmon resources originating from or passing through Hood Canal waters...." As part of the negotiations, the parties involved established production levels for each of the species reared at the hatcheries located in Hood Canal. (Anadromous species of salmonids produced at Quilcene NFH consist of spring chinook (SCS), coho, and chum salmon.) Technical staff representing each of the three parties visited the Hood Canal hatcheries to review the respective programs (includes Quilcene NFH and state and tribal facilities). The constraints imposed by species selection and rearing space were thoroughly considered during the review. A package containing various production scenarios for each of the hatcheries was developed and approved by the negotiators.

The production levels established during negotiations for Quilcene NFH, referred to as "equilibrium brood level" in the Plan, are presented in Table 1. Deviations from the equilibrium brood levels are expected in the next few years until sufficient numbers of spring chinook broodstock begin returning to the hatchery. In the interim, coho smolt production will remain above its equilibrium brood level to offset the lack of SCS production and allow the hatchery to function at full capacity. The level of coho smolt production may range between 300,000 and 500,000 yearlings depending on the number of spring chinook juveniles available for rearing.

The parties recognize that the Plan is not static and that a continuous "...timely exchange of resource management information..." is needed. Therefore, schedules were established for exchanging information. As a participant in the Plan, the Service, through the Olympia FAO, will participate in annual program reviews and development of resource planning documents. We will also communicate with member parties prior to implementing any major program changes.

Fish and egg distribution as reported by the hatchery is presented in Tables 2 and 3, respectively.

Table 1. Equilibrium brood programs established for Quil
Hood Canal Management Plan.

Species	Stock	Fish (millions)	Size (Fish/lb)	Release
Chum	Quilcene	2.20	550	Big Qui
Coho	Quilcene	.25	450-800	Area 12.
	Quilcene	.25	18	Big Quil
Spring Chinook	Quilcene	.40	15	Big Quil
	Quilcene	.20	65	Big Quil

Table 2. A record of Quilcene NFH salmon releases made into the open waters of Washington State
during 1985.

Spring Chinook

The viral disease, IHN, was discovered at Cowlitz Hatchery and has resulted in a restriction on the exportation of Cowlitz SCS eggs out of that watershed. The termination of the Nooksack X Cowlitz broodstock program means that the Quilcene SCS restoration program must now primarily rely on returns to the hatchery as a source of broodstock. Rack returns during 1984 provided a minimal number of eggs (approximately 29,000 fingerlings were on hand as of August 1985). We solicitated WDF in an effort to secure other sources of brood (eggs, fry, or adults). As a result, WDF provided 206,000 SSC fry (brood year 1984, approximately 195,000 fish were on hand as of August 1985). These fry were from the Department's Nooksack Hatchery but originally came from the Soleduck Hatchery (Cowlitz and Umpqua stocks were used in the Soleduck program). Over several years of rearing, the Nooksack Hatchery had maintained this stock separate from the other two chinook stocks cultured there (native Nooksack spring chinook and Nooksack fall chinook) based on time of entry to the hatchery. Presumably interbreeding between the three stocks occurred and some native N.F. Nooksack influence, similar to that used originally in the restoration program, is present in these fingerlings.

Spring chinook released from Quilcene NFH in 1985 included 401,730 S.F. Nooksack X Cowlitz and 55,289 N.F. Nooksack X Cowlitz yearlings (Table 2).

Terminal Area Returns: Refer to the 1984 programing and evaluation report for a description of the 1984 SCS return. Three, four, and five-year-old fish are expected to return in 1985 from the 1980-82 brood years (Table 4). Due to the severity of a BKD epizootic in the 1982 brood yearlings, we anticipate a low overall survival and return of three-year-olds from this release. A subyearling release of 51,928 from the 1982 brood was not as severely affected and should provide some three-year-old returns in 1985. We are anticipating four-year-old returns from a release of 155,051 S.F. Nooksack X Cowlitz yearlings (1981 brood year). A total of 15 observed recoveries have been reported for the tag code (5-10-33) applied to this group of fish (Table 5, Appendix A). Some additional four-year-old returns may result from a premature release of 152,245 N.F. Nooksack X Cowlitz yearlings in October of 1982. These fish were released early because of flooding. However, no CWT recoveries from this group have been reported to date. Some five-year-old fish may also return from a plant of Hoodsport stock into the Dosewallips River. Thirty-two strays from this plant were recovered in the Quilcene River last year as four-year-olds. Total returns in 1985 by age class will be reported in the 1986 report.

We conducted snorkel surveys during the spring and summer to monitor the 1985 return. Our objectives were to enumerate the number of fish entering the river and to determine the entry timing of the run. Observations regarding poaching were also made during the surveys. The snorkel surveys began on April 5 and continued at approximately two week intervals. Returning SCS adults were not observed until the second survey conducted on April 17. A steady increase in the total number of adults was observed through June (Table 6, Figure 1). As the surveys progressed through July no further increase in adult counts was recorded and there appeared to be a decline while very few fish entered the hatchery. After the July 17 survey, approximately 19 fish were unaccounted for and presumably lost to poachers. Poaching gear such as large treble hooks, heavy sinkers, and

Table 4. Record of Quilcene NFH spring chinook releases and age of adults anticipated to return 1985 through 1988.

Brood Year	Number Released	Date Released	Number/ Pound	Age Class	Stock	Tag Code	Age at Return 1985	1986	1987	1988
80	25,906 1/	5/4/82	10.3	Yearling	Hoodsport	None	5	N/A	N/A	N/A
81	152,245	10/22/82	17.3	Yearling (fall rel.)	N.F. Nooksack X Cowlitz	5-10-17	4	5	N/A	N/A
81	155,051	5/9/83	11.9	Yearling	S.F. Nooksack X Cowlitz	5-10-33	4	5	N/A	N/A
82	51,928	6/3/83	92.1	Subyearling	S.F. Nooksack X Cowlitz	5-14-19	3	4	5	N/A
82	217,833	3/20/84	12.5	Yearling	S.F. Nooksack X Cowlitz	5-13-48	3	4	5	N/A
82	109,764	3/20-21/84	9.6	Yearling	N.F. Nooksack X Cowlitz	5-13-47	3	4	5	N/A
83	150,392	6/4/84	67.0	Subyearling	N.F. Nooksack X Cowlitz	5-15-54		3	4	5
83	51,560	6/4/84	69.0	Subyearling	S.F. Nooksack X Cowlitz	5-14-26		3	4	5
83	401,730	5/14-15/85	17.2 2/	Yearling	S.F. Nooksack X Cowlitz	5-14-53		3	4	5
83	55,289	5/14/85	10.2	Yearling	N.F. Nooksack X Cowlitz	5-14-52		3	4	5

1/ This group of fish was released into the Dosewallips River. Some adult returns were recovered at Quilcene NFH during 1984 (see 1984 Annual Programing and Evaluation Report) and we anticipate a few five-year-old returns to Quilcene NFH in 1985.

2/ Weighted average size at release.

Table 6. Counts of brood year 1985 spring chinook adults in the Quilcene River and Quilcene NFH. Counts of adults in the river are estimates based on snorkel observations.

Cummulative Count	4/5	4/17	5/3	5/17	6/5	6/18	7/2	7/17	7/23	8/7	8/30
Hatchery 1/	-	-	1	4	34	56	89	101	149 2/	154	154
River	-	10	24	36	99	133	87	56	17	8	14
TOTAL	0	10	25	40	133	189	176	157	166	162	168

1/ Includes mortalities.

2/ Forty-six fish were netted in the hole directly below hatchery and transferred to hatchery holding pond.

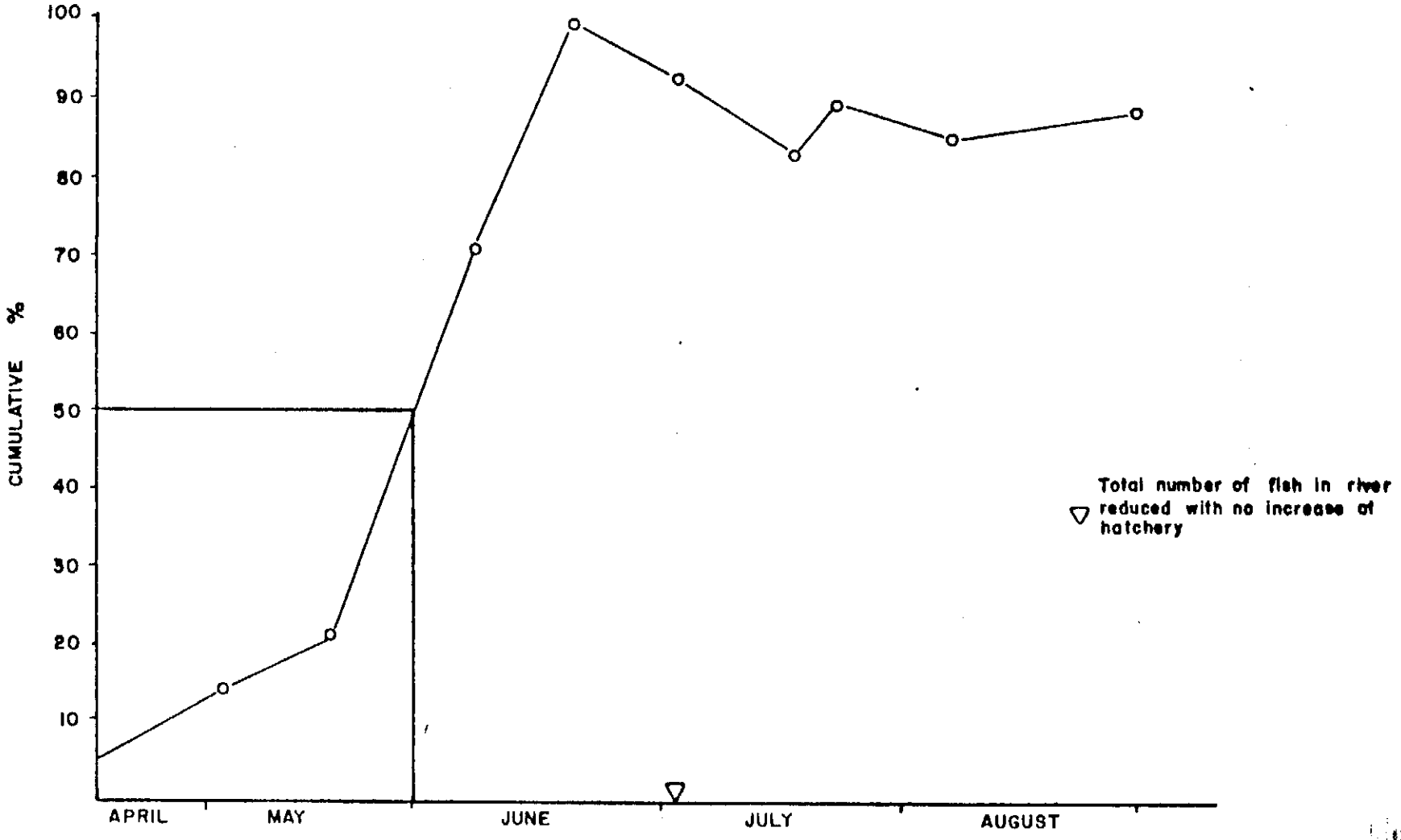

Figure 1. Timing of the 1985 spring chinook return to the Quilcene River.

heavy fishing line were observed at several points along the river. To avoid further loss, we and the Quilcene NFH staff captured SCS broodstock in the river on July 23. Since the majority of fish were holding in the hole directly below the hatchery, the capture logistics were relatively simple. The brood stock collection effort went smoothly with no apparent adverse affects on the 46 fish that were captured.

It is apparent, from the two years of experience with SCS returns, that two important measures are needed to provide protection for SCS in the Quilcene River. First it would be prudent to increase the law enforcement effort in the Quilcene watershed to deter poaching. The SCS run at Quilcene is small and outside sources of brood stock are no longer available to supplement the run. Therefore, losses to poaching are a serious concern. Second, we believe a later opening date for trout fishing in the Quilcene River would allow more effective enforcement of the salmon closure. Our snorkel surveys revealed that very few trout are available in the river during May, June, and July when the number of SCS adults is increasing. Large numbers of WDG steelhead smolts and Quilcene NFH coho and chinook smolts remain in the river for a period of time prior to outmigrating and are susceptible to the sport fishery during these months. In response to a request from WDG for input on the 1986 game fish regulations, we recommended an opening date of August 1 below Quilcene NFH.

During 1985, WDF retained liberal sport fishing regulations for chinook in Hood Canal concurrent with closures in other areas of Puget Sound. The regulations included a bag limit of three salmon (all three fish may be chinook), allows two rods per person, and no maximum size limit. WDF implemented these regulations in an effort to correct a chinook allocation imbalance in the Hood Canal area. We suggested several measures to WDF for protecting SCS. First, we requested WDF establish a maximum 30" size limit during the period April - June. The length data collected during the 1984 return indicated that four-year-old fish would have been given some protection by a maximum size limit. However, these fish were Hoodsport stock and the four-year-old age class returning in 1985 will be Nooksack X Cowlitz stock. Analysis of the four-year-old age class returning to the hatchery rack in 1985 will provide a better estimate of the average length of age four Nooksack X Cowlitz fish. The second measure we suggested included a closure of Area 12A (Quilcene Bay) from April 4 through June 30 to protect milling chinook before they entered the river. WDF did not implement the maximum size limit but did impose partial closure of Quilcene Bay.

Program Evaluations: The 1985 SCS release represents the last in a series of coded-wire tag (CWT) releases comparing the South Fork (S.F.) and North Fork (N.F.) Nooksack X Cowlitz stocks. A summary of pertinent information regarding the tagging and tag release data for the two groups is presented in Appendix B. A complete assessment of the Nooksack X Cowlitz broodstock evaluation will not be available until the 1988 fishery recovery data is processed and compiled.

A primary goal of our hatchery programming and evaluation efforts is to determine an appropriate time and size at release strategy for each hatchery program. We rely on a variety of information as the basis for these recommendations. These sources of information include strategies used at other hatcheries, the available literature, and CWT data. It is

often necessary, however, to design specific CWT studies to provide a better basis for our recommendations.

In the case of Quilcene SCS, additional effort is needed to identify the release strategy that will provide maximum survival and a subsequent return of broodstock for the restoration program. An evaluation of release strategies was incorporated into the N.F. and S.F. Nooksack stock comparison study beginning with brood year 1982. Only the S.F. Nooksack X Cowlitz stock was used initially since sufficient numbers of the N.F. Nooksack X Cowlitz cross were not available. Commencing with brood year 1983, sufficient numbers of fish from both crosses were available and included in both yearling and subyearling releases.

Various outmigration patterns have been exhibited by spring chinook stocks (Wunderlich, 1982). Based on scale sample data, native Puget Sound stocks (includes Nooksack) reportedly exhibit a high rate of subyearling emigration (Pete Castle (WDF), pers. comm.). No outmigration pattern for wild Cowlitz stock has been reported. The success of the Cowlitz Hatchery SCS program, however, is attributed to the strategy of releasing yearlings in the spring. Only minor returns are attributed to either the subyearling releases or yearling fall release (Guy Norman (WDF), pers. comm.). We are currently recommending a yearling release strategy for SCS at Quilcene NFH based upon success rates observed in other Puget Sound spring chinook programs. However, we will continue to examine all available data regarding an appropriate release strategy. We are particularly interested in physiological smolt indicators and intend to assess their value as predictors of smolt functionality and time of release in future CWT studies.

Juvenile salmon outmigration and seawater survival depends on the proper combination of a complicated set of biological factors. Wedemeyer et al. (1980), describe the complex morphological, behavioral and biochemical changes that occur during smolting. Two factors thought to be strongly indicative of smolt functionality, gill Na^+-K^+ ATPase enzyme levels and the ability to survive in sea water (as indicated by a saltwater challenge) are being looked at by the Quilcene NFH staff. The Na^+-K^+ ATPase enzyme levels of brood year 1983 SCS (both stock crosses) were monitored at two different time periods during their rearing. A steady rise in the enzyme level was observed during the early spring and summer. The subyearling groups were released at the peak of this rise (Kenworthy et al., 1985). For those fish held on station to be released as yearlings, the enzyme levels steadily declined until September at which time monitoring of the enzyme activity was discontinued. The hatchery staff renewed the blood sampling effort the following March; a steady rise was observed right up until the release (Figure 2). This rise of Na^+-K^+ ATPase enzyme level would appear to indicate smolt functionality. However, the sea water rearing test conducted on these two stocks provided some interesting results. As part of their effort to evaluate smolt functionality the hatchery had arranged to have 25 fish samples for each of the stocks released reared in sea water at the Marrowstone Field Station of the National Fishery Research Center in Nordland, Washington. Of the two groups, the S.F. Nooksack X Cowlitz fish began to experience immediate mortality; within one month 50% of this group had died. Only six fish remained after 89 days of rearing in sea water. The N.F. Nooksack X Cowlitz fish, on the other hand, survived the

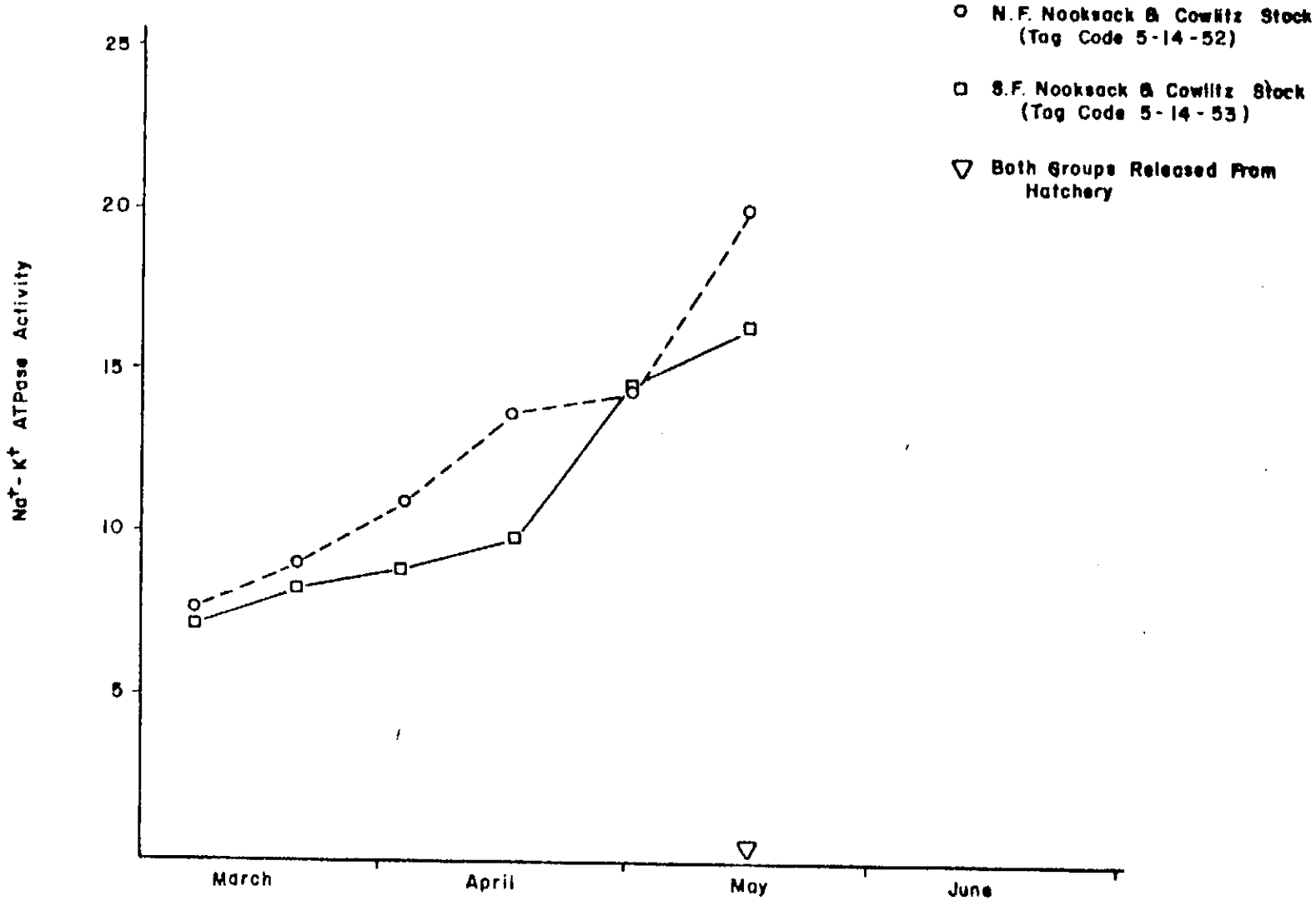

Figure 2. $Na^+ - K^+ ATPase$ activity (uM Pi/mg protein · hour) observed in brood year 1983 Spring Chinook reared at Quilcene N.F.H. during the spring of 1985.
(Information provided by Wally Zaugg, National Marine Fisheries Service, Cook Field Station, Cook, Washington)

seawater rearing relatively well, losing only five fish during the same 89 day time period (Lou Salsbury, Marrowstone Lab., pers. comm.).

We are not sure, at this time, what the results of the sea water rearing test mean or why such a high mortality occurred in fish that reportedly had rising Na^+-K^+ ATPase levels. The level of enzyme activity observed in the South Fork group (approximately 16 uM Pi/mg · protein hour) could be considered marginal for smolt functionality for SCS yearlings (Wally Zaugg (NMFS), pers. comm.). The level of enzyme activity in the North Fork group, however, was 18 uM Pi/mg protein . hour and may not be significantly higher. At this time we can not rule out the possibility that the high loss incurred by the S.F. Nooksack X Cowlitz stock was due to a disease epizootic rather than an inability of the fish to hypoosmoregulate; no blood chemistry or pathological analyses were conducted on the test fish during their sea water rearing. A review of the CWT recovery data will provide additional information regarding each group's overall survival.

Hatchery practices may also influence the fish's outmigration patterns and subsequent rate of survival and need to be investigated. Ewing, et al. (1980) reported that distinct patterns of gill Na^+-K^+ ATPase levels were associated with varied feeding levels; fish fed the highest ration had relatively higher peaks of enzyme activity than groups fed lower rations. The hatchery staff believes that growth rate and fish size may affect smolting patterns of the spring chinook being reared at Quilcene NFH. Additionally, the stress imposed by this apparent smolting is believed to have precipitated an epizootic of bacterial kidney disease (BKD) (Gib Taylor, Olympia Fish Health Center, pers. comm.) in the 1982 brood (tag codes 5-13-48 and 5-13-47). The epizootic was so severe it was necessary to release the fish prior to the recommended target date to avoid further losses. In an effort to control the stress associated with excessive growth, the hatchery staff implemented a rearing program with brood year 1983 SCS to carefully program the percent body weight fed. The controlled feeding regime enabled the hatchery to carry the smolts to yearling age and release them on the scheduled target date of May 15. Furthermore, a relatively low prevalence of BKD was detected prior to the release of this brood (9.75%) as compared to the 1982 brood (76%) (Gib Taylor, Olympia Fish Health Center, pers. comm.). The average size at release was 17.3 fish per pound for brood year 1983 yearlings as compared to 11.9 fish per pound for brood year 1982 yearlings. We have adjusted the target size of release for yearling SCS to 15 fish per pound as a result of the hatchery's efforts to control excessive fish growth.

Future CWT evaluations will be designed to evaluate smolt quality as it relates to time and size at release. It will be several years, however, before the Quilcene SCS program is large enough to provide sufficient numbers of fish required to rigorously analyze the combined effects of growth rate, Na^+-K^+ ATPase enzyme activity, and time and size at release strategies. In the interim we will continue to examine patterns of observed recoveries of past CWT groups and design production tagging studies to determine if fishery management periods, fishing patterns, size limits, and bag limits are adversely impacting the Quilcene NFH spring chinook restoration efforts.

Coho

The coho program at Quilcene NFH in 1985 involved the release of 221,128 yearling smolts into the Big Quilcene River (Table 2), the transfer of 427,500 eggs to several cooperators (Table 3), and the transfer of 317,367 fingerlings to WDF (Table 7). The coho fingerlings transferred to WDF evolved from our efforts during 1985 to make effective use of surplus coho fry. The fingerlings were planted by WDF into under seeded streams of Quilcene and Dabob bays and other streams of the Northeast Olympic Peninsula. Providing surplus fry to state and tribes was identified in Region One's Important Resource Planning document and is consistent with the Hood Canal Management Plan.

Terminal Area Returns: A total of 3,893 coho adults and 378 jacks were recorded in the 1984 hatchery escapement. The adult returns originated from a yearling smolt release (brood year 1981) of 352,298 fish at 14 fish per pound during early May, 1983. No brood year 1981 subyearling releases were made. The jack returns, which were numerically well below prior returns, are attributed to brood year 1982 smolt releases made in 1984 (21,754 fish at a size of 24 fish per pound and 271,035 fish at a size of 14.5 fish per pound on March 18 and May 15, respectively). Approximately 145,050 fingerlings from the 1982 brood year at a size of 160 fish per pound were also released, but these fish probably made a minimal contribution to the jack return.

The 1984 escapement of 3,893 adults to the rack was approximately 1.1% of the total release and is slightly higher than the rate calculated for the CWT group released in this brood year (Table 5, CWT code 5-11-88). This rate of escapement was considerably above the hatchery's brood requirements. Approximately 800 adults were required to meet the hatchery's production requirements in 1984. Historically over-escapement has occurred at Quilcene NFH and is probably the result of a combination of factors including low fishing effort in Area 12A, fishery regulation to protect wild stocks co-mingled in Area 12, and the early run timing of the Quilcene stock. Upon further analysis, however, a major contributing factor appears to be the way the river fishery is managed. In the past, the Tribal net fishery did not occur until the hatchery had met escapement. Furthermore, the sport fishery is not opened until October 1. With these restrictions of the fisheries, treaty fishermen caught an estimated 1,622 coho in the river and an estimated 9,628 fish in Area 12A (preliminary data, Nick Lampsakis (PNPTC), pers. comm.). WDF reported 291 coho were taken in the Quilcene River sport fishery (Tim Flint (WDF), pers. comm.).

Additional numbers of Quilcene NFH coho are harvested by the Puget Sound sport, non-treaty net and ocean sport and commercial fisheries. Estimated contribution to these fisheries will be presented in a comprehensive evaluation of CWT coho from Quilcene NFH (Kenworthy and Tajac, in preparation). In those years when no CWT recovery data is available, we will rely on the WDF run reconstruction model to estimate contribution to the Puget Sound net fisheries. Estimates from this model are based upon hatchery rack escapement estimates, run timing, and stock composition in mixed stock fishing areas. While these estimates have shown relatively good agreement with CWT estimates of terminal contribution, they do not provide estimates of pre-terminal (ocean and sport fisheries) catches.

Table 7. Fingerling releases of brood year 1984 Quilcene NFH coho made by WDF into various streams of the Northeast Olympic Peninsula.

Location	Date	Number 1/	Size	Lbs.
Chimicum Cr.	4/10/85	50,800	668	76
Naylor Cr.	4/10/85	7,300	668	11
East Fk. Chimicum Cr.	4/10/85	36,700	668	55
Tarboo Cr.	4/10/85	46,800	668	70
Tarboo Cr.	5/23/85	39,000	198	197
Jimmy Come Lately Cr.	4/10/85	31,400	668	50
Little Tarboo Cr.	4/10/85	19,400	668	29
Little Quilcene R.	4/10/85	54,100	668	81
Little Quilcene R.	5/23/85	37,600	198	190

1/ Number rounded to the nearest 100 by WDF.

In an effort to alleviate the over-escapement and to provide for a more desirable catch to escapement ratio the PNPTC biologists will provide openings of the commercial river fishery throughout the entire run in 1985. The sport fishery, however, will remain closed until October 1. We have recommended that WDF open the sport fishery on September 1. We believe that both of these measures would provide for an effective harvest of available coho and would not impact the returning spring chinook.

As part of our CWT studies we measure returning marked fish to monitor trends in length. Table 8 presents the length data collected at the rack for five consecutive CWT brood releases. A steady decline in fish length is evident in the data. The average length of the 1984 return was 7.4 cm (2.9 in.) shorter than the 1980 return. There are several possible explanations which may account for this trend. First, a major portion of this stock is harvested by gill nets which are selective for particular sizes of fish depending upon the mesh size used. Second, the El Nino phenomenon may have adversely effected growth rates for the latter two brood years. A drastic reduction in the size of adult coho in the ocean and at Oregon hatcheries was noted in 1983 and attributed to the El Nino event (Van Dyke and Wood, 1984). Another possible explanation is a change in ocean migration patterns or residualism in Puget Sound where growth rates are reduced. Hatchery rearing practices may also contribute to this pattern.

In the past, CWT have enabled us to positively identify a portion of the returning fish by brood year and age class. Future evaluation, however, will need to rely on accurate biological data collected at the hatchery rack to determine age. In the past the hatchery staff used their own minimum length criterion to separate jacks and adults for spawning. During our review of the length data obtained from CWT fish for past broods (Table 8), we observed a high degree of overlap in length between jacks (age - 2 fish) and adults (age - 3 fish) returning in the same year. This overlap would appear to make it difficult to determine age solely on fish length. This was corroborated by data collected from a subsample of the 1984 coho return. A sample of 198 fish were sorted by the hatchery staff using their own existing criterion. They identified 178 of these fish as jacks and the remaining 30 fish as adults. The age class breakdown based on scale data, however, determined that there was only one jack in the sample. Because of the difficulty in separating coho jacks from adult males based on size, we looked at the lengths of CWT jacks and adult males that had been recovered at the Quilcene NFH rack. Our objective was to develop a theoretical separation length that would aid the hatchery staff in identifying jacks and more accurately enumerate the number of fish returning for each age class. The length data used for the analysis was from return years 1980, 1982 and 1983. These three years provided sufficient CWT returns of both age classes thereby allowing length comparison analysis. We determined the theoretical separation length according to the method described by Vandyke and Wood (1983) as, "that length where the cumulative frequency, beginning with the smallest length interval, equaled the jack count." At the separation length the number of shorter adults equaled the number of longer jacks. Our analysis indicated that lengths of 41.0, 44.5 and 43.0 cm would have been appropriate separation lengths for the three return years, respectively. As a guideline we recommend that the average (43 cm.) be considered as the separation length between jacks and adult male coho. However, it should be realized that annual variation will alter the

Table 8. Average length of CWT coho recovered at the Quilcene NFH rack.

Return Year	Age Class	CWT	Avg. Length (cm) Adults	Avg. Length (cm) Jacks	Range Min.	Range Max.	Number of Fish Measured
1979	2	5-5-17		33.8	31	39	9 1/
1980	3	5-5-17	61.2		40	76	147
	2	5-6-21		34.4	22	41	60
1981	3	5-6-21	59.3		41	75	98
	2	5-8-18		31.0	28	34	2 1/
1982	3	5-8-18	59.7		31	74	182
	2	5-8-54		33.6	29	53	67
1983	3	5-8-54	55.2		26	72	307
	2	5-11-19		33.0	22	64	421
1984	3	5-11-19	53.8	____	34	70	287
Mean Length:			57.8	33.7			

1/ Small sample size and therefore not included in determining the overall average size of each age class.

theoretical separation length. We plan to biosample coho in return year 1985 to accurately enumerate the number of fish returning for each age class and to continue monitoring trends in both jack and adult lengths.

Program Evaluations: We are currently evaluating past releases of CWT coho from Quilcene NFH. Kenworthy and Zajac (in preparation) have analyzed and will report recovery data for Quilcene coho groups from the 1977 through 1979 brood years. Prior to initiating any further coho studies, two additional broods (1980-81) of outstanding recovery data need to be analyzed.

Our analysis of brood years 1977 through 1979 indicated that survival of yearling coho released directly into the Big Quilcene River was relatively good and compared favorably to WDF hatcheries producing coho in Puget Sound and the Strait of Juan de Fuca. Using the data developed during these analyses we calculated the overall average survival to be 9.79%; the average survival to catch is calculated to be 8.57%. Based on the number of fish released in 1985 (Table 2), the estimated average survival rate and an escapement need of 1,200 fish, we anticipate approximately 20,600 Quilcene coho will be available for harvest in 1987. We caution, however, that some degree of error exists in these estimates. The survival estimates calculated for each CWT brood year release were developed from recovery data that are considered to be point estimates only; no confidence limits have been developed around these estimates. Additionally, these estimates are subject to several sources of variation which will be discussed more fully in our final report.

The hatchery staff and hatchery biologists continually test and implement new ideas regarding spawning, incubation and rearing techniques to improve fish health and smolt quality. The hatchery staff has implemented a feeding regime that controls growth so coho yearlings can be held until May while reaching our recommended target size of 20 fish per pound. The impacts of such hatchery practices will be incorporated into future CWT studies. Several areas recommended for future evaluation were developed upon completing the analysis of the 1977 through 1979 broods and are listed below:

1. Continue evaluations to determine an optimum time and size at release strategy.

2. Assess the effects of broodstock selection criteria (size) on the resulting size, contribution and survival of the progeny.

3. Evaluation of survival and contribution of the on and off station releases of surplus coho fingerlings into the rivers and streams of Quilcene and Dabob bays.

4. Examine the potential for increased Quilcene coho harvest in the terminal area with respect to co-mingled wild stocks.

Further recommendations may evolve from the analysis of the outstanding recovery data.

Chum

During 1985 we continued with the plan of transferring the Walcott chum run to the Big Quilcene River. Approximately 2,334,500 fry were released into the Quilcene River and 832,700 were released at Walcott Slough (Table 2). Beginning with brood year 1985, total chum production will be reduced from the past level of 3,200,000 to 2,200,000 fed fry. This cut in production was made to improve fry quality by reducing raceway loadings.

Terminal Area Returns: The hatchery reported an escapement of 6,204 fish to the rack at Walcott Slough and 1,419 fish to the rack at the hatchery on the Quilcene River in 1984. Sufficient escapement occurred to meet the hatchery's brood requirements and to fill several requests for eggs (Table 3).

We continued biosampling efforts to determine age and length of fish returning to both the slough and the hatchery rack (Tables 9 and 10). No meaningful difference in size was observed between fish returning to either location.

Table 9. Age and mean fork length of chum salmon returns to Walcott Slough, 1984.

	Male			Female		
Age	No.	%	Length (mm)	No.	%	Length (mm)
3	1,408	42	698	1,186	41	658
4	1,729	52	754	1,611	56	708
5	193	6	809	77	3	736
TOTAL	3,330			2,874		

Table 10. Age and mean fork length of chum salmon returns to Quilcene NFH rack, 1984.

Age	Male			Female		
	No.	%	Length (mm)	No.	%	Length (mm)
3	270	30	695	99	20	94
4	638	70	750	408	80	389
5	4	1	761	0		
TOTAL	912			507		

This determination is based on the average length of three and four-year-old fish only, since no age five fish of hatchery origin were expected to return to Quilcene River. Four age-five adults (<1%), however, were observed at the rack but are attributed to either brood year 1979 wild chum or hatchery escapees. The percent age composition of three and four-year-old fish returning to Quilcene NFH was determined to be 26 and 74 percent, respectively (95% of the return was sampled). At Walcott Slough we determined the age composition to be 42, 54 and 4 percent for three, four and five-year-old fish, respectively (based on 24% of the run sampled). Percentage returns to the hatchery continue to be well below returns at Walcott Slough (Table 11). The weighted average return to the Quilcene NFH rack was .06% for three and four-year-old fish. On the other hand, a large number of hatchery fish remain in the river and never enter the hatchery.

Quilcene NFH chum are caught primarily in the Puget Sound net fishery. No estimate is available regarding Canadian net fishery interceptions. During return year 1984 the WDF chum reconstruction model predicted an estimated 14,554 Walcott Slough fish returning to Puget Sound (Jim Ames (WDF), pers. comm.). The difference between this number and the Walcott Slough rack count (6,204) provides a gross contribution estimate of 8,350 fish to the Puget Sound net fishery for production releases made at the Slough. Good estimates of the fishery contribution for chum fry released directly into the river are not available.

Program Evaluations: The 1984 return provided additional information upon which to evaluate the change in target release size for chum. Prior to the 1979 brood year, chum released at Walcott Slough were approximately 200/pound. Survival rates to the rack for the 1977 and 1978 brood years was .03% and .01%, respectively. These low rates of return were not sufficient to maintain the run. Information from the literature (Iwata 1982) and results in other programs indicated that the Quilcene fry may have been too large. Beginning with the 1979 brood year, the target size

Table 11. Percent return of chum salmon to Walcott Slough, 1984.

Brood Year	Release Site	Release Number	Size at Release	Age at Return	Number Return	% Return To Rack
1981	Walcott	1,962,618	517	3	2,594	.13
	Quilcene R.	1,474,949	501 1/	3	369 2/	.03
1980	Walcott	1,500,860	562	4	3,340	.22
	Quilcene R.	1,053,255	537	4	1,046 2/	.10
1979		3,398,926	394	5	270	.01

1/ Weighted average size of fed fry only -- approximately 28% (414,540 fry) of the release were liberated as unfed fry.

2/ Does not include estimated escapement to the river.

at release was reduced to a smaller size of 400-700/pound. The 1979 brood year ranged in size from 338-630/pound at release and survived to the rack at .1% or 10 times higher than the 1978 brood year (Table 12). The 1980 brood year plant at Walcott Slough ranged in size from 409-697/pound. Although five-year-olds have not returned from this release, the survival to the rack of three and four-year-olds increased to .29%. This analysis assumes that variability in marine survival and fishery interceptions during these years did not account for the observed trend in survival. Considering the magnitude of the observed differences, we believe this to be true. We also believe the present target of 400-700/pound is a much more appropriate release strategy and will continue to recommend this size at release.

The hatchery staff is evaluating fish cultural practices in an effort to increase survival and returns. They are examining alternative diets for starting fry, testing artificial substrate during incubation to produce hardier fry and implementing a night release strategy as a means of predator avoidance. Adjustments have also been made to increase ladder flows in an effort to attract more chum adults into the hatchery's holding pond.

We plan to continue monitoring rack returns to assess the combined effects of the release and rearing strategies. No chum fisheries are planned in Area 12A or Quilcene River until the program is stabilized. Therefore, the tagging of Quilcene NFH chum remains low on our list of priorities. When the chum program does stabilize at Quilcene NFH we recommend that it be evaluated using CWT or genetic stock identification techniques. Survival, contribution and run timing information would be an invaluable aid for managing chum fisheries in the terminal area.

Table 12. Sex, age composition, and survival of 1979 and 1980 brood chum at return to Walcott Slough.

Brood Year	Number Released	Return Year	Age	Male	Female	Total Return	% Return To the Rack
1979	3,398,926	1982	3	155	352	507	.01
		1983	4	1,021	1,453	2,474	.07
		1984	5	193	77	270	.01
			Total	1,369	1,882	3,251	.1
1980	1,500,860	1983	3	583	491	1,074	.07
		1983	4	1,729	1,611	3,340	.22
			Total	2,312	2,102	4,414	.29

The Makah Steering Committee met twice during the reporting period to discuss the hatchery's program and future brood stock development for fall chinook (FCS) and chum salmon. Both the Service and the Makah Tribe were particularly concerned about the future of the fall chinook program. A revised benefit/cost analysis of Makah NFH indicated several years delay could be expected in reaching full production, a positive benefit/cost ratio and terminal fishing if the hatchery is required to pass native Sooes FCS upstream for natural spawning prior to taking broodstock. WDF, however, was concerned with maintaining a distinction between the hatchery and native Sooes stock and utilization of the natural spawning habitat above the hatchery. The selection of an appropriate stock was exacerbated by the unavailability of nearby coastal hatchery stocks due to their depressed status. Consequently, it was the concensus of the committee that the native Sooes stock would be used. A plan was adopted whereby the hatchery would use all available returning native Sooes River FCS and the shortfall in the desired upriver escapement would be mitigated with outplants of FCS pre-smolts.

Regarding the source of chum broodstock, the committee agreed to continue using Walcott stock. Furthermore, it was agreed that the hatchery would use as many chum broodstock returning to the Sooes River as needed, and that no upriver mitigation would be required for under-escapement above the hatchery weir.

A third programming item discussed was the tribe's request for an annual release of 10,000 steelhead smolts into the Waatch River. Several allocation issues are involved and the tribe has agreed to meet with the Washington Department of Game to discuss these issues prior to making any changes in the Makah NFH steelhead program.

Fall Chinook

The generally depressed status of North Coastal fall chinook stocks has made the development of a successful FCS program at Makah NFH a high priority. During 1985, 43,455 fingerlings were released into the Sooes River (Table 13).

Terminal Area Returns: The 1984 return is indicative of the depressed status of Sooes River FCS. Only 22 fish were spawned at the hatchery rack. One FCS was taken in the Makah Tribal net catch incidental to other species being targeted. We assume that some upriver escapement may have occurred in 1985, but Makah Tribal biologists were unable to determine the escapement because high river flows disrupted the spawning ground surveys. Table 14 presents the bio-data collected from the FCS used for broodstock. Due to the small number of returns and the small biosample size no expansion of the age class data was made.

Table 13. Record of salmon and steelhead releases made by the Makah NFH into the open waters of Washington State, 1985.

Species	Stock	Brood Year	Location	Date	Number	Size No/Lb	Weight (lbs)
Coho	Quinault NFH	83	Sooes R.	4/12/85	257,091	11.7	21,974
	Quinault NFH	83	Waatch R.	4/12/85	50,000	11.7	4,274
Chum	Walcott 1/	84	Sooes R.	5/15/85	1,911,741	454.9	4,202
Steelhead	Quinault NFH	84	Sooes R.	5/2/85	65,202	5.3	12,302
	Quinault NFH	84	Waatch R.	5/2/85	10,000	5.3	1,887
Fall Chinook	Sooes R.	84	Sooes R.	5/30/85	43,455	81.9	530

1/ Approximately 30,000 fry of Sooes River origin were in this release.

Table 14. Age and length of fall chinook biosampled at Makah NFH, 1984 (data was not expanded due to the small number of adult returns and small sample size).

Age	Male		Female	
	No.	Length (mm)	No.	Length (mm)
3	2	455	1	715
4	2	712	2	930
5	1	775	5	944
TOTAL	5		8	

Increased fall chinook returns are anticipated in 1985. The Makah Tribe reported an estimated escapement of 410 fish during the 1981 brood year; four-year-old fish of this brood will be returning in 1985, and the hatchery has installed a more efficient electrical weir for the purpose of diverting adults to the hatchery's fish ladder. Furthermore, the Makah Tribe is not planning any fisheries that target FCS stocks to allow adequate escapement to the hatchery.

Program Evaluations: If adequate brood stock is available, we intend to begin evaluating the FCS program beginning with the 1985 brood year. The study will be designed primarily to determine survival to adult, rate of interception by Canadian and U.S. ocean fisheries and return timing of the stock. We are currently recommending a mid-May release at 75 fish per pound. This release strategy is based on data obtained in 1982 during outmigration of the native Sooes fall chinook.

Coho

During 1985 the coho program at Makah NFH was in a state of transition. The coho smolts liberated into the Sooes and Waatch rivers were Quinault stock originating from eggs obtained from the Quinault NFH (Table 13). These eggs were needed to complete the transition from Quilcene stock to the later timed Quinault stock because the brood year 1984 returns were presumed to include second generation Quilcene stock. Beginning in 1985 the returns will primarily be Quinault stock although some native Sooes and remnant Quilcene stock may also be included in the run. We are, therefore, recommending that, to the extent possible, only fish spawned after November 1 be kept for the hatchery's smolt program to further ensure a later return time. The later return timing is desired to maintain separation from the FCS run. The progeny of fish spawned prior to November 1 should be culled from the program and provided to the Makah Tribe for use in their stocking programs.

Approximately 356,250 fingerlings of the 1984 brood were provided to the Makah Tribe to seed various reservation streams (Table 15). The Makah Tribal biologists will be evaluating these subyearling releases.

Table 15. Record of Makah NFH coho fry releases made by the Makah Tribe, 1985.

Location	Date	Number	Size	Weight
Sail Cr.	5/21/85	100,000	375	267
Village Cr.	5/21/85	20,000	375	53
Waatch R.	5/21/85	150,000	375	400
Educket Cr.	5/21/85	86,250	375	230

Terminal Area Returns: Returns to the Sooes and Waatch rivers are comprised of both wild and hatchery coho. The Makah Tribal fishery reportedly took 874 and 1,069 coho in the Sooes and Waatch rivers, respectively (John Blum, Makah Tribe, pers. comm.). We presume that hatchery stocks made a major contribution to these catches, however, without the aid of CWT data the hatchery/wild catch composition cannot be quantified.

The Makah NFH reported a total return of 1,778 adult coho and 264 jacks (undoubtedly some wild fish entered the hatchery). The 1984 adult returns were from Quinault stock releases of 105,152 and 41,191 smolts at a size of 20 and 15 fish per pound, respectively, and 31,403 second generation Quilcene stock smolts at a size of 15 fish per pound. All three groups were released May 2, 1983. The jack segment of the 1984 return originated from the April 11, 1984 release of 187,700 Quinault stock smolts at a size of 12.7 fish per pound.

Program Evaluations: CWT coho from Quilcene NFH were released into the Sooes River from brood years 1974-80 and into the Waatch River from the 1974 brood year. We are evaluating recoveries from the 1974-79 brood year releases (Kenworthy and Tajac, in preparation). Unfortunately, this information is of limited use because of the change from Quilcene to Quinault brood stock at Makah NFH. However, recoveries from these tagging studies indicated contribution rates which were comparable to some other WDF off station releases on the Washington coast. The distribution pattern of the recoveries ranged from northern British Columbia into Puget Sound and south to the Oregon Coast.

In our attempts to maximize survival and benefits from the Makah NFH coho program, we are recommending a May 15 release date and a size of 20 to 15

fish/pound. During 1985, the hatchery staff formulated rearing strategies to meet the target date and size. We believe a CWT study is needed to evaluate this new rearing and release program. This CWT study would allow us to estimate the interceptions made by Canadian and U.S. fisheries (includes treaty and non-treaty catch), total survival and run timing of the Quinault stock. This CWT evaluation will require three consecutive CWT brood releases following the recommended release strategy. Our first priority regarding CWT evaluations will be to evaluate the onstation releases into the Sooes River, followed by CWT evaluations of the Waatch River coho smolt releases (both programs are lower in priority then the FCS program).

Chum

The chum program at Makah NFH is still in a development phase. Brood year 1983 and 1984 Walcott stock eggs were provided for the program by the Quilcene NFH (Table 16). Quilcene NFH is programmed to provide eggs again in brood year 1985. Major returns of the Walcott stock releases are not expected until 1987 and 1988.

Table 16. Walcott stock chum releases from Makah NFH.

Brood Year	Date	Number	Size No/Lb
1983	5/18/84	854,940	548
1984	5/15/85	1,911,741 1/	455

1/ Includes an estimated 30,000 Sooes stock fry.

We are currently recommending a release strategy similar to the Quilcene NFH chum program (releasing fed fry at a size range of at least 700 but no larger than 400 fish/pound). Incubation and rearing strategies are being implemented by the hatchery staff in an effort to meet the release strategy and produce quality fry.

Terminal Area Returns: The Sooes River chum run is in an extremely depressed status. Only 38 adults were spawned at the hatchery rack. A total of 16 chum were reported taken in the net fishery and were incidental to other species being targeted (John Blum, Makah Tribe, pers. comm.). No biosampling of the 1984 Sooes River chum returns occurred.

Steelhead

In 1985, the hatchery reported the liberation of 65,202 and 10,000 steelhead smolts into the Sooes and Waatch rivers, respectively (Table 13). These fish were entirely Quinault NFH stock. We are using the Quinault NFH stock in an effort to maintain separation between the hatchery and wild fish returning to the Sooes River. Additionally, only fish returning prior to February 1 will be spawned by the hatchery. Fish returning after this date are presumed to be native stock and will be allowed to pass upstream. We are currently recommending Makah NFH steelhead smolts be released in mid-May at a size of 7 fish per pound.

Terminal Area Returns: The hatchery reported a total of 73 adults at the rack. Of this total, 26 males and one female were released above the electric weir. The hatchery ceased operation of the electric weir on February 1. We do not know how many fish may have returned after this date. Table 17 presents sex and age data for the 1985 return. Approximately 67% of the returns were biosampled. The age-3 fish were from a release of 33,553 smolts (Sooes River stock) at a size of 9.5 fish per pound released May 24, 1983. The age-2 fish were from a release of 71,827 smolts (combined Sooes River and Quinault NFH stock) at a size of 6.6 fish per pound.

Table 17. Sex and age composition of steelhead returns to the Makah NFH during the winter of 1984-85.

	Male			Female		
Age	No.	%	Length (mm)	No.	%	Length (mm)
2	15	34	449	0	--	--
3	23	52	642	25	86	620
4	5	11	715	4	14	736
5	1	2	810	0	--	--
TOTAL	44			29		

The Makah Tribe reported 198 fish were taken in the Sooes River net fishery. Although biological data were collected from some of these fish, we could not determine the hatchery/wild composition of the catch because of the small sample size.

- Program Evaluations: Major returns of hatchery reared fish will return in the winter of 1985-86. Harvest of Makah NFH steelhead occurs entirely in freshwater and bio-data collected at the hatchery rack will be combined with bio-data collected in the fishery to provide information relating to total survival of hatchery fish, contribution of hatchery/wild stocks to the tribal fishery and the respective run timing of the two stocks.

The Fish and Wildlife Service operates the Quinault NFH for the Bureau of Indian Affairs (BIA) under a Memorandum of Agreement (MOA). The MOA is renegotiated annually. Under the MOA negotiated for 1985, the lead programming role (selection of appropriate stocks, species mix, release strategies and hatchery evaluation) is the responsibility of the Quinault Tribe. Olympia FAO will review the draft hatchery program proposed for the upcoming fiscal year and will provide comment on those programs proposed by the Tribe that represent a departure from past programs or a change in hatchery operation. BIA will coordinate interagency program review and resolve questions raised by other agencies in a "negotiation forum".

The Service recommends that a steering committee be organized to resolve questions raised by other agencies. Our experience with the Makah NFH steering committee has been very positive and we believe that the establishment of a Quinault NFH steering committee would provide an appropriate forum for discussion of the complex biological and management issues relating to the hatchery's operation.

Salmon and steelhead produced by Quinault NFH are released into the waters of coastal Washington. The hatchery reported that the on station releases into Cook Creek were comprised of 785,554 yearling coho, 673,052 subyearling coho, 166,761 yearling steelhead, 463,552 subyearling steelhead, 1,688,709 chum fry and 354,170 fall chinook fingerlings. The off station distribution reported by the hatchery included 443,152 and 82,080 yearling coho released into the Salmon and Quinault rivers, respectively. Also, 39,926 yearling steelhead were released into the Hoh River. Table 18 presents a record of releases made during 1985. Surplus salmon and steelhead fry produced by the Quinault NFH are released by the Quinault Tribe into streams on and off the reservation. The hatchery reported that 2,937,839 coho fry and 768,520 steelhead fry, surplus to the hatchery's need, were provided to the Quinault Tribe for their use. Tables 19 and 20, respectively, present a record of subyearling coho and steelhead releases made during 1985. When available, surplus salmon and steelhead eggs are provided to other tribes and agencies. The hatchery reported that 2,590,500 coho eggs and 265,000 steelhead eggs were transferred to other cooperators. Table 21 presents a record of egg transfers made during 1985.

Table 18. Record of salmon and steelhead releases made by Quinault NFH into the open waters of Washington State, 1985.

Species	Stock	Brood Year	Location	Date	Number	Size No/Lb	Weight (lbs)
Coho	Quinault NFH	83	Cook Creek	3/25/85	785,554	13.8	56,785
	Quinault NFH	83	Quinault R.	4/16/85	82,080	12.1	6,784
	Quinault NFH	83	Salmon R. Smolt Ponds	3/12/85	443,152	14.9	29,742
	Quinault NFH	84	Cook Creek	3/13/85	155,792	824 1/	158
	Quinault NFH	84	Cook Creek	6/3/85	517,260	183	2,833
Steelhead	Quinault NFH	84	Cook Creek	5/3/85	166,761	6.7	24,931
	Quinault NFH	84	Hoh R.	5/16/85	39,926	6.6	6,049
	Quinault NFH	85	Cook Creek	5/9/85	167,225	2300	73
	Quinault NFH	85	Cook Creek	7/16/85	296,327	310	955
Chum	Quinault NFH	84	Cook Creek	4/24/85	1,688,709	440	3,836
Fall Chinook	Quinault NFH	84	Cook Creek	8/7/85	354,170	38.3	9,239

1/ Weighted average size at release.

Table 19. Record of Quinault NFH coho fry and fingerling releases made by the Quinault Tribe, 1985.

Location	Date	Number	Size No/Lb	Lbs.
Raft R.	3/14/85	201,685	1,045	193
Moclips R.	3/14/85	113,905	1,054	109
Moclips R.	3/22/85	198,336	1,033	192
Cook Creek (RM 0)	3/21/85	200,402	1,033	194
Cook Creek (F 15)	4/15/85	50,736	643	40
Tributary of Cook Creek	4/15/85	25,000	643	40
Cook Creek (RM 0)	4/17/85	100,000	643	155
Elk Creek	3/21/85	75,409	1,033	73
Red Creek	3/21/85	75,409	1,033	73
Chow Chow Creek	3/21/85	50,000	1,033	48
Chow Chow Creek	4/15/85	25,736	643	40
Ten O'Clock Creek	3/21/85	50,000	1,033	48
Boulder Creek	3/21/85	50,000	1,033	48
Mounts Creek	3/22/85	98,135	1,033	95
Railroad Creek	3/22/85	98,135	1,033	95
Boulder Creek	3/22/85	76,442	1,033	75
Lunch Creek	3/29/85	50,175	1,033	45
Quinault R.				
Amanda Park	3/14/85	202,730	1,045	194
Amanda Park	3/27/85	200,590	1,033	166
Camp 7	3/14/85	202,730	1,045	194
Camp 7	3/27/85	199,369	1,033	193
Camp 7	3/29/85	50,175	1,033	45
9115 Road	3/14/85	200,640	1,045	192
F6	3/29/85	200,700	1,033	180
Camp Chitwin Gate	4/15/85	50,000	643	78
F9	4/17/85	91,400	643	142

Table 20. Record of Quinault NFH steelhead fry and fingerling releases made by the Quinault Tribe, 1985.

Location	Date	Number	No/Lb	Size Lbs.
Red Creek	5/9/85	123,500	2,300	54
Elk Creek	5/9/85	130,000	2,300	57
Moclips River	5/9/85	214,500	2,300	93
Copalis R. 6000 Line	7/26/85	50,000	310	161
Wishkah Pond Mayr Bros.	7/26/85	250,520	310	808

Table 21. Record of egg transfers made by the Quinault NFH, Fiscal Year 1985.

Species	Brood Year	Location	Date	Number	State of Development
Coho	84	Quinault Tribe	10/13/84	306,000	green
	84	Quinault Tribe	10/19/84	300,000	green
	84	Quinault Tribe	10/26/84	432,000	green
	84	Quinault Tribe	12/3/84	327,000	green
	84	Quinault Tribe	12/6/84	301,500	eyed
	84	Quinault Tribe	12/11/84	180,000	green
	84	Quinault Tribe	12/18/84	250,000	eyed
	84	Quinault Tribe	12/24/84	144,000	green
	84	Makah NFH	1/23/85	350,000	eyed
Steelhead	85	Makah NFH	3/26/85	50,000	eyed
	85	Lummi Tribe	3/26/85	100,000	eyed
	85	Squaxin Tribe	3/26/85	80,000	eyed
	85	Quileute Tribe	3/26/85	35,000	eyed

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Appendix A. Observed recoveries of CWT spring chinook (tag code 5-10-33) released from Quilcene NFH. Recoveries are presented by recovery strata.

Strata	Date	Length (cm)
Puget Sound Sport	12/9/84	69
	1/19/85	58
	1/22/85	54
	4/8/85	66
	5/11/85	NA
	5/25/85	59
Puget Sound Net	8/14/84	53
	8/13/84	56
	9/20/84	40
British Columbia Sport	8/3/84	NA
	7/7/84	NA
	8/10/84	NA
	8/17/84	NA
British Columbia Troll	5/1/85	72
	5/3/85	62

Appendix B: Summary of CWT data for brood year 1983 releases.

Brood year: 1983

Tag Code: 5-14-53

Stock: S.F. Nooksack X. Cowlitz Spring Chinook

Date Tagged: April 30, May 1, 1984 Size: 200/lb

Tag Retention: 87.9% Sample Size: 339 Tag Loss Days: 21

Release Date: May 14 & 15, 1985

Age Class: Yearling

Size: 17.3/lb

Number of Tagged Fish: 25,737

Location: Directly into the Big Quilcene River from the hatchery.

Health History:	Date	Report	Treatment
	1/17/84	Low level white spot	
	3/9/84	Aeromonid gill disease Drop out	Hyamine
	10/17/84	No apparent problems	
	1/18/84	No apparent problems	

A low level of bacterial kidney disease was reported in this stock prior to release.

The fish used for tagging were obtained randomly from the production lot and are considered representative of 375,993 untagged fish.

Appendix B. (continued)

Brood year: 1983

Tag Code: 5-14-52

Stock: N.F. Nooksack X Cowlitz Spring Chinook

Date Tagged: April 20 & 23, 1984 Size: 180/lb

Tag Retention: 91.9% Sample Size: 310 Tag Loss Days: 30

Release Date: May 14, 1985 1/

Age Class: Yearling

Size: 10.2/lb

Number of Tagged Fish: 26,974

Location: Directly into the Big Quilcene River from the hatchery.

Health History:

Date	Report
1/17/84	Low level white spot
10/17/84	No apparent problems
1/18/85	No apparent problems

A low level of bacterial kidney disease was reported in this stock prior to release.

The fish used for tagging were obtained randomly from the production lot and are considered representative of 28,315 untagged fish.

1/ Approximately 2,000 tagged and untagged fish escaped on March 31 when a raceway screen fell.