# Chapter 5: CAUSES OF DECLINE

## ENVIRONMENTAL PROBLEMS IN GRAYS HARBOR AND THE LOWER CHEHALIS RIVER

### Pulp Mill Effluents

In 1928, Grays Harbor Pulp and Paper Co. (now ITT-Rayonier) began discharging untreated acid waste into the Harbor (GHRPC 1992). The effluent killed alarming numbers of fish, crab, and shrimp (Wendler and Deschamps 1955b) and by 1940 prompted the Washington Water Pollution Control Commission (now WDOE) to investigate. The Commission concluded that mill waste was virtually smothering fish by taking dissolved oxygen out of the water and that the waste would have poisoned the fish had it not smothered them first (Pine and Tracy 1971). In 1957, the Weyerhaeuser Company opened the area's second pulp mill in Cosmopolis (GHRPC 1992). Their effluent was pumped to the Harbor via a series of ponds and discharge structure in South Aberdeen. Like ITT, Weyerhaeuser came under pressure to improve water quality (GHRPC 1992).

The industrial processes, treatment procedures, and resulting effluent of the two mills have been described by Hallinan (1989), Reif (1989a), and Johnson *et al.* (1990). Work on pollution effects on salmon has been well summarized by the reviews of WDF (1971), Seiler (1987, 1989), and Schroder and Fresh (1992) and much of what is reported here is based on these works.

#### Differential Adult Production

Seiler (1987) reported that Humptulips River chinook production averaged 33.6 percent of the Chehalis Basin total over the previous 17 years, although the Humptulips system watershed area is only about 10 percent of the Chehalis Basin total area. Recent wild steelhead run size estimates (QFiD and WDW 1991) suggest disproportionately high production from the Humptulips relative to the Chehalis River System, since Humptulips wild steelhead made up 28.0 percent of the Basin's wild steelhead runs in the 1984-1990 period.

#### Differential Smolt Survival to Adult Catch

In the early 1970s, a group of Satsop hatchery fall chinook was released into the Humptulips and survived to adult 18 times as well as on-station releases (Fuss *et al.* 1981). Several recent studies summarized by Seiler (1989) agree that coho smolts originating in the Chehalis system contribute to the marine catch no more than half as well as smolts coming from the Humptulips system. Seiler (1987) considered steelhead to be affected by poor water quality in the inner Harbor in the same way as coho.

## Poor Smolt Survival in the Estuary

WDF coordinated a series of studies of inner Harbor pollution on salmon. Primary findings included (Schroder and Fresh 1992):

- Inner Harbor fish were more highly stressed and less able to resist disease than fish from North Bay;
- smolts move in and out with the tide and rest in low-velocity areas, i.e., coho spend considerable time in areas most likely to be polluted;
- Inner Harbor fish showed four times the mortality of North Bay fish during long-term observation;
- in the short term, full-strength Weyerhaeuser effluent was intermittently lethal to coho smolts;
- over the long-term, liver enzymes involved in the metabolism of toxicants and other foreign compounds increased in fish exposed to dilutions of Weyerhaeuser effluent at 30 percent and higher;
- swimming stamina was reduced when smolts were forced to swim in effluent solutions from either mill;
- in lab experiments, coho usually avoided low concentrations of Weyerhaeuser effluent, but failed to avoid any odors after exposure to ITT effluent.

In a variety of other tests over recent years, effluent from both plants was variously lethal or toxic to a variety of non-salmonid tests organisms (WDF 1971; WDE 1975; Hallinan 1989; Reif 1989a,b; Johnson *et al.* 1990; Schroder and Fresh 1992).

## Toxic Chemicals in Mill Effluent

Studies reviewed and/or conducted by Reif (1989b), Johnson *et al.* (1990) and Schroder and Fresh (1992) analyzed effluent of both mills for metals and a variety of organic compounds including herbicides, pesticides, guaiacols, catechols, dioxins, furans, cadmium, copper, lead, nickel, zinc, chloroform, 4-methylphenol, and resin acids.

Schroder and Fresh (1992) stated that, at 30 percent dilution, all potential toxins in the effluent would fall below detection limits. This suggested that unidentified constituents of the effluent affected mortality. Over 4,000 chlorinated organic chemicals may occur in pulp mill effluent, but the effects on fish are known only for a few of them. They hypothesized that the bioassay organisms were responding to either (1) different chemicals than the ones that could be analyzed in correlation, (2) lower concentrations of chemicals than previously reported to be toxic or (3) other toxicants not analyzed.

## WDF's Conclusions and Recommendations

WDF's general conclusions (Schroder and Fresh 1992) were that:

(1) many potentially toxic chemicals were in the effluents;
(2) Weyerhaeuser tended to have more detectable compounds than ITT;
(3) all chemicals were typical of pulp mills;
(4) all known chemical concentrations were below known danger levels for aquatic organisms; and
(5) none of the compounds could be directly linked to salmon survival.

Schroder and Fresh (1992) recommended continuing to coded wire tag coho smolts at least until the 1992 brood year; resuming hatchery fall chinook tagging; and investigation into the role of sediment contamination in the pollution block. In the event that tagging does not indicate improved survival, they recommended investigating the interaction of the intensity and location of parasite infestation, particularly *Nanophyetus*, with effluent composition.

## Relative Importance of Effluents to Fish Mortality

Through painstaking research, the agencies ruled out virtually every other hypothesis for Chehalis system smolt mortality. Some of the substantiating evidence follows.

(1) Upper Chehalis coho smolt production is similar to production in other western Washington rivers (Seiler 1987).

(2) Northern squawfish (*Ptychocheilus oregonensis*) could only be consuming about seven percent of hatchery smolts and less than one percent of wild smolts in the Chehalis River (Schroder and Fresh 1992).

(3) Upper Chehalis waters do not have chronic or widespread toxicity problems (Michaud 1989).

(4) Neither the Aberdeen, Hoquiam, and Cosmopolis sewage treatment plants were impairing aquatic organisms (Schroder and Fresh 1992).

(5) Physiological tests determined that coho smolts usually entered the lower Chehalis as robust, stress-free fish (Schroder and Fresh 1992).

## Recent Clean-up of Pulp Mill Effluent

In 1990, both mills began substituting oxygen or other chemicals for chlorine in the bleaching process, and took steps to prevent accidental spills of toxic materials into the mill waste stream. Each mill also took unique steps to further reduce effluent toxicity (Reif 1989a; Johnson *et al.* 1990).

## Monitoring Pulp Mill Effluent

The NPDES requires pulp mills to obtain discharge permits administered by WDOE. These permits require certain basic water quality levels to be maintained in terms of BOD, pH, TSS, and fecal coliform bacteria. In addition, they require both mills to pass acute and chronic bioassay tests every two months (Don Kjosness, WDOE, pers. comm.). Several other tests, particularly for total dioxin and AOX -- a measure of absorbable organic chlorides -- have been proposed by WDOE and are being considered by the Water Pollution Control Board.

## Sediments

The EPA found no difference in detected metals between the inner Harbor and North Bay (Schroder and Fresh 1992). However, sediment chromium was slightly above the EPA criterion for damage to Puget Sound benthic infauna, and nickel was about four times the criterion. Concentrations of 4-methylphenol and N-nitrosodiphenylamine were predicted to adversely affect sediment benthic infauna. EPA also found Dioxin in sediments below both mill outfalls (Schroder and Fresh 1992). WDOE sediment chemistry revealed that "Chromium and nickel were somewhat elevated" at both outfall sites, and "exceeded the most stringent proposed Apparent Effects Threshold values" at the ITT site (Reif 1989b).

## Bioaccumulation

In 1990, FWS sampled sediment, eelgrass (*Zostera marina*), amphipods (*Corophium* species), clams, mud shrimp, crabs (*Cancer magister*), salmon, and flatfish in Grays Harbor (Frederick 1991). Dioxins and furans were detected in several samples, with highest levels of dioxin in amphipods and crabs (Frederick 1991). Contamination of amphipods may be a potential contributor to delayed salmon smolt mortality.

## Future Outlook

Studies of the relation between water quality, sediments, and fish survival should be broadened by looking at both water and sediment pathways. Fish can pick up contaminants either by absorbing them through their gills directly from the water or by feeding on contaminated organisms. Contaminants, including dioxins, can get into the water either directly from mill outfalls or by resuspension from the sediment. That is, contaminants either redissolve into the water or ride up into the water on clay particles. Resuspension may result from wave and tidal action, or from dredging and spoil disposal.

To summarize the current status of inner Harbor pollution in relation to salmon production, (1) an unidentified substance intermittently present in pulp mill effluent as late as 1989 was weakening coho smolts after short-term exposure and probably contributed to mortality, (2) both mills have since upgraded their waste treatment, and (3) the first results of post-cleanup fish

tagging studies will begin in 1992 to indicate whether the pollution block has been reduced. A number of years of fish tagging will be required to make final conclusions about the success of cleanup.

### Current Harbor Dredging and Fish Survival

Regulatory agencies thoroughly examined the current harbor deepening and spoil disposal project and ultimately agreed that operations would not significantly diminish fish survival (USACE 1990, Ging 1989). Potential negative effects were considered and either minimized by requiring judicious operating plans or mitigated through habitat enhancement.

The USACE (1990) arguments against negative effects of dredging and spoil disposal notwithstanding, sediment contamination with potentially toxic chemicals is widespread enough to be a concern (Table 15). Their own argument that winds and tides resuspend sediment throughout the harbor (USACE 1990) implies that dioxin and other contaminants, even though bound to sediment particles, remain available to the food chain that may lead to salmon and shorebirds.

### Parasitism in the Lower Chehalis

Parasitism was identified by Schroder and Fresh (1992) as the only contributor to low survival aside from the inner Harbor environment. Biopsies indicated that both Chehalis and Humptulips systems had low pathogen infestation overall, and similar species composition of parasites. One notable exception was the kidney fluke *Nanophyetus salmincola*, which occurred more frequently in the lower Chehalis system and the inner Harbor than in the Humptulips or North Bay. The authors stated that parasitism alone could not account for differential survival between the two systems because (1) infestation was highly variable within and between watersheds; (2) no linkage had previously been noted between parasite infestation and survival in the absence of additional stressors; and (3) other coho populations that had high survival rates had higher levels of the parasite. However, heavy parastism by *Nanophyetus* coupled with additional stressors can cause coho to die prematurely (Schroder and Fresh 1992).

## CHEHALIS-CENTRALIA TEMPERATURE AND OXYGEN BLOCK

Chinook salmon attempt to hold in the Chehalis River between Centralia and Chehalis before gradually moving upstream to spawn in early fall; important chinook spawning grounds lie upstream. In late summer, a complex combination of natural and human-induced conditions often results in the reach being 1) unsuitable for chinook holding and/or 2) impassable for adults migrating upstream, because of high temperature and/or low dissolved oxygen (Hiss *et al.* 1983a). The marginal conditions also make fish particularly susceptible to mortality from pollution, such as sudden spills of toxic material or oxygen-robbing waste (Pickett 1992).

Near Weyerhaeuser diffuser (WDE Sites 33-36, USACE Site 9)

Furans:

* 2,3,7,8 TCDF well above detection limits in flounder and clams.
* Same substances verified near detection levels by FWS the following year.
* Substance also occurred in chinook juveniles at the same site (Frederick 1991).

Total aliphatics: Levels were higher in amphipods (WDE Sites 33-36, USACE Site 9).

ITT outfall (WDE Sites 37 and 38, near USACE sites 7 and 8)

Sediment guaiacols: Were found only near here.

Inner Harbor From Elliott Slough to Crossover Channel

Elutriate bioassay: Sediment elutriate was toxic to oyster larvae in bioassay.

Sediment Resin acids: Were at highest levels in inner navigation channel.

Inner Bowerman Basin

Dioxins and furans:

* Total TCDD, 2,3,7,8-TCDD, various higher chlorinated dioxins, Total TCDF, 2,3,7,8-TCDF, and various higher chlorinated furans, were found well above detection limits in amphipods.

Total aliphatics: High levels occurred relative to other Grays Harbor sites sampled;

South Bay: Levels of 2,3,7,8-TCDF well above detection limits were found in Dungeness Crab liver.

North Bay: Levels of 2,3,7,8-TCDF well above detection limits were found in Dungeness Crab liver.

*Table 15. Summary of sediment contamination in Grays harbor (Johnson and Coots 1989; USACE 1990; Frederick 1991).*

## Temperature

Chinook salmon prefer temperatures between 7 and 14 degrees centigrade (45 to 58 degrees fahrenheit); salmon and trout show stress when temperatures exceed 18 degrees for more than a few hours or days (Bell 1984). Adult Nooksack River spring chinook absolutely require temperatures below 23 degrees centigrade (75 degrees fahrenheit) (Mike Barclay, Nooksack Indian Tribe, pers. comm.). The Washington Administrative Code states that "Temperature shall not exceed 18.0 °C due to human activities" (WAC 173-201-045(2)(c)(iv)) in waters classified as are the Chehalis streams.

Present Condition. Throughout the mid-Chehalis, the temperature standard is routinely exceeded from June to September, particularly near Centralia (Hiss *et al.* 1983a; Aroner 1991; Pickett 1992). Clearly, these conditions are unsuitable for holding adult salmon. If temperatures remain high enough throughout the night, migration through the area could also be blocked.

Efforts to reduce temperature have been very local; temperature controls have been engineered into the Skookumchuck Dam, and are under study for the Wynoochee Dam, but temperature problems in the Chehalis Basin have not been studied in detail (Pickett 1992).

Causes. Shade removal, resulting from logging (Newman, Weyerhaeuser Co., pers. comm.), agriculture, and residential and industrial development (Barber, WDF, pers. comm.), has contributed to seasonally recurring high temperatures (Pickett 1992). Although current logging regulations sometimes require a certain number of mature trees per length of stream bank to contribute to instream woody debris, this arrangement guarantees only partial shading from a thin row of large trees, rather than the potentially more complete shading and cooling effect of a naturally dense growth of shrubs and trees of various heights. Some farmers maintain pastures and crops directly adjacent to the streambank and thus prevent shade trees and shrubs from establishing. Numerous water withdrawals cumulatively reduce instream flow thereby raising temperatures.

## Oxygen

Salmonids require a concentration of at least five mg/l dissolved oxygen in the water for survival (Bell 1984) although six mg/l is still considered stressful. The WAC states that "freshwater dissolved oxygen shall exceed 8.0 mg/l" (WAC 173-201-045(2)(c)(ii)(A)), except that because of naturally low water velocity in some reaches, the "Chehalis River from Scammon Creek (RM 65.8) to Newaukum River (RM 75.2) dissolved oxygen shall exceed 5.0 mg/l from June 1 to September 15." (WAC 173-201-080(8)).

Present condition. The Chehalis-Centralia area between Miles 66 and 76 has been the site of low dissolved oxygen in late summer and fall (Bernhardt 1974). Dissolved oxygen violations were also recorded at Centralia, Porter, Montesano, and in the Satsop River (Hiss *et al.* 1983a; Aroner 1991; Pickett 1992).

Causes. Seasonally recurring low dissolved oxygen is attributed to nutrient enrichment and treatment plant effluent (Pickett 1992). Water withdrawal exacerbates the problem (Figure 22), by cumulatively reducing instream flow, raising temperatures, and lowering the ability of the water to retain oxygen.

A total phosphate-phosphorus standard of 100 micrograms per liter applies to the Chehalis Basin (Aroner 1991). Excessive nitrogen or phosphorus loading supports a boom-and-crash cycle of algal growth; this occurred often at Centralia and sometimes at Porter and Montesano (Aroner 1991).

At Centralia, ammonia, total phosphorus, and ortho-phospohorus all showed a negative correlation to discharge, which may be the result of point source discharges providing most of the loading (Pickett 1992), while nonpoint sources dominate in the other reaches.

### Effects on Fish

The combination of high temperatures and low oxygen probably form a block to fish migration, particularly for spring chinook. These fish reach the Oakville area in May and June and hold there until spawning in the Newaukum and upper Chehalis from late August until early October. If the range of summer steelhead is to be extended to the upper Chehalis, the same concern may limit their migration. Wolfe (FWS, pers. comm.) believes deteriorating temperatures and oxygen levels over the last several decades have also hurt American shad.

High summer temperatures and low oxygen may prevent juvenile salmon and trout from using otherwise suitable rearing areas in the main stem Chehalis. In August 1989 spot-check snorkeling surveys, no juvenile coho or steelhead were found in habitat where expected (Bisson, Weyerhaeuser Co., pers. comm.).

### Total Maximum Daily Load Process

TMDL is a WDOE program intended to achieve full and permanent compliance with water quality standards in river systems where existing point-source pollution controls have not achieved the standards (WDOE 1990). TMDL is required by the Clean Water Act when conventional technology-based controls fail to protect water quality. In the Chehalis system, the process includes all waters from Porter upstream. WDOE has identified biological oxygen demand and coliform bacteria as the key pollutants and will now determine the total amount of pollutants that can be assimilated without harming designated uses. This level of pollution is called the Total Maximum Daily Load (TMDL) which is being determined by intensive monitoring of Basin water quality and modeling to predict water quality conditions at the most susceptible times and locations. This phase will be completed by September 1993.

After WDOE identifies point sources and nonpoint sources, the agency establishes a forum in which representatives of each pollution source allocate shares of the TMDL among themselves in a binding agreement with WDOE. This Waste Load Allocation (WLA) agreement also allows a share for anticipated

increases in polluting activities. At that point, WDE implements pollutant load reductions by incorporating WLA into wastewater discharge permits, developing and promoting more effective waste management practices, and educating the public.

## DAMS AND DIVERSIONS

Probably because of the Basin's relatively low gradient, the two largest dams, on the Wynoochee and Skookumchuck rivers, were built relatively far upstream on tributaries. While they and other smaller dams have taken a toll on fish production, the Basin has escaped the major impacts associated with large-scale dams as has occurred on the Columbia River.

### Wynoochee Dam

Wynoochee Dam was built by the USACE at RM 50 of the Wynoochee River in 1972. The reservoir stores about 70,000 acre-feet from a 70-square-mile drainage area. The city of Aberdeen now operates and maintains the dam under the Water Resources Development Act as amended in 1990 (BPA 1992). The dam controls flooding, provides recreation, augments low flows, and provides municipal and industrial water for the City of Aberdeen (via a diversion at RM 8.1). There is currently a joint Aberdeen/Tacoma project to develop hydropower at the dam.

Upstream Adult Passage. Chinook and coho salmon, steelhead, and sea-run cutthroat trout spawned upstream of the dam site before construction (Findlay 1967), and numbers of all but chinook were estimated.

| Species | Spawning escapement | |
|---|---|---|
| | Reservoir site | Upstream of reservoir |
| Fall chinook | unknown | unknown |
| Spring chinook | unknown | unknown |
| Coho | 0 | 1,500 |
| Steelhead | 1,000 | 400 |
| Sea-run cutthroat trout | 330 | 165 |

The Wynoochee project included a barrier dam and fish trap two miles downstream of the main dam. All migrating adult salmonids are trapped and trucked for release upstream of the reservoir. This facility has apparently provided adequate upstream passage in most years (Ging, FWS, pers. comm.).

To substitute for combined steelhead and cutthroat production lost to inundation, USACE agreed to provide WDW with funds for expansion of the Aberdeen Hatchery to rear 170,000 steelhead smolts, calculated to produce 1,700 adult steelhead, in addition to its then-existing programs. Chinook salmon were not considered in the mitigation arrangement (USACE 1967) apparently because their abundance was not determined.

Downstream Smolt Passage. To allow downstream smolt passage, the dam was built with six outlet pipes at various elevations so that smolts might locate them at any pool elevation. These open into the tailrace at the foot of the dam. Experiments (Dunn 1978; LaVoy and Fenton 1979) have shown that this arrangement was killing a number of coho and steelhead smolts. This work also demonstrated delayed migration past the dam and the possibility of mortality in the tailrace. As a remedy, the USACE subsequently constructed a baffle in the tailrace but visual observation indicated no improvement, and the baffle was removed (Dunn, FWS, pers. comm.). Costello (1984) wrote that induced mortalities and egression delay were due to failure of the original mitigation measures to (1) account for fish migrational behavior, (2) meet biological and engineering criteria set forth in the multilevel outlet design, and (3) account for circulation and velocity patterns in Wynoochee Lake, especially the forebay.

Mitigation. Agency attention shifted to further evaluating the effect of the dam on total adult returns (Mathews 1980), culminating in the recommendation by Hiss *et al.* (1983b) to provide additional mitigation for the equivalent of 806 adult coho and 254 adult anadromous trout annually.

Interest in resolving mitigation was renewed in 1990 with the transfer of operation and maintenance responsibilities from the USACE to Aberdeen. Aberdeen and Tacoma have been successful at obtaining federal funds of $1.3 million for the additional mitigation. Negotiations are ongoing between the USACE, Tacoma, Aberdeen, WDF, and WDW to determine the best mitigation package. The currently proposed hatchery project is being challenged in the environmental review process.

### Skookumchuck Dam

Skookumchuck Dam was built in 1970 and is managed by Pacific Power and Light Company (PP&L) of Portland, Oregon. The project provides water for two coal-fired power plants south of Bucoda. The dam can store up to 35,000 acre-feet (Mahlum 1976), and maintains summer flows, of which up to 30 cfs have been diverted at Mile 7.8 and pumped to the plants. The diverted water is turned into steam at the power plant, and not returned to the river.

Dam construction permanently inundated approximately two miles of former spawning habitat, and, since it has no fish ladder, blocked access to 12 additional miles of spring chinook, fall chinook, coho and steelhead spawning area above the reservoir (Hiss *et al.* 1982). This resulted in an estimated loss of 500 spring chinook, 311 fall chinook, 1,800 coho (Finn 1973) and about 700 steelhead spawners (WDG 1970). Half the potential coho rearing area (Finn 1973) and 90 percent of the potential steelhead spawning grounds on the Skookumchuck were above the dam (PP&L 1979).

The power company mitigates this loss under agreements with WDF and WDW by:

- guaranteeing adequate downstream spawning and rearing flow for chinook,
- artificially rearing coho, and
- providing both artificial rearing and fish passage for steelhead (PP&L 1979).

Although trap and haul enables WDW to pass steelhead upstream of the dam, WDF does not use the trap to pass coho, because WDF considered the other aspects of mitigation sufficient. Expanding the season for trap-and-haul operations to include salmon could restore access to potential coho spawning and rearing habitat.

### Hoquiam River System Dams

Three diversion dams exist in the Hoquiam system and supply municipal water to the City of Hoquiam. These affect passage for up to 10.2 river miles upstream, depending on whether the fish ladders are passable at all flows.

| Location of dam | Stream mile | Accessible miles upstream | Ladder present |
|---|---|---|---|
| North Fork Little Hoquiam | 2.0 | 2.0 | no |
| Davis Creek | 0.3 | 1.7 | yes |
| West Fork Hoquiam | 10.7 | 8.3 | yes |
| Total | | 12.0 | |

The Stream Catalog (Phinney *et al.* 1975) states that North Fork Little Hoquiam Dam is a total barrier to all species, and that the dams on Davis Creek and the West Fork Hoquiam, while equipped with fishways, may periodically not pass chinook, coho, or chum; coho in particular were reluctant to use the West Fork fishway. However, QFiD has been evaluating escapement on the West Fork since 1985 and has built a trap in the fish ladder. They discovered that, with proper flows, chinook, chum, and coho salmon, steelhead, and cutthroat trout all use the ladder. For example, an average of 300 coho move upstream past the ladder each year (Chitwood, QFiD, pers. comm.).

The three dams also tend to fill with silt and organic debris, which has been periodically flushed downstream. The flushing has been known to cause fish mortality (Chitwood, QFiD, pers. comm.) and degrade spawning gravels for some distance downstream (Bill Banks, City of Hoquiam, pers. comm.). An alternative silt removal procedure may exist to remove this danger.

### Water Withdrawal

There have never been any calculations of fish flow requirements in the Chehalis Basin except that WDF and WDW settled on flow agreements with the Corps after construction of Wynoochee Dam and with Pacific Power and Light upon construction of Skookumchuck Dam.

The State of Washington has granted thousands of surface water rights and claims, divided into categories of "Industrial and Commercial" (833 cfs), "Municipal" (590 cfs), and "Individual and Community Domestic" (197 cfs) (Joe Cason, WDOE, pers. comm.; Harper, in prep.). The principal industrial uses

are pulp manufacture and power generation. There is also extensive irrigation pumping for individual farms.

Aberdeen draws all its municipal water from the Wishkah River. Hoquiam obtains its supply from three dams in the Hoquiam system. Centralia and Chehalis get water from the North Fork Newaukum when water conditions permit, and Chehalis also pumps some of its supply from the Chehalis River.

Cumulative negative impacts of reduced stream flows occur in some Chehalis Basin locations. Low flows can block upstream passage, reduce total available rearing habitat, and exacerbate water quality and temperature problems.

Other non-consumptive water uses are the fish hatcheries on the Satsop River, Van Winkle Creek, and the Humptulips River; several satellite rearing ponds; and several private trout farms, primarily on the Black River;

**North Fork Newaukum**

The cities of Centralia and Chehalis operate run-of-the-river intake structures at Mile 12.6 on the North Fork of the Newaukum River. This ordinarily supplies the cities with municipal and industrial water. The cities have rights to virtually all the water during low flow, and this would happen if they relied entirely on the Newaukum. In previous years, this diversion has almost certainly resulted in reduced habitat and warmer temperatures for spring chinook, which regularly attempt to spawn in the North Fork Newaukum.

In the spring of 1991, increased suspended solids from a landslide about one mile upstream rendered the supply system inoperable. This caused the cities to rely on a combination of wells and diversions from the main stem Chehalis (Louis Ciolli, City of Chehalis, pers. comm.).

If all the cities' water needs could be met from alternative sources, North Fork Newaukum flow could be permanently allocated to support larger spring chinook, coho, and steelhead populations. If the cities find it feasible to reactivate the diversion, an agreement to protect instream resources would be very desirable. The City of Centralia is now applying for a WDOE grant to study this issue.

**Wynoochee River**

The Cities of Aberdeen and Tacoma (1985) describe Wynoochee flow considerations as follows:

(1) Presently 117 cfs is withdrawn from the Wynoochee River by the City of Aberdeen for industrial water supply at RM 8.1, approximately 43 miles below the Wynoochee Dam. The City's existing water right permits the maximum withdrawal of 300 cfs. The 1985 projections by the City indicated that no increase would be necessary for the next 20 years, unless a new water-consuming industry settles there. Water releases

from the dam are scheduled according to industrial needs in Aberdeen.

(2) Aberdeen must leave 120 cfs below Mile 8.1 for fish passage.

(3) Application has been made to WDOE for withdrawal of 35 cfs for future irrigation at RM 27 during June, July, and August. The current irrigation withdrawal is approximately 3 cfs.

(4) Minimum allowable releases from the dam to maintain fish habitat are 190 cfs, except as necessary between May 1 and June 30, when it is reduced to 140 cfs to complete refilling the reservoir.

(5) The dam operator must not fluctuate water levels more than one ft/hr immediately downstream of the dam when flows are less than 2,500 cfs, to avoid stranding fish downstream.

More liberal releases of water in the late summer and early fall could benefit summer steelhead, spring chinook, and possibly fall chinook even in drought years. Proposed Wynoochee hydropower addition (BPA 1992), to the degree that it reduces fall drawdown and winter storage capacity, is expected to add more flexibility for enhancing instream flow, especially below the Aberdeen diversion. If an Instream Flow Incremental Method (IFIM) study were conducted on the Wynoochee, the amount of flow needed for improved fish rearing and holding would be much clearer. Further changes in reservoir operation, whether or not they are related to hydropower addition, would probably have to be approved by the City of Aberdeen, Tacoma City Light, Quinault Indian Nation, and the State and federal resource agencies.

## Agricultural Irrigation Withdrawals

Irrigated acreage has declined during the past decade (USDA unpublished data)

| County | Irrigated Acres | |
|---|---|---|
| | 1987 | 1982 |
| Grays Harbor | 3,270 | 4,256 |
| Lewis | 7,242 | 7,971 |
| Thurston | 3,513 | 6,218 |
| Total | 14,015 | 18,445 |

and new irrigation development is not expected to increase substantially, with the possible exception of the Wynoochee, as mentioned above. The main agricultural centers, based on lands having surface water rights, are the South Fork Chehalis, Newaukum, and Black River valleys (Mahlum 1976). Irrigation water is mostly lost to the river by evaporation or percolation into the water table.

WDF (Phinney *et al.* 1975) recognized irrigation's potential to greatly reduce fish habitat, and listed particularly susceptible streams. The following year, WDOE closed many Basin streams to further water appropriation to protect instream flows. These included the South Fork Chehalis, Skookumchuck, Black, and Wynoochee rivers and 17 of their tributaries.

## FOREST PRACTICES

### Splash Dams

There are still lingering effects of splash dams and log driving in the Chehalis Basin: (1) the stream bottom may have been scoured down to bedrock, especially in the upper Chehalis and the South Fork; (2) the channel may have been straightened; (3) pools may have been obliterated; and (4) creation of new pools may be retarded by up to a century due to absence of sufficiently large woody debris entering the stream. As a consequence, salmon spawning and rearing habitat has not recovered (Jeff Cederholm, WDNR, pers. comm.). See pages 18-19 for further discussion of splash dams.

### Logging-associated Landslides

Logging-associated landslides most often are associated with failure of logging roads, some of which are built on slopes whose stability cannot be accurately predicted. During major rainstorms, some of these ongoing landslides trigger sudden flows of boulders, trees, and smaller material into streams. During these events, known as debris torrents, debris typically travels down the streambed for less than a mile and creates a blockage. If this jam is within an area formerly accessible to anadromous fish, potential habitat is lost, the degree of damage depending on the number of accessible and useful miles upstream. Blockage may persist for a few days or many years, until a subsequent high flows break the debris dam. Debris torrents also can remove all potential spawning gravel, vegetative cover, and pool-maintaining woody debris in their path.

A clear example of an impassable debris jam exists on Thrash Creek, a tributary of the upper Chehalis, (Bisson *et al.* 1986). Bisson (Weyerhaeuser Co., pers. comm.) suggests that debris jams may also be affecting fish access to parts of Cinnabar, George, and Big creeks. Warren Sorensen (Weyerhaeuser Co., pers. comm.) observed evidence of fresh debris torrents on Swem, Smith, and Ludwig creeks after the severe rainstorms of January and February of 1990.

Streams made accessible by fish ladders or culverts are susceptible to blockage by any form of accelerated erosion. Increases in large bed load -- that is, gravel, cobble, and boulders moving down the streambed -- can plug, bury, or otherwise destroy fish access. For example, on Roger Creek, a tributary to the upper Chehalis, accelerated erosion rendered the fish ladder at the creek mouth ineffective (Brian Benson, WDF, pers. comm.).

### Sedimentation

Logging-induced sedimentation clearly reduces fish populations (Cederholm and Reid 1987) by reducing water circulation around eggs and alevins in the spawning beds. Construction, use, and maintenance of forest roads contributes sediment to streams by mass slope failures or surface erosion of the road. In areas of steep slope and unstable soils, mass failures are often the primary path, but in more stable areas, erosion of road surfaces may be the

predominant sediment source (Bilby et al. 1989). Sedimentation may also occur around improperly constructed culverts, and to a lesser degree from the logged-off land itself (Larse 1970).

### Stream Clearance

Harvest of all streamside timber occurred until the early 1980s. While this practice is now allowed only in exceptional situations, there are many streams where the amount of large woody debris and the composition and structure of riparian vegetation was degraded as a result of this activity, according to Bilby and Ward (1991). They worked in the Chehalis Basin, and concluded that

(1) Compared to old growth stream reaches, streams flowing through areas clearcut within the previous five years tended to have:

   (a) smaller debris pieces (i.e., less stable fish cover);
   (b) fewer pools (i.e., less coho rearing area during the summer), and
   (c) less accumulated spawning gravel.

(2) Compared to clearcut stream reaches, stream reaches passing through second growth approximately 50 years old tended to have even less woody debris than recently clearcut areas. Clearcutting had created riparian stands composed largely of red alder, but this type of vegetation might not supply sufficient large woody debris, especially to larger streams.

### Forestry Chemicals

Forestry herbicides are used to kill hardwoods so that planted conifers can grow without competition. Forest spraying has also been done for pest control or to apply fertilizer. Forestry chemicals can enter steams either by runoff or direct application over streams. In the Chehalis Basin, regulations cover permissible chemicals, methods of application, and timing, but they remain a common concern (CRC 1991). The direct effect of forest spraying on aquatic life has not been documented in the Basin.

### Current Forest Practices

Timber harvest continues to reduce abundance of the largest and most persistent forms of wood, and thus impedes habitat recovery. For example, salvage of red cedar after timber harvest is still a common practice in the Pacific Northwest (Bilby and Ward 1991). Bilby (1984) studied the effect of debris removal on Salmon Creek, a tributary in the Upper Chehalis sub-basin. Removal of any type of large woody debris destabilizes the wood remaining in the channel, thus allowing flushing of wood downstream, contributing to the decrease in the amount of woody debris in natural fish rearing areas, and destabilizing the stream channel (Bilby 1984).

## AGRICULTURE

### Grazing Practices

Range management has also damaged the fishery resource. Livestock are at times still given free access to streams. They trample the bank, accelerating erosion and reducing bank vegetation and instream cover. SCS has recognized instream values and has begun to assist farmers to remedy these problems.

### Sedimentation

Agricultural practices tend to increase stream siltation and sedimentation. When streambank vegetation is cleared for grazing or row crops, there is an increase in bank erosion. Cattle trampling streambanks causes sedimentation. Run-off from tilled farmlands results in a higher silt load.

### Agricultural Pollution

Agricultural pollution has long been recognized as a major detriment to water quality and fish survival in the Chehalis Basin (Pickett 1992), and is the object of extensive improvements statewide (Troy Colley, Grays Harbor Conservation District, pers. comm.). Agricultural sources include farms, feedlots, and tree plantations. Agricultural pollution falls into two major categories: animal waste and toxic chemicals.

Improper animal waste management, especially from dairy herds, allows plant nutrients and pathogenic bacteria to enter surface waters (Diane Harvester, WDOE, pers. comm.). Manure is at times improperly collected, stored, or spread on fields, then rain washes bacteria and nutrients into the stream, contributing to contamination and overnourishment (Pickett 1992). In particular, there is a problem with low DO on the Black River and Gerrard Creek (Diane Harvester, WDOE, pers. comm.).

Pesticides and herbicides may enter streams when improperly applied or when equipment is improperly cleaned. The degree of pollution cannot be easily assessed because these chemicals tend to enter the stream from one particular spill or other event, do their damage, then dilute or break down before they can be identified or traced to their source. Lincoln and Independence Creeks have had several fish kills in recent years, probably caused by improper application of agricultural chemicals (Jay Hunter, WDW., pers. comm.).

### Aquaculture

There are four commercial fish farms located in the vicinity of Rochester to take advantage of abundant groundwater. Aquaculture discharge poses a potential risk to natural fish production from either chronic conditions, such as from removal of fish wastes and algae during pond cleaning, or short-term events, such as accidental spills of toxic chemicals used to sterilize ponds

after disease outbreaks. Such events have never been proven to occur, but were among the many hypotheses considered during the investigation of the 1989 Black River fish kill. Aquaculture pond discharges are regulated under state and federal law, and are monitored periodically for compliance.

## URBANIZATION AND INDUSTRIALIZATION

### Stormwater Runoff

Urbanization creates impermeable surfaces in the watershed due to roofs, streets, and parking lots. The Puget Sound Water Quality Authority (1990) lists five effects of urbanization on water quantity:

(1) Peak storm runoff volume and stream discharge increases.
(2) Runoff reaches streams much more quickly.
(3) Flooding increases in frequency and severity.
(4) Stream velocities are higher.
(5) Streamflow during dry weather is reduced because less water has soaked into the ground and moved slowly into the stream.

All these problems degrade fish habitat by creating wider, less stable stream channels and accelerating stream bank erosion. The resulting sediment fills ponds, streambeds, and stormwater facilities (Pressley and Hartigan 1991). Urbanization-related sedimentation is considered an issue within the Chehalis Basin (CRC and Lewis County CD 1992); of their 20 recommendations to reduce ecological damage associated with improper stormwater management, six are in some way related to sedimentation.

Surface runoff that would have otherwise seeped into the ground instead washes dust, soot, leaves, and whatever else is on the pavement into streams. This material tends to decompose in the water, thus increasing the oxygen demand. The contribution to total instream BOD is difficult to measure but the increase is directly proportional to the amount of impermeable land in the watershed, unless good stormwater management systems are in place. Stormwater also carries unwanted chemicals such as oil, fertilizer, and herbicides into streams. These problems are common to most urbanized areas (Puget Sound Water Quality Authority 1990), although poorly documented in the Chehalis Basin. One example is the Southwest Washington Fairgrounds where stormwater collecting from the surrounding areas is considered by WDOE to potentially threaten Salzer Creek with contaminated runoff (Pickett 1992).

### Bank Hardening

Farmers, seeking to protect their fields from stream erosion, harden the streambank with rock riprap, tires, or other materials. Many non-agricultural miles of Chehalis Basin streams have also been riprapped, primarily to protect roads and urbanized areas. Pressure to harden the bank is particularly heavy in the Newaukum system, where agriculture is widespread and the bank is largely loose sand and gravel. Aside from the effects of vegetation removal (and resulting increased temperatures) which usually go along with bank

hardening, other detrimental changes (Fraser 1987) include:

(1) loss of local variation in water velocity;
(2) loss of collecting places for woody debris and other instream cover;
(3) excessive deepening in the protected reach;
(4) acceleration of bank erosion downstream; and
(5) loss of bank gravel needed for maintaining downstream spawning habitat.

Bank protection has degraded fish habitat in the main stem Chehalis, Skookumchuck, Satsop, Wynoochee, Humptulips, Newaukum, and Skookumchuck rivers. Measures to make up for lost fish habitat, such as substituting dense willow plantings for riprap rock, or anchoring fallen trees to add instream cover and trap gravel, can be applied to certain sites.

### Municipal Sewage

Sewage treatment effluent produces biological oxygen demand and coliform bacteria with the potential for exceeding regulated levels in unusual conditions. Sewage plants also potentially release heavy metals, pesticides, and toxic petroleum-based chemicals. There are sewage treatment plants in Chehalis, Centralia, Elma, McCleary, Montesano, Aberdeen, Cosmopolis, and Hoquiam. The plants are periodically tested to ensure compliance with WDOE regulations for oxygen demand and bacteria. In addition, the Chehalis and Centralia plants will be given consideration in the WLA process mentioned earlier. The McCleary plant discharges into Wildcat Creek, a tributary of Cloquallum Creek, which enters the Chehalis. Water quality in the creek may still be limited due to nutrient enrichment, and WDOE has recommended addressing eutrophication prior to future expansion of the plant (Pickett 1992). The Aberdeen, Cosmopolis, and Hoquiam plants contributed insignificantly to the toxicity of inner Harbor water in 1988 and 1989 (Schroder and Fresh 1992). This information, along with the recent increases in inner Harbor dissolved oxygen to the point that WDOE standards are seldom violated, argues against treating inner Harbor municipal sewage as a major fish habitat concern.

### Septic System Leakage

Failing septic systems are given high priority in water cleanup efforts by the Chehalis River Council, in part because previous WDOE-sponsored watershed studies, known as Early Action Watershed Plans, indicated it was a pervasive problem elsewhere in western Washington (CRC and Lewis County CD 1992). A septic system can fail if (1) it is too small for its present load, (2) it is built on land that is either too porous or not porous enough, (3) the tank is not pumped periodically to remove the sludge, or (4) tree roots have grown into the drainfield and blocked the pipes. In each case, sewage finds a way out of the system before it has been fully treated and contaminates groundwater or surface water.

Septic system failure is thought to be widespread in the Chehalis Basin because the rural land is not served by sewer systems (CRC and Lewis County CD

1992). The effect on surface water is expected to increase in areas like the Black River which has seen a rapid increase in rural residences (Blocher 1991).

### Industrial Chemical Storage and Disposal

Waste chemicals are nonpoint sources when they enter the stream either because of poor storage or when they are dumped by hand. One example is of the American Crossarm Company near Chehalis, where old leaking electrical condensers were stored. Floodwaters rose, destroyed the berm around the site, and carried off unknown amounts of PCB-laden oil (Craig Harper, CRC, pers. comm.). Several possibilities of improper industrial waste disposal were also proposed during the Black River fish kill investigation and, although none was verified, it was clear that, where river conditions were already marginal, a seemingly small event could trigger a fish kill (Van Dyk 1989).

### Log Storage Runoff

Large stacks of logs are stored in Centralia, Montesano, Aberdeen, Cosmopolis, and Hoquiam before shipment to mills. In storage, logs are sometimes treated with preservatives, which can wash into surrounding waters unless adequate settling basins are used. Schroder and Fresh (1992), in their analysis of contamination of Grays Harbor receiving waters and suspended solids, identified several compounds typical of wood storage potentially toxic at higher concentrations. A wood waste landfill on Dillenbaugh Creek has been suspected of leaching toxic materials into the creek (Pickett 1992).

### Land Application of Food Processing Waste

National Frozen Foods holds a Washington State Discharge Permit to apply food processing waste to land near Salzer Creek. In the summer of 1979, the failure of a wastewater pipe caused a spill directly into the creek, resulting in very low DO levels at Centralia (Pickett 1992) and killing a number of spring chinook salmon (Jim Fraser, WDF, pers. comm.). An alarm system to show loss of pressure now ensures prompt action to minimize spills.

## GRAVEL MINING

Chehalis Basin gravel mining near Rochester and Elma from the 1940s to the early 1980s probably damaged shad and sturgeon (John Wolfe, FWS, pers. comm.). Gravel operations consisted of pits in the active channel. Wolfe hypothesizes that, since shad eggs drift with currents before settling, they may settle in silt holes and suffocate. Entrapment in mined pits also probably occurred.

Collins and Dunne (1986, quoted in Mark *et al.* 1986) listed the possible negative fishery effects of gravel mining as elimination of fish habitat such as pools, side channels, and eddies; lowered water table and consequent damage to riparian vegetation; and increased bank erosion. Collins and Dunne (1988) cited evidence that gravel was being removed faster than the natural rate of

replenishment on the Humptulips and other southern Olympic rivers.

Three kinds of gravel mining have been used in the Basin: in-channel excavation; bar scalping; and off-channel pit excavation. Although in-channel excavation is now prohibited, the other two types continue. Two main fishery issues remain unsettled. First, is the annual gravel harvest limit low enough to ensure against downcutting the river bed and depleting the gravel available for fish in coming years? Second, will present operations destabilize the mined bars or cause channel shifts that make the gravel less suitable for spawning and incubating salmonid eggs?

## SEDIMENTATION

Sedimentation occurs in the form of (1) siltation, that is, deposition of mud and silt carried by the stream and then deposited as flows recede, and (2) bedload aggradation, that is, excessive addition of sand, gravel and boulders which the stream pushes along its bed. Siltation can smother gravel beds, making them unsuitable for fish spawning or incubation. It can also decrease production of aquatic insects, upon which fish depend for food. Bedload aggradation causes the channel to widen and shift position more than normal, thus potentially drying incubating eggs and rearing fry. There are five sources of sedimentation: timber-related activities; urbanization; flushing of sediments from behind dams; runoff from tilled farmlands; and natural slope failures. All but the last have already been discussed.

Natural slope failure is presently the most obvious source of sedimentation. For example, recent movement of a chronically unstable slope on the North Fork Newaukum created a landslide that entered the stream, and raised the suspended solids in the water to the point that it was not suitable for municipal use for many months (Ciolli, City of Chehalis, pers. comm.).

## EFFECTS OF FISHING

Every fishery has the potential to overfish the wild stock so that it fails to meet its escapement goal. Bycatch, marine interception, terminal harvest, and poaching singly or together could theoretically contribute to overfishing. State and tribal fishery managers make every effort to avoid overharvest in the terminal area.

### Bycatch

Bycatch is the incidental catch of salmon and steelhead in a fishery that targets another species. Many workers have studied bycatch of North American salmonids in the Japanese squid fishery (Myers *et al.* 1990; Burgner *et al.* 1992; Ishida and Ogura 1991; Yatsu and Hayase 1991), the Alaskan groundfish trawl fishery (Myers and Rogers 1988), and the Japanese salmon gillnet fishery (Harris 1988; Burgner *et al.* 1992), and, despite emotional arguments to the contrary, high seas bycatch has not been shown to have damaged Washington stocks (Dr. Kate Myers, University of Washington, pers. comm.).

## Interception

Interception is the catch of a given salmon stock outside its terminal area, where a salmon fleet fishes on a mix of stocks bound for different rivers. Interception may occur on the high seas or in coastal waters. The high seas are defined for this report as marine waters outside the 200-mile national fishery management zone.

High Seas Japanese Salmon Gillnet Fisheries. There is little or no catch of Washington chinook, coho, or chum salmon or steelhead in this fishery (Harris 1988; Walker 1990).

U.S. and Canadian Coastal Salmon Sport and Troll Fisheries. Marine fisheries within 200 miles of the Washington, British Columbia, and Alaskan coast intercept large numbers of chinook and coho bound for the Chehalis Basin. This remains a major influence on terminal run size, and appears to contribute to the difficulty in meeting wild escapement goals. Grays Harbor coho have been a limiting stock in U.S. ocean salmon fisheries management and have limited access to other stocks in terminal fisheries (Dick Stone, WDF, pers. comm.). Marine fisheries do not intercept enough Chehalis Basin chum salmon or steelhead to affect terminal fishery management.

## Terminal Area Fisheries

Fishery managers make pre-season, in-season, and post-season run size estimates. The pre-season estimates help to set the fishing regulations and in-season estimates provide an opportunity to adjust regulations based on how the season is progressing. Overfishing in the directed fishery results when fishery managers overestimate the run size before or during the season, and consequently allow too much fishing. Inaccurate pre-season predictions may result from variation in migration route, variations in marine survival, and/or changes in time and intensity of mixed-stock fishing pressure. Differences between pre-season and post-season estimates of Grays Harbor terminal area natural coho run sizes clearly show the magnitude of the problem (Salmon Technical Team 1991).

| Catch year | Forecast | Post-season return |
|---|---|---|
| 1984 | 28,700 | 106,900 |
| 1985 | 56,400 | 22,200 |
| 1986 | 51,600 | 42,000 |
| 1987 | 103,300 | 62,000 |
| 1988 | 26,400 | 68,100 |
| 1989 | 43,000 | 70,800 |

Inaccurate in-season run size updates during terminal fisheries, resulting from unusual entry timing into the terminal area, variations in effort, and variations in catchability caused by temperature patterns, flow regimes, and

tidal influences, add to difficulty in consistently meeting escapement goals.

Incidental overfishing in the terminal fishery also results when the fishing period of a harvestable stock overlaps with the presence of a non-harvestable species or the wild component of the same species. For example, in 1988 a strong return of hatchery coho was predicted but wild Chehalis coho were predicted to fall short of the escapement goal (Samuelson 1989), and terminal fisheries were regulated in an attempt to selectively harvest the hatchery fish. However, run reconstruction (Dick Stone, WDF, pers. comm.), as illustrated below, showed that both hatchery and wild Chehalis coho experienced the same harvest rate.

| Chehalis system coho | Hatchery | Wild |
|---|---|---|
| Terminal area catch | 2,834 | 4,441 |
| Terminal area run | 26,671 | 41,040 |
| Exploitation rate | 10.6% | 10.8% |

Fortunately in this case, the terminal run size was initially underestimated and as a result the wild escapement goal was met.

### Poaching

This perennial problem adds much uncertainty to fishery management. Poaching includes all forms of unreported catches and, although it causes inaccuracies in post-season run estimates, does the most harm by reducing the number of spawners. The topic raises many virtually unanswerable questions. Does it make sense to account for poaching in managing terminal fisheries? Does annual variability in poaching contribute to the difficulty in predicting run sizes? Was poaching a major factor in the historical decline of the catches? What can be done to control poaching?

Poaching may have extinguished the native Wynoochee spring chinook run in the early 1950s, shortly after a road was built to the Wynoochee Falls 50 miles upriver (Dick Stone, WDF, quoting Jack Thompson, pers. comm.). Poachers desire fish for personal food, and roe for bait, either for personal use or for sale.

## LOCATION, QUANTITY, AND UTILIZATION OF EXISTING HABITAT

Habitat information is briefly reviewed here. Data from the FWS habitat survey begun on March 1, 1992, will totally meet the requirements of this section, and will be reported and analyzed in Volume II.

## Adult Holding Habitat

Holding habitat is the freshwater area used by adult spring chinook and summer steelhead while waiting to spawn. Spring chinook holding has been documented in the Skookumchuck from the dam down to Bucoda, in the South Fork and main stem Newaukum at least downstream to Mile 4, and the main stem Chehalis at least downstream to the vicinity of Adna (Hiss *et al.* 1983a), based on underwater visual observations. Some holding must also occur in the main stem Chehalis between Chehalis and Oakville, based on occurrence of adult chinook in fish kills (Gene Deschamps, Chehalis Tribe, pers. comm.). Quantity of habitat has not been studied, but is presently being documented during the FWS habitat surveys.

## Spawning Habitat

Location of accessible streams and occurrence of spawning spring chinook, fall chinook, coho, and chum are listed in the "Stream Catalog" (Phinney *et al.* 1975). However, more recent spawner surveys have led to some extensions and deletions of actual spawning grounds, for example in the case of spring chinook (Hiss *et al.* 1985). Steelhead spawning grounds are listed by stream and available miles for the entire watershed in WDW unpublished files. Extent of utilization is estimated annually in spawning ground surveys for spring chinook, fall chinook, coho, chum, and winter steelhead. Summary escapement data for the Basin was presented in Chapter 3. Sea-run cutthroat trout and a few Dolly Varden char can be expected to migrate at least as far upstream to spawn as steelhead and coho, but agencies do not estimate their escapement. American shad may spawn as far upstream as Rainbow Falls, and white sturgeon as far as Centralia, but this is known only from chance encounters, not systematic observation. Total habitat accessible to anadromous fish will be documented during the FWS habitat surveys, as will the extent of spawning gravel for chinook.

## Juvenile Rearing Habitat

### Freshwater Rearing

Generally, salmonids can be expected to rear at least as far upstream as they spawn, and, for species rearing in summer, disperse as far downstream as high temperatures permit. Juvenile chinook salmon emerge from the gravel in March and some remain in freshwater until October but virtually all migrate to saltwater by the end of summer (WDF 1971). Coho emerge from the gravel in March and April, and rear in freshwater for one year. Quantity of summer rearing habitat for coho has been roughly estimated for use in setting habitat-based escapement goals (Stone, WDF, pers. comm.). However, smolt trapping studies (Seiler 1987) indicate that coho escapement could be larger than those based on coho habitat quantity. One possible explanation is that there is much more habitat than indicated in the stream catalog (Phinney *et al.* 1975). Quantity of summer rearing habitat for steelhead has been roughly estimated for use in setting habitat-based escapement goals (WDW unpublished files).

**Estuarine Rearing**

Juvenile chinook, coho, and chum salmon use Grays Harbor for rearing before entering the ocean; extent of use by each species has been well documented (Simenstad and Eggers 1981).

These authors concluded that:

(1) Chehalis Basin chinook migrate out of streams at age 0.

(2) Regarding migration route, juvenile outmigrant chinook

   (a) reach Sand Island above Cosmopolis by early April,
   (b) tend to concentrate in the inner Harbor, mainly near Cow Point on the north bank opposite the Weyerhaeuser pulp mill outfall (Figure 2), and
   (c) reach Stearns Bluff on the south bank of Grays Harbor opposite Point New by mid-April.

(3) Chinook initially use the intertidal zone, but shift to open waters of the Harbor by August.

(4) Hatchery chinook depend on the estuary for a shorter period than some naturally-spawned individuals.

(5) Chinook fingerlings released from hatcheries in early June were at Westport by mid-June and left shortly thereafter.

The authors speculate that early summer may be a critical time in their life history, because growth was depressed until most fish left the area, at which time the remaining fish resumed growing. In Oregon, late summer estuarine residents contributed most heavily to the adult return (Reimers 1973).

Coho yearlings were abundant in the inner Harbor from mid-April to early June (Simenstad and Eggers 1981). In a sense, the Harbor is less important to coho than to chinook because individual fish pass through more quickly and do not take time to grow there (Moser *et al.* 1989). These investigators found that radio-tagged coho released in the lower Chehalis River generally migrated in the direction of the current; however, most tagged fish also tended to hold their position in areas of low current velocity near large structures such as pilings and docks, particularly around Cow Point. Holding periods ranged from several hours to 12 days. Fish then used either the North or South Channel to migrate to the outer Harbor.

Juvenile chum salmon also rear in the shallow intertidal zone; migration into the estuary probably starts in January and continues through mid-May (Simenstad and Eggers 1981). Chum depend more on the shallow intertidal zone than other juvenile salmon for food supply, since they enter the estuary at a size too small to prey on large, open-water zooplankton, depending instead on relatively smaller epibenthic crustaceans (Hiss and Boomer 1986a).

Other salmonid species seem to depend less on the estuary as a nursery ground, although steelhead were present in low numbers from mid-May to late July, cutthroat smolts were found in July, and Dolly Varden juveniles were found in March (Simenstad and Eggers 1981).

## ANTICIPATED HABITAT PROBLEMS

### Centralia Area Flood Control

The USACE has proposed to rehabilitate 7,000 feet of existing levee along the Skookumchuck River within the City of Centralia, and to add 1,300 to 1,700 feet of new levee. This could cause more rapid winter velocities in the main stem and remove low-velocity side channels that serve as refuge for overwintering coho salmon and cutthroat trout. This project has been indefinitely postponed because the cities of Centralia and Chehalis could not obtain the additional sponsors required by USACE.

Another flood control project has been proposed on Salzer Creek, which enters the Chehalis between the cities of Centralia and Chehalis. The object is to quickly remove floodwater from the county fairgrounds and airport. Floodwaters come from both the creek and from the Chehalis, which backs up into this area in high water. This project is also in abeyance until the cities get additional sponsors. Issues may arise regarding preservation and restoration of riparian habitat, fish access to potential off-channel rearing areas, and fish safety if floodwater pumping is involved.

### Satsop Energy Development

Construction of both Satsop nuclear plants has been halted until regional power needs are re-assessed. The Bonneville Power Administration (BPA) is reviewing proposals by potential contractors such as Washington Public Power Supply System (WPPSS). The earliest that BPA may decide to begin reactivating the nuclear projects is 1993 (Jason Zeller, Washington Energy Office, pers. comm.). A Final Environmental Statement has been prepared (Nuclear Regulatory Commission 1985) and would have included an agreement with the City of Aberdeen to allow 67 cfs, taken out of the city's water right, to remain instream to compensate for the plant's withdrawal of water from the Chehalis River near Satsop (Cities of Aberdeen and Tacoma 1985).

### Urbanization

Issues in the rapidly growing suburban area around Grand Mound, Centralia, and southern Thurston County generally include:

(1) predicting the effect of increases in municipal well withdrawal on groundwater supply and reduced seepage to the river,
(2) ensuring that the new Grand Mound Sewage Treatment Plant will not increase the risk of more fish kills on the Black and Chehalis Rivers,
(3) mitigating the effect of vegetation removal during new construction, and

(4) countering the permanent effect of urban runoff on an already delicate river system.

Growing suburban development and light industry in the upper watershed will degrade fish habitat by increasing the intensity of storm runoff, making high flows higher and perhaps low flows lower. This means more scouring of spawning beds in the winter and less rearing area in the summer.

### Industrial Expansion

The Grays Harbor Navigational Improvement salmon mitigation site, an artificial slough managed for early estuarine fish rearing, may be threatened by potential development of nearby lowlands for industry or log storage (Gwill Ging, FWE, pers. comm.). Runoff from the adjacent developments could pollute the slough and thus reduce rearing habitat value for juvenile salmon.

### Aquaculture

Aquaculture in the Black River area has been criticized on the grounds that it increases the risk of groundwater depletion. If so, an increase in aquaculture could reduce instream flow now coming from local infiltration, since the Black River valley has a strong groundwater connection to the main stem Chehalis.

### Bank Protection

Until recently, agricultural agencies assisted farmers and ranchers in stabilizing eroding streambanks. This process permanently removed key salmonid habitat features including undercut banks, instream woody debris, and shading vegetation (Chapman and Knudsen 1980). Currently, agricultural and fishery agencies usually cooperate to make up for the loss by planting shade trees along the protected bank (Rich Bainbridge, SCS, pers. comm.). Some projects include other added habitat features, such as boulder groins to create pools and eddies, anchored trees to provide instream cover, or dense willow plantings to reduce the need for rockwork. However, since improper bank protection upstream accelerates erosion downstream, the demand for more riprap continues. Although one riprap project with suitable considerations for fish will likely not cause long-term deleterious effects on fish populations, the cumulative effects of numerous riprap projects will be negative.

# Chapter 6: FEDERAL, STATE, TRIBAL, AND LOCAL GOVERNMENT ROLES AND RELATIONSHIP TO PRIVATE FISHERY CONSERVATION ACTIVITIES

## FEDERAL GOVERNMENT

### U.S. Department of the Interior, Fish and Wildlife Service

The Fish and Wildlife Service is part of the Department of the Interior. The Service is divided for most operational functions into seven geographical regions. Region One, with its office in Portland, Oregon, covers Washington, Oregon, California, Idaho, Nevada, and Hawaii. Region Eight, having nationwide coverage, conducts basic research for the Fish and Wildlife Service.

#### Portland Regional Office

The Portland Regional Office administers all Service activities in Region One except basic research. Of concern in the Chehalis Basin, are Fisheries and Federal Aid, Fish and Wildlife Enhancement, and Refuges and Wildlife programs.

*Fisheries and Federal Aid*

The Assistant Regional Director for Fisheries and Federal Aid has two primary responsibilities. The Division of Federal Aid is responsible for funding state programs to increase sport fish populations and sport fishing access through federal taxes on sport fishing equipment and motor boat gasoline and oil. The Washington Departments of Fisheries and Wildlife receive approximately equal federal funding and have programs in the Chehalis Basin (Jerry Davis, FWS, pers. comm.).

Through the Division of Fisheries, FWS plays an important role in restoring depleted fish stocks of national, interjurisdictional significance, in this case the Pacific salmon. The Western Washington Fishery Resource Office (WWFRO) in Olympia conducts applied fishery research and planning to restore depleted salmonid stocks, evaluate programs of National Fish Hatcheries, and help determine the effects of the Pacific Salmon Treaty on local stocks. In the early 1980s, WWFRO assessed the status of Chehalis spring chinook. Recently, WWFRO has taken the lead responsibility to satisfy the requirements of the Chehalis Basin Fisheries Resource Restoration Study Act.

There are no National Fish Hatcheries in the Chehalis Basin. In the recent past, winter steelhead smolts from Quinault National Fish Hatchery were released into the Humptulips River, but production has been transferred to the Humptulips Hatchery.

The Olympia Fish Health Center has performed fish health certification and diagnostic services for Sea Farms of Washington, Global Aqua, and Swecker's Sea Farms on the Black River (Kim True, OFHC, pers. comm.).

*Fish and Wildlife Enhancement*

Fish and Wildlife Enhancement (FWE) local offices within the Region conduct environmental review of federal projects under the Fish and Wildlife Coordination Act, and other development requiring federal permits. This component of the Service also deals with endangered species (except anadromous salmonids), contaminants, wetlands, and habitat restoration.

The Olympia Field Office of Fish and Wildlife Enhancement covers the Chehalis Basin. FWE has contributed to protection of the Basin's fishery resource principally through environmental review, but also through contaminant monitoring in recent years.

Environmental Review. FWE's environmental review work helped shape two major federal projects: (1) the widening and deepening of the Grays Harbor navigation channel; and (2) the construction and hydropower addition to the Wynoochee Dam. They have also reviewed several Corps flood control projects in the vicinity of Centralia.

Contaminant monitoring. Recent contaminant monitoring has become the pivotal factor in discussions of acquisition of additional land for the Grays Harbor Wildlife Refuge at Bowerman Basin, just west of Hoquiam (Frederick 1991). Additional Service monitoring now under consideration for a wider area of the Harbor may also shed light on the salmon smolt survival issue.

Habitat Restoration. The new Washington Ecosystems Project provides fish and wildlife habitat restoration to landowners and may be useful in Chehalis Basin restoration recommendations for specific habitat improvements. Providing at least some of the project is on private land, partial funding may be available on cooperative restoration projects.

*Refuges and Wildlife*

All the National Wildlife Refuges of western Washington are administered through the Nisqually Wildlife Refuge Complex near Olympia. The only refuge within the Basin is the Grays Harbor Refuge, located in Bowerman Basin just west of Hoquiam. The Refuge was recently established to protect large, seasonal concentrations of migratory shorebirds. Acquisition of further land is conditioned upon absence of significant contamination, particularly dioxins and furans concentrated in intertidal crustaceans that form the bulk of shorebird prey.

**Seattle National Fishery Research Center**

The Seattle National Fishery Research Center provides basic research in fish genetics, populations, physiology, and pathology for Service offices and other federal agencies. Center personnel have been involved in Chehalis Basin fisheries issues by studying the role of water pollution in poor survival of Chehalis System coho smolts. This work has been reported in Schroder and Fresh (1992).

## U.S. Department of Agriculture, Forest Service

Although the Forest Service has jurisdiction over only a small portion of Chehalis Basin forest lands, it has an aggressive program of fish habitat management and recreational fishery development. Within the Chehalis Basin, the Olympic National Forest is divided into two Ranger Districts. The upper Humptulips watershed is in the Quinault Ranger District while the upper Satsop and Wynoochee watersheds are in the Hood Canal District. The Forest Service is responsible for integrated management in these areas. Management means designing timber harvest to minimize ecosystem damage, mitigating for unavoidable damage, and restoring the effects of past degradation. In working toward these goals, the Forest Service has recently begun to assess resource conditions throughout rivers originating on National Forest land, even if the greater portion of a particular stream, and the runs of anadromous fish it supports, lies outside Forest boundaries.

## U.S. Department of Agriculture, Soil Conservation Service and Related Agencies

The Soil Conservation Service is responsible for improving agricultural practices through technical support. Local offices assist Conservation Districts in practically every county of each state. Local offices of the Agricultural Stabilization and Conservation Service administer financial support to farmers.

The Conservation Districts can support individual farmers in riparian habitat restoration including stream fencing and revegetation programs, improved grazing practices, agricultural waste management, and improved irrigation practices. Recently, the Conservation Districts have become active in public outreach and planning to improve water quality and urban runoff management. (Individual Districts are described under local governments.)

## U.S. Environmental Protection Agency

EPA's Region Ten headquarters is in Seattle. EPA contributes to habitat protection and improvement through its regulatory functions, grants to state (WDOE) and local groups, and design of citizen monitoring programs.

### Regulatory Functions

EPA is directly responsible for NPDES permits on federal lands and Indian reservations; EPA delegates this authority to WDOE on state and private lands (Bev Poston, EPA, pers. comm.). EPA supports WDOE in routine testing of pulp mill waste and provided extra technical and financial assistance during the 1987-1990 smolt survival study as reported by Schroder and Fresh (1992).

In addition, the agency has recently been assigned the task of coastal zone management planning nationwide (EPA 1991). This mandates states to require very specific pollution control measures in whatever coastal areas they

identify as needing help. Each state must provide for the implementation of measures in conformity with detailed guidance related to agricultural, urban, and forestry runoff, marinas, dams, levees, and shoreline erosion.

### Streamwalk Program

EPA is now designing a database and data retrieval system to support citizen monitoring of the aquatic and riparian environment throughout the Pacific states. It is developing a list of variables, a field protocol, a monitoring plan describing frequencies and locations, and instructions on recording, managing and retrieving data. The agency is designing a regional GIS database to which physical and chemical data can be attached. The database will be compatible with technical criteria set forth by the Adopt-a-Stream Foundation, although EPA will require fewer variables to be measured than the Foundation.

## U.S. Department of Commerce, National Marine Fisheries Service

NMFS's Regional Office and Northwest Fisheries Science Center are located in Seattle. There is also a research station in Manchester, Washington. The agency performed a key part of the research in the smolt survival study using its marine netpens (Schroder and Fresh 1992). NMFS also regulates domestic fisheries in the 3-to-200-mile U.S. fishing zone through the PFMC.

## U.S. Department of Defense, Army Corps of Engineers

The USACE civil works mission is primarily navigation and flood control but also development of water supply. Water resource development activities assigned to the Corps in the Chehalis Area are administered by the Seattle District. These projects and the procedures leading up to them are described in a recent review (USACE 1991). The USACE is also responsible for protecting wetlands under Section 10 of the Rivers and Harbors of 1899 and Section 404 of the Clean Water Act.

### Navigation

Grays Harbor navigational channel dredging for widening and deepening is nearing completion; all dredging is complete, but a railroad bridge still needs to be widened. Fish and crab mitigation is in place and under evaluation. Maintenance dredging will be ongoing.

### Flood Control and Floodplain Management

A 4.2-mile levee is planned for Cosmopolis to Aberdeen, with mitigation by installation of one floodgate and upgrading four existing floodgates for fish passage into south bank streams, and wetland creation to replace levee fill.

USACE is presently planning a floodgate and pumping station on Salzer Creek

(USACE 1990b); the plan is complete but project is on hold because of lack of matching local funds.
Skookumchuck flood control projects being considered are

(1) dam modification for added flood control -- City of Centralia cannot afford to sponsor it but is looking for way to raise funds; and

(2) Lower Skookumchuck levee construction -- City will not consider this unless comparative cost of dam modification is greater.

**Water Supply**

USACE constructed Wynoochee Dam in 1972 for flood control, water supply, recreation, and fish habitat improvement (Findlay 1967). Current issues include:

(1) ongoing fish mitigation dispute (Mike Scuderi, USACE, pers. comm.);
(2) potential title transfer to Aberdeen which would allow development;
(3) rule curve change which might improve smolt migration through dam (Scuderi, USACE, pers. comm.).

## STATE OF WASHINGTON

### Washington Department of Fisheries

WDF preserves, protects, perpetuates, and manages the food fish resources of the State of Washington (WDF 1990). The agency is charged with balancing the needs of all user groups for the overall benefit Washington citizens. The Director is appointed by the Governor. The Department consists of several divisions having distinct functions. The agency is funded by direct appropriation from the general fund of Washington state.

**Harvest Management**

Harvest Management contributes to decisions for Washington-based commercial and sport fisheries in cooperation with Indian Tribes, PFMC, and PSC. WDF also produces annual sport fishing regulations for salmon, sturgeon, and shad and pre- and post-season stock assessment reports for salmon.

Most WDF harvest management activities for the Chehalis Basin are conducted at the Coastal Lab in Montesano. They cooperatively manage terminal salmon harvest and balance terminal fishing opportunity to allow equal catch by Indian and non-Indian fisheries. They also attempt to balance the needs of commercial and sport non-Indian fisheries. Coastal Lab personnel also conduct routine spawning ground surveys, ensure that non-Indian commercial catch is properly recorded and reported, participate in planning forums, and, along with the Salmon Culture Division, help develop and manage cooperative rearing projects.

For management of coho and chinook, State and Tribal co-managers divides the Basin into two river systems, the Humptulips and the Chehalis, but manages chum in the Basin as a single entity because of the difficulty of assigning chum catch and escapement to a particular river system.

## Habitat Management

WDF divides the Basin into four habitat management regions, each with its own Habitat Manager, whose primary duty is to inspect projects for which Washington State Hydraulic Permits are required, and ensure that fish habitat is not compromised. Habitat managers may also represent the agency in watershed planning forums and local habitat improvement projects.

## Salmon Culture

The Salmon Culture Division in Olympia coordinates WDF hatchery programs statewide, and determines the number of fish reared annually and site of release. The Division also provides eggs and fry to cooperative rearing projects. WDF Chehalis Basin hatchery facilities are the Simpson Hatchery on the East Fork Satsop and the Humptulips Hatchery. WDF also shares in certain operations of the Mayr Brothers Hatchery on the Wishkah. In addition, WDF owns and manages rearing ponds at the Skookumchuck Dam.

## Research and Planning

The Research and Planning Division monitors salmon smolt production from several tributaries of the Basin, and counts all upstream and downstream migrants on Bingham Creek. The Division also coordinated the 1987-1990 smolt survival study (Schroder and Fresh 1992). This division is also responsible for completing three planning processes. In 1985, WDF began developing CRPMP process to guide fishery restoration and land use in Washington watersheds (Anonymous 1986). These Plans formalize agreement among all fishery restoration and management agencies and tribes. They state management goals and criteria and list the principal habitat problems.

The second is the Sport Fishery Enhancement Plan (WDF 1989a), a statewide effort to maximize sport fishing opportunities and thus increase economic contribution to Washington. For the Chehalis Basin, the Plan recommends that Humptulips fall chinook production increase from 500,000 smolts to 1 million.

The third is the recent Salmon 2000 Report (Appleby *et al.* 1992) which calls for integrated planning of enhancement projects, a recognition of the importance of wild stocks, and management of fish culture with ecological and genetic criteria.

## Washington Department of Wildlife

WDW preserves, protects, and perpetuates Washington's wildlife resource, while providing maximum recreational opportunity (WDW 1991b). WDW manages Washington's game and sport fish (including steelhead and trout). The agency is responsible to the Washington Wildlife Commission, which represents citizens with an interest in sport fishing and wildlife in various regions of the State. The Director is appointed by the Governor.

### Fisheries Management Division

The Division produces annual pre-season sport fishing regulations for winter and summer run steelhead trout, sea-run cutthroat trout, and resident game fish. Winter steelhead terminal commercial harvest is managed jointly with the Quinault Nation to allow equal catch by Indian and non-Indian fisheries.

WDW conducts routine steelhead spawning ground surveys, sees that commercial catch of this species is properly recorded and reported, participates in planning forums, and develops and manages cooperative rearing projects. WDW divides the Basin into two river systems, the Humptulips and Chehalis, for estimating commercial catch and hatchery escapement, but divides the Basin into 15 separate river systems in estimating sport catch and wild escapement.

### Steelhead Culture

WDW's only hatchery in the Basin is at Lake Aberdeen. WDW also shares in the cost of steelhead production at the Mayr Brothers Hatchery on the Wishkah and at the WDF Humptulips Hatchery. In addition, PP&L, in coordination with WDW, operates an adult steelhead trap at the Skookumchuck Dam. Progeny are reared to smolts in a rearing pond at the base of the dam and released volitionally each spring. WDW also supports a number of cooperative rearing projects.

## Washington Department of Ecology

WDOE is responsible for water resource development and water quality management as well as other environmental programs throughout the State of Washington. Its Director is appointed by the Governor but receives advice and guidance from the Ecological Commission. The agency is funded by direct appropriation from the state's general fund as well as numerous dedicated sources and federal grants.

WDOE is divided into Offices, Programs, and Sections on the state level, with many parallel sections at the regional level. Five parts of the agency deal in some way with fish habitat in the Chehalis Basin which is in WDOE's Southwest Region.

## Office of Central Programs and Enforcement

*Central Programs*

Central Programs cover four areas:

(1) environmental review and sediment management, which reviews EISs, and projects dealing with disposal of dredged material (the Water Quality Program also participates in this activity);
(2) enforcement support functions with the Shorelands and Water Quality Programs and the Southwest Region, as well as other programs;
(3) spill management investigated the 1989 Black River fish kill and oil and other spills; and
(4) regulation of major industrial sources such as pulp mills. In Grays Harbor, this Section routinely monitors chemical content and biological effects of pulp mill effluent as called for in National Pollution Discharge Elimination System permits. The Water Quality Program is an active participant in this effort.

*Environmental Investigations and Laboratory Services Program:*

This Program is responsible for water quality monitoring. It conducts ambient monitoring for surface and ground water as well as special investigations such as toxic discharges. This program performed much of the bioassay and chemical analysis in the Grays Harbor smolt survival study (Schroder and Fresh 1992).

This office supports the TMDL study and modelling of biological oxygen demand and coliform bacteria (WDOE 1990).

## Office of Water and Shorelands

*Shorelands and Coastal Zone Management Program*

This Program provides advice on hydrology and water resources for flood control, and acts as a liaison with the Adopt-a-Stream Foundation. The Program also administers the Shoreland Management Act, local government master programs, and Coastal Zone Management grants. They also implement wetlands and shellfish programs.

*Water Resources Program*

The purposes of this Program are:

(1) regulate and maintain official records of surface and ground water rights and claims;
(2) review Federal Energy Regulatory Commission licenses for hydroelectric power;
(3) assists in biological investigations and establish and regulates instream flow requirements of various streams for fish species; and
(4) adjudicate water rights claims.

*Water Quality Program*

This program establishes water quality programs for point and nonpoint sources and adopts and administers surface and ground water standards by:

(1) maintaining liaison with the SCS;
(2) developing stormwater management programs and guidelines; and
(3) overseeing nonpoint watershed planning, particularly in Puget Sound;
(4) developing agricultural policy and writes discharge permits, working with Central Programs, the Southwest Region;
(5) promulgating forest practices rules with the Forest practice Board and evaluating the effect of forest practices on water quality, working through the Timber, Fish, and Wildlife Process;
(6) developing aquaculture policy and fish farm waste discharge permits, working with Central Programs and the Southwest Region; and
(7) setting effluent limits and writing permits for wastewater treatment plants and other industrial activities.

*Water Quality Financial Assistance Program*

This program administers funds under Washington's Centennial Clean Water Fund. The program supports the Chehalis River Council and the Grays Harbor Regional Planning Commission in producing water quality improvement plans, and is the most commonly-sought funding source for the Conservation Districts' habitat restoration projects. The program also administers state and federal grants for local government water quality programs. This includes grants to GHRPC, CBFTF, and local conservation districts.

**Southwest Regional Office**

The Southwest Regional Office covers the Olympic Peninsula and southwest Washington. The Region participates along with the Central Office in the Spill Response Team. It also includes two Sections that implement programs of Water Resources and Water Quality programs. Responsibilities for the TMDL and WLA processes are coordinated through this office. The regional office conducts inspections of facilities, investigates general complaints, and initiates enforcement actions for water quality violations. NPDES and State Waste discharge permits are written and administered in the regional office.

**Washington Department of Natural Resources**

WDNR manages the State's public timber and mining resources and its subtidal shellfish beds. It implements the Forest Practices Act, manages the Aquatic Lands Program, and conducts research in fish habitat restoration.

## Forest Practices Board

The Forest Practices Board was formed under The Forest Practices Act of 1974 to regulate forest practices on private and state land. The Board has representatives from the Washington Departments of Natural Resources, Agriculture, Trade and Commerce, and Ecology, timber interests, the Tribes, and the counties.

The Board's rules are adopted following the Washington Administrative Procedures Act, which requires public notice and a hearing (Dan Bigger, WDNR, pers. comm.). At the same time, an EIS procedure begins as specified in SEPA and culminates in a 30-day review period, after which the new regulations go into effect (Bigger, WDNR, pers. comm.). The approved rules become a part of the Washington Administrative Code Title 222; and are published, along with explanatory text, in the Forest Practice Rules and Regulations (Washington Forest Practices Board 1988), for use by timber operators.

## Timber, Fish, and Wildlife Process

WDNR, working with other state agencies, the Northwest Renewable Resources Center, and various Indian tribes, developed a revolutionary process in 1986 to facilitate regulation of logging practices on state and private timberlands under jurisdiction of the Forest Practices Act. Under this agreement, a number of government agencies, tribes, and associations suddenly became reviewers of timber practices. TFW participants address the issues of streamside buffer zones, accelerated erosion and slope failure from road construction, the value of instream woody debris, and other technical habitat questions. The current trend is toward intensive research to adapt general rules to individual timber sales, and thus to balance profit with environmental safety for fish and wildlife.

The principal product of TFW negotiations in the mid-1980s was the 1988 revision (Washington Forest Practices Board 1988) of the Forest Practice Rules and Regulations giving fishery and environmental agencies an avenue for commenting on proposed timber sales and helping design activities to reduce risk to fish. However, several controversies demanded rule revision. (1) Optimum fish habitat protection required exhaustive negotiation between timber operators and state habitat biologists (Randy Carman, WDF, pers. comm.). (2) FEMA considered State timber practices to be causing an unacceptable increase in flood insurance claims (Bigger, WDNR, pers. comm.). (3) A Snohomish County court ruled against the Forest Practices Board for failing to consider cumulative impacts (Bauersfield, WDF, pers. comm.).

## Aquatic Lands Program

This is a grant program for local entities to improve the quality of state lands for fish and wildlife and public access.

**Stewardship Incentive Program**

The recently created Stewardship Incentive Program offers cost-sharing to private landowners in fish and wildlife habitat restoration. This program serves agriculture as well as timber lands, and is coordinated with local Conservation Districts.

**Fish Habitat Research**

WDNR is authorized to conduct research on cost-effective means to quickly restore the fish-rearing capacity of lands where logging has occurred. In the Chehalis Basin, the agency has installed many instream habitat enhancement features in Porter Creek and is evaluating their success.

## INDIAN TRIBES

### Quinault Indian Nation

The Quinault Indian Nation is a recognized successor-in-interest to the tribes and bands which were party to the Treaty with the Quinault, 12 Stat. 971. The decision in United States v. Washington, which was affirmed by the United States Supreme Court, authoritatively holds the Treaty with the Quinault and other Stevens Treaties secure to the tribal treaty signatories a right to harvest on a river-by-river, run-by-run basis one-half of the harvestable salmon and steelhead passing through usual and accustomed tribal fishing grounds and stations.

The Quinault Nation's presently adjudicated usual and accustomed fishing grounds and stations include the Queets, Raft, Quinault, Moclips, and Copalis Rivers, the Grays Harbor watershed, including the lower portions of the Chehalis River basin, and the adjacent waters of the Pacific Ocean. Quinault fisheries inside the Grays Harbor watershed presently operate primarily in the Humptulips River, North Bay, the inner Harbor, and the mainstem of the Chehalis River from the Harbor to the vicinity of Montesano.

The Quinault Nation is the only tribe fishing within the United States v. Washington Case Area that has been adjudicated by the federal district court to possess complete self-regulatory status. As the result of this status, tribal members exercising Quinault treaty rights are not subject to state regulation and are regulated exclusively by the Quinault Indian Nation. The Nation's self-regulating status also exempts the Quinault Nation from state permit requirements for fishery research and enhancement activities. Although the Nation and its members are exempt from state fishery regulation, the Nation's Fisheries Division routinely consults with the WDF and WDW with respect to its salmon and steelhead management, research and enhancement activities.

The Nation's fisheries management goals are:

1. Protect and enhance the Quinault Indian Nation fisheries resources.

2. Protect and enhance the self-regulatory capabilities of the Quinault Indian Nation.

3. Protect and enhance the fisheries of the Quinault Indian Nation.

Several fisheries operate within the Nation's usual and accustomed fishing area. River fisheries are managed cooperatively between the State of Washington and the Nation. Marine fisheries are negotiated with the Pacific Fisheries Management Council, the International Halibut Commission and the Pacific Salmon Commission. Management authority rests with the Fisheries Manager, the Quinault Fish and Game Commission and three fish committees, one each for the Queets River, the Quinault River and Grays Harbor (off-reservation). Technical expertise is provided to the management authorities by the staff of the Quinault Fisheries Division, part of the Nation's Department of Natural Resources.

The Fisheries Division is comprised of 25 full-time and up to 20 seasonal staff. The division is divided into three sections; harvest management, technical services, and resource enhancement. Harvest management staff are responsible for analyzing catch and tag data, modeling runs, determining harvest options, and reporting to regional data management centers. Technical services activities include catch monitoring, bio-sampling, spawning escapement estimation, juvenile assessment, tagging projects and wild stock supplementation efforts. Resource enhancement covers a wide range of fish culture work including broodstock capture, spawning, incubation, rearing, tagging, feeding, and caring for cultured fish.

**Chehalis Indian Tribe**

The Chehalis Tribe's goal is to promote the economic welfare of its individual members and the Tribe as a whole through tribal commercial fishing and other tribal businesses (Gene Deschamps, Chehalis Tribe, pers. comm.). Since the formation of the Reservation, Federal law has recognized the Chehalis Tribal right to fish on the Reservation. However, the Tribe has claimed it should be allowed to fish the Chehalis River off-reservation. This was denied in a recent court decision, which the Tribe appealed to the Ninth Circuit Court. Until resolved, the Tribe confines its fishing to the Reservation. A decision favoring the Tribe would lead to a guaranteed harvest share and expand the Tribe's fishing area.

The number of harvestable fish available to the Tribe presently depends largely on negotiations between the State and the Quinault Nation. Chehalis tribal fisheries are managed under pre-season catch quotas annually set by written agreements between WDF, WDW, and the Quinault Nation, based on modeling of predicted run sizes.

The Tribe has not been able to harvest many hatchery fish in the Chehalis

Basin because the reservation is upriver of major existing hatcheries. To address this, the Tribe is proposing a major hatchery at Cedar Creek, which enters the Chehalis just downstream of the Reservation. A feasibility study has been prepared (Jones *et al.* 1987) and the Tribe anticipates publishing an EIS shortly.

## LOCAL GOVERNMENTS

### Counties

The Chehalis Basin includes most of Grays Harbor, a large part of Lewis, smaller parts of Mason, Thurston, and Pacific, and very small parts of Wahkiakum and Pacific counties. Grays Harbor and Thurston counties have been most active in aquatic habitat protection. Grays Harbor County Regional Planning Commission has attempted to review the county Shoreline Management Plan to make sure fish habitat and water quality are considered. Thurston County Health Department has been active in monitoring and protecting water quality, particularly in the Black River system (Blocher 1991).

#### Grays Harbor Regional Planning Commission

The GHRPC was created under the Area Redevelopment Act, PL-8716, primarily for furthering local economic development (Bill Banks, City of Hoquiam, pers. comm.). Membership in GHRPC includes nine cities in Grays Harbor County, the County itself, the Grays Harbor Public Utility District, Port of Grays Harbor, the Grays Harbor Transit District, two local school districts, and the Grays Harbor Parks and Recreation District. GHRPC has no regulatory authority of its own but helps the County and cities develop their respective zoning ordinances.

This group recognizes the potential value of improved fish runs for economic recovery, and works under the assumption that fishery restoration is compatible with the present practices of Grays Harbor industries. They have advocated the priority of (1) extensive fish habitat restoration in the middle and upper Basin and (2) comprehensive public education. They have called for a large volunteer program to achieve these objectives.

### Cities

All cities in the Chehalis Basin are responsible for managing their wastewater, whether from storm runoff or from municipal sewage, to maintain adequate water quality. Additionally, the cities of Centralia, Chehalis, Aberdeen, and Hoquiam withdraw surface water for municipal needs. They are legally responsible for withdrawing no more than their water rights specify. Centralia and Chehalis have the option of drawing from either surface or groundwater or a combination of the two. While they have no statutory responsibility to choose the source based on the least ecological effect, they have the option of managing for this purpose.

### Port of Grays Harbor

The Port exists to promote trade and commerce within Grays Harbor County (GHRPC 1992). The Port manages all shipping traffic in the Harbor and co-sponsored the recent widening and deepening of the navigation channel. The Port is interested in increasing tourism though enhanced fishing opportunities so manages coho netpens at Aberdeen, Westport, and Ocean Shores.

## PRIVATE FISHERY CONSERVATION AND MANAGEMENT ACTIVITIES

### Chehalis Basin Fishery Task Force

The CBFTF, formerly the Grays Harbor Fishery Enhancement Task Force, is a non-profit, non-partisan group of fishery, business, and community leaders allied to enhance salmon, steelhead, and sea-run cutthroat trout resources, and to restore habitat critical to these species, in the Chehalis River Basin (CBFTF 1991). It sees its role as identifying fishery enhancement and habitat restoration projects, soliciting grants and donations, matching projects with appropriate funding, enlisting community support to maintain projects, and fostering mutual support among fishery user groups. The Task Force is one of 12 regional fishery enhancement groups statewide partially funded under the WDF Regional Salmon Enhancement Program. The Task Force supported 11 fish rearing projects (four major hatchery operations, three smolt rearing stations, and four fry hatching stations) and one cooperative educational effort in 1992 (CBFTF 1992).

### Long Live the Kings

Long Live the Kings (LLTK) works toward restoring chinook salmon runs on streams with depleted natural production, and specializes in rapidly mobilizing support and resources for new fish culture programs. LLTK sponsors a fall chinook hatchery program on the Wishkah River, in coordination with CBFTF. LLTK is trying to rebuild wild stocks using short-term artificial enhancement of wild brood stocks.

### Black River Watch

This citizen group monitors water quality in the Black River and thus forestall fish kills such as occurred in September of 1989. It is supported and guided largely by the Thurston County Department of Environmental Health, The Chehalis Indian Tribe, and several of the commercial trout farms in the Black River watershed.

### Trout Unlimited

Trout U a nationwide sport fishing group whose Grays Harbor Chapter works with the CBFTF in supporting three major fish rearing projects: fall chinook, coho, and chum salmon at the Satsop Springs ponds on the East Fork Satsop;

sea-run cutthroat trout at the Mitchell Creek Pond on the East Fork Satsop; and winter steelhead at Loomis Ponds on the Humptulips River.

### Weyerhaeuser Corporation

Weyerhaeuser supports fishery projects in the Basin by channeling funds through Long Live the Kings and by supporting a full-time fishery enhancement project coordinator for the CBFTF. The company also supports extensive, long-term research on forestry effects on fisheries.

### Grays Harbor Conservation District

All Conservation Districts, although essentially administered by the SCS, act as private organizations in that they are governed by a local volunteer board. The GHCD is based in Montesano. The District specializes in school programs in ecological awareness and in salmon enhancement (Troy Colley, GHCD, pers. comm.). They also provide assistance to farmers in streambank protection and elimination of nonpoint pollution. GHCD proposes to conduct a survey of land use and riparian condition throughout the Basin, including all other counties, to assist in repairing habitat damage associated with agriculture.

### Lewis County Conservation District

The LCCD, located in Chehalis, supports fish habitat improvement in three ways. First, it supports administration of the Chehalis River Council, a citizen group working to improve water quality in the upper Chehalis. Second, it has incorporated shrub and tree planting into bank protection measures. Third, LCCD proposed a multi-million-dollar dairy waste digester to reduce dairy waste run-off into streams from the farms along the South Fork Chehalis.

### Thurston Conservation District

TCCD emphasizes habitat restoration projects in cooperation with private landowners. The Long Range Plan of 1992 (Thurston CD 1992) specifies the CD as leading fishery habitat protection in the areas of farm planning, riparian protection, and in providing plants for streambank revegetation.

### Columbia-Pacific Resource Conservation & Development Council

The Council was formed to combine SCS and private industry funds to address certain resource problems facing Grays Harbor, Pacific, and Wahkiakum counties. It is based in Aberdeen. The Council has entered into a contract with the USFS to develop an enhancement plan for spring chinook and steelhead in the Wynoochee (Walls 1991).

### Grays Harbor Poggie Club

This group represents local sport fishers and maintains a coho net pen in Aberdeen. The club works mainly through the CBFTF.

### Grays Harbor Gillnetters

This group represents the non-Indian commercial fleet fishing within Grays Harbor. The Gillnetters operate coho egg box programs on the Hoquiam and Johns rivers under the CBFTF. The resulting fry are released in the two respective sub-basins.

### Washington Trollers Association

This is one of several groups representing the joint interests of trollers based throughout western Washington. The Association also rears Wynoochee native coho on Hillian Creek, a tributary of the Wynoochee. They sponsor a cooperative coho smolt rearing project with the Onalaska School District at Merryman's Pond on the South Fork of the Newaukum.

### Elma Game Club

This group works in the Satsop sub-basin with TU to jointly hatch and rear coho at the Muller Hatchery and to rear sea-run cutthroat trout at the Mitchell Creek Pond. Both are located on the main stem Satsop River.

### Chehalis Basin Technical Advisory Board

Also known as the Lower Chehalis Water Quality Board, this group existed to provide technical advice and review for the GHRPC in preparation of the Lower Chehalis Water quality Study (GHRPC 1992). The Board's job is now complete.

### Chehalis River Council

The mission of the CRC is "to promote conservation and restoration of the Chehalis Basin, with consideration for current and potential uses, through (1) fostering recognition by all land and water users of the direct link between individual actions or inactions and water quality, (2) facilitate citizen empowerment, (3) seek solutions to resource problems, and (4) foster communications among Chehalis Basin interest groups, and work with all interested citizens within the Chehalis Basin" (CRC 1991). As described in the CRC newsletter (Lewis County CD 1990), the primary goal is to develop a plan to identify, correct, and prevent nonpoint source pollution, and thus protect beneficial uses of water. The WDOE provides technical assistance and administers grants from the State Centennial Clean Water Fund to prepare watershed plans. The Upper Chehalis Action Plan will enable the CRC to apply for an implementation grant through the Centennial Clean Water Fund.

The CRC roster includes Trout Unlimited, the Washington Environmental Council, Grays Harbor, Lewis, and Thurston Conservation Districts, the City of Centralia, Lewis County Public Works, the Chehalis Tribe, the Thurston County Office of Water Quality, the Washington State Dairy Federation, and the Weyerhaeuser Company.

**Educational Activities**

Grays Harbor College has a two-year fishery technician program with a demonstration hatchery and habitat improvements on local streams.

The Onalaska Public School District has strongly promoted a fisheries and natural resources curriculum complete with a full-scale coho rearing pond.

The SCS is very active in natural resource education and outreach, especially through the Grays Harbor Conservation District. They have emphasized land management to protect and restore fish habitat, primarily on agricultural lands. The main focus has been farmers and, more recently, school programs.