Chapter 7: ONGOING RESEARCH AND NEEDS FOR ADDITIONAL INFORMATION

Attempts to address declines of the fisheries resource have not only been based on research, but also on such obvious problems as declining catch, visible pollution, and fish mortality. Therefore, "research" is broadly interpreted here to include scientific studies as well as habitat information, hatchery records, fish tag returns, annual catch reports, and professional opinion.

This analysis of ongoing research and needs for additional information will be addressed relative to fisheries restoration possibilities. The concept of restoration itself has changed, and will probably continue to change, as fishery managers and concerned citizens weigh the risks and rewards of new fisheries enhancement initiatives. Restoration has been, and can be, approached through habitat management, hatchery production, and fishing regulation, or some combination of these three general approaches.

HABITAT MANAGEMENT

Water Quality

Inner Grays Harbor Water Quality

Inner Harbor water quality has apparently been the most critical factor influencing restoration of Chehalis salmon and steelhead; it contributed to poor coho smolt survival at least until 1989 (Schroder and Fresh 1992). The same conditions may have reduced chinook salmon and steelhead smolt survival. Results of pulp mill effluent clean-up efforts will become known in a few more years. Further study may be necessary but can be delayed pending the outcome of ongoing (plus expanded) survival evaluation (Schroder and Fresh 1992).

Current Additional Information Needs

Coho tagging.- Ongoing Chehalis Basin wild and hatchery coho coded-wire tagging programs should be continued to evaluate success in cleaning up inner Harbor water quality (Schroder and Fresh 1992).

Fall chinook tagging.- Fall chinook from Satsop Springs and the Humptulips Hatchery should be coded-wire-tagged to verify whether this species suffers from a pollution block (Schroder and Fresh 1992). This would also allow more accurate estimation of marine interception. Work should begin with the 1993 release and continue through 1996. Sufficiently large release groups of zero-age chinook are available for tagging at both Humptulips and Satsop Springs, but tagging has been precluded by lack of funding (Johnson, WDF, pers. comm.).

Contaminant studies.- Dioxins, furans, and related compounds should be studied for both their extent in the Grays Harbor environment and benthic organisms, and their effects on salmonid prey organisms. The links between the contaminants, the prey organisms, and the salmonids should also be studied.

Feasibility of oyster larvae bioassays.- Studies to evaluate effluent bioassays on oyster larvae should be completed. If feasible, the bioassays should be required on at least a quarterly basis for continued NPDES licensing of pulp mills.

Potential Additional Information Needs

If coded-wire tagging studies indicate salmon survival has not improved, the following studies should be conducted.

Parasite/contaminant studies.- The combined effects of parastism by *Nanophyetus* (a liver fluke) and/or *Ceratomyxa* (a myxosporidian known to cause salmonid mortalities) and exposure to various pulp mill effluents on coho smoltification should be investigated (Schroder and Fresh 1992).

Further effluent toxicity tests.- Although waste treatment at both Grays Harbor pulp mills has been upgraded, the new effluent has not been retested for toxicity to salmonids. One argument is that fish are less likely to be killed by dioxins as a group now than before, because dioxins produced in oxygen bleaching are below detection limits. The rebuttal is that detection limits may be greater than the highest safe dose for long-term fish survival. Detection limits are set by equipment capability, technique, precision, and cost. There is a chance that although total dioxins are reduced, TCDD, the more toxic of the 135 forms of dioxin, may be more abundant now than before (Malek, EPA, pers. comm.). It is also possible that a synergistic effect of a variety of contaminants could be affecting salmonids; toxicity tests similar to those reported by Schroder and Fresh (1992) should be conducted for all salmonid species if tagging does not indicate improved survival.

Sediment as a contaminant reservoir.- If sediments serve as a reservoir of contaminants that are killing fish, then cleanup of mill waste may not immediately resolve the problem, and the need would arise for a more comprehensive picture of the distribution of the most toxic substances as body burden in salmon prey organisms.

Long-term survival of contaminated fish.- If contaminant analysis shows tainted juvenile salmon in the inner Harbor and clean fish in North Bay, fish might be captured from each area and held for a number of months in uncontaminated saltwater, with mortality and condition at death observed. This experiment would differ from previous studies (Schroder and Fresh 1992) on long-term survival in that the experimental groups of fish would be assumed to have eaten contaminated or clean prey, respectively.

Upper Chehalis River System Water Quality

As seen in Chapter 5, the water quality problem in the mid-Chehalis is reasonably well documented. However, there are a number of areas where information could be improved.

Continuous water quality monitoring.- There are some problems with existing water quality monitoring. For example, oxygen is measured each month at one time of day, although periods of daily oxygen lows lasting less than a month are strongly suspected. Continuous oxygen monitoring should be invoked, especially at known problem locations. Nutrient levels should be monitored often enough to detect changes in loading over the season. Enough stations need to be chosen to isolate the effects of all major point sources, and define the relative importance of tributaries as nonpoint sources. Monitoring should occur annually from July through mid-October.

Extent of water quality problems.- Existing plans for analysis have apparently not yet been focused sharply on all degraded qualities of the water. In particular, no plans have been made to use existing temperature models to determine how increased shading may reduce the temperatures. The models should be used to predict the cooling effect of bank revegetation, with the goal of directing tree planting efforts where they can do the most good.

Acute toxic contamination.- Additional information is needed to further reduce the risk of acute toxic contamination, for example from improper or illegal waste disposal from agriculture or light industry.

Relation between water quality and quantity.- Detailed investigations are need to increase understanding of the relation between water quality and water quantity. For example, municipal and agricultural water withdrawal may influence temperature and nutrient concentration.

Septic contamination of river.- A hydrological study is desirable to determine whether the aquifer in the vicinity of Centralia has a net flow into or out of the Chehalis river during the summer. This would help the CRC and the Lewis County Conservation District decide how much emphasis to place on the connection between septic systems and river nutrient loading. It would also help the City plan for future water supply.

Water Quantity

Dams

Wynoochee Dam

There may be opportunity for further enhancement of Wynoochee River summer flows, since the City of Aberdeen now uses far less than its water right. The history of determining actual Wynoochee "fish flows" should be reviewed, and arguments for and against a full-scale instream flow study should be made explicit. If an instream flow study were chosen as the basis for negotiating flows, the necessary field work could be completed in one to two years.

Skookumchuck Dam

Work should be done to determine the feasibility of using the trap at Skookumchuck Dam to pass coho salmon above the dam. If feasible, this process could open additional spawning and rearing area. There is concern, however, that the large, reservoir-reared coho smolts would prey on spring chinook fry (Stone, WDF, pers. comm.).

North Fork Newaukum Diversion Dam

The three sources for the cities of Centralia and Chehalis are the North Fork Newaukum River, the main stem Chehalis, and wells, the principal one being north of Centralia. The primary issue is whether increased use of the city well would deplete Chehalis River instream flow as much as existing surface withdrawals do. A hydrological study might be able to answer this.

The feasibility of informally protecting instream flow on the North Fork Newaukum should be investigated. An instream flow study of habitat available at different flows would help resolve this question.

Conservation of Irrigation Water

Information is needed to support meeting the established WDOE base flows on all streams by promoting voluntary conservation of irrigation water. Irrigated agriculture in the upper Chehalis River System centers around the Newaukum and South Fork Chehalis sub-basins, where most streams have been closed to further water appropriation since 1975 to protect water quality and fishery resources. Basic information, such as instream flow studies and continual monitoring of streamflows is needed to assess the present situation and monitor rehabilitation programs.

Agricultural Practices

GIS-based soils and land-use maps are necessary components for 1) helping to determine regions where streams flow through mostly farmland, and 2) guiding recommendations for fencing and vegetation in streambank restoration projects.

Forest Practices

Timber, Fish, and Wildlife Ambient Monitoring

The Chehalis Basin is particularly important for forestry research because of its large size and extent of land in commercial timber (Jeff Light, Weyerhaeuser Co., pers. comm.). Past TFW ambient monitoring has been conducted by Quinault Nation on Brittain and Elwood Creeks, tributaries of the Humptulips, and on an unnamed tributary of the West Fork Satsop (Dave Schuett-Hames, NWIFC, pers. comm.). Not enough ambient monitoring had been done to date in the Chehalis Basin or in southwest Washington as a whole; a special need exists for documenting baseline conditions in old growth, for no such

data exists at present in southwest Washington. This area is geologically different enough from the rest of western Washington to warrant special attention, because of the abundance of basaltic formations and marine sediments. Specific needs are to monitor (1) old growth sites, including those already studied by Dr. Bilby of Weyerhaeuser Co., and (2) streams in managed forest over a wider range of gradient, channel confinement, and channel size than present resources have allowed. Current FWS habitat inventory effort is the most intensive and extensive to date in the Basin, and results are expected to be useful to evaluate future timber harvest (Dave Schuett-Hames, NWIFC, pers. comm.). Streams of particular interest because of previous or ongoing research are Thrash, Stillman, and Bingham creeks (Light, pers. comm.).

Porter Creek Habitat Restoration

The Washington Department of Natural Resources is evaluating habitat enhancement designed to increase coho overwintering habitat in Porter Creek. Large, woody debris in the streambed is essential for habitat complexity (Cederholm and Reid 1987). As in many Chehalis Basin streams, timber removal from the entire stream corridor 40 to 50 years ago destroyed the pools and instream winter cover, which in turn reduced coho smolt production. By constructing instream winter cover, coho production should be restored. The rationale for introducing cover now rather than waiting for nature to take its course is that nature may take 100 years to replace as much natural, large woody debris as could be artificially placed in one or two years (Jeff Cederholm, WDNR, pers. comm.).

Experimental design consists of 1,500 meters of untouched control area, and two test areas of the same size, one featuring log weirs and cabled log clusters, and the other featuring debris pieces placed at the lowest possible cost, with minimal attention to permanence, clustering, or high-water access (Jeff Cederholm, WDNR, pers. comm.). Fish populations are estimated twice a year and outmigrants are counted below each reach. Temperatures are also monitored. Data has been collected for two years pre-project and two years during construction. Two or three years of post-project monitoring are planned. Results should provide good direction for habitat modification as a restoration technique.

Urbanization

Urbanization in northern Lewis and southern Thurston Counties raises several water quality questions. Monitoring should be incorporated into the design and development of the new Grand Mound sewage treatment plant to avoid an increase in fish kills in the area. Also, application of WDOE's 900-page manual of best management practices for stormwater runoff management, developed for Puget Sound, should be applied and evaluated in the Chehalis Basin.

Gravel Mining

The most common form of gravel removal affecting fish habitat is bar scalping. State and county regulations reduce many detrimental effects but a few risks remain unaddressed due to lack of reliable data on instream gravel transport rates. Two main fishery issues remain unsettled. 1) Is the annual gravel harvest limit low enough to ensure against downcutting the river bed and depleting the gravel available to both fish and miners in coming years? 2) Will present operations destabilize the mined bars or cause channel shifts that make the gravel less suitable for spawning and incubating salmonid eggs? Grays Harbor County is working with the Quinault Indian Nation to monitor the location and amount of gravel removal and find the answers to these questions.

Enhanced Rearing Habitat

Gravel Pit Rehabilitation

Recent work by Samuelson *et al.* (1989) has demonstrated that converting abandoned gravel pits to salmon rearing ponds in the lower Chehalis and Humptulips River Systems may help to increase production. Any additional fish production at these projects should be evaluated to determine whether additional sites should be developed.

Side Channel Habitat Enhancement

Existing aerial photos should be reviewed for the purpose of identifying side channels, sloughs, and gravel pits blocked off from the river as of 1992. Site visits should begin in 1993. Site-specific plans, construction, and post-project evaluation should be developed. Fish production at these projects will also be evaluated.

Enhanced Spawning Habitat

WDF created a chum salmon spawning channel on the lower Satsop River in 1985 by excavating the floodplain, placing spawning gravel, and ensuring fish access from the river (Randy Young, WDF, pers. comm.). No subsequent evaluation has been conducted (Dave King, WDF, pers. comm.).

Grays Harbor College students have rehabilitated the Weyerhaeuser-Briscoe gravel pits on the Wynoochee River for chum salmon spawning and coho rearing (Samuelson *et al.* 1989). They have also rehabilitated parts of Alder Creek and Swano Lake in South Aberdeen. All these projects should be subjected to continuing, organized evaluation so that decisions can be made about the efficacy of additional similar projects.

WILD STOCK MANAGEMENT AND ROLE OF HATCHERIES

To maximize opportunities for artificial enhancement without jeopardizing wild stocks, adequate information on the history of introduced stocks and release locations is needed. Although this exists, it has not been analyzed, because most of the data is on paper only, and not computerized. A complete river-by-river history of stock identity would be useful in sketching the degree of similarity between hatchery and native stock for each river system in the Basin, at a minimum for fall chinook and winter steelhead. For example, the Satsop received more outside fall chinook transfers than the rest of the Basin (Brix, WDF, pers. comm.); verifying this observation against actual release records could confirm or modify the present policy of limiting transfers of Satsop chinook outside that system.

This information would allow fishery management agencies to formally agree on the role of hatcheries in augmentation, supplementation, and wild stock management in each sub-watershed and each segment of Grays Harbor where a particular fishery operates.

Further research is also needed on the genetic, disease, and ecological interaction effects of supplementation of wild stocks using hatchery-reared fish. Population simulation models should be developed to evaluate the sizes and locations of enhancement facilities that can be established without causing harm to wild stocks.

REGULATION OF FISHING

Current management of Chehalis Basin terminal salmon and winter steelhead has at times resulted in overharvest (Figures 8, 10, 12, and 13, Table 5). Managers will have more success if the following information needs are met.

Escapement Goals

The total spawning habitat available for coho, chinook, and steelhead is thought to be greater than previously estimated. If true, habitat-based escapement goals could be adjusted so that escaping adults more fully utilize all available habitat. This is why one goal of the current FWS habitat survey is to begin assessing the quantity of coho and steelhead spawning and rearing habitat and chinook spawning habitat. Some additional work will be needed over the next several years to enable refinement of the goals.

Escapement Estimation Evaluations

Current QFiD spawning escapement evaluation work should continue. They count the number of fish passing upstream at a trap in the fish ladder of the West Fork Hoquiam diversion dam. Spawning surveys are then conducted on the stream so that, on an annual basis, estimated escapements are compared to actual populations, species composition on the spawning grounds are verified, and within-species sex composition is determined.

Stock Status

Fall Chinook

It is presently difficult to accurately assess the marine catch of fall chinook. Numerical stock status information could be greatly enhanced by coded-wire tagging representative groups from Simpson and Humptulips hatcheries. Caution would be necessary in using Simpson fall chinook as an indicator for wild stocks since Simpson Hatchery fall chinook are a mixture of a number of imported stocks (Stone, WDF, pers. comm.).

Spring Chinook

Restoration of Wynoochee spring chinook is an important goal of the CBFTF. WDF personnel do not believe any native Wynoochee spring chinook exist (Stone, WDF, pers. comm.). The details of a restoration program depends partly on the present distribution and abundance of any spring chinook (likely Cowlitz stock) returning to the Wynoochee, which has not been systematically assessed. The first step required to support restoration is to assess the river's potential to support pre-spawning adults through the summer. Agencies need to know the river entry timing and spawning distribution of any existing spring-summer chinook. This could probably best be done by a systematic snorkeling survey.

Chum

Harvest managers are presently using a single, relative index for annual chum escapement estimation. Ascertainment of chum escapement numbers, by system, could greatly enhance chum management (Dick Stone, WDF, pers. comm.).

Coho

Ongoing investigations of Bingham Creek and upper Chehalis smolt production should be continued, as should coded-wire tagging of wild and hatchery coho in the Basin. Evaluation of escapement estimation techniques should continue.

Winter Steelhead

Freymond (1989) cited a need for more accurate sport catch reporting throughout the Chehalis Basin. He also encouraged that river of origin be specified in catch reporting for both sport and commercial fisheries.

Summer Steelhead

Return rates of hatchery fish to certain rivers has decreased in recent years, for unknown reasons. If management decides to emphasize this run, it might be advisable to investigate reasons for decline in post-release survival.

Smolt Survival Studies

Steelhead smolt survival studies conducted by QFiD should continue. For several years, steelhead yearlings have been coded wire tagged at Wishkah Ponds prior to transfer to Loomis Ponds on the Humptulips. Loomis Ponds are the imprinting and release site for a steelhead enhancement program. Data from tag recoveries are used for exploitation analysis, estimates of marine survival, and contribution to the high seas and terminal area fisheries.

Interception

Terminal area recovery and consistent reporting of coho coded-wire tags has usually not been adequate to estimate marine interception in most years. Terminal area catch is often only partially or inconsistently sampled or reported from one year to another with the exception that Quinault Indian Nation gillnet fisheries are systematically sampled for biological and tag recovery data and catches are consistently reported.

Complete and consistent tagging and recovery information would be useful to estimate not only the effectiveness of the Pacific Salmon Treaty in reducing interceptions, but also the total run size, and hence, the true measure of rebuilding. Ideally, coded-wire tagging studies of chinook and coho, at least from the hatcheries, would be useful indefinitely as index stocks. This will require a consistent system of estimating tag recoveries for all terminal fisheries. This, in turn, requires:

(1) expanding mark sampling to include the Chehalis and Humptulips system river and estuary sport fisheries and expand carcass sampling;
(2) estimating the portion of the catch mark sampled in these fisheries, probably through creel census;
(3) developing improved sport catch estimates for these two systems for years when creel census is not feasible; and
(4) ensure consistency in designating and recording tag recovery areas for all terminal fisheries as is done for all Quinault gillnet fisheries.

SUMMARY OF ADDITIONAL INFORMATION NEEDS

Current information provides significant data on the extent of available habitat and degraded areas. There are, however, numerous information gaps. The FWS habitat inventory being conducted under the Chehalis River Basin Fishery Resources Restoration Study Act during 1992 is designed to fill these gaps. However, some other gaps will remain and these can be addressed to a reasonable degree by a modest program of future investigation as shown below.

Topic	Periodicity	Data type
CURRENT INFORMATION NEEDS		
Coho tagging	Annually	Coded wire tagging and recovery
Fall chinook tagging	Annually	Coded wire tagging and recovery
Extent of dioxin and furans in Grays Harbor	Once	Sampling sediments and benthic animals
Oyster bioassay feasibility	Once, then quarterly	Regulatory bioassay
Continuous temperature, oxygen, and nutrient monitoring	Daily in summer	Chemical tests
Extent of water quality degradation in Upper Chehalis	Once	Chemical tests to determine which parameters are deleterious
Acute toxic contamination	Once	Planning for spills, etc.
Relation between water quality and water quantity	Once	Model development
Septic link verification	Once	Hydrological study
Wynoochee flow augmentation	Once	Instream flow study
Newaukum Diversion	Once	Instream flow study
Agricultural water conservation	Once	Investigation followed by planning process
Instream gravel mining	Once	Gravel deposition and scour rates
Side channels and gravel pits	Undetermined	Photography, survey, fish trapping
Evaluation of enhanced spawning	Continual	Assessment of fish use
History of stock introductions	Once	Hatchery records
Genetic, disease, and ecological concerns re. hatchery/wild	Ongoing	Scientific research
Hatchery/wild population simulation	Once for each stock	Modeling
Reassessment of escapement goals	Once	Use all habitat survey data

Total chinook and coho run sizes	Annually	Coded wire tag recoveries
Timing and distribution of Wynoochee spring chinook	5 years	Snorkel and spawner survey
Survival of summer steelhead	Once	Undetermined
Escapement estimation evaluation	Ongoing	Surveys and analysis
Smolt survival studies	Ongoing	Coded wire tagging and recovery
Spring/fall chinook competition studies	Once	Biological investigations

POTENTIAL INFORMATION NEEDS

Parasite/contaminant studies	Once	Physiological tests and bioassays
Effluent toxicity tests	Once	Bioassays
Sediments as contaminant reservoir	Once	Sediment sampling
Long-term fish survival	Once	Long-term seawater survival tests

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Restoration Monitoring and Evaluation

It will be necessary to monitor the effectiveness of the restoration program so that mid-course correction can be made, if necessary. Each type of proposed habitat improvement activity will require post-project monitoring to determine relative effectiveness in restoring fish populations.

Chapter 8: RESTORATION PROGRAM RECOMMENDATIONS

PROPOSED FISHERY RESTORATION GOAL

Based on the findings in this report, there is high potential for restoring salmon and steelhead runs in the Chehalis Basin. The following is a general Chehalis Basin fisheries restoration goal.

> **To optimize natural salmon and steelhead production while maintaining the existing genetic adaptation of wild spawners and allowing the highest compatible level of hatchery production.**

Natural production will be restored when the total estimated wild catches consistently lie within the range of historical estimates, and when wild escapement goals are consistently met. This leads to the following goals for each species.

(1) Doubling Chehalis River System coho salmon smolt-to-adult survival, compared to the 1989 level, so that Chehalis River System smolt survival equals Humptulips River smolt survival.

(2) Increasing chum salmon run sizes to historical levels.

(3) Sustaining the recent increase in Chehalis River System fall chinook salmon by improving water quality throughout the Chehalis River System and ensuring escapements that fully and consistently utilize the wild spawning habitat.

(4) Expanding spring chinook salmon wild production to its full potential range.

(5) Ensuring that wild winter steelhead fully and consistently use spawning habitat in each available Chehalis River Basin sub-basin.

(6) Evaluating existing wild summer steelhead populations in Chehalis Basin tributaries.

RESTORATION CRITERIA

Criteria for Habitat Improvements

Habitat restoration projects in the Chehalis watershed may not be cost-effective unless recent effluent treatment upgrades at the two inner Grays Harbor pulp mills result in significant improvement of survival. If survival has improved sufficiently, habitat restoration throughout the basin will be worthwhile and projects using promising techniques should be initiated to begin restoration. If survival has not improved, further efforts should be directed to solving the poor inner Harbor survival problems before extensive watershed habitat restoration proceeds. Since it will take at least two more

years before results of tagging studies can confirm clean-up effectiveness, preliminary habitat restoration projects should be started and evaluated. Once the inner Harbor water quality allows reasonable smolt survival, proven habitat restoration projects can begin throughout the Basin on a larger scale. Selection of habitat restoration projects will be guided by the ongoing habitat survey.

Criteria for Hatchery Programs

Hatchery production supports a large share of the catch in several important fisheries. However, once habitat problems have been corrected, the primary hatchery role in fishery restoration should be to augment, rather than replace, natural production. Hatcheries may produce fish poorly adapted for wild survival and can jeopardize the health of wild runs, so programs must be developed cautiously. Any new hatchery initiatives should meet these concerns by either (1) being phased out after reaching optimum natural production, or (2), if permanent, support harvest at a time and place that does not preclude meeting the wild escapement goal.

Ongoing State and Tribal processes are designed, and should continue, to carefully evaluate all hatchery programs for both their likely production contributions and their potential interaction with wild stocks. Artificial enhancement can and should be utilized wherever it will not harm the integrity of wild stocks. The key to successful integration of hatchery and wild production is

1) choosing locations and stocks that do not conflict biologically or in harvest strategies with natural runs, and/or
2) possible acceptance of hatchery stock overescapement.

Restoration Project Evaluation

It will be necessary to monitor the effectiveness of the restoration program so that mid-course corrections can be made, if necessary. The FWS recognizes the immediate need to extend the existing coded wire tagging program to evaluate relative survival of hatchery fall chinook from the Chehalis and Humptulips River Systems. Most other proposals to study inner Harbor water quality and environmental contaminants should be postponed until the effect of the 1989 waste treatment improvements at both Grays Harbor pulp mills is adequately evaluated. If survival does not increase significantly, additional studies leading to further water quality remedial actions will be necessary.

Some types of both hatchery and habitat restoration projects have not yet been proven for their effectiveness. Therefore, it is recommended that all unproven restoration projects initially include careful evaluation to determine how well they produce additional fish. As the most productive restoration techniques become apparent, they will be emphasized in the restoration efforts. The general type of restoration projects needing evaluation include

spawning channels,
off-stream rearing habitat,
acclimation ponds,
remote site incubators,
fry, pre-smolt, and smolt stocking,
addition of woody debris,
stream fencing,
riparian vegetation improvements,
changes in instream flows,
reduction in streambed sediments, and
changes in water quality.

Information ascertained through the ongoing habitat survey will be used to identify highest priority restoration projects. The first of these most dramatic cases will serve as pilot projects, having evaluation built in as an integral part of the project.

Public and Interagency Involvement

Public and interagency cooperation is vital to the success of restoration. This requires the active participation of the tribes and agencies named in the Chehalis Act as the Restoration Plan is implemented. These key entities will identify and explore avenues of cooperation with all interested private organizations and agencies not already involved. The public will be invited to a Basin-wide fisheries conference in the fall of 1992 where study findings will be presented and suggestions for restoration priorities sought.

The FWS recommends that the Chehalis Basin Steering Committee, formed under the Chehalis Basin Fishery Restoration Study Act, be continued to provide policy guidance to the restoration proposed in this report. Furthermore, a Chehalis Basin Fishery Restoration Project Review Team should be formed to strategically plan Chehalis Basin fisheries restoration and implement all the restoration recommendations detailed below. The Team would be composed of representatives of each relevant agency, tribe, and the public and would meet regularly to review project proposals. Each project proposal would be evaluated for its likelihood to restore fish, cost-effectiveness, cost-share requirements, and performance evaluation. All proposed habitat and artificial production proposals should be subjected to the planning criterion path presented in the "Salmon 2000" report (Appleby et al. 1992).

It is also critical that all existing programs designed to protect, restore, and enhance fisheries and their habitat continue to be fully supported and funded.

RESTORATION OBJECTIVES

To achieve full restoration, the primary emphasis should be on habitat improvement because state, local, and tribal hatchery projects are already relatively well-developed and state and tribal harvest managers continue to work together to maximize harvest while allowing adequate escapement.

The overall life-span of the restoration project is 20 years, assuming full funding is made available. Some tasks can be completed in one or several years while others will be accomplished gradually over the 20 years. Since all restoration projects will at least initially be evaluated for fish restoration effectiveness, these recommendations will need to be revised over time. Projects found to be ineffective will not be further pursued. The costs of these evaluations has been included in the project costs estimated below.

Objectives

FWS recommends that the following objectives be simultaneously pursued to achieve full restoration of Chehalis Basin fishery resources. A general description of the tasks required is provided under each objective. Tasks have been prioritized as follows:

PRIORITY 1: Expected to produce excellent results and/or should be at least begun for evaluation.

PRIORITY 2: Expected to produce very good results but not necessary to start immediately.

PRIORITY 3: Expected to produce good results.

OBJECTIVE 1: Restore or improve natural spawning or rearing habitat.

PRIORITY 1:

* *Open access to spawning grounds blocked by landslides, culverts, dams, or water diversions.*
* *Reopen and rehabilitate side channels and oxbows or convert abandoned gravel pits to salmon rearing ponds.*
* *Create additional groundwater-fed spawning channels.*
* *Restore habitat degraded by logging, agriculture, road building, and urbanization by planting trees for shade, fencing streams to eliminate livestock and protect trees, adding or removing woody debris as appropriate, and/or building sediment ponds to reduce flash runoff.*

PRIORITY 3:

* *Determine whether existing gravel removal operations reduce spawning success.*

OBJECTIVE 2: Improve water quality to meet State standards year-round in the middle and upper Chehalis River System.

PRIORITY 1:

* *Initiate routine monitoring to detect critical seasonal water conditions in the middle Chehalis River.*

PRIORITY 3:

* *Determine how increased flow in the main stem Chehalis could help to reduce temperature and oxygen problems.*
* *Determine link between septic system seepage and Chehalis water quality.*
* *Determine how to prevent fish kills from acute toxic chemicals, especially when fish are stressed from high temperatures and low oxygen.*

OBJECTIVE 3: Ensure that the environmental conditions causing poor smolt survival in inner Grays Harbor are remedied.

PRIORITY 1:

* *Coded-wire tag two 250,000-fish groups of Chehalis and Humptulips chinook salmon to evaluate relative survival.*
* *Continue coded-wire tagging of Chehalis and Humptulips wild and hatchery coho salmon to evaluate relative survival.*

PRIORITY 3:

* *Determine the extent of dioxins, furans, and related compounds in the Grays Harbor environment and benthic organisms, and the links between contaminants, prey organisms, and salmonids.*
* *Further investigate effluent toxicity, parasite and contaminant relationships, and sediment as a contaminant reservoir (only if coho and chinook tagging studies indicate poor survival continues).*

OBJECTIVE 4: Ensure that storage dam operation and surface water withdrawal is compatible with fish production.

PRIORITY 2:

* *Conduct Wynoochee River instream flow studies if necessary and negotiate improved flows for fish.*
* *Determine how to improve smolt passage at Wynoochee Dam and implement improvements.*
* *Reduce inflow of organic material and nutrients.*

PRIORITY 3:

* *Develop an agreement to protect instream flows in the North Fork Newaukum River.*
* *Encourage meeting established WDOE base flows on all streams by promoting voluntary conservation of irrigation water.*

OBJECTIVE 5: Extend the range of salmon and steelhead within the Basin to achieve optimum habitat use.

PRIORITY 2:

* *Restore full natural production of spring chinook to the Wynoochee River*
* *Manage all salmon and steelhead hatchery programs and fisheries to provide recreational fisheries while meeting wild escapement goals that consistently and fully utilize all wild spawning habitat in the Basin.*

OBJECTIVE 6: Optimize opportunities for artificial enhancement without jeopardizing wild stocks.

PRIORITY 1:

* *Develop remote-site incubation to increase chum production and possibly extend the range of chum within the Basin.*

PRIORITY 2:

* *Continue experimentation in developing fall-run brood stock and rearing at Satsop Springs for eventual in-river directed harvest.*
* *Investigate reasons for decline in post-release steelhead survival in recent years.*

PRIORITY 3:

* *Conduct a complete review and summary of all historical artificial stock introductions to help with decisions about future management.*
* *Evaluate cooperative rearing projects for their contributions to fisheries and gradually phase out inefficient projects.*

OBJECTIVE 7: Use fisheries harvest management techniques and increased enforcement to increase run sizes.

PRIORITY 1:

* *Revise estimates of available salmon habitat and refine escapement goals to optimize natural habitat use.*

PRIORITY 2:

* *Improve chum salmon stock assessment by refining absolute value of chum escapement and redefining escapement goal.*
* *Improve terminal area sport and commercial salmon and steelhead catch sampling to ensure that stock estimates are accurate and consistent.*
* *Increase enforcement to reduce poaching of salmon and steelhead.*

OBJECTIVE 8: Increase public awareness of the values of fisheries to the Chehalis Basin.

PRIORITY 3:

* *Develop an education program for Chehalis Basin schools.*
* *Develop a video supporting the value of Chehalis Basin fisheries restoration.*
* *Sponsor a contest to develop a logo for Chehalis Basin fisheries restoration program.*
* *Ensure that all restoration projects are identified by at least small signs carrying the restoration program logo.*

FUNDING NEEDS

Some restoration has occurred and will continue under existing federal, state, local, and volunteer programs. The proposed habitat restoration projects complement existing programs but should not replace them.

Since it is important that restoration techniques be demonstrated to be effective before they are fully implemented, it is recommended that restoration be funded gradually over 20 years. After careful review of the size and scope of all tasks necessary for full restoration, it is recommended that a total of $1 million be committed to Chehalis restoration from interested agencies in each of the 20 years. This level of funding is expected to restore significant fish populations, ultimately stimulating the economic recovery of the Chehalis Basin. The Fish and Wildlife Service is not prepared at this time to request additional funds for its share of this work. However, funds may become available by reprogramming from lower priority activities or through other sources.

RESTORATION PLAN

The Chehalis Basin Fisheries Restoration Program has begun and restoration of the anadromous populations will require a 20-year program of implementation. The following step-down plan represents the first 6 years of scheduling for actions and responsibilities in the Restoration Program. Adjustments to the step-down plan will be necessary each year to adapt to continuing changes in program needs. Funding levels represent only the federal contribution to restoration.

STEP-DOWN PLAN

Action	Fiscal Year* 94	95	96	97	98	99
Restore/improve natural spawning or rearing habitat (FWS/WDF/WDW/Tribes/CBFTF)						
Open access to spawning grounds	$55	120	100	75	75	50
Reopen side channels	105	120	100	50	25	25
Create spawning channels	30	50	40	40	40	
Restore degraded stream habitat	102	200	150	120	100	50
Determine effects of gravel removal						50
Improve middle and upper Chehalis water quality (WDOE,Tribes,FWS)						
Chehalis River water quality monitoring		100	100	25	20	20
Determine flow/temperature relation in main stem Chehalis					50	50
Work on septic contamination					50	50
Prevent fish kills					50	50
Ensure adequate smolt survival in Inner Grays Harbor (FWS,WDF,WDOE,Tribes)						
Tag Chehalis Basin chinook		75	75	75	75	75
Continue tagging Chehalis coho *						
Understand dioxins in the Grays Harbor food chain					200**	200**
Reduce impacts of dams and diversions on salmonids (FWS,WDOE,WDF,WDW,Tribes)						
Wynoochee River instream flow			50	50		
Improve smolt passage at Wynoochee Dam			30	30	30	50
Protect North Fork Newaukum River instream flows						50

Action	Fiscal Year* 94	95	96	97	98	99
Seek voluntary conservation of irrigation water						40
Restore salmon and steelhead to original ranges (FWS,WDF,WDW,Tribes,CBFTF)						
Restore Wynoochee spring chinook			50	50	40	40
Ensure all spawning and rearing habitat is fully utilized			50	30	30	20
Maximize artificial enhancement without jeopardizing wild fish (FWS,WDF,WDW,Tribes,CBFTF)						
Use remote incubators for chum		75	70	50		
Explore expansion of Satsop wild brood for directed harvest				50	30	
Improve steelhead post-release survival				50	50	50
Complete artificial enhancement review					30	
Evaluate cooperative rearing projects						75
Improve harvest management and enforcement (WDF,WDW,Tribes)						
Refine habitat-based escapement goals		100	50	50		
Improve chum escapement estimates and goals				50	50	
Improve catch sampling				50	50	50
Increase fisheries enforcement				50	100	100
Increase public awareness of Chehalis fisheries (FWS,WDF,WDW,Tribes,CBFTF)						
Develop school program		50				
Develop Chehalis fisheries video			30			
Develop Chehalis fisheries logo		5				

Action	Fiscal Year*					
	94	95	96	97	98	99
Supply signing for restoration projects		5	5	5	5	5
Program administration, coordination and evaluation (FWS)						
Program administration	30	30	30	30	30	30
Program coordination	50	30	30	30	30	30
Program evaluation		40	40	40	40	40

* presently funded by WDF
** necessary only if evaluations show smolts continue to die in the estuary

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