Lower Columbia River and Columbia River Estuary Subbasin Summary

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Introduction

This summary of information covers two ecological provinces as defined by the Northwest Power Planning Council:

- Lower Columbia River—Bonneville Dam to RM 34 near Skamokawa
- Columbia River Estuary—RM 34 to the ocean including near-coastal waters, as far as the plume extends

The summary includes descriptive information about the mainstem of the Columbia River and the tidally influenced sections of its tributaries. Also included with this summary is information about Youngs Bay.

Basin summary information covering the Cowlitz, Washougal, Willamette and Sandy Rivers are included in separate documents.

General Information

In the Lower Columbia River and Columbia River Estuary provinces, the Columbia River runs a varied course along the 146 river miles from Bonneville Dam (RM 146) to the Pacific Ocean.

The Willamette River, by far, is the largest tributary to the lower Columbia River. Other major tributaries originating in the Cascades include the Sandy River in Oregon and the Washougal, Lewis, Kalama and Cowlitz Rivers in Washington. Major Coast Range tributaries include the Elochoman and Grays Rivers in Washington and the Lewis and Clark, Youngs and Clatskanie Rivers in Oregon. Other numerous minor tributaries drain small watersheds. Many of the Columbia's major tributaries (Willamette, Sandy, Cowlitz, Lewis, Skamokawa, Kalama, Elochoman and Washougal rivers) are covered in more detail in other subbasin summaries. For this reason, this document will mention and reference, but not focus on these.

Flows in the lower Columbia River average 273,000 cubic feet per second (cfs) at the mouth, with a former, unregulated minimum of 79,000 cfs and maximum flood flows of over 1 million cfs. Peak flows occur during winter storm events. Spring freshets, once a major source of flooding, are now controlled by upriver dams and occur for longer periods with a lower peak. Late summer and fall flows are generally higher and slower due to regulation, and river water is a few degrees warmer.

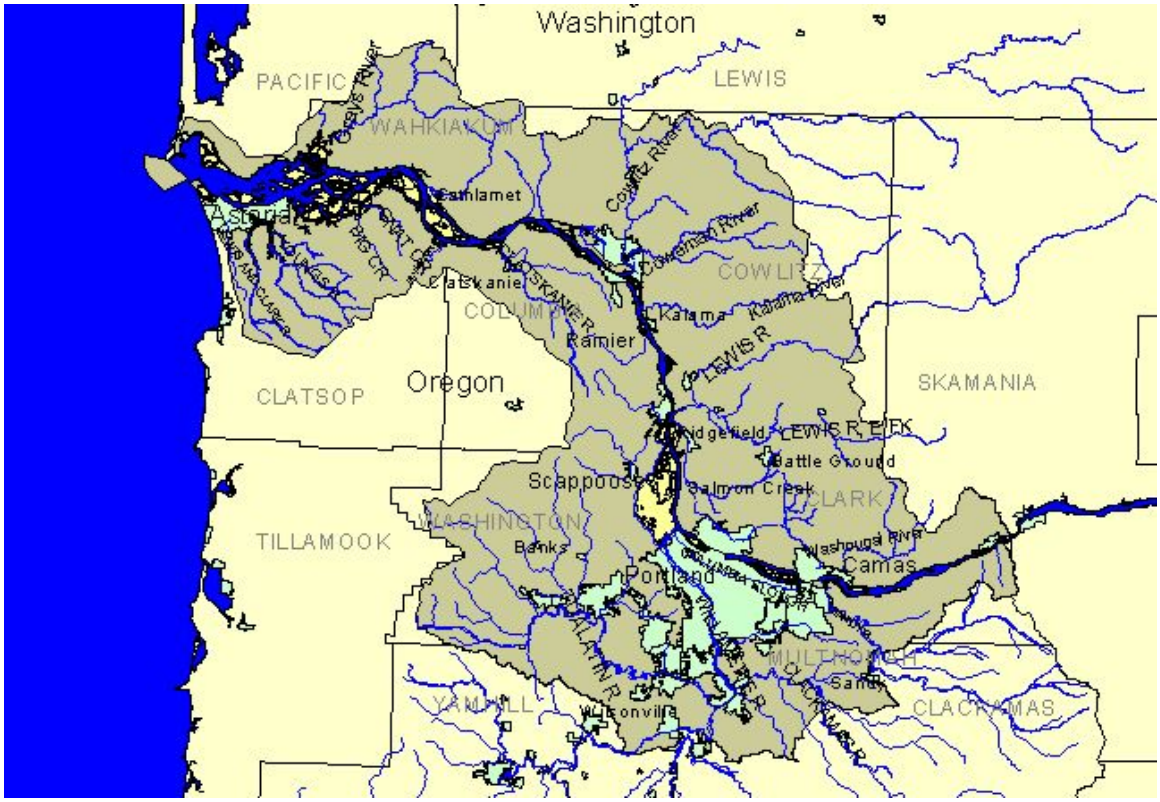

Figure 1. Lower Columbia River & Estuary

Highlights: From Bonneville to the Ocean

The river is relatively narrow at the Bonneville Dam—as little as 0.2 miles wide directly below the dam. It emerges from the steep-walled Columbia Gorge about 20 miles east of Portland. Below Washougal and Troutdale, the river valley widens to include a broad floodplain.

Elongated islands divide the river and form sloughs and side channels in the formerly marshy lowlands. The floodplain expands around the Columbia River's confluence with the Willamette River, where they form the sloughs and lakes of North Portland, Sauvie Island, and the Vancouver lowlands. These regions contain the metropolitan area's last major remnants of the swamp riparian system which were nourished by annual flooding of the free-flowing rivers before dams were constructed.

Downstream from the town of St. Helens, the Columbia cuts through the Coast Range, a passage marked by steep-shouldered bluffs and broad alluvial floodplains. The river channel, dotted with low islands of deposited sediments throughout its lower reaches, opens out as it approaches the Pacific Ocean.

Below Skamokawa, the river channel splits into several broad bays that extend more than 30 miles to the Pacific Ocean.

This area includes the brackish-oligohaline region above the open expanse of the main estuary (upstream from 18.6 to 34.1 miles from the entrance), as well as the broad, euryhaline region in the lower 18.6 miles of the estuary.

This estuary area is a drowned river valley but, unlike most estuaries, it is primarily freshwater in nature due to the tremendous influence of river flows.

Approximately 26,550 hectares (about 71.2%) of the 37,289 hectares of this estuarine region are composed of shallow-water habitats. Except in peripheral bays, where silt and clay sediments dominate, most of the estuary's sediments are composed of sand.

At its mouth below Astoria, Oregon, the river passes between two jetties approximately two miles apart as it enters the Pacific Ocean. This lower "estuarine" area encompasses a complex network of main, distributary and dendritic tidal channels, unvegetated shoals, emergent and forested wetlands, and extensive mudflats in peripheral bays.

Studies in the estuary further partitioned the euryhaline region into seven subareas:

1. Entrance
2. Trestle and Baker Bays
3. Youngs Bay
4. Estuarine channels
5. Mid-estuary shoals of the "estuarine mixing zone"
6. Grays Bay
7. Cathlamet Bay

Drainage Area

The study area (limited to the tidally influenced areas) drains about 4,300 square miles. Adding the tributaries that drain into the study area increases the drainage area more than fourfold—to about 18,000 square miles, or about seven percent of the entire Columbia Basin.

Climate

Between the Columbia River Gorge and the mouth of the Columbia River, rainfall ranges from 40 to 140 inches annually.

The flow of the lower Columbia River is strongly influenced by climatic variations and tides. The tidal influence on water surface elevation is evident all the way to Bonneville Dam. During low-flow periods, tides may cause river flow to reverse up to about RM 80. Tidal salinity extends upstream to approximately RM 23.

Gradual climate warming has contributed to the change in freshet timing. Also, the annual average flow at the mouth has been reduced from about 8,500 m^3s^{-1} to less than 7,000 m^3s^{-1}, with about half of the decrease due to climate change and half to water withdrawal.

The seasonal spring peak flows and summer low flows in this geographic region are, in part, a product of the regional climate. Of the three types of spring freshet, two involve the melting of a large winter snowpack, with or without heavy spring rains. Because accumulation of the snowpack begins six months before the freshet, high flows

related to melting of the winter snowpack can be controlled by drawdown of reservoirs before the freshet and storage during the freshet.

Freshets related to an abnormally wet spring cannot be anticipated in advance, but the gradual warming of the region has made accumulation of a low-elevation spring snowpack less likely. Climate change scenarios suggest that the region will be warmer with wetter winters in coming decades. Under these climate scenarios, winter snowpacks will likely be smaller, decreasing the spring freshet volume. Winter flows will likely increase, with an increase in the number of winter high-flow events related to melting of the interior subbasin snowpack.

The lowest river flows generally occur during September and October, when rainfall and snowmelt runoff are low. The highest flows occur from April to June, resulting from snowmelt runoff from the Cascade and Rocky Mountain ranges to tributaries of the upper Columbia. High flows also occur between November and March, caused by heavy winter precipitation in the tributary basins of the lower river, primarily the Willamette in Oregon and the Cowlitz in Washington. The discharge at the mouth of the river ranges from 100,000 to 500,000 cfs, with an average of about 260,000 cfs.

Although the frequency and magnitude of rainfall-dominated stream peak flows in any part of the Columbia River Basin are a function of the long-term climatic regime of that locale, their effects in stream channels (e.g., sediment loads, and frequency and intensity of channel scouring) vary according to topographic and geologic structure of the watersheds and channel morphology. Soils and topography also determine the inherent ability of a given watershed to provide stable, cool summer flows during the low-flow period.

Topography/geomorphology

The estuary, formed over geologic time by the forces of volcanism, glaciation, hydrology and the erosion and deposition of sediments, now has a surface area of approximately 41,200 hectares (101,750 acres). Circulation of sediments and cycling of nutrients within the estuary are driven by river hydrology and coastal oceanography. Sea levels have risen since the late Pleistocene, resulting in coarse and fine sand deposits in submerged river channels.

Periodic massive disturbances are an integral part of the natural environment that forms the basis for the ecology and evolution of anadromous fish in the Columbia River Basin. Natural events of large magnitude, such as the Mount St. Helens eruption which impacted steelhead runs on the Toutle River in Washington, have often occurred in localized regions.

The estuarine shoreline in both states consists of rocky, forested cliffs and low, wet floodplain areas that have been diked. A number of minor creeks and rivers with small drainage basins enter the estuary from both shores, but, because of their small size, they do not have much influence on the Columbia River. The topography of the riverine portion of the two-province area does not vary significantly. The river's shoreline and adjacent lands have been diked and developed extensively for agricultural and industrial development as well as for commercial and residential uses.

Major Land Uses

The Lower Columbia River and Columbia River Estuary provinces offer a unique profile. A rich variety of sights and uses are encountered along the 146 miles from the Bonneville Dam to the Pacific Ocean.

- Approximately 2.5 million people live in the 18,000 square miles of the lower Columbia River basin. Many more visit for rest, recreation, and business.
- Hundreds of species—175 species of birds alone—use the estuary as permanent or migratory habitat. More than a dozen rare and endangered species depend on the lower river and estuary for survival.
- Six major pulp and paper mills contribute significant dollars and jobs to the regional economy.
- Aluminum plants along the Columbia River produce 43 percent of the nation's aluminum.
- Bonneville Dam generates power for the region and beyond—part of the Columbia River system that constitutes the world's largest hydropower system.
- A portion of the magnificent Columbia River Gorge—a National Scenic Area—lies within the lower Columbia River basin. The waterfall-draped walls of this natural wonder rise 3,000 feet above the river, affording spectacular views for miles.
- Extraordinary recreational opportunities abound, including fishing, boating, swimming and hiking. The Columbia Gorge is considered the windsurfing capital of the world.

While commercial fishing of salmon and steelhead has declined in recent years, it still plays a significant role in the regional economy. Recreational fishing is also an important activity. More than 2,000 people now work directly on restoring the salmon runs, spending $400 million annually. Once the largest in the world, the Columbia River's salmon runs are now decimated.

Five deep-water ports support a shipping industry that moves 30 million tons of foreign trade worth $13 billion each year, according to the Department of Commerce (1998).

This diverse and expansive character makes the lower Columbia River and estuary one of the most significant estuaries in the nation. Few rivers or estuaries command such beauty *and* supply the lifeblood for such a broad region, with widespread effects well beyond its own vast watershed.

The Lower Columbia River and Columbia River Estuary provinces encompass a myriad of land uses, from highly urbanized population centers to National Wildlife Refuges.

The area encompasses multiple population centers and political jurisdictions. It contains 28 cities, including the largest population center in Oregon (Portland) and the fourth largest Washington population center (Vancouver). Nine counties have jurisdiction in the two-province area, and there are 14 port districts, whose jurisdictions overlap with city or county boundaries.

Major industries in the estuarine area include forest products, fishing and tourism. There is a small agricultural industry, limited primarily to commercial cranberry bogs

around Baker Bay and to raising beef and dairy cattle on diked lands (former marsh and swamp lands). Industrial use is more varied along the river, particularly in the urbanized areas around Longview, Kalama, Portland and Vancouver.

The Portland/Vancouver metropolitan area has grown from a population of 100,000 in 1890 to more than 1.9 million in 2000. That figure is estimated to increase by almost 30 percent to nearly 2.2 million by the year 2010. Most of those people live in the two-province area. The population of the entire lower Columbia River basin is approximately 2.5 million.

Washington Counties

Communities along the river in **Pacific County** include the fishing port of Ilwaco and the rural communities of Chinook and Megler. Fishing, timber, agriculture, tourism and home-based industries provide the economic base for Pacific County. Key features of the Pacific shoreline are Cape Disappointment, Baker Bay, Fort Canby, Fort Columbia State Park and the Lewis and Clark Interpretive Center.

In **Wahkiakum County**, Cathlamet is the largest community along the Columbia and is also the county seat. Other smaller communities include Roseburg, Grays River, Puget Island, and Skamokawa. The county's economy is based on natural resources such as timber, fish, and agriculture. In recent years, new development activities have been devoted to tourism and retirement needs. Grays Bay, Puget Island, and the Julia Butler Hansen National Wildlife Refuge dominate the river shoreline. Areas of interest include County Line and Skamokawa Vista Parks. In addition, the entire Skamokawa area is listed on the Washington and National Registers of Historic Places.

The Longview-Kelso urban area occupies the central shoreline of **Cowlitz County**, with a combined population of over 46,000. The characteristic uses of this area are urban, industrial, and commercial shipping. Evidence of the 1980 eruption of Mount St. Helens to the north is found along the banks of the Cowlitz River in the form of large deposits of volcanic residue dredged from the river.

The Vancouver urban area dominates the river's shoreline in **Clark County**, with a population of about 132,000. This area, along with the communities of Camas and Washougal to the east, represent sites of major industrial and commercial shipping activities. The Ridgefield National Wildlife Refuge is located north of Vancouver.

The lower Columbia River area also includes approximately the western third of **Skamania County**, including the rural communities of Skamania and North Bonneville. The river's shoreline is predominantly a forested rural area. Key features include Bonneville Dam and Beacon Rock State Park. The federally designated Columbia River Gorge National Scenic Area covers portions of Skamania and Clark Counties in Washington and Multnomah County in Oregon.

Oregon Counties

The shoreline land use in **Clatsop County** is predominantly rural agricultural, designated primarily as conservation and natural shorelands. The area near Astoria is urban residential and water-dependent industrial. Principal industries in this county include fishing, timber,

agriculture and recreation. Areas of special interest are Fort Stevens State Park, Lewis and Clark National Wildlife Refuge and the Fort Clatsop/Lewis and Clark Expedition Memorial.

Columbia County includes the towns of Clatskanie, Rainier, Columbia City, Scappoose and St. Helens, with forested areas in between. The principal industries in this county are agriculture, timber and fishing. Although industrial development has expanded, dairies and horticulture remain important. A particularly unique and rich fish and wildlife area is located on lower Sauvie Island, where thousands of migrating waterfowl and several endangered species use the island and Sturgeon Lake for feeding and wintering habitat.

Multnomah County includes the cities of Portland, Troutdale, Gresham and Fairview, as well as part of Sauvie Island. Although the county is the smallest in area in Oregon, it is the largest in population, with 642,000 people. Residential, recreational and industrial uses are widespread in the county, along with farming on Sauvie Island. The principal industries include manufacturing, transportation, wholesale and retail trade and tourism. The Port of Portland, the largest port in the area, is of particular economic importance. Areas of special scenic and recreational quality include the Columbia River Gorge National Scenic Area, Multnomah Falls and Rooster Rock State Park.

A very small portion of **Clackamas County** is included in the two-province area near Oregon City and West Linn, which are at the head of tide (the upper reach of the tidally influenced water) on the Willamette River. The northern portion of the county is heavily populated; the southern portion, and the largest land area, is heavily forested and farmed.

Table 1. Cities along the Lower Columbia River Estuary Program Study Area and 1998 population

Oregon		Washington	
Astoria	10,090	Camas	10,300
Clatskanie	1,870	Cathlamet	545
Columbia City	1,635	Ilwaco	876
Fairview	5,910	Kalama	1,555
Gladstone	11,745	Kelso	12,100
Gresham	83,595	Longview	34,060
Lake Oswego	34,280	North Bonneville	532
Milwaukie	20,220	Ridgefield	1,795
Oregon City	22,560	Stevenson	1,212
Portland	509,610	Vancouver	132,000
Rainier	1,800	Washougal	7,685
Scappoose	4,855	Woodland	3,570
St. Helens	9,060		
Troutdale	14,040		
Warrenton	4,175		
West Linn	21,405		

Table 2. Counties along the Lower Columbia River Estuary Program Study Area and 1997 population

Oregon		Washington	
Clackamas	323,600	Clark	328,800
Clatsop	34,700	Cowlitz	93,100
Columbia	42,300	Pacific	21,500
Multnomah	641,900	Skamania	9,900
		Wahkiakum	3,900

Fish and Wildlife Resources and Status

Overview

Hundreds of species—from large mammals like black bear and elk to the smallest aquatic species and amphibians—use the estuary as permanent or migratory habit. This summary describes the tremendous variety of aquatic species, birds, mammals, reptiles and amphibians found in the lower Columbia River and estuary. The health and future of these species depend on the health and future of the river and its tributaries.

Fish and other Aquatic Species

The Columbia River provides essential habitat for a great number of freshwater and marine fish species. The estuary is an important feeding and breeding area for numerous ocean fish and shellfish, including oysters, clams, mussels and the commercially valuable Dungeness crab. Sturgeon is an important commercial and recreational fish, and populations are stable throughout the lower river.

The Columbia River basin has historically produced some of the world's largest runs of chinook salmon and steelhead. Estuarine habitats provide important nursery and rearing areas for young salmon and steelhead, and adults use them as temporary holding areas during their return migration from the ocean to upstream spawning areas. These anadromous fish are present in the river almost year round either as juveniles or adults, although some periods of use are more important than others. As in the estuary, sub-yearling juvenile chum and fall Chinook prefer shallow waters and yearling juvenile coho, spring chinook, and sockeye salmon and steelhead trout appear to prefer deeper waters.

All salmonid species need adequate flow and water quality, spawning riffles and pools, a functional riparian zone, and upland conditions that favor stability, but some of these specific needs vary by species, such as preferred spawning areas and gravel. Although some overlap occurs, different salmon species within a river are often staggered in their use of a particular type of habitat. Some are staggered in time, and others are separated by distance.

The juveniles of spring chinook salmon stocks in the Columbia Basin exhibit some distinct juvenile life history characteristics. Generally, these stocks remain in the basin for a full year. However, some stocks migrate downstream from their natal tributaries in the

fall and early winter into larger rivers, including the Columbia River, where they are believed to over-winter prior to outmigration the next spring as yearling smolts.

Adult summer chinook begin river entry as early as June in the Columbia. Coho begin to leave the river a full year after emerging from their gravel nests with the peak outmigration occurring in early May. Coho use estuaries primarily for interim food while they adjust physiologically to saltwater.

Unfortunately, overall populations of the basin's anadromous fish stocks are estimated at less than 10 percent of their historic size, despite major hatchery programs. Artificial production now accounts for about 75 percent of all fish returning to the Columbia River system. Wild stocks of salmon, steelhead and sea-run cutthroat trout are virtually gone in some areas. The Columbia River basin's historically large chum salmon stocks have declined to less than one percent of their original level.

Most wild chinook stocks are very weak, and natural spawning of native fall chinook stocks is believed to be low or nonexistent in many tributaries. Several Columbia River salmon species are listed as endangered or threatened. In 1998, steelhead were added to the list of threatened species in the lower Columbia River basin making the Portland-Vancouver metropolitan area the first urban area in the United States with an Endangered Species Act listing. In March 1999, Upper Willamette River Chinook Salmon and Upper Willamette River Steelhead were designated as threatened species.

Notably, 12 Evolutionarily Significant Units (ESU) of salmon identified in the 2000 Federal Columbia River Power System Biological Opinion pass through the area and/or spawn. The FCRPS provides geographical boundaries, historical, habitat, hatchery influence, and population trends and risks information in its sections 4.1 and 4.2. The 12 ESU include:

- Snake River Spring/Summer Chinook
- Snake River Fall Chinook Salmon
- Upper Columbia River Spring-run Chinook Salmon
- Upper Willamette River Chinook Salmon
- Lower Columbia River Chinook Salmon
- Snake River Steelhead
- Middle Columbia River Steelhead
- Upper Willamette River Steelhead
- Lower Columbia River Steelhead
- Columbia River Chum Salmon
- Snake River Sockeye Salmon
- Upper Columbia River Steelhead

All listed species of salmon must traverse and utilize estuarine habitat as juveniles and adults. Estuaries are considered important to rearing of juvenile salmon and represent an integral component of the continuum of habitats that salmon occupy for significant periods of time.

All salmon life history types use the lower Columbia River and estuary as a migratory corridor to move between freshwater and marine habitats. Adequate food

resources and free flowing and high quality water are important attributes that are required for recovery of all endangered salmon stocks. However, this region is particularly important to endangered stocks of salmon that exhibit an ocean-type life history pattern. Juvenile salmon that emulate an ocean-type pattern migrate to and rear in the lower river and estuary for extended periods of time (months). Endangered salmon ESUs with this life history pattern include Snake River Fall Chinook Salmon, Upper Willamette River Chinook Salmon, Lower Columbia River Chinook Salmon, and Columbia River Chum Salmon. Important habitat attributes include not only adequate food resources but also shallow water, low velocity habitats that serve as refuge areas for juveniles to rear, avoid predators, and grow.

Table 3. Species of Fish taken in the Columbia River Estuary between February 1980 and July 1981

Pacific lamprey	River lamprey	Spiny dogfish
Big skate	Green sturgeon	White sturgeon
American shad	Pacific herring	Northern anchovy
Chum salmon	Coho salmon	Sockeye salmon
Chinook salmon	Mountain whitefish	Cutthroat trout
Steelhead	Whitebait smelt	Surf smelt
Night smelt	Longfin smelt	Eulachon
Common carp	Peamouth	Northern squawfish
Largescale sucker	Yellow bullhead	Brown bullhead
Pacific hake	Pacific tomcod	Walleye Pollock
Threespine stickleback	Bay pipefish	Pumpkinseed
Warmouth	Bluegill	Largemouth bass
White crappie	Black crappie	Yellow perch
Redtail surfperch	Shiner perch	Striped seaperch
Spotfin surfperch	Walleye surfperch	Silver surfperch
White seaperch	Pile perch	Pacific sandfish
Snake prickleback	Saddleback gunnel	Pacific sand lance
Bay goby	Black rockfish	Kelp greenling
Lingcod	Padded sculpin	Coastrange sculpin
Prickly sculpin	Buffalo sculpin	Red Irish lord
Pacific staghorn sculpin	Cabezon	Warty poacher
Tubenose poacher	Pricklebreast poacher	Slipskin snailfish
Showy snailfish	Ringtail snailfish	Pacific sanddab
Speckled sanddab	Butter sole	English sole
Starry flounder	C-O sole	Sand sole
Larval smelt	Larval flatfish	Other larval fish

Results are from an 18-month survey of fishes in the Columbia River Estuary as part of the *Columbia River Estuary Data Development Program (CREDDP) from 1980-1981.*
Source: Fishes of the Columbia River Estuary, June 1984, Lichatowich, J.; Bottom, D.; Jones, Kim; Herring, Margaret

Birds

More than 175 species of birds use the food and habitat of the lower Columbia River and estuary. Some of the islands in the lower river support large gull and tern nesting colonies, and large great blue heron colonies are found throughout the area. Bald eagle nesting sites are found along the length of the lower river. Peregrine falcons, hawks, eagles, osprey and owls find abundant prey in the area's diverse habitats.

The lower Columbia River is one of the most important areas in the Pacific Flyway for migrating shorebirds, with peak counts in the estuary of almost 150,000 birds and substantial numbers using other areas along the river, up to Sauvie Island and the Willamette Valley. Wintering waterfowl populations in the lower Columbia area reach peaks of more than 200,000 birds. Several wildlife refuges, including Ridgefield National Wildlife Refuge and the State of Oregon's Sauvie Island Wildlife Area, contain agricultural lands that are intensively managed to provide feed and resting areas for wintering waterfowl.

The lower Columbia River also provides important migratory and breeding habitat for a variety of other neo-tropical migrant bird species. One survey of a bottomland forest during peak migration recorded some of the highest concentrations of neo-tropical migrants ever reported.

Several species of birds that depend on the area for habitat are listed as endangered or threatened, including the bald eagle, northern spotted owl, marbled murrelet and brown pelican.

Brown pelicans can be seen along the Oregon Coast from April through October and forage in nearshore waters of the ocean and within the estuary itself. Double-crested cormorants can be found in large nesting colonies on East Sand and Rice Islands. Caspian terns occupy a large breeding colony (about 10,000 pairs) on Rice Island. Gulls also utilize the disposal islands in the estuary as well as Cape Disappointment as nesting sites.

Great blue herons are common estuarine species. Other marsh birds such as the egret are also present in the estuary in small numbers. Great blue heron rookeries can be found in the estuary and at various points along the river. Other water birds present on the river include cormorants, western grebes and loons. Snow geese and tundra swans also use the river and its associated wetland areas during the winter.

Shorebirds are abundant within the estuary and in upriver areas. On a seasonal basis, they can be found in intertidal marsh/mudflats, non-tidal freshwater marshes and flooded agricultural lands along the Columbia River. Western sandpipers, sanderlings, dunlins, least sandpipers, common snipe and red-necked phalaropes are the most abundant species present. Other birds common to wetlands and marshes associated with the river include rails, coots and sandhill cranes. Sandhill cranes use the marshes and wetlands in the upper portion of the river.

Waterfowl are commonly found in the estuary during spring and fall migrations, although some species winter over. Diving ducks and dabblers are found in the lower and upper estuary, respectively. Geese are present throughout the estuary. Swans generally stay

in the middle and upper reaches of the estuary. Baker, Grays and Cathlamet Bays, and Lewis and Clark and Julia Butler Hansen National Wildlife Refuges provide particularly important waterfowl habitat. Geese, cinnamon teal, mallards and wood ducks also nest in the estuary.

Waterfowl species using the mainstem Columbia River include mallard, northern pintail, cinnamon and green-winged teal and Canada goose. Agricultural lands along the river offer substantial foraging habitat for waterfowl. Some nesting by Canada goose, mallard, wood duck, and cinnamon teal does occur along the river but the overall production value of the river is limited. Disposal islands have become important nesting sites for resident Canada geese and mallards. However, the river's primary value to waterfowl is as migratory, foraging or resting habitat.

Raptors present in the estuary include bald eagles, peregrine falcons, hawks, ospreys and owls. These species forage on the bird, fish and/or small mammal resources of the estuary. Common raptor species associated with the river include red-tailed hawk, northern harrier, bald eagle, osprey, great horned owl and western screech owl. Many of the existing disposal areas are utilized by these species as feeding areas. Red-tailed hawks are abundant along the river with substantial nesting and wintering populations making use of island and mainland habitat. Northern harriers are present as residents, migrants, and wintering birds and are associated primarily with grasslands, marshes, and agricultural fields.

Game bird species such as grouse, quail and pheasant are present in the estuary but in small numbers. Upland game birds such as quail and pheasant can also be found within the riverine portion of the two-province area. They are sometimes found in pasturelands, reed canary grass and large willow stands (habitat generally associated with islands in the river) but are usually found in upland vegetation. Band-tailed pigeons and ruffed grouse are found in forested uplands and mourning doves are commonly associated with riparian forest/agricultural lands in the more upriver portions of the area.

Resident and migratory passerine birds are common to the estuary. Some of the more abundant species include blackbirds, song sparrows, Swainson's thrushes and belted kingfishers. Riparian vegetation seems to be their preferred habitat. Upland areas, including vegetated disposal sites, are used by savannah and white-crowned sparrows, horned larks and western meadowlarks. Some of the higher marshes containing bullrushes and/or willows provide nesting habitat for common yellowthroats and song sparrows. Swallows forage over marshes, mudflats and open water.

Passerine birds are also common to the mainstem Columbia River and are present on a seasonal, migratory or residential basis. Song sparrows, tree swallows, American robins, golden-crowned kinglets and western meadowlarks are representative of the species using the Columbia River corridor.

Pelagic birds associated with the offshore habitat of the Columbia River include shearwaters, common murres, gulls and storm-petrels. Phalaropes, fulmars and California gulls are commonly associated with the fall coastal migration, whereas the winter pelagic bird populations include murres, auklets and kittiwakes in addition to the former species.

Mammals

Northern and California sea lions are present offshore and in and around the jetties and lower estuary. The harbor seal is the most common of the pinnipeds. Haul-out areas are located at Desdemona Sands and Taylor Sands and at a few sites in the upper estuary, particularly the Astoria East End Boat Basin. The seals feed primarily on anchovies, eulachon and lamprey. Other marine mammals located offshore include the northern fur seal, northern elephant seal, killer whale, gray whale and harbor porpoise. Elephant seals, harbor porpoises and gray whales are sometimes seen in the estuary.

The Columbia River estuary provides habitat for abundant populations of nutria, beaver, muskrat and raccoon. River otter, once abundant in the estuary, are now limited in number. Sources differ on how frequently mink use the estuary, varying from rarely to occasionally. Small mammals like voles, shrews and moles are common in the estuary and along the river. They are present in upland and marsh habitat and are often found to use disposal sites.

Species that occur occasionally within the estuary include coyote, skunk and opossum. Muskrat and nutria are common to the shoreline and riparian areas of the river. They prefer tidal marshes, Sitka spruce and willow habitat. River otter are present along the river but in limited numbers. Opossums, skunks and raccoons are also present along the river. Several species of bats use the area. There is a minor trapping effort in the estuary for nutria, muskrat, mink and river otter.

Black bear, black-tailed deer, Roosevelt elk and the listed Columbian white-tailed deer are the four large terrestrial mammals associated with the estuary. Deer use the shoreline habitat, with black-tailed deer most common in the lower estuary and Columbian white-tailed deer more prevalent in the upper estuary. Elk generally do not inhabit the developed areas along the river, but they can be found in diked marshes, i.e., the Julia Butler Hansen National Wildlife Refuge, and in coniferous-forested hills adjacent to the river (but out of the two-province area) where they overwinter. Black bear and Roosevelt elk inhabit similar areas. Black-tailed deer, Columbian white-tailed deer, elk and black bear are also present along the river corridor. Except for the Columbian white-tailed deer, these big game animals prefer forested, upland communities, although they can sometimes be found using the river shoreline. Low-lying mainland areas and islands in and along the Columbia River from about Skamakowa, Washington (RM 33) to Port Westward, Oregon (RM 54) are the preferred habitats of the Columbian white-tailed deer.

Reptiles

Northwestern pond turtles, painted turtles, common garter snakes and western fence lizards are representative of the reptiles found throughout the two-province area. These species inhabit a variety of habitat types ranging from ponds, streams, marshes and moist forests to woodlands, meadows and grasslands.

Amphibians

Amphibians in the area, including the red-legged frog, Pacific chorus frog, bullfrog, western toad, long-toed salamander and roughskin newt, live in moist forests or forested wetlands and all require some type of waterbody such as a pond, lake or stream for breeding.

Table 4. Endangered and Threatened Species of the Lower Columbia River

Snake River Sockeye Salmon
Snake River Chinook Salmon
Snake River Steelhead
Snake River Spring/Summer Chinook Salmon
Upper Columbia River Steelhead
Lower Columbia River Steelhead
Oregon Chub
Columbian White-tailed Deer
Oregon Silverspot Butterfly
Bald Eagle
Northern Spotted Owl
Aleutian Canada Goose
Western Snowy Plover
Brown Pelican
Marbled Murrelet
Nelson's Checker-mallow
Water Howelia
Lower Columbia River Chum Salmon
Lower Columbia River Chinook Salmon
Upper Willamette River Steelhead
Middle Columbia River Steelhead
Upper Columbia River Spring Chinook Salmon
Upper Willamette River Chinook Salmon
Columbia River Bull Trout
Potential Threatened and Endangered Species
Columbia River Coho Salmon - candidate
Coastal Cutthroat Trout - proposed threatened

Habitat Areas and Quality

Introduction and Overview

This section summarizes the role of the lower Columbia River and estuary as habitat for a wide variety of plant life, birds, mammals, fish and other aquatic animals.

The Columbia River is a near sea-level corridor cut through the Cascade Range that connects the Columbia Plateau with the Pacific Ocean. Characterized by abrupt topographic changes, this area supports a variety of habitat types.

The Columbia River provides essential habitat for a great number of freshwater and marine fish species. The estuary is an important feeding and breeding area for numerous shellfish, including oysters, clams, mussels, and the commercially valuable Dungeness crab. Sturgeon is an important commercial and recreational fish, and populations are stable throughout the lower river.

Estuarine habitats provide important nursery and rearing areas for young salmon and steelhead, and adults use them as temporary holding areas during their return migration from the ocean to upstream spawning areas. Changes in the environment and the loss or degradation of habitat have contributed to decreased runs of native fish.

Throughout the two provinces, water chemistry, flow and the physical stream components unique to each stream have resulted in a wide variety of distinct salmon stocks for each salmon species throughout Oregon and Washington. Within a given species, stocks are population units that do not extensively interbreed because returning adults rely on a stream's unique chemical and physical characteristics to guide them to their natal grounds to spawn. This maintains the separation of stocks during reproduction, thus preserving the distinctiveness of each stock.

Salmon habitat includes clean, cool, well-oxygenated water flowing at a natural rate for all stages of freshwater life. In addition, salmon survival depends upon specific habitat needs for egg incubation, juvenile rearing, migration of juveniles to saltwater, estuary rearing, ocean rearing, adult migration to spawning areas and spawning. These specific needs can vary by species and even by stock.

The estuary provides an ideal area for rapid growth, and some salmon species are heavily dependent on estuaries, particularly chinook, chum, and to a lesser extent, pink salmon. Estuaries contain new food sources to support the rapid growth of salmon smolts, but adequate natural habitat must exist to support the detritus-based food web, such as eelgrass beds, mudflats and salt marshes. Also, the processes that contribute nutrients and woody debris to these environments must be maintained to provide cover from predators and to sustain the food web. Common disruptions to these habitats include dikes, bulkheads, dredging and filling activities, pollution and alteration of downstream components such as lack of woody debris and sediment transport.

Numerous areas of "special biological significance" are located within the Estuary and lower Columbia River provinces, providing critical natural habitats and playing key

roles in maintaining the delicate balance of the ecosystem; some of these areas are listed in the table below. These special resources have declined over time.

Table 5. Areas of Special Biological Significance in the Lower Columbia River Estuary Program study area

- Pierce Island Natural Area Preserve and a high-quality, black cottonwood-Oregon ash community, both in Skamania County
- Puget Island Natural Area Preserve
- White Island Natural Area Preserve, black cottonwood-willow community, and high-quality surge-plain wetlands in Wahkiakum County
- High-quality wetlands in Pacific County
- Ridgefield National Wildlife Refuge
- Vancouver Lake Lowlands, including Shillapoo Wildlife Recreation Area
- Julia Butler Hansen National Wildlife Refuge, which includes Tenasillahee Island in Oregon and the lower Elochoman River area in Washington
- Tenasillahee Island Research Natural Area; the upstream tip of the island consists of a spruce swamp that is a remnant of a once widespread habitat type in the program study area
- Lewis and Clark National Wildlife Refuge, which includes most of the islands and the open water between RM 18 and 25; managed primarily for waterfowl
- Bald eagle nesting sites in the lower estuary
- Baker Bay, Youngs Bay, Trestle Bay, Grays Bay and Cathlamet Bay are especially productive areas for benthic organisms, anadromous fish and waterfowl
- Clatsop Spit in Fort Stevens State Park is a significant migratory shorebird feeding and nesting area for sanderlings
- Sauvie Island Wildlife Management Area
- Steigerwald Lake Wildlife Refuge
- Franz Lake Wildlife Refuge
- Pierce Ranch Wildlife Refuge
- Other areas of special biological significance include: Bradwood Cliffs, Kerry Island, Big and Little Creek Estuary, Tansy Point, Tongue Point, Cooperage Slough, Russian Point Marsh, East Sand Island, Gnat Creek Marsh, Blind Slough Spruce Swamp, Burnside Marsh, Deer Island, Wallace Island, Prescott and Carr Slough, Wapato Bay, Scappoose Flats, Sandy Island, Burlington Bottom, Smith and Bybee Lakes, Virginia Lake, McGuire Island, Sandy River Delta, Gary, Flat, and Chatham Islands, Horsetail Creek Wetlands and Rooster Rock State Park wetlands

Water quality effects on habitat

Water quality problems are the result of land use practices that affect streams basinwide, flows altered by dams and irrigation withdrawals, and discharge of pollutants from point sources.

According to the Spirit of the Salmon, completed in 1995, (Wy-Kan-Ush-Mi Wa-Kish-Wit Spirit of the Salmon: The Columbia River Anadromous Fish Restoration Plan of the Nez Perce, Umatilla, Warm Springs, and Yakama Tribes), the major water quality issues related to anadromous fish production in the Columbia River basin involve temperature, silt and sediment, dissolved gases and chemical pollution.

In portions of many rivers and streams throughout the Columbia River Estuary Subbasin, water temperatures commonly exceed lethal levels for salmonids during August (Collins 1963; Thompson 1974; Liscom et al. 1985; Vigg and Watkins 1991; Meyer 1989; Karr 1992). Water temperatures now commonly exceed 21^{o}C (70^{o}F) in the mainstem (Collins 1963; Shew et al. 1985; Meyer 1989). These increased water temperatures equal or exceed levels that are lethal for Columbia River basin salmon stocks which migrate during this time (Karr 1992). Duston et al. (1991) noted that increases in water temperature interfere with the ability of juvenile salmon to achieve smoltification. In addition, "ecological death" as a result of loss of equilibrium occurs at even lower temperatures (Coutant 1970). Adult salmon may be further stressed by warmer waters in the reservoirs, and suffer prespawning mortalities (McGie 1992).

Also, during high-flow periods in late spring and early summer, spillage over the dams causes excess entrainment of dissolved gases, particularly nitrogen. The resulting supersaturation is significant enough to threaten the survival of juvenile salmonids and has caused large numbers of mortalities.

Salmon habitat includes the physical, chemical and biological components of the environment that support salmon. Within freshwater and estuarine environments, these components include water quality, water quantity or flows, stream and river physical features, riparian zones, upland terrestrial conditions, and ecosystem interactions as they pertain to habitat. However, these components closely intertwine. Low stream flows can alter water quality by increasing temperatures and decreasing the amount of available dissolved oxygen, while concentrating toxic materials. Water quality can impact stream conditions through heavy sediment loads, which result in a corresponding increase in channel instability and decrease in spawning success. The riparian zone interacts with the stream environment, providing nutrients and a food web base, woody debris for habitat and flow control (stream features), filtering runoff prior to surface water entry (water quality), and providing shade to aid in water temperature control.

Significant Habitat for Columbian White-tailed Deer

Today, there are only two Columbian white-tailed deer (CWTD) populations of any consequence west of the Cascades. One is located along the lower Columbia River. (The other is near Roseburg, OR.). The Columbia River population of CWTD numbers approximately 300-400 animals, most of which occur along the lower river in Oregon and Washington from Wallace Island (RM 50) downstream to Karlson Island (RM 32). Four

major subpopulations of CWTD and one minor one occur within this area, each separated from the next by a main river channel or patches of unfavorable habitat which limit consistent interchange. The largest subpopulation occurs on the Washington mainland near Cathlamet. Establishment of the CWTD National Wildlife Refuge in 1972 secured about 4,800 acres of this prime habitat along the Columbia River. The refuge population on the Washington mainland has been declining since 1977.

History

The varied habitats required by anadromous fish have been altered extensively since European settlement of the region, and attempts to manage these habitats have become increasingly complex. Generally, the impacts of these alterations are experienced in more than one habitat, e.g., altered flow regimes, blocked access, and water quality and quantity. They begin in the tributaries and continue in the mainstem, estuary and potentially the ocean. For example, mainstem dams and their operation have created a series of reservoirs along the mainstem, which led to altered flows, higher temperatures and related changes in habitat conditions in the estuary.

Destruction of habitat required by anadromous species has occurred in a variety of ways throughout the basin. For salmon, human impact in the Columbia River basin is often categorized as the "4 Hs"—those related to the Hydrosystem, Habitat, Hatcheries and Harvest. Because the needs of anadromous organisms encompass habitats in different ecosystems, any break in the habitat chain becomes a problem for these species. Weakening of a given link similarly reduces the ability of these organisms to cope with environmental stress. Among the major impacts addressed for restoration in the Columbia River basin are those involving reductions in available habitat, habitat degradation, water quality impacts, mortalities related to passage and harvest.

Habitat has also been eliminated by excessive water withdrawals for irrigation, which effectively de-waters portions of watersheds. Habitat has also been eliminated by elevated temperatures which have forced fish to rear only in the cooler waters of the upper portion of watersheds.

Where access to tributaries has been blocked or constrained, anadromous fish populations often become fragmented. Fragmentation of these historically interconnected salmon stocks resulted in the development of numerous smaller subpopulations that have an increased risk of becoming extinct. In much of the remaining high-quality habitat, stream systems are often punctuated with segments of poor or unsuitable habitat. This effectively relegates both anadromous and resident native fish to disconnected areas of good habitat. Overall survival is further reduced either by nonexistent or poor-quality overwintering habitat.

Extensive losses of habitat have occurred in the lower Columbia River and Estuary provinces as a result of dredging, filling, diking, and channelization. Estimates from 1870 to 1970 indicate that 20,000 acres of tidal swamps (with woody vegetation; 78% of estuary littoral area), 10,000 acres of tidal marshes (with nonwoody vegetation) and 3,000 acres of tidal flats have been lost. Further, major projects of the U.S. Army Corps of Engineers to aid the annual navigation of more than 2,000 ocean vessels continue to alter the shape of the estuary (Simenstad et al. 1990).

A 1992 "Lower Columbia River Natural Inventory" by the Oregon Natural Heritage Program attempted to identify remnant habitat approximating conditions prior to European settlement along the lower Columbia River floodplain. The watershed analysis area falls within the river segment termed "the overflow plains" (Longview to Skamania). The inventory determined that the primary tree species on the lower Columbia River floodplain are cottonwood, ash and Pacific willow, and Sitka spruce would have been found in the lower river below the analysis area.

The floodplain and lowlands were likely much more heavily forested, with hardwood and perhaps some coniferous riparian species. There were many more lakes, ponds, sloughs, overflow channels, backwaters and wetlands. Openings were likely associated with the wet areas, accreting lands or lands having recently experienced a scouring flood. These openings would have been dynamic in location; they would not have remained stationary in the landscape. Uplands were likely characterized by a coniferous forest. Fish and wildlife were much more abundant and diverse.

Based on the available information, it may not be unreasonable to speculate that the composition of the landscape types at the time of the Lewis and Clark expedition was in the range of (excludes the Columbia River itself):

60 - 70% forest (hardwood, conifer and mixed forest
15 - 25% openings (meadows, accreting lands, recently scoured lands
15 - 25% water and wetlands (lakes, ponds, sloughs, wetlands, streams

Land use management is particularly difficult, because effects and impacts of activities are interrelated, and the results of improving one type of land use practice may be offset or reversed by detrimental changes in others.

Approximately 50% of the current anadromous fish habitat in the Columbia River basin is federally owned. Thus, wilderness and roadless areas on federal lands serve as increasingly important areas, where much of the salmon production in the subbasins co-managed by the tribes is concentrated.

Current land use practices commonly impact all freshwater habitats and have pervasive and widespread impacts on aquatic species (Chamberlin et al. 1991; Hicks et al. 1991; Platts 1991). They may also affect side channels and oxbow lakes, which are often some of the more productive of remaining fish rearing and refuge areas. In some terrain, grazing tends to break down stream banks and create wider and shallower channels. This reduces the area available for rearing, and contributes to faster increases in water temperature during the summer months. In other areas, grazing can lead to entrenchment, where streams form a steep-sided gully, cause increased erosion, and reduce available habitat. In turn, the water table is lowered, and this reduces summer flows and riparian productivity. Problems with decreased water quantity resulting from permitted irrigation withdrawals are further exacerbated by the practice of water spreading.

Geographic description

The lower Columbia River and estuary provide diverse habitat. The following information is divided by geographic areas:

A. Bonneville to Portland/Vancouver (RM 146 to 102)
B. Portland/Vancouver to River Mile 34 (RM 102 to RM 34)
C. RM 34 to the estuary area, mouth, plume and Youngs Bay

A. Bonneville to Portland/Vancouver

Between Bonneville and the Portland/Vancouver metropolitan area, the Columbia winds through the steep walls of the Columbia Gorge before opening up into the floodplains of the Washougal, Sandy and Willamette Rivers.

In the eastern end of the province, ice and snow concentrated along steep slopes and stream channels can also be a highly erosive force. During the winter months, debris slides, torrents or avalanches made up of ice or snow occur in the study area. Their accumulations create jams at channel constrictions, and cause flows to back up. When failures happen, they often lead to extensive and rapid downslope erosion along with denuding of vegetation within riparian areas. This action also results in long-term erosion along side slopes and channels. Surface disturbance from the undercut side slopes along channels is prevalent for years after the passage of debris torrents. Freeze-thaw events in the winter and dry gravel of surface soils in the summer continue to occur until slopes are revegetated.

Vegetation plays a critical role in stabilization of the steep and wet slopes common to the analysis area. Root strength appears to be the major element keeping soil on slopes. Slopes are more prone to failure for a period of 10 to 15 years after removal of vegetation. Slides occur on undisturbed, fully vegetated slopes, but the rate of mass failure and erosion is higher when soil or vegetation disturbance occurs in steep areas. After clearcutting or an intensive burn, the risk of slope failure may be three to ten times greater than on a forested slope that is fully vegetated with understory and overstory canopy.

Dramatic topographic features include the steep Oneonta Canyon and the spectacular basalt cliffs with many waterfalls, including Horsetail and Multnomah Falls.

A western hemlock zone which is characterized by high rainfall and fairly moderate winters largely dominates lower elevations, up to 3,000 feet. Within the steep, rocky faces of the Gorge are found drought-prone habitats that are more suitable for Douglas fir, which in some areas is the primary species. The dominant species changes to pacific silver fir above 3,000 ft, and mountain hemlock becomes more dominant above 4,000 ft. These zones extensively interfinger depending on the soil and topographic aspects of the sites. Interspersed within this predominantly coniferous matrix are many notable habitats: wetlands, riparian areas, cold streams and seeps, wet cliffs and associated spray zones, mountain meadows, ridge balds, talus and/or rocky areas and basalt cliffs. Each of these habitats is associated with a vegetation community; for example, grasses and shrubs such as huckleberry often cover the ridge balds. In contrast, herbaceous plants, many of which are sensitive and rare, often dominate wet cliffs.

The majority of the forest in the watershed is in mid-seral stage with very little early and late seral. Extensive logging and catastrophic fires have eliminated most of the late

seral. Less frequent but more intense fires, such as the Yacoult burn in the 1920s, have replaced more frequent and less intense fires.

Recent logging continues only on the private lands in the western portion of this watershed. Introduction of exotic flora, such as noxious weeds, is steadily becoming more of a serious problem. Most of these weeds respond to and colonize newly disturbed ground, often out-competing and eventually eliminating the native flora. Infestations of exotic flora become established in a variety of ways, including introduction as garden plants, such as purple loosestrife and English ivy, as well as transportation by vehicles and livestock. Grain transported by the railroad occasionally contains knapweed. Consequently, seed dispersal and knapweed infestation occur along the railroad route.

Continued efforts are being made to limit the spread of exotic plants, which has retarded their impacts on the native flora. However, if unattended, the problem could become quite severe, with permanent damage to the native plant community. The overall effects of these changes are mostly unstudied, but some possible outcomes would be loss of sensitive plant habitat, loss of unique plant communities, increased fire danger and unsightly or inhospitable recreation areas. Currently, noxious weeds have gained strongholds throughout the Columbia Gorge. The following are examples of some of the weeds found in the watershed: Canada thistle (*Cirsium arvense)*, bull thistle (*Cirsium vulgare)*, Japanese knotweed *(Polygonum cuspidatum),* St. John's wort (*Hypericum perforatum)*, diffuse knapweed (*Centaurea diffusa)*, spotted knapweed (*Centaurea maculosa)*, tansy ragwort (*Senecio jacobaea)*, Himalayan blackberry (*Rubus bicolor),* Scot's broom (*Fabacae),* exotic geranium and English ivy.

Special Habitats

In the eastern end of the Lower Columbia River province, there are a number of special habitats set within this predominately forested landscape. These habitats, occurring with perhaps greater frequency in the analysis area than is typical of the Cascades in general, include: high basalt cliffs, talus and scree slopes, wet waterfall zones, riparian hardwood communities and some subalpine parkland on high peaks (e.g., Larch Mountain). These special habitats are home to many sensitive species that are directly dependent on one or more of these notable habitats. Some species such as Oregon bolandra (*Bolandra oregana),* Howell's daisy (*Erigeron howelli),* an endemic, and Oregon sullivantia (*Sullivantia oregana),* an endemic, grow only on moist basalt cliffs. Cold water corydalis (*Corydalis aquae-gelidae)* requires cool, flowing water. Long-beard hawkweed (*Hieracium longeberbe)*, an endemic to the Gorge, inhabits open balds on ridge tops, open slide areas and other open habitats. The Larch Mountain salamander (*Plethodon larsellii)* inhabits moist talus slopes. Low elevation pika populations are also found associated with talus slopes. Wahkeena Creek, which emerges from the ground as a large spring, has the Wahkeena Falls flightless stonefly (*Nemoura Wahkeena*) which lives in the cool waters. The rare noble polypore, *Bridgeoporus nobilissimus,* is found associated with the large remnant noble firs at the top of Larch Mountain. Specific acreage for these special habitats is unknown.

Natural Areas

The Oregon Natural Heritage Data Base program and the Nature Conservancy inventoried representative plant communities and botanically significant areas in the CRGNSA. The watershed contains seven of these sites. Most of these sites have been designated SMA Open Space.

Table 6. Name of each botanically significant site, its acreage, ownership and significance

Name	Acres	Ownership	Significance
Rooster Rock	570	State Parks, Private	Wetlands, *Sagittaria* marsh community
Bridal Veil Creek	320	Private	Low elevation riparian forest
Multnomah Basin	5600	US Forest Service	Rare plants, animals, wetlands
Waterfalls State Parks (Lower Latourell, Bridal Veil, Coopey Falls)	80	USFS, State Parks	Waterfall spray zone, rare plants, rare animals
Forest Service Waterfalls (Mist, Wahkeena, Multnomah, Oneonta Gorge, Horsetail Falls)	320	US Forest Service	Waterfall spray zone, rare plants, rare animals
Angels Rest	350	US Forest Service	Dry basalt cliffs, rare plants, rare animals
Horsetail Creek Wetlands	190	US Forest Service	Wetlands

The Oregon Columbia River Tributaries Watershed Analysis provides information on stream reaches including Bridal Veil Creek, Horsetail Creek, Multnomah Creek, Oneonta Creek and Wahkeena Creek.

In the eastern end of the province, limited anadromous fish habitat exists. Streams with waterfalls block anadromous fish migration usually less than one half mile from stream mouths. The anadromous fish habitat in the lower reaches of all the streams has been highly impacted by human activities for many years. Railroads, highways, fish hatcheries, logging and other developments have damaged fish habitat for many years, causing their environment to be in generally poor condition. The current conditions of these streams are established using number of pools per mile, amount of large woody debris per mile and stream gradient.

Table 7. Significant Natural Areas name, acreage, ownership and significance

Name	Acres	Ownership	Significance
Cape Horn	40	US Forest Service	Special plant communities, Peregrine Falcon.
West Fork of Sasquatch Creek	320	Private, DNR	Rare flora, Larch Mt. salamander
Columbia Falls	765	DNR Heritage, USFS	Rare plants, animals, waterfall habitat
Pierce Island	200	TNC	Rare plants, fish and riparian habitats
Table Mt./Greenleaf Basin	2300	DNR, US Forest Service	Rare plants, rare animals, some old growth remnants, and forested wetland.

The Western Washington Columbia River Tributaries Watershed Analysis provides more detailed information on stream reaches including Archer Creek (not yet surveyed), Canyon Creek (not yet surveyed), Cedar Creek (not yet surveyed), Duncan Creek and Greenleaf Creek, Hamilton Creek, Hardy Creek (not yet surveyed), Indian Mary Creek (not yet surveyed), Lawton Creek, Little Creek (not been surveyed) and Woodard Creek.

Although anadromous fish habitat is limited on the Washington side of the river, it is not as limited as on the Oregon side of the Columbia River where waterfalls block anadromous fish migration usually less than one half mile from stream mouths. The lower reaches of all the streams have been highly impacted by human activities for many years. Railroads, highways, logging, and other developments have damaged fish habitat for many years causing their environment to be in generally poor condition. The current condition for anadromous fish is shown below in tables for each stream surveyed in the watershed. The current conditions of these streams is established using number of pools per mile, amount of large woody debris per mile and stream gradient.

Air and Water Quality

In the Columbia River Gorge, seasonal variation occurs in air quality and visibility. Two Interagency Monitoring of Protected Visual Environments (IMPROVE) sites monitor the air quality in the National Scenic Area. Visibility is impaired by pollutants that include vehicle emissions, industrial activities at fixed sites, dust from building and road construction, smoke from burning yard debris and slash fires. The Clean Air Act of 1963 (as amended) directs that all areas of the country be placed into one of three classifications: Class I, Class II or Class III. The CRGNSA is presently designated as a Class II air shed.

The quality of water is important to the human residents and the animal populations, as well as the recreationists who visit the watershed. Dissolved oxygen, water temperature and suspended sediment are the major concerns for healthy fisheries, whereas

water turbidity and the absence or presence of bacteria is of greater significance for the recreationists.

Moving further west, 48 acres of Columbia River wetlands lie about midway between the I-5 and the I-205 bridges crossing the river. A functional wetlands assessment completed in 2000 categorized about 40 acres as riverine flow through, or riverine impounded, and about 7 acres as depressional. Of the 9 functions related to habitat suitability (…for a broad range of animal species, …for invertebrates, …for amphibians, … for anadromous fish, …for resident fish, …for wetlands-associated birds and …mammals, …for native plant richness, and …for primary production and organic export), riverine wetlands scored above 7 (on a 1-10 scale) in 66% of habitat suitability categories. Opportunity to function as prime habitat scored high in general habitat suitability and medium as "habitat suitability for anadromous fish." In addition, over the last 6 years of volunteer wildlife monitoring, over 90 species of birds, mammals, fish and amphibians/reptiles have been identified and submitted to the Washington State Naturemapping database.

B. Portland/Vancouver to RM 34

As the mainstem Columbia River passes the Portland/Vancouver metropolitan area, it turns north taking in the flows of the Willamette River. On the Oregon side, the river passes Sauvie Island. Sauvie Island contains approximately 24,000 acres of land and lakes, and had its origin in alluvial deposits from the Columbia and Willamette rivers as their velocities decreased by changes in direction and by lava extrusions located on the north end. The island is 16 miles long and 4.5 miles at the widest point. The Sauvie Island wildlife area includes 8,053 acres of deeded land and 3,490 acres of land leased from the Division of State Lands for wildlife management purposes. Acquisition has been confined to the northern half of the island with all but 1,000 acres subject to annual flooding during spring and winter freshets. The 1,000 acres of flood protected area are within the Columbia Drainage District, protected by a 24-foot above mean sea level (MSL) levee. A State Legislative Wildlife Refuge exists within private and state ownership and includes approximately 3,500 acres. The island is bounded on the east by the Columbia River; on the south by the Willamette River and on the west by the Multnomah Channel. Across the river on the Washington side, Scappoose Bay provides fish and wildlife habitat.

To the east, the Columbia River opens to accept the flows of Salmon Creek, and the Lewis River and passes the Ridgefield National Wildlife Refuge (NWR) offers a diversity of habitat for migratory birds such as neotropical songbirds, wading birds, shorebirds and waterfowl, as well as indigenous fish and plant species of the lower Columbia River ecosystem. The Ridgefield NWR also contains agricultural lands that are intensively managed to provide feed and resting areas for wintering waterfowl.

At the Kalama River, a shallow bar that inhibits fish passage at low tide extends well into the Columbia (WDF 1951). Tidal influences extend up to approximately Modrow Bridge at Kalama RM 2.8.

Extensive industrial development has occurred within the historic floodplains in the lower two miles of the Kalama, especially to the west of Interstate-5. Most of the lower river has been channelized and diked to facilitate this development. Residential

development has increased along the lower river as well. The construction of Interstate-5 and development near the mouth has reduced already limited floodplain habitat within the lower Kalama River.

C. RM 34 to the estuary area, mouth, plume and Youngs Bay

About 7,000 acres of these wetlands are protected by inclusion in the Lewis and Clark and the Julia Butler Hansen National Wildlife Refuges. In addition to the feeding, spawning, nursery and migratory habitat they provide, these wetlands are critical to flood control and water quality. [Wetland acreage numbers were culled from three sources: the Lower Columbia River Bi-State Program's *The Health of the River 1990-1996 Integrated Technical Report,* the Lower Columbia River Bi-State Program's *Fish and Wildlife Habitat Draft Report,* and the Oregon Wetlands Joint Venture Oregon Wetlands Plan.]

Much of the eastern end of this segment is forested with conifers and hardwoods. Early seral and hardwood vegetation communities are common, with hardwoods especially abundant along the Columbia River. Large hardwood stands in uplands areas were once largely dominated by conifers. Some bare ridges have not reforested since the Yacolt burn. There is essentially no old growth in the watershed and the forested structure lacks complexity (snags, variety of tree sizes, dead and down, etc.).

Estuarine wetlands were once common in the Columbia River estuary, including Youngs Bay, Skipanon River and Nicolai-Wickiup watersheds. Many of these wetlands have been diked, disconnecting them from saltwater influences and changing the structure of the wetlands. All existing estuarine wetlands currently accessible to salmonids need to be protected. Those wetlands disconnected by dikes need to be evaluated for potential restoration. Palustrine wetlands are a dominant feature in the Youngs Bay watershed. Streamside wetlands need to be protected, especially those that are in current salmonid distributions. Streamside wetlands that have been disconnected due to diking need to be evaluated for restoration opportunities. Other wetlands should be protected for their roles in maintaining water quality, flood attenuation and habitat.

Nicolai-Wickiup watershed

In general, data were lacking to evaluate current stream morphology. Most of the reaches that were surveyed by ODFW were above major fish blockages, including the Gnat Creek and Big Creek fish hatcheries. Overall, both Big Creek and Gnat Creek had good habitat conditions with moderate gravel and pool frequency. These areas could provide good spawning grounds for salmonids, especially coho, fall chinook, and winter steelhead. Restoration of habitat should focus in areas of current coho distribution, since coho is currently thought to be a natural run (ODFW 1995).

Streams generally had moderate instream large woody debris (LWD) including key pieces, volume and number of pieces. Much of this is probably a result of moderate riparian recruitment. Areas that lack LWD would benefit from riparian planting and instream LWD placement.

Skipanon River watershed

Overall, data were insufficient to evaluate current fish passage problems in the Skipanon River watershed. Only a small number of culverts have been evaluated. There are 48 stream/road crossings in the Skipanon River watershed. ODFW conducted a survey of

culverts for state and county roads. Of the six culverts surveyed by ODFW, only two did not meet standards, suggesting that they block access to upstream habitat areas.

None of the riparian areas in the Skipanon River watershed demonstrated an adequate potential to contribute LWD to the stream channel. Wetlands are a dominant landscape feature in the Skipanon River watershed. Although wetlands may or may not contribute LWD to the stream channel depending on the wetland type, they do provide several important habitat features such as back channels and cover. Many of these wetlands are diked and disconnected from the stream, limiting access to this habitat. Wetland features in the Skipanon River watershed may have historically been a more important feature than LWD. Stream shading in the Skipanon River watershed was generally low to moderate. Both subwatersheds had large proportions of wetlands in the riparian areas, ranging from 20 to 42 percent. Wetlands can provide shade from vegetation although many of these wetlands are diked and disconnected from the stream. Stream temperatures need to be monitored in these riparian wetlands.

In general, data were lacking to conduct an overall evaluation of the current stream morphology. ODFW has conducted aquatic inventories on the larger river systems in the subbasin. The limitation of this data is that it captures the habitat characteristics at the time of the survey but may not reflect current conditions. Overall, the upper reaches of the rivers had desirable geomorphologic conditions. Gravel beds were generally desirable in these areas. These areas could provide good spawning grounds for salmonids, especially coho, fall chinook and winter steelhead. Streams generally lacked instream LWD including key pieces, volume and number of pieces. Much of this is probably a result of poor riparian recruitment. Streams within current fish distributions would benefit from instream LWD placement. Riparian recruitment was moderate in this watershed.

Estuarine wetlands were once common in the Columbia River estuary. None of the riparian areas in the Skipanon River watershed demonstrated an adequate potential to contribute LWD to the stream channel. Wetlands are a dominant landscape feature in the Skipanon River watershed. Although wetlands may or may not contribute LWD to the stream channel depending on the wetland type, they do provide several important habitat features such as back channels and cover. Many of these wetlands are diked and disconnected from the stream, limiting access to this habitat. Wetland features in the Skipanon River watershed may have historically been a more important feature than LWD.

Watershed Assessment

Introduction

This chapter lists information about recent watershed assessments directly related to the two-province study area. While many studies include assessment information, the documents outlined in this chapter represent broader studies covering many aspects of a geographical area.

In an effort to avoid duplication of materials within this summary, this chapter is brief. Further details related to these and other studies are also included in Section I, Existing and Past Efforts and all of Section II of this document.

For ease of use, assessments are separated geographically into four river stretches: (1) Bonneville to Portland, (2) Portland to Skamokowa River Mile 34, (3) River Mile 34 to Astoria and (4) Mouth, Plume and Youngs Bay.

Overall Study Area

The listings below summarize key assessments (studies underlined) and efforts covering the entire or large parts of the two-province area. It should be noted that details on the Sandy, Willamette and Washougal Rivers are available in a separate subbasin summary.

The Bi-State Water Quality Program, States of Oregon and Washington, 1989

In 1989, the States of Washington and Oregon recognized that more information was needed about the health of the lower Columbia River. While much activity was ongoing in the Columbia basin, the emphasis generally focused above Bonneville Dam. Not much attention had been paid to the lower 146 miles. A nomination to the National Estuary Program was being discussed, but data was lacking to confirm the degradation that would warrant participation in the program. To address that need, the Lower Columbia River Bi-State Water Quality Program (Bi-State Program) was created in 1990 and continued to 1996. Its study area was the lower part of the river from Bonneville Dam to the Pacific Ocean, a stretch of 146 river miles.

The Bi-State Program was a public/private partnership jointly administered by the Washington Department of Ecology and the Oregon Department of Environmental Quality and assisted by a Bi-State Steering Committee. Steering Committee members came from the many groups with an active interest in the health of the river: environmentalists, industry representatives, private citizens, public ports, local governments, fishing interests, Native American tribes, the Northwest Power Planning Council and state and federal agencies dealing with environmental and natural resource issues. The citizens of Oregon and Washington, the Northwest Pulp and Paper Association and the region's public ports financially supported the program. Private contractors and state and federal agencies conducted the studies. During its six-year existence, the Bi-State Program invested over $5 million in its work.

The Bi-State Program assessed the health of the river by looking at how well the "beneficial uses" of the river were being met. Beneficial uses are defined in state laws and regulations and include water supply, agriculture, fish and wildlife, recreation and

commercial uses. The program focused on those beneficial uses that relate to the health of humans, fish and wildlife.

The findings of the Bi-State Program supported nomination of the Lower Columbia River Estuary to the National Estuary Program. The U.S. Environmental Protection Agency announced the Columbia River as one of the waterways accepted into the program in July 1995.

Comprehensive Conservation and Management Plan for the lower Columbia River, Lower Columbia River Estuary Program, 1999

Based on the results of the Bi-State Program (discussed above), the Comprehensive Conservation and Management Plan for the lower Columbia River consists of a series of actions designed to address seven priority issues related to the health of the lower Columbia River. The seven priority issues are:

1. Institutional constraints
2. Public awareness and stewardship
3. Habitat loss and modification
4. Toxic contaminants in sediments and fish tissue
5. Conventional pollutants
6. Impacts of human activities and growth
7. Biological integrity

A key component of the plan is the implementation of a long-term monitoring program. This will generate a new set of data to help fill in existing gaps, address continuing questions, track trends and evaluate the effectiveness of proposed management actions.

A second component is the strategy, which is designed to effectively manage the large volume of existing and new information.

Lower Columbia Fish Recovery Board

Created in 1998, the Lower Columbia Fish Recovery Board is the Washington's pilot project for integrating fish recovery and watershed management. In that capacity, the Board is leading a collaborative recovery planning effort among federal and state agencies, tribes and local governments to restore lower Columbia salmon, steelhead and other threatened fish stocks to healthy and harvestable levels. In formulating recovery strategies, the Board is committed to funding solutions that restore fish and provide for the needs of the region's citizens. The plan will integrate all recovery actions associated with habitat, hydrosystem, hatcheries and harvest. The first draft will be completed by June 2002.

In addition to this work, the Board acts as the lead agency for two multi-WRIA Watershed Planning Units working to develop watershed management plans. The groups represent a broad array of water-use interests, both governmental and non-governmental. Both groups have embarked on a technical assessment of water quality and quantity issues on a subbasin level. The Planning Units will complete the first draft management plans in

early 2003. Together these plans will provide a comprehensive long-range regional program for providing sufficient clean water for people and fish.

Bonneville to Portland

The listings below summarize key assessments (studies underlined) and efforts covering areas between Bonneville and Portland. It should be noted that details on the Sandy, Willamette and Washougal Rivers are available in a separate subbasin summary.

Salmon and Steelhead Limiting Factors Water Resource Inventory Area 28, Washington State Conservation Commission, 2000

WRIA 28 is located in southwest Washington, with boundaries that extend to the western margins of the Wind River to the east, the Columbia River to the south and the East Fork Lewis River to the north. The inventory area includes the southern and eastern portions of Clark County and southwestern Skamania County. For purposes of this report, WRIA 28 was divided into three major subbasins: the Lake River Subbasin, the Washougal River Subbasin and the Bonneville Tributaries Subbasin. These drainages cover approximately 316,365 acres or 494 square miles and enter the Columbia River between river mile (RM) 87.6, at Lake River, and RM 142.3 near Bonneville Dam.

Oregon Columbia Tributaries West: Watershed Analysis, Columbia River Gorge National Scenic Area 2001 (OCTW)

This study is a compilation of prevailing knowledge of the area by various resource specialists. They provide descriptive data about past and present physiological, ecological and cultural conditions. Recommendations drawn from a synthesis of this information provides management guidance for the federal lands located in the watershed. The study provides analysis and recommendations for desired future conditions.

Western Washington Columbia River Tributaries Watershed Analysis USDA Forest Service Columbia River Gorge National Scenic Area 2001

This analysis, completed in 2001 by the USDA Forest Service, describes the land uses and management within the Columbia River Gorge National Scenic Area. The Management Plan (CRGNSA) provides a Recreation Intensity Class (RIC) overlay to the underlying land use designations for maximum habitat protection. It explains that in the Columbia River watershed, the Northwest Forest Plan (NFP) applies to the National Forest lands in the CRGNSA and Gifford Pinchot National Forest (GPNF). The NFP describes Land Allocations meant to protect habitat areas.

Land use direction for the Columbia River comes from three management plans: the Columbia River Gorge National Scenic Area Management Plan, the Gifford Pinchot National Forest Land and the Resource Management Plan. The most protective guidelines in the watershed give precedence to fish and wildlife protection.

Portland to Skamokowa River Mile 34

The listings below summarize key assessments (studies underlined) and efforts covering areas between Bonneville and Portland. It should be noted that details on the Sandy and Willamette Rivers are available in a separate subbasin summary.

Salmon and Steelhead Limiting Factors Water Resource Inventory Area 25 and 24

Water Resource Inventory Area (WRIA) 25 is located in southwest Washington. The area encompasses 322,582 acres including all of Wahkiakum and portions of Cowlitz, Pacific,

and Lewis counties. Located along the Lower Columbia River, the majority of this watershed is in the Coast Range eco-region. All of the drainage's within the WRIA are tributaries to the Columbia River. Although located in WRIA 24, the Chinook River is the western most tributary to enter the Columbia River in Southwest Washington and has been included in this report.

Salmon and Steelhead Limiting Factors Water Resource Inventory Area 26

WRIA 26 is located in southwest Washington within portions of Lewis, Cowlitz, Skamania, Pierce and Yakima Counties, and it includes the Cowlitz River systems and its major tributaries: the Coweeman, Toutle, Tilton and Cispus Rivers. The Cowlitz River enters the Columbia River at RM 68.

Salmon and Steelhead Limiting Factors Water Resource Inventory Area 27

WRIA 27 is located in southwest Washington within portions of Skamania, Clark and Cowlitz Counties, and it includes three major watersheds: the Kalama River, the Lewis River (North Fork) and the East Fork Lewis River. All river systems within WRIA 27 drain to the Columbia River. Six stocks of anadromous salmon and steelhead return to these rivers. For purposes of this analysis, the WRIA was separated into four subbasins: lower and upper Lewis River (below and above the dams), East Fork Lewis and Kalama.

River Mile 34 to Astoria

Lower Columbia-Clatskanie Watershed Assessment

Portland State University prepared the Lower Columbia-Clatskanie Watershed Assessment for the Lower Columbia River Watershed Council. The watershed assessment will be used as a guide for the prioritization and design of restoration projects.

The Lower Columbia-Clatskanie Watershed Assessment describes the watershed and discusses the following:

- Declining wild salmon and steelhead populations
- Water quality parameters for E. Coli and dissolved oxygen
- Loss of streamside vegetation and functions and increased amount of sediment entering streams from forestry activities
- High summer water temperatures in streams
- Stream straightening and channelization

Salmon and Steelhead Limiting Factors Water Resource Inventory Area 25 and 24

See Portland to Skamokawa above.

Mouth, Plume and Youngs Bay

Ecology Of Marine Predatory Fishes: Influence on Salmonid Ocean Survival

This National Marine Fisheries Service study identifies the temporal dynamics and abundance of marine fish predators and forage fishes in the nearshore ocean off the Columbia River during the juvenile salmon outmigration period and the food habits of predatory marine fishes. The study measures selected oceanographic conditions in the nearshore ocean off the Columbia River and distribution and abundance of predator and forage fish with respect to oceanographic conditions. It also looks at ocean survival of juvenile salmonids historically and to the present to identify the impacts of predators on salmonids.

Ocean Survival Of Juvenile Salmonids In The Columbia River Plume

This study describes interannual variation in ocean recruitment of salmon and its association with variation in nearshore ocean conditions. The study proposes to characterize, over a 10-year period, the physical and biological features of the nearshore ocean environment with real-time and modeling projections of the Columbia River plume as it interacts with the coastal circulation regime; it will relate these features, both spatially and temporally, to variations in salmon health, condition and survival.

Youngs Bay, Nicolai-Wickiup River and Skipanon River Watershed Assessments

The purpose of these watershed assessments is to inventory and characterize watershed conditions of the Youngs Bay, Nicolai-Wickiup and Skipanon River watersheds and to provide recommendations that address the issues of water quality, fisheries and fish habitat, and watershed hydrology. These assessments were conducted by reviewing and synthesizing existing data sets and some new data collected by the Watershed Council, following the guidelines outlined in the Oregon Watershed Enhancement Board (OWEB) watershed assessment manual (WPN 1999).

Artificial Production

Introduction

This chapter covers information about limited hatchery production in the two-province area. Additional details concerning net-pen sites can be found in the description of the Select Area Fishery Evaluation Project (SAFE). The SAFE Project is an extension of the existing hatchery system that evaluates the feasibility of utilizing lower Columbia River off-channel sites for net-pen rearing and acclimation of coho, spring chinook and fall chinook salmon. Future plans of the SAFE project include possible expansion into other acceptable sites or use of additional species at existing sites.

All hatcheries in the Columbia River basin below Bonneville Dam are located on tributary streams; however, net-pens are used for both rearing and acclimation at several sites within the boundaries of the lower Columbia River Province. Net-pens receive spring chinook, coho and fall chinook salmon from a variety of hatcheries within the Columbia River basin depending on the species and the net-pen site. The net-pens function as both long-term (over winter) rearing and short-term (less than a month) acclimation facilities, with the majority of the releases being long-term rearing situations.

There are five net-pen sites in the lower Columbia River at this time, including those in Youngs Bay, Tongue Point and Blind Slough in Oregon plus Deep River and Steamboat Slough in Washington. Brief descriptions of each site and the species released from these sites are as follows:

1. Youngs Bay is a large bay that enters the Columbia River just downstream of the town of Astoria (RM 14). The net-pens are located in Youngs Bay within a mile of the confluence of Youngs Bay and the Columbia River. The Youngs Bay site includes releases of all three species: coho salmon, spring chinook salmon and fall chinook salmon.

2. The Tongue Point site is a side channel of the Columbia River located at RM 18, with net-pens located in the John Day Channel near Mott Basin. The Tongue Point

site is currently releasing only coho salmon. Past releases of spring chinook were discontinued due to excessive straying; however, further testing for methods to reduce straying is planned with the intent of reintroducing spring chinook at this location.

3. Blind Slough is the tidewater portion of Gnat Creek, a Columbia River tributary that enters the Columbia River at RM 27. The net-pen site is located approximately two miles upstream from the confluence of Blind Slough and the Columbia River. Both coho salmon and spring chinook salmon are released from this location.

4. Deep River enters the Columbia River via Grays Bay which is located at RM 21. There are two net-pen sites that are located in Deep River approximately two and three miles upstream from the confluence of Deep River and the Columbia River. Only coho salmon are released from these sites.

5. Steamboat Slough is a side channel of the Columbia River that creates Price Island and stretches from RM 34 to RM 35. The net-pen site is located at the downstream end of the slough on the Washington shore. This site releases only coho salmon.

Limiting Factors

Introduction

This summary includes key factors believed to limit the survival of various target populations. The information below is derived from subbasin limiting factor analysis as well as studies on target populations. Other subbasin studies cover many of the Columbia's major tributaries (Willamette, Sandy, Cowlitz, Lewis, Skamokowa, Kalama, Elochoman and Washougal rivers) in more detail.

Description of Effort by Project Area

The information is presented by project (underlined) or effort. The overall project area section contains information that is relevant to the entire two-province area. The remaining projects are sorted by geographic area within the two-province area: Bonneville to Portland, Portland to Skomokawa RM 34, RM 34 to Astoria, and Mouth, Plume and Youngs Bay.

Overall Study Area

This section includes information relevant to the entire, or large portions of the two-province area.

Bull Trout Biological Opinion Effects to Listed Species from Operations of the Federal Columbia River Power System, *U.S. Fish and Wildlife Service, December 1999*

The U.S. Fish and Wildlife Service has reviewed the biological assessment and National Environmental Policy Act documents dated December, 1999 submitted by the Bonneville Power Administration, Corps of Engineers, and the Bureau of Reclamation (Bureau) regarding operations of the Federal Columbia River Power System. The action agencies' request for formal consultation was received in December, 1999. This document represents the Service's biological opinion of the effects of the proposed action on two listed fish species: the endangered Kootenai River white sturgeon (*Acipenser transmontanus*) and the threatened bull trout (*Salvelinus confluentus*). This biological opinion is based on

information provided in the documents noted above, numerous telephone conversations, meetings and other sources of information. This biological opinion provides the following limiting factors for bull trout in the Columbia River basin:

- Restriction or elimination of migratory bull trout following fishery management actions (bounties/lake trout introductions).
- Habitat alterations, including dams or seasonal or permanent obstructions.
- Detrimental changes in water quality and increased temperatures.
- The result in the loss of migratory life history types and isolated resident forms from interacting with one another (USDA, 1983).
- Activities that have altered or disrupted habitats, including: water diversions, dams, timber extraction, mining, grazing, agriculture, introduction of non-native fishes that compete or hybridize with bull trout, poaching, past fish eradication projects, and channelization of streams. These threats are prevalent throughout the Columbia River basin, except in wilderness areas.

Revised Columbia White-Tailed Deer Recovery Plan, *U.S. Fish and Wildlife Service, 1976*

The Revised Columbia White-Tailed Deer Recovery Plan outlined methods of re-establishing white-tailed deer near the Columbia River. Land use practices since 1972 via an interim management plan have encouraged the regrowth and reestablishment of permanent cover on many areas of the refuge with a history of heavy grazing. Continuous evaluation of deer responses to land use changes is necessary so that the proper balance between short grass/forb pastures and dense cover is maintained. The integrity of the Columbia River population of Columbia white-tailed deer (CWTD) and their habitat is threatened by a variety of factors, including both natural and man-caused phenomena including:

- Degradation of riparian habitats through logging and brush removal (Crews 1939; Scheffer 1940; Gavin 1978).
- Recent interest in development of riparian zones for beef production, cottonwood and alder harvest and for marina development.
- Automobile collisions.
- Poaching.
- Entanglement in barbed wire fences.
- Competition with livestock.
- Introduction of feral swine on Wallace Island in 1980.
- Major flooding.
- The inundation of over 1,400 acres for nearly 1.5 years due to a dike failure.
- High tides which are a limiting factor on undiked islands of the lower river.
- Disease (foot rot) and parasites (stomach worms), two threats common to the Columbia River population.
- The potential threat of black-tailed deer to CWTD by direct competition for available food sources and by hybridization.
- Presence of Roosevelt elk on the mainland portion of CWTD NWR.

Ecology of Bald Eagles on the Lower Columbia River, *Oregon State University, 1988*

This report provides information regarding diet, management implications and environmental contaminants impacting bald eagles on the lower Columbia River. The major limiting factors included in this report include:

- Declines of bald eagles are due to environmental contaminants including DDE, DDD, hexachlorobenzene, mirex, PCBs, mercury, cadmium and lead.
- Declines in raptor populations have been associated with eggshell thinning induced by the DDT-metabolite DDE (Newton 1979:239).
- Contaminants entering the Columbia River system have an effect on the population.
- The Columbia River acts as a sump for many kinds of contaminants including PCBs.

Bonneville to Portland

This section presents limiting factors information about mainstem and minor tributary projects from Bonneville Dam to the Portland/Vancouver metropolitan area. Limiting factors information for the Willamette, Sandy, and Washougal rivers is included in other subbasin summaries.

Bonneville Tributaries Subbasin – Limiting Factors Analysis, Washington State Conservation Commission, 2000

A number of the Bonneville subbasin tributaries fall within the Columbia River Gorge National Scenic Area and are protected from future development pressure. However, timber harvests, transportation corridors, passage barriers, and rural development have all contributed to habitat degradation in the subbasin, and smaller communities are rapidly developing (see Appendix A). Major habitat-limiting factors in this area include:

- There is a limited amount of lower gradient habitat for spawning and rearing of anadromous salmonids, located mainly in the lower reaches. The railroads, State Route (SR) 14, dikes, and other artificial structures reduce or eliminate access to some of the most productive habitat within the subbasin, as well as reduce overall habitat quality.
- There is a limited amount of low gradient floodplain and side-channel habitat available within the Bonneville tributaries subbasin. Transportation corridors and other development along the Columbia have reduced or eliminated already limited floodplain habitat in many of these stream systems.
- Fine sediment conditions within Gibbons Creek and its tributaries are “poor” and likely a major limiting factor. Fine sediments have also accumulated in the spring-fed areas of Duncan Creek. Spawning substrates within the springs need cleaning now that the area is accessible to “threatened” chum salmon. Stream-adjacent roads also likely contribute excessive fine sediments to Hardy, Woodward, and lower Duncan Creeks.
- Heavy loads of course sediments are deposited where the streams emerge from steep canyons in the Gorge. To some degree this is a natural process, and to some degree these sediment loads have increased due to land use activities and artificial structures within the subbasin. Culverts along SR 14 and the railroads exacerbate this natural condition as they alter or constrict the movement of coarse sediments down through these systems.

- Almost throughout the subbasin, functioning large woody debris (LWD) is scarce or absent. Consequently, pool habitat and habitat diversity are also scarce.
- Riparian conditions are poor along almost every stream within the subbasin, especially along the lower reaches with productive anadromous habitat.
- Numerous stream adjacent roads reduce riparian functions along Woodward Creek and Duncan Creek.
- Other than some limited data on Gibbons, Campen, and Hardy Creeks, water quality data is lacking within the Bonneville tributaries subbasin. Water temperatures and fecal coliform exceed state standards in Gibbons and Campen Creeks.
- Both elevated peak flows and low flows are considered limiting factors for salmonids in the Bonneville tributaries subbasin. Urbanization, forestry, agriculture, and other land uses have left portions of subbasin hydrologically immature.
- The rapid residential development occurring in the Gibbons Creek watershed and in the City of North Bonneville adds to already high levels of impervious surfaces and the loss of forest cover along these streams.
- Escapement for most anadromous fish is well below historic numbers and the lack of carcasses contributing nutrients to stream systems may be limiting production. Additionally, habitat alterations and non-native introductions influence competitive interactions and ecological processes in the Bonneville tributaries subbasin.
- Floods have their greatest impact to salmon populations during incubation, and flood impacts are worsened by human activities.
- Dikes, bulkheads, dredging and filling activities, pollution, and alteration of downstream components such as lack of woody debris and sediment transport are limiting factors.
- Low flows and associated high temperatures and low dissolved oxygen can be problems.
- Less frequent and shallow pools from sediment inputs and lack of canopy from an altered riparian zone or widened river channel can worsen these flow and water quality problems because there are fewer refuges for the adults to hold prior to spawning.

Oregon Columbia Tributaries West: Watershed Analysis, USDA Forest Service, Columbia River Gorge National Scenic Area, 2001

This study is a compilation of prevailing knowledge of the area by various resource specialists. These specialists provide descriptive data about past and present physiological, ecological and cultural conditions. Recommendations drawn from a synthesis of this information provide management guidance for the federal lands located in the watershed. While the study provides analysis and recommendations for desired future conditions, it is not a decision-making document. The Watershed Analysis identifies the following limiting factors:

- Hydroelectric dams along the Columbia have led to hydrological and other natural disturbance patterns. Due to damming, sediment deposited by side tributaries is not carried away. This results in an increased material buildup. Without the influence of scouring flood events, vegetation is more stable and side channels are not regularly

inundated. In the reference period, water volumes varied seasonally, while water volumes today are much more uniform. Tidal effects continue to change the water levels up to the Cascades rapids.

- Stable vegetation results in less large woody debris (LWD) entering stream channels which has concomitantly decreased fish habitat. Culverts prevent stream downcutting action, and other man-made diversions limit the meanders of Multnomah, Moffet, Oneonta, Bridal Veil, Horsetail and Bell Creeks. Major debris jams are quickly cleared in lower stream channels. As far as the presence of LWD and mass wasting, the study area is probably near the lower limit of the range of variability for the reference period. The river's riparian system and the first mile of the tributaries are outside the range of natural variability. Water level changes affected fish predation and probably resulted in a different pattern of species competition and composition. Stream sediment is not a problem. The coarse material usually dissipates within 24 hours after a major slide. The streams and tributaries of the watershed have some of the cleanest water of the entire region, and their dissolved oxygen contents are also high.
- A buildup of understory debris has fueled catastrophic fires.
- Lack of underburning has resulted in an increase of hemlock and silver fir and a reduction of vine maple threatening ecosystems.
- Noxious weeds have gained strongholds along I-84, in railroad corridors, and along the forest roads and trails.
- Gill netting and sport fishing have a great impact because fishermen are taking a larger percentage of the salmon population.
- Industrial pollution, automobile exhaust emissions, slash burning and wood stoves have increased air pollution in the transportation corridor and watershed.

Sandy River Delta Watershed Analysis and Plan, US Forest Service, Columbia River Gorge National Scenic Area, 1995 and 1996

Regional History: The majority of the extensive pre-European settlement wetlands, prairies and riparian forests of the lower Columbia River have been inundated, cleared, diked, drained, farmed and urbanized. The Columbia River hydropower system has significantly decreased the frequency and magnitude of high flow rates (floods). This, in turn, has encouraged the human use of riparian habitats and their destruction. The pre-dam Columbia River floods and pattern of floods were a causal factor associated with creating and maintaining a unique set of wetland, meadow, and riparian habitat conditions in this floodplain. As a result of the hydropower system, wetland, meadow, and riparian forest habitats are becoming increasingly scarce in the region.

Before European settlement, the area was largely forested, with some level "prairies", small lakes and wetlands. Beginning in the late 1800s, forests were cleared, grazing was initiated and ditches installed to drain wetlands. Prior to completion if the Columbia River Hydroelectric Dam System, annual spring floods in the 800,000 cfs range were common. Flows over 1,000,000 cfs were occasionally observed. Now, spring flows rarely exceed 300,000 cfs. As a result, the land is massively altered. The natural disturbance regime was altered by the dam system, and the land has been cleared, drained, diked, grazed, seeded and invaded by undesirable species.

Current Condition: The project area is a former pasture infested with reed canary grass, blackberry and thistle. The limited overstory is native riparian species such as cottonwood and ash. The shrub and herbaceous layers are almost entirely non-native, invasive species. Native species have a difficult time naturally regenerating in the thick, competing reed canary grass, Himalayan blackberry and thistle. A system of drainage ditches installed by past owners drains water from historic wetlands. The original channel of the Sandy River was diked in the 1930s, and the river diverted into the "Little Sandy River." The original Sandy River channel has subsequently filled in and largely become a slough.

Western Washington Columbia River Tributaries Watershed Analysis, USDA Forest Service, Columbia River Gorge National Scenic Area, 2001

This analysis describes the land uses and management within the Columbia River Gorge National Scenic Area. The Management Plan (CRGNSA) provides a Recreation Intensity Class (RIC) overlay to the underlying land use designations for maximum habitat protection. It explains that in the Columbia River watershed, the Northwest Forest Plan (NFP) applies to the National Forest lands in the CRGNSA and Gifford Pinchot National Forest (GPNF). The NFP describes Land Allocations, meant to protect habitat areas. The analysis identifies the following limiting factors:

- Industrial pollution from aluminum plants and paper mills and automobile exhaust emissions have increased air pollution in the transportation corridor and watershed. Air pollution has had an effect on lichens and mushrooms.
- Scale and intensity of fires is increasing, leaving soils permanently damaged and having a direct impact on watersheds.
- Sediment transport from splash damming, fire and logging is decreasing the area for spawning, hiding cover and pools and is increasing rates of channel cutting.
- Urban and rural development removes trees from the riparian area, leading to development of floodplains, confining and straightening stream channels, and constricting streams at points of road and rail crossings. Natural "recovery" processes occurring in developed areas are often prevented or discouraged if they are not seen as beneficial to the current land use.
- Dams lead to increased buildup of sediment near the mouths of tributaries in this reach, stabilization of some features by vegetation encroachment, and reduced inundation of side channels reducing sediment brought to bars, islands and streambanks in the lower reaches. This is because the eroded sediments on these features are no longer being replaced as they once were.
- Dams reduce spring flooding frequency, duration and volume. Likewise extremely low water levels also seldom occur. Due to damming, sediment deposited by side tributaries is not carried away.
- Logging has created forests that are predominantly younger and structurally more stable, which results in less large woody debris (LWD) entering stream channels, which concomitantly has decreased fish habitat.
- Culverts increase stream downcutting action, and other man-made diversions limit the meanders of Woodward, Lawton, Hamilton and other creeks. Major debris jams are quickly cleared in lower stream channels. As far as the presence of LWD and mass wasting, the study area is probably near the lower limit of the range of

variability for the reference period. The river's riparian system and the first mile of the tributaries are outside the range of natural variability.

- Large woody debris contributes to the loss of anadromous fisheries.

Salmon and Steelhead Limiting Factors Water Resource Inventory Area 28, Washington State Conservation Commission, 2000

WRIA 28 is located in southwest Washington, with boundaries that extend to the western margins of the Wind River to the east, the Columbia River to the south, and the East Fork Lewis River to the north. The inventory area includes the southern and eastern portions of Clark County and southwestern Skamania County. For purposes of this report WRIA 28 was divided into three major subbasins: the Lake River Subbasin, the Washougal River Subbasin, and the Bonneville Tributaries Subbasin. These drainages cover approximately 316,365 acres or 494 square miles and enter the Columbia River between River Mile (RM) 87.6, at Lake River, and RM 142.3 near Bonneville Dam (see Appendix C). There were a number of habitat-limiting factors and recommendations to address these factors that apply across the entire WRIA, including:

- Various land uses practices have negative impacts on habitat conditions for salmonids. If these impacts continue at the existing rate in many of the subbasins of WRIA 28, habitat degradation will outstrip any possible restoration strategy. The Technical Advisory Group (TAG) suggests that critical areas ordinances be developed and/or updated to ensure protection of critical habitat for threatened and endangered salmonids.
- Stormwater in urban areas contributes to increased peak flows, leading to bed and bank scour and channel shifting. These inputs also contribute fine sediments and reduce water quality. Where possible, alter stormwater facilities to reduce direct runoff to streams and increase infiltration. Protect and enhance wetlands and other water recharge areas.
- Almost every stream system within WRIA 28 has inadequate levels of large woody debris (LWD). Supplement LWD in appropriate stream channels to provide short-term habitat benefits. Protect and enhance riparian habitat to increase LWD supplies over the long term.
- Riparian restoration is needed almost throughout WRIA 28. Many commercial forestlands are in the process of recovering from disturbances early in the last century. Other areas have reduced riparian function due to urban and rural development. Protect existing functional riparian habitat and restore those areas that have been degraded by past activities, starting with productive anadromous tributaries.
- The headwaters of most streams within WRIA contain the vast majority of functional habitat. These areas also provide cool, clean water, spawning sediments and woody debris that help buffer downstream land use activities. Focus on protecting these more pristine habitat reaches from additional land-use impacts.
- Elevated water temperatures are a problem in many stream systems within WRIA 28. Poor riparian conditions, low-flow problems, high width-to-depth ratios, and impounded water all contribute to elevated water temperatures. A comprehensive approach to water quality improvements is needed to address all of these related problems across the watershed.

- Water withdrawals, for both industrial and domestic uses, reduce instream flows and the habitat available for salmonids. Explore opportunities to protect and augment stream flows in WRIA 28 during low-flow periods.

Portland to Skamokowa (River Mile 34)

Salmon and Steelhead Limiting Factors Water Resource Inventory Area 26, *Washington State Conservation Commission, 2000*

This report is based on a combination of existing watershed studies and knowledge of the TAG participants. WRIA 26 is located in southwest Washington within portions of Lewis, Cowlitz, Skamania, Pierce, and Yakima Counties, and it includes the Cowlitz River systems and its major tributaries: the Coweeman, Toutle, Tilton, and Cispus Rivers. The Cowlitz River enters the Columbia River at River Mile 68. Five stocks of anadromous salmon and steelhead and coastal cutthroat trout return to the rivers. More detail on tributaries in WRIA 26 are included in other subbasin summaries covering these areas specifically. The major habitat limiting factors common to most streams within WRIA 26 included:

- Mayfield, Mossyrock, and Cowlitz Falls Dams form complete barriers to natural upstream migration and inhibit downstream migration. Over 300 miles of formerly productive habitat is either inaccessible or inundated by the reservoirs. Almost throughout WRIA 26, LWD abundance is below habitat standards.
- Lack of large woody debris in streams, particularly larger key pieces, is critical to developing pools, collecting spawning gravels, and providing habitat diversity and cover for salmonids.
- Poor riparian conditions within most of the basins affect water quality, erosion rates, streambank stability, and instream habitat conditions.
- Water quality, especially high water temperatures, was identified as a major limiting factor within certain subbasins of WRIA 26.
- The low flows that limit the rearing habitat and connectivity and the increased peak flows that alter instream habitat were considered significant problems in many subbasins.
- Most of the historic off-channel and floodplain habitat has been disconnected from the river by diking and hardening the channels and due to the 1980 eruption of Mount St. Helens. Loss of these off-channel habitats limits rearing and over-wintering habitat for juvenile salmonids within most subbasins.

Salmon and Steelhead Limiting Factors Water Resource Inventory Area 27, *Washington State Conservation Commission, 2000*

WRIA 27 is located in southwest Washington within portions of Skamania, Clark, and Cowlitz Counties, and it includes three major watersheds; the Kalama River, the North Fork Lewis River, and the East Fork Lewis River. All river systems within WRIA 27 drain to the Columbia River. Six stocks of anadromous salmon and steelhead return to the rivers. For purposes of this analysis the WRIA was separated into four subbasins, lower and upper Lewis River (below and above the dams), East Fork Lewis River, and Kalama River. More detail on tributaries in WRIA 27 are included in other subbasin summaries covering these areas specifically. The major habitat-limiting factors that were common to all streams within WRIA 27

included:

- Almost throughout WRIA 27, large woody debris abundance was below the habitat standards. Adequate large woody debris in streams, particularly larger key pieces, is critical to developing pools, collecting spawning gravels, and providing habitat diversity and cover for salmonids.
- Riparian conditions were also poor within most of the basins. Loss of riparian function affects water quality, erosion rates, streambank stability and instream habitat conditions.
- Water quality, especially high water temperatures, was identified as a major limiting factor within certain subbasins of WRIA 27.
- Water quantity was also identified as a limiting factor almost throughout WRIA 27. The low flows that limit the rearing habitat and access and the increased peak flows that alter instream habitat were considered significant problems in many of the subbasins.
- Most of the historic off-channel and floodplain habitats have been disconnected from the river by diking and hardening the channels. Loss of these off-channel habitats limits rearing and over-wintering habitat for juvenile salmonids.

River Mile 34 to Astoria

Salmon and Steelhead Limiting Factors Water Resource Inventory Area 25 and 24, *Washington State Conservation Commission, 2000*

WRIA 25 is located in southwest Washington within portions of Lewis, Cowlitz, and Pacific Counties. This area encompasses numerous tributaries to the Columbia River including Coal Creek, Germany Creek, Abernathy Creek, Mill Creek, Elochoman River, Skamokawa Creek, Grays River, and Deep River. Five stocks of anadromous salmon and steelhead and coastal cutthroat trout return to the rivers. For purposes of this analysis, WRIA 25 was separated into three subbasins; Mill-Germany, Elochoman-Skamokawa, and the Grays. Although located in WRIA 24, the Chinook River is the western-most tributary to enter the Columbia River in southwest Washington and has been included in this report (see Appendix D). The major habitat-limiting factors common to most streams within WRIA 25 included:

- Access: Fish passage improvement projects continue to be implemented in the subbasin. Several locations were identified that need further assessment, including natural barriers and the limitations that they may pose to natural fish distribution and habitat utilization.
- Floodplain Connectivity: Floodplain connectivity and access to off-channel habitat and floodplain habitat has been affected by management practices, including diking, channel hardening and the historic practice of splash damming.
- Side Channel Availability: Similar practices that have affected floodplain connectivity have affected the availability of side channels. A combination of limiting factors has resulted in an overall reduction in channel complexity. Most of the streams in WRIA 25 can be characterized as having a single thread channel.
- Bank Erosion/Stability: Stream surveys identified several areas of active bank erosion that are considered a concern. These areas are typically associated with alluvial soil with little or no riparian vegetation. Although data was not readily

available to assess bank stability, TAG members identified several areas within the Chinook-Grays and Skamokawa-Elochoman subbasins where bank stability is a concern.

- Riparian Conditions: Riparian conditions are considered poor within the three subbasins. Loss of riparian function affects water quality, erosion rates, streambank stability and instream habitat conditions.
- Large Woody Debris: Almost throughout WRIA 25, LWD abundance was below habitat standards. Adequate large woody debris in streams, particularly larger key pieces, is critical to developing pools, collecting spawning gravels, and providing habitat diversity and cover for salmonids.
- Pool Frequency: Although isolated areas were identified where pool frequency rated "Fair" to "Good," pool frequency was below habitat standards almost throughout the subbasins.
- Water Quality: Elevated stream temperatures are a concern for rearing salmonids and resident fisheries during summer months. With the onset of fall freshets, water temperatures appear to quickly return to levels satisfying spawning water quality criteria.

Oregon Department of Fish and Wildlife

The entire Columbia River estuary subbasin lacks viable self-sustaining populations of chum, chinook, and coho salmon that were historically present. ODFW identified the following causative agents and remedial actions:

Habitat loss

Significant habitat loss in the lower Columbia estuary has occurred as a result of diking of tidal wetlands. Large portions of the estuary and its tributaries, sloughs, and bays have been altered and are no longer subjected to tidal and flood events. This has resulted in direct loss of critical rearing and staging habitat utilized by juvenile salmonids during their physiological adaptation to a salt-water environment, as well as degradation of water quality and changes in plant species composition. Loss of this crucial habitat also likely affected populations of lamprey, smelt, herring and other aquatic species.

Woody debris

Woody debris adds habitat complexity and may serve as juvenile salmon rufgia as well as augmenting levels of epibenthic prey. Drainages in the lower Columbia have been affected by past logging activities that decreased the volume of large wood recruiting into both the stream and estuary. Additionally, suppression of water flow in the Columbia reduced flood events to far below historical levels. These flood events deposited wood and other organic material that supported various aquatic and terrestrial species. In Youngs Bay, commercial fishers directly removed woody substrate to prevent fouling of nets. Historical volumes of wood in the bay and the value of this habitat to aquatic species are not known.

Water removal

The Lewis & Clark River has limited habitat available to salmonids during the summer below the City of Warrenton's dam located at River Mile 16.5 due to water withdrawals. Currently the City of Warrenton does not have adequate storage facilities to retain the ample winter flows, and future growth will put more demands on the system.

Alteration of nutrient pathways

As salmon populations in the subbasin rivers and tributaries declined, so did the amount of nutrients supplied to the system in the form of carcasses and excess eggs. Decomposing adult salmon carcasses are incorporated into riverine and terrestrial food webs, and these nutrients are cycled through the food chain and ultimately become available to salmonids primarily through insect prey. Young salmon also feed on the carcasses directly. Other restoration activities may meet with limited success without reestablishing these nutrient pathways.

Remedial actions

There are many habitat enhancement opportunities available in the Columbia River estuary subbasin. They include modification or removal of dikes and tidegates to increase the water exchange and help restore tidal wetlands. The removal of dikes and direct land acquisition opportunities are also available in the area. The placement of large wood in upland sections of the watershed will provide habitat in the stream and the estuary. There are also opportunities to place wood in selected areas that do not interfere with transportation or commercial fishing. The restoration of riparian vegetation will also provide the source material for future recruitment and provide long-term stability for the subbasin. Fish carcass placement in streams is a component of fish resource management.

Mouth, Plume and Youngs Bay

Ecology of Marine Predatory Fishes: Influence on Salmonid Ocean Survival, U.S. National Marine Fisheries Service, 1998 to present

This study examined the temporal dynamics and food habits of juvenile salmon and their marine fish predators and forage fish prey in the nearshore ocean off the Columbia. Measurements were made in relation to oceanographic conditions. Historical and present impacts of fish predators on the ocean survival of juvenile salmonids were identified. This study has identified:

- Piscine predators off the mouth of the Columbia River vary in abundance and distribution and could account for variation in salmon survival both in a spatial and temporal context.
- Baitfish abundance off the mouth of the Columbia also vary in abundance and distribution and could account for variation in salmon survival both in a spatial and temporal context.
- Both piscine predator populations and baitfish populations appear to be influenced by the Columbia River plume dynamics.
- Baitfish abundance buffer juvenile salmon predation by representing an alternate prey base to piscine predators.
- It is unclear how modification of the plume by human influence has affected the benefits of this environment to salmon.

Ocean Survival of Juvenile Salmonids in The Columbia River Plume, National Marine Fisheries Service, Oregon Graduate Institute, Oregon State University

A study by NMFS, Oregon State University, and the Oregon Graduate Institute this report hypothesizes that variation in the physical and biological conditions of the Columbia River estuary and nearshore environment, particularly that associated with the Columbia River

plume, affects overall survival of Columbia River stocks. The report states that primary factors driving the variation in the nearshore environment include:

- Food availability and habitats.
- Time of ocean entry, smolt nutritional quality, and growth and bioenergetic status during the first growing season in the ocean.
- Predation.

The report identifies the following limiting factors to ocean survival:

- Hydrosystem flow regulation, water withdrawal for irrigation, and climate change have altered the seasonality and reduced the mean flow rate of the Columbia River. This has resulted in reduced sediment discharge and alterations to the both estuarine and nearshore ecosystems, specifically in the Columbia River plume.
- Decreased spring flows and lower sediment discharges have reduced the extent, speed, thickness and turbidity of the Columbia River plume. Mixing of plume and nearshore water masses at frontal zones would also be altered.
- The Columbia River plume likely provides essential rearing habitat during the early ocean entry phase of juvenile salmon. Low river inflow is unfavorable for salmon survival because of a) reduced turbidity, which may increase the foraging efficiency of bird and fish predators, b) decreased intensity of frontal zones that concentrate food resources, and c) reduced overall total secondary productivity based on upwelled and fluvial nutrients.
- The impact of reduced spring river flow and suspended particulate matter (SPM) transport on salmon production in the estuarine and coastal plume environment may be large, as flows in most years may now be sub-optimal for salmon production.
- Most juvenile salmonids have historically entered the ocean when Columbia River flows are high but after the upwelling season and after plankton production has begun. The time of ocean entry in relation to climatic variations affecting ocean windstress, precipitation and advective transport of plume and oceanic currents will affect prey resources of ocean-entry salmonids.
- Similarly, survival of juvenile salmonids at sea may depend on the match/mismatch between ocean entry of smolts in the spring and the arrival of predators such as hake and mackerel. These predators usually arrive in Oregon waters by May.
- Hatchery and natural salmonid stocks may be differentially affected by the significantly altered conditions in the estuary and plume environments. The altered state of the system and the resultant poor ocean survival likely contributes to the overall reduction of salmon stocks.

> Youngs Bay, Nicolai-Wickiup River and Skipanon River Watershed Assessments, E&S Environmental Chemistry, Inc. and the watershed councils of Youngs Bay, Nicolai-Wickiup River and Skipanon River, 1999

These watershed assessments inventoried and characterized watershed conditions of the Youngs Bay, Nicolai-Wickiup and Skipanon River watersheds and provided recommendations that address the issues of water quality, fisheries and fish habitat and watershed hydrology. These assessments were conducted by reviewing and synthesizing existing data sets and some new data collected by the watershed council, following the guidelines outlined in the Oregon Watershed Enhancement Board (OWEB) watershed assessment manual (WPN 1999). The watershed assessment identified the following limiting factors:

- Increased stream temperatures due to barriers to fish passage and dewatering negatively impact fish survival.
- Water rights have potential negative impacts to the watershed.
- Land use practices have increased landslide frequency and magnitude.
- Culverts are in need of repair or are at risk of causing damage to the stream network.
- Water draining from roads can constitute a significant sediment source into streams.
- Twenty-four percent of the surveyed length has experienced stream bank erosion.

Existing and Past Efforts

Overview

This summary of information includes accomplishments of existing and past efforts. Efforts include ongoing fish and wildlife activities, habitat improvements, studies and long-term planning activities.

Description of Effort by Project Area

Geographic areas for each activity are separated for ease of use. Items underlined indicate a report, those in bold indicate efforts by organizations.

Overall Study Area

This section includes existing and past efforts covering the entire or a large portion of the two-province area.

The Bi-State Water Quality Program, States of Oregon and Washington, 1989

In 1989, the States of Oregon and Washington recognized that more information was needed about the health of the lower Columbia River. While much activity was on-going in the Columbia Basin, the emphasis generally focused above Bonneville Dam. Not much attention had been paid to the lower 146 miles. A nomination to the National Estuary Program was being discussed, but data was lacking to confirm the degradation that would warrant participation in the program. To address that need, the Lower Columbia River Bi-State Water Quality Program (Bi-State Program) was created in 1990 and continued until 1996. Its study area was the lower part of the river from Bonneville Dam to the Pacific Ocean, a stretch of 146 river miles.

The Bi-State Program was a public/private partnership jointly administered by the Washington Department of Ecology and the Oregon Department of Environmental Quality and assisted by a Bi-State Steering Committee. Steering Committee members came from the many groups with active interests in the health of the river: environmentalists, industry representatives, private citizens, public ports, local governments, fishing interests, Native American tribes, the Northwest Power Planning Council, and state and federal agencies dealing with environmental and natural resource issues. The citizens of Oregon and Washington, the Northwest Pulp and Paper Association, and the region's public ports financially supported the program. Private contractors and state and federal agencies conducted the studies. During its six-year existence, the Bi-State Program invested over $5 million in its work.

The Bi-State Program assessed the health of the river by looking at how well the "beneficial uses" of the river are being met. Beneficial uses are defined in state laws and regulations and include water supply, agriculture, fish and wildlife, recreation, and commercial uses. The program focused on those beneficial uses that relate to the health of humans, fish, and wildlife.

The studies were conducted in four steps:
1990-1991: Existing Data were gathered and studied so researchers could start with a coherent picture of what was already known about the river and its problems.
1991-1993: Reconnaissance Surveys were broad preliminary studies designed to provide information about existing environmental conditions and pollutants of concern by sampling and analyzing water, sediment and fish. These were the first environmental studies to examine the entire lower Columbia River broadly, rather than focusing on a particular type of pollution, beneficial use or interest group.
1993-1996: Baseline Studies were specific studies suggested by the results of the reconnaissance surveys. They were designed to fill gaps in the information gathered so far. Three types of studies were performed: regular water testing over the course of a year ("ambient monitoring"), a close look at the impact of pollution on fish and wildlife health, and a preliminary look at possible human health risks of eating fish from the river.
1995-1996: Advanced Studies were in-depth studies of priority problems based on the findings of all previous phases. They included a more detailed human health risk assessment and a study to identify pollutant sources.

These studies generated over 50 technical reports, which are summarized in an integrated technical report called ***The Health of the River 1990-1996***. Based on this work, the Bi-State Program identified four major problems in the study area that warranted further study and action:

- Toxic contaminants in sediment and fish tissue that affect the health of humans, fish, and wildlife.
- Habitat loss or modification that affects fish and wildlife resources.
- Water quality problems that affect the beneficial uses in parts of the estuary.
- An overall decline in fish and wildlife health, including that of a number of threatened and endangered species.

The findings of the Bi-State Program supported nomination of the lower Columbia River estuary in the National Estuary Program. The U.S. Environmental Protection Agency announced the Columbia River as one of the waterways accepted into the program in July 1995.

Bull Trout Biological Opinion Effects to Listed Species from Operations of the Federal Columbia River Power System

The U.S. Fish and Wildlife Service has reviewed the biological assessment and National Environmental Policy Act documents dated December, 1999 submitted by the Bonneville Power Administration, Corps of Engineers, and the Bureau of Reclamation (Bureau) regarding operations of the Federal Columbia River Power System. The action agencies' request for formal consultation was received in December 1999. This document represents the Service's biological opinion of the effects of the proposed action on two listed fish species: the endangered Kootenai River white sturgeon (*Acipenser transmontanus*) and the

threatened bull trout (*Salvelinus confluentus*). This biological opinion is based on information provided in the documents noted above, numerous telephone conversations, meetings and other sources of information.

Columbia River Estuary Dredged Material Management Plan, 2001, Columbia River Estuary Study Taskforce

In 1979 the Columbia River Estuary Study Taskforce (CREST) completed the *Dredged Material Management Plan for the Columbia River Estuary*. The plan identified 98 dredged material disposal sites, established priorities for their use, and recommended techniques for their protection and control. The sites were then protected through the comprehensive plans of Oregon jurisdictions and through the Shoreline Management Master Programs of the Washington jurisdictions. In 1986, the CREST reevaluated and updated the plan to produce the *Columbia River Estuary Dredged Material Management Plan*. Since 1986 there have been many changes in the dredged material disposal needs, limitations, and opportunities in the Columbia River estuary. Some identified sites are now developed with permanent structures in place. Other sites have received more material that was outlined in the *Columbia River Estuary DMMP*. In addition, opportunities for beneficial use of dredged material should be incorporated into the *Columbia River Estuary DMMP*. Furthermore, an analysis and update of the dredged material disposal site inventory is necessary to ensure the adequacy of identified dredged material disposal sites for any future construction and maintenance activities.

The objective of this task is to draft a revised and updated Dredged Material Management Plan for the Columbia River Estuary. The plan will be suitable for incorporation into local comprehensive plans in Oregon and shoreline master programs in Washington. The update of the CREDMMP will be a coordinated bi-state effort between the three coastal counties within the Columbia River Estuary - Clatsop, Pacific and Wahkiakum. The Plan will update the current policies, criteria, standards, methods and processes for dealing with both disposal and the designation of dredged material disposal sites, in-water and upland. The outcome of the update will be it's adoption into the Comprehensive Plan (OR) or Shoreline Management Master Programs (WA) of the participating jurisdictions, thus providing a consistent approach towards dredged material management within the estuary, recognizing that the actions within one county will have impacts beyond local significance.

Through updating the Dredged Material Management Plan, the local jurisdictions will be providing themselves with a tool for a coordinated approach to the management of dredged material disposal. The discussion of beneficial uses of the dredged material will give the Counties further options for the best use of their land and water resources within the coastal zone.

Columbia River Estuary Regional Management Plan, 1979, Columbia River Estuary Study Taskforce

This document is the culmination of 4 ½ years of planning by the Columbia River Estuary Study Taskforce (CREST), local jurisdictions, state and federal agencies, and concerned citizens. Impetus for developing the plan came from growing conflicts over use and development of estuarine areas. Responding to the need to preserve rapidly dwindling natural resources, particularly in coastal areas new environmental protection laws

drastically changed the ground rules for development, to the confusion of ports and the private sector. The regional plan was also in response to state coastal zone management programs and federal funding under the 1972 Coastal Zone Management Act. The needs for better management data, long term protection to critical natural resource areas, and channel development all contributed to the planning program.

The Columbia River Estuary Regional Management Plan expresses decisions of the CREST Council on estuarine management issues. The plan has no legal authority except as it is implemented by local governments in revised local comprehensive plans (Oregon) and amended local Shoreline Management Master Programs (Washington). Also, the decisions in the plan do not supercede or negate other management and regulatory authorities, except to the extent provided in state and federal consistency procedures.
Plan Includes:

- Summary of Regional Policies
- Management System and Development Standards
- Land and Water Use Plan
- Dredged Material Management Plan
- Restoration and Mitigation Plan
- Plan Implementation

Revised Columbia White-Tailed Deer Recovery Plan

The Revised Columbia White-Tailed Deer Recovery Plan, completed in 1976 by the U.S. Fish and Wildlife Service, outlined methods of re-establishing white-tailed deer near the Columbia River. Land use practices since 1972 via an interim management plan have encouraged the regrowth and reestablishment of permanent cover on many areas of the refuge with a history of heavy grazing. Continuous evaluation of deer responses to land use changes is necessary so that the proper balance between short grass/forb pastures and dense cover is maintained.

The Columbia white-tailed deer (CWTD) was Federally listed as an Endangered Species in 1968. In 1972 the Service acquired approximately 4,800 acres of CWTD habitat and established the CWTD National Wildlife Refuge with headquarters near Cathlamet, Washington. The primary objective of the refuge is to protect CWTD and their habitat. Refuge objectives for CWTD management are carried out through a variety of activities including research, areas closures, hunting prohibitions, law enforcement, grazing, haying, shrub and tree plantings, and public information and education.

In addition to direct land management, the Service is also involved in CWTD conservation by providing planning guidance, project review, consultations, and technical expertise to developers, local governments, public land management agencies and others. These actives are conducted by Ecological Services in Portland and by the Endangered Species Team in Olympia and include Section 7 consultation, recommendations resulting from permit application reviews, and comments on environmental assessments. State wildlife agencies are also directly involved in CWTD conservation through law enforcement, hunting closures and public education. Local representatives of each state agency are called upon to alleviate CWTD crop depredation problems. The environmental planning branches of each agency are also involved in the review and comment of permits, environmental documents, etc. WDG and ODFW have also been cooperators in CWTD

research projects conducted through the University of Washington and Oregon State University.

The USFWS, WDG, and ODFW are jointly involved in CWTD conservation as participants in the CWTD Recovery Team. The Recovery Team was formed in 1974, and was responsible for drafting the CWTD Recovery Plan approved in 1976.

Ecology of Bald Eagles on the Lower Columbia River

This report, written by the Oregon Cooperative Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, completed in 1988, provides information regarding diet, management implications and environmental contaminants impacting bald eagles on the Lower Columbia River.

Evaluation of live capture selective harvest methods for commercial fisheries on the Columbia River, Oregon and Washington Departments of Fish and Wildlife, 2001.

The ongoing project is a cooperative effort between the Oregon and Washington Departments of Fish and Wildlife, funded by the BPA in 2001. The purpose of the first year of the study was to determine if using tangle nets to capture spring chinook would allow for the live release of non-target species (i.e. unmarked chinook, steelhead, etc.) and to evaluate how well those fish survive after release.

Continued evaluation of new tangle net technology is necessary to observe inter-annual variation in gear performance and more precisely estimate post-release survival rates. The effectiveness of tangle nets must be evaluated on a full-fleet scale, and the appropriate gear specifications and fishing practices need further refinement. Additionally, implementation of these new techniques will require careful training of participants in the fishery and thorough monitoring of any adopted live capture fisheries.

Evaluation of Spawning for Fall Chinook and Chum Salmon just below the four Lower most Columbia River Dams, BPA project number 1999-003-001, Washington Department of Fish and Wildlife

Fish and Wildlife Program funding for this project began in October 1998 (Fiscal Year 1999). The project is composed of three closely related activities. Pacific States Marine Fisheries Commission (PSMFC) is leading the adult studies portion, ODFW is leading the juvenile studies portion, and the U.S. Fish and Wildlife Service (USFWS) is leading the habitat assessment portion of the project. ODFW and PSMFC have conducted chum salmon spawning ground surveys from The Dalles Dam downstream to the estuary, and are scheduled to continue those surveys. These two Agencies also began adult and juvenile studies in the Ives/Pierce Island complex in 1998, and those studies are also ongoing. USFWS began habitat assessment studies in 1998 and were joined by the U.S. Geological Survey (USGS) and Pacific Northwest National Laboratories (PNNL) in 1999. Habitat assessment studies are ongoing downstream from Bonneville Dam. PNNL is also assisting with portions of the adult and juvenile studies. Adult, juvenile, and habitat studies are designed to be complementary to achieve the purposes of this project, and each lead Agency is responsible for their respective objectives based on their special skills, knowledge, and experience in those areas.

Fundamental life history and habitat characteristics were described for both fall chinook and chum salmon. Evidence of fall chinook spawning below The Dalles and John Day dams and fall chinook and chum spawning below Bonneville Dam was documented. Locations of shallow and deep water redds were recorded using GPS, and a GIS map of the known spawning area was developed. Population estimates were produced for fall chinook and chum salmon spawning in the Ives/Pierce Island complex below Bonneville Dam. Fall chinook and chum emergence and emigration timing from the Ives/Pierce Island complex was determined. The physical and biological aspects of chum/chinook stranding/entrapment as a result of flow fluctuations in the Ives/Pierce Island complex were described. In-season hydrosystem management recommendations were provided to the salmon managers and hydrosystem operators regarding spawning habitat conditions and flows required for chum and fall chinook salmon to complete incubation and emergence. Extensive in-season analysis was conducted to determine flows required to protect alevins and juveniles from elevated total dissolved gas levels and stranding.

Population estimates were made for other areas where chum were present in Washington Columbia River non-index areas. At least one survey for chum was completed on each of the 33 Washington tributaries. Chum were found in only 7 of the 33 areas surveyed. The largest population between the Grays River and Hamilton/Hardy/Ives Island index populations was the Wood's Landing/Rivershore seeps near the I-205 Bridge. A total of 33 Oregon Columbia River tributaries were surveyed for the presence of adult chum salmon with only one chum observed. Based on allozyme analysis, it was determined the Ives/Pierce Island complex and Wood's Landing/Rivershore chum are relatively similar to each other and most closely related to the chum populations in Hardy and Hamilton creeks.

Earlier spawning Lower Columbia River (tule) fall chinook were documented using the Ives/Pierce Island complex. Over 100 upriver bright fall chinook redds were documented and mapped in deep water near Ives and Pierce Islands. Substrate type at the redds was characterized and velocity measurements were collected at selected redd sites. CWT's were applied to 10,000 juvenile fall chinook captured in the Ives/Pierce Island complex.

Piezometers were successfully installed within the study area, and resulting temperature data indicated a temperature gradient between the hyporheic zone and the river. Temperature data from piezometers was used to estimate emergence and emigration timing for chinook and chum in the Ives/Pierce Island complex.

Microhabitat parameters (depth, velocity, substrate, slope) were measured for spawning fall chinook and chum salmon, and geographic locations of important hydraulic features and river bathymetry were recorded and entered into a GIS. Models were developed to provide spawning and incubation flows for fall chinook and chum salmon below Bonneville Dam. A 2-dimensional hydraulic model was calibrated to provide hydraulic and physical data for habitat modeling.

Washington and Oregon Eulachon (Columbia River smelt) Management Program, Washington and Oregon Departments of Fish and Wildlife

The Washington and Oregon Departments of Fish and Wildlife conduct a small scale program of monitoring sport and commercial eulachon (Columbia River smelt) fisheries and sampling for eulachon eggs and larvae in the mainstem lower Columbia River and tributaries to index run size and to identify the extent and distribution of spawning activity of Bonneville Dam has reduced the historic extent of eulachon spawning habitat, possible reducing potential productivity and thus increasing the population's sensitivity to losses. The current egg and larvae sampling program is insufficient to insure a full assessment of spawning activity. Only selected tributaries are sampled systematically and the mainstem lower Columbia River is sampled less intensively, being restricted to a small potion of the river. A more extensive mainstem Columbia River egg and larvae sampling program is needed to properly assess harvest impacts and insure proper resource management.

Ecosystem Diagnosis and Treatment (EDT), Washington Department of Fish and Wildlife

The Washington Department of Fish and Wildlife is applying an analytical approach called EDT, a habitat-based approach for relating environmental conditions to the performance of salmon populations. EDT captures a wide range of information and makes it accessible to planners, decision makers and scientists as a working hypothesis of the ecosystem. WDFW has completed or is completing EDT modeling for the following rivers/subbasins below Bonneville Dam:

WRIA 25--Grays River Subbasin

WRIA 26--Lower Cowlitz Subbasin (Mayfield down), Toutle River Subbasin, Coweeman River Subbasin

WRIA 27Kalama River Subbasin, Lewis River Subbasin

WRIA 28 Washougal River Subbasin, Hardy, Hamilton, Duncan Creeks

Evaluation of live capture selective harvest methods for commercial fisheries on the Columbia River, Oregon and Washington Departments of Fish and Wildlife, 2001.

The ongoing project is a cooperative effort between the Oregon and Washington Departments of Fish and Wildlife, funded by the BPA in 2001. The purpose of the first year of the study was to determine if using tangle nets to capture spring chinook would allow for the live release of non-target species (i.e. unmarked chinook, steelhead, etc.) and to evaluate how well those fish survive after release. Although data analysis is ongoing, preliminary results are positive. Tangle nets can effectively capture spring chinook, and this gear, coupled with alterations in fishing methods such as reduced drift length times, using recovery boxes for released fish, and shorter nets, appear to significantly improve survival of released fish compared to conventional gill nets.

The tangle net is presently being evaluated as an alternative to the conventional gill net for spring chinook and preliminary results show that most captured fish can be released live and survive significantly better than fish released from the conventional gill net.

Expedited Reconnaissance Study 2001

This feasibility study, authorized by a resolution of the Senate Committee on Environment and Public Works, investigates and recommends appropriate solutions to accomplish

ecosystem restoration in the lower Columbia River and estuary, including wetland/riparian habitat restoration, stream and fisheries improvement, water quality and water-related infrastructure improvements.

Habitat Restoration Site Inventory 2001

Building on past restoration planning activities, CREST and LCREP continues to expand its spatially referenced habitat database identifying potential habitat restoration, protection, and enhancement opportunities in the Lower Columbia from the mouth of the Columbia to Bonneville dam. The data gathered to this point is iterative and interactive to include more site-specific conditions and reflect changes in restoration planning strategies. The database serves as the first "crack" at a comprehensive restoration strategy for the Lower Columbia.

Impacts of the Proposed Columbia River Channel Deepening Project on Fish & Wildlife Resources, Fish and Wildlife Resource Office, Oregon State University

This study, completed in 1999 by the Fish and Wildlife Resources office, Oregon State University, provided impacts of proposed deepening of the Columbia River channel on fish and wildlife resources.

Lower Columbia River Estuary Partnership Management Plan Actions Status Report, Lower Columbia River Estuary Partnership 1999

The Lower Columbia River Estuary Partnership Management Plan Actions Status Report, updated in June 2001 by the Lower Columbia River Estuary Partnership, identifies needed actions within the watershed, the lead entity to complete the action, and the status of the action. The Actions Status Report identifies 43 recent actions (past two years) described below.

1. Inventory and prioritize habitat types and attributes needing protection and conservation. Identify habitats and environmentally sensitive lands that should not be altered.

- The Estuary Partnership completed the field portion of the habitat-mapping project for the lower 46 river miles of the Columbia River in August 2000.
- The project used a successful collaboration of state, federal and local agencies, organizations and volunteers to complete the first part of the project.
- The data is being analyzed in combination to provide a comprehensive, geographically-accurate dataset on basic tidal and freshwater habitat types from the mouth to the head of Puget Island to identify important habitat for native species, prioritize habitats for protection and restoration, and develop indices of biological integrity.
- The Estuary Partnership is seeking $300,000 funding to complete the analysis of hyperspectral data collected in 2000 and to complete the project for the rest of the study area. The Corps of Engineers has agreed to fund half if the Estuary Partnership can find the remainder of the funds. The Estuary Partnership has submitted a proposal for joint funding to OWEB and the SRFB.
- NMFS is conducting an assessment of historical habitat use by salmonids. That data will help determine salmon habitat needs and priority habitats for protection and restoration.
- NMFS has completed a preliminary study on the role of the estuary in the decline and recovery of salmonids.

- The Lower Columbia Fish Recovery Board is conducting a salmonid-limiting factors analysis of the watersheds on the Washington side of the river. The mainstem of the Columbia River is included in this analysis. That analysis should be complete in the fall of 2001.
- In June 2001, the Estuary Partnership, in cooperation with the Corps of Engineers, American Rivers and CREST, hosted a workshop for habitat specialists to develop and agree to a set of criteria that can be used to evaluate habitat projects and prioritize them for protection and restoration. Over 100 people participated in the workshop. Eight workgroups developed criteria that will be synthesized into a basic set. A technical group will be formed to use the new criteria to assess possible habitat projects.
- The NWPPC will begin subbasin planning for the lower Columbia River and the Columbia River estuary provinces in July 2001. Planning will be completed in spring 2002. Areas will identify where actions need to be taken to improve fish and wildlife survival.
- NMFS completed its Biological Opinion on the operation of the Columbia River Federal Power System and identified the need to inventory and assess lower river habitat.

2. Protect, conserve and enhance identified habitats, particularly wetlands, on the mainstem of the lower Columbia River.

- In FY00, the Estuary Partnership secured $79,400 in grant funds from OR319 and WA 319 programs to hire a habitat specialist. The specialist was hired in March 2001 to work for CREST to identify specific habitats for protection, work with land owners and land conservation organizations to acquire, protect and restore important habitats, establish technical assistance team, recruit and train volunteers, and implement a test project. Project will be competed in Summer 2002. The Science Work Group oversees this project, including identification of specific habitats.
- In March 2000, Columbia Land Trust received a $999,000 grant from the U.S. Fish and Wildlife Service to purchase, protect and restore 4,400 acres in the Columbia River corridor. Most of the acreage is on the mainstem. The Land Trust will be working with Ducks Unlimited and a variety of other organizations to implement the protection and restoration activities.
- In 2000, Westport Slough was opened up to the Clatskanie River to allow more habitat access for fish. The project was completed by the Corps of Engineers in partnership with the Lower Columbia River Watershed Council and with funds from a variety of organizations. The Estuary Partnership granted $10,000 to the project but the funds were not needed and the money was diverted to other action projects.
- In 2001 the Estuary Partnership, through its mini grant program, funded several small habitat restoration projects on tributaries to the mainstem Columbia (see Action 4).
- Other organizations are actively involved in acquiring important habitat and managing restoration and protection efforts on many of the tributaries to the

mainstem Columbia, including several watershed councils on the Oregon side of the river; The Nature Conservancy; the Natural Resource Conservation Service, the Lower Columbia Fish Recovery Board in Washington, Sea Resources in Chinook, Washington, and the Pacific Coast Joint Venture.

- In the fall of 2000, Congress passed the Water Resources Development Act that authorizes the Corps of Engineers to spend up to $30 million on restoration projects in the lower Columbia River and Tillamook Bay. For FY 01-02, the Estuary Partnership is working with the Corps, Tillamook Bay and American Rivers to identify projects that could begin immediately. $7.4 million was requested.
- An ESA Executive Committee has been established to address salmon restoration planning on the mainstem Columbia River. It includes representatives from the two governors' offices, NMFS, Corps of Engineers, USFW, LCFRB, and the Estuary Partnership. They plan to identify possible salmon habitat restoration projects.
- In addition, the U.S. Army Corps of Engineers is actively seeking restoration sites as part of the requirements of the Biological Opinion on the Channel Deepening Project.
- Finally, protecting and conserving habitats and sensitive lands is the focus of major efforts in both Washington and Oregon with respect to endangered salmonid populations. The fish and wildlife agencies in both Oregon and Washington are leading this effort with extensive collaboration from all the natural resource agencies in both states as well as watershed councils and other groups. Most of this effort is focused on the tributaries to the Columbia River.

3. Adopt and implement consistent wetland, riparian, and instream habitat protection standards to increase the quality and quantity of protected habitat to protect aquatic species.

- Using EPA Wetland Protection Grant funds, the Estuary Partnership contracted with CREST to assess current wetland protection laws and develop methods to better coordinate and gain consistency. CREST developed the WIRED database to track wetland projects. That project is complete and in use.
- With a second EPA Wetland Protection Grant, CREST developed a database of potential restoration sites with maps and detailed descriptions for many of the sites. That database is contained in WetMAP and is being used to help identify potential habitat projects.
- In June 2001, the Estuary Partnership, in cooperation with the Corps of Engineers, American Rivers and CREST, hosted a workshop to identify criteria for selecting and prioritizing habitat protection and restoration sites. In addition to developing consistent criteria, the process will eventually lead to a consistent, science-based process for selecting habitat projects and tracking their implementation and effectiveness over time.
- OWEB and the SRFB are independently developing guidelines for assessing habitat condition. Such guidelines should ultimately lead to a more consistent process for funding and evaluating projects.
- There are nationwide efforts to develop habitat protection protocols and monitoring standards. A variety of techniques have been developed and several programs have

been implemented on the state and local level around the country, but universally accepted standards are still not available.

4. Preserve and/or restore buffer areas in appropriate locations along tributaries and the Columbia River to a condition that is adequate to maintain a healthy, functioning riparian zone for the lower river and estuary.

- This project is included in the Foundation Fund-Raising Strategy.
- Sea Resources in Chinook, Washington is in the process of restoring riparian areas along the tidal portions of the Chinook River, planting native vegetation and installing large woody debris. Grants from the Estuary Partnership have helped fund a portion of this work. In 2001, Sea Resources acquired two SRFB grants to acquire and restore portions of the Chinook River watershed. These grants will go together with the 900-acre Chinook River habitat restoration project funded through the Columbia Land Trust.
- In 2000, the Estuary Partnership funded several small restoration projects that were completed. These included restoring large woody debris to lower portion of Lewis and Clark River, restoring riparian habitat on Hall Creek, and restoring riparian habitat along Hardy Creek.
- In 2001, the Estuary Partnership is funding restoration work in Multnomah Channel for native turtles, riparian habitat improvements on Hardy Creek and Gnat Creek, and identification of fish passage barriers in the Scappoose Bay watershed.
- A variety of other organizations are actively involved in preserving and restoring riparian habitat on many of the tributaries to the mainstem Columbia, including: several watershed councils on the Oregon side of the river, The Nature Conservancy, Columbia Land Trust, the Natural Resource Conservation Service, the Lower Columbia Fish Recovery Board in Washington, Washington Fish and Wildlife Department, U.S. Fish and Wildlife, the Oregon Department of Fish and Wildlife and other participating agencies in the Oregon Plan. Projects include:
  1) The Corps of Engineers is cooperating with Vancouver Parks and Clark County to restore 120 acres of riparian, forest and marsh habitat on Salmon Creek.
  2) The Columbia Land Trust received two grants from the SFRB to restore 500 acres in the Grays River watershed.
  3) The Lower Columbia Fish Recovery Board is the lead entity for numerous projects in the lower Columbia area. Most are funded by the SRFB but WADOT and WDFW are funding some. They include 8 acquisition/restoration projects, 20 riparian restoration projects, 11 fish passage projects and 7 watershed assessments.
  4) There are also projects on tributaries to the lower Willamette River including Columbia Slough and Johnson Creek.

5. Restore 3000 acres of tidal wetlands along the lower 46 river miles to return tidal wetlands to 50% of the 1948 level.

- The 2000 NMFS Biological Opinion for the Operation of the Federal Power System on the Columbia River calls for the restoration of 10,000 acres of tidal habitat by 2010 (half the time called for in the Management Plan). BPA, the Corps, NMFS, USFW and other are in discussions about how to address this issue.

- The Year 1 goal for the Estuary Partnership is 500 acres of restored wetlands. That goal has not been met. However, numerous projects are underway that will ensure this goal is met in the next year.
- CREST (with the Science Work Group) has developed an inventory of potential wetland protection, enhancement and restoration sites for the Estuary Partnership using EPA Wetland Planning Grant monies. The WetMAP database has a large number of potential sites identified including background data for many of the sites. The Estuary Partnership, CREST, the Corps and others have been continuing to develop that list of projects. An ESA Executive Committee has been established to help oversee project development and coordinate ESA activities on the mainstem lower Columbia River.
- In June 2001, Workshop on Habitat Conservation and Restoration Projects in the Lower Columbia River and Estuary used the database and habitat inventory work to help develop criteria for prioritizing habitat protection and restoration sites. In the next few months the criteria will be refined and a list of prioritized sites developed. Funding through the WRDA will be used to implement projects in FY 02-03.
- 319 grant funds from Oregon and Washington are being used to fund a habitat specialist to move the habitat prioritization process forward. The specialist will work with the scientific community, the Science Work Group, to identify possible sites and work with local landowners and land conservation organizations to develop ways to acquire important habitats for restoration.
- In March 2000, Columbia Land Trust received a $999,000 grant from the U.S. Fish and Wildlife Service to purchase, protect and restore 4,400 acres in the Columbia River corridor. The project is currently underway. The Land Trust will be working with Ducks Unlimited and a variety of other organizations to implement the protection and restoration activities. Approximately 900 acres are estuarine habitat on the Chinook River. If the tidegate can be removed or modified at the Chinook River mouth, that will once again be tidally influenced.

6. Monitor the effectiveness of habitat protection, restoration and mitigation projects.
   - The Estuary Partnership, through the Science Work Group, will establish a team of technical experts from participants in the June 2001 habitat workshop and the Science Work Group. Those experts will work directly with the habitat specialist hired with OR and WA 319 funds to develop criteria to assess wetland conditions and monitor them over time to make sure they are functioning as expected and being properly maintained.
   - The Estuary Partnership's long-term monitoring strategy has a habitat-monitoring component. The following summarizes the implementation status of the elements of the habitat-monitoring component:
     1. Hold biological integrity workshop: The Estuary Partnership hosted a biological integrity workshop in May 1999 near Sandy, Oregon. Approximately 55 attendees identified the need to develop indicators of biological integrity for ecosystem subunits such as habitat, fish, macroinvertebrates, etc. and to develop overall suite of indicators of ecosystem condition or health. Workshop attendees also identified

need to develop highly detailed habitat data as first step to understanding ecosystem. A workshop summary was completed and distributed.
2. Share habitat data: In 2000, the Estuary Partnership implemented a comprehensive, high-resolution habitat mapping and assessment project. Raw habitat data and classified habitat data on GIS maps will be made available to interested parties.
3. Develop habitat-monitoring procedures: Discussions have been ongoing in the Science Work Group and other forums about appropriate monitoring and evaluation procedures. Discussions have also occurred regarding the use of indicators of habitat condition. No decisions have been made, but it is planned to set up a technical workgroup to tackle this issue.
4. Survey existing habitat metadata: In March 2001, with funds from OR and WA 319 programs, Estuary Partnership and CREST hired a habitat specialist to evaluate existing data and new data from aerial mapping work and develop scheme to prioritize sites for protection and restoration.
5. Develop habitat-monitoring scheme: Discussions are ongoing about how to ensure monitoring and evaluation are built into every habitat project and how to ensure that M & E efforts are funded. Any overall habitat-monitoring scheme for the lower river will be dependant on project selection efforts and results of analysis of habitat data from 2000 survey work and funding availability.
6. Hold habitat monitoring workshop: A workshop on developing habitat protection and restoration criteria was held on June 12-13, 2001 in Astoria. Over 100 people attended. Eight workgroups developed possible criteria and tested them against two proposed projects. A workgroup will be established from the attendees and overseen by the Science Work Group and will carry on with refining criteria and prioritizing protection and restoration sites. Indicators of habitat condition will be developed to provide the basis for long-term habitat monitoring.
7. Conduct remote sensing using satellite images and hyperspectral imaging to map and characterize habitat: Landsat images at 25m and 15m resolution were acquired in 2000. The GIS habitat classification of the entire study area will be completed in late summer 2001. The lower 46 miles of river were flown in July 2000 to gather hyperspectral habitat data. Data was collected for three target areas in conjunction with on-the-ground field data using 50 volunteers. Some of the data has been processed, but there are insufficient funds to complete the analysis or continue the work upriver.
8. Conduct system-wide bathymetry survey: No system-wide effort is scheduled. Some limited work is being done by OGI in the estuary.
9. Reconstruct historical habitat structure: NMFS using BPA funds will be reconstructing historic patterns of salmonid use of the estuarine habitat in summer and fall of 2001.

7. Develop floodplain management and shoreland zoning protection programs.
   - The Association of Counties is challenging the Department of Ecology's updated Shoreline Guidelines.

- During the 2001 legislative session, the Department of Ecology and the governors requested that funds be provided for updates and that the two-year compliance deadline be extended. Both requests failed to pass. The Department of Ecology will once again seek funds and a time extension in the 2002 session. Currently, no lower Columbia River communities are in the process of updating their shoreline guidelines.
- The Washington State Departments of Fish and Wildlife (WDFW), Ecology (Ecology), and Transportation (WSDOT) are developing Aquatic Habitat Guidelines employing an integrated approach to marine, freshwater and riparian habitat protection and restoration. This is a technical assistance program and not a regulatory program.
- Guidelines are being developed for stream habitat restoration and channel design, treated wood issues, on- and over-water structures in marine and freshwater ecosystems, marine and estuarine shoreline modification issues, water crossings, floodplain and riparian corridor issues, and dredging/gravel removal in marine and freshwater ecosystems.
- At the Department of Ecology, the guidelines will become an integral part of implementing the Shoreline Management Act and overseeing local shoreline master programs.
- Prior to Ecology's effort to seek funds and a time extension in the 2002 session, several local governments are using Coastal Zone Management or local funds to begin work on local updates. The shoreline regulations would apply to individual projects after the local government amends its local master program.
- The Southwest Washington Coastal Erosion Study is a federal-state-local cooperative research program to address the coastal geology, processes and natural hazards of the southwest Washington coast. The project involves fundamental and applied studies to develop a regional perspective and understanding of coastal processes, sediment transport, and associated shoreline changes. This project will examine the effects of man-made influences (enhanced runoff, dredging operations, Columbia River dams) and natural processes (climate variability, co-seismic subsidence, coastal dune development) on sediment budgets and on the long-term shoreline change trends and stability of the southwest Washington coast. The study area includes the 165 km littoral cell from Tillamook Head, Oregon to Point Grenville, Washington.

8. Reduce the volume and velocity and improve the water quality of stormwater runoff in developed areas.

- Much activity continues to take place throughout the region on stormwater issues. The Urban Watershed Institute hosted its second annual Stormwater Matters Conference in May. The focus was on transportation and stormwater.
- Native landscaping seminars designed to educate homeowners about the benefits of naturescaping continue to take place across the region.
- The Estuary Partnership's Nonpoint Education for Municipal Officials (NEMO) Project is ongoing in the communities of Longview, WA and Oregon City, OR. The Project is examining local ordinances for requirements that inhibit innovative

stormwater practices, developing both existing and future impervious surface maps, and making educational presentation to local officials and neighborhood groups.

- City of Portland Clean River Incentive and Discount Program.
- The program provides stormwater discounts to ratepayers for existing private stormwater management facilities. Also, the program provides financial incentives, technical assistance and public education resources to ratepayers who wish to add or upgrade private stormwater management facilities.
- The City of Portland also recently released it Clean River Plan. Stormwater Management is a central component of the plan.
- The Regional Coalition for Clean Rivers and Streams (a group of agencies and municipalities in the Portland/Vancouver metro area) developed a public education campaign on the impacts of stormwater runoff pollution.
- Metro released a draft Green Streets Handbook in May 2001 that details ways to provide efficient multi-modal transportation systems that protect the region's stream system.

9. Use tools and incentives in local planning ordinances and state laws to ensure that development is environmentally sensitive.

- The Estuary Partnership's NEMO Program with Oregon City and Longview partially addresses many aspects of this action. In particular, the project will be comprehensively assessing Longview's and Oregon City's local ordinances to identify obstacles to environmentally sensitive development.

10. Establish, or modify, minimum flows (including Columbia River flows) to meet instream fish and wildlife needs. Evaluate the cumulative impact of all proposed water withdrawals, diversions, or instream structures to ensure that established minimum flows are maintained.

11. Avoid the introduction of unwanted exotic species and control the deliberate introduction of desirable exotic species in the lower Columbia River and estuary.

- The Estuary Partnership participates in the NW Ballast Water Work Group coordinated by Sea Grant and the Aquatic Nuisance Species Work Group coordinated by the Corps of Engineers. Both of these groups share information, do public outreach, and are seeking ways to address exotic species problems on a regional basis. The Estuary Partnership will also be on the technical advisory committee to oversee implementation of the lower Columbia River aquatic nuisance species survey scheduled to begin in the fall of 2001.
- The Estuary Partnership's long term monitoring strategy has a specific component for monitoring exotic species. The following is a summary of the implementation status of each of the elements of the exotic species monitoring actions.
  1. Develop agreements to share data and develop consistent monitoring procedures: Technical Advisory Committee in place to oversee implementation of lower Columbia River aquatic nuisance species survey. Committee will address issues of sharing data and developing standard monitoring protocols. There is also a

proposed bill in the Oregon legislature to set up an Invasive Species Coordination council of key resource management agencies.
2. Evaluate existing information on exotic species to begin developing strategy for monitoring: U.S. Coast Guard and U.S. Fish and Wildlife are funding the lower Columbia River aquatic nuisance species survey. A consortium of universities (PSU, OSU and UW) will conduct the survey. The first step in the survey, which is scheduled to begin this fall, is to evaluate existing information and formulate a sampling plan. The literature review and sampling plan development will be done in early summer 2002.
3. Implement sampling plan aimed at species not currently being sampled: Based on the literature review, monitoring will focus on information gaps and building the database. Monitoring will begin in summer 2002. There is limited monitoring going on at present to look for green crabs, Chinese mitten crabs and purple loosestrife. The green crab project and the Purple loosestrife project are funded through the Estuary Partnership's mini grant program. The mitten crab project is funded through PSU.
4. Evaluate impacts of exotic species: An evaluation of impacts will not be feasible until results of survey are complete at the end of 2003. No actions currently planned.
5. Develop strategy for monitoring introduction: Port of Portland is currently undertaking a risk assessment on ballast water discharge in the lower Columbia River. There is a proposal in Congress to evaluate ballast water introductions and build on the Port study. There would be a detailed look particularly at bulk carriers and barges. There is also a bill in the Oregon legislature to make it mandatory for vessels to exchange ballast water at sea. In Washington, ballast exchange at sea is already mandatory.
6. Create educational program: Both Oregon and Washington have statewide ANS management plans that include education and outreach elements. Washington has an active program with 1 FTE devoted to plan implementation**.** Oregon is doing limited outreach using interns when available**.** Oregon and Washington Sea Grant (MIST) have active education and outreach programs directed at invasive species. That work is closed tied to national efforts directed through the National Invasive Species Act of 1996.
7. Implement program to monitor mechanisms of introduction: No action, awaiting data from survey.
8. Develop agreements to implement ongoing program to assess impacts of exotic species: No action, awaiting data from survey.
9. Expand educational efforts: Education and outreach has been expanding and will likely continue. LCREP has incorporated information about exotic species in its presentations to schools.

12. Require human-caused changes in the river morphology and sediment distribution within the river channel and estuary to be managed so that native and desired species are not harmed.

- The NMFS withdrew its initial no-jeopardy opinion on the Columbia River Channel Deepening Project in August 2000, effectively putting the project on hold. Since then, the Ports, Corps, NMFS and USFWS have been working in a collaborative process to try to more accurately assess the biological issues. NMFS expects to issues a draft Biological Assessment in Sept/Oct and a final Biological Assessment in Oct/Nov. Currently, they expect a draft Biological Opinion to be released in Jan/Feb 2002 and a final Biological Opinion in Feb/March 2002. As part of this process, numerous additional studies have been undertaken.
- Washington's updated Shoreline Guidelines were invalidated by the Shorelines Hearings Board – See Action 7.
- The Oregon Division of State Lands (ODSL)is nearing completion of a three-year project that has identified and documented all docks, piers, tidegates and other structures on the Oregon side of the lower Columbia River. Washington Dept. of Natural Resources continues work on a similar project on the Washington side.
- ODSL is also working with the U. S. Army Corps of Engineers to develop a type of "one-stop permit" for state and federal permits required for removing material or filling in streams and wetlands for certain projects meeting prescribed conditions.

13. Create an entity that serves as an advocate for the lower Columbia River and estuary and carries out the goals of the *Management Plan.*

- Columbia River Foundation, a 501(C)(3), was formed to assist in fund raising and administrative oversight.
- The Implementation Committee was formed in July 1999 to oversee Management Plan implementation. The committee was comprised of 38 members representing various interests and agencies involved with the lower river.
- On July 1, 2001, the Lower Columbia River Estuary Program and the Columbia River Foundation merged to form the Lower Columbia River Estuary Partnership. The purpose and functions of the Estuary Partnership remain the same.
- The Implementation Committee became the Board of Directors.
- Public and private fund-raising strategy underway; a private foundation gift of $250,000 received for educational programs; the second annual Founders Dinner and family event is planned.
- The Estuary Partnership worked with a number of partners to secure passage of Water Resources Development Act 2000 which authorized $30 million to implement Columbia River and Tillamook Management Plans. Parties continue to work with Congress to secure appropriation.
- Annual status report of implementation has been prepared.
- At the request of the Governors, LCREP has convened an ESA executive committee to coordinate restoration efforts. (See action 18.)
- Stewardship for the lower River is developed through the Education program. (See action 15.)
- Coordination is happening largely through ESA committees and NWPPC planning process.

14. Establish a common vision for and unified commitment to the health of the river.

- Estuary Partnership hosted the Endangered Species Recovery Forum September 19, 2000. Representatives from state and federal agencies and the governor's offices of Oregon and Washington attended to discuss the Estuary Partnership's role in ESA issues and discuss various efforts underway regarding ESA.
- With a request from the Governors for the Estuary Partnership to help coordinate species recovery and get on the ground actions, the Estuary Partnership convened the Endangered Species Act Forum attended by stakeholders, interested parties, state and federal agencies, and the governors' offices of Oregon and Washington on January 11, 2001. The group evaluated how to modify or adjust the Estuary Partnership Management Plan so that it could become a stronger tool for species recovery and support existing ESA recovery plans and efforts.
- The Governors formed an ESA Executive Committee to continue the work begun at the forum, and they asked the Estuary Partnership to coordinate the work. The Committee is charged with aligning the Management Plan and the BiOp, identifying priority actions to undertake in the next five years and working collaboratively to secure funding for them.
- In June, the ESA Committee took on an expanded role of helping NMFS to coordinate development of the Phase 2 recovery standards. In August, the Estuary Partnership was appointed by the NWPPC to serve as lead entity for subbasin summary and plan development.
- On June 12-13, 2001, the Estuary Partnership, American Rivers, CREST and the Corps of Engineers hosted a Habitat Protection and Restoration Workshop. The participants worked to identify the ecological values and processes that are important to the lower Columbia River and to determine what criteria can be used to develop habitat protection and restoration priorities.
- The Estuary Partnership has been working with Oregon Watershed Councils to develop a unified message for the lower Columbia River that will be displayed on materials distributed to the public.
- In a number of forums held by the Estuary Partnership and in meetings with various parties active on river issues, there is an interest in having the Estuary Partnership be the entity that coordinates various activities and efforts on the lower river and estuary. The Estuary Partnership is perceived as a body that has no vested interest other than doing what is good for the ecosystem. It is a two-state body that can be objective in presenting information.

15. Provide public information and education efforts about the lower river and estuary that focus on endangered species, habitat loss and restoration, biological diversity, and lifestyle practices and connections to the river.

- July 2000: Education Coordinator and Volunteer Coordinator positions were filled.
- In September 2000, the Estuary Partnership kicked off the new Kids for Columbia Club. This new program celebrates the contribution that children can make toward protection of the lower Columbia River.
- The September kick-off was also the first annual Founders Dinner and Family Festival. This event had nearly 150 people in attendance, including over 30 children. Gov. Kitzhaber and First Lady Kitzhaber attended and were the first

signers of the Fish Friendly pledge, a new program in partnership with the City of Portland to raise awareness of individual impacts on the lower Columbia River. Planning is underway for the second annual dinner and festival. The Governors and First Ladies are honorary chairs.

- The Estuary Partnership released the 2001 Kids for the Columbia Club calendar. This calendar featured artwork collected at the 2000 Family Festival. This calendar was distributed to all Fish Friendly pledge takers and Kids Club members, artists in the calendar, and fourth-grade teachers throughout the study area.
- The Estuary Partnership began class visits to classrooms throughout the study area. These visits cover topics such as watersheds, food webs, wetlands and water quality. Visits have included, in some cases, volunteer projects. These visits started in February 2001. Through the end of the school year, 67 classes were visited and 1500 students were reached.
- Crossing Boundaries program: Astoria Middle School, Astoria High School, Broadway Middle School in Seaside, Warrenton, and Hilda Lahti Elementary School in Knappa have been actively involved in watershed education through hands-on fieldwork. While each school may do slightly different activities, the main subjects covered by each school in the Crossing Boundaries program includes water quality monitoring, fish, forestry, soils and watersheds. Typical activities include seventh grade weekly visits to the Youngs Bay hatchery to monitor water quality and measure fish growth to determine the K factor, and macroinvertebrate studies, forestry studies by the eighth graders, and other similar activities.
- Four weeks of Headwaters to Ocean boat trips have been scheduled. In all, this particular program will reach nearly 1000 students and citizens. Through the OWEB grant process, the Estuary Partnership received almost $34,000 to continue the program in Spring 2001. Four weeks of community trips were scheduled in Scappoose, Clatskanie, St. Helens and Astoria, but because the H20 boat was out of commission, the four weeks of trips have been rescheduled for fall of 2001.
- The Estuary Partnership is currently in the process of updating and improving the program web site. Changes, which will include a kids' section, more graphics and photographs and program updates should be complete by Summer 2001.
- Many other education and outreach activities continue to take place throughout the region.

16. Use best management practices to reduce non-point source pollution.
    - The Estuary Partnership NEMO Project continues. Presentations have been made to City Councils and Planning Commissions in both Oregon City and Longview.
    - State agencies continue to work with their constituents to implement Best Management Practices, with a particular emphasis on water conservation measures this year because of the drought.
    - The Oregon Dept. of Land Conservation and Development Water Quality Model Code Guidebook contains a large best management practices (BMPs) section.
    - Metro's draft Green Street Handbook also details a number of transportation-related BMPs for more environmentally-sensitive development.

17. Help local governments implement federal, state and local environmental and land use laws.

- The Estuary Partnership currently has two pilot cities (Oregon City and Longview) as part of the NEMO Project. Several presentations have been made to the planning commissions in both cities and more presentations are planned. Additionally, a contractor has been selected to do the majority of the technical work related to land use laws.
- The National Marine Fisheries Service sponsored 22 4(d) rule workshops in Oregon and Washington in September-November of 2000. These workshops were designed to educate federal, state, regional and local governments, watershed councils, community groups and private citizens about the implementation of the 4(d) rule at the local level.

18. Coordinate federal and state threatened and endangered species recovery activities in the lower Columbia River and estuary and help local communities meet species recovery requirements.

- Estuary Partnership hosted the Endangered Species Recovery Forum on September 19, 2000. Representatives from state and federal agencies and the governors' offices of Oregon and Washington attended to discuss the Estuary Partnership's role in ESA issues and discuss various efforts underway regarding ESA. Members continued to meet periodically throughout 2000 to share information.
- With a request from the governors for the Estuary Partnership to help coordinate species recovery and get on-the-ground actions, the Estuary Partnership convened the Endangered Species Act Forum attended by stakeholders, interested parties, state and federal agencies, and the governors' offices of Oregon and Washington on January 11, 2001. The group evaluated how to modify or adjust the Estuary Partnership Management Plan so that it could become a stronger tool for species recovery and support existing ESA recovery plans and efforts.
- The governors formed an ESA Executive Committee to continue the work begun at the forum and they asked the Estuary Partnership to coordinate the work. The Committee is charged with aligning the Management Plan and the BiOp, identifying priority actions to undertake in the next five years and working collaboratively to secure funding for them.
- In June, the ESA Committee took on an expanded role of helping NMFS to coordinate development of the Phase 2 recovery standards. In August, the Estuary Partnership was appointed by the NWPPC to serve as lead entity for subbasin summary and plan development.
- On June 12-13, 2001, the Estuary Partnership, American Rivers, CREST and the Corps of Engineers hosted a Habitat Protection and Restoration Workshop. The participants worked to identify the ecological values and processes that are important to the lower Columbia River and to determine what criteria can be used to develop habitat protection and restoration priorities.

19. Enforce existing environmental and land use laws.

- DEQ has revised its Enforcement Procedure and Civil Penalties rule, which broadens the scope of water quality violations likely to be referred for civil penalty, clarifies the seriousness of water quality violations, and increases civil penalties for water quality violations. DEQ also allows civil penalties to be mitigated through "Supplemental Environmental Projects," which direct penalty money to specific environmental enhancement projects. DEQ maintains an active education program to help the public and regulated community understand the laws, rules, and environmental harm resulting from violations, and publishes an annual enforcement report documenting the number and types of formal enforcement actions.
- Both Washington (Ecology) and Oregon (DLCD) have state statutes describing the state interest and expectations for local land use planning. Once land use plans are in place, compliance with land use plans and ordinances is enforced at the local level.
- Tribes can exercise authority similar to that discussed above for the states on tribal reservation lands.
- DEQ and Ecology both regularly release lists of enforcement actions and fines assessed for environmental infractions.

20. Improve coordination among government agencies.
    - A forum was held on monitoring and research (March 21, 2000) to identify what entities were engaged in what type of monitoring and research. The activities of this group will be folded into the Estuary Partnership Science Work Group.
    - A forum was held with permit holders and regulators (April 20, 2000) to discuss opportunities to make more use of monitoring done as part of the permit process.
    - The Estuary Partnership convened federal and state parties involved with ESA on Jan 6, 2000 and May 18, 2000 to discuss various efforts underway regarding ESA. The participants expressed an interest in meeting on a regular basis. One outcome of the meetings will be to help define what help can be provided by whom (including the Estuary Partnership) to local governments as they address ESA issues.
    - The Estuary Partnership convened federal and state parties involved in ESA on September 19, 2000 to discuss the Estuary Partnership's role in ESA issues and discuss various efforts underway regarding ESA.
    - On January 11, 2001, the Estuary Partnership convened the Endangered Species Act Forum attended by stakeholders, interested parties, state and federal agencies, and the governors' offices of Oregon and Washington. The group evaluated how to modify or adjust the Estuary Partnership Management Plan so that it could become the primary tool for species recovery and support existing ESA recovery plans and efforts.
    - The Estuary Partnership established a Science Work Group to meet monthly to provide scientific guidance to the Estuary Partnership and promote sharing of information and coordination among government agencies.
    - The Oregon Watershed Enhancement Board has published "A Guide to Oregon Permits" issued by State and Federal Agencies.

- The Estuary Partnership staff have inventoried municipalities to determine current access to the Internet. Approximately four municipalities out of the 41 do not have Internet access.
- The Ecosystem Restoration Information Center (discussed under Action 27) is the beginning of a clearinghouse. The Information Strategy deals with the web site as a means of providing access to data. The monitoring forum held March 21, 2000 discussed the need for a web site. The Science Group will oversee this aspect of the action.
- There is no Estuary Partnership activity providing mechanisms for information flow, developing or maintaining a catalog of permit agencies, providing points of contact, or developing a clearinghouse due to inability to access state funds.

21. Design, support and agree to use dispute resolution processes leading to resolution of institutional conflicts that affect the river.

- In conjunction with the Oregon Community Dispute Resolution Program, a new Community Dispute Resolution Center will soon open in Clatsop County.
- There is also a dispute resolution center in Vancouver, called Community Mediation Services.

22. Develop and implement consistent water quality related activities, laws, rules, and standards. Focus on function and performance of ecosystems.

- On March 21, 2000, the Estuary Partnership hosted a forum on research and monitoring activities in the lower Columbia River. Participants included local, state and federal agencies and university researchers. The purpose of the meeting was to identify who was doing what, where the gaps are, and how the various organizations can be better coordinated. Several participants agreed to become members of the Estuary Partnership's Science Work Group.
- On April 20, 2000, the Estuary Partnership hosted a forum for major permitted dischargers on the lower Columbia and the state water quality regulatory agencies, DEQ and Ecology. The purpose of the meeting was to discuss monitoring on the river and what opportunities may exist to cooperate in implementing the Estuary Partnership's long-term monitoring strategy. A small work group has been formed to continue this dialogue.
- The Estuary Partnership's Science Work Group, which includes local, state and federal agencies and university researchers, meets monthly to provide scientific guidance to the Estuary Partnership and promote sharing of information and coordination of efforts. The SWG has been assessing the Estuary Partnership's Long-term Monitoring Plan in order to prioritize monitoring efforts.
- On June 12-13, 2001, the Estuary Partnership, American Rivers, CREST and the Corps of Engineers hosted a Habitat Protection and Restoration Workshop. The participants worked to identify ecological values and processes that are important to the lower Columbia River and to determined criteria for developing habitat protection and restoration priorities.

23. Establish an award program to promote successful stewardship and pollution prevention activities.

- The Estuary Partnership put together guidelines and procedures in March 2001. The awards program was announced in May 2001 and the first annual awards were given out at the 2001 Family Festival in September.

24. Administer grant programs to assist users with *Management Plan* implementation and to assist schoolchildren in educational efforts that focus on endangered species and habitat loss.

The Estuary Partnership awarded $50,000 FY99-00 for the following projects that are now complete:

- Nicolai-Wickiup, Skipanon, and Youngs Bay Watershed Councils for four habitat restoration and assessment projects.
- Chinook Trails Association for riparian restoration on Hardy Creek.
- Columbia Slough Watershed Council for a project to try to control purple loosestrife in wetlands associated with Columbia Slough.
- Sea Resources for the development of a native plant nursery.
- Northwest Ecological Research Institute for habitat restoration on Hall Slough.

In FY 00-01 the Estuary Partnership will award $48,705.00 for the following projects that are currently underway:

- Scappoose Bay Watershed Council to complete a comprehensive fish passage barrier assessment and prioritization project.
- Headwaters to Ocean (H2O) to conduct three trips on the Columbia River in the H2O vessel for boys and girls to inspire them to become involved in environmental issues.
- Ridgefield High School to implement an interdisciplinary environmental education adventure involving the biology, physical science, horticulture, and manufacturing technology departments.
- CREST will monitor the presence, abundance, and distribution of invasive crab species in the Columbia River estuary working with local schools.
- METRO will introduce basking structures and track selected turtle and amphibian populations as part of a plan to restore and monitor approximately 325 acres of floodplain habitat along Multnomah Channel.
- The Chinook Trail Association will relocate a mile of trail along Hardy Creek to reduce siltation and enhance chum salmon habitat.
- Clatsop Soil and Water Conservation District will document the extent of purple loosestrife infestation in the Youngs Bay Estuary.
- CREST will work with students from the Crossing Boundaries program to place interpretive signs along a nature trail at the Gnat Creek Fish Hatchery for self-guided tours and train the students in watershed education and water quality monitoring techniques.

Total number of grants awarded to date: 32
Total amount awarded to date: $300,000

25. Coordinate volunteer monitoring programs and create or coordinate volunteer opportunities on the lower river.

- The Estuary Partnership provided funds ($49,000) to CREST to assess volunteer monitoring effects in the study area, identify gaps and needs, and propose a mechanism to coordinate volunteer efforts on both sides of the river. The report is complete.
- The Estuary Partnership staff attended the National Volunteer Monitoring Conference in Austin, Texas in April 2000. NW Volunteer organizations are anxious to see better coordination among the various groups and have recommended that EPA take a lead in providing regional coordination.
- The Estuary Partnership has hired Jennie Boyd to be the volunteer coordinator. Jennie has been addressing recommendations made in the CREST report completed in 2000, planning volunteer projects on the Columbia River to fill data gaps, and recruiting volunteers to participate in these projects.
- The Estuary Partnership has recruited volunteers to participate in SOLV's "Down by the Riverside" project, the Estuary Partnership's habitat inventory project (2000, 2001) and has already recruited hundreds of volunteers to participate in the Estuary Partnership's Snapshot Water Quality Monitoring Event. This event was held on September 28-29, 2001 and provided citizens the opportunity to experience the Columbia River and learn about water quality
- The Estuary Partnership, in coordination with Oregon DEQ, has held several water quality training sessions to teach consistent protocols and procedures for testing water quality.
- Washington has developed a statewide Naturemapping Data Bank for reporting, storing and retrieving water quality data collected by volunteers and students. Additional funding is needed to expand this system to include the lower Columbia River and the Oregon portion of the Estuary Partnership study area and for expanding to include other data.
- The Estuary Partnership secured OR 319 funds to work with CREST to recruit and train volunteers to do habitat restoration.

26. Identify and improve points of public access to the river. Ensure that access does not cause further loss or degradation of habitat, increased erosion, loss of riparian vegetation, or degradation of water quality.

- The Estuary Partnership will take the lead on developing and promoting the Lower Columbia River Water Trail. On August 27, 2001 the Partnership hosted a meeting designed to re-energize the water trail concept. Forty stakeholders attended the meeting and expressed enthusiastic support for the water trail concept moving forward quickly and for the Estuary Partnership taking the lead while working with an advisory group comprised of stakeholders.
- The National Parks Service Rivers Trails and Conservation Assistance (Rivers and Trails) program helped plan and facilitate the August 27 meeting. The Estuary Partnership requested and was granted Technical Assistance from Rivers and Trails to help develop the water trail.

- The Water Trail will increase public access to the lower Columbia River, unite communities around a common positive theme, be a forum for environmental, historical and cultural interpretation, and tie into the upcoming Lewis and Clark exhibition.

27. Implement the Estuary Partnership information management plan.
    - The Estuary Partnership is entering into a partnership with Oregon Graduate Institute to establish ERIC, an Ecosystem Restoration Information Center.
    - All the stakeholders in the study area have identified information-sharing as a critical need. Whether it is technical data or information about progress and events, people would like to have one place that could link them to information and data about the lower Columbia River. The Estuary Partnership developed a data and information management strategy during the development of its management plan. That strategy has yet to be implemented due primarily to a lack of adequate funding.
    - This issue is currently being considered by the Estuary Partnership's Science Work Group, which meets monthly and has representation from many of the key information-gathering agencies. The Science Work Group will be developing a strategy to move this issue forward in 2001.
    - Estuary Partnership has completed a literature review and has available on floppy disk a listing of much of the technical literature published on the lower Columbia River. Other organizations such as NMFS and CREST have been looking at available literature on salmonid use of the estuary and habitat data. These various data searches will be consolidated.

28. Implement the Estuary Partnership long-term monitoring plan.
    - The Habitat inventory described in Action 1 is addressing part of the habitat-monitoring element of the monitoring plan. Monitoring of the lower 46 miles of the river was completed in August 2000. Accurate GIS habitat maps for that portion of the river have been developed and some of the high resolution data has been analyzed. The data are being used to identify critical sites and develop indices of biological integrity. Phase 1 ($100,000) was funded by the Estuary Partnership. Phase 2 ($300,000), which would provide high resolution for the entire 146 river miles, has not been funded. Several requests are being made to public and private sources.
    - DEQ and the Estuary Partnership are coordinating with the EPA's Environmental Mapping and Assessment Program to characterize the condition of Oregon coastal estuaries and the lower Columbia River using a random, probabilistic sampling scheme. In 1999, 27 samples were taken in lower Columbia River bays, and in 2000, an additional 50 monitoring sites were sampled on the lower river from the mouth to Bonneville. Results from the analysis of that data will be contrasted with data from the 1991 and 1993 bi-state monitoring to identify changes and help pinpoint monitoring sites and needs for the long-term monitoring strategy.
    - $24,000 of the Estuary Partnership's funds have been allocated to add 2-3 ambient monitoring sites on the mainstem Columbia for FY 01-02. The Estuary Partnership

has developed an agreement with DEQ to add these sites to its ambient monitoring program. In 2000, the three sites were monitored every other month for basic water quality parameters. The 2001 monitoring is ongoing. Ultimately this data will be used to develop a water quality index for the lower river. In addition, the DEQ undertook special surveys in the summer of 2001 to characterize dissolved oxygen and pH levels in the lower river at selected sites to assess the need for TMDL action.

- The Estuary Partnership, CREST, American Rivers and the Corps of Engineers jointly hosted a workshop on developing habitat protection and restoration criteria on June 12-13, 2001 in Astoria. Over 100 people attended. Eight workgroups developed possible criteria and tested them against two proposed projects. A workgroup will be established from the attendees and overseen by the Science Work Group and will carry on with refining criteria and prioritizing protection and restoration sites. Indicators of habitat condition will be developed that will provide the basis for long-term habitat monitoring.
- The Science Work Group has as one of its priorities seeking ways to implement the long-term monitoring plan. The group is reviewing the various elements of the plan, identifying gaps and additional needs, and seeking to engage the various monitoring organizations in discussion on how to expand existing monitoring and development agreements to ensure long-term commitment.
- The USGS reduced its ambient monitoring effort on the lower Columbia from two sites to one site at the Beaver army terminal. They continue to monitor six times annually for a wide range of parameters including some toxics. USGS also continues to monitor Osprey along the lower river for toxics.
- The Army Corps of Engineers continues to monitor for temperature and total dissolved gas at several sites along the river. The EPA, in coordination with Oregon, Washington, the Corps and NMFS, is developing total maximum daily load (TMDL) plans for these two parameters.
- The monitoring program is included in the Foundation Fund-Raising Strategy.

29. Monitor and evaluate potential effects of pollutants on human health and fish and wildlife.

- Activity on this project is supported by FY 99 EPA funds earmarked for a public health project. Using those funds ($46,000), the Estuary Partnership contracted with EVS Consultants, who assessed all the existing data on bacterial contamination and toxics in fish tissue and developed information summaries to inform the public, especially at-risk groups, about the possible risks. The project found no trends in exceedances in bacterial contamination in the Columbia River and too little consistency in the available data on toxics in fish tissue to allow any formal trend analysis. People with direct water contact such as swimmers and other recreationists were found to face the greatest risk from bacterial exposure, and subsistence fishers were concluded to face the greatest risk from fish contamination.
- Since completion of the public health project, the Estuary Partnership has increased ambient monitoring activities on the lower Columbia River with the addition of

three new ambient sites. Bacterial concentrations are now monitored every other month at four sites on the lower river.
- A broader study project is also included in the Foundation Fund-Raising Strategy.

30. Develop a basin-wide strategy for identified toxic and conventional pollutants that defines their sources, fate and effects, and reduces their discharge.
- This project is included in the Foundation Fund-Raising strategy.
- In 1998-99 the Estuary Partnership collaborated with the USGS to undertake a lipid bag study in the Columbia River basin to track the concentrations of lipid soluble organics in the water column. The results of that study have provided additional information about what watersheds toxics are originating from and their fate in the water column. The study identifies the Portland/Vancouver area as a source of elevated levels of contaminants and demonstrates that the contaminants do not remain in the water column very far from the source. It also suggests that contaminant distribution in the sediment is not necessarily indicative of distribution in the water column.
- More work will be needed to pinpoint actual sources.
- As noted in Actions 10 and 34, a joint federal and state effort is underway to develop TMDLs for temperature and total dissolved gas in the lower Columbia. In addition, DEQ will be sampling the Columbia in 2001 to better assess listings for pH, dissolved oxygen and bacteria.
- DEQ and the Estuary Partnership are coordinating with the EPA Environmental Mapping and Assessment Program to characterize the condition of Oregon coastal estuaries and the lower Columbia River using a random, probabilistic sampling scheme. In 1999, 27 samples were taken in lower Columbia River bays, and in 2000, an additional 50 monitoring sites were sampled on the lower river from the mouth to Bonneville. Results from the analysis of that data will be contrasted with data from the 1991 and 1993 bi-state monitoring to identify changes and help pinpoint monitoring sites and needs for the long-term monitoring strategy. Measurements will include toxics in sediments and fish flesh. Although this work will not pinpoint sources or hot spots, it will provide the opportunity to compare different sites and previous sampling data and will help focus future toxics work.
- The USGS continues to sample for toxic contaminants in osprey populations along the river and contaminants in their food.
- The Army Corps of Engineers samples sediments in the shipping channel for toxics on a regular basis.
- The 2001 Oregon legislature is on the verge of providing enough funding to start up a fertilizer and pesticide use tracking system through the Oregon Dept. of Agriculture. All commercial users of fertilizers and pesticides will be required to report usage. Homeowners are not included in the legislation.
- This is another issue the Science Work Group will take up as it addresses the implementation of the long-term monitoring plan.

31. Use pollution prevention to reduce or eliminate toxic and conventional pollution generated during manufacturing and industrial processes.

- The Oregon Department of Environmental Quality is encouraging pollution prevention by establishing incentives and rewards, such as tax credits. This approach is being encouraged in all programs within the agency.
- Both Ecology and DEQ have programs to encourage pollution prevention. Both agencies are participants in a three-state recycling information system already in place called the Industrial Materials Exchange (IMEX). The Industrial Materials Exchange is a free service designed to match businesses that produce wastes, industrial by-products, or surplus materials with businesses that need them. By utilizing IMEX, waste generators can be matched with waste users.
- Toxics Reduction Engineer Efficiency (TREE) Team matches Ecology toxics reduction engineers with businesses for an in-depth look at free or low-cost techniques to reduce waste and save money.
- Ecology also runs the HWTR Technical Assistance Services, which provides businesses with advice and consultation on waste reduction and hazardous substance use reduction techniques.
- Both agencies use a team approach to encourage pollution prevention – DEQ in the auto industry and Ecology to reduce toxic contaminants use or water use.
- Many local governments are also involved in pollution prevention efforts, both for city-run activities and for encouraging pollution prevention by residents and industry.
- U.S. EPA maintains effluent guidelines for industry. EPA's Persistent, Bioaccumulative, and Toxic (PBT) Strategy focuses attention on reducing risks from highly-toxic substances that can build up in food chain to levels harmful to human health.
- The Green Products effort promotes environmentally-preferable purchasing and safe labeling. These programs encourage the consideration of environmental factors in the purchasing and use of products.
- Business Practices initiatives aim to facilitate adoption of P2 through changes in finance and business management. Featured programs include environmental assistance to small businesses, P2 Finance, the Voluntary Standards Network, and the Environmental Accounting Project.
- The City of Portland is also engaged in an extensive pollution prevention program. The City holds workshops on targeting levels of sustainability for organizations that buy or specify goods and services. The City also holds workshops for non-profit organizations that engage in pollution prevention programs. The City gives out annual awards for organizations that have exhibited exemplary practices in pollution prevention.

32. Reduce and maintain temperature and total dissolved gas, in the mainstem Columbia River and tributaries to help sustain native species.

- Memorandum of Agreement for Columbia and Snake Rivers, signed October 2000 between Idaho DEQ, Oregon DEQ, Washington DOE, EPA region X, and the tribes for total dissolved gas and temperature. TMDLs for the Snake and Lower Columbia Rivers will be completed by December 2001.

- As part of this project, involved agencies have developed a computer model of temperature on the mainstem which suggests that flows must be altered to maintain cooler temperatures to protect fish and other beneficial uses. Likewise, spill at the dams must be controlled to minimize TDG problems. Discussions are underway as to how these actions can be implemented. The Estuary Partnership participates on the work group known as the Water Quality Team that oversees this activity.

33. Reduce the bacterial contamination sometimes found in the Columbia River and its tributaries to limit human exposure to contaminated water.

- The City of Portland continues to work on its Combined Sewer Overflow Project. CSO construction projects for the Columbia Slough were officially completed in 2001, reducing CSOs by over 99% in the Slough. In 2001 the City also began five years of construction on a series of westside CSO projects. With a citizen task force, the City has developed a Clean River Plan that would allow it to focus on a comprehensive plan to manage stormwater and control overflows. Under the plan, the city is now engaged in habitat restoration, floodplain restoration, watershed assessment and planning, increased pollution prevention, and planting of vegetation, as well as construction solutions. The City is actively buying out properties in the Johnson Creek watershed and restoring the sites to passive use.
- The City, in partnership with the Johnson Creek Watershed Council, completed a watershed plan for the urban creek.
- The City of Portland and the Army Corps of Engineers have just entered into an agreement to jointly fund a $4.5 million restoration of the Columbia Slough. (Seventy-five percent of the funds comes through the Corps Section 1135 authority.)
- Parties are beginning to look at SSOs throughout the Willamette Valley and their impact on the lower Willamette and Columbia confluence at Portland.
- The Oregon Department of Environmental Quality recently endorsed the City of Astoria's revised plan to fix sewage overflows. The plan, submitted in 1998 to the state Environmental Quality Commission (EQC), would modify the city's legally binding 1993 agreement with the EQC, which currently requires the city to reduce the amount of raw sewage dumped into area waters by 98%. The city's new plan would eliminate 96% of the untreated sewage and reduce the project's cost from $36 million to $22 million. The EQC may review the revised plan in early 2002.

34. Develop maximum pollutant loads for streams that do not meet water quality standards.

- U.S. EPA, in coordination with the Corps of Engineers, NMFS, DEQ, and Ecology, is working on reducing temperature and total dissolved gas levels in the river and developing TMDLs for these two parameters. As part of this project, they have developed a computer model of temperature on the mainstem which suggests that flows must be altered to maintain cooler temperatures to protect fish and other beneficial uses. Likewise, spill at the dams must be controlled to minimize TDG problems.
- U.S. EPA, in coordination with DEQ, and Ecology, developed a Memorandum of Agreement that discussed TMDL development on the mainstem lower Columbia

River. The EPA will work with DEQ and Ecology on temperature TMDL, scheduled to be completed July/August 2002. Ecology and DEQ are responsible for developing TMDL for total dissolved gas for the mainstem by December 2001.

- DEQ and Ecology are responsible for developing TMDLs for the other parameters of concern on the lower Columbia, including pH, dissolved oxygen, bacteria and certain toxics. DEQ will be undertaking studies this summer to better characterize the extent of the problem with each of these parameters. TMDLs for the Oregon side of the river must be in place by December 31, 2001.
- Ecology has a different TMDL schedule that projects development of TMDLs for the Columbia in 2009. Ecology has proposed several locations on the Columbia River for Total Dissolved Gas, Arsenic, and Bis (2-ethylsexyl) Phthalate TMDL development for 2001-2002.

35. Eliminate new sources of persistent, bioaccumulative and toxic chemicals; eliminate existing point source discharges of persistent, bioaccumulative and toxic chemicals; and control persistent, bioaccumulative and toxic discharges from contaminated sites.

- Ecology has released a draft PBT reduction strategy for public comment. This draft strategy calls for making continual reductions of PBT releases into Washington's environment over the next 20 years. A "starter list" of nine PBT chemicals is proposed. Ecology is proposing to identify and assess, on a chemical-specific basis, options for pollution prevention, incentive-based strategies, rule development, and permitting and compliance efforts which over time will reduce and, where possible, eliminate PBTs from our environment. In addition, Ecology will track existing agency environmental media efforts through sampling/analysis and data comparisons to determine whether a reduction in PBTs is occurring.
- In addition, Ecology is proposing to develop a public education program that is designed to provide objective information about the threats PBTs pose to public health and the environment. Ecology is proposing to develop and implement a baseline monitoring program to monitor past, current, and future trends of PBTs in Washington's environment.
- In Oregon, the Governor issued an executive order in September 1999 calling for the elimination of PBTs. A workgroup has been established and a schedule of actions identified that will lead to a set of state strategies for reaching the zero release goal for selected priority PBTs. Thus far, the group has adopted the EPA's priority list, examined agency data bases to see what data is currently available, and applied for two EPA PBT grants. Since that executive order, no further action has been taken.

36. Require all permitted discharges to surface water to use alternatives to chlorine to protect aquatic life where such alternatives provide equivalent removal and treatment of bacteria.

- Due to extremely low water conditions, the Oregon Department of Environmental Quality urged facilities using chlorine for disinfection or discharging feed water that carries a chlorine residual to minimize the amount of chlorine that is discharged. Chlorine is extremely toxic to fish and other aquatic life and lower-

flowing streams may not be able to dilute and assimilate wastes that are typically discharged into water.

37. Require that industrial wastewater that is discharged to municipal wastewater treatment facilities does not contain materials that exhibit chronic toxicity or that interact with other chemicals to cause toxic effects.

- Ecology has a Whole Effluent Toxicity (WET) testing program that tests effluent toxicity by exposing living organisms to a sample of the effluent and measuring their response. The test measures the total toxicity of an effluent regardless of the number of individual chemicals combined together. WET tests are required as part of some wastewater discharge permits and encouraged for many others.

38. Reduce hydrocarbon (PAHs) and heavy metal discharges associated with petroleum-powered vehicles and equipment that contaminate runoff with toxic chemicals.

- EPA's nine-year phase out of two-cycle engines continues. By 2006, there must be a 75% reduction in outboard and personal watercraft engine hydrocarbon emissions.
- EPA has developed two phases of regulations for two-cycle engines under 19 kW. Under Phase I regulations, engines had to meet emission standards, which have resulted in reductions of 32% of hydrocarbon emissions from these engines. Under Phase 2, 60-70% reduction in emissions is targeted. Additionally, emission standards for new non-road vehicles and engines as well as those that are unregulated will be developed in 2001. These include:
    - Industrial spark-ignition engines rated above 19 kW (25 hp) (e.g., forklifts and generators)
    - Recreational gasoline engines (e.g., snowmobiles and off-road motorcycles)
    - Recreational marine diesel engines
    - All sterndrive and inboard gasoline engines
- Over the next decade, new federal emissions rules, announced in December 1999 and scheduled to be phased in between 2004 and 2009, will produce cleaner fuels and will significantly strengthen tailpipe emission standards for cars, SUVs and light duty trucks. The measures will cut smog-causing pollution from new vehicles by 77-95%. The rules will apply a uniform tailpipe standard to passenger cars, SUVs and other light duty trucks. The rules will also reduce average sulfur levels in gasoline by 90%, from nearly 300 to 30 parts per million. EPA is also developing a strategy that would reduce pollution from heavy-duty trucks and the largest SUVs by 90%.

39. Clean up hazardous waste sites.

- DEQ maintains a publicly accessible database on its web site that can be searched for a wide range of information concerning sites with suspected or known releases of hazardous substances (except information about petroleum releases from underground storage tanks, which is available in other DEQ-maintained databases). The Environmental Cleanup Site Information System (ECSI) contains information on more than 2000 sites in Oregon. DEQ maintains an orphan site program using funding from the sale of general obligation bonds.

- Ecology maintains a similar publicly accessible list, the Confirmed & Suspected Contaminated Sites Report, which includes all sites that have been assessed and ranked using the Washington Ranking Method (WARM). Also listed are National Priorities List (NPL) sites.

40. Regulate and track the use of hazardous material to prevent re-uses that contaminate surface water or groundwater.

41. Provide subsidized hazardous material disposal opportunities for small volume users and generators.

- The Oregon Department of Environmental Quality continues to offer communities the opportunity to apply for DEQ Household Hazardous Waste Collection Events. No lower Columbia River area communities are signed up to host events in 2001. A mercury thermometer exchange was added as a part of this year's events. DEQ continues to promote hazardous waste reduction through various educational means, such as the Household Hazardous Waste Minimizer distributed through local governments.
- The 16th annual Hazardous Waste Conference on Household and Small Business Waste was in Portland in early September 2001. Department of Ecology, Metro, Oregon DEQ and Clark County were conference co-sponsors.
- Metro has free household hazardous waste roundups scheduled for 35 weekends this year in many communities throughout the Portland metropolitan area. Metro also distributes a Hazardless Home Handbook and will take up to 35 gallons of hazardous waste for free at its two Portland-area waste facilities.
- Cowlitz County continues to operate its Household Hazardous Waste Facility, which provides free hazardous waste disposal for Cowlitz and Wahkiakum County residents. The County also operates a number of hazardous waste collection events throughout Wahkiakum and Cowlitz County.

42. Require all marine facilities to have safety, spill prevention and clean up plans in place, and to have sewage and bilge pump-out facilities and treatment procedures.

- The Oregon State Marine Board has provided funding for a number of facilities upgrades in the Portland, including composting toilets (Bartlett Landing), flush restroom repairs (Rooster Rock), pumpout float repairs (Multnomah Channel), a vault toilet (Sauvie Island), and a flush restroom (Willamette Eastbank).
- The U.S. Coast Guard continues to conduct regular exercises as part of its Northwest Area PREP (Preparedness For Response Exercise Program). The U.S. Coast Guard, the EPA, Ecology, DEQ and Idaho Bureau of Hazardous Materials comprise the Northwest Area Committee that coordinates the Northwest Area PREP. PREP exercises are an opportunity to continuously improve the response plans and the response system. Plan holders are responsible for addressing any issues that arise from evaluation of the exercises and for making changes to the response plans as necessary to ensure the highest level of preparedness. At this time, PREP addresses the exercise requirements for oil pollution response only. Regulations for hazardous substance releases are currently under development and,

once completed, the hazardous substance exercise requirements will be incorporated into PREP.

43. Pursue safe deposition and timely clean up of nuclear wastes stored at the Trojan and Hanford nuclear facilities.

- On June 13, 2000 Washington DOE fined the U.S. Department of Energy $200,000 for failing to complete a required assessment of double-shell tanks that store highly-radioactive waste at Hanford.
- In May 2000 Governor Locke and U.S. Energy Secretary Bill Richardson agreed to seek a consent decree from the federal court to oversee the cleanup of nuclear wastes stored in underground tanks. The decree, which will probably be added to the existing consent decree reached in 1998, would address key issues of retrieving liquid and solid wastes from all the single- and double-shell tanks and turning them into a glass-like substance through vitrification. In December 2000, USDOE awarded a $4 billion contract to a consortium led by Bechtel to construct facilities to immobilize the tank waste. It is to be finished by 2007 and in full operation by 2011.
- In March 1999, the Oregon Office of Energy's Nuclear Safety Division, under contract with the Washington Department of Ecology, produced a report entitled "Protecting the Columbia River: The Need to Retrieve and Immobilize Hanford's High-Level Radioactive Tank Waste."
- In March 2000, a modification was made to the Hanford Facility Dangerous Waste (RCRA) Permit transferring corrective action condition from the federal to the state portion of the permit. This was appealed by the USDOE and in December 2000, Ecology and DOE reached an agreement on when litigation can be imposed.
- Ecology and USDOE are currently seeking comments on a proposal to add milestones guiding double-shell tank evaluations to the Tri-Party Agreement. Under the agreement, USDOE would be required to assess the structural integrity of all 28 double-shell tanks by Sept. 2007.

Conservation Partnership

The Conservation Partnerships in Oregon and Washington are a unique coalition of local, tribal, state and federal groups that mobilizes staff and program funding to help people and communities address natural resource conservation issues. Relying on mixed expertise, authorities, and the common sense each member organization brings to the table, the Partnership strives to realize a shared vision – local people making informed decisions for healthy and economically viable lands.

Natural Resource Conservation Service (NRCS) and the rest of the conservation partnership use the National Performance and Results Measurement System (PRMS) to report conservation progress on private lands. PRMS is not complete for SWCDs and other conservation partners to enter all their accomplishments so the following report underestimates total accomplishments of the partnership. Nationally, state and local options are being added to PRMS which will improve its capability to capture total accomplishments.

During federal fiscal year 2000, over 2,100 acres of resource management systems (RMS) were planned and almost 1,600 acres applied in the lower Columbia and Columbia estuary subbasins. These RMSs benefit fish, wildlife, water quality and overall watershed health by reducing erosion, controlling non-point source pollution and restoring riparian and upland wildlife habitat.

Table 8. Performance and Results Measurement System Summary for Selected Performance Items in FY2000 for the Willamette Basin[1]

Performance Items	Total
Resource Management Systems Planned, acres	2,102
Resource Management Systems Applied, acres	1,642
Riparian Forested Buffers, acres	562
Tree and Shrub Establishment, acres	845
Nutrient Management, acres	449
Pest Management, acres	327
Wildlife Habitat Management, acres	1,503

[1] From NRCS Performance and Results Measurement System, http://sugarberry.itc.nrcs.usda.gov/Netdynamics/deeds/index.html

Oregon Department of Fish and Wildlife

More than 187 habitat enhancement activities have occurred in the Columbia River Estuary Subbasin. The Oregon Watershed Enhancement Board (OWEB) database has information on the cooperators, location, cost and type of habitat improvement that was conducted. Details on individual projects can be obtained through OWEB by referencing the project number. OWEB can also provide information on all projects based on 4th field HUC. Information can be obtained from OWEB's website at http://www.oweb.state.or.us/monitoring/index.shtml. Projects that have been conducted in 2000 have not been entered into the database. Other projects conducted by county and city agencies or private citizens may not have been recorded in this database. The StreamNet project consolidates, standardizes and distributes fisheries related information from across the Columbia Basin.

SteamNet cooperators include the four state fish and wildlife agencies (ID, MT, OR, and WA), the Columbia River Intertribal Fish Commission, the Shoshone-Bannock Tribes and U.S. Fish and Wildlife Service. StreamNet is administered by the Pacific Stares Marine Fisheries Commission and are a component of the Northwest Power Planning Council's Fish and Wildlife Program. Funding is through the Bonneville Power Administration (BPA) with additional funding from EPA and NMFS.

StreamNet focuses on historical and current information related to fish abundance and fish habitat. Data are acquired from management agencies across the basin and standardized into consistent formats. The data are distributed primarily through a queriable online database at http://www.streamnet.org. The project also provides customized data services and mapping.

Lower Columbia Fish Recovery Board, Southwest Washington Lead Entity, Washington State ESA Recovery Region.

Established by the Washington legislature in 1998, The LCFRB encompasses five counties in southwest Washington—Clark, Cowlitz, Lewis, Skamania, and Wahkiakum. The 15-member Board is comprised of representatives from the legislature, city and county governments, the Cowlitz Tribe, private property owners, hydro-project operators, the environmental community, and concerned citizens.

LCFRB activities include:

- Participating in the development of a regional fish recovery plan, particularly habitat recovery measures. In doing so, the Board is to coordinate with local governments, the state, and the National Marine Fisheries Service.
- Assessing the factors for decline of salmon and steelhead on a "stream-by-stream" basis.
- Implementing the local government responsibilities for habitat restoration and preservation, including prioritizing and approving projects and programs, and receiving and disbursing funds.

Assisting the Board is an 18-member Technical Advisory Committee (TAC) comprised of experts in fish biology, natural resource management, and hydrogeology from local, state and federal agencies, and the private sector. The Committee recommends projects for funding and advises the Board on a variety of recovery issues. It meets monthly and is currently developing a watershed characterization template to evaluate habitat conditions on a stream-by-stream basis.

Subbasins included in the LCFRB study areas include: Bonneville, Cispus, Cowlitz/Upper/Lower, Toutle, Coweeman, Chinook, Grays, Elochoman/Skomakawa, Mill/Abernathy/Germany, Kalama, Lewis/East Fork Lewis, Salmon, Lake, Riffe, Tilton/Mayfield, Wallicut, Washougal, Wind, White, and the Salmon/Little White

Organization

The LCFRB has organized a recovery planning steering committee consisting of federal agencies, tribes, state agencies and local governments. The committee has developed a recovery plan outline and a work plan and schedule for plan development. Completion of the initial recovery plan draft will possibly occur in mid-2003. This plan will provide a comprehensive long-range regional program for providing sufficient clean water for people and fish. Watershed planning will be coordinated with fish recovery efforts to ensure consistency and to avoid costly or needless duplication of efforts.

The Board acts as the lead agency for two multi-WRIA Watershed Planning Units working to develop watershed management plans. The groups represent a broad array of water-use interests, both government and non-government. Both groups have embarked on a technical assessment of water quality and quantity issues on a subbasin level.

Accomplishments

- The Board hosted a Willamette/Lower Columbia NMFS Technical Review Team Technical Forum. Over 50 key scientists, technical staff and local public officials met for a day to discuss the technical phase of NMFS recovery

planning. The group also participated in focus groups discussing population identification and viability and habitat functions. Information gathered from this workshop was recorded for the TRT's work. It is expected that additional follow-up workshops and other public forums will be conducted later this year or early next year to review draft recovery goals.

- The Board is a member of the Lower Columbia River Estuary Partnership board of directors. The Partnership provides a forum to work with federal agencies and Oregon agencies and organizations on estuary and mainstem habitat protection and restoration and recovery planning issues.
- The Board serves on the Oregon and Washington Governor's ESA Executive Committee comprised of federal and state agencies, local governments, and tribes. The committee is working with NMFS to develop a process for integrating recovery planning efforts by the Board, LCREP, and the Willamette Restoration Initiative into a NMFS recovery plan for the entire Willamette/Lower Columbia Domain.
- The Board is participating in hydro-relicensing efforts on the Cowlitz and Lewis rivers. Habitat, hatchery, and fish passage measures developed, as part of these efforts, will become elements of the regional recovery plan.
- The Board is actively participating in the Northwest Power Planning Council's Provincial Subbasin Summary and Planning Process. The Board provided the lead writer assessment data for key lower Columbia tributaries to complete the subbasin summaries by October 26, 2001. Following the completion of these summaries, the Board will continue to participate in the Council's development of subbasin plans. It is hoped this planning process can be integrated into the LCFRB work so that the Board's regional recovery plan will satisfy NWPPC planning needs for salmon and steelhead.
- The Board and the Conservation Commission collaborated in expediting the completion of the Lower Columbia Limiting Factors Analysis (WRIAs 25-29). The Board contracted with Lewis and Clark Counties, the Cowlitz and Lewis Conservation Districts, and WDFW to assist Conservation Commission staff in completing LFAs for WRIAs 25, 26, 27, and 28. LFAs for WRIAs 26, 27, and 28 have been published. The WRIA 25 LFA is in final editing.
- WDFW has assigned staff to assist in the preparation of key elements of the recovery plan, including stock identification and status, recovery goals, and limiting factors. The Board contracted with WDFW for consulting biologist services and for a habitat and fish stock assessment for the East Fork Lewis River. WDFW has assisted in developing habitat strategies and priorities, establishing watershed assessment protocols, defining the content of a recovery plan, and developing a plan and schedule for preparation of the recovery plan.
- The Board's outreach activities include conducting more than 40 workshops, tours and information meetings on salmon recovery issues and habitat protection and restoration. The Board also maintains an active communication network among more than 1000 interested parties who subscribe to the Board's informational email distribution and website notices.

- Since 1998, the Board has secured more than $8.5 million for 62 habitat projects awarded to 24 sponsors. The Board places a high value on partnerships with local volunteers. During the Washington State Salmon Recovery Funding Board's early 2000 cycle sponsors received $1.1 million for nine projects. Eight of the nine project sponsors were non-profit organizations working in cooperation with other groups and agencies. These sponsors provided $1.6 million or 61% match for these projects.

SSHIAP (Salmon Steelhead Habitat Inventory Assessment Program), Washington State Department of Fish and Wildlife

The SSHIAP program combines data from multiple sources in a comprehensive GIS based data system for salmon and steelhead habitat in the Lower Columbia region. All fish bearing streams within the Lower Columbia region (WRIA's 24 through 30) are included in this assessment. Estuary habitat is also included in this assessment, and encompasses estuary area from the mouth of the Columbia River to Bonneville dam. SSHIAP core attribute variables include:

1. Fish passage barriers
2. Hydromodifications (anthropogenic features such as dikes, rip rap, etc.)
3. Fish Distribution
4. Habitat type (large trib, small trib, Rosgen type, Confinment)

Other data including but not limited to flow, stream widths, land use, and historical conditions will be added where available. All data will be 'attached' to a gradient-segmented 24K hydrolayer. From this, multiple habitat variables will be accessible via the internet. Also, multiple habitat queries can be performed to access specific stream/stock/habitat information. Hardcopy maps will also be available. The intention of SSHIAP is to assist in the prioritization of restoration-type projects, as well as provide a centralized visual data storage in a dynamic updateable system available to all agencies and the general public.

Washington and Oregon Eulachon (Columbia River smelt) Management Program, Washington and Oregon Departments of Fish and Wildlife

The Washington and Oregon Departments of Fish and Wildlife conduct a small scale program of monitoring sport and commercial eulachon (Columbia River smelt) fisheries and sampling for eulachon eggs and larvae in the mainstem lower Columbia River and tributaries to index run size and to identify the extent and distribution of spawning activity. Sampling has demonstrated that the number of eulachon returning each year varies and the number of tributaries and portions of the mainstem Columbia River use for spawning also varies from year to year. Occasionally, a portion of the run travels to and sometimes passes above Bonneville Dam, presumably in an attempt to spawn in pre-impoundment spawning sites.

The goal of the Oregon and Washington eulachon management program is to maintain healthy populations of eulachon returning annually to spawn in the mainstem Columbia River and tributaries. The primary strategy involves estimating run size and regulating fisheries to only harvest excess surplus. The magnitude of spawning is indexed through sampling for eulachon eggs and larvae at a small number of selected sites.

White Sturgeon Mitigation and Restoration in the Columbia and Snake Rivers Upstream from Bonneville Dam, Washington Department of Fish and Wildlife, the Oregon Department of Fish and Wildlife, and The U.S. Geological Survey

The Washington Department of Fish and Wildlife, the Oregon Department of Fish and Wildlife, and The U.S. Geological Survey have been studying impounded white sturgeon populations since 1987. These studies involved many activities, including sampling for sturgeon eggs, larva, and young-of-the-year (YOY) to measure natural production. Recruitment failures (lack of YOY) were documented during years when hydrosystem operation reduced spring/summer flows. Reduced population productivity has negatively impacted ongoing tribal and sport fisheries. Supplementation experiments were conducted to identify possible mitigation measures, including transporting juvenile white sturgeon from the unimpounded lower Columbia River (the reach within the Lower Columbia Province) upstream to The Dalles and John Day reservoirs

Transporting white sturgeon from the unimpounded lower Columbia River was adopted as a mitigative measure to address the negative impact that hydrosystem operation has had on natural production of impounded populations. The removal of over 26,000 white sturgeon and the planned removal of 5,000-10,000 juvenile fish annually for an unspecified number of years will have an impact on the white sturgeon population residing in the Lower Columbia Province.

Wy-Kan-Ush-Mi Wa-Kish-Wit Spirit of the Salmon The Columbia River Anadromous Fish Restoration Plan of the Nez Perce, Umatilla, Warm Springs, and Yakama Tribes

The Spirit of the Salmon, completed in 1995 by the Columbia River Intertribal Fish Commission, provides a framework to restore the Columbia River salmon, simply stated: put the fish back into the rivers. According to Spirit of the Salmon, past attempts to maintain or restore declining salmon numbers all assumed that technology alone could "fix" the damage caused by disregard for the underlying, interconnected processes of nature which gave rise to and sustained the great salmon runs of the Columbia Basin. Simple solutions could not replace the complexity of nature; naturally these attempts failed. Accomplishing this requires a common understanding of habitat requirements of salmon relative to the present conditions they face in the Columbia River Basin.

Bonneville to Portland Specific

Oregon Columbia Tributaries West: Watershed Analysis, Columbia River Gorge National Scenic Area 2001

This study, completed in 2001 by the USDA Forest Service, is a compilation of prevailing knowledge of the area by various resource specialists. It provides descriptive data about past and present physiological, ecological and cultural conditions. Recommendations drawn from a synthesis of this information provide management guidance for the federal lands located in the watershed. While the study provides analysis and recommendations for desired future conditions, it is not a decision-making document.

Re-introduction of Columbia River Chum Salmon into Duncan Creek, Washington Department of Fish and Wildlife, 2000-2001

Duncan Creek is located approximately five miles below the Bonneville Dam on the Washington side of the Columbia River. In the 1960's a dam and culvert were

placed across the stream to create an artificial lake. Surveys conducted by the Washington Department of Fisheries before the dam was installed indicated that four to five hundred chum salmon returned to the stream and used natural springs or seeps as spawning areas. After the dam was installed, chum salmon were no longer able to use the stream as a natural spawning area. Fish-passage work completed in 2000 and recent landowner agreements, however, will allow chum salmon to once again enter the stream. Significant renovation work on Duncan Creek is currently taking place, gravel in four branches of the stream is being removed and replaced with gravels that are expected to maximize chum salmon egg-to-fry survival rates. Uplands immediately adjacent to the channels will be planted with indigenous vegetation to protect the integrity of the rehabilitated areas.

Sandy River Delta Ongoing Projects

These projects are at the Sandy River Delta, and are in both the Sandy and Lower Columbia watersheds. They have been funded in 1999, 2000 and 2001.

Project 99-025, Lower Columbia River Wetlands Restoration and Evaluation Program, has the following goals: restore 200 acres of wetland and associated upland habitat, and monitor and evaluate restoration success; convert vegetation on 200 acres from invasive species (reed canary grass) to a more native plant community; convert 10 existing acres of seasonal open water to 25 acres of seasonal open water; convert 55 acres of upland meadow to palustrine emergent wetlands; improve vegetative condition on remaining 120 acres palustrine emergent wetlands; develop a restoration and management model that can be implemented in other Pacific Northwest watersheds; and document the contribution of restored wetlands to biodiversity.

Project 99-026, Sandy River Delta Riparian Restoration has the following goals: restore a 600-acre block of "gallery" Columbia River bottomland riparian forest (dense, unbroken stands of black cottonwood, willow, and ash).

Watershed Analysis for the Sandy River Delta, U.S. Forest Service, 1995

This Watershed Analysis, describes the Sandy River Delta, natural processes, and watershed conditions and identifies issues in the delta. Landscape restoration alternatives developed for the Watershed Analysis for the Sandy River Delta emphasize various amounts and types of wetlands restoration, meadow restoration and riparian forest restoration. Restoration activity is proposed in all of the floodplain area. All intensive recreation development is proposed out of 100-year floodplain (buildings, main parking lots, roads) or on state lands (interchange). All alternatives propose trail development in the floodplain. More detailed information specific to the Sandy River is included in a separate subbasin summary.

Western Washington Columbia River Tributaries Watershed Analysis USDA Forest Service Columbia River Gorge National Scenic Area 2001

This Watershed Analysis, completed in 2001 by the USDA Forest Service, describes the land uses and management within the Columbia River Gorge National Scenic Area. The Management Plan (CRGNSA) provides a Recreation Intensity Class (RIC) overlay to the underlying land use designations for maximum habitat protection. It explains that in the Columbia River watershed, the Northwest Forest Plan (NFP) applies to the National Forest

lands in the CRGNSA and Gifford Pinchot National Forest (GPNF). The NFP describes Land Allocations, meant to protect habitat areas.

Land use direction for the Columbia River comes from three management plans: the Columbia River Gorge National Scenic Area Management Plan, the Gifford Pinchot National Forest Land and Resource Management Plan. The most protective guidelines in the watershed have precedence to protect fish and wildlife.

Salmon and Steelhead Limiting Factors Water Resource Inventory Area 28, Washington State Conservation Commission, 2000

This inventory, describes Water Resource Inventory Area 28, located in Southwest Washington, with boundaries that extend to the western margins of the Wind River to the east, the Columbia River to the south, and the East Fork Lewis River to the north. The inventory area includes the southern and eastern portions of Clark County and southwestern Skamania County. For purposes of this report WRIA 28 was divided into three major subbasins: Lake River, Washougal River, and Bonneville Tributaries Subbasins. These drainages cover approximately 316,365 acres or 494 square miles and enter the Columbia River between river mile (RM) 87.6 at Lake River, and RM 142.3 near Bonneville Dam.

Agency Partnering, WDFW, Land Trust and the City of Vancouver

Several agencies developed a plan to protect the area between the Grays River and Hamilton/Hardy Creeks in Vancouver, Washington, approximately one mile upstream of the I-205 bridge on the north shore of the Columbia River, under the guidelines of the 2000 FCRPS biological opinion, action 157. The partners, including WDFW, Columbia Land Trust and the City of Vancouver, submitted a grant proposal to the Washington State Salmon Recovery Funding Board to acquire the parcel of land adjacent to the seeps and conservation easements on two surrounding pieces of property. The partners have identified an additional land acquisition and purchase of conservation easements of the uplands, wetlands and creek. This second project would entail development of an offshore spawning channel, habitat restoration, removal of non-native plants and vegetation, removal of a fish passage barrier, educational tours and installation of a salmon-viewing camera. WDFW would continue biological research and monitoring for spawning adults, and emerging and outmigrating juveniles (see Appendix E).

Portland to Skamokawa – River Mile 34

Lake River Subbasin Stock Summary and Habitat Priorities

Abernathy, Germany, and Mill Creeks—Multiple projects, Washington Department of Fish and Wildlife

Related to the mainstem Columbia, the Washington Department of Fish and Wildlife is implementing projects to determine abundance and monitor natural production of juvenile, smolt and adult salmonids in Abernathy, Germany and Mill Creeks. Adult trapping of coho will provide additional data necessary to better evaluate the origin (hatchery vs. wild) of naturally produced smolt. These projects include:

- Juvenile Trapping – The WDFW began trapping juvenile coho and steelhead outmigrants in the spring of 2001 on Abernathy, Germany and Mill Creeks. A cone

screw-trap was used on Abernathy Creek, and "V"-weirs were used on Germany and Mill Creeks to develop juvenile/smolt production estimates for these systems.

- Adult Trapping –The WDFW is preparing to trap adult fish (primarily coho) on Abernathy creek beginning in October 2001.
- Steelhead Redd Surveys: The WDFW conducts annual winter steelhead redd surveys on these creeks to develop wild winter steelhead population estimates.
- Chinook/Coho Spawning ground surveys: PSMFC conducts these surveys to recover CWTs and gather data for natural spawner escapement estimates.

Elochoman/Skamokawa Subbasin Stock Summary and Habitat Priorities

Salmon and Steelhead Limiting Factors Water Resource Inventory Area 25 and 24

Water Resource Inventory Area (WRIA) 25 is located in southwest Washington. The area encompasses 322,582 acres including all of Wahkiakum and portions of Cowlitz, Pacific, and Lewis counties. Located along the Lower Columbia River, the majority of this watershed is in the Coast Range eco-region. All of the drainage's within the WRIA are tributaries to the Columbia River. Although located in WRIA 24, the Chinook River is the western most tributary to enter the Columbia River in Southwest Washington and has been included in this report (see Appendix E).

Lower Columbia-Clatskanie Watershed Assessment

Portland State University completed the Lower Columbia-Clatskanie Watershed Assessment for the Lower Columbia River Watershed Council in 2001. The watershed assessment will be used as a guide for the prioritization and design of restoration projects.

Scappoose Bay Watershed Assessment, Scappoose Bay Watershed Council 2000

The Scappoose Bay Watershed Council published the Scappoose Bay Watershed Assessment in January 2000. The report was produced by David Evans and Associates with a grant from OWEB. Based on existing data only, it includes both historical information (published reports as well as oral history) and recent data (such as a 1999 field survey by ODFW and ongoing fish monitoring data collected by the Council at Bonney Falls on North Scappoose Creek). The Assessment includes an analysis of data gaps, which provided direction for subsequent Council field study, and a list of recommendations which the Council is using to develop an Action Plan. A unique feature of this assessment is a chapter identifying salmonid refugia within the watershed. This chapter (which was funded by a grant from Oregon Trout) includes a (GIS-generated) map that has been especially valuable as a tool for focusing Council action, educating the community, and securing additional grants and matching funds.

Salmon and Steelhead Limiting Factors Water Resource Inventory Area 26, Washington State Conservation Commission, 2000

This inventory, describes Water Resource Inventory Area 26. This report is based on a combination of existing watershed studies and knowledge. WRIA 26 is located in southwest Washington within portions of Lewis, Cowlitz, Skamania, Pierce, and Yakima Counties, and it includes the Cowlitz River systems and its major tributaries, the Coweeman, Toutle, Tilton, and Cispus Rivers (see Map 4 in Appendix A). The Cowlitz River enters the Columbia River at River Mile (RM) 68. Five stocks of anadromous

salmon and steelhead and coastal cutthroat trout return to the rivers. (More detailed information on activities specific to these areas are included in other subbasin summaries.)

Salmon and Steelhead Limiting Factors Water Resource Inventory Area 27, Washington State Conservation Commission, 2000

This inventory, completed in 2000 by the Washington State Conservation Commission, describes Water Resource Inventory Area 27, located in southwest Washington within portions of Skamania, Clark, and Cowlitz Counties, and it includes three major watersheds, the Kalama River, the Lewis River (North Fork), and the East Fork Lewis River. All river systems within WRIA 27 drain to the Columbia River. Six stocks of anadromous salmon and steelhead return to the rivers. For purposes of this analysis the WRIA was separated into four subbasins: lower and upper Lewis River (below and above the dams), East Fork Lewis, and Kalama. (More detailed information on activities specific to these areas are included in other subbasin summaries.)

The Wetlands Functional Assessment City of Vancouver Marine Park, City of Vancouver Water Resources Education Center

This functional assessment, completed in 2001, summarizes findings and reviews provided by a joint city/community advisory committee and stakeholder forums from neighbors and other citizens. The management plan will specify objectives and address opportunities for wetlands enhancement that continue to protect high habitat values.

River Mile 34 to Estuary

Avian Predation on Juvenile Salmonids in the Lower Columbia River, United States Geological Survey Oregon Cooperative Fish and Wildlife Research Unit at Oregon State University and the Columbia River Inter-Tribal Fish Commission, 1997

This BPA funded study, assesses the impacts of piscivorous waterbirds (i.e., gulls, terns, and cormorants) on the survival of juvenile salmonids in the lower Columbia River. These investigations indicated that Caspian terns nesting on Rice Island, a dredged material disposal island in the Columbia River estuary, are the most significant avian predator of juvenile salmonids on the lower Columbia River (Roby et al. 1998; Collis et al. 1999; Collis et al., in review). The magnitude of predation on juvenile salmonids by Rice Island terns led to management action in 1999. Resource managers sought to relocate terns nesting on Rice Island to East Sand Island, where terns were expected to prey on fewer juvenile salmonids (USACE 2001). Efforts to attract terns to nest on East Sand Island included restoration of nesting habitat, use of social attraction techniques, and predator control, with concurrent efforts to discourage terns from nesting on Rice Island. This approach was successful in completely relocating the tern colony from Rice Island to East Sand Island by the third breeding season (Roby et al., in review).

Caspian Tern 2000 Draft Season Summary, Oregon State University, Washington Department of Fish and Wildlife, Columbia River Inter-Tribal Fish Commission, and Real Time Research, 2000

The data provided in this summary are in-season weekly reports and background information on a study investigating the impacts of piscivorous waterbirds (i.e., terns, cormorants, and gulls) on the survival of juvenile salmonids in the lower Columbia River.

Weekly reports on managed Caspian terns are available to monitor and evaluate the 2001 Caspian Tern Management Plan.

The Columbia River Estuary Atlas of Physical and Biological Characteristics, Columbia River Estuary Data Development Program (CREDDP), 1984

The Columbia River Estuary Atlas of Physical and Biological Characteristics includes a comprehensive data set of Columbia Estuary ecosystem dynamics. The Atlas was used as an important planning tool for decision makers with a stake in the health of the estuary. The research focused on the linkages among different elements of the food web and the influence on the food web of various physical processes such as current, sediment transport, and salinity intrusion.

Draft Habitat Criteria Summary/Workshop Outcomes, Lower Columbia River, CREST, LCREP, Army Corps of Engineers, and American Rivers, 2001

This summary, lists criteria developed by over 100 participants interested in restoration of the Columbia River Estuary at the June 2001 Habitat Workshop held in Astoria. With continued input from resource scientists, the draft criteria will be refined and used to steer restoration priorities and individual projects.

Ecology Of Marine Predatory Fishes: Influence On Salmonid Ocean Survival, U.S. National Marine Fisheries Service, 1998 to present

This is an ongoing study to evaluate the role of piscine predation in the nearshore environment off the mouth of the Columbia River as a factor affecting survival of juvenile salmon. Ocean survival of salmonids from the Columbia and other Northwest rivers has declined markedly in the last 20 years. While the events causing this poor salmon survival are empirically unknown, predation by large marine fishes (e.g., hake and mackerel) is suspected to be a principal source of mortality. Although it is unclear whether ocean mortality of salmon is abrupt or evenly distributed over the entire marine lifestage, there is evidence that the time period shortly after ocean entry is a critical period. Factors potentially affecting marine survival of Columbia River salmon include specific timing of ocean entry and distribution and abundance of marine fish predators and forage fishes in the nearshore marine habitat adjacent to the Columbia River.

The hypothesis driving the research is that the marine fish community off the mouth of the Columbia River has changed since the 1980s and is structured by physical oceanographic characteristics. The investigators further hypothesize that the distribution and abundance of the nearshore marine predator and forage fish community directly or indirectly affects the amount of predation on juvenile salmonids. They propose to characterize, over a five-year period, the temporal and dynamic nature of the marine fish community off the Columbia River during the spring-summer transition (peak salmonid migration period) and relate dynamics in this marine fish community with salmonid survival. A primary focus will be identification of the strength of trophic linkages between forage and fish predator species, and the influence of these relationships on predation rates on juvenile salmon.

To identify if large marine fishes are a major source of salmon smolt mortality, they will collect predatory and forage fishes off the mouth of the Columbia River, estimate their abundance, and determine predatory fish feeding habits. Sampling will be conducted from

late April to June when juvenile salmon begin outmigration into the nearshore ocean environment. A representative sample of these large marine fish predators will be identified, measured, weighed, and their stomach contents retained for analysis. They will also assess ocean water conditions (salinity, temperature, and chlorophyll). These data will be used to estimate the relationship between the marine fish community structure and juvenile salmon consumption rates in the nearshore ocean adjacent to the Columbia River and begin to describe the environmental factors that influence this predation.

Estuarine Habitat and Juvenile Salmon – Current and Historic Linkages in the Lower Columbia River and Estuary, by NMFS, USACE, University of Washington, ODFW, WDFW, and the Oregon Graduate Institute, 2000-present

This is a study to identify important estuarine habitats and to evaluate the role of the Columbia River estuary to juvenile salmon. Estuaries are considered important to rearing of juvenile salmon and represent an integral component of the continuum of habitats that salmon occupy for significant periods of time. There is, however, a general lack of science-based information concerning attributes of these tidal freshwater and oligohaline transition zones needed to support juvenile salmon, particularly in the Columbia River estuary.

Further, recent evidence supports the concern that flow in the Columbia River significantly affects the availability of estuarine habitats, that flow is much reduced compared to historic levels, and that seasonal flow patterns are much different now than a century ago. The long history of wetland loss in the Columbia River estuary coupled with change in flow patterns suggests that restoration of these habitats may benefit recovery of depressed salmon stocks. The need to develop effective restoration strategies drove the researchers to propose empirically identifying the benefit of these habitats to juvenile salmon by evaluating habitat-salmon linkages in the lower Columbia River and estuary. They propose a monitoring approach to identify associations between salmon and habitat in the lower Columbia River and estuary. They further propose a historic reconstruction of flow and sediment input in the system and historic reconstruction of critical salmon habitat using GIS for comparison to present day conditions and to gauge loss and factors associated with loss of critical habitats and to identify areas for future restoration.

The approach will be to 1) determine the relationship between habitat and the presence, use, and benefit to juvenile salmon, with an emphasis on subyearling chinook salmon, in the lower Columbia River and estuary and 2) understand change in flow, sediment input, and availability of habitat in the lower Columbia River and estuary. To be successful, this approach requires that both establish relevant empirical associations between habitat variables and juvenile salmon and accurately model physical changes in the lower Columbia River and estuary. For example, salinity conditions of estuaries influence the composition of emergent plant communities which in turn, determines the quality and quantity of prey available to juvenile salmon in wetland habitats. If empirical associations are developed between habitat attributes (e.g., salinity, depth, channel morphology, vegetation type, prey resources, etc.) and juvenile salmon distribution and performance (e.g., abundance, residence time, and growth) in the lower Columbia River and estuary, then responses of juvenile salmon relative to predicted physical change can be predicted.

During later years of this proposed study, a modeling effort to evaluate the impact of physical change (natural and anthropogenically-induced variability) on the availability of critical salmon habitat is planned. To accomplish this objective, researchers plan to use the CORIE numerical modeling system for the lower Columbia River and estuary. This modeling system is being independently developed and validated. It will be used here to evaluate availability of habitat affected by variation imposed by both natural processes and anthropogenic manipulation of the system and further, to a limited extent, associations between salmon use and habitat type.

Accomplishments to date include:

- Identification of beach seining sites along a transect near the mouth of the Columbia River with sampling to commence in August pursuant to receipt of federal and state permits.
- Selection of 2-3 replicate sites for detailed emergent wetland assessments for salmon-habitat linkages near Russian Island.
- Testing of gear suitability using fyke nets to insure site drainage at low tide.
- An overflight with Coast Guard assistance to identify other wetland sites in more forested slough sites in Cathlamet Bay.
- Meetings with LCREP and CREST to collect data and assess ongoing GIS efforts to insure complementary historical mapping of salmon habitats in the lower Columbia River and estuary.
- Deployment of physical monitoring stations in the Cathlamet Bay region to complement the existing network of real-time physical monitoring stations in the Columbia River estuary (CORIE).
- Establishment of historical tide series needed to fully characterize change in habitat opportunity.

Additional efforts in continuing years will include:

- An effort to better characterize life histories of juvenile salmon among different habitats using scale and otolith analyses.
- Use of light traps to achieve diurnal resolution of juvenile salmon use and abundance of estuarine habitats and to validate beach seining estimates of juvenile salmon abundance.
- Refining and evaluating methodologies to estimate in continuum habitat opportunity for juvenile salmon in Cathlamet Bay.
- Developing methods for evaluating the amount of fine and coarse sediment inputs to the Columbia River estuary.

The Columbia River Estuary and The Columbia River Basin Fish and Wildlife Program

This is a report by the Independent Scientific Advisory Board (ISAB) of the Northwest Power Planning Council, Nov 28, 2000, ISAB 2000-5.

The Northwest Power Planning Council (Council) requested the Independent Scientific Advisory Board (ISAB) to undertake a review of the impacts of estuarine conditions on the Council's mission to "protect, mitigate and enhance fish and wildlife in the Columbia River" as affected by development and operation of the hydroelectric system. The ISAB agreed to undertake the review but cautioned that it was unlikely that it could

quantify the impact of changes in the estuary relative to specific program or management actions taken in the upper river. The ISAB could, however, provide a historical perspective and qualitative assessment of impacts, identify potentially useful collaborations, and provide recommendations concerning future efforts needed to more quantitatively address this issue.

While conducting this review, the ISAB became aware that there was extensive overlap between a study by the National Marine Fisheries Service (NMFS) and this ISAB assignment. The ISAB expects the NMFS study will add significantly to an informed response to the Council. Consequently, this report has been prepared as a preliminary reply, with additional detail possible following publication of the NMFS study
The ISAB recognizes the limitations of data to directly assess impacts of changes in the estuary on the Fish and Wildlife Program. After our review it is the ISAB's assessment that these changes have been "detrimental" to salmonids and the rebuilding objectives of the Program. This advice is principally based on three major issues:

- The significant loss of peripheral wetlands and tidal channels. These habitats are important to the early rearing, survival and growth of chum salmon, sub-yearling chinook, and smaller coho salmon in other west coast estuaries.
- The extent of change to seasonal flows following development of the hydrosystem. The effects of these changes are closely associated with the impact of the development of the navigation channel. In combination, these developments have resulted in changes to estuarine circulation, deposition of sediments, and biological processes.
- The need for precautionary advice given the current state of most salmonid populations in the Basin, the magnitude of change in the estuary, and the lack of investigations upon which to base alternative advice.

As the Fish and Wildlife Program is developed, the ISAB recommends an aggressive experimental program targeted to reduce the likelihood of prolonged uncertainty about the impact of estuarine conditions. Such a program should incorporate monitoring of the physical environment (such as currently begun via the CORIE program, Oregon Graduate Institute) combined with evaluation of large-scale manipulations of estuarine habitats. The intent of these manipulations would be to study changes presumed to have had negative impacts and to conduct these on a scale that can be measured within the natural environment. These types of programs would be consistent with the vision statement in the 2000 Fish and Wildlife Program:

"Wherever feasible, this program will be accomplished by protecting and restoring the natural ecological functions, habitats, and biological diversity of the Columbia River Basin."

Initially, the ISAB anticipates that people will think that such programs are unnecessary and/or impractical. To achieve the vision statement of the Fish and Wildlife Program in the estuary province, however, programs of these magnitudes are likely necessary given the magnitude of the estuary and the stated desire to evaluate these actions. The Columbia River estuary is the interface between a highly modified freshwater system and the open ocean environment. All of the investment and effort in the Fish and Wildlife

Program flow through this unique environment, but interaction of change in the estuary with projects of the Fish and Wildlife Program, and their combined effect, has basically been ignored. The ISAB strongly recommends that the Council recognize the potential value of the estuary to the Fish and Wildlife Program and the immediate need to improve the understanding of its ecological processes.

Salmon at the River's End, NMFS, 2001

The Salmon at the River's End, assesses the potential impact of flow regulation on juvenile salmon utilization of the estuary. The analyses identified flow regulation and climate effects on hydrology and sediment transport, both of which have likely consequences for the estuarine physical environment. The study evaluated the capacity of the estuary to support salmon, including the effects of flow regulation on this capacity. Six analyses were completed and the results interpreted based on the relationships between habitat and salmon life histories.

The analyses indicated that habitat and food-web changes within the estuary and other factors affecting salmon population structure and life histories have altered the capacity of the estuary to support juvenile salmon. Diking and filling activities in the estuary have likely reduced the rearing capacity for fry and subyearling life histories by decreasing the tidal prism and eliminating emergent and forested wetlands and floodplain habitats adjacent to shore.

The study noted that while the risk of extinction of many Columbia River populations implies the need for immediate recovery action, lack of data on estuarine habitat use by salmon argues that further study may be necessary before we can define appropriate restorative measures. Both of these concerns can be addressed by initiating targeted restoration activities, where there is reasonable confidence in their ecological benefits, and by simultaneously collecting new data to better understand salmon habitat requirements and restoration needs.

Mouth, Plume, Youngs Bay

Ecology Of Marine Predatory Fishes: Influence on Salmonid Ocean Survival, U.S. National Marine Fisheries Service, 1998 to present

This study supported by the Bonneville Power Administration examined the temporal dynamics and abundance of marine fish predators and forage fishes in the nearshore ocean off the Columbia River during the juvenile salmon outmigration period, and the food habits of predatory marine fishes. It also considered measures of selected oceanographic conditions in the nearshore ocean off the Columbia River and distribution and abundance of predator and forage fish to oceanographic conditions and ocean survival of juvenile salmonids historically and to the present to identify the impacts of predators on salmonids.

Ocean Survival Of Juvenile Salmonids In The Columbia River Plume, U.S. National Marine Fisheries Service, Oregon State University and Oregon Graduate Institute, 1998 to present

A study by NMFS, Oregon State University, and the Oregon Graduate Institute has been ongoing since 1998 to evaluate the role of the Columbia River plume on growth and survival of juvenile salmon. Inter-annual variation in ocean recruitment of salmon is high and thought to be associated with variation in nearshore ocean conditions. The nearshore

ocean environment, particularly that associated with the Columbia River plume, is a critical habitat to outmigrating juvenile salmon. Several investigators have already suggested that survival during the first year of ocean life is a key to establishing year-class strength. However, the factors and processes associated with the plume environment that enable or alter survival potential is largely unknown. Moreover, hydropower generation in the Columbia River has altered the amount and timing of water delivered to the plume, potentially affecting the beneficial features of the plume environment to juvenile salmon. In the case of salmonids originating in the Columbia River Basin, survival success likely hinges on the complex interaction of smolt quality and the abiotic and biotic ocean conditions at the time of entry and during their first year of ocean existence.

This study focuses on the hypothesis that variation in the physical and biological conditions of the nearshore environment, particularly that associated with the Columbia River plume, affects overall survival of Columbia River stocks. Primary factors being evaluated include (a) food availability and habits, (b) time of entry, smolt quality, and growth and bioenergetic status at the time of entry and during the first growing season in the ocean, and (c) predation. (A companion study on predation on juvenile salmon is ongoing.) The study proposes to characterize, over a 10-year period, the physical and biological features of the nearshore ocean environment with real-time and modeling projections of the Columbia River plume as it interacts with the coastal circulation regime, and to relate these features, both spatially and temporally, to variation in salmon health, condition, and survival.

Findings to date include:

- Nutrient concentration in the plume is similar to nutrient concentrations in up-welled waters off Oregon and Washington. (Nutrients provide the ingredients driving primary and secondary productivity which are critical to juvenile salmon growth and survival.)
- Prey resources (zooplankton) appear higher in plume waters.
- Productivity and recruitment of baitfish (a source of alternate prey for predator fish that may otherwise consume juvenile salmon) is associated with and related to plume dynamics.
- There are differences in growth of juvenile salmon associated with the plume.
- Juvenile salmon appear to associate with frontal regions of the plume. (These are areas where oceanographic features concentrate prey resources that attract juvenile salmon.)
- Juvenile salmon feed opportunistically and selectively on the available prey resources, thus features (e.g. fronts) that concentrate food resources benefit juvenile salmon, particularly in a turbid environment.
- The abundance of juvenile salmon (particularly coho) in June in coastal waters of Oregon and Washington continues to relate to smolt-to-adult returns (SARs). This supports the contention that the early ocean environment that juveniles encounter greatly influences survival.
- There is a movement of juvenile salmon from farther offshore in May, during the period that the plume is farther offshore, to further nearshore in September, during the period when the plume is greatly diminished and closer inshore.

Youngs Bay, Nicolai-Wickiup River and Skipanon River Watershed Assessments, Youngs Bay Watershed Council, Nicolai-Wickiup Watershed Council, Skipanon River Watershed Council, 1999

These watershed assessments, inventoried and characterized watershed conditions of the Youngs Bay, Nicolai-Wickiup and Skipanon River watersheds and provided recommendations that address the issues of water quality, fisheries and fish habitat, and watershed hydrology. These assessments were conducted by reviewing and synthesizing existing data sets and some new data collected by the Watershed Council, following the guidelines outlined in the Oregon Watershed Enhancement Board (OWEB) watershed assessment manual (WPN 1999).

Existing Goals, Objectives and Strategies

Introduction

This section summarizes goals, objectives and strategies that protect fish, wildlife or their habitat. These are provided within plans, reports and studies, and come directly from the organizations and agencies.

Description of Effort by Project Area

The material is organized by geographic area, beginning with documents that relate to the overall study area from Bonneville Dam to the Columbia River plume. This is followed by goals, objectives and strategies specific to four geographic areas:

1. Bonneville to Portland specific
2. Portland to Skamokawa (River Mile 34)
3. River Mile 34 to Astoria
4. Mouth, Plume and Youngs Bay

Reports, studies and plans are listed at the beginning of each section and titles are underlined. Other information submitted by agencies is found after the reports and is listed with the agency or organization name in bold.

Overall Study Area

This section provides agency and program goals covering the entire or large portions of the two-province area.

Evaluation of live capture selective harvest methods for commercial fisheries on the Columbia River, Oregon and Washington Departments of Fish and Wildlife, 2001.

The primary goal of this project is to develop, evaluate, and implement commercial live capture, selective harvest methods in the Lower Columbia River. The states' intent is for commercial fishers to contribute to the conservation of depressed or listed species by selectively harvesting fish from strong stocks, while releasing those from weak stocks live and unharmed to continue their upstream migration. This method of fishing requires developing and evaluating new gears and fishing methods that allow live capture of target and non-target species.

Evaluation of Spawning for Fall Chinook and Chum Salmon just below the four Lower most Columbia River Dams (BPA project number 1999-003-001), Washington Department of Fish and Wildlife

Fish and Wildlife Program funding for this project began in October 1998 (Fiscal Year 1999). The project is composed of three closely related activities. Pacific States Marine Fisheries Commission (PSMFC) is leading the adult studies portion, ODFW is leading the juvenile studies portion, and the U.S. Fish and Wildlife Service (USFWS) is leading the habitat assessment portion of the project. ODFW and PSMFC have conducted chum salmon spawning ground surveys from The Dalles Dam downstream to the estuary, and are scheduled to continue those surveys. These two Agencies also began adult and juvenile studies in the Ives/Pierce Island complex in 1998, and those studies are also ongoing. USFWS began habitat assessment studies in 1998 and were joined by the U.S. Geological Survey (USGS) and Pacific Northwest National Laboratories (PNNL) in 1999. Habitat assessment studies are ongoing downstream from Bonneville Dam. PNNL is also assisting with portions of the adult and juvenile studies. Adult, juvenile, and habitat studies are designed to be complementary to achieve the purposes of this project, and each lead Agency is responsible for their respective objectives based on their special skills, knowledge, and experience in those areas.

The primary goal of this project is to restore, protect, and enhance the fall chinook and chum salmon populations that spawn downstream from the Columbia River mainstem dams. The objectives of this project are three-fold: 1) Document the existence of fall chinook and/or chum salmon populations spawning downstream from Bonneville, The Dalles, John Day, and McNary dams and estimate the size of the populations; 2) Profile the stocks for important population characteristics including spawning time, genetic make-up, emergence timing, emigration size and timing, and juvenile to adult survival rates and relate these population characteristics to river flows and water temperatures; 3) Determine physical habitat use and preference for fall chinook and chum salmon, and describe the relationship between streamflow/backwater effects and the quantity, quality, and location of physical habitat.

A fundamental strategy towards realizing the goal of this project is to develop the information necessary to make recommendations for hydrosystem operations and water management that are required for fall chinook and chum salmon to successfully carry out their life cycles by providing mainstem spawning and rearing habitat in the Columbia River.

As an additional strategy directed at restoration of currently depressed Columbia River chum salmon populations, WDFW and ODFW began more intensive chum spawning ground surveys as part of this project in 2000. This information was required by NMFS to determine the importance of Ives Island spawners to the population structure of the ESU. In addition, these surveys will provide preliminary information regarding chum salmon spawning habitat quality in lower Columbia tributaries and identify possible opportunities for habitat restoration.

White Sturgeon Mitigation and Restoration in the Columbia and Snake Rivers Upstream from Bonneville Dam, Washington Department of Fish and Wildlife, the Oregon Department of Fish and Wildlife, and The U.S. Geological Survey

The goal of the transport program is to replace small or missing year classes in order to rebuild recruitment to fisheries and to broodstock. This is an ongoing need as long as hydrosystem operations limit natural production. Current strategy includes transporting 5,000 to 10,000 juvenile white sturgeon (fish less than 36 inches) annually. Progress is being measured by conducting intensive stock assessments every five years. Annual natural production is being indexed annually.

Lower Columbia River Estuary Program - Management Plan

The Lower Columbia River Estuary Program became one of 28 programs in the National Estuary Program (NEP) in 1995. The NEP was established in 1987 by amendments to the federal Clean Water Act. Its primary goal is "to protect estuaries of national significance that are threatened by degradation caused by human activity."

A management committee of stakeholders carefully reviewed the technical studies conducted under the Bi-State Water Program from 1990-96. Those studies provide the background for the technical elements of this plan. Using the technical data based on this assessment and supplementary information, the Management Committee identified seven priority issues of concern to the Lower Columbia River Estuary:

1. Biological Integrity
2. Impacts of Human Activity and Growth
3. Habitat Loss and Modification
4. Conventional Pollutants
5. Toxic Contaminants
6. Institutional Constraints
7. Public Awareness and Stewardship

These issues are interrelated. The Estuary Program's fundamental goal is to achieve a high level of biological integrity for the lower Columbia River and estuary. That integrity has been degraded by human activity and growth over the last hundred years. The degradation is evidenced by habitat loss and modification, conventional pollutants (such as elevated temperature, increased dissolved gases, bacteria and sediment), and toxic contaminants in fish tissue and sediments. Institutional constraints from multiple jurisdictions and lack of public awareness and stewardship make protection of the river challenging.

Stated in terms of future management of the lower Columbia River and estuary, actions taken to lessen the impacts of human activity, such as controlling urban stormwater runoff, will also help address water quality problems. Similarly, actions that protect and restore habitat will help provide the conditions critical to maintaining biological diversity. Better public awareness of the river ecosystem and the cause/effect relationships that affect it will bring greater political will to bear on managing growth and development, which will in turn affect all the other issues. Actions include:

Habitat and Land Use

- Inventory and prioritize habitat types and attributes needing protection and conservation. Identify habitats and environmentally sensitive lands that should not be altered.
- Protect, conserve and enhance identified habitats, particularly wetlands, on the mainstem of the lower Columbia River.
- Adopt and implement consistent wetland, riparian and instream habitat protection standards to increase quality and quantity of habitat to protect aquatic species.
- Preserve and/or restore buffer areas in appropriate locations along tributaries and the mainstem of the Columbia River to a condition that is adequate to maintain a healthy, functioning riparian zone for the lower river and estuary.
- Restore 3,000 acres of tidal wetlands along the lower 46 river miles to return tidal wetlands to 50% of the 1948 level.
- Monitor the effectiveness of habitat protection, restoration and mitigation projects.
- Develop floodplain management and shoreland zoning protection programs.
- Reduce the volume and velocity and improve the water quality of stormwater runoff in developed areas.
- Use tools and incentives in local planning ordinances and state laws to ensure that development is environmentally sensitive.
- Establish, or modify, minimum flows (including mainstem Columbia River flows) to meet instream needs. Evaluate the cumulative impact of all proposed water withdrawals, diversions or instream structures to ensure that established minimum flows are maintained.
- Avoid the introduction of unwanted exotic species and manage the deliberate introduction of desirable exotic species in the lower Columbia River and estuary.
- Require that human-caused changes in the river morphology and sediment distribution within the river channel and estuary are managed so that native and desired species are not harmed.

Education and Management

- Create an entity that serves as an advocate for the lower Columbia River and estuary and carries out the goals of the Management Plan.
- Establish a common vision for and unified commitment to the health of the river.
- Maintain public information and education efforts about the lower river and estuary that focus on endangered species, habitat loss and restoration, biological diversity and lifestyle practices and connections to the river.
- Use best management practices to reduce non-point source pollution.

- Help local governments implement federal, state and local environmental and land use laws.
- Coordinate federal and state threatened and endangered species recovery activities in the lower Columbia River and estuary and help local communities meet species recovery requirements.
- Enforce existing environmental and land use laws.
- Improve coordination among government agencies.
- Design, support and agree to use dispute resolution processes leading to resolution of institutional conflicts that affect the river.
- Develop and implement consistent water quality-related activities, laws, rules and standards.
- Establish an award program to promote successful stewardship and pollution prevention activities.
- Administer grant programs to assist users with Management Plan implementation and to assist schoolchildren in educational efforts that focus on endangered species and habitat loss.
- Coordinate volunteer monitoring programs and create or coordinate volunteer opportunities on the lower river.
- Identify and improve points of public access to the river. Ensure that access does not cause further loss or degradation of habitat, increased erosion, loss of riparian vegetation or degradation of water quality.
- Implement the Estuary Program information management plan.
- Implement the Estuary Program long-term monitoring plan.

Conventional and Toxic Pollutants

- Monitor and evaluate potential effects of pollutants on human health and wildlife.
- Develop a basin-wide strategy for identified toxic and conventional pollutants that defines their sources, fate and effects, and reduces their discharge.
- Use pollution prevention to reduce or eliminate toxic and conventional pollution generated during manufacturing and industrial processes.
- Reduce and maintain temperature and total dissolved gas in the mainstem Columbia River and its tributaries to help sustain native species.
- Reduce the bacterial contamination sometimes found in the Columbia River and its tributaries to limit human exposure to contaminated water.
- Develop maximum pollutant loads for streams that do not meet water quality standards.

- Eliminate new sources of persistent, bioaccumulative and toxic chemicals; eliminate existing point source discharges of persistent, bioaccumulative and toxic chemicals; and control persistent, bioaccumulative and toxic discharges from contaminated sites.
- Require all permitted discharges to surface water to use alternatives to chlorine to protect aquatic life where such alternatives provide equivalent removal and treatment of bacteria.
- Require that industrial wastewater that is discharged to municipal wastewater treatment facilities does not contain materials that exhibit chronic toxicity or that interact with other chemicals to cause toxic effects.
- Reduce hydrocarbon (PAHs) and heavy metal discharges associated with petroleum-powered vehicles and equipment that contaminate runoff with toxic chemicals.
- Clean up hazardous waste sites.
- Regulate and track the use of hazardous material to prevent re-uses that contaminate surface water or groundwater.
- Provide subsidized hazardous material disposal opportunities for small volume users and generators.
- Require all marine facilities to have safety and spill prevention and clean-up plans in place and to have sewage and bilge pump-out facilities and treatment procedures.
- Pursue safe deposition and timely clean up of nuclear wastes stored at the Trojan and Hanford nuclear facilities.

Lower Columbia Fish Recovery Board Interim Regional Habitat Strategy, 2001

The Lower Columbia Fish Recovery Board (LCFRB) was established by RCW 77.85.200 to coordinate fish recovery activities in the lower Columbia region of Washington State. State law directs the Board to:

- Participate in the development of a regional fish recovery plan, particularly habitat recovery measures. In doing so, the Board is to coordinate with local governments, the State and the National Marine Fisheries Service.
- Assess the factors for decline of salmon and steelhead on a "stream-by-stream" basis.
- Implement the local government responsibilities for habitat restoration and preservation, including prioritizing and approving projects and programs, and receiving and disbursing funds.

The Board's key activities include recovery planning, watershed planning and habitat restoration and protection. The LCFRB has developed an Interim Regional Habitat Strategy that outlines the goals and strategies the Board and its Technical Advisory Committee will use to:

- Identify and rank habitat restoration and protection needs.
- Evaluate and rank habitat project proposals.

It should be noted that this document is an interim habitat strategy. The adequacy and sophistication of available information on fish stocks, watershed functions and habitat conditions varies significantly across the lower Columbia region. The strategy will be refined as better information and analytical tools become available. It is anticipated that this strategy will evolve over the next several years to become an integral element in a comprehensive salmonid recovery plan for the lower Columbia.

In the near-term, this strategy will assist the Board and project sponsors to better target limiting factors and habitat protection needs in a way that will help maximize benefits for fish recovery and ensure the most effective use of limited resources.

The strategy provides fish recovery and habitat recovery goals. It prioritizes fish stocks and habitat recovery and protection needs. And, finally, it sets forth the means the Board and its Technical Advisory Group (TAG) will use to evaluate and rank project proposals.

It is the overall habitat goal of the Lower Columbia Fish Recovery Board to provide the habitat necessary to support healthy, harvestable populations of ESA-listed fish species in the lower Columbia region of Washington. Specific goals for fish recovery and habitat restoration and protection are:

Fish Recovery Goals:

- Support recovery of ESA-listed stocks.
- Support biodiversity through recovery of native wild stocks.
- Restore or sustain geographic distribution of stocks.
- Maintain healthy stocks of a listed species.
- Support recovery of critical stocks of listed species.

Habitat Protection and Restoration Goals:

- Restore access to habitat.
- Protect existing properly functioning habitat conditions.
- Restore degraded watershed processes needed to sustain properly functioning habitat conditions.
- Support critical salmonid life-history stages.
- Secure near- and long-term benefits.

Wy-Kan-Ush-Mi Wa-Kish-Wit Spirit of the Salmon The Columbia River Anadromous Fish Restoration Plan of the Nez Perce, Umatilla, Warm Springs, and Yakama Tribes, Nez Perce, Umatilla, Warm Springs, and Yakama Tribes, 1995

The Spirit of the Salmon provides a framework to restore the Columbia River salmon which is, simply stated: put the fish back into the rivers. According to Spirit of the Salmon, past attempts to maintain or restore declining salmon numbers all assumed that technology alone could "fix" the damage caused by disregard for the underlying, interconnected processes of nature which gave rise to and sustained the great salmon runs of the Columbia basin. Simple solutions could not replace the complexity of nature; naturally these attempts failed.

Goals:

- Restore anadromous fish to the rivers and streams that support the historical, cultural and economic practices of the tribes. (These are generally areas above Bonneville Dam.)

- Emphasize strategies that rely on natural production and healthy river systems to achieve this goal.
- Protect tribal sovereignty and treaty rights.
- Reclaim the anadromous fish resource and the environment on which it depends for future generations.

Objectives:

- Halt the declining trends in salmon, sturgeon and lamprey populations originating upstream of Bonneville Dam within seven years.
- Increase the total adult salmon returns of stocks originating above Bonneville Dam to 4 million annually and in a manner that sustains natural production to support tribal commercial as well as ceremonial and subsistence harvests within 25 years.
- Increase sturgeon and lamprey populations to naturally sustainable levels that also support tribal harvest opportunities within 25 years.
- Restore anadromous fish to historical abundance in perpetuity.

Conservation Partnership

The Conservation Partnership in Oregon and Washington is a unique coalition of local, tribal, state and federal groups that mobilizes staff and program funding to help people and communities address natural resource conservation issues. Relying on the mixed expertise, authority and common sense that each member organization brings to the table, the partnership strives to realize a shared vision—local people making informed decisions for healthy and economically viable lands. These goals and objectives were derived from NRCS state and basin strategic plans and from individual Soil and Water Conservation District workplans.

Goals:

- View and manage functional aquatic, wetland, riparian and upland habitats that support diverse native fish and wildlife populations as essential components of healthy watersheds.
- Manage quantity and quality of water in an efficient and sustainable manner, making sure it is acceptable for its intended uses.

Objectives:

- Focus fish and wildlife restoration efforts on the connectivity between uplands, riparian areas and wetlands within a watershed.
- Furnish the technical and financial assistance needed by landowners to meet local, state and federal goals for fish and wildlife and water quality.
- Utilize a cooperative approach between local groups (i.e., SWCDs and watershed councils), state and federal agencies with fish, wildlife and water quality responsibilities to provide technical assistance, implementation funding and environmental certainty to private landowners.
- Develop partnerships to ensure participation through outreach and education of all interested parties.
- Conserve private land through voluntary, locally-led approaches.
- Work together to carry out the Oregon Plan through watershed management.
- Promote public awareness, interest and participation in natural resource protection program.

Strategies:

- Ensure farm conservation plans and watershed plans contain scientifically sound alternatives to enhance fish and wildlife objectives consistent with the requirements under the Endangered Species Act and with those of the landowner.
- Ensure farm conservation plans contain scientifically sound alternatives to protect and improve water quality consistent with state water quality requirements (Agricultural Water Quality Management Plans, Total Daily Maximum Loads and state water quality standards) and with those of the landowner.
- Market the concept that properly managed, productive agricultural lands provide habitat for numerous species of concern.
- Work with state and federal agencies and private groups to coordinate the provision of technical and financial assistance to develop and implement conservation plans with private landowners.
- Provide a trained, qualified staff with the expertise needed to work with private landowners.
- Maintain partnerships to efficiently use and leverage available implementation funds (EQIP, WHIP, WRP, CRP, CREP, OWEB, 319, etc.).
- Implement adopted Agricultural Water Quality Management Area Plans (SB1010).
- Provide assistance to Confined Animal Feeding Operations (CAFOs) to eliminate or control pollution.
- Conduct educational and outreach efforts related to soil, water and other natural resources.
- Maintain NRCS Field Office Technical Guides to provide the latest guidance, tools and technical standards for planning and implementation.
- Seek streamlined permitting processes and ESA consultations.
- Participate on local, state and regional initiatives to guide efforts to protect and restore fish and wildlife and water quality.

Bonneville to Portland Specific

This section covers programs and efforts specific to the Bonneville to Portland segment of the Columbia River.

Aquatic Conservation Strategy, Forest Service Management Plan

The Aquatic Conservation Strategies (ACS) covers the following objectives:

- Maintain and restore the distribution, diversity and complexity of watershed and landscape-scale features to insure the protection of the aquatic systems to which species populations and communities are uniquely adapted.
- Maintain and restore the spatial and temporal connectivity within and between watersheds. Lateral, longitudinal and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.
- Maintain and restore the physical integrity of the aquatic system, including shorelines, banks and bottom configurations.
- Maintain and restore water quality necessary to support healthy riparian, aquatic and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical and chemical integrity of the system and benefits survival growth,

reproduction and migration of individuals composing aquatic and riparian communities.

- Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate and character of sediment input, storage and transport.
- Maintain and restore instream flows sufficient to create and sustain riparian, aquatic and wetland habitats and to retain patterns of sediment, nutrient and wood routing. The timing, magnitude, duration and spatial distribution of peak, high and low flows must be protected.
- Maintain and restore the timing, variability and duration of floodplain inundation and water table elevation in meadows and wetlands.
- Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion and channel migration, and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.
- Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.

Columbia River Estuary Dredged Material Management Plan, Columbia River Estuary Study Taskforce, 2001

In 1979, the Columbia River Estuary Study Taskforce (CREST) completed the *Dredged Material Management Plan for the Columbia River Estuary*. The plan identified 98 dredged material disposal sites, established priorities for their use, and recommended techniques for their protection and control. In 1986, the CREST reevaluated and updated the plan to produce the *Columbia River Estuary Dredged Material Management Plan*. The objective of this task is to draft a revised and updated Dredged Material Management Plan for the Columbia River Estuary.

Oregon Columbia Tributaries West Watershed Analysis, USDA Forest Service, Columbia River Gorge National Scenic Area, 2001

This study is a compilation by various resource specialists of prevailing knowledge of the area. They provide descriptive data about past and present physiological, ecological and cultural conditions. Recommendations drawn from a synthesis of this information provide management guidance for the federal lands located in the watershed. While the study provides analysis and recommendations for desired future conditions, it is not a decision-making document. The following goals, objectives and recommendations relate directly to the mainstem of the Columbia River. Others relating to the tributaries can be found in the original document.

Goals (related to mainstem of the Columbia River):

- Recognizing the existing dam situation, the desired future condition is a healthy hardwood riparian community. A healthy riparian community would improve habitat for riparian-dependent species, and enhance both east-west connectivity along the Columbia River and north-south connectivity across the river.
- Enhance natural wetland plants in wetland areas along Columbia River (Rooster Rock, Horsetail Falls, etc.).

- Leave riparian zone widths as detailed in the Northwest Forest Plan.
- Encourage Oregon State Parks to improve riparian habitat, especially on lower elevation parks near the Columbia River.

Recommendations:

- Re-establish natural stream channels as opportunities arise.
- Widen flow channels by constructing more fish-friendly culverts (with a natural stream bottom), more bridges and more overflow channels.
- As opportunities arise, work with other agencies and landowners to eliminate or reduce flow restrictions at stream mouths.
- Increase the amount of pool habitat in the anadromous streams where it is below standards and the upland reaches.
- Explore opportunities for a pond to hold overwintering fry at McCord Creek.
- Preserve hardwood riparian habitat on all ownerships, especially along the Columbia River.
- Support other agencies to re-introduce Columbia River flushing flows to carry sediment and vary water level.
- Recreate and/or enhance hardwood riparian habitat wherever possible. Facilitate an interagency effort where necessary.
- Add large wood to anadromous portions of streams and three previously mentioned resident streams to provide more fish cover and pool habitat for juvenile salmonid rearing on both federal and non-federal lands.

Other goals:

- The management goal is a watershed that eventually mimics the healthy ecological conditions present during the reference period (100 AD to 1650 AD). The Desired Future Condition (DFC) would include the following conditions: older stands (up to 600 years) along riparian zones and other moist areas; Douglas fir stands with low fire and ladder fuels on the face of the Gorge; and riparian hardwood communities that dominate the Columbia River.
- About 50% to 80% of the total area should be in ‘old growth’ stands over 200 years in age. The remaining 20% to 50% should consist of bare ridges and younger stands. Fires and/or silvicultural treatments may be used to achieve these conditions.
- Snags should be created where necessary to enhance wildlife habitat. Existing CRGNSA forest practice guidelines should be examined to integrate long-term ecosystem health. A robust environment containing a broad spectrum of species is desirable. In addition, a noxious weed-free habitat for naturally occurring species should be achieved by remaining within the Vegetation Desired Future Condition.
- Manage the environment to enhance forest health.
- Prescribe 10- to 40-acre low-intensity fires.
- Review CRGNSA forest practice guidelines to integrate the recommended DFC and long-term ecosystem health at the landscape scale.
- Use silvicultural treatments and fire to hasten stand evolution toward 50% to 80% **“**old growth,” particularly in riparian areas, and to maintain a diversity of stand ages and openings to mimic the reference period conditions.

- Reduce fire fuels through a regular treatment program (fire and other) to lessen the occurrence of a catastrophic wildfire and to mimic the presumed conditions of the reference period.
- Focus on fine fuels reduction and treatment of high risk areas, including lands adjoining private lands, lands adjoining wilderness, hotter and drier south aspects, areas that have high fire occurrence, steeper headwalls that are more prone to mass wasting and riparian reserves.
- Incorporate the long-term role of fire or silviculture when developing the Late Successional Reserve (LSR) assessment.
- Increase incidents of low-intensity fires. (These were more prevalent in reference period and usually took place outside of the true fir zone.)
- Maintain existing habitat for east-west demographic and genetic exchanges and enhance habitat on the north side of the river. Promote nesting habitat for snag-dependent and large tree-dependent species.
- Work cooperatively with the State of Washington and United States Fish and Wildlife Service to insure long-term maintenance of diverse upland forest communities near the Columbia River to facilitate avian connectivity across the river.
- Protect instream fauna by limiting the amount of dredging and gravel removal.
- Maintain high water quality in streams in the long term, recognizing short, recurrent periods of high sedimentation from large storm events, mass wasting and fire.
- Maintain current air quality in CRGNSA, recognizing short, recurrent periods of smoke from fires. (Note: most air quality problems are generated outside of the watershed.)

Sandy River Delta Plan and EIS 1996, and Watershed Analysis 1995, US Forest Service, Columbia River Gorge National Scenic Area.

The Sandy River Delta was historically a wooded, riparian wetland with components of ponds, sloughs, bottomland woodland, oak woodland, prairie, and low and high elevation floodplain. It has been greatly altered by past agricultural practices and the Columbia River hydropower system. Restoration of historic landscape components is a primary goal for this land. The Sandy River Delta comprehensive management plan envisions wetland, riparian forest, shrub-scrub, upland forest, and upland meadow restoration, with moderate recreation and natural resource interpretation. Riparian forest and wetland restoration were identified as first priorities. The long-term objectives are re-establishment of 600 acres of Columbia River bottomland riparian forest (dense stands of black cottonwood, will and ash), and re-establishment of about 200 wetland acres and associated upland habitat. Monitoring will evaluate restoration success. Breaching of levees and dikes can be considered to restore sloughs and backwater channels. Restoration of open upland areas (meadow/prairie) would follow substantial completion of the riparian and wetland restoration.

Western Washington Columbia River Tributaries Watershed Analysis, (Draft) USDA Forest Service, Columbia River Gorge National Scenic Area, 2001

This study is a compilation of prevailing knowledge of the area by various resource specialists. It provides descriptive data about past and present physiological, ecological and cultural conditions. Recommendations drawn from a synthesis of this information provides management guidance for the federal lands located in the watershed. While the study provides analysis and recommendations for desired future conditions, it is not a decision-

making document. The following goals, objectives and recommendations relate directly to the mainstem of the Columbia River. Others relating to the tributaries can be found in the original document.

Goals (related to mainstem of the Columbia River):

- Recognizing the existing dam situation, the desired future condition is a healthy hardwood riparian community. A healthy riparian community would improve habitat for riparian dependent species, and enhance both east-west connectivity along the Columbia River and north-south connectivity across the river. Enhance natural wetland plants in wetland areas along Columbia River. Leave riparian zone widths as detailed in the Northwest Forest Plan.
- The management goal is a watershed that eventually mimics the healthy ecological conditions present during the reference period (100 AD to 1650 AD). The Desired Future Condition (DFC) for the public lands (about 50% of the watershed primarily in the eastern portion and the upper reaches of the tributaries) would include the following conditions: older stands (up to 600 years) throughout the watershed but primarily along riparian zones and other moist areas; Douglas fir-dominated stands with low ladder fuels in a fire friendly condition on the face of the Gorge; and riparian hardwood communities that dominate the Columbia River. About 40% to 60% of the total area should be in "old growth" stands over 200 years in age. The remaining 40% to 60% should consist of bare ridges and younger stands.

Recommendations:

- Re-establish natural stream channels as opportunities arise.
- Widen flow channels by constructing more fish-friendly culverts (with a natural stream bottom), more bridges and more overflow channels.
- As opportunities arise, work with other agencies and landowners to eliminate or reduce flow restrictions at stream mouths.
- Add large wood to anadromous portions of all streams where they are currently below standards and to the upper reaches of resident habitat of Lawton, Woodward, Hamilton and other creeks. Facilitate an interagency effort where necessary.
- Preserve hardwood riparian habitat on all ownerships, especially along the Columbia River.
- Support other agencies to re-introduce Columbia River flushing flows to carry sediment and vary water level.
- Re-examine the road access to Beacon Rock boat launch site/Doetsch day use area.
- Reduce road density and/or stream crossings wherever possible to enhance stream function.
- Recreate and/or enhance hardwood riparian habitat wherever possible. Facilitate an interagency effort where necessary.
- Add large wood to anadromous portions of streams and three previously mentioned resident streams to provide more fish cover and pool habitat for juvenile salmonid rearing on both federal and non-federal lands.
- Work with USFWS on re-routing of Lawton Creek to its historical route.
- Explore possibilities of a separate routing for "Marshal" Creek at SR14 crossing. (It is now channelized to join Good Bear Creek.)
- Manage the environment to enhance forest health.

- Prescribe 10- to 40-acre low-intensity fires.
- Implement patch cuts, thinnings,and shaded fuel breaks to enhance and promote old growth stands on public lands.
- Review CRGNSA forest practice guidelines to integrate the recommended DFC and long-term ecosystem health at the landscape scale.
- Use silvicultural treatments and fire to hasten stand evolution toward 40% to 60% "old growth," particularly in riparian areas, and to maintain a diversity of stand ages and openings to mimic the reference period conditions on public lands.
- Reduce fire fuels through a regular treatment program (fire and other) to lessen the occurrence of a catastrophic wildfire and to mimic the presumed conditions of the reference period.
- Focus on fine fuels reduction and treatment of high risk areas, including lands adjoining private lands, hotter and drier south aspects, areas that have high fire occurrence, steeper headwalls that are more prone to mass wasting and riparian reserves.
- Incorporate the long-term role of fire or silviculture when developing the Late Successional Reserve (LSR) assessment.
- Increase incidents of low-intensity fires. (These were more prevalent in reference period and usually took place outside of the true fir zone.)
- Work cooperatively with the State of Washington and United States Fish and Wildlife Service to insure long-term maintenance of diverse upland forest communities near the Columbia River to facilitate avian connectivity across the river.
- Investigate improving pond and painted turtle habitat.
- Explore beaver reintroduction to enhance wetlands on public lands.
- Protect instream fauna by limiting the amount of dredging and gravel removal.
- Maintain high water quality in streams in the long term, recognizing short, recurrent periods of high sedimentation from large storm events, mass wasting and fire.
- Maintain current air quality in CRGNSA, recognizing short, recurrent periods of smoke from fires. (Note: most air quality problems are generated outside of the watershed.)
- Acquire a management buffer on lower Lawton Creek to allow protection and enhancement of fisheries.
- Acquire trail access by some means across lower Lawton Creek.
- Protect and enhance all Open Space, and associated resource values, cliff habitat and scenic features, anadromous fisheries, and the Columbia River shoreline (not including the Skamania Landing).
- Create an east-west trail route on public land.
- Adjust boundaries with Washington State DNR and Heritage to consolidate holdings and promote management efficiency.
- Protect forest resource land from rural residential development.
- Acquire/retain a management buffer on Duncan Creek to allow protection and enhancement of fisheries. Do not emphasize fee acquisition for fisheries purposes in the Duncan Creek subwatershed. Do not split lots to acquire Duncan Creek in fee.

- Acquire stream/buffer rights-of-way on the anadromous east branch (Archer Creek) in the southeast quarter of Section 31 to allow fisheries protection and enhancement. Do not emphasize fee acquisition for fisheries purposes in the Archer Creek subwatershed. Do not split lots to acquire Archer Creek in fee.
- Acquire/retain National Forest lands in Section 20 and the northwest corner of Section 30 for a possible trail route.
- Analyze land adjustment between the Washington Heritage Program/DNR and the Forest Service to consolidate holdings and promote management efficiency. National Forest lands in the Archer Mountain area could be traded to Washington State Heritage Program to manage with adjacent Heritage Program lands.
- Acquire small vacant lots where adjacent to a large block of National Forest, state or private forest resource land to prevent residential development (e.g., Sections 6, SW of 31 and SE of 36).
- Protect and enhance all Open Space and associated resource values, anadromous fisheries, talus habitat (pika habitat), the Columbia River shoreline outside of the North Bonneville Urban Area, and cultural resource sites in the Lakes area.
- Adjust boundaries with Washington State Parks, DNR and Heritage to consolidate holdings and promote management efficiency.
- Acquire into public ownership all SMA lands in Greenleaf, Hamilton and Hardy Creeks subwatersheds (outside of the Urban Area).
- In the North Bonneville Urban Area, acquire some public interest in the mouths of Hamilton and Greenleaf Creeks and a buffer (based on willing sellers), or work with private landowners and USFWS on stream enhancement where the authority exists.
- Analyze land adjustment between the Washington Heritage Program/DNR and the Forest Service to consolidate holdings and promote management efficiency.
- Analyze land adjustment between Washington State Parks and the Forest Service to promote mutual goals and management efficiency. Beacon Rock State Park desires to make the East Fork of Woodard Creek the park's western boundary. The Forest Service could consolidate ownership east of Hamilton Creek, while Beacon Rock State Park could consolidate ownership west to the East Fork of Woodard Creek.
- Complete a stream buffer on the East Fork of Woodard Creek. Outside of this buffer, no further acquisition is necessary on the East Fork.
- Acquire enough interest in the stream channel/buffer on the West Fork of Woodard Creek to implement stream restoration work. Acquisition of private lands at higher elevations west of the creek is not critical.
- Strongly pursue public acquisition of a rare, wet meadow and a 300' buffer at the headwaters of Woodard Creek in T2N, R6E, Section 3. The land is located outside of the National Scenic Area. Alternately, encourage a partnership with the landowners or other agencies to provide proper protection.

Franz Lake National Wildlife Refuge

The following goals for the Franz Lake National Wildlife Refuge provide general targets toward which refuge development and management efforts are directed.
Goals:

- Maintain a native diversity of wetland habitats for breeding/migrating/wintering waterfowl and other aquatic migratory birds, with a special emphasis on tundra swans.
- Provide and enhance habitat for endangered, threatened and sensitive species.
- Enhance wildlife diversity through habitat management.
- Restore natural, dynamic stream/river systems, including their associated in-water and riparian habitats for anadromous fish, breeding neotropical birds and other native fish and wildlife.
- Provide opportunities for quality, wildlife-dependent recreation, education and research to enhance public appreciation, understanding and enjoyment of refuge fish, wildlife and habitats.
- Preserve designated cultural resources.

Pierce National Wildlife Refuge

The following goals for the Pierce National Wildlife Refuge provide general targets toward which refuge development and management efforts are directed.

Goals:

- Maintain native diversity of wetland habitats for breeding/migrating/wintering waterfowl and other aquatic migratory birds with a special emphasis on Canada geese.
- Provide and enhance habitat for endangered, threatened and sensitive species.
- Enhance wildlife diversity through habitat management.
- Restore natural, dynamic stream/river systems, including their associated in-water and riparian habitats for anadromous fish, breeding neotropical birds and other native fish and wildlife.
- Provide opportunities for quality, wildlife dependent recreation, education and research to enhance public appreciation, understanding and enjoyment of refuge fish, wildlife and habitats.
- Preserve designated cultural resources.

Steigerwald Lake National Wildlife Refuge

The following goals for the Steigerwald National Wildlife Refuge provide general targets toward which refuge development and management efforts are directed.

Goals:

- Restore natural, dynamic stream/river systems, including their associated in-water and riparian habitats for anadromous fish, breeding neotropical birds and other native fish and wildlife.
- Provide wetland and cropland/grassland habitats for feeding and resting by migrating and wintering ducks, geese, cranes and other migratory birds and for reducing crop depredation on private lands.
- Preserve, enhance and protect habitats that support endangered species, threatened species and species of special concern.
- Provide opportunities for quality, wildlife-dependent recreation, education and research to enhance public appreciation, understanding and enjoyment of refuge fish, wildlife and habitats.
- Preserve designated cultural resources.

Abernathy, Germany, and Mill Creeks—Multiple projects, Washington Department of Fish and Wildlife

Related to the mainstem Columbia, the Washington Department of Fish and Wildife is implementing projects to determine abundance and monitor natural production of juvenile, smolt and adult salmonids in Abernathy, Germany and Mill Creeks. The objectives of the aforementioned projects are to determine abundance and monitor natural production of juvenile, smolt and adult salmonids in Abernathy, Germany and Mill Creeks. Adult trapping of coho will provide additional data necessary to better evaluate the origin (hatchery vs. wild) of naturally produced smolt.

Columbia-Clatskanie Watershed Assessment, Portland State University, 2001

The watershed assessment, which was prepared for the Lower Columbia River Watershed Council, will be used as a guide for the prioritization and design of restoration projects.
Objectives:

- Conduct culvert inventories and evaluation of fish passage at falls.
- Conduct biological surveys to verify the distribution and status of the species of concern within the subbasin.
- Conduct additional habitat surveys to cover all streams in which species of concern are believed to exist.
- Take turbidity samples and road inventories to identify the sources of high levels of fine sediment in riffle habitats.
    - Check for clean and properly functioning ditches and culverts.
    - Check for cut-and-fill slopes that are eroding into ditches.
    - Check for road surface rilling, slumping and slope failures related to roads.
- Provide habitat restoration for reconnecting to floodplain habitats, LWD placement and riparian tree planting.
- Provide habitat protection for Plympton Creek, Carcus Creek, Clatskanie River and wetlands along Westport Slough.
- Identify the cause of the low dissolved oxygen samples.
- Evaluate instream flows for streams identified within the Hydrology and Water Use assessment that have stream flows which do not meet instream water rights.
- Improve and expand water quality monitoring.
- Improve turbidity and suspended sediment sampling that involves sampling during and immediately after winter and spring storm events.
- Expand all water quality sampling to include all of the watersheds within the range of the species of concern.

The Wetlands Functional Assessment City of Vancouver Marine Park, City of Vancouver Water Resources Education Center, 2001

This functional assessment, completed in 2001, summarizes findings and reviews provided by a joint city/community advisory committee and stakeholder forums from neighbors and other citizens. The management plan will specify objectives and address opportunities for wetlands enhancement that continue to protect high habitat values.
Objective:

- Protect high quality habitat while providing education and passive recreation opportunities compatible with habitat functions.

Julia Butler Hansen Refuge for the Columbia White-Tailed Deer

The following goals for the Julia Butler Hansen Refuge for the Columbian White-tailed Deer (JBH Refuge) provide general targets towards which refuge development and management efforts are directed. They are a revision of goal statements last approved in 1986 (see below) and are intended to provide interim direction until a Refuge Comprehensive Management Plan is completed.

Basis for the goals:

- Preserve, restore and enhance in their natural ecosystems (when practicable) all species of animals and plants that are endangered or threatened.
- Perpetuate the migratory bird resource.
- Preserve a natural diversity and abundance of fauna and flora on refuge lands.
- Provide an understanding and appreciation of fish and wildlife ecology and man's role in his environment; provide refuge visitors with high quality, safe, wholesome and enjoyable recreation experiences for the purposes for which the refuge was established.

Refuge Goals:

- Manage for healthy and balanced populations of Columbian white-tailed deer (CWTD) as outlined in the CWTD Recovery Plan on the refuge, and cooperate with others in management of off-refuge deer.
- Maintain a native diversity of wetland habitats for breeding/migratory/wintering waterfowl and other aquatic migratory birds associated with the Columbia River estuary.
- Maintain a native diversity of habitats for fish and wildlife associated with the Columbia River estuary.
- Provide opportunities for wildlife/wildlands-dependent recreation, education and research.

Former Goal Statements from 1986 Management Plan:

- Meet objectives of the Columbian White-tailed Deer Recovery Plan through effective refuge management and cooperation with others in management of off-refuge deer.
- Protect and enhance migratory birds and associated habitats of the Columbia River estuary with emphasis on increasing overwintering carrying capacity for dabbling ducks and Canada geese.
- Increase wildlife diversity through habitat enhancement with special emphasis on water birds and bald eagles.
- Maintain the quality of refuge waterfowl hunting with a minimum of regulation.
- Implement a quality program of environmental education, interpretation and wildlife observation.
- Cooperate with other agencies, institutions of higher education, private organizations and individuals in providing technical assistance and research opportunities.
- Permit approved wildlife-related recreation while discouraging non-conforming and non wildlife-oriented activities.

Revised Columbia White-Tailed Deer Recovery Plan, U.S. Fish and Wildlife Service, 1976

This plan outlines methods of re-establishing white-tailed deer near the Columbia River. Land use practices since 1972 via an interim management plan have encouraged the regrowth and reestablishment of permanent cover on many areas of the refuge with a history of heavy grazing. Continuous evaluation of deer responses to land use changes is necessary so that the proper balance between short grass/forb pastures and dense cover is maintained.

Objective:

- Secure the Columbia white-tailed deer within its historical range, protect its habitat and delist the species by accomplishment of the sub-objectives for the Columbia River population.

Three sub-objectives:

- Downlist the Columbia River population to "threatened" by maintaining a minimum of 400 CWTD in at least three viable subpopulations, two of which must be located in secured habitat.
- Restore the Columbia River population to a minimum of 400 CWTD in at least three viable subpopulations, one subpopulation being Tenasillahe Island with a viable herd of at least 50 deer.
- List the species.

Ridgefield National Wildlife Refuge

The following operational goals for the Ridgefield National Wildlife Refuge provide general targets toward which refuge development and management efforts are directed.

Basis for the goals:

- Provide high-quality wintering habitat for all Canada geese, especially the dusky subspecies, to ensure a healthy, viable goose population that minimizes damage to private agricultural lands in the lower Columbia River area.
- Protect, restore and develop habitats for and otherwise support the recovery of federally listed endangered and threatened species and help prevent the listing of candidate species and species of management concern.
- Protect, restore and develop a diversity of habitats for all other migratory birds such as neotropical songbirds, wading birds, shorebirds and waterfowl, as well as indigenous fish and plant species of the lower Columbia River ecosystem.
- Provide high-quality opportunities for wildlands and wildlife-dependent recreation and environmental education to enhance public appreciation, understanding and enjoyment of refuge fish, wildlife, habitats and cultural resources.

River Mile 34 to Astoria

Estuarine Habitat and Juvenile Salmon – Current and Historic Linkages in the Lower Columbia River and Estuary, National Marine Fisheries Service and U.S. Army Corps of Engineers

In a study with the USACE, the National Marine Fisheries Service proposes as an overall goal to develop an understanding of how the estuary currently and historically benefited juvenile salmon by determining where salmon are (presence/absence and abundance) and their performance in relation to specific attributes of a variety of habitats in the tidally influenced lower river and estuary. Regions include shallow water areas either adjacent to

peripheral forests and wetlands or centrally located in the river, dendritic and channel margins, and backsloughs. NMFS also recognizes the need to place the salmon habitat associations in a historical context by evaluating river discharges and sediment inputs into the estuary for the past 100 years and reconstructing past and present availability of salmon habitat through the lower Columbia River and estuary using GIS mapping. NMFS recommends developing a regional 3-dimensional numerical model of the lower Columbia River and estuary that can be used to characterize the impact of physical processes (flow, bathymetry, salinity, temperature, etc.) on potential availability of juvenile salmon habitat.
Recommended Objectives:

- Compare trends in abundance and life histories of juvenile salmon at a landscape scale on representative transects of shallow-water habitat between Puget Island and the Columbia River mouth.
- Describe salmonid use and performance in selected emergent and forested wetlands and their relationship to local habitat features.
- Characterize historical changes in flow and sediment input to the Columbia River estuary and change in habitat availability throughout the lower river and estuary.

Lewis and Clark National Wildlife Refuge

The following goals for the Lewis and Clark National Wildlife Refuge (NWR) provide general targets toward which refuge development and management efforts are directed. They capture the intent of refuge objectives last approved in 1986, and are intended to provide interim direction until a Refuge Comprehensive Management Plan is completed.
Basis for the goals:

- Preserve, restore and enhance in their natural ecosystems (when practicable) all species of animals and plants that are endangered or threatened.
- Perpetuate the migratory bird resource.
- Preserve a natural diversity and abundance of fauna and flora on refuge lands.
- Provide an understanding and appreciation of fish and wildlife ecology and man's role in his environment; provide refuge visitors with high quality, safe, wholesome and enjoyable recreation experiences for the purposes for which the refuge was established.

Refuge Goals:

- Manage for conservation and recovery of threatened and endangered animal species in their natural ecosystems.
- Maintain a native diversity of wetland habitats for breeding/migratory/wintering waterfowl and other aquatic migratory birds associated with the Columbia River estuary.
- Maintain a native diversity of habitats for fish and wildlife associated with the Columbia River estuary.
- Provide opportunities for wildlife/wildlands-dependent recreation, education and research.

Objective Statements from 1986 Management Plan:

- Provide refuge habitat and protection necessary to maintain at least current numbers of Columbian white-tailed deer, and explore opportunities to increase the refuge population.
- Provide refuge habitat and protection necessary to maintain at least current numbers for bald eagles and explore opportunities to enhance nesting.

- Provide habitat and protection to produce 300-500 Canada geese each year.
- Provide habitat and protection to produce 1,000 ducks each year.
- Provide habitat capable of supporting migrating and wintering Canada geese with peak populations of 2,000 birds and a total of 100,000 use days per year.
- Provide habitat capable of attracting and supporting a peak of 650 swans and 60,000 use days per year.
- Protect and enhance migratory birds and associated habitats of the Columbia River estuary. Provide habitat capable of attracting and supporting an average peak of 27,000 ducks and 2,140,000 use days per year.
- Maintain at least current average peak use of 40,000 and 1,600,000 use days for shorebirds and waterbirds. Increase wildlife diversity through habitat enhancement with special emphasis on colonial nesting birds and waterbirds.
- Provide refuge habitat to support moderate populations of river otter, beaver, muskrat, mink, raccoon, etc. Continue control program to limit the population growth of nutria.
- Assist with ecological monitoring programs of other FWS divisions, other agencies and organizations.
- Maintain quality of refuge waterfowl hunting at a maximum level of administrative efficiency.
- Provide fishing opportunities at current levels of approximately 3,500 activity hours.
- Provide visitors with an opportunity to observe refuge environment and wildlife during all seasons of the year. The management target is to maintain current level of 1,500 activity hours each year for wildlife/wildlands observation and 2,300 activity hours for boating and picnicking.

Mouth, Plume and Youngs Bay

Ecology Of Marine Predatory Fishes: Influence on Salmonid Ocean Survival, U.S. National Marine Fisheries Service, 1998-present

This BPA-supported study examines the temporal dynamics and abundance of marine fish predators and forage fishes in the nearshore ocean off the Columbia River during the juvenile salmon outmigration period. It identifies the food habits of predatory marine fishes and measures selected oceanographic conditions in the nearshore ocean off the Columbia River and distribution and abundance of predator and forage fish in relation to oceanographic conditions and ocean survival of juvenile salmonids historically and to the present to identify the impacts of predators on salmonids.

Goals and Objectives:

- Identify the temporal dynamics and abundance of marine fish predators and forage fishes in the nearshore ocean off the Columbia River during the juvenile salmon outmigration period.
- Identify the food habits of predatory marine fishes.
- Measure selected oceanographic conditions in the nearshore ocean off the Columbia River.
- Relate predator and forage fish distribution and abundance to oceanographic conditions and ocean survival of juvenile salmonids historically and to the present.

Ocean Survival Of Juvenile Salmonids In The Columbia River Plume, U.S. National Marine Fisheries Service, 1998-present

NMFS has identified the Columbia River plume as a probable critical habitat for the survival of juvenile salmon. Moreover, because management of the hydropower system affects the plume, NMFS has as a goal to understand the role of the plume and the influence of physical and biological factors that affect the interaction between the plume environment and salmon. To achieve this goal, NMFS has recommended that the following objectives be pursued.

Objectives:

- Characterize and enhance (through integrated numerical modeling, real-time and time-delayed data from moored instruments, remote sensing and vessel observations) the understanding of:
    - Tidal, seasonal and inter-annual variability of the circulation, hydraulic residence times and physical properties of the Columbia River below Bonneville Dam.
    - Extent and physical properties of the Columbia River plume and its variability at tidal, seasonal and inter-annual scales.
    - Physical properties of the nearshore ocean environment outside (north and south) the plume.
- Describe the nutrient dynamics and the biological oceanographic features of the Columbia River plume environment and compare to the nearshore ocean environment outside (north and south) of the plume during the principal outmigration and growing season (May-September).
- Determine the relationship among time of entry of outmigrating juvenile salmon, quality and health of juveniles, survival and oceanographic conditions using known date of ocean entry of tagged (PIT and coded-wire) groups of Columbia River salmonids.
- Identify the influence of the Columbia River plume habitat on the survival potential of juvenile salmon by measuring differences in growth and health (bioenergetics and disease status) of juvenile chinook and coho salmon inside and outside (north and south) of the plume during the first year (spring through fall) of ocean life. Relate differences in health, quality and growth of juvenile salmon to abiotic and biotic oceanographic features inside and outside of the plume.
- Describe the food habits of juvenile salmon inside and outside of the Columbia River plume and relate to the physical and biological oceanography of the Columbia River plume environment and the nearshore ocean environment outside (north and south) of the plume.

Salmon at River's End: The Role of the Estuary in the Decline and Recovery of Columbia River Salmon, U.S. National Marine Fisheries Service, Seattle, January 2001

Salmon at the River's End completed this analysis to evaluate the capacity of the estuary to support salmon. Its goals are to promote salmon recovery and improve estuarine conditions, as well as to advance understanding of salmon rearing requirements. To do so, the study identified a number of needs which are further detailed in this summary document's chapter on fish and wildlife needs.

Oregon Department of Fish and Wildlife

The goal for the rivers and sloughs from RM 0-11 is to increase the use by fish and wildlife species in the available habitat by improving water quality and fish passage. Passage and water quality can be improved by but limited to: removal of tidegates, propping the tidegate covers open during non-flooding cycles, replacing tidegate covers that allow fish passage and placement of slide gates in the tidegate cover to allow a restricted saltwater intrusion.

Present Subbasin Management

Research, Monitoring, and Evaluation Activities

Introduction

The following discussion briefly and generally describes existing monitoring programs in the two-province area. It also discusses the monitoring plan and strategy of the Lower Columbia River Estuary Partnership, which is coordinating many of the monitoring efforts.

STATE AGENCY PROGRAMS

Oregon Department of Environmental Quality

The Oregon Department of Environmental Quality (DEQ) has an extensive statewide network of water quality ambient monitoring sites. In addition to three sites on the mainstem Columbia River, DEQ maintains sites on many of the lower Columbia River tributaries. DEQ supports additional monitoring which will help support agency programs. However, the current program is fiscally limited as it tries to meet the requirements of assessing Total Maximum Daily Load (TMDL) requirements compliance statewide and the additional monitoring commitments of the Oregon Plan for Salmon and Steelhead.

Washington Department of Ecology

The Washington Department of Ecology (Ecology) currently has ambient monitoring sites on the major tributaries on the Washington side of the lower Columbia and the upper Columbia. There are no sites on the mainstem. Like DEQ, Ecology is required to meet TMDL requirements statewide and address declining salmon and steelhead populations. Ecology supports monitoring efforts on the lower Columbia River which help meet agency needs regarding these two issues.

Other State Agency Programs

Because of the Endangered Species Act listing of the Lower Columbia River Steelhead, the Departments of Fish and Wildlife in Washington and Oregon are either implementing or planning to implement extensive habitat enhancement and restoration efforts in the study area. These activities are limited to the tributaries of the lower river but may ultimately provide long-term water quality benefits to the estuary and the lower river. The habitat protection, enhancement and restoration efforts of these agencies have monitoring components to assess habitat condition and success of implementation.

Federal Programs

U.S. Geological Survey

USGS is primarily a data gathering and research organization. It provides cost sharing so it can cooperate with local agencies to undertake monitoring needs beyond the compliance bounds of the state agencies; thus, it can implement special studies and research projects given sufficient support. The USGS, through its National Stream Quality Accounting Network (NASQAN) program, currently maintains one ambient water quality sampling site on the Columbia River, one on the Snake and one on the Willamette. These sites have provided most of the data for long-term trend analysis for the lower river and now provide a backbone for the Estuary Program Monitoring Strategy.

In 1999, the Estuary Program completed a cooperative study with USGS using Semi Permeable Membrane Devices (SPMD or Lipid Bag) to monitor the entire Columbia River for trace levels of lipid soluble organics in the water column. Results of this effort identified measurable levels of contaminants in the water column, particularly below the mouth of the Willamette River. This new sampling technique holds considerable promise for future application on the river.

The USGS Biological Resources Division is also conducting a long-term monitoring study throughout the Columbia basin including several sites in the study area for the occurrence and distribution of contaminants in biota tissues. This will provide information critical to our understanding of toxics in animal tissue.

U.S. ENVIRONMENTAL PROTECTION AGENCY

EPA is currently conducting a temperature study of the Columbia River above Bonneville Dam. Using historic temperature data, EPA has developed a model for predicting water temperature and will attempt to answer questions regarding what causes elevated mainstem water temperatures and what management actions might be taken to reduce them. No actual field work is being done. The results, however, will be used to set at TMDL for temperature and as the basis for a temperature management plan.

In 1997, EPA also undertook a one-time survey of contaminants in fish flesh in the river system above Bonneville, looking specifically at the exposure of Native Americans to toxic contaminants through fish consumption. The results have not been released, but this information may help direct fish tissue sampling efforts in the lower river.

EMAP Study – EPA's Environmental Assessment and Monitoring Program recently completed a major monitoring effort in the Columbia River (see Action 28, 2nd bullet in this summary's existing and past efforts section).

U.S. ARMY CORPS OF ENGINEERS

The USACE conducts routine monitoring for temperature and total dissolved gas at 11 sites in the lower river. This effort provides long-term information on two parameters that are of particular concern because of non-compliance with water quality standards and the probable negative impacts on migrating salmonids.

Because of its responsibilities for channel maintenance dredging and the proposed channel deepening project, the USACE also conducts sediment sampling for toxic contaminants. This information provides background data on toxic contaminants in the sediments of the navigation channel.

U.S. FOREST SERVICE, COLUMBIA RIVER GORGE NATIONAL SCENIC AREA

The U.S. Forest Service is directing the following monitoring activities for:

- Neotropical use of several riparian forest areas, including Sandy River Delta riparian forest.
- Wildlife use, particularly waterfowl, at Sandy River Delta wetland restoration
- Vegetation response to reed canary grass control, using tools of disking, flooding and scalping.
- Planting success at Sandy River Delta riparian forest restoration
- Fisheries habitat on perennial streams with National Forest land within the Columbia River Gorge National Scenic Area.

Other Monitoring Efforts

Portland Harbor Contaminated Sediments

A recent joint DEQ/EPA survey of sediments in the Willamette River in the Portland Harbor area identified areas of extensive toxic contamination. It is possible that this contamination provides the source of sediment contamination found in the lower Columbia.

Research

The Columbia River Intertribal Fish Commission, the National Marine Fisheries Service, the University of Washington, Oregon State University, Portland State University and perhaps others are conducting research projects in the lower river. These projects are specific to certain research needs and they contribute valuable pieces of information about the lower river.

Air quality is monitored by two Interagency Monitoring of Protected Visual Environments (IMPROVE) sites in the National Scenic Area. Visibility is impaired by pollutants that include vehicle emissions, industrial activities at fixed sites, dust from building and road construction, smoke from burning yard debris and slash fires.

Monitoring of air quality began recently, with installation of the Wishram Station in 1993 and the Cape Horn Station in 1996. This station includes a full IMPROVE aerosol monitoring system, two automatic cameras, an open-air integrating nephelometer and associated meteorological and recording instruments.

Although data collection at the Wishram Station was interrupted for nearly a year when the shelter burned down in 1994, a nearly continuous data set will be available for analysis in 2001. The results of air quality data analysis will be used by agencies, the Columbia River Gorge Commission and industry to better manage and protect the area's natural resources.

The Forest Service monitoring strategy recommends a minimum of five year's worth of data to determine the nature of visibility impairment. Since the station at Cape Horn started operating in late 1996, an accurate characterization of the visibility resource could be expected in 2001 at the earliest. Lichen specialist Linda Geiser is in the process of analyzing lichen data from the Gorge. She has produced initial maps patterning sulfur, nitrogen and lead deposition.

Oregon Graduate Institute

The Oregon Graduate Institute has an ongoing project in the Columbia River estuary with continuous monitoring stations for temperature, salinity and conductivity. This system, known by the acronym CORIE, provides instantaneous water quality data for these constituents.

Lower Columbia Fish Recovery Board

The Lower Columbia Fish Recovery Board participates in a number of research, monitoring and evaluation activities. All projects that are funded through the LCFRB are required to have a monitoring component. The LCFRB will be developing a database of ongoing monitoring activities that are occurring on salmon restoration and protection

projects funded through the State of Washington in the lower Columbia. Various watershed assessment activities are also underway through the LCFRB. The LCFRB is developing watershed assessment protocols for use in all the major streams on the Washington side of the lower Columbia. With funding from Washington State's Salmon Recovery Funding Board and the Centennial Clean Water Fund, the LCFRB will be performing comprehensive watershed assessments of the Washougal and Kalama Rivers and developing prioritized lists of restoration and protection actions for salmon and steelhead. As funding becomes available, the LCFRB plans to perform similar assessments on all the major Washington tributaries to the lower Columbia.

Permitting Dischargers

All municipal and industrial facilities with permitted discharges are required to do routine monitoring of their outfalls. The extent of the monitoring required and the constituents monitored vary.

Coordination

Comprehensive, long term environmental monitoring for further understanding of the lower Columbia River involves tracking trends in the health of the river and its resources, pinpointing problem areas, assuring compliance with water quality standards, measuring biological integrity and assessing the effectiveness of management actions over time.

The Lower Columbia River Estuary Partnership, in its Interagency Long-Term Monitoring Plan to Assess Water Quality, Sediment Quality, Aquatic Health, and Biological Integrity in the Lower Columbia River, identified and summarized the many agencies and programs conducting monitoring in the two-province area. From this information, the Estuary Partnership formed its Aquatic Ecosystem Monitoring Strategy, March 1999.

The strategy includes cooperative agreements between all of the involved parties that have been sought to ensure commitments for:

- implementing the monitoring strategy;
- developing comparable sampling protocols and procedures;
- developing comparable quality assurance procedures;
- storing and sharing data;
- analyzing and assessing data; and
- disseminating information to the public.

With the exception of one-time studies, most of the elements of the strategy are long-term features. Such things as measuring trends in water quality, assessing river health and tracking the success of management actions can only be accomplished with persistent, consistent sampling efforts over the long run.

The strategy is built upon existing ambient monitoring programs and supports the continuation and enhancement of these monitoring programs, providing the framework for a cooperative, collaborative monitoring effort by all monitoring organizations as well as an oversight mechanism to ensure effective coordination.

The strategy identifies four general monitoring areas: water column, toxics in sediments, toxics in tissues, and habitat and biological integrity. It then includes

recommendations for the specific monitoring actions and special studies needed to provide critical information and support the monitoring objectives. The monitoring plan offers the recommendations and a relative priority for each.

The monitoring objectives, which are evolving as more data becomes available and the understanding of the ecosystem improves, are to:

- incorporate and augment existing monitoring and assessment programs;
- develop specific approaches for addressing specific monitoring questions;
- develop hypotheses that can be tested as part of the monitoring strategy;
- select monitoring variables as appropriate for sampling locations, sampling frequency, media, chemical and biological parameters, and quality control;
- provide for coordinated data management and assessment;
- assure the gathering of comparable, high-quality baseline data and issue-specific data by all participating programs;
- provide for the processing and analysis of data to address immediate information needs and determine seasonal, annual and long-term trends; and
- provide for periodic assessment of all data and re-evaluation of the Monitoring Strategy.

As part of this strategy, the Estuary Partnership is taking the lead in coordinating and managing the large volume of existing information. This process is being developed and will make the information readily available to all interested parties.
The basic components of the Monitoring Strategy include:

- coordinating and overseeing the program;
- developing a data management system;
- monitoring for and assessing the impacts of conventional pollutants and toxic contaminants;
- measuring and assessing habitat health, measuring primary productivity, developing an understanding of food web relationships; and
- evaluating the impacts of exotic species.

A summary of ongoing data collection and monitoring activities in the Columbia River basin (1999) is included in Appendix F.

Prioritization of Monitoring Plan Recommendations

The recommendations in the monitoring plan were developed from an analysis of issues identified by the Bi-State Water Quality Report, the seven priority issues of the Management Committee and from the Environmental Indicators papers. All recommendations are essential to achieving a comprehensive, sustained monitoring effort that will ultimately provide an ongoing analysis of river health.

To help further refine the recommendations in the monitoring plan and identify their priority for implementation, the recommendations were prioritized based on the degree to which each:

- adds information to highly valued topics;
- fills data gaps;
- is mandated or is already being done;

- fulfills management needs; and
- is cost effective.

Other decision factors include:

- whether other actions depend on its implementation;
- whether it meets estuary program objectives;
- the need for the information;
- whether funding is available;
- cost;
- coordination with existing programs;
- timing;
- benefits;
- agency missions; and
- the needs and concerns of Estuary Program stakeholders.

Responsibilities for Implementation

A number of parties will implement aspects of the Monitoring Strategy. As described earlier, several agencies currently monitor at a number of sites. It is anticipated that existing ambient monitoring will continue. When the strategy calls for collecting additional data at existing agency monitoring sites, it may be feasible for that agency to extend its sampling to meet the additional data needs. When the strategy calls for new efforts, those efforts could either be completed by an existing agency or contracted out. In either case, new efforts will require new funds.

Some of the factors to consider in assigning responsibility for implementation include:

- Capability – does the agency or organization have expertise and knowledge to undertake the task?
- Capacity – does the agency or organization have the lab capacity and field staffing necessary to accomplish the task?
- History – has the agency or organization been involved in monitoring the Columbia River previously?
- Commitment – can the agency or organization commit to a long-term program?
- Existing efforts – does the agency or organization have ongoing programs that can be built upon?
- In-kind resources – can the agency or organization bring additional resources to the project such as matching funds or in-kind services?
- Mission – is the project consistent with the agency or organization's main mission?

The Estuary Program will take the lead in overseeing the implementation of the Monitoring Strategy. This will include convening and coordinating appropriate parties to seek the commitment and support to ensure that the strategy is implemented.

Conclusions

Comprehensive, long term environmental monitoring is critical to further our understanding of the lower Columbia River, track trends in the health of the river and its

resources, pinpoint problem areas, assure compliance with water quality standards, measure biological integrity, and assess the effectiveness of management actions over time.

With the exception of one-time studies, most of the elements of the *Strategy*, once it reaches full-scale implementation, are long term features. Such things as measuring trends in water quality, assessing river health and tracking the success of management actions can only be accomplished with persistent, consistent sampling efforts over the long run. The Estuary Program and its participating partners need to seek sustained dependable funding from a variety of sources to maintain the monitoring effort over time.

A comprehensive, coordinated *Monitoring Strategy*, built upon existing ambient monitoring programs, is the most resource efficient way to implement long term environmental monitoring on the lower river. The *Strategy* should support the continuation and enhancement of existing monitoring programs and provide the framework for a cooperative, collaborative monitoring effort by all monitoring organizations as well as an oversight mechanism to ensure effective coordination.

Because it is a two state stakeholder process, the Estuary Program plays a critical role in ensuring the full and long term implementation of monitoring for the lower river and estuary. The Estuary Program will take the lead by adopting this *Monitoring Strategy*.

Cooperative agreements between all involved parties will be needed to ensure commitments for:

- implementing the monitoring strategy;
- developing comparable sampling protocols and procedures;
- developing comparable quality assurance procedures;
- storing and sharing data;
- analyzing and assessing data; and
- disseminating information to the public.

The Estuary Program will take the lead in developing cooperative agreements with all organizations participating in the monitoring to ensure their commitment and participation. All those involved in implementing the Estuary Plan should commit to supporting the *Monitoring Strategy* for the long term.

Effectively managing the large volume of existing information and that which will be developed as the *Monitoring Strategy* is implemented is critical to the success of the program: so is making that information readily available to all interested parties. The Estuary Program will take the lead in coordinating information management.

A phased approach to implementation that supports and augments existing programs and that implements top priority monitoring recommendations as resources are available is the most logical approach in light of limited funding and resources. A stable, long term funding source is needed to ensure the viability of the *Monitoring Strategy*. The *Monitoring Strategy* is meant to be here for the long run. Continued monitoring will be needed to track trends over time and to make sure that the public and decision-makers are continually appraised of the health of the river. Constant vigilance in the form of monitoring will be needed or gains made today will be lost over the long run to the continuing, insidious onslaught of population growth. The Willamette River is a case in

point. Forty years ago we celebrated saving it from the brink of extinction only to face the reality that once again it is in need of saving. Constant surveillance and aggressive natural resource management will be needed to prevent the incremental deterioration of the lower Columbia River. Stable funding and a long-term commitment from the project participants and supporters are the only way this effort can be meaningful.

Data Management

Along with monitoring coordination, the Estuary Partnership plans to implement a full-scale data management system for the two-province area in four phases. The Lower Columbia River Information Management Strategy is continued in Volume II of the CCMP. The goals of the Columbia River Estuary Program Information Strategy are to:

- Improve the exchange of information among potential users
- Make data more accessible and meaningful to the public
- Track the implementation of management plan action
- Create an institutional framework that will maintain and permit exchange of high quality data and information over the long term

The strategy proposes to phase in over time as follows:

- PHASE ONE: Data Storage – This phase, a part of which is underway, will focus on locating all existing data, improving access to the existing data and heightening public awareness of the information available.
- PHASE TWO: Data Organization – This phase will focus on establishing uniform procedures. At a minimum, Task 1 would need to be completed before the implementation of the long-term monitoring plan.
- PHASE THREE: Data Management (short-term) – This phase would develop a short-term (up to three years) approach to managing the data.
- PHASE FOUR: Data Management (long-term) – This phase would focus on seeking resources for the development of a dedicated data management system for the lower Columbia River which would allow dynamic access, reporting and analysis of all relevant information, be accessible to all interested parties through the Internet, and provide a home for all "orphaned" information.

Table 9. Sources of Data and Information on the Lower Columbia River

Federal Agencies
U.S. Geological Survey - routine long-term monitoring and special studies
U.S. Army Corps of Engineers - routine long-term monitoring associated with dam operations and special studies related to dredging and channel maintenance
National Marine Fisheries Service - special fisheries research studies primarily in the estuary
U.S. Fish and Wildlife Service - special wildlife research studies
U.S. Environmental Protection Agency - pollution studies, currently modeling temperatures
Bonneville Power Administration - contracted research studies
U.S. Forest Service - Wildlife and vegetation monitoring at Sandy River Delta

Regional Governmental Bodies
METRO - special studies related to the lower Willamette River
Columbia River Estuary Study Task Force (CREST) - special studies related to the estuary including the Columbia River Estuary Data Development Program (CREDDP) after 1981
Northwest Power Planning Council - special studies on power generation and fisheries
Pacific Northwest River Basins Commission - special studies prior to 1981 including CREDDP, no longer in existence

State Agencies
Oregon Department of Environmental Quality - routine ambient monitoring and special studies
Oregon Department of Fish and Wildlife - studies related to fish and wildlife and habitat
Oregon Division of State Lands - information related to wetlands
Governors Watershed Enhancement Board - information related to Oregon's watershed councils
Washington Department of Ecology - routine ambient monitoring and special studies
Washington Department of Fish and Wildlife - studies related to fish and wildlife and habitat
Washington Department of Natural Resources - information related to submerged lands

Local Governments
City of Portland Bureau of Environmental Services - water quality studies

Universities
Oregon State University - specific research projects
Portland State University - specific research projects
University of Washington - specific research projects
Washington State University - specific research projects

Other Educational Institutions
Clatsop Community College - student projects
Oregon Graduate Institute - maintains continuous monitoring of physical parameters at mouth
Marine and Environmental Research and Training Station - special projects
Local school districts and schools - student projects

Tribes
Columbia River Inter-Tribal Fish Commission - special contracted studies
Confederated Tribes - Umatilla, Warm Springs, Nez Perce, Yakima

Ports
The Port of Portland - special studies related to Port operations

Private Industry
Private industry, particularly the NW Pulp and Paper Association and Portland General Electric, has compiled a number of reports on studies of the lower river.

Non Profit Organizations
A number of nonprofit organizations also have collected or will be collecting data and have compiled reports. This includes a number of watershed councils on the lower river.

Monitoring of sport and commercial eulachon, Washington and Oregon Departments of Fish and Wildlife

The Washington and Oregon Departments of Fish and Wildlife conduct a small-scale program of monitoring sport and commercial eulachon (Columbia River smelt) fisheries and sampling for eulachon eggs and larvae in the mainstem lower Columbia River and tributaries to index run size and to identify the extent and distribution of spawning activity. Sampling has demonstrated that the number of eulachon returning each year varies and the number of tributaries and portions of the mainstem Columbia River use for spawning also varies from year to year. Occasionally, a portion of the run travels to and sometimes passes above Bonneville Dam, presumably in an attempt to spawn in pre-impoundment spawning sites.

Statement of Fish and Wildlife Needs

Overview

This summary includes needs of fish and wildlife to meet near-term fish and wildlife project management goals, objectives and strategies. The information below is derived from conclusions and recommendations of studies and efforts relating to the two-province area.

Following information about the two-province area, this chapter is organized geographically in river sections from east to west: Bonneville to Portland, Portland to Skamokowa River Mile 34, River Mile 34 to Astoria, and the mouth, plume and Youngs Bay. Within the river sections, the information is organized alphabetically by the study name.

Overall Study Area

The following reports give recommendations for fish and wildlife needs throughout the entire area of study. While later sections deal with needs in specific geographical areas, this section addresses either needs of specific species or goals of specific agencies throughout the study area.

Ecology of Bald Eagles on the Lower Columbia River, *U.S. Army Corps of Engineers, 1988*

The Ecology of Bald Eagles on the Lower Columbia River provides the following needs to protect and enhance bald eagles and their habitat:

- Review all dredging operations for potential effects on bald eagle populations, particularly resident breeding pairs and in Baker, Cathlamet, and Grays Bays
- Place more controls on the use and deposition of PCB-containing substances
- Check and replace all transformers and circuit breakers on hydroelectric dams and major waterways and replace if they contain PCBs
- Cap and dredge sediments in the Willamette River (River Mile 13.5) to eliminate PCB-contaminated sediments
- Place emphasis on the entire Columbia River system and all potential sources of environmental contaminants

The Columbia River Estuary and the Columbia River Basin Fish and Wildlife Program Independent Scientific Advisory Board (ISAB) report

The ISAB provided independent scientific advice and recommendations on The Columbia River Estuary and the Columbia River Basin Fish and Wildlife Program related to regional fish and wildlife recovery programs under the Northwest Power Act and the Endangered Species Act. The intent of this report has been to provide a summary of more technical documents (see Seaman 1977, Simenstad et al. 1984, Small 1990, Thomas 1983) and to relate changes in the estuary to the Fish and Wildlife Program. The types of large-scale programs that are envisioned include:

- Remove dikes in the lower river and upper estuary to restore connections between peripheral floodplains and the river or fluvial zone of the estuary. Productivity of flooded versus diked peripheral plains and use of flooded plains should be monitored
- Actively manage sources of salmonid predation in the estuary through restoration of natural habitats, removal of habitats artificially created due to channel construction and/or maintenance, or controlling predator populations
- Establish an allocation of water within the annual water budget for the Basin that would simulate peak seasonal discharge, increase the variability of flows during periods of salmonid emigration, and restore tidal channel complexity in the estuary (aided by removing pile dikes where feasible)

Lower Columbia River Estuary Program Comprehensive Conservation and Management Plan Volume 2 Aquatic Ecosystem Monitoring Strategy for the Lower Columbia River Information Management Strategy

Lower Columbia River Information Management Strategy, completed in 1999, suggests that the ideal data management system would ensure that the appropriate data is readily accessible and easily interpreted. The strategy lists constraints that may make the attainment of this ideal difficult. They include funding and staffing, agreements on data sharing and data standards, and timing. The strategy suggests the system will need to be accessible to federal, state, county, city and non-government organizations.

The following is a list of criteria relevant to the evaluation of the various data management alternatives: (Note: these are *not* in priority order.)

- Sufficient capacity to store and report environmental monitoring data, including water quality, habitat, fish and wildlife, and pollutant loading data
- Sufficient capacity to store and report geographic data
- Sufficient capacity to store and report hydrologic data
- Reasonable cost to develop and maintain
- An easy-to-use standard interface to individual water quality databases
- Common data element names and definitions
- Assurance of data quality and integrity
- Ability to be queried and to provide reports including such elements as trend analysis
- Availability at the beginning of the long-term monitoring program
- Easy access to data for non-computer experts
- Easy access to data for the interested public
- Coordinated data sharing through linkages to other agencies
- Easily updated

- Continued utility independent of the Lower Columbia River Estuary Program
- Flexibility to be modified as needs or resources change and technology evolves

Comprehensive, long-term environmental monitoring is critical to further our understanding of the lower Columbia River, track trends in the health of the river and its resources, pinpoint problem areas, assure compliance with water quality standards, measure biological integrity, and assess the effectiveness of management actions over time.

With the exception of one-time studies, most of the elements of the *Strategy*, once it reaches full-scale implementation, are long term features. Such things as measuring trends in water quality, assessing river health and tracking the success of management actions can only be accomplished with persistent, consistent sampling efforts over the long run. The Estuary Program and its participating partners need to seek sustained dependable funding from a variety of sources to maintain the monitoring effort over time.

A comprehensive, coordinated *Monitoring Strategy*, built upon existing ambient monitoring programs, is the most resource efficient way to implement long term environmental monitoring on the lower river. The *Strategy* should support the continuation and enhancement of existing monitoring programs and provide the framework for a cooperative, collaborative monitoring effort by all monitoring organizations as well as an oversight mechanism to ensure effective coordination. A summary of ongoing data collection and monitoring activities in the Columbia River basin (1999) is included in Appendix F.

Because it is a two-state stakeholder process, the Estuary Program plays a critical role in ensuring the full and long term implementation of monitoring for the lower river and estuary. The Estuary Program will take the lead by adopting this *Monitoring Strategy*.

Cooperative agreements between all involved parties will be needed to ensure commitments for:

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The Estuary Program will take the lead in developing cooperative agreements with all organizations participating in the monitoring to ensure their commitment and participation. All those involved in implementing the Estuary Plan should commit to supporting the *Monitoring Strategy* for the long term.

Effectively managing the large volume of existing information and that which will be developed as the *Monitoring Strategy* is implemented is critical to the success of the program: so is making that information readily available to all interested parties. The Estuary Program will take the lead in coordinating information management.

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Wy-Kan-Ush-Mi Wa-Kish-Wit Spirit of the Salmon The Columbia River Anadromous Fish Restoration Plan of the Nez Perce, Umatilla, Warm Springs, and Yakama Tribes, 1995

The Spirit of the Salmon, provides a framework to restore the Columbia River salmon, simply stated: put the fish back into the rivers. According to Spirit of the Salmon, past attempts to maintain or restore declining salmon numbers all assumed that technology alone could "fix" the damage caused by disregard for the underlying, interconnected processes of nature which gave rise to and sustained the great salmon runs of the Columbia Basin. Simple solutions could not replace the complexity of nature; naturally these attempts failed. The Spirit of the Salmon provides institutional and technical recommendations below.

Institutional Recommendations

- Use the Columbia River Fish Management Plan, the Northwest Power Planning Council's Fish and Wildlife Program, and orders of the Federal Energy Regulatory Commission as a basis for management
- Plan and implement production called for in the Columbia River Fish Management Plan
- For public lands and water project management, implement a dispute resolution process similar to Columbia River Fish Management Plan and Federal Energy Regulatory Commission processes
- Establish a new state and tribal fish and wildlife entity using Bonneville Power Administration funding
- Support ongoing and implement new subbasin planning through a Columbia Basin watershed trust program
- Base Endangered Species Act listing on the status of species throughout a significant portion of its spawning and rearing range. In the absence of scientific proof, the National Marine Fisheries Service should withdraw its Evolutionarily Significant Unit (ESU) interim policy as a basis for Endangered Species Act listings
- Transfer federally funded hatcheries located on reservations and at other upriver sites to tribal control

- Encourage state, tribal and federal fish agencies to coordinate and set priorities for research, monitoring and evaluation programs
- Continue development of and make research and monitoring data available through a coordinated information system
- Update provisions of the Pacific Salmon Treaty and the Columbia River Fish Management Plan based on the latest survival rate and catch level information Continue coordinated harvest law enforcement; develop habitat protection law enforcement

Technical Recommendations

- Begin improving in-channel stream conditions for anadromous fish by improving or eliminating land-use practices that degrade watershed quality
- Protect and increase instream flows by limiting additional consumptive water withdrawals, using the most efficient irrigation methods, preventing soil compaction and riparian vegetation removal and wetland destruction; where necessary, restore soil, restore riparian vegetation and re-create wetlands
- Actively restore watersheds where salmon populations are in imminent danger of extirpation. Use "Coarse Screening Process" to develop demonstration projects
- Use supplementation to help rebuild salmon populations at high demographic risk of extirpation
- Use supplementation to reintroduce salmon to watersheds from which they have been extirpated
- Use flow, spill, drawdowns, peak efficiency turbine operation, new turbine technology, and predator control projects to improve inriver juvenile salmon survival; avoid fluctuations caused by power peaking operations
- Protect and restore critical estuary habitat
- Establish Alaskan and Canadian ocean fisheries based on chinook abundance.
- Use stored cold water, additional ladders, ladder improvements and ladder maintenance to enhance mainstem adult passage; incorporate 24-hour video fish counting
- Improve water quality by eliminating sources of toxic pollution that accumulates in fish tissue and by reducing discharges of other contaminants to meet water quality criteria for anadromous fish
- Closely monitor tributary production and escapement to improve management
- Conduct research on Pacific lamprey and design artificial propagation strategies to supplement natural production
- Develop artificial propagation and management strategies for white sturgeon populations above Bonneville Dam

Oregon Department of Fish and Wildlife

- Mitigate the loss of salmon spawning habitat caused by dams on the mainstem of the Columbia River
- Adapt the management and selective harvest on mixed stock of salmon to respond to changing conditions
- Implement new live capture techniques to allow harvest on hatchery fish while reducing the impact on natural spawning populations

- Encourage select area fisheries to develop a commercially viable program that will use a brood stock that will minimize impact on naturally spawning populations
- Tag hatchery fish with a fin mark and coded wire tags to enable staff to collect the data and provide analysis to modify or improve the program

White Sturgeon Mitigation and Restoration in the Columbia and Snake Rivers Upstream from Bonneville Dam, Washington Department of Fish and Wildlife, the Oregon Department of Fish and Wildlife, and The U.S. Geological Survey

The removal of over 26,000 white sturgeon and the planned removal of 5,000-10,000 juvenile fish annually for an unspecified number of years will have an impact on the white sturgeon population residing in the Lower Columbia Province. The significance of this action needs to be assessed. Construction of Bonneville Dam reduced the only spawning habitat used by the lower river population, possible reducing potential productivity and thus increasing the population's sensitivity to losses. Current knowledge of the status of the lower river population is inadequate to determine the impact of removing juvenile fish. State funded monitoring programs designed to meet fishery management obligations are limited to indexing annual legal size (42"-60") abundance and estimating harvest. Sublegal, over-legal, and broodstock population parameters are not monitored. An accurate assessment of the sublegal, legal, over-legal, and broodstock population is needed to properly evaluate transport strategies.

Bonneville to Portland

Bonneville Tributaries Subbasin Stock Summary and Habitat Priorities

The Bonneville Tributaries Subbasin Stock Summary and Habitat Priorities report (see Appendix A) identifies the following needs to mitigate the effects of the listed limiting factors:

- Reconnect and preserve off-channel and side channel habitat and associated wetlands wherever they occur. Lower Gibbons Creek, Steigerwald Refuge, Frans Lake, and Greenia Creek wetlands are priorities
- Protect and enhance riparian corridors, especially in the upper watersheds of the Bonneville Tributaries Subbasin
- Protect existing mature riparian vegetation for LWD recruitment
- Maintain current appropriate pieces of LWD, and other natural structures through increased education and enforcement
- Preserve healthy riparian corridors in the headwaters of all the subbasins' tributaries, especially in Hardy, Hamilton, and Greenleaf Creeks
- Protect riparian corridors in all headwaters areas to maintain the supply of cool, clean water to critical downstream spawning and rearing areas
- Protect the supply of water to springs that provide critical chum spawning sites in Duncan, Hardy, and Hamilton Creeks
- Preserve riparian corridors and wetlands with native vegetation

Oregon Columbia Tributaries West: Watershed Analysis, Columbia River Gorge National Scenic Area, 2001

The Oregon Columbia Tributaries West Watershed Analysis, completed in 2001, describes how the study area has changed over time, the existing conditions and how management or

restoration can move the watershed toward the desired future condition. The following needs were identified as necessary to the restoration of the watershed:

- Maintain the general healthy condition of upper stream reaches of Multnomah, Oneonta, Horsetail, Gordon, and Moffett creeks and enhancement of Bridal, Young and Latourell creeks. Also mimic streams with similar characteristics that are in good condition
- Based on conditions, either achieve Mount Hood National Forest westside standards, or defer to the professional judgment of the wildlife fish biologist
- Enhance natural wetland plants in wetland areas along Columbia River (Rooster Rock, Horsetail Falls etc.). Leave riparian zone widths as detailed in the Northwest Forest Plan
- Encourage Oregon State Parks to improve riparian habitat, especially on lower elevation parks near the Columbia River
- Re-establish natural stream channels as opportunities arise
- Widen flow channels by constructing more fish-friendly culverts (with a natural stream bottom) and more bridges and overflow channels
- As opportunities arise, work with other agencies and landowners to eliminate or reduce flow restrictions at stream mouths
- Add large wood to anadromous portions of all streams where they are currently below standards and to the upper reaches of resident habitat of Bridal Veil, Young, Latourell, Lawton, Woodward, Hamilton and other creeks. This will provide more fish cover and pool habitat for juvenile salmonid rearing on both federal and non-federal lands. Facilitate an interagency effort where necessary
- Increase the amount of pool habitat in the anadromous streams where it is below standards and in the upland reaches of the three aforementioned creeks
- Explore opportunities for a pond to hold overwintering fry at McCord Creek
- Preserve hardwood riparian habitat on all ownerships, especially along the Columbia River
- Support other agencies to re-introduce Columbia River flushing flows to carry sediment and vary water level
- Recreate and/or enhance hardwood riparian habitat wherever possible. Facilitate an interagency effort where necessary
- Re-examine the road access to Beacon Rock boat launch site/Doetsch dayuse area
- Reduce road density and/or stream crossings wherever possible to enhance stream function
- Work with USFWS on re-routing of Lawton Creek to its historical route
- Explore possibilities of a separate routing for “Marshal” Creek at SR14 crossing. (It is now channelized to join Good Bear Creek.)
- Maintain existing habitat for east-west demographic and genetic exchanges and enhance habitat on the north side of the river
- Promote nesting habitat for snag-dependent and large tree-dependent species.
- Investigate improving pond and painted turtle habitat
- Explore beaver reintroduction to enhance wetlands in upper watershed
- Protect instream fauna by limiting the amount of dredging and gravel removal

Re-introduction of Columbia River Chum Salmon into Duncan Creek, Washington Department of Fish and Wildlife, 2000-2001

Duncan Creek is located approximately five miles below the Bonneville Dam on the Washington side of the Columbia River. In the 1960's a dam and culvert were placed across the stream to create an artificial lake. Surveys conducted by the Washington Department of Fisheries before the dam was installed indicated that four to five hundred chum salmon returned to the stream and used natural springs or seeps as spawning areas. After the dam was installed, chum salmon were no longer able to use the stream as a natural spawning area. Fish-passage work completed in 2000 and recent landowner agreements, however, will allow chum salmon to once again enter the stream. Significant renovation work on Duncan Creek is currently taking place, gravel in four branches of the stream is being removed and replaced with gravels that are expected to maximize chum salmon egg-to-fry survival rates. Uplands immediately adjacent to the channels will be planted with indigenous vegetation to protect the integrity of the rehabilitated areas.

Questions about possible domestication effects, and whether such fish demonstrate higher straying proclivities than wild cohorts need to be addressed. The assumption that natural colonization into newly created spawning and incubation habitats will be low also needs to be evaluated. Finally too, the physical parameters used as criteria for the renovated portions of Duncan Creek were derived from data collected on Puget Sound chum salmon. How well chum salmon native to the Columbia River survive in such areas needs to be assessed as well as whether the habitat created actually resembles what was recommended. The approach to chum salmon recovery in place in the Columbia needs to be tested and its consequences evaluated. Further refinement on how spawning and incubation habitats for this species should be built in this part of the basin may need to be examined.

For the Duncan Creek project the following general information needs should be addressed:

- What egg-to-fry survival rates are being achieved in the renovated portions of the stream
- What is the survival of the eggs and fry used in the artificial rearing program that will take place at Duncan Creek
- What is the survival and spawning ground distribution of adult chum salmon produced from the renovated habitat areas and from the rearing program
- What is the straying rate of non-project chum into Duncan Creek
- What are the physical characteristics present in the renovated portions of Duncan Creek (dissolved oxygen, water temperature, velocity, up- and down welling zones, gravel composition, suspended sediments, and flow and how do these attributes affect survival)

Sandy River Delta Plan and EIS 1996 and Sandy River Watershed Analysis, Columbia River Gorge National Scenic Area, 1995

The Sandy River Delta Plan and EIS 1996 and Sandy River Watershed Analysis has identified the following needs:

- Restore wetland, riparian forest, shrub-scrub, upland forest, and upland meadow habitats.
- As first priorities, restore riparian forest and wetland restoration, with long-term objectives of re-establishing 600 acres of Columbia River bottomland riparian forest (dense stands of black cottonwood, will and ash), and re-establishing about 200 wetland acres and associated upland habitat.
- Consider breaching levees and dikes to restore sloughs and backwater channels.

Portland to Skomokowa River Mile 34

Columbia-Clatskanie Watershed Assessment, *Portland State University, 2001*

This watershed assessment, prepared for the Lower Columbia River Watershed Council, will be used as a guide for the prioritization and design of restoration projects. The conclusions drawn lead to the following list of needs:

- Complete fieldwork to verify impacts to wetlands from road building within the interior of the subbasin
- Incorporate the list of data gaps identified in each section of the watershed assessment in a monitoring program
- Conduct culvert inventories and natural barrier evaluations to determine if all potential habitat is accessible and being utilized by the species of concern
- Conduct aquatic habitat surveys and biological surveys for some watersheds to determine the current status of habitats and verify the assumptions made for the distribution of the species of concern. Watersheds that need to be surveyed include: Green Creek, Goble Creek, Beaver Creek (below the falls), Merrill Creek, Tide Creek, Fox Creek, Nice Creek and McBride Creek
- Include the following subwatersheds, within the Clatskanie River watershed, in the surveys: Page Creek, North Fork Clatskanie River and Little Clatskanie River
- Address the lack of large woody debris for instream habitat complexity, high stream temperatures, a lack of large conifers within the riparian zone and floodplain connectivity

Revised Columbia White-Tailed Deer Recovery Plan, *U.S. Fish and Wildlife Service, 1976*

The Revised Columbia White-Tailed Deer Recovery Plan outlines methods of re-establishing white-tailed deer near the Columbia River. The conclusions of the Revised Columbian White-Tailed Deer Recovery Plan includes the following Columbia River white-tailed deer population needs:

- Secure the habitat of one additional subpopulation so that there are three secure and viable subpopulations
- Secure habitat through acquisition (fee title or easement) or long-term agreements with private organizations, e.g., Columbia Land Trust and The Nature Conservancy, which own habitat
- Develop a monitoring/management plan that will be required to ensure the population remains recovered

Scappoose Bay Watershed Assessment

The Scappoose Bay Watershed Assessment suggests that protection be given a higher priority than restoration, and recommends that areas identified as "refugia" be targeted for protection first. In Scappoose Bay Watershed, where refugia are primarily in private hands, that means either convincing private landowners to voluntarily increase protection standards for critical habitat, or securing conservation easements and/or buying critical habitat.

A prioritized list of protection and restoration opportunities identifies the Scappoose Creek estuary (a remnant intact wetland and nodal refugia at the south end of Scappoose Bay) as the highest protection opportunity in the watershed. Also listed as high priority are protection of North and South Scappoose Creek headwaters (primarily private timberland), correction of barriers to fish passage (now underway), road maintenance and/or removal projects, riparian planting and large wood placement in "adjunct refugia" (the corridors through which salmonids must pass to reach refugia), and restoration within the diked, channelized and tide-gate challenged flood plain. The Council's Comprehensive Assessment of Fish Passage Barriers identifies and prioritizes 107 barriers to fish passage in this small (85,000 acre) watershed. An OWEB grant in the amount of about $450,000 has been awarded to address the first ten barriers. Additional funding is being provided by county and municipal governments, private timber, and other non-profit agencies (including For the Sake of the Salmon).

Evaluation of Spawning for Fall Chinook and Chum Salmon just below the four Lower most Columbia River Dams (BPA project number 1999-003-001), Washington Department of Fish and Wildlife, 1999-2001

The project is composed of three closely related activities. Pacific States Marine Fisheries Commission (PSMFC) is leading the adult studies portion, ODFW is leading the juvenile studies portion, and the U.S. Fish and Wildlife Service (USFWS) is leading the habitat assessment portion of the project. ODFW and PSMFC have conducted chum salmon spawning ground surveys from The Dalles Dam downstream to the estuary, and are scheduled to continue those surveys. As part of these efforts, the following needs have been identified.

Chum Salmon

- Additional land acquisition and purchase of conservation easements for total protection of the Wood's Landings and Rivershore seeps. This is essential to protect one of the only two mainstem spawning sites for Columbia River chum salmon.
- Determine the effects of water flows and tides on spawning habitat, and identify, record, and map chum spawning locations at this site.
- Continue to survey the mainstem Columbia River downstream from Bonneville Dam to identify other potential chum spawning habitat including spring seeps and areas with ground water/surface water interactions for possible acquisition or restoration.
- Continue annual chum spawning ground counts (both index and non-index) to determine presence/absence, spawn timing, generate population estimates, determine carrying capacity, and determine trends in populations.

- Continue collecting chum at the Bonneville trap and collect biological and genetic data plus radio tag a portion of those fish to determine migration routes and spawning locations above Bonneville Dam.
- Continue collecting biological data from adult chum salmon to profile age, age at return, sex ratios, fecundity, and potential production.
- Continue collecting biological data from juvenile chum to estimate egg to fry survival rates, and use strontium to mark the juveniles to determine fry to adult survival rates and straying rates.
- Determine total emergence, emergence timing, rearing duration, rearing distribution, and emigration timing for chum salmon.

Fall chinook

- Conduct annual spawning ground surveys for Lower Columbia River and upriver bright fall chinook in the Ives/Pierce Island complex to estimate the population size, determine the carrying capacity, and collect data for age composition and CWTs to profile the stock composition.
- Determine rearing duration, rearing distribution, and emigration timing for fall chinook in the Ives/Pierce Island complex.
- Continue to apply CWT's to juvenile chinook captured in the Ives/Pierce Island complex to determine juvenile to adult survival rates, ocean and freshwater distribution, and harvest impacts.

Stranding Studies

- Quantify the effect of Bonneville Dam flow fluctuations on stranding of salmonid species below the dam, and determine the relative impact of stranding on the total population.

Habitat

- Conduct surveys of the entire mainstem Columbia River downstream from Bonneville Dam to identify areas outside the Ives/Pierce Island complex that may be used by Lower Columbia River fall chinook, bright fall chinook, or chum salmon for spawning/rearing.
- Investigate whether there is a relationship between mainstem spawning and rearing habitat for fall chinook/chum salmon, and production of adults.
- Complete physical modeling for a real-time water elevation model that incorporates ocean tides and tributary backwater effects on Bonneville discharges and associated physical habitat parameters. This is required for both habitat modeling and stranding evaluations.
- Conduct temperature profiling of river bed temperatures over large spatial areas around chum salmon spawning sites to create a spatial data layer that would indicate the extent of chum spawning habitat. Determine how river bed temperatures in spawning areas change as surface water temperature changes, and as river discharge changes. Determine the effect of these changes on spawning habitat selection by chum salmon.
- Develop a more quantitative understanding of the source and configuration of groundwater resources around chum salmon spawning areas so hydrosystem

management actions don't negatively impact the potential interaction of groundwater and surface water thus restricting potential spawning habitat.

- Determine particle size distribution and hydraulic conductivity of bed sediments to quantify groundwater flux. Determine the relationship between groundwater flux and spawning habitat selection by chum salmon.
- Conduct an evaluation of the effect of hourly flow fluctuations resulting from power production at Bonneville Dam on mainstem spawning and rearing habitat.
- Continue to provide in-season recommendations for hydrosystem operation to maintain or enhance spawning, incubation, and rearing habitat for fall chinook and chum salmon.
- Complete a real-time, Internet-based tool that fish and wildlife managers and hydrosystem operators can use to evaluate the effects of hydrosystem management options on habitat for mainstem spawning fish species in areas downstream from Bonneville Dam.
- Investigate physical and/or hydraulic parameters used by spawning and rearing white sturgeon downstream from Bonneville Dam, and determine the relationship between hydrosystem operation/river discharge and physical habitat.

Limiting Factors

- Columbia River discharge as controlled by Bonneville Dam currently limits production of mainstem spawning anadromous salmonids, white sturgeon, and possibly other species. In addition, hourly flow fluctuations resulting from power production have a negative effect on spawning and rearing habitat, and cause direct mortality of both adults and juveniles. Alternate watering and de-watering of areas characterized by groundwater/surface water interaction is negatively effecting spawning and rearing habitat in critical areas for ESA listed Columbia River chum salmon.

Abernathy, Germany, and Mill Creeks—Multiple projects, Washington Department of Fish and Wildlife

Related to the mainstem Columbia, the Washington Department of Fish and Wildlife is implementing projects to determine abundance and monitor natural production of juvenile, smolt and adult salmonids in Abernathy, Germany and Mill Creeks. Continued monitoring at current levels is necessary to provide annual adult escapement and juvenile/smolt production estimates for these systems. In addition, adult trapping needs to be expanded to include Germany and Mill Creeks. Tributaries Subbasin Stock Summaries and Habitat Priorities for these streams are included in Appendix D.

River Mile 34 to Astoria

Salmon at River's End: The Role of the Estuary in the Decline and Recovery of Columbia River Salmon, *U.S. National Marine Fisheries Service, Seattle, January 2001*

Salmon at the River's End offers the following recommendations as potential means to promote salmon recovery and improve estuarine conditions, as well as to advance understanding of salmon-rearing requirements:

Retrospective analyses

- Identify and protect the full variety of geographic features and disturbance processes in the basin that allow for diverse salmon life histories, including different patterns of estuarine rearing. Evaluate information on hatchery, harvest, and habitat management practices that reduce salmon life-history diversity, particularly diversity of subyearling, ocean-type migrants that are potentially most dependent on estuarine habitats
- Reconstruct the historical structure of mainstem and tributary shallow-water habitat in the predevelopment tidal floodplain and compare with contemporary conditions. Evaluate the potential habitat function of this extensive area for juvenile salmon rearing and migration, and its contribution to the estuary in terms of sediment accretion and erosion, large woody debris and food web sources, and disturbance regimes
- Evaluate options for restoring more natural flow regimes to the estuary and assess their potential effects on habitat opportunity under a variety of different wetland-recovery scenarios
- Evaluate effects of past hatchery rearing and release practices on the sizes and times of downstream migration, estuarine residence periods, and potential densities of juvenile salmon in the estuary. Propose hatchery management alternatives for expanding the diversity of estuarine rearing behaviors and reducing the risks of hatchery programs on salmonid performance in the estuary
- Revise historical bathymetric data and acquire new data on present-day, shallow-water bathymetry and circulation processes to resolve the lack of confidence and robustness in model predictions of habitat opportunity, especially those based on the depth criterion
- Review the scientific basis for proposed habitat and bathymetric changes in the estuary relative to the restoration goals of the Columbia Basin Fish and Wildlife Program.
- Review the scientific assumptions of Columbia River dredging and disposal programs relative to the goals and conceptual framework of the Columbia Basin Fish and Wildlife Program
- Review the potential effects of historical changes in bathymetric profile on the distribution and availability of salmonid habitat and, in particular, the estuary's capacity to support a diversity of salmon life histories
- Review the significance of dredge disposal activities as a factor in estuarine habitat and ecosystem change that could affect the performance of juvenile salmon
- Review the scientific design and results of recent estuarine predation studies in the context of historical changes in salmon populations and estuarine habitat opportunity
- Review results of estuarine predation studies in the context of salmon population and habitat change
- Review the effects of bird predators on rates of adult salmon returning to the Columbia River Basin
- Evaluate historical and present-day relationships between flow variability, production of key salmonid prey species (e.g., Corophium spp.), and the timing of salmonid migrations to the estuary

- Assess long-term human and climatic effects on sediment budgets and inputs of organic matter

Experimental/observational studies

- Establish experimental restoration projects at a few representative wetland sites to evaluate the effectiveness of dike removal as a method of salmon recovery. Conduct a monitoring program at experimental and previously unaltered (undiked) reference sites to assess rates of habitat recovery, and identify conditions that affect salmonid use and performance
- Monitor variations in life-history diversity, habitat use, and performance of juvenile salmon in the estuary
- Monitor fish use of a variety of potential rearing habitats to assess variability and causal relationships affecting size characteristics, residence times, growth, and habitat use among hatchery-reared and wild salmonids
- Initiate intensive studies of the spatial and temporal distribution, abundance, and ecology of subyearling, ocean-type juvenile salmon in selected shallow-water habitats of the estuary. Document variability in life-history diversity in their use of emergent and forested wetlands
- Identify upstream sources and freshwater histories of fish captured in the estuary through mark and tag recovery and DNA, scale, and otolith analyses. Initiate in-depth life-history studies based on analyses of existing or new materials including scales or otoliths
- Investigate patterns of movement and migration through the estuarine gradient, from tidal freshwater through brackish and estuarine habitats in different regions of the estuary
- Compare patterns of estuarine wetland use by juvenile salmonids in the Columbia River with those in the Fraser River as a method for further evaluating flow regulation and hatchery influences, which are much greater in the Columbia system
- Examine the assumptions and results of ongoing predator studies in the context of historical and present-day estuarine habitat opportunity; salmon migration, rearing, and feeding behaviors; and fish densities in the estuary
- Assess the effects of altered habitats and food webs on the capacity of the estuary to support juvenile salmon
- Use natural stable isotope analyses or other methods to investigate potential food web disruptions due to habitat loss and degradation. These losses also should be evaluated in terms of changes to estuarine physical processes, through numerical model investigations and analyses of historical and contemporary data
- Evaluate through field studies and modeling the potential risk imposed on salmon recovery by non-indigenous species influencing estuarine habitats and food webs supporting juvenile salmon. This should include, but not necessarily be limited to American shad, Asian clam (*Pseudodiaptomus inopinus*), purple loosestrife (*Lythrum salicaria*), and other potential non-indigenous community dominants
- Evaluate the potential effect of sea-level rise on the feasibility of salmon recovery actions that involve estuarine habitat restoration and river-flow modifications

Computer modeling

- Use physical observations and hydrodynamic modeling to assess the effects of bathymetric change, flow regulation, and alternative restoration designs on habitat opportunity for juvenile salmon
- Conduct new simulations that include three-dimensional modeling of salinity intrusion and stratification as a third environmental variable (in addition to depth and velocity) that is an important determinant of juvenile salmon distribution and residence time. Use the model to evaluate sensitivity of the estuary to incremental physical changes associated with diking, dredging, and flow regulation and the implications of these results for future management of the estuary
- Re-examine the results of hydrodynamic modeling to evaluate landscape connectivity and other spatial indices affecting salmon habitat opportunity between historical conditions and the modern estuary configuration
- Conduct simulations to evaluate changes in salmon habitat opportunity for alternative restoration scenarios and a range of flow conditions

Management actions

- Adopt an explicit ecologically-based conceptual framework for estuary management and restoration that identifies and protects diverse salmon life histories, including variations in the estuarine rearing behaviors of subyearling migrants
- Establish performance criteria for evaluating whether management activities in the basin will impact salmon diversity and the productive capacity of the estuary
- Protect and restore opportunities for salmon to access emergent and forested wetlands in the estuary and riparian wetlands in the tidal floodplain
- Develop a comprehensive plan for wetland restoration throughout the tidal river and estuary, including habitat recovery objectives; criteria for site selection and restoration priorities; an inventory of diked, filled, and excavated lands; and a list of high-priority sites most likely to benefit salmon recovery
- Expand phenotypic diversity of salmon, including a broader range of sizes, times of entry, and duration of residency in the estuary
- Improve accessibility of all hatchery data and accounting of all marked groups of salmon to allow future auditing of hatchery practices and their effects on the estuarine rearing patterns of juvenile salmon
- Expand marking programs or develop alternative techniques to improve discrimination of hatchery from wild fish in the estuary. These data are critical to discern differences between the estuarine rearing behaviors of hatchery and wild fish, and ultimately, to evaluate whether basin-wide salmon recovery programs are succeeding
- Recommend methods for testing alternative hypotheses to explain high predation rates, and identify what, if any, further recovery measures may be appropriate

Salmon and Steelhead Limiting Factors Water Resource Inventory Area 28, Washington State Conservation Commission, 2000

WRIA 28 is located in Southwest Washington, with boundaries that extend to the western margins of the Wind River to the east, the Columbia River to the south, and the East Fork Lewis River to the north (see Map A-1). The inventory area includes the southern and

eastern portions of Clark County and southwestern Skamania County. For purposes of this report WRIA 28 was divided into three major subbasins: the Lake River Subbasin, the Washougal River Subbasin, and the Bonneville Tributaries Subbasin. These drainages cover approximately 316,365 acres or 494 square miles and enter the Columbia River between river mile (RM) 87.6, at Lake River, and RM 142.3 near Bonneville Dam.

There were a number of habitat limiting factors, and recommendations to address these factors, that apply across the entire WRIA including:

- Various land uses practices have negative impacts on habitat conditions for salmonids. If these impacts continue at the existing rate in many of the subbasins of WRIA 28, habitat degradation will outstrip any possible restoration strategy. The TAG suggests that critical area ordinances be developed and/or updated to ensure protection of critical habitat for threatened and endangered salmonids.
- Stormwater in urban areas contributes to increased peak flows, leading to bed and bank scour and channel shifting. These inputs also contribute fine sediments and reduce water quality. Where possible, alter stormwater facilities to reduce direct runoff to streams and increase infiltration. Protect and enhance wetlands and other water recharge areas.
- Almost every stream system within WRIA 28 has inadequate levels of large woody debris (LWD). Supplement LWD in appropriate stream channels, to provide short-term habitat benefits. Protect and enhance riparian habitat to increase LWD supplies over the long-term.
- Riparian restoration is needed almost throughout WRIA 28. Many commercial forestlands are in the process of recovering from disturbances early in the last century. Other areas have reduced riparian function due to urban and rural development. Protect existing functional riparian habitat and restore those areas that have been degraded by past activities, starting with productive anadromous tributaries.
- The headwaters of most streams within WRIA contain the vast majority of functional habitat. These areas also provide cool, clean water, spawning sediments and woody debris that help buffer downstream land use activities. Focus on protecting these more pristine habitat reaches from additional land-use impacts.
- Elevated water temperatures are a problem in many stream systems within WRIA 28. Poor riparian conditions, low-flow problems, high width-to-depth ratios, and impounded water all contribute to elevated water temperatures. A comprehensive approach to water quality improvements is needed that addresses all of these related problems across the watershed.
- Water withdrawals, for both industrial and domestic uses, reduce instream flows and the habitat available for salmonids. Explore opportunities to protect and augment stream flows in WRIA 28 during low-flow periods.

Subbasin Stock Summary and Habitat Priorities for the Elochoman/Skomakawa, Lake and Chinook Rivers are included in Appendices B, C and E respectively.

Mouth, Plume and Youngs Bay

Ecology Of Marine Predatory Fishes: Influence on Salmonid Ocean Survival

This study examined the temporal dynamics and abundance of marine fish predators and forage fishes in the nearshore ocean off the Columbia River during the juvenile salmon outmigration period, the food habits of predatory marine fishes, and measures of selected oceanographic conditions in the nearshore ocean off the Columbia River. It also identified the distribution and abundance of predator and forage fish to oceanographic conditions and ocean survival of juvenile salmonids historically and to the present to identify the impacts of predators on salmonids.

A comprehensive program to rebuild anadromous salmon runs must:

- Focus on all life history stages and all opportunities to increase salmonid survival. However, efforts to date have largely been limited to the freshwater life stages, with attempts to rehabilitate and mitigate for losses occurring primarily in the riverine environment
- Focus on the entire salmonid life cycle (NRC 1996). In particular, research into the transition period of juvenile salmonids from freshwater to seawater is clearly warranted
- Measure, predict and reduce salmonid losses in the marine environment if the marine environment affects recruitment success in a predictable manner (relative to specific measurable variables). This information would strongly complement freshwater-related salmonid restoration efforts by providing measures of project success using adult return data that would not be confounded by fluctuations in marine mortality
- Develop tools for forecasting salmonid survival by understanding interactions between physical and biological attributes in the marine environment and long-term trends in coastal salmon production. Such tools are essential for rational harvest management. Many fisheries managers believe that salmon populations cannot be rebuilt by just improving freshwater habitats and/or improved hatchery practices.
- Conduct estuarine and nearshore ocean research. This research is critical to developing information to effectively manage Pacific salmon populations (Emmett and Schiewe 1997)
- Demonstrate the effect of ocean conditions on stock size if improvements to habitat do not result in immediate improvements in this area

Youngs Bay, Nicolai-Wickiup River and Skipanon River Watershed Assessments

The purpose of these watershed assessments, completed in 1999, is to inventory and characterize watershed conditions of the Youngs Bay, Nicolai-Wickiup and Skipanon River watersheds and to provide recommendations that address the issues of water quality, fisheries and fish habitat, and watershed hydrology. These assessments were conducted by reviewing and synthesizing existing data sets and some new data collected by the watershed council, following the guidelines outlined in the Oregon Watershed Enhancement Board (OWEB) watershed assessment manual (WPN 1999).

The following needs were commonly identified in the OWEB watershed assessment conducted by most watershed councils in the Columbia River Estuary subbasin:

- Prioritize restoration and watershed management activities in areas with known salmonid use for both spawning and rearing, following protocols established by state and federal government.
- Maintain data in an accessible location and format.
- Collect additional data in priority areas.
- Get expert advice on data collection and processing.
- Evaluate the GIS data layers.
- Verify all land use categories before restoration actions occur.
- Develop a study to verify the accuracy of the roads coverage.
- Verify the channel habitat type in the field before any restoration actions occur
- Perform a more rigorous analysis of the GIS data. (Field data have been provided to the watershed council.).
- Refine the land use layer. Continue to develop the land use layer to reflect changes in land use. Update the layer with digital NWI data as they become available.
- Develop and update a fish limits coverage. This process has been started by ODFW.
- Work with ODFW to identify viable populations and distributions of sensitive species, particularly salmonids. These data are critical in developing watershed enhancement strategies.
- Identify and survey areas currently used by salmonids. Collect stream survey data according to ODFW protocols.
- Work with ODFW to establish a brood stock development program that will provide fish stocks capable of establishing self-sustaining populations of coho, chum, chinook, sea-run cutthroat, and steelhead.
- Field verify the channel habitat type GIS data layer. A statistical approach should be applied to these data.
- Field verify the riparian GIS data layers. A statistical approach should be applied to these data.
- Prioritize stream reaches for restoration of riparian vegetation. Start in areas currently used by salmonids and lacking in LWD recruitment potential, good shade conditions, or instream LWD.
- Plant riparian conifers and native species in areas lacking LWD recruitment potential. Start in areas of known salmonid use, and use the riparian vegetation map provided with the watershed assessments and ODFW stream surveys to identify candidate reaches. Before any reaches are targeted for planting, they should be field verified for suitability and actual conditions. Vegetation planting should use only native species and mimic comparable undisturbed sites.
- Develop a riparian fencing strategy to maintain riparian vegetation.
- Complete a culvert survey of all culverts that have not been evaluated for fish passage. Data should be maintained in a GIS. The road/stream crossing coverage is a good place to start. The culvert survey should begin in priority subwatersheds at the mouth of each of the streams. Establish priorities for culvert replacement.
- Replace priority culverts identified in the culvert survey.
- Install fish passages at known fish passage barriers that are caused by human influences.

- Prioritize estuarine wetlands for restoration options based on their value to salmonids for restoration, creation, or maintenance. Landowners with priority wetlands can then be contacted for possible wetland restoration.
- Prioritize for restoration, creation, or maintenance, palustrine wetlands that are connected to streams and provide back water rearing areas for salmonids. Start in areas with known salmonid rearing and spawning habitat.
- Create, restore, and maintain estuarine wetlands based on their prioritization.
- Create, restore, and maintain palustrine wetlands based on their prioritization.
- Develop a strategy to collect continuous discharge data in the primary rivers that flow into Youngs Bay. Work with OWRD or the USGS to get stream gages installed.
- Collect meteorologic data and rainfall data to improve modeling capabilities for water availability and flooding. This could be accomplished through local high schools or volunteers.
- Develop an outreach program to encourage water conservation. One of the primary water withdrawals is for municipal use. Educate the public about dewatering effects and how water conservation will help salmonids in the watersheds.
- Identify water rights that are not currently in use and that may be available for instream water rights through leasing or conversion.
- Update and refine the roads layer. Keep in contact with ODF as the roads layer is updated. Check with other groups (private land owners) to update the roads layer and evaluate its accuracy.
- Identify roads that have not been surveyed for current conditions and fill these data gaps. Work with ODF to develop road survey methodologies.
- Map road failures in areas where data are lacking. Coordinate with watershed stakeholders that are currently collecting road data such as ODF and private timber companies. Develop a strategy to fill in the data gaps.
- Map culvert locations and conditions in conjunction with the culvert survey conducted for fish passage barriers. Check with ODF, ODFW, and local foresters for the best methodologies and data to collect.
- Map all debris flows and landslides. Begin in the areas most susceptible to landslide activity as identified in the DOGAMI debris flow hazard map
- Where possible, conduct road restoration activities such as road reconstruction, decommissioning, and obliteration.
- Replace undersized culverts that are at risk of washing out. Prioritize these culverts from the culvert surveys.
- Develop a systematic water quality monitoring program for areas with high priority for restoration activity. Focus the water quality monitoring on constituents that are important for the specific area being restored. Use the water quality data to refine the restoration plans.
- Develop or expand the continuous temperature monitoring network with monitors at strategically located points such as the mouths of tributary streams, at locations of known spawning beds, at the interface between major land use types, or downstream of activities with the potential to influence water temperature.

- Include a plan for long-term monitoring in any restoration plan to measure the effects of the restoration activity. Begin to develop the capacity within the watershed council to conduct high quality, long-term water quality monitoring to document the success of restoration activities.
- Locate and map potential sources of nitrogen, phosphorus, and bacteria in the watershed.
- Conduct all water quality monitoring activities according to established guidelines such as those published by the Oregon Plan for Salmon and Watersheds (OPSW 1999), or EPA (1997, 1993). Cooperate with DEQ and other agencies to share data and expertise. Coordinate the council's monitoring activities with those of the agencies, including DEQ's efforts to develop Total Maximum Daily Loads for water quality limited stream segments.

WDFW Future Fish Management needs within the Lower Columbia/Estuary Provinces

1. Monitor and evaluate chum salmon in the Lower Columbia, including the Gray's River, I-205 seeps, mainstem Columbia, Hardy/Hamilton/Duncan Creeks, and Pierce/Ives Island populations.
2. Monitor non-index tributaries for the presence of chum salmon and/or suitable habitat. Implement appropriate recovery measures for chum salmon.
3. Assess the effect of Bonneville Dam operations on the fish and wildlife production capacity of tributaries and mainstem areas below the dam.
4. Evaluate and monitor fisheries for meeting performance indicators identified in the NMFS Fisheries Management and Evaluation Plan (FMEP) for the Lower Columbia River.
5. Expand monitoring and development of live capture gear and techniques (such as tangle nets) to allow selective harvest of salmonids by commercial fishers.
6. Continue assessment of habitat within the province to determine areas of critical importance and prioritize habitat restoration/preservation projects. Implement restoration actions identified in the watershed assessments that are consistent with recovery of fish and wildlife populations and their habitat. Determine the effectiveness of habitat restoration projects on achieving the desired physical change and measure the response of wild salmonid populations to these changes.
7. Continue watershed coordination and local stewardship programs.
8. Increase monitoring of naturally produced juvenile, smolt and adult salmonids within Lower Columbia River tributaries. Determine abundance, distribution, survival by life-stage, and status of fish and wildlife native to the watersheds within the province including steelhead, coastal cutthroat, fall chinook, bull trout, coho salmon, lamprey, crayfish and others.
9. Increase evaluation of hatchery and wild fish interactions within Lower Columbia River tributaries. Determine genetic and life history types of native fish and wildlife within the province and the strength of their current expression relative to historical and desired future conditions.

10. Implement an aquatic macro-invertebrate monitoring program within tributaries of the Lower Columbia.
11. Assess the effects of transporting white sturgeon from the unimpounded Lower Columbia River upstream to The Dalles and John Day reservoirs, including an accurate assessment of sub-legal, legal, over-legal, and broodstock populations.
12. Expand the mainstem Columbia River smelt egg and larvae sampling program to properly assess harvest impacts and insure proper resource management.

Lower Columbia/Columbia Estuary Subbasin Recommendations

Projects and Budgets

The following subbasin proposals were reviewed by the Lower Columbia and Estuary Province Budget Work Group and are recommended for Bonneville Power Administration project funding for the next three years.

Continuation of Ongoing Projects

Project: 199306000 - Select Area Fishery Evaluation Project

Sponsor: Washington Department of Fish and Wildlife (WDFW)
Oregon Department of Fish and Wildlife (ODFW)
Clatsop County Economic Development Council (CEDC)

Short Description:

Develop and enhance fisheries in the lower Columbia River utilizing hatchery stocks; while protecting depressed wild stocks through application of net-pen rearing; and monitor and evaluate rearing effects on habitat at net-pen sites.

Abbreviated Abstract

In it's 1993 Strategy for Salmon, the Northwest Power Planning Council recommended that terminal fishing sites be identified and developed to harvest abundant fish stocks while minimizing the incidental harvest of weak stocks. The NPPC called on BPA to "Fund a study to evaluate terminal fishery sites and opportunities." In response, BPA initiated the Columbia River Terminal Fisheries Project, with the goal of determining the feasibility of creating and expanding known stock fisheries in the Columbia River Basin to allow harvest of strong anadromous salmon stocks while providing greater protection to depressed stocks. Development of fisheries in terminal areas is also required in the recent Biological Opinion concerning hydrosystem operations in the Columbia River (Measure 9.6.3.3 - Measures to provide alternative fishing locations).

The Project, now named the Select Area Fishery Evaluation (SAFE) project, is authorized under a Section 7 Consultation conducted by NMFS (Nov. 18, 1998) with a finding of "No Jeopardy" to listed stocks (NMFS, 1998), and under the Final Environmental Assessment of Lower Columbia River Terminal Fisheries Research Project (BPA, 1995), and the resultant Find of No Significant Impact. Additionally, in June 2001 the SAFE Project provided additional data regarding 1) SAFE Project smolt releases, 2) straying of adult returns from SAFE Project smolt releases, and 3) harvest on listed species while conducting Select Area fisheries. These data were summarized and distributed as per "Directive 6" of the Biological Opinion concerning the SAFE Project.

Monitoring and evaluation (M&E) activities associated with this project include water quality and benthic analysis at net-pen rearing sites to ensure no detrimental damage

to critical habitat occurs; use coded-wire tag (CWT) recoveries to track escapement returns of Project fish, and assess straying of project fish; fishery evaluation to assess effectiveness of fishers to capture Project fish with minimal impact to non-target weak stocks using CWT recoveries; and evaluation of rearing and release techniques to optimize smolt to adult survival rates, using CWT analysis. Extensive M&E activities will be required to assure compliance with the terms and conditions in the Project Biological Opinion.

The move from the feasibility testing phase to the full production phase is supported by information concerning rearing and release strategies collected by this project, accumulated environmental data, and harvest management. This phase of the Project will see more emphasis on a full capacity production, especially for spring chinook. Youngs Bay and Blind Slough will be targeted for quick build-up of rearing and release of spring chinook.

As returns on production fish are harvested, commercial fishers and processors each pay a voluntary 5% assessment on these landings. Revenue from the increased releases of 3.8 million spring chinook alone will generate over $450,000 annually. This will reduce future funding requests by over 50%.

The expected outcome of this project is the demonstration that significant, and sustainable, known stock fisheries can be implemented while allowing for rebuilding of weak and listed stocks. Additionally, it is expected that the project will culminate with Select Area fisheries being established in all sites that have proven to be acceptable with regards to water quality and impacts to listed species. Project will also continue to evaluate possibility of expansion into additional sites.

Relationship to Other Projects

Project #	Title/description	Nature of relationship
8201300	Coded-wire tag recovery program	CWT recovery essential for evaluation of project
8906600	Annual stock assessment-CWT program (WDFW)	CWT recovery essential for evaluation of project
8906900	Annual stock assessment-CWT program (ODFW)	CWT recovery essential for evaluation of project
9202200	Wild Smolt Behavior/Physiology (ESA)	Juvenile rearing and increased returns.
9702400	Juvenile Salmonids in the Columbia River Basin	Juvenile rearing, increased returns, and avian predation

Relationship to Existing Goals, Objectives and Strategies

BPA is responsible for funding measures consistent with the NWPPC's (Council) 1994 Columbia River Basin Fish and Wildlife Program (Program), as amended. The goal of the Program is to increase the average annual returns of adult anadromous fish (salmon and steelhead) to the Columbia River Basin by approximately 2.5 million fish. The Council recently amended its Program, and two amendment measures request the investigation of terminal fishing opportunities to reduce potential mainstem harvest pressure on depressed salmon stocks. The need for this proposed action is based upon the Council's language

recommending a study of "terminal fishing opportunities to harvest abundant stocks while minimizing the incidental harvest of weak stocks" (BPA, 1995).

In March 1995, the NMFS produced the "Proposed Recovery Plan for Snake River Salmon" which called for protection of listed species through expansion of fisheries in terminal areas in section 3.4. Specifically section 3.4.b. calls for a greater emphasis on terminal area fisheries as a method to reduce impacts on depressed or listed stocks.

In the SAFE project Biological Opinion (NMFS, 1998), NMFS has determined that the proposed action is not likely to jeopardize the continued existence of salmon and steelhead in the Columbia River Basin listed under the ESA, or result in the destruction or adverse modification of their critical habitat. Some adverse impacts to substrate and water quality may occur as a result of net-pen operation, but these effects are very localized. This determination is based on a number of proposed activities intended to reduce the adverse impacts on listed species of disease occurrence, genetic introgression, and resource competition resulting from the release and adult return of SAFE Project fish, and on steps taken to minimize the impacts of net-pen operation on habitat conditions in the area of the net pens.

NMFS has also determined that the proposed action is not likely to jeopardize the continued existence of salmonids in the Columbia River Basin listed under ESA. In addition, potential risk to chum salmon from predation by SAFE project coho salmon is expected to be adequately reduced. Most recently, in response to concerns expressed by the NMFS, modifications to releases have been incorporated to reduce stray rates for spring and fall chinook, and results of these modifications were provided to the NMFS in June 2001.

Select Area fisheries are also supported in the 2000 NMFS draft Biological Opinion. Measure 9.6.3.2 requires additional harvest reform and specifically calls for expansion of fishing opportunity in known-stock terminal areas. Measure 9.6.3.2.1 addresses effects of selective fishing on the fishery management system. The SAFE Project fisheries are intensively monitored to recover CWT's and collect biological data. These recovery efforts provide the ability to provide stock-specific and fishery-specific data that is called for in this measure. Measure 9.6.3.3 requires the action agencies to identify, develop, and create alternative terminal fishing opportunities; as has occurred and is currently occurring with the SAFE Project. This measure requires that fisheries occur in known-stock terminal areas where abundant fish can be harvested with minimal impacts to listed species. Several such fisheries now exist as a result of the ongoing SAFE Project. Measure 9.6.3.4 also calls for enhancing fishery value while reducing impacts to listed fish. The proposal to expand spring chinook production for Select Area fisheries is a direct response to this measure.

The project goal of evaluating the potential of SAFE project sites was in direct response to the NPPC Fish and Wildlife Program Measure 8.3c, which calls for identification and development of Select Area fishing opportunities to harvest abundant stocks while minimizing the incidental harvest of weak stocks. The goal of identifying suitable locations and developing fisheries in these sites has been achieved; however, additional work is required. Most recently the 2000 Draft Biological Opinion, and the associated all-H Paper, have called for expansion of these terminal area fisheries and enhancement of value for these fisheries. Results to date provide project managers with

the information necessary to move in that direction and the proposal for 2003-2005 is a direct reflection of the project's ability to keep pace with changing fishery management needs. The SAFE Project is now moving from the feasibility study phase to the full capacity production phase at several sites, as originally planned, as is called for in the 2000 Draft Biological Opinion.

Review Comments

This project represents a majority of the funding for the Lower Columbia and Estuary Province budget. This project's budget should be reviewed in line with other opportunities in this province.

Budget

FY2003	FY2004	FY2005
$2,290,844 Category: High Priority	$2,613,811 Category: High Priority	$2,129,510 Category: High Priority

Project: 199801400 - Survival and Growth of Juvenile Salmonids in the Columbia River Plume

Sponsor: National Marine Fisheries Service (NMFS)

Short Description:

Evaluate the role of the Columbia River plume in survival of juvenile salmon through long-term observations, fine-scale process studies, retrospective assessments, and modeling to assess management of flow to improve habitat opportunity.

Abbreviated Abstract

The nearshore ocean environment, particularly that associated with the Columbia River plume, is a critical habitat to outmigrating juvenile salmon. Recent evidence suggests that improvement in survival of the estuarine and early ocean life history phase of Columbia River salmon may be critical to recovery of endangered stocks. In the case of salmonids originating in the Columbia River Basin, survival success hinges on the complex interaction of smolt quality and the abiotic and biotic ocean conditions at the time of entry and during their first year of ocean existence. We hypothesize that variation in the physical and biological conditions of the nearshore environment, particularly that associated with the plume, affects overall survival of Columbia River stocks. We further hypothesize (a) that primary factors driving the variation in the nearshore and plume environment include oceanographic and land-based (river flow) processes modulated by climatic and anthropogenic factors, (b) that trophic relationships modulated by these physical variations affect growth and survival of juvenile salmon and (c) that management of the hydropower system can be used to regulate the Columbia River plume habitat to benefit salmon growth and survival. We propose to characterize, over an extended period, the physical and biological features of the nearshore ocean environment using mesoscale and fine scale oceanographic surveys, develop coupled

physical-biological models and perform retrospective assessment of the Columbia River plume as it interacts with coastal circulation. With our new understanding of salmon-plume-coastal circulation interactions, we will develop a set of hydropower management scenarios that could benefit survival, growth, and health of juvenile salmon by changing the dynamics of the Columbia River plume.

Relationship to Other Projects

Project #	Title/description	Nature of relationship
	Optimization of FCRPS impacts on juvenile salmonids: Restoration of lower-estuary and plume habitats	Will providea physical understanding of lower estuary-plume processes in relation to forcing by the FCRPS, coastal circulation, and climate.
	Historic habitat oppportunities and food-web linkages of juvenile salmon in the Columbia River estuary and their implications for managing river flows and restoring estuarine habitat	Identifies the role of the Columbia River estuary on salmon growth and survival

Relationship to Existing Goals, Objectives and Strategies

A comprehensive program to rebuild anadromous salmon runs must focus on all life history stages and all opportunities to increase salmonid survival (NRC 1996). Efforts to date have focused on the freshwater life stages, with attempts to rehabilitate and mitigate for losses occurring in the riverine environment. Many fisheries managers believe that salmon populations cannot be rebuilt solely by improving freshwater habitats and hatchery practices. A better understanding of the ecology of salmonids in estuarine and nearshore ocean research is critical to effectively manage Pacific salmon populations (Emmett and Schiewe 1997). If the marine environment affects recruitment success in a predictable manner, then measuring and predicting salmonid losses in the ocean may be possible.

Understanding interactions between physical and biological attributes in the marine environment and long-term trends in coastal salmon production will assist with the development of effective tools (e.g., models) for forecasting salmonid survival. Such tools are essential for rational harvest management. Moreover, these same tools can be used to assess in a comprehensive manner the impact of various management scenarios on habitat opportunity and access. This would be particularly useful when addressing channel modification, habitat restoration options, or a suite of flow scenarios developed on projected climate conditions or regional power needs and economic.

Specifically, the research proposed here is in support of the Columbia River Estuary subbasin summary document, which recognizes the plume as an integral component of the estuary subbasin. Moreover, the summary concludes that understanding the role of the plume in salmon survival is a critical need. This project also supports several Reasonable and Prudent Alternatives set forth in the National Marine Fisheries Service 2000 FCRPS Biological Opinion. These include

- RPA 158 (model physical and biological features of the historical lower river and estuary
- identify limiting biological and physical factors in the estuary

- identify impacts of the FCRPS system on habitat and listed salmon in the estuary and develop criteria for estuarine habitat restoration)
- RPA 164 (develop a conceptual model of the relationship between estuarine conditions and salmon population structure and resilience)
- RPA 194 (develop a physical model of the lower Columbia River and plume that can be used to characterize potential changes to estuarine habitat associated with modified hydrosystem flows and the effects of altered flows where they meet the California Current to form the Columbia River plume)
- RPA 195 (investigate and partition the causes of mortality below Bonneville Dam after juvenile passage through the FCRPS)
- RPA 197 (develop an understanding of juvenile and adult salmon use of the Columbia River plume).

The efforts outlined in this proposal will identify the benefit of the Columbia River plume to juvenile salmon, the critical habitat features that benefit salmon, the historical and current role of the plume to salmon survival, and will be useful in evaluating potential impacts of modifying flows to restore important habitat opportunities for salmon through the estuarine environment.

All proposed freshwater habitat rehabilitation and restoration efforts will operate within the context of uncertainty associated with environmental variability and environmental change. The NRC (1996) report stated that variations in ocean conditions powerfully influence salmon abundance. Throughout most of the 1980's and 1990's, ocean conditions in the Pacific Northwest region were poor, and the low ocean survival might well explain the limited success to date of habitat restoration efforts. We are just now beginning to understand what happens to salmon during the major part of their lives—the years spent at sea; new insights already demonstrate that variations in salmon abundance are linked to phenomena on spatial and temporal scales that biologists and managers have not previously taken into account (the entire North Pacific Basin and decadal time scales). Given the recent increases in productivity of the California Current and related increases in chinook and coho salmon stocks, it now appears that the declines of the 1990's may be reversing. Will we have sufficient data and understanding in place that will allow managers to decide the extent to which sound management practices should be credited or whether salmon fortunes were due to a reversal in natural climate cycles? Alternatively, it should be noted that if improvements in freshwater habitat quality do not result in immediate improvements in stock size, we must be able to demonstrate the degree to which ocean conditions and plume-ocean interactions have affected salmon survival.

Review Comments

NMFS has identified this project as a BiOp project.

Budget

FY2003	FY2004	FY2005
$2,092,855 Category: High Priority	$2,376,199 Category: High Priority	$2,090,000 Category: High Priority

Project: 200001200 - Evaluate factors limiting Columbia River gorge chum salmon populations.

Sponsor: U.S. Fish and Wildlife Service (USFWS)

Short Description:

Evaluate factors limiting chum salmon production in Hardy Creek, Hamilton Springs, and Columbia River side-channel.

Abbreviated Abstract

This project currently has and will continue to have two major components: smolt production and abundance and adult spawning and movement. Smolts will be monitored in Hamilton Springs with a modified fyke net or trap, Hardy Creek with a floating fyke net, Hardy Creek spawning channel with a D-frame fyke net, and Columbia River with a screw trap and/or fyke net. Abundance estimates will be calculated by: marking a sub sample of smolts in the caudal fin, calculating trap efficiency, and statistically analyzing the results. Egg-to-smolt survival will be evaluated by installing redd caps and monitoring swim-up timing. Also, installing piezometers and monitoring ground water quality will calculate temperature units for egg incubation**.**

Weirs will be installed in Hamilton Springs, Hardy Creek, and Hardy Creek spawning channel to collect baseline biological data on adult chum salmon. Adults will be collected in the Columbia River via tangle nets and seines and fitted with radio tags. Radio receiver arrays will be installed in the various spawning areas to monitor movement. Spawning ground surveys will be conducted in Hamilton Springs, Hamilton Creek, Hardy Creek, and Hardy Creek spawning channel to evaluate spawning success and peak count. Piezometers will be installed to monitor upwelling water quality and quantify any differences with ambient water quality.

Relationship to Other Projects

N/A

Relationship to Existing Goals, Objectives and Strategies

Specific Benefits to the Northwest Power Planning Council's (NPPC) Fish and Wildlife Program.

2.2A Support Native Species in Native Habitat

The Hardy and Hamilton creek chum population has remained viable despite the system-wide crash of the 1950s (ODFW and WDFW 1995). This stock of fish is one of the few native, naturally reproducing and genetically pure populations of salmon in the Columbia River basin. The Hardy-Hamilton-Ives Island complex supports greatest number of adults upstream of the Grays River population and are genetically distinct. Therefore, maintaining this population is critical to chum salmon in the Columbia River.

2.2E Columbia River Basin Reservoir Operation and Accounting Procedure
The Hardy-Hamilton-Ives Island spawning fish are affected by the operation of Bonneville Dam. Along with other factors, release of large amounts of water create stagnant and backwater conditions in Hardy Creek. This impedes spawning activity and can caused siltation and destruction of redds. Conversely, low flow conditions significantly reduce or eliminate access to all three spawning areas.

3.3 Endangered Species Act Monitoring
Chum salmon are currently proposed for listing as threatened under the Endangered. Species Act. Monitoring and evaluation of this population of chum salmon will continue to be the focus of this project.

4.1 Salmon and Steelhead Goal: Double Salmon and Steelhead Runs without Loss of Biological Diversity
Continued monitoring and evaluation of the Hardy Creek spawning channel will help to assess the feasibility of similar projects for future enhancement goals.

4.3C Population Monitoring
This stock of chum salmon, being one of a few remaining in the Columbia River, should be the indicator population in the area and should be the focus of more intensive monitoring and enhancement.

7.1A Evaluation of Carrying Capacity
Completion of the objectives outlined in this project will help facilitate chum salmon recovery and enhancement in other areas as well as the Hardy-Hamilton-Ives complex.

7.1C Collection of Population Status, Life History, and Other Data on Wild and Naturally Spawning Populations
Baseline biological characteristics of chum salmon adults and smolts along with basic life history requirements are essential to recovery.

7.1D Wild and Naturally Spawning Policy
This stock of chum salmon is one of the last wild and naturally spawning populations of any salmonid species, not influenced by artificial propagation, in the Columbia River basin. Therefore, conservation and management of this stock should be given priority.

7.5D Columbia River Chum Salmon
This project mitigates for chum salmon losses due to hydropower development and will improve management and enhancement of a stock currently affected by hydropower operations.

7.6 Habitat

This project will help to identify critical habitat and conditions associated with spawning, incubation, emergence, and emigration of chum salmon.

Review Comments

NMFS has identified this project as a BiOp project.

Budget

FY2003	FY2004	FY2005
$255,212 Category: High Priority	$267,972 Category: High Priority	$281,371 Category: High Priority

Project: 200105300 - Re-introduction of Lower Columbia River Chum Salmon into Duncan Creek

Sponsor: Pacific States Marine Fisheries Commission (PSMFC)
Washington Department of Fish and Wildlife (WDFW)

Short Description:

Monitor and evaluate the success of the recently restored spawning channels for chum salmon at Duncan Creek. If necessary, jump start the population by collecting brood stock from adjacent populations

Abbreviated Abstract

Duncan Creek was historically an important spawning area for chum salmon. In 1963, a dam and culvert were placed near the mouth of the creek. Chum returns rapidly declined and by 1969, no chum were found in the basin.

A three-pronged approach is being used to once again produce a self-sustaining chum salmon population in Duncan Creek. This approach includes modifying the dam, enhancing spawning habitat, and using local brood stock to reintroduce chum into the basin. Dam modification was accomplished in November 2000, stream restoration was completed in November 2001, and brood stock collection was begun in November/December 2001.

This proposal addresses the continued collection of brood stock and outlines a comprehensive plan for monitoring and evaluating the Duncan Creek chum reintroduction. To "jump-start" the reintroduction program, eggs are currently being collected from adjacent chum salmon stocks (e.g. Hardy and Hamilton Creeks, and the Ives/Pierce Island complex), incubated at the Washougal Hatchery, and will be liberated into Duncan Creek after hatching. In future years, incubation may occur in streamside incubators as well. Developing embryos will have their otoliths thermally marked during incubation. Otolith marks will be utilized to evaluate the fry-to-adult survival rates of the introduced fish. The occurrence of non-marked adult chum entering the stream will be used to estimate how quickly wild fish are re-colonizing the stream. The physical conditions in the newly renovated stream channels will be monitored as well as the egg-to-fry survival rates of natural spawners.

The principle objectives of this project are to continue the collection of brood stock for use in the Duncan Creek reintroduction, to monitor and maintain the physical conditions necessary for chum salmon spawning in the newly renovated stream channels, and to evaluate the viability of using this approach to chum salmon recovery as a template for future reintroduction projects.

Relationship to Other Projects

Project #	Title/description	Nature of relationship
199900301	Evaluate Spawning of Fall Chinook and Chum Salmon Just Below the Four Lowermost Mainstem Columbia Dams	One goal of that project is to perform intensive spawning ground surveys for chum salmon habitat and opportunities for restoration. The Duncan Creek project will provide valuable information for those efforts.
200001200	Evaluate Factors Limiting Columbia River Gorge Chum Salmon Populations	The primary purpose of that project is to evaluate factors limiting chum salmon production in Hamilton and Hardy creeks plus the mainstem Columbia. The Duncan Creek project will expand the coverage into that system.
	StreamNet	The Duncan Creek project will provide biological data that can be incorporated into the StreamNet database.

Relationship to Existing Goals, Objectives and Strategies

This project represents just one part of an ongoing effort to re-establish chum in the Duncan Creek basin. WDFW along with local Skamania landowners have forged a partnership to reopen this watershed. In the fall of 2000, salmon recovery funds from the State of Washington and the Skamania Landowners Association were used to significantly alter an outlet to a man-made lake that was created by damming Duncan Creek in 1963. A total of over $500,000 (including $130,000 in cash contribution from the Skamania homeowners) was spent to retrofit the dam with a passage structure.

The dam modification and stream restoration work completed to date on Duncan Creek has reopened the basin for chum. This project proposes to evaluate the success of this habitat as a spawning refugia by conducting adult fish counts, determining egg-to-fry survival rates and by monitoring a variety of physical parameters, e.g. intra-gravel and surface water temperatures, vertical hydraulic gradients, coefficients of permeability, intra-gravel DO, gravel composition, flow, water velocity and water depth in the created spawning area.

The project will also examine the utility of "jump-starting" chum salmon recovery efforts by importing eggs obtained from adjacent populations. All chum eggs imported into the system will be thermally marked making it possible to identify these fish at the adult stage. The number of adult chum salmon originating from strays and imported eggs returning to Duncan Creek will be determined making it possible for us to evaluate the relative contribution rates of artificially introduced fish and natural strays returning to the

Duncan Creek site. The newly established habitat and our reintroduction effort will both provide clear survival benefits to Lower Columbia chum salmon returning to the Bonneville subbasin. The enhanced spawning channels may also be used as spawning and rearing areas for steelhead, coho, and cutthroat, which also inhabit the area. Steelhead are listed as threatened under ESA, while coho and cutthroat stock status are being reviewed for possible listings.

The creation of protected spawning areas for chum salmon has a long history, with the development of spawning channels in Canada representing the first use of this management tactic. This project is the third phase in the effort to produce a self-sustaining population of chum salmon in Duncan Creek. This type of approach is suggested in a number of recent plans that have been developed to recover listed chum salmon populations, and is consistent with the goals of the WDFW Fisheries Management and Evaluation Plan (FMEP) (Rawding et al. 2001). Recently, the Grays River Hatchery Management Plan (WDFW 1999) and the Hood Canal ESU Summer Chum Conservation Initiative that was jointly developed by WDFW, Point-no-Point Treaty Tribes, USFWS, and reviewed by NMFS (WDFW et al. 2000), propose that chum salmon recovery can be realized by creating natural, protected spawning areas for these fish. Both also advocate that donor brood stock from adjacent populations should be used to re-establish chum populations in streams where they used to exist. This proposal is also consistent with the Columbia Basin System Planning Salmon and Steelhead Production Plan for chum salmon in the lower Columbia Subbasin (WDF 1990). Planners recommended that a combination of natural and hatchery production would be the most likely way to produce the most rapid sustainable improvement in chum runs. Specifically, it was assumed that improving habitat conditions would promote efficient natural production. It was also assumed the most rapid way to rebuild the run would be to combine releases of an appropriate stock into the improved habitat (WDF, 1990).

The biological and environmental data collected during the course of this recovery effort will also be used to assess the success of this type of recovery strategy in the Columbia. WDFW and ODFW staffs are currently surveying the Lower Columbia to ascertain the occurrence and abundance of chum salmon in this part of the river. Additionally, the habitat attributes of the spawning sites found are being recorded. These data will be used to examine the possibility of creating additional protected spawning sites for other locally adapted chum salmon populations (e.g. in the Elochoman, Lewis, Washougal and Cowlitz rivers plus Skamokawa, Mill, Germany, Abernathy creeks and elsewhere). Hence, this project is a vanguard effort that can be used to assess the basic idea of using protected spawning locations, habitat restorations, and brood stock collection for "jump-starting" reintroduction as tools for chum salmon recovery in the Columbia River.

The work outlined in this proposal directly addresses limiting factors outlined in the Subbasin Summary concerning the limited amount of low gradient habitat available in the Bonneville subbasin, the accumulation of fine sediment in Duncan Creek, and the lack of water quality data within the subbasin. This project also correlates directly to RPA Action 157 of the 2000 NMFS Biological Opinion for the Federal Columbia River Power System (FCRPS), which states "BPA shall fund actions to improve and restore tributary and mainstem habitat for CR chum salmon in the reach between The Dalles Dam and the mouth of the Columbia River." The Chum Salvage Plan incorporated into this project

relates to RPA Action 15 of the 2000 FCRPS Biological Opinion, which addresses flows supporting chum salmon spawning in the Ives Island area below Bonneville Dam, and to RPA 177, which addresses the implementation of NMFS-approved, safety-net projects.

Review Comments

NMFS has identified this project as a BiOp project.

Budget

FY2003	FY2004	FY2005
$381,671 Category: High Priority	$321,823 Category: High Priority	$294,949 Category: High Priority

New Projects

Project: 30001 – Historic habitat opportunities and food-web linkages of juvenile salmon in the Columbia River estuary: Implications for managing flows and restoration.

Sponsor: Northwest Fisheries Science Center (NWFSC)
National Marine Fisheries Service (NMFS)

Short Description:

Evaluate the role of river flow on habitat opportunities and food web structure for juvenile salmon by comparing historic and current conditions using model simulations and empirically derived food-web linkages

Abbreviated Abstract

The Columbia River estuary serves as an important migration, rearing, and transition environment for juvenile anadromous salmon before they enter the sea. Historical modifications to the estuary, including diking of peripheral wetland and floodplain habitats and regulation of river flows by dams, have reduced salmonid access to shallow rearing habitats and may have eliminated sources of macrodetritus that fuel the estuary's food webs. Although there is emerging evidence that these estuarine changes are limiting juvenile salmon production and life history diversity, lack of information about historic and modern habitat conditions in the estuary, or the ecological consequences of habitat change, undermine existing salmon recovery efforts of the Columbia Basin Fish and Wildlife Program. This proposal addresses specific information needs identified in a recent interdisciplinary assessment of the hydroelectric system's impacts on estuarine habitat conditions for juvenile salmon. The primary elements of this proposal include: (1) retrospective analyses to reconstruct historic bathymetric features and assess effects of climate and river flow on the extent and distribution of shallow water, wetland and tidal-floodplain habitats; (2) computer simulations using a 3-dimensional numerical model to evaluate the sensitivity of salmon rearing opportunities to various historical modifications affecting the estuary (including channel changes, flow regulation, and diking of tidal wetlands and floodplains); and (3) life-history specific information based on present and

historic food web sources as determined by stable isotope, microchemistry, and parasitology techniques. From these data and additional modeling simulations that will be selected during an estuarine habitat restoration workshop, we will (4) examine effects of alternative flow-management and habitat-recovery scenarios on habitat opportunity and the estuary's productive capacity for juvenile salmon.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
199801400.	Survival and growth of juvenile salmon in the Columbia River plume	Development of habitat metrics in the plume and 3D model will couple with estuary model and habitat metric development to provide an assessment of the role of river flow on habitat opportunity through the estuary and plume
	Optimization of FCRPS Impacts on Juvenile Salmonids: Restoration of Lower-Estuary and Plume Habitats	Would provide a detailed physical understanding of plume and lower-estuary processes needed for the development of future management scenarios and of historic conditions influencing salmonid survival

Relationship to Existing Goals, Objectives and Strategies

There are a number of important Regional salmon recovery initiatives (i.e., FCRPS Hydropower Biological Opinion, All-H paper, Lower Columbia River Estuary Partnership [LCREP] Comprehensive Conservation and Management Plan [CCMP], and the WY-KAN-USH-MI WA-KISH-WIT [Spirit of the Salmon Report]) that identify protection and restoration of the Lower Columbia River to be vital in rebuilding the productivity of salmon and steelhead runs throughout the Columbia River Basin. Implementation of this proposal will contribute to the development of a fundamental body of knowledge on salmonid life histories and habitat needs that directly support these Regional efforts. In particular, this proposal will provide a strong technical basis to guide salmon recovery efforts in the Lower Colombia River and estuary.

Specifically, the research proposed here is in support of the Columbia River Estuary subbasin summary document, which concludes that understanding the role of the estuary for salmon survival is a critical need. Additionally, the FCRPS Hydropower Biological Opinion identifies a number of action items (Section 9.6.2.2) that the Corps and BPA must carry out to support estuary recovery. Actions 158 and 162 of the Biological Opinion are supported by this proposal. Proposal objectives 1 and 3, through the reconstruction of historic habitat changes supports the desire on the part of NMFS, the Corps, and BPA to have a mechanism to inventory and evaluate habitat for its potential for salmonid recovery. All of the proposal objectives support Action 162 through emphasizing an understanding of the relationship of hydropower flow releases to habitat changes over time and current/future habitat opportunity for salmonids.

The All-H paper, a basin-wide salmon recovery strategy, identifies the need to assess estuarine habitat important to salmonids, model critical linkages between estuary

conditions and salmon population resilience, and identify the flow requirements necessary to support estuarine habitat requirements for salmon. The LCREP CCMP is a document designed to provide a broad framework for managing the Lower Columbia River and estuary. The Governors of Oregon and Washington recently recognized the CCMP as a key vehicle to support salmonid recovery efforts in this portion of the Columbia River Basin. The CCMP specifically identified 10 actions related to habitat protection, conservation, and enhancement in the Lower Columbia River. Of these, Actions 1 (Inventory and prioritize habitat types and attributes needing protection and conservation. Identify habitats and environmentally sensitive lands that should not be altered) and Action 10 (Establish or modify minimum flows [including Columbia River flows] to meet instream fish and wildlife needs) specifically relate to this proposal. The Columbia River anadromous fish restoration plan of the Nez Perce, Umatilla, Warm Springs, and Yakama Tribes (The Spirit of the Salmon Report) identifies a number of recommendations to protect estuarine habitat that relate to this proposal. Those include protecting the remaining wetlands and intertidal areas in the estuary upon which anadromous fish are particularly dependent, undertaking an immediate assessment of remaining and potential estuary habitat, protecting existing estuary habitat complexity, and reestablishing sustained peaking flows that drive critical estuarine processes.

This proposal supports the identified actions/recommendations in the All-H paper, the LCREP CCMP, and the Spirit of the Salmon Report through the development of a comprehensive understanding of salmonid life history strategies in the Lower Columbia River and estuary, how habitat changes over time have affected those life history patterns, and how flow, bathymetry and habitat changes affect the potential for habitat opportunity for salmonids in the Lower Columbia River and estuary.

Review Comments

NMFS has identified this project as a BiOp project.

Budget

FY2003	FY2004	FY2005
Rec: $597,559 Category: High Priority	Rec: $675,000 Category: High Priority	Rec: $606,000 Category: High Priority

Project: 30002 - Optimization of FCRPS Impacts on Juvenile Salmonids: Restoration of Lower-Estuary and Plume Habitats

Sponsor: Oregon Health Sciences University (OHSU)

Short Description:

Restore Columbia River estuary and plume juvenile salmonid habitats and optimize FCRPS impacts on the plume through improved understanding of estuary and plume physical processes and definition of possible future management scenarios

Abbreviated Abstract

This project assembles a group of leading coastal scientists to tackle a complex, urgent problem, optimization of the interaction of the Federal Columbia River Power System (FCRPS) with the lower Columbia River estuary and plume in support of endangered salmonids. The timing and magnitude of flows released by the FCRPS strongly affect juvenile salmonids as they move through the estuary and plume. Restoration of the properties of the lower estuary and plume that constitute habitat for juvenile salmonids requires advances on several fronts. We seek to:

- *Objective 1: Define how the lower-estuary and plume interacted historically with coastal currents, how operation of the FCRPS has altered the lower-estuary and plume, and how climate change and the FCRPS will impact the system in coming decades.*
- *Objective 2: With Action Agencies, define needs and opportunities for science-based input to operational FCRPS management practices, given uncertain climate and coastal circulation forecasts.*
- *Objective 3: With FCRPS managers, define management scenarios: a) that are based on physical understanding, b) that can be evaluated in terms of habitat opportunity and other constraints on the system, and c) whose implementation can lead to a qualitative improvement in survival of juvenile salmonids.*

Innovative oceanographic methods, remote sensing, management science and analyses of numerical model results will be used to achieve the goals of the project, as it moves from research toward provision of definite strategies over the next 6 to 10 years. A Project Advisory Board (PAB) that includes Action Agency personnel, FCRPS managers and external scientists will be formed to help ensure productive application of the insights achieved. Tight cooperation with work carried out in the estuary and plume by the National Marine Fisheries Service (NMFS) will be facilitated by participation of PIs in this project as well as in two projects proposed by NMFS.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
	NMFS Survival and Growth of Juvenile Salmonids in the Columbia River Plume	This project will provide the physical and management science basis for future management related to impacts on the lower Columbia River Estuary and plume. The NMFS project will provide numerical simulations and evaluations of habitat opportunity
	NMFS Estuary Habitat Project	This project will define the physical processes and habitat conditions of the lower estuary, and provide an interface between the NMFS Plume and Estuary projects

Relationship to Existing Goals, Objectives and Strategies

The Federal Columbia River Power System (FCRPS) Biological Opinion of 21 December 2000 requires a broad range of reasonable and prudent actions (RPAs) by BPA and other federal agencies. The RPAs address the four "H's" (Hydropower, Habitat, Harvest and Hatcheries) and are designed to enhance the survival and recovery of endangered salmonids. These actions include research, monitoring and evaluation (RM&E) programs that will resolve "a wide range of uncertainties, including determining population status, establishing causal relationships between habitat (or other) attributes and population response, and assessing the effectiveness of management actions" (p. 9-4). One of the greatest of these uncertainties is the nature of the specific features and processes of the lower CR estuary and plume that support juvenile salmonids. Resolution of this issue requires acquisition of the process understanding proposed here, and its application through the management scenarios discussed below. Clearly, the proposed work is consistent with the overall intent of the Biological Opinion. As laid out in the following paragraphs, it implements Habitat and Hydropower RPAs specified in the Biological Opinion. It is also consistent with the one and five-year implementation plans, and the Estuary Subbasin Summary.

1. Relationship to the Biological Opinion*:* It is an indicator of the importance of the estuary and plume, that a number of the RPAs address these environments. The Habitat program "has three overarching objectives: 1) protect existing high quality habitat, 2) restore degraded habitats on a priority basis and connect them to other functioning habitats, and 3) prevent further degradation of tributary and estuary habitats and water quality" (Section 9.6.2, p. 9-133).

Thus, protection and restoration of the estuary (including the plume) is specifically a part of the Biological Opinion. This restoration of the benefits of pre-FCRPS coastal zone and protection of those benefits from further degradation due to climate change and climate fluctuations is an expected outcome of the proposed work. Furthermore, Section 9.6.2.2 on "Actions Related to Estuarine Habitat" states: "Estuarine protection and restoration must play vital roles in rebuilding the productivity of listed salmon and steelhead throughout the CR basin. . . The following action items [RPAs 158-163] call on the Action Agencies to play an important role in estuary restoration efforts" (pp. 9-138 to 139). The proposed work will improve returns throughout the basin and forms an integral part of restoration of the system as whole.

The specific Habitat RPAs relevant to the proposed work include:

- RPA 158: *During 2001, the Corps and BPA shall seek funding and develop an action plan to rapidly inventory estuarine habitat, model physical and biological features of the historic lower river and estuary, identify limiting biological and physical factors in the estuary, identify impacts of the FCRPS system on habitat and listed salmon in the estuary relative to other factors, and develop criteria for estuary habitat restoration*.
- RPA 159: *BPA and the Corps, working with LCREP* [Lower Columbia River Estuary Program] *and NMFS, shall develop a plan addressing the habitat needs of salmon and steelhead in the estuary.*
- RPA 161: *Between 2001 and 2010, the Corps and BPA shall fund a monitoring and research program acceptable to NMFS and closely coordinate with the LCREP*

monitoring and research efforts… to address the estuary objectives of this biological opinion.

- RPA 162: *BPA, working with NMFS, shall continue to develop a conceptual model of the relationship between estuarine conditions and salmon population structure and conditions. The model will highlight the relationship among hydropower, water management, estuarine conditions, and fish response.*

The proposed work, in concert with the ongoing SGS project, will identify impacts of the FCRPS on conditions in the lower estuary and plume, related these to climate and coastal circulation processes, and develop management scenarios to effect restoration. Coordination of the proposed work with LCREP and other regional entities will be carried out through the Project Advisory Board.

The relevant Hydropower RPAs are part of the RM&E plan, which "calls for actions affecting fish survival in the hydropower corridor, in tributary habitat, and in the estuary and nearshore ocean environment" (p. 9-161). As part of these actions, "(d)iscrete hypothesis testing and resolution of critical uncertainties are very important in the near term to assess the status of ESUs" (p. 9-162). In addressing FCRPS operations, the Biological Opinion says:

> "An important, but often overlooked, aspect of the biology of Columbia River basin salmonids is the effect of the FCRPS on their use of estuarine and ocean (plume and nearshore) environments. The FCRPS can have a direct and substantial impact on conditions in these habitats through its alteration of the hydrograph, water quality and other impacts. Regional analyses have identified these environments as critical to population growth potential, and, thus, appropriate for mitigation actions."
>
> "Unfortunately, little is known about salmonid use of these habitats. Of primary importance are the following: …Cause and effect links between estuary/ocean resources and juvenile survival . . . The influence of natural variation versus that of humanly caused changes in environmental conditions affecting juvenile and adult survival in the estuary/ ocean phase" (pp. 9-176 to 9-177).

These critical issues will be addressed by this project, working together with the SGS program.

The specific RM&E Hydropower RPAs relevant to the proposed work are:

- RPA 187: *The Action Agencies and NMFS shall work within the annual planning and congressional appropriation processes to establish and provide the appropriate level of FCRPS funding for studies and analyses to evaluate relationships between ocean entry timing and SARs for transported and downstream migrants.*
- RPA 195: *The Action Agencies shall investigate and partition the causes of mortality below Bonneville Dam after juvenile salmonid passage through the FCRPS.*
- RPA 196: *The Action Agencies and NMFS shall work within the annual planning and congressional appropriation processes to establish and provide the appropriate level of FCRPS funding for studies to develop an understanding of juvenile and adult salmon use of the Columbia River estuary….*
- RPA 197: *The Action Agencies and NMFS shall work within the annual planning and*

congressional appropriation processes to establish and provide the appropriate level of FCRPS funding for studies to develop an understanding of juvenile and adult salmon use of the Columbia River plume.

- RPA 199: *The Action Agencies shall implement the specific research/monitoring actions outlined in Appendix H.* In Appendix H, Research Action 2004 (research to identify the benefit to juvenile salmon of estuarine habitats) is particularly relevant.

Appropriate research is required to understand how the FCRPS and estuary/plume processes affect juvenile salmon, especially with regards to estuary/ocean conditions. Thus: "(l) inking ocean entry timing to conditions at the time of entry would improve NMFS' understanding of aspects of the plume environment that influence early ocean survival" (p. 9-174). The work proposed here provides the physical basis for understanding "ocean conditions", historically, at present, and in the future.

2. *Relationship to the 2002 and Five-Year Implementation Plans:* The Biological Opinion provides a framework within which more detailed planning of actions is carried out at the five-year and one-year levels. The 2002 Implementation Plan is the first annual plan for implementation of the RPAs and provides the most detailed guidance as to specific measures that should be carried out under the five-year plan. The primary requirement of the *Five-Year Implementation Plan* for estuary and plume projects is that they be consistent with the LCREP plan. The proposed work fits LCREP's Biological Integrity and Impacts of Human Activity and Growth Priorities. It fulfills an urgent need to provide the physical process basis underlying habitat preservation and restoration in the lower estuary and plume.

The 2002 Implementation Plan will be carried out through a series of strategies and sub-strategies. The most relevant of these for the proposed work occur under the RM&E heading, especially under the Critical Uncertainties category:

RM&E Substrategy 1.4 *Status of fish populations and the environment in the estuary and ocean zone*. In this substrategy, the Action Agencies will evaluate the relationships between estuary, plume and nearshore ocean conditions and juvenile growth and survival; *RPAs 196, 197*.

RM&E Substrategy 3.4 *Critical Uncertainties at the estuary and ocean level*. For this substrategy, the Action Agencies will implement projects in 2002 addressing the critical uncertainty of delayed mortality mechanisms relative to the effect of the timing of ocean entry; *RPA 187*.

As discussed in Section 9-B.9, this project will develop physical understanding of estuary and ocean conditions, including those that may cause delayed mortality. It will also, together with the SGS project, explore the implications of various FCRPS management strategies for improving these conditions.

Review Comments

Project would provide information to managers regarding the effects of flow on % habitat available (i.e., what % of habitat would be lost/gained during different flows below Bonneville Dam). Project could lead to the development of management schemes. NMFS has identified this project as a BiOp project.

Budget

FY02	FY03	FY04
$435,192 Category: High Priority	$355,705 Category: High Priority	$415,428 Category: High Priority

Project: 30004 - Blind Slough Restoration Project - Brownsmead, Oregon

Sponsor: Columbia River Estuary Study Taskforce (CREST)

Short Description:

Restoration of tidal exchange between the Columbia River Estuary and Blind Slough in the community of Brownsmead, Oregon. BPA funds will be used to match U.S. Army Corps Section 1135 funding for 25% of the total project costs

Abbreviated Abstract

The project restores tidal exchange between the Columbia River Estuary and Blind Slough in the community of Brownsmead, Oregon. BPA funding will provide 25% cost share for Section 1135 of Army Corps of Engineers environmental restoration program to partially underwrite the cost of project implementation, planning, engineering, and design. BPA funds will also be used to develop and implement an effectiveness monitoring program for the project. The Columbia River Estuary Study Taskforce (CREST), Clatsop Diking Improvement Company No. 7, and the Army Corps have prioritized the following array of activities to restore Blind Slough: installation of water control structures to breach the Blind Slough dike, replacement and/or installation of five (5) constricted culverts, and channel enhancement. The goal of these activities is to restore historic hydrologic and bio-physical connection to the Columbia River Estuary. Restoration of Blind Slough enhances water quality and reconnects seven (7) miles of habitat for aquatic species including migrating salmonids.

Funds will provide 25% of construction costs during the project implementation phase, as well as engineering, planning and required environmental feasibility studies. In addition, funds are used to develop an effectiveness monitoring program that partners Clatsop Diking Improvement Company No. 7, CREST, the Nicolai-Wickiup Watershed Council, and volunteer landowners from the Brownsmead area. The monitoring activities assist in testing scientific assumptions developed about reconnecting diked tidelands to the estuarine tidal prism. These assumptions were identified in part by the success of previous restoration projects implemented in the Brownmead area which demonstrated water quality improvements and increased fish access to tidal wetland habitat. Through the development of a comprehensive effectiveness monitoring program, information on water quality improvements and increased fish use of the Blind Slough will be compiled and applied to future restoration projects.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
	Refine and Implement the Habitat	New project funding will

Project ID	Title	Nature of Relationship
	Restoration Program for the Columbia River Estuary and Lower Columbia River	continue support of CREST / LCREP Wetland Program

Relationship to Existing Goals, Objectives and Strategies

Blind Slough's historic connection to the Columbia River Estuary elevates its restoration significance. Recent program and policy initiatives point to the Columbia River Estuary as an important component in the overall ecological integrity of the entire Columbia Basin. Described below are the extent of existing strategies, policies, and/or programs in the Columbia River Estuary and how they manifest in the justification of the Blind Slough restoration project.

Review Comments

NMFS has idenfied this project as a BiOp project.

Budget

FY02	FY03	FY04
$173,550 Category: High Priority	$5,000 Category: High Priority	$5,000 Category: High Priority

Project: 30006 - Effectiveness monitoring of the Chinook River estuary restoration project.

Sponsor: Sea Resources

Short Description:

This is a project to monitor and evaluate changes in habitat attributes and juvenile salmonid use before and after the Chinook River estuary restoration project**.**

Abbreviated Abstract

Certain estuarine habitat types are recognized as important rearing and staging areas for some salmonid species – especially those that exhibit ocean-type life history patterns. Over the past 150 years, the Columbia River estuary has suffered considerable loss of these critical habitat types due to a variety of development activities. It is possible that restoration of these estuarine habitat types will aid in the recovery of some endangered Columbia River salmon stocks. However, since little is known about the ecological importance of the estuary for Columbia River salmon, current restoration plans in the estuary are based on inferences from studies in other watersheds. Therefore, it is important that any early restoration projects in the Columbia River estuary be carefully monitored in order to evaluate salmon responses to estuary restoration. The Chinook River estuary restoration project offers an excellent opportunity to answer some of the uncertainties regarding estuary restoration and salmon recovery. The project described in this proposal will design and implement a long-term monitoring and evaluation plan to investigate salmon responses to the Chinook River estuary restoration project. We will establish a pre-restoration baseline condition of existing estuary use by juvenile salmon as well as monitor

certain habitat attributes. We will continue to monitor these parameters after the restoration project is completed in order complete pre and post project comparative analyses. We will use a variety of capture and marking techniques to determine abundance and length of residency of salmon in the Chinook River estuary. We will also implement a concurrent habitat monitoring component to measure specific habitat attributes by installing five data loggers for continuous monitoring of temperature, salinity, dissolved oxygen and tidal stage.

Relationship to Other Projects

N/A

Relationship to Existing Goals, Objectives and Strategies

Vision for the Columbia River Basin

The underlying vision of the Northwest Power Planning Council (Council) is to restore and maintain an ecosystem that supports an abundant, productive, and diverse community of fish and wildlife by mitigating for the effects of the hydrosystem. The program emphasizes the restoration and protection of natural ecological functions, habitats, and biological diversity in the Columbia River Basin. To achieve this vision, the Council adopted a policy that management "actions must be taken in an adaptive, experimental manner…This includes using experimental designs…and integrating monitoring and research with those management actions to evaluate their effects on the ecosystem."

Strategies

Habitat Strategies include the protection and restoration of mainstem habitat conditions as a "critical piece of this habitat-based program." The Council also believes that "the choice of which approach to use is best left to a local, site-specific decision, subject to scientific review." Sea Resources is a community-based watershed restoration and education organization. We make every attempt to be consistent with the most current scientific thinking available regarding our efforts by maintaining awareness of similar ongoing projects, and consulting with our Science Advisory Committee regarding the strategies we employ to meet our restoration objectives. Members of this committee include Dan Bottom (NMFS), Charley Dewberry (Ecotrust), Jim Lichatowich (Alder Fork Consulting) and Charles Simenstad (University of Washington).

The program's Habitat Strategies also addresses the need to include the estuary in its restoration analysis, and that improvements to the estuary may benefit most anadromous salmonids. Given its location near the mouth of the Columbia, all salmon produced in basin will have the opportunity to access the Chinook River estuary for rearing.

We believe this project meets the standard outlined for monitoring and evaluation in that the restoration project has measurable, quantitative biological objectives (see methods section below) and that our monitoring will collect data that are appropriate for measuring the biological outcomes identified in the objectives. The data will be available in electronic format, and our methods will be available for approval by the Council.

2000 FCRPS Biological Opinion

RPA Section 9.4.2.8 Research, Monitoring, and Evaluation Plan

Action 9: This action concerns the development of a Research, Monitoring, and Evaluation Plan. Monitoring, and evaluation data resulting from this project will help resolve some uncertainties related the present use of estuarine habitats by salmon and population responses to estuary restoration.

9.6.2.1 Actions Related to Tributary Habitat

Action 157: This action stresses the need to improve Lower Columbia River chum salmon habitat. The restoration of the Chinook River estuary will improve passage for returning adult chum salmon as well as improve rearing conditions for juvenile chum salmon. The restored habitat will be accessible to juveniles originating from both the Chinook River and other upriver sources. The monitoring effort described in this proposal will also provide information regarding use of restored estuarine habitats by juvenile chum salmon.

9.6.2.2 Actions Related to Estuarine Habitat

The Federal agencies support actions described in the Lower Columbia River Estuary Program's (LCREP) Comprehensive Conservation and Management Plan (CCMP) that work to protect and restore salmon. The restoration and monitoring work described in this proposal are consistent with the LCREP CCMP actions outlined below.

LCREP CCMP Action 2**:** Protect, conserve, and enhance identified habitats, particularly wetlands, on the mainstem of the lower Columbia River.
Reclaim habitat by selectively using tools such as seasonally managing or breaching dikes, augmenting inadequate stream flows, decompacting wetland soil, lowering surface elevations of mainstream reservoirs, modifying dam operations, re-establishing sustained peak flows, installing fish-friendly tide gates, not disposing of dredge sediment in streams, restoring riparian floodplain connections, and removing or modifying structures that prevent natural flows.

LCREP CCMP Action 5: Restore 3,000 acres of tidal wetlands along the lower 46 river miles to return tidal wetlands to 50 percent of the 1948 level.

LCREP CMMP Action 6: Monitor the effectiveness of habitat protection, restoration, and mitigation projects

- Action 158: This action describes the importance of understanding the connection between habitat attributes in the estuary and rearing salmon. This project will measure several habitat parameters and document changes in the parameters after restoration actions are completed. We will measure juvenile salmon use patterns in the estuary (of both hatchery and natural origin), variability in salinity, temperature, water depth (tidal stage), pH, and dissolved oxygen.
- Action 159: This action will develop a plan for addressing specific estuary habitat needs of salmon. This project will investigate current use of estuarine habitats by juvenile salmon and seek to establish habitat/life history relationships.
- Action 162: The action calls for the development of a conceptual model that describes the relationship between salmon populations and estuary habitat conditions. Our work could contribute to this effort as it seeks to provide similar information, especially as it relates to salmon populations in the Chinook River watershed.

Chinook River Sub-Basin Stock Summary and Habitat Priorities (Washington State Limiting Factors Analysis)
This document prioritizes factors limiting salmon abundance and potential restoration and preservation needs in the Chinook River watershed. It places a high priority on removal or replacement of the tidegate system at the river's mouth and the subsequent restoration of the estuary. The analysis states that restoration of the Chinook River estuary will improve fish passage, decrease the likelihood of thermal and dissolved oxygen barriers, and increase floodplain connectivity. The analysis also identifies the need to determine how juvenile salmonids from the Chinook River and other Columbia Basin watersheds use the estuary to better target restoration efforts. A medium priority action also identified is to increase water quality monitoring in the Chinook River watershed to provide better guidance for restoration efforts.

d. Relationships to other projects
Estuarine Habitat and Juvenile Salmon – Current and Historic Linkages in the Lower Columbia River and Estuary, NMFS and U.S. Army Corps of Engineers.
In 2000, the National Marine Fisheries Service (NMFS), U.S. Army Corps of Engineers, University of Washington, Oregon Department of Fish and Wildlife, and the Oregon Graduate Institute initiated a study to understand historic and present-day ecological links between juvenile salmon and estuarine habitats in the Columbia River. This project will compliment this work by expanding the spatial extent of sampling and by investigating salmon population response to restoration work.
Lower Columbia Chum Salmon Reintroduction Program, WDFW Described above, Sea Resources is cooperating with WDFW to reintroduce Lower Columbia chum salmon into the Chinook River. This proposal will monitor use of the lower Chinook River by juvenile chum salmon and the success of the reintroduction effort.

Review Comments
This project should be coordinated with other estuary assessment projects. Budget should be reviewed in line with other assessments funded in the estuary. NMFS has identified this project as a BiOp project.

Budget

FY02	FY03	FY04
$124,804 Category: High Priority	$80,000 Category: High Priority	$80,000 Category: High Priority

Project: 30011 - Preserve and Restore Columbia River Estuary Islands to Enhance Juvenile Salmonid and Columbian White-tailed Deer Habitat

Sponsor: U.S. Fish and Wildlife Service (USFWS)
Columbia Land Trust (CLT)
U.S. Geological Survey (USGS)

Short Description:

Purchase 626 acres on Crims and Walker islands and restore tidal emergent marsh and riparian forest habitat by enhancing tidal channels to provide juvenile salmonid rearing/ foraging habitat and to achieve the recovery of the Columbian white-tailed deer

Abbreviated Abstract

This project would acquire and restore 626 acres of tidal emergent marsh, swamp, slough, and riparian forest habitat on islands in the upper Columbia River Estuary to benefit fish and wildlife. This is a cooperative effort between BPA, USFWS, Columbia Land Trust, USGS, Corps of Engineers, WDFW, and ODFW. The Columbia Land Trust would acquire 426 acres on Crims Island and 109 acres on Walker Island. USFWS would acquire an additional 90 acres on Crims Island. At Crims Island, the Corps of Engineers would provide funding through Section 1135 of the Clean Water Act to enhance 75 acres of tidal emergent marsh by excavating canary grass wetland and connecting subtidal channels to the mainstem Columbia. In addition, tidal flow would be reestablished to 100 acres of wooded swamp by excavating a man-made plug in a channel and 100 acres of riparian forest would be reestablished on upland areas of the island. These actions would provide productive rearing and foraging habitat for juvenile salmon and increase the export of detrital nutrients to the estuary. A monitoring program would be initiated to measure the response of fish, especially juvenile salmon, and vegetation to these enhancements. Approximately 150 acres of existing tidal emergent marsh on Crims and Walker Islands would be restored by controlling invasive exotic plants, principally purple loosestrife and reed canarygrass. Columbian white-tailed deer would be reintroduced to these and nearby islands to restore this native species to the upper estuary. This action would establish a new subpopulation of the deer on secure habitat to meet the goals of the Columbian White-tailed Deer Recovery Plan. Funding for the reintroduction would be shared between BPA, USFWS, WDFW, and ODFW.

Relationship to Other Projects

Project #	Title/description	Nature of relationship
200001200	Evaluate factors limiting Columbia River Gorge Chum salmon population.	Providing rearing habitat for opportunistic use by chum salmon moving down Columbia River
199900301	Evaluation of spawning for fall chinook and chum salmon just below the four lowermost Columbia River dams.	Enhancing and restoring salmon rearing habitat used by chinook and chum juveniles
	RPA 160 - The Corps and BPA, working with LCREP shall develop and implement an estuary restoration program	LCREP lists purchase and restoration of Crims Island in its preliminary plan of priority habitat restoration projects
	RPA 196 - implement studies to develop	Results from monitoring of this

Project #	Title/description	Nature of relationship
	an understanding of juvenile and adult salmon use of the Columbia River estuary	project will provide valuable information on the benefits of tidal habitats to juvenile salmon
	Project EST-P-02 of the USACOE Anadromous Fish Evaluation Program "Estuarine habitat and juvenile salmon - current and historic linkages in the lower Columbia River and estuary"	Monitoring results will contribute complementary data to the understanding of the current use of estuarine habitats by juvenile salmonids

Relationship to Existing Goals, Objectives and Strategies

The Crims and Walker islands acquisition and habitat protection and restoration project is consistent with the 2000 Fish and Wildlife Program (Program). The overall vision for the Program states "Wherever feasible, this program will be accomplished by protecting and restoring the natural ecological functions, habitats, and biological diversity of the Columbia River Basin." The Habitat Strategies section emphasizes the importance of protection and restoration of mainstem habitat conditions. Specific Habitat Strategies include:

- Restore ecosystems, not just single species: the proposed project would restore tidal emergent marsh and riparian forest, which are vital components of the estuary ecosystem.
- Use native species wherever feasible: reintroduction of the Columbian white-tailed deer would restore a native species to the ecosystem.
- Include the estuary: the proposed project site lies within the upper estuary.

The Basin Level Biological Objectives in the Program call for coordinating wildlife mitigation activities with fish mitigation and restoration efforts by coordinating wildlife habitat restoration and acquisition with aquatic habitats. This project links recovery of the Columbian white-tailed deer with protection and restoration of aquatic and riparian habitat for fish and other wildlife. These islands are important perching and foraging habitat for peregrine falcons and bald eagles, and there is a bald eagle nest site on Crims Island.

The habitat restoration objectives in the proposed project are consistent with the Provisional Statement of Biological Objectives for Environmental Characteristics at the Basin Level (Appendix D of the Program). For example, Biological Objective 2 includes:

- Increase the connections between rivers and their floodplains, side channels and riparian zones.
- Manage riparian areas to protect aquatic conditions and form a transition to floodplain terrestrial areas and side channels.

In addition, the Subbasin Summary contains a recommendation by the Independent Scientific Advisory Board to "Remove dikes in the lower river and upper estuary to restore connections between peripheral floodplains and the river . . ." Salmon at River's End: The Role of the Estuary in the Decline and Recovery of Columbia River Salmon (USNMFS 2001) recommends a management action to "Protect and restore opportunities for salmon to access emergent and forested wetlands in the estuary and riparian wetlands in the tidal

floodplain." The outer margins of Crims Island consist of a berm of dredged material that was apparently intended as the beginning of a dike. The island is thus bowl-shaped, with lower areas in the interior. The project includes opening connecting channels through the low dike to restored tidal emergent marsh, removing a plug to open a channel and restore tidal flow to a swamp, and establishing riparian forest adjacent to marsh and slough habitat.

Biological Objective 4 aims to increase energy and nutrient connections within the system to increase productivity and expand biological communities. The proposed project would address this need by connecting tidal flow to a swamp, enhancing productivity and connectivity in a tidal marsh, and establishing riparian forest to provide detrital nutrients. A monoculture of reed canarygrass on Crims Island would be replaced with a more diverse assemblage of vegetation native to the Columbia River floodplain.

The Subbasin Summar*y* incorporates the technical recommendations of Wy-Kan-Ush-Mi Wa-Kish-Wit Spirit of the Salmon including "Begin improving in-channel stream conditions for anadromous fish by improving or eliminating land-use practices that degrade watershed quality." The principal land use on Crims Island is year-round cattle grazing. Cattle have access to the entire island and grazing is degrading the habitat quality of the tidal marsh and swamp. Implementation of the project would end cattle grazing on the island and increase the value of the wetlands as salmonid rearing and foraging habitat. The 2000 FCRPS Biological Opinion, section 9.6.2.2, supports the actions of the LCREP Comprehensive Conservation and Management Plan. Action 2 of the *Plan* is to "protect, conserve, and enhance identified habitats, particularly wetlands, on the mainstem of the lower Columbia River." The environmental measurement for this action is to permanently enhance, protect, or reclaim 10,000 acres of wetland habitat and 3,000 acres of upland habitat by 2,010. Similarly, RPA Action 160 in the 2000 Biological Opinion calls for protecting and enhancing 10,000 acres of tidal wetlands and other key habitats over the next 10 years to rebuild productivity in the lower 46 river miles. To help achieve these goals, LCREP and NMFS developed a list of proposed habitat restoration projects that included the acquisition and restoration of Crims and Walker islands. The proposed project would contribute more than 200 acres of riparian forest and more than 425 acres of wetlands toward achievement of the goals of Action 2 and RPA Action 160. Regarding RPA Action 160, it should be noted that Crims and Walker Islands are above river mile 46 (they are located at approximately river mile 55 and 61, respectively). Nevertheless, they are within the Estuary Province and contribute valuable detritus and other nutrients to the entire estuary. The restoration elements of the proposed project would increase these contributions. NMFS indicates that this project should contribute to RPA Action 160 (Cathy Torterici, NMFS, pers. comm. 2001). The restoration elements are also are in line with the examples of acceptable estuary habitat improvement work in RPA Action 160 which include the following:

Acquiring rights to diked lands
Breaching levees
Improving wetlands and aquatic plant communities
Supplementing the nutrient base by importing nutrient-rich sediments and large woody debris into the estuary
Creating shallow channels in intertidal areas
Enhancing connections between lakes, sloughs, side channels, and the main channel

The proposed project would help meet the requirements in RPA Action 7 for habitat measures that provide offsite mitigation. The project would restore and protect shallow water and wetland habitat along the Columbia River.

RPA Action 157 calls for improvement and restoration of tributary and mainstem habitat for Columbia River chum salmon between The Dalles Dam and the mouth of the Columbia River. The proposed tidal marsh enhancement on Crims Island has the potential to restore rearing habitat for chum salmon fry in the Columbia River.

RPA Action 158 requires the Corps and BPA to develop an action plan to rapidly inventory estuarine habitat, and develop criteria for estuarine habitat restoration. The proposed project would serve as an example of a restoration project that would be used to develop and refine the criteria for future estuarine restoration projects.

RPA Action 159 requires BPA and the Corps to develop a plan that addresses the habitat needs of salmon and steelhead in the estuary. Enhancement of tidal marsh and channels at Crims Island would serve as an example of a project that addresses several major habitat needs of anadromous fish in the estuary and lower Columbia River – restoration and reconnection of floodplain habitat with the Columbia River, restoration of rearing habitat and high flow refugia for juvenile salmonids, and restoration of macrodetritus input to the riverine/estuarine system.

Action 6 of the LCREP Comprehensive Conservation and Management Plan is to monitor the effectiveness of habitat protection, restoration, and mitigation projects. RPA Action 196 in the 2000 Biological Opinion directs action agencies and NMFS to provide funding for studies to develop an understanding of juvenile and adult salmon use of the estuary. The proposed project includes monitoring fish and vegetation response to tidal wetland restoration. The results of the monitoring would make an important contribution to knowledge of the effectiveness of habitat restoration in the estuary, as well as use of upper estuary tidal wetlands by juvenile salmon. The project would be included in the Columbia River Ecosystem Research and Monitoring Inventory.

The proposed project would also contribute to the programs of the National Wildlife Refuge system, specifically the Julia Butler Hansen Refuge for the Columbian White-tailed Deer. Refuge goals, as stated in the Subbasin Summary, include:

Manage for healthy and balanced populations of Columbian White-tailed Deer (CWTD) as outlined in the CWTD Recovery Plan on the refuge, and cooperate with others in management of off-refuge deer.

The project would increase the size and range of the Lower Columbia River population of the deer and preserve important habitat. Completion of the project could lead to delisting the deer.

Review Comments

Crediting will be applied to Oregon since there are remaining credits in Oregon and not Washington. Information will be provided to CBFWA regarding what facility the credits will be applied to. NMFS has identified this project as a BiOp project. The project sponsor has offered several cost savings suggestions for this budget. In the budget, Section

5, Objective 3, task C could be removed for a savings of $15,000. Under Section 7, Objective 2, tasks A and B could be removed for an additional savings of $117,000. Finally, in the outyear based budget for Section 7, Objective 3 could be removed for an annual savings of $196,000. The budget has been modified to reflect these changes.

Budget

FY02	FY03	FY04
$585,437 Category: High Priority	$199,250 Category: High Priority	$40,000 Category: High Priority

Project: 30015 - Lower Columbia River and Columbia River Estuary Ecosystem Monitoring and Data Management

Sponsor: Lower Columbia River Estuary Partnership (LCREP)

Short Description:

Develop protocols, procedures, and indicators for measuring habitat condition, assess exposure levels to toxic contaminants, develop ecosystem restoration information center for housing and accessing data specific to lower Columbia River and estuary.

Abbreviated Abstract

Our ability to understand the relationship of sensitive organisms such as salmonids to the Lower Columbia River and Columbia River Estuary ecosystem is greatly hindered by major data gaps and poor access to existing data. The Lower Columbia River Estuary Partnership (LCREP) proposes to implement elements of its Aquatic Ecosystem Monitoring and Data Management Strategy to address habitat and toxics monitoring needs, and data management. The proposal addresses RPAs 161, 163, and 198.

A pilot habitat monitoring program will be implemented to develop protocols, procedures, and indicators for measuring habitat condition for both long term habitat monitoring and restoration project M and E requirements. It will focus specifically on habitats important for juvenile salmonids. A technical team will develop the methods, critique and test the methods, assess the results, and recommend future work. Based on the results, a long term habitat monitoring program will be implemented.

Additionally, a toxic contaminant monitoring project will be implemented to address issues such as the accumulation of toxic contaminants in sensitive habitat areas, contaminant trends over time, and possible impacts on sensitive species. Toxic contaminant concentrations in fish and macroinvertebrate tissues, sediments and the water column will be determined. A technical team will assess the results and recommend future work. Based on the results, a long term toxics monitoring program will be implemented.

Finally, a prototype information center designed to house, store, analyze and disseminate data specific to the lower Columbia River and estuary will be developed and tested. The prototype will be the first step in the process of building a novel environmental information system that provides on line access to all data on the lower river and estuary in

a variety of formats including raw data, processed data in report form, customized data as needed and on line assistance to pinpoint data needs and expedite access for users.

Relationship to Other Projects

N/A

Relationship to Existing Goals, Objectives and Strategies

The proposed project is based on the findings detailed in the discussions above. There is clearly a need to enhance our understanding of the lower Columbia River and estuarine ecosystem particularly through targeted studies in the areas of habitat and toxics monitoring. To assess habitat condition it is critical that protocols be developed that will allow us to do both long term status monitoring and project specific monitoring and evaluation (M and E). This need ties directly to a second proposal to the NWPPC by the Estuary Partnership that calls for the establishment of a habitat restoration program with specific habitat restoration project monitoring and evaluation requirements.

To evaluate the effects of toxics on the lower river and estuary, we must develop the baseline information and evaluate specific problem areas. Efforts to protect and restore the river for the benefit of salmonids and other organisms will only be successful if we understand enough about the complex needs of those organisms in relation to their habitats that we can make sound decisions about the type of restoration needed to meet those needs.

The proposal is part of the larger initiative designed to address ecosystem health envisioned by the Estuary Partnership Management Plan. The proposal covers both the Lower Columbia River Subbasins and Columbia River Estuary Subbasin because they are in reality one system and the proposed project addresses them as one system. This is in keeping with the purview of the LCREP, which encompasses the lower river from Bonneville Dam to the mouth.

The project will fill critical gaps in our knowledge base of the lower Columbia River ecosystem and to provide a strong scientific basis for making decisions about the ecological significance of proposed projects and for evaluating the effectiveness of those projects once they are implemented. It meets the biological objectives of RPAs 161 and 163. In addition, the proposal addresses the long standing issue of storage and access to both historic data and current data relating to the lower river and estuary and the processing of that data into forms that will address the needs of scientists, decision makers, and the public. This meets the objectives of RPA 198.

Specifically the project addresses the goals and objectives of the following reports and initiatives:

c1 LOWER COLULMBIA RIVER AND LOWER COLUMBIA RIVER ESTUARY SUBBASIN SUMMARY:

The Lower Columbia River and Lower Columbia River Estuary Subbasin Summary Existing Goals, Objectives, and Strategies Section identifies the goals and objectives of a series of initiatives by a variety of organizations involved in managing the resources of the lower Columbia River and estuary. The organizations include: Estuary Partnership, the Lower Columbia Fish Recovery Board, the US Forest Service, the US Fish and Wildlife

Service, Oregon and Washington Fish and Wildlife Departments, National Marine Fisheries Service, the Columbia River Intertribal Fish Commission, local watershed councils, and others. Broadly speaking the goal of all of those organizations is to enhance and protect habitat for salmonids and other species. The monitoring part and data management objectives of the proposed project are consistent with and support that broad goal and provide key building blocks to the attainment of that goal.

More specifically, the proposal directly addresses the following actions of the Lower Columbia River Estuary Partnership's Management Plan as identified in the subbasin summary. The Management Plan's overall goal is to enhance and protect the lower Columbia River and estuary ecosystem.

Habitat Monitoring:
Action 3: "*Adopt and implement consistent wetland, riparian, and instream habitat protection standards to increase the quality and quantity of protected habitat to protect aquatic species.*" The action calls for the adoption of habitat protection protocols, including standards for monitoring mitigation projects. This directly relates to developing methods to monitor habitat condition as called for in the proposal.

Action 6: "*Monitor the effectiveness of habitat protection, restoration, and mitigation projects.*" This action calls for establishing a team of experts to ensure projects are monitored for effectiveness and adequately maintained over time. It also calls for developing criteria (including indicator species and best assessment tools) for evaluating the effectiveness of habitat protection, restoration, and mitigation projects.

Toxic Monitoring:
Action 28: "Implement the Estuary Partnership long term monitoring plan." The Aquatic Ecosystem Monitoring Strategy developed Estuary Partnership and work group of some 30 monitoring experts calls for monitoring water column, sediments, and tissues for toxic contaminants to determine spatial distribution, trends, and impacts of sensitive species.
Action 29: "Monitor and evaluate potential effects of pollutants on human health and fish and wildlife." This action speaks directly to the need to determine the effects of elevated toxic contaminants on fish and wildlife.
Action 30: "Develop a basin-wide strategy for identified toxic and conventional pollutants that defines their sources, fate, and effects and reduces their discharge." The proposal to develop a routine toxics monitoring program would provide the baseline data necessary to the development of a basis wide strategy.

Data Management:
Action 27: "Implement the Estuary Program information management plan." This action calls for building the data management capability to show trends, analyze trends, and develop reports for customers. The Lower Columbia River Information Management Strategy lays this process out in detail.

c2 2000 FISH AND WILDLIFE PROGRAM:

The overall vision for the 2000 Fish and Wildlife Program (NWPPC, 2000) states "Wherever feasible, this program will be accomplished by protecting and restoring the natural ecological functions, habitats, and biological diversity of the Columbia River Basin." The Habitat Strategies section emphasizes the importance of protection and restoration of mainstem habitat conditions. Specific Habitat Strategies include:

- Restore ecosystems, not just single species: the proposed project would restore tidal emergent marsh and riparian forest, which are vital components of the estuary ecosystem.
- Use native species wherever feasible: reintroduction of the Columbian white-tailed deer would restore a native species to the ecosystem.
- Include the estuary: the proposed project site lies within the upper estuary.

The Basin Level Biological Objectives in the Program call for coordinating wildlife mitigation activities with fish mitigation and restoration efforts by coordinating wildlife habitat restoration and acquisition with aquatic habitats.

The habitat monitoring objectives in the proposed project are consistent with the Provisional Statement of Biological Objectives for Environmental Characteristics at the Basin Level (Appendix D of the Program). In particular, the call for "identifying, protecting, and restoring ecosystem functions in the Columbia River estuary and nearshore ocean discharge plume as affected by actions within the Columbia River watershed."

Habitat Monitoring: The proposal to develop agreed upon habitat monitoring protocols and measures is directly germane to the call for identifying, protecting, and restoring ecosystem functions. Clearly we must be able to measure what those functions and establish a baseline for evaluating those functions are if we are in fact to determine whether we have protected or restored them.

Toxics Monitoring: Toxic contamination remains a key issue in determining habitat suitability for sustaining viable populations of organisms. We must be able to determine whether contaminants in the sediments and water column play a role in salmon survival and if so, take actions to mitigate those impacts.

Data Management: As noted above in several locations, data is only useful if it is readily accessible and usable by those who need it to make decisions. The biological objectives call for protecting and restoring ecological functions, which translates into some form of monitoring to determine whether functions have been restored. This in turn requires ready access to good baseline data that can be compared to current conditions and can show trends over time.

c3 NMFS BIOLOGICAL OPINION:
RPA 161: "Between 2001 and 2010, the Corps and BPA shall fund a monitoring and research program acceptable to NMFS and closely coordinated with the LCREP monitoring and research efforts (Management Plan Action 28) to address the estuary objectives of this biological opinion."

Note: LCREP is the Estuary Partnership

The Estuary Partnership Monitoring Strategy calls for the development of a comprehensive ecosystem monitoring program that focuses on toxic contaminants, conventional pollutants, exotic species, habitat monitoring, and food web interactions. Some elements of this plan are underway including routine monitoring for conventional pollutants, accessing the current status of exotic species, and some of the food web interactions being developed by NMFS. Key elements missing from this picture are habitat monitoring and toxic contaminants. The project proposal directly addresses these critical issues.

RPA 163: "The Action Agencies and NMFS, in conjunction with the Habitat Coordination Team, will develop a compliance monitoring program for inclusion in the 1 and 5 year plans."

The habitat monitoring proposal outlined in this proposal provides a key linkage to developing a compliance monitoring program. Clearly we must have agreed upon protocols to measure habitat condition and we must have baseline data to compare with current conditions if we are in fact going to be able to successfully determine compliance over the long term.

RPA 198: "The Action Agencies, in coordination with NMFS, USFWS, and other Federal agencies, NWPPC, states, and Tribes, shall develop a common data management system for fish populations, water quality, and habitat data."

The data management project (ERIC) described in this proposal directly addresses action 198 particularly with respect to water quality and habitat data. Fish population data are currently available through StreamNet, but other data types are not readily accessible. In the long term, ERIC would bring the connections to all data about the lower river and estuary under one roof and actively manage that site to ensure the maximum access to the data to all interested parties.

c4 OTHER PLANS:
As noted earlier, other plans such as the Lower Columbia Fish Recovery Board plan for salmon restoration (currently under development), Wy-Kan-Ush-Mi Wa-Kish-Wit Spirit of the Salmon, the Oregon Plan for Salmon and Steelhead, and local watershed plans will all benefit from elements of this proposal. Specifically, the development of habitat monitoring protocols for habitats key to salmon survival will help all parties involved in salmon restoration to establish procedures for determining the effectiveness of their projects and actions. In addition, the data base (ERIC) will provide a place where all data can be stored and accessed thus facilitating the abilities of all parties to track progress, compare with other actions, and make decisions about priorities for future actions.

Review Comments

Proposed work will focus on the mainstem, an area where management activities are absent. Efforts under this project should be well coordinated with other Basinwide data management efforts. NMFS has identified this project as a BiOp project.

Budget

FY02	FY03	FY04
$472,000 Category: High Priority	$1,024,000 Category: High Priority	$849,000 Category: High Priority

Project: 30016 - Implement the Habitat Restoration Program for the Columbia Estuary and Lower Columbia River

Sponsor: Lower Columbia River Estuary Partnership (LCREP)
Columbia River Estuary Study Taskforce (CREST)

Short Description:

Establish program to identify and prioritize on-the-ground habitat restoration projects and plan their monitoring and evaluation. Take action on six restoration projects already processed and approved through regional and local workgroups.

Abbreviated Abstract

Restoration of habitat for juvenile salmonids migrating through the Lower Columbia River (below Bonneville Dam) and the Columbia Estuary is an important component of regional recovery plans. The lower river and estuary are critical areas in the migration corridor for Columbia Basin anadromous fish, especially ocean-type listed as Threatened or Endangered, because they provide refugia from predators, feeding grounds, and areas to transition physiologically from freshwater to saltwater. However, over the last 100 years, the amount of available wetland habitat in this region has decreased by about 75% over historical levels because of dike and levee building, hydrosystem operations, and other activities. Efforts to protect existing habitat and restore altered habitat have been initiated and a long-term action plan developed. The work to be accomplished under this project will continue to institutionalize this effort as it implements the habitat restoration program for the long-term and takes action on beneficial, already-scrutinized habitat restoration projects in the short-term (three years). The outcome of this project will be increased survival of juvenile salmonids.

Relationship to Other Projects

N/A

Relationship to Existing Goals, Objectives and Strategies

All current regional salmon recovery programs for the Columbia Basin recognize that a comprehensive program for habitat restoration and its implementation in the Lower

Columbia River and Estuary will be integral to recovery and enhancement of salmon and steelhead populations (Nez Perce et al. 1995, Council 2000, and NMFS 2000). For example, the habitat restoration project we propose is entirely consistent with the vision statement of the Council's 2000 Fish and Wildlife Program, "Wherever feasible, this program will be accomplished by protecting and restoring the natural ecological functions, habitats, and biological diversity of the Columbia River Basin." In addition, the ISAB (2000) said, "The ISAB strongly recommends that the Council recognize the potential value of the estuary to the Fish and Wildlife Program…" Finally, habitat restoration in the lower river and estuary was recommended by numerous contributors to the subbasin summary (Marriott et al. 2001).

This project specifically and directly addresses Reasonable and Prudent Alternatives (RPAs) 159 and 160 in NMFS (2000). RPA 159 states, "BPA and the Corps, working with LCREP and NMFS, shall develop a plan addressing the habitat needs of salmon and steelhead in the estuary." RPA 160 states, "The Corps and BPA, working with LCREP, shall develop and implement an estuary restoration program with the goal of enhancing and protecting 10,000 acres of tidal wetlands and other key habitats over 10 years, beginning in 2001, to rebuild productivity for listed populations in the lower 46 river miles of the Columbia River. The Corps shall seek funds for the Federal share of the program, and BPA shall provide funding for the non-Federal share. The Action Agencies shall provide planning and engineering expertise to implement the non-Federal share of on-the-ground habitat improvement efforts identified in LCREP, Action 2." This project will result in a habitat restoration program with a coordinated, scientific basis to select, implement, and evaluate habitat restoration work. The project will also implement, including monitoring and evaluation, specific habitat restoration jobs that have already moved through the selection process, but have not been funded. As appropriate, we will seek matching funds from other agencies such as the Corps of Engineers. In addition, habitat restoration projects by partner agencies and future projects in this program may be funded via sources other than BPA but, regardless, will be coordinated through this program. The restoration program for the lower river and estuary will take advantage of the LCREP's and CREST's broad base of regional support and their proven capability to facilitate meaningful participation of all stakeholders

Review Comments

Proposal represents two projects under one project number. NMFS has identified this project as a BiOp project.

Budget

FY02	FY03	FY04
$5,236,200 Category: Recommended Action	$5,100,000 Category: Recommended Action	$5,100,000 Category: Recommended Action

Project: 30017 - Columbia River Tidewater assessment for Recovery Planning

Sponsor: University of Portland

Short Description:

Characterize habitat/fish productivity relationships; identify factors that limit recovery, early actions for recovery; and research, monitoring, and evaluation needs

Abbreviated Abstract

The Willamette and Lower Columbia Technical Recovery Team (WLC-TRT) has been tasked with developing population delisting criteria for five salmonid Evolutionarily Significant Units (ESUs)[1] and assisting the National Marine Fisheries Service (NMFS) and local entities in the development and implementation of habitat recovery measures. Delisting will occur when factors that placed the ESUs at risk and/or are limiting recovery have been addressed. Habitat quantity and quality in Columbia River estuary and tidewater are thought to be major factors limiting the viability of listed ESUs in the Columbia River basin. For example, the productive capacity of the estuary for salmonids has decreased – by over 50 percent, according to one estimate – due to changes in hydrological conditions, loss of shallow-water habitats due to diking and filling, a shift from a macrodetritus-based food web to one dominated by microdetritus, and the introduction and spread of non-native species (Bottom et al. 2001 This is not in the reference list). These factors, in combination with reduced life-history diversity of salmonid populations, exert considerable influence over the long-term viability, and hence the prospects for recovery, of listed salmonids.

This project would facilitate the analysis and recommendations of WLC-TRT and the recently formed Interior Columbia-Snake Technical Recovery Team (ICS-TRT), and would generally benefit regional salmon recovery efforts, by identifying and securing essential habitat data on estuary/tidewater areas in the lower Columbia River and its principal tributaries. Consistent with needs identified in the NWPPC's Fish and Wildlife Program, the FCRPS Biological Opinion, and BPA's evaluation criteria for Reasonable and Prudent Criteria, the project would address four primary objectives:

- Characterize habitat/fish productivity relationships;
- Identify factors for decline and factors that limit recovery;
- Identify early actions for recovery; and
- Identify research, monitoring, and evaluation needs.

The information obtained through this project would enable estimates of current and historic estuary/tidewater habitat capacities, which will be informative in setting goals and monitoring fish performance (e.g., distribution, abundance, and survival and growth rates), and identifying the location, amount, type, and quality of habitat needed to ensure recovery. In combination with data being collected under the auspices of NMFS, U.S. Army Corps of Engineers (USACE), LCREP and other research programs, this project will greatly improve our knowledge base, identify critical uncertainties and knowledge gaps, and provide information necessary to assess habitat health and prioritize conservation actions in the Columbia River estuary and tidewater areas.

[1] Lower Columbia Steelhead, Lower Columbia Chum, Lower Columbia Chinook, Upper Willamette Steelhead, and Upper Willamette Chinook.

The Columbia River estuary and tidally influenced areas serve as important migratory, rearing, and, in the case of certain chum populations, spawning habitat for ESA-listed and non-listed anadromous fish stocks that originate in the Columbia River and Snake River basins. This project will describe the historical and current availability (opportunity) and use of tidewater habitat by different life stages of all anadromous species. Data collection and analysis will be carefully coordinated with LCREP, NMFS, WLC-TRT, ICS-TRT, and other research and management entities active in the lower Columbia River. In particular, we will work closely with the WLC- and ICS-TRTs and regional salmon recovery planning bodies (e.g., Lower Columbia River Fish Recovery Board) to ensure that their information needs are met and that opportunities for review and comment occur on an ongoing basis. All information generated by this project will be shared with interested parties and disclosed to the public in a timely manner.

Relationship to Other Projects

N/A

Relationship to Existing Goals, Objectives and Strategies

The effectiveness of salmon recovery and habitat conservation efforts in the Columbia River requires a thorough understanding of the historical conditions and selective pressures under which the species persisted. That the Columbia River has been extensively altered from its historical state is well known; urban and rural development, agricultural practices, timber harvesting and road construction, hydroelectric development, land conversions, channelization, and loss of riparian and floodplain habitats are some of the more prominent causes of change. However, the effects of these factors on physical and ecological processes and characteristics of tidally influenced areas are not well understood. This project will help provide a better understanding to ensure that the conditions necessary for salmon recovery and general ecosystem health are restored and maintained over time.

The Lower Columbia River Basin includes all tributaries and associated watersheds that drain into the Columbia River from its mouth to river mile 146. The geographic area that is the focus of this study includes the section of the Columbia River upstream of Puget Island, extending to Bonneville Dam on the mainstem and to Willamette Falls on the Willamette River. The project area comprises a complex network of main, distributary, and dendritic side channels, unvegetated and vegetated bars and islands, emergent and forested wetlands, and extensive mudflats in low-velocity, peripheral areas.

The project area encompasses a diversity of landscapes and supports a substantial human population of more than 2 million people. Historically, the area supported a diverse mix of wildlife and salmon species. All anadromous salmon that utilize areas upstream must pass through the tidal-fluvial area and estuary en route to and from the ocean. Importantly, the various species and populations have evolved diverse life history strategies to maximize their overall fitness by avoiding competitors, predators, etc. and by efficiently exploiting resources in the lower river and estuary. Management has shifted from one emphasizing production, in which salmon were presumed to move rapidly through these areas without significant mortality, to one that recognizes the linkages between freshwater, estuarine, and ocean phases and the role that habitat plays in influencing salmonid survival during each of these phases. This conceptual model, which was first articulated by Rich

(1939) has only recently gained ascendancy in fisheries management circles due to a misplaced faith in hatchery production (Lichatowich 1999).

Two basic ecological tenets drive salmonid management as it applies to the estuary and lower river. One is that the geographic distribution and life history strategies exhibited by salmon populations should reflect their ecological requirements and the varied conditions that they encounter in completing their life cycles. The other is that resource exploitation and partitioning by different species and life stages should maximize productivity and resilience of salmon by increasing opportunity and spreading risk over time and space. When viewed through this lens, salmon recovery becomes an exercise in identifying the ecological requirements of salmon, describing the habitat and other conditions necessary to fulfill those requirements, determining what action are needed to create or restore the desired conditions, and implementing those actions.

Delisting and recovery efforts will focus on maintaining, restoring, and protecting the diverse character and functions of the lower Columbia River and estuary. As tributary and upriver factors improve for listed and non-listed anadromous species, we can expect their utilization and dependence on the tidal-fluvial reach to increase.

A holistic, ecosystem-based perspective will be required to ensure that the area is capable of supporting the diversity and number of populations expected in the future. Neither the historical or current status of the area has been adequately described for recovery planning to be effective. This proposal is meant to address these shortcomings.

The information and analysis developed through this study will assist in the identification of habitat protective/restorative measures for the recovery of ESA-listed salmonids within the Columbia River basin. The project area is unique due to its hydrological and sedimentological characteristics, because of its position within the overall system, because (essential) habitat for all anadromous species originating upriver.

It is generally held that humans have modified aquatic habitats in the tidal-fluvial reach of the Columbia River to the detriment of salmonids. Concern over these human-induced changes has led to the creation of several habitat conservation programs, including the Columbia River Estuary Data Development Program (CREST), Lower Columbia River Bi-State Water Quality Program, National Estuary Program (NEP), the Lower Columbia River Estuary Program (LCREP), Environmental Protection Agency's (EPA) superfund designation of the Portland Harbor, and the U.S. Army Corps of Engineers (USACE) navigation and flood control programs.

Additionally, several watershed conservation planning efforts are underway at the local level. The NWPPC is currently compiling subbasin summaries of the watershed to aid in project selection. These efforts have been stymied by a lack of empirical information on fish distribution and survival, fish habitat, and the factors that influence them. This project will contribute information that fisheries managers and local planning bodies can use to identify and prioritize habitat conservation actions.

The above-mentioned programs have generated a surfeit of habitat data, but as their primary goal is often something other than salmon recovery, the information may not exist in a useable form or be directly applicable to salmon recovery. One of the first steps will be to review and synthesize existing habitat information to identify data gaps and facilitate analysis by the TRT. Ensuing tasks will focus on habitat measurement and

characterization, production estimates, and identification of threats and/or factors limiting salmonid production.

General Approach

Based on our review of available information and conversations with other researchers, several critical issues and information needs related to habitat availability and quality in the tidal-fluvial reach remain unresolved.

With regard to its utility in salmon recovery planning, the extent and applicability of existing habitat data is unknown. Therefore, we propose to compile and review existing information as a prelude to developing a more detailed scope of work. Potential data sources:

- CREST reports
- Hudson Bay Corporation reports
- BLM land surveys
- Oregon and Washington habitat, fish and wildlife surveys
- Bi-State water quality reports
- NEP publications
- EPA studies
- LCREP reports
- Lower Columbia River Fisheries Development Program reports
- USACE reports
- FEMA flood insurance studies
- Willamette Basin Atlas and GIS coverage
- Storm drainage master plans
- Sub-basin summaries
- Watershed limiting factors reports
- Habitat project grant applications
- NMFS studies
- University theses and dissertations
- Newspaper and other historical accounts
- Interviews with citizens and community elders

Primary Questions/Expected Products:

1. What are the historical and current distributions of steelhead, chinook, and chum salmon species and life stages within the tidal-fluvial reach? How has the geographic distribution and timing for each species/life stage changed due to human actions?

   Products would include:

   i. Maps (scale 1:24,000 desirable and probable, otherwise 1:100,000 if not practical) and tabular summaries;
   ii. Narrative description of major changes and timeframes in which they took place;

iii. Comparison of historical vs. current distributions by species. Note that an effort will be made to differentiate among habitat/area usage by lower Columbia/Willamette ESU populations versus upper basin ESU's.

2. How have aquatic habitat and riparian conditions changed from historical conditions? Specifically, what are the changes in:

   - Riparian vegetation composition and structure?
   - Available wetlands for 10, 20, 50, and 100-year storm events?
   - Available secondary and tertiary channels, connected wetlands, marshes, or backwater sloughs?
   - Hydrograph changes due to upriver hydroelectric project and land use practices.

   Products would include:

   i. Maps (scale 1:24,000 desirable, otherwise 1:100,000 if not practical) and tabular summaries;
   ii. Narrative description of major changes and timeframes in which they took place; and
   iii. Comparison of historical vs. current distributions by area.

3. What was the historical production capacity by species? What are they currently? What are the primary factors for any changes from historical to current?

   Products would include:

   i. Compilation of available information on smolt production capability, estimates from ODFW, WDFW, USFS, NWPPC, NMFS, EDT, etc.;
   ii. Graphical and/or tabular summaries for each species; and
   iii. Narrative description of primary limiting factors.

4. What are the current conditions of accessible habitat (e.g. suitable, non-suitable, and marginal)? What areas are considered non-suitable for spawning and rearing (were they non-suitable historically)? What river/estuary areas are critical for completing necessary life cycle stages and expressing life history diversity, may include upwelling and nursery areas.

   Products would include:

   i. Classification and assessment of habitat suitable for salmonids;
   ii. Map and tabular summaries by area; and
   iii. Narrative description of existing threats degrading habitat quality.

5. Where are the most productive habitats (e.g., areas of greatest utilization) remaining for each species? Where do important nursery areas exist? Where are the best remaining habitats?

   i. Define criteria for selection of core areas or Refugia

ii. Maps and tabular summaries for each subbasin.

Review Comments

NMFS has identified this project as a BiOp project.

Budget

FY02	FY03	FY04
$137,338 Category: Recommended Action	$0 Category:	$0 Category:

Project: 30018 - Salmonid Population and Habitat Monitoring in the Oregon Portion of the Columbia Estuary

Sponsor: Oregon Department of Fish and Wildlife (ODFW)

Short Description:

Implement fish population and habitat monitoring (EMAP) in the Oregon portion of the Columbia Estuary.

Abbreviated Abstract

A coordinated and integrated approach to the monitoring and evaluation of status and trends in anadromous and resident salmonid populations and their habitats is needed to support and evaluate restoration efforts in the Columbia Estuary. Currently, independent research projects and some monitoring activities are conducted by various state and federal agencies and to some extent by watershed councils or landowners, but there is no overall framework for coordination of efforts or for interpretation and synthesis of results. We propose that the structure and methods employed by the Oregon Plan for Salmon and Watersheds Monitoring Program (Nicholas, 1997a; 1997b; 1999) be extended to Oregon's portion of the Lower Columbia Province (Willamette, Sandy, Lower Columbia Subbasins). This approach, successfully implemented in Oregon's coastal watersheds, applies a rigorous sampling design to answer key monitoring questions, provides integration of sampling efforts, and has greatly improved coordination among state, federal, and tribal governments, along with local watershed groups. ODFW proposes to monitor the status, trends, and distribution in adult coho and steelhead populations, juvenile salmonids populations, and the habitats they depend on at the Provincial and Subbasin scales. The proposed project is high priority based on the elevated level of emphasis the NWPPC Fish and Wildlife Program and Subbasin Summaries, NMFS 2000 FCRPS Biological Opinion, and the Oregon Plan for Salmon and Watersheds have placed on monitoring and evaluation to provide the real-time data to guide restoration and adaptive management in the region.

Relationship to Other Projects

N/A

Relationship to Existing Goals, Objectives and Strategies

The program described in this proposal is consistent with and supports the monitoring needs specified by the amended NWPPC's Columbia Basin Fish and Wildlife Program and Subbasin Summaries, NMFS 2000 FCRPS Biological Opinion, and the Oregon Plan for Salmon and Watersheds. The Fish and Wildlife Program (Chapter 9) calls for monitoring and evaluation of biological and environmental conditions at the scale of provinces and subbasins. The subbasin summary this proposal addresses (Columbia Estuary) calls for a framework for the coordination and integration of monitoring efforts and increased monitoring of the status trends in anadromous and resident fish populations and habitats in their respective "Fish and Wildlife Needs" sections. The proposed monitoring program will provide a framework for improved coordination and integration of monitoring efforts. ODFW will monitor and evaluate the status and trends in fish populations (abundance and distribution) and habitat (quantity and quality) at the Province (Oregon Portion) scale. The purpose of the monitoring and evaluation program is to assure that the effects of actions taken under sub-basin plans are measured, that these measurements are analyzed so that we have better knowledge of the effects of the action, and that this improved knowledge is used to choose future actions.

This proposal addresses several action items under the NMFS 2000 FCRPS Biological Opinion. In Section 9.6.5 Research, Monitoring, and Evaluation Plan, the Reasonable and Prudent Alternatives (RPA) require that a comprehensive monitoring and evaluation program be developed to determine the effectiveness of the suite of actions called for under the RPA. The RPA proposes that research, monitoring, and evaluation must address five areas: population status monitoring, environmental status monitoring, effectiveness monitoring, quality of regional databases, and compliance monitoring. The monitoring program described in this proposal will address population status monitoring and the habitat component of environmental status monitoring. Action 174 (Reform of Artificial Propagation) is supported by developing estimates of the abundance and distribution of hatchery fish in natural production areas through counts of adult salmon spawners. Action 180 (Population Status and Environmental Status Monitoring) is fundamentally supported by ODFW's proposed monitoring program. ODFW's monitoring program contains all of the essential elements of NMFS framework for monitoring. Action 184 (Hatchery Reform Monitoring) is partially supported by the proposed monitoring program by estimating the distribution and abundance of adult hatchery fish on spawning grounds.

Under the Oregon Plan (Coastal Salmon Restoration Initiative, Steelhead Supplement, Executive Order No. EO 99-01) monitoring is one of the four essential elements to implement the Plan. ODFW's monitoring proposal for the Lower Columbia Province Project Selection is consistent and complimentary to the program ODFW has implemented in coastal watersheds. This proposal also supports the implementation of the Oregon Plan statewide for all salmonids at-risk throughout the state.

Review Comments

The cost appears excessive. Could the budget be reduced? This level of effort should be well coordinated with other monitoring efforts throughout the Basin.

Budget

FY02	FY03	FY04
$528,913 Category: High Priority	$555,359 Category: High Priority	$583,126 Category: High Priority

Project: 31001 - Artificial production facilities improvements to support Lower Columbia chum salmon reintroduction into the Chinook River

Sponsor: Sea Resources

Short Description:

Improve Sea Resources hatchery facilities to enable staff to perform tasks in support of the reintroduction of Lower Columbia chum salmon into the Chinook River.

Abbreviated Abstract

In March 1999, NMFS listed Lower Columbia chum salmon under the Endangered Species Act. Currently, only two population centers remain in the Columbia River Basin – Grays River and Hamilton/Hardy Creeks. Sea Resources has been cooperating with the Washington Department of Fish and Wildlife (WDFW) to reestablish a viable self-sustaining population of chum salmon in the Chinook River. The objective of the chum salmon recovery program is to reestablish stable populations of chum salmon in other watersheds within their historic range. This effort will reduce the risk of extinction in the short-term, and work to achieve complete recovery of the stock in the long-term. 2001/02 will be the third year that WDFW delivers artificially produced chum salmon fry from the Grays River Hatchery. The brood sources for these fry are wild Grays River chum salmon. In the fall of 2002 we expect the first returns from these releases. WDFW plans that a portion of returning adults will be taken into Sea Resources' hatchery facility in an effort to maintain and supplement natural production until habitat conditions are assessed and improved. This will require that Sea Resources enhance its facilities by designing and installing a water filtration system to remove excessive suspended sediments and installing a thermal marking system to permit necessary monitoring tasks associated with this reintroduction and supplementation effort. The artificial production component of this reintroduction project is a temporary measure until a stable population of Lower Columbia chum salmon is established in the Chinook River watershed.

Relationship to Other Projects

N/A

Relationship to Existing Goals, Objectives and Strategies

Fish and Wildlife Program

Vision for the Columbia River Basin

The underlying vision of the Northwest Power Planning Council (Council) is to restore and maintain an ecosystem that supports an abundant, productive, and diverse community of

fish and wildlife by mitigating for the effects of the hydrosystem. The program emphasizes the restoration and protection of natural ecological functions, habitats, and biological diversity in the Columbia River Basin. This is the focus of Sea Resources' restoration activities. We believe that artificial production has the potential to complement our emphasis on habitat restoration. Since there are uncertainties related to using artificial production in the context of a recovery effort we will implement rigorous monitoring protocols per WDFW instructions that will allow us to treat this effort in an experimental fashion.

Artificial Production Strategies

The Council outlines the appropriate conditions for using artificial production as actions designed to "complement habitat improvements" and "replace lost salmon" populations. This project will support a very modest supplementation effort to expand the spatial distribution of a salmon species at risk of extinction into a watershed within its former range. Significant habitat improvements are in the planning stages and include a large estuary restoration project in the lower Chinook River described below. Chum salmon exhibit a life history pattern that includes significant estuary rearing (Levy et al. 1979; Sibert et al.; 1977 Sims 1975). Optimal estuary habitat conditions are critical to support a stable, naturally reproducing population of chum salmon.

The Council also believes that "the decision of whether to employ supplementation for this purpose [restoration] is one that should be made locally, as part of the subbasin plan. The object…is to restore and maintain healthy fish populations, with sufficient genetic and life history diversity to ensure that eventually, after appropriate habitat improvements, they will become self-sustaining. Sea Resources is a community-based watershed restoration and education organization. We make every attempt to be consistent with the most current scientific thinking available regarding our efforts by maintaining awareness of similar 2000 FCRPS Biological Opinion.

9.6.2.1 Actions Related to Tributary Habitat

Action 157: This action stresses the need to improve Lower Columbia River chum salmon habitat. The artificial production component of this reintroduction effort complements habitat restoration activities such as the restoration of the Chinook River estuary. This and other projects will improve passage for returning adult chum salmon as well as improve rearing conditions for juvenile chum salmon. The restored habitat will be accessible to juveniles originating from both the Chinook River and other upriver sources.

Review Comments

Funding this project should be based on the results of Project 30005. NMFS has identified that this project is a BiOp project.

Budget

FY02	FY03	FY04
$41,865 Category: Recommended Action	$ Category:	$ Category:

Project: 31003 - Distribution and life history characteristics of lampreys in tributaries of the lower Columbia River Basin

Sponsor: U.S. Forest Service (USFS)

Short Description:

With emphasis on Pacific lampreys, identify tributaries containing lamprey, and quantitatively evaluate populations and their habitats in two streams below Bonneville Dam.

Abbreviated Abstract

Pacific lamprey (*Lampetra tridentata*) in the Columbia River basin have declined to a remnant of their pre-1940s populations. The Northwest Power Planning Council's Fish and Wildlife Program has noted the decline and identified the need for information necessary to restore the characteristics of healthy lamprey populations. Studying the biology, population dynamics, ecology, identification, as well as the relationships among sympatric species of lampreys *(L. ayresi,* and *L. richardsoni*) in the Columbia River basin will assist in rehabilitating Pacific lamprey populations. Since 2000, the U.S. Fish and Wildlife Service at the Columbia River Fisheries Program Office has been collecting quantitative baseline data, including adult and larval abundance estimates, larval distribution and habitat requirements, immigration and emigration timing, and spawning habitat requirements for lamprey in Cedar Creek, Washington. The proposed project is to conduct a survey for lamprey in other tributaries of the lower Columbia River basin to identify two additional sites in which to perform work similar to the ongoing project in Cedar Creek. The proposed and ongoing projects will provide baseline references to characteristics and variability of lamprey that are not directly influenced by reservoirs and passage impediments at hydropower facilities in the mainstem Columbia River. This information is intended to contribute to evaluating restoration efforts performed upstream of mainstem hydropower facilities and assist in assessing effects of ocean conditions on lamprey populations.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
200001400	Evaluate habitat use and population dynamics of lampreys in Cedar Creek	similar methods for comparison purposes
9402600	Pacific lamprey research and restoration projects	similar methods for comparison purposes between tributaries upstream and downstream of Bonneville Dam

Relationship to Existing Goals, Objectives and Strategies

The proposed project will complement both current and proposed lamprey work in the Columbia River basin. It is modeled after the ongoing project, "Evaluate habitat use and population dynamics of lampreys in Cedar Creek--BPA contract 200001400." Objectives

of the Cedar Creek project are to: 1) estimate the abundance of larval and adult lamprey and measure biological characteristics; 2) determine larval distribution and habitat use; 3) determine outmigrant timing of larvae and macropthalmia; 4) evaluate spawning habitat requirements; and 5) evaluate homing fidelity, survival rates, and ocean residence. The proposed project shares objectives 1-4 with the Cedar Creek project and expands their spatial scope to two additional streams, which will be identified by surveying several tributaries to the lower Columbia River during the first year of the proposed project. These objectives and those of the ongoing project, "Evaluate status of Pacific lamprey in the Clearwater River drainage, Idaho–BPA contract 00000090–00001," are similar in generating life history information, and comparisons between results of the two projects may yield insights into factors influencing Pacific lamprey in both areas of the basin and potential restoration approaches. Expanding areas surveyed for lamprey in the proposed project may improve the likelihood of collecting river lamprey, which could identify sources for individuals to be used in other ongoing projects (e.g., "Identification of larval Pacific, river, and western brook lampreys and thermal requirements of early life history stages of lampreys–BPA contract 00AI23249"). The estimates and variability of lamprey abundance and life history characteristics generated by the proposed project will assist in evaluating restoration efforts likely to be implemented elsewhere in the basin.

Budget

FY02	FY03	FY04
$173,281 Category: Recommended Action	$337,096 Category: Recommended Action	$353,950 Category: Recommended Action

Project: 31006 - Protect Wood's Landing Chum Spawning Site

Sponsor: City of Vancouver

Short Description:

Through acquisition of property and easements on 12 acres and 1000 feet of shoreline the project will protect a significant chum spawning site on the mainstem of the Columbia and will also restore the lower 350 feet of the adjacent creek.

Abbreviated Abstract

The project will protect the largest Lower Columbia River chum production site between the Grays River near the mouth of the Columbia River and Hardy/Hamilton Creeks just below Bonneville Dam. Federal, state, and regional reports including the Federal Columbia River Power System Biological Opinion and the Lower Columbia Subbasin Summary, have described the importance of good chum spawning habitat in the Lower Columbia.

Through acquisition the project will protect the area, 11.96 acres and 1000 feet of shoreline, above this significant chum spawning habitat on the Columbia River shore in Vancouver, Washington. The properties include tidelands and mostly forested upland areas with very good riparian habitat. The current zoning allows 1 unit per 10,000 square feet

(0.23 acres). Such residential development degrades habitat by increasing pollutant loading and bringing people and pets that disturb the spawning chum and their eggs.

Restoration of 350 feet of the Joseph's Creek, which enters the Columbia River immediately downstream of the mainstem spawning site, will provide additional spawning habitat. The restoration will include adding spawning gravel, removing invasive plants from the banks, and stabilizing and revegetating the banks.

Partners in the project are Washington Department of Fish and Wildlife, Columbia Land Trust, City of Vancouver and the Wood family members who own the property. All partners share salmon conservation goals. Washington Department of Fish and Wildlife will develop a management plan in cooperation with the partners. Columbia Land Trust will manage the acquisition and then give the title and easements to Washington Department of Fish and Wildlife. The project provides a unique opportunity within the Lower Columbia subbasin to protect existing, critical, high quality chum salmon habitat in the main stem.

Relationship to Other Projects

N/A

Relationship to Existing Goals, Objectives and Strategies

The project implements three actions in the Reasonable and Prudent Alternatives Summary in the National Marine Fisheries Service 2000 Federal Columbia River Power System Biological Opinion.

Action 157. "BPA shall fund actions to improve and restore tributary and mainstem habitat for Columbia River chum salmon in the reach between The Dalles Dam and the mouth of the Columbia River." The project clearly provides an opportunity to protect an important, existing, threatened chum spawning site and restore an adjacent site.

Action 150. "In subbasins with listed salmon and steelhead, BPA shall fund protection of currently productive non-Federal habitat, especially if at risk of being degraded . . ." As stated above the project clearly provides an opportunity to protect an important, existing, threatened chum spawning site and restore an adjacent site.

Action 152. "The Action Agencies shall coordinate their efforts and support offsite habitat enhancement measures undertaken by other Federal agencies, states, Tribes, and local governments by the following: . .leveraging funding resources through cooperative projects, agreements and policy development . . ." The project is a partnership among the Washington State Department of Fish and Wildlife, the City of Vancouver, the non-profit Columbia Land Trust and the Wood family and has the support of the Lower Columbia Fish Recovery Board and the Washington Department of Ecology.

The project implements the salmon recovery strategies of the Washington State Salmon Recovery Funding Board, the Washington Department of Fish and Wildlife and the Lower Columbia Fish Recovery Board to protect existing good habitat of critical stocks (e.g. p. 100 of the Subbasin summary). Washington Department of Fish and Wildlife and the Lower Columbia Fish Recovery Board both rated the Columbia River chum as Tier 1 in stock priority.

Review Comments

M&E would be performed through other BPA funded chum projects. NMFS has identified that this project is a BiOp project.

Budget

FY02	FY03	FY04
$765,810 Category: High Priority	$0 Category:	$0 Category:

Project: 31014 - Evaluate juvenile salmonid use of restored floodplain wetlands in the Lower Columbia River Estuary

Sponsor: Ducks Unlimited (DU)

Short Description:

Evaluate benefits and effects of wetland habitat restoration on juvenile salmonids rearing and migrating through the Lower Columbia and implications for restoration and salmon recovery

Abbreviated Abstract

Floodplains associated with major rivers are among the most productive and diverse systems in the world (Junk et al. 1989). The seasonal influence of the hydrological regimen of the fluvial system is critical (Bayley 1995; Poff et al. 1997; Michener and Haeuber 1998) because its timing and magnitude maintains various successional stages of vegetation across the floodplain (Junk et al. 1989), which in turn maintains biological and physical diversity. This process also maintains high biological production through rapid turnover of organic matter and nutrients, which results in high yields of fish (Bayley 1991; Bayley 1995) and supports high densities of other fauna, including migratory birds (Junk et al. 1989). Finally, the nature and timing of surface water connections are clearly important for access by fish.

There are many floodplain restoration projects currently being planned or implemented in the lower Columbia basin. However, restoration of vegetation and other habitat features cannot be separated from the influence of the hydrological regimen that is largely controlled by precipitation and human activities upstream. Species utilizing floodplains may survive, but not thrive, under moderate departures from natural flow patterns, because the lack of flooding prevents aquatic biota from accessing the productive, seasonally flooded land in the wet months and also, the augmented flow in the summer that helps dilute effluent discharged into rivers keeps what was once adjacent wetlands inundated further reducing habitat diversity. However, present flows depart considerably from natural levels in some seasons and these departures vary across systems. For example, in the Willamette River low flows are maintained at discharges 70% higher natural summer flows, restricting the generation of many wetland plants and associated fauna. In the Columbia River, however, dam operations result in sharply reduced flows during May and June, when shallow water in accessible floodplains was naturally present and is needed by emergent and submerged vegetation. This early growth supports

invertebrate production, which, in turn supports higher animals, including native fishes and wildfowl.

Among the native species expected to benefit from floodplain restoration are anadromous salmonids, many of which are in peril. Early results from restoration in aggregate-mined floodplains (Bayley and Baker 2000) indicate that wild chinook salmon and cutthroat trout utilize such areas, particularly in December through May. Fast growth rates were observed from young chinook, some of which survived in relatively warm water at least through August. Apart from use of regularly connected off-channel habitats, as also indicated in Western Washington and British Columbian streams (Peterson 1982; Cederholm and Peterson 1988; Swales et al. 1988), large quantities of native fishes were observed to invade briefly flooded fields and woodlands in adjacent floodplains during peak floods in the Willamette valley, and feed heavily on terrestrially derived fauna (Bayley and Baker 2000). This project will monitor fish use of a variety of floodplain wetland habitats, and evaluate ingress/egress, residence times, growth rates, habitat use, and life history diversity of juvenile salmonids in the Lower Columbia River estuary.

Relationship to Other Projects

N/A

Relationship to Existing Goals, Objectives and Strategies

Wetland restoration in the Pacific Northwest demands adaptive implementation of cutting-edge techniques to meet the challenges offered by the diverse spectrum of conservation opportunities. The majority of wetland restoration opportunities in the Pacific Northwest occur in the floodplains of major river systems, many of which harbor federally protected species of anadromous and resident fishes. DU has met the challenge of incorporating fish habitat, passage and protection into project designs, yet few of these applications have been evaluated sufficiently to document the benefits to fish. In the fall of 2000, DU launched a fisheries monitoring program to evaluate three specific wetland projects and their impacts on fish. This effort has already yielded valuable information and created new partnership opportunities.

General ecological attributes of salmonid use of wetlands are, at best, poorly understood. Available information suggests that wetlands are productive foraging grounds, that even when used in short duration can result in substantial growth. Although increased biological productivity associated with restoration is expected to benefit fish and aquatic species in general, we do not know how the various species will interact with each other and with other species, and with habitat conditions as they are influenced in turn by temperature, hydrology, and vegetation through the seasons. Also, there are other species of particular interest, such as red-legged frogs and western pond turtle that may benefit under conditions that are distinct from some native fishes. Spring egg-mass surveys will be conducted to monitor red-legged frogs, and field personnel will assist Metro with turtle surveys in Smith and Bybee lakes.

Review Comments

It is not clear that this project is well coordinated with other assessment projects in the Lower Columbia/Estuary. The scope and budget should be reviewed in line with other assessments funded in the estuary. NMFS has identified that this project is a BiOp project.

Budget

FY02	FY03	FY04
$150,000 Category: Recommended Action	$150,000 Category: Recommended Action	$150,000 Category: Recommended Action

Project: 31015 - Sturgeon Lake/Dairy Creek Restoration

Sponsor: West Multnomah Soil and Water Conservation District (WMSWCD)

Short Description:

Reopen the Dairy Creek channel to Upper Sturgeon Lake, construct a rock spur jetty in the Columbia River, re-construct and replace an existing debris boom, and repair an existing culvert

Abbreviated Abstract

Sturgeon Lake provides 3,200 acres of wetland lake and off-channel habitat along the Lower Columbia River. The lake is located on Sauvie Island in northwest Multnomah County, Oregon, and is bounded by the Columbia River to the east and Multnomah Channel to the west. It is owned by the State of Oregon and managed by Oregon Department of Fish & Wildlife (ODFW). It is valued for its rich diversity of fish and wildlife habitat. In addition to providing habitat for waterfowl, bald eagles, peregrine falcon and sandhill cranes, Sturgeon Lake is used by salmonid juveniles for off-channel feeding during their downriver migration.

Natural flows of water into this basin have been severely restricted by Federal levees. Due to these levees, salmonid migration is restricted to an entrance at the far downstream end, via the Gilbert River. The only other entrance point for migrating fish (including white Sturgeon, once highly dependant on feeding on spawned out salmon) is the Dairy Creek Channel located at the upstream end of the basin. Federal and State permits were obtained to clean out and relocate this channel and the project was completed in 1987. Fish monitoring studies were conducted by ODFW, but were suspended several years later when sandy sediments blocked water flows. The 1996 flood brought in substantially more sediments and logs and currently nearly all flushing is absent. To restore the influence of the Dairy Creek Channel on the Lake basin, this proposal requires reconnecting the Dairy Creek Channel to Sturgeon Lake.

This restoration project requires the removal of a large sand shoal that is migrating into the channel. It will also require the re-analysis and construction of a 200-ft long rock jetty, designed for phase three of this project by the Corps of Engineers to keep sediment from building up again. It is to be constructed in the Columbia River just downstream of the Dairy Creek channel. Other work tasks include: reconstructing log debris deflection

boom and attaching them to existing pilings at the channel entrance, repairing or replacing culverts on Reeder Rd damaged by the 1996 flood, and removing logs and fine sediments that have accumulated in 900 feet of channel between Reeder Rd. and the sand shoal at the mouth.

Relationship to Other Projects

Project #	Title/description	Nature of relationship
1	US Army COE Sauvie Island flood Control project	1-Proposal's proximity to the COE, used for Sec. 1135 eligibility
2	US Army Columbia River Navigation Channel	2-Dairy Cr. entrance has been impacted by past activity and potentially by the channel deepening project
975900	Securing Wildlife Mitigation Projects-Oregon	Proposal calls for enhancement and management of similar wetland habitats statewide.
9705908	Securing Wildlife Mitigation sites-Oregon Multnomah channel	This proposed project is directly connected to Multnomah Channel and will beneficially impact its biota and richness.

Relationship to Existing Goals, Objectives and Strategies

Construction of a stable entrance channel leading to the Sturgeon Lake ecosystem offers one of the first significant opportunities for backwater feeding and refugia for salmon for 100 miles or more of river. It is at this stopover for the fish that they first experience a slight tidal effects and cyclic water movements that they will encounter to an even greater extent as they move downriver. Such areas have been lost from Sturgeon Lake to the Bonneville Dam because the river above has lost similar areas due to diking and industrial development on both sides of the river. Not so incidentally, this proposed action will support the diversity and abundance of waterfowl of Sturgeon Lake, vital to recovering populations of northern bald eagle and peregrine falcon.

Review Comments

NMFS has identified that this project is a BiOp project.

Budget

FY02	FY03	FY04
$121,000 Category: Recommended Action	$86,000 Category: Recommended Action	$23,000 Category: Recommended Action

Project: 31024 - Protect, Enhance and Maintain Wetland, Riparian and Upland Habitat on the Shillapoo Wildlife Area

Sponsor: Washington Department of Fish and Wildlife (WDFW)

Short Description:

Maintain and implement measures to restore and enhance wetland, riparian, and upland habitat in the Vancouver Lake Lowlands area.

Abbreviated Abstract

The 2,371 acre Shillapoo Wildlife Area (SWA) is located in Clark County in Southwest Washington (Figure 1). This Wildlife Area was originally established in 1952 with the purchase of 277 acres between Shillapoo Lake and the Columbia River. Other parcels were added, primarily in the 1990's, to bring the wildlife area to its current size.

The primary management goal of the Shillapoo Wildlife Area is to protect, enhance, and maintain wetland, riparian, and upland habitats that support breeding and wintering Canada geese, mallards and dabbling ducks, as well as mink, great blue herons, sandhill cranes, black capped chickadees, western meadowlark, and yellow warblers. With the exception of the sandhill crane, these species were identified as "indicator" species in the construction and loss assessments for Bonneville, The Dalles and John Day dams (Rasmussen and Wright 1989). Numerous other wildlife species also benefit directly from this project.

Planned and ongoing habitat enhancement, maintenance and protection measures include riparian and oak forest tree plantings, wetland developments, weed control, waterfowl forage improvements such as pasture management and food plots, and maintenance of water control structures, fences, roads and other necessary infrastructure. Long-term operation and maintenance (O&M) is required in order to protect and maintain habitat/wildlife values on all units comprising the Shillapoo Wildlife Area. Planned monitoring activities include measuring both wildlife and habitat response to habitat manipulation and protection measures.

WDFW proposes to fund all startup, enhancement and O&M activities for 2003 using existing BPA MOA funds. This funding proposal request is for only out-years 2004 and 2005.

Relationship to Other Projects

Project #	Title/description	Nature of relationship
9062	Sandy River Delta Riparian Reforestation	Complements riparian restoration goals.
5513100	Kalama Wetland Preserve-Deep Water	Complements wetland management goals
9107800	Burlington Bottoms Wildlife Mitigation Project	Complements riparian, wetland and upland management.
	Steigerwald Lake NWR	Complements wetland restoration efforts upstream.
	Lower Columbia Ecoregion Restoration Project--Phase I	Project lands a component of eco-regional based wetland restoration effort.
	Lower Columbia Ecoregion Restoration Project--Phase II	Project lands a component of eco-regional based wetland restoration effort.

Project #	Title/description	Nature of relationship
	Lower Columbia Ecoregion Restoration Project--Phase II	Project lands a component of eco-regional based wetland restoration effort.

The presence of over 2,300 acres of undeveloped habitat adjacent to the Columbia River creates a unique opportunity to provided and maintain quality wetland, riparian and oak woodland habitat in the subbasin. This BPA funded mitigation project provides habitat for both T&E and Priority Habitat & Species (PHS) animals. It is an important link in WDFW's efforts to protect, enhance and increase wetland and oak woodland habitats for associated wildlife species including, within a limited area, anadromous fish.

The goals, objectives and strategies described for the Shillapoo Wildlife Area Workplan Draft (WDFW) are consistent with those identified in the Lower Columbia River and Columbia River Estuary Subbasin Summary (see the following table).

Lower Columbia River Goals, Objectives and Strategies	Shillapoo Wildlife Area Goals, Objectives and Strategies
Manage functional aquatic, wetland, riparian and upland habitats that support diverse native fish and wildlife populations as essential components of healthy watersheds.	Maintain, improve and restore desired habitats in specific areas including herbaceous, scrub shrub and forested wetlands, riparian forest, oak and grass/shrub habitat for multiple species benefits. Develop and/or maintain the infrastructure necessary for effective management of the Shillapoo Wildlife Area and conduct maintenance activities, as required, throughout the site.
Maintain and restore the species compositions and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion and channel migration, and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.	Restore, enhance and maintain an estimated 194 acres of riparian, upland and wetland forested habitats in identified areas. Reestablish wetland hydrology to approximately 900 acres within the Shillapoo lakebed. Implement moist soil management practices on an estimated 155 acres within the South Unit.
Protect high quality habitat while providing education and passive recreation opportunities compatible with habitat function.	Manage appropriate public use and recreation in a manner that minimizes impacts to habitat and its use by wildlife. Develop and publish a pamphlet for public distribution, with maps, that outlines history, objectives, and rules for the Wildlife Area by the end of FY 2003. Develop similar products for posting at public access points.

Lower Columbia River Goals, Objectives and Strategies	Shillapoo Wildlife Area Goals, Objectives and Strategies
Provide high-quality wintering habitat for all Canada geese, especially the dusky subspecies, to ensure a healthy, viable goose population that minimizes damage to private agricultural lands in the lower Columbia River area.	Rehabilitate or improve management of an estimated 950 acres of pasture and agricultural areas located throughout the Shillapoo Wildlife Area that will remain following native type habitat developments in order to continue to provide a diverse forage base critical to management of wintering waterfowl in the region.
Protect, restore and develop habitats for, and otherwise support, the recovery of federally listed endangered and threatened species and help prevent the listing of candidate species and species of concern.	Expand and rehabilitate areas no longer suitable for Great Blue Heron nesting within a 40-acre area where trees have died and fallen. Clear brush as necessary and plant cottonwood trees by the end of FY 2002.
Protect, restore and develop a diversity of habitats for all other migratory birds such as neotropical songbirds, wading birds, shorebirds and waterfowl, as well as indigenous fish and plant species of the lower Columbia River ecosystem.	Restore, enhance and maintain an estimated 194 acres of riparian, upland and wetland forested habitats in identified areas. Reduce the levels of noxious weeds and other undesirable plants that limit habitat quality and pose a significant threat to the long-term viability of planned enhancements.
Provide high-quality opportunities for wildlands and wildlife-dependent recreation and environmental education to enhance public appreciation, understanding and enjoyment of fish, wildlife, habitats and cultural resources.	Establish or improve four access points and an estimated eight miles of travel routes located throughout the Shillapoo Wildlife Area and develop materials for public distribution and posting.

As an ongoing mitigation project, the Shillapoo Wildlife Area project is also consistent with the Northwest Power Planning Council's 2000 Program including, but not limited to the following sections:

- Overall Vision (Section III A-1) "Wherever feasible, this program will be accomplished by protecting and restoring the natural ecological functions, habitats, and biological diversity of the Columbia River ecosystem…."
- Planning Assumptions (Section III, A-2) "This is a habitat based program, rebuilding healthy, natural producing fish and wildlife populations by protecting, mitigating, and restoring habitats and the biological systems within them…"
- Scientific Principles (Section III, B-2) i.e., Principles one through eight
- Biological Objectives (Section III, C-1) "Recovery of fish and wildlife affected by the development and operation of the hydro system that are listed under the Endangered Species Act," (Section III, C-2a.4) "Develop and implement habitat acquisition and enhancement projects to fully mitigate for identified losses; Coordinate fish and wildlife activities throughout the basin . . .; maintain existing and created habitat values; and monitor and evaluate habitat and species responses to mitigation actions."

- Wildlife (Section III, D-7) "Complete the current mitigation program for construction and inundation losses and include wildlife mitigation for all operational losses as an integrated part of habitat protection and restoration."

The Shillapoo Wildlife Area Project also contributes toward prioritized actions outlined in NMFS Biological Opinion:

- Action 153: BPA shall, working with agricultural incentive programs such as the Conservation Reserve Enhancement Program, negotiate and fund long-term protection for 100 miles of riparian buffers per year in accordance with criteria BPA and NMFS will develop by June 1, 2001.
- Action 160: The Corps and BPA, working with LCREP, shall develop and implement an estuary restoration program with a goal of protecting and enhancing 10,000 acres of tidal wetlands and other key habitats over 10 years, beginning in 2001, to rebuild productivity for listed populations in the lower 46 river miles of the Columbia River. The Corps shall seek funds for the Federal share of the program, and BPA shall provide funding for the non-Federal share. The Action Agencies shall provide planning and engineering expertise to implement the non-Federal share of on-the-ground habitat improvement efforts identified in LCREP, Action 2.

The Shillapoo Wildlife Area has been approved as a wildlife mitigation project by BPA. This project will partially meet BPA's mitigation obligation to compensate for wildlife losses resulting from the construction of Bonneville, The Dalles and John Day dams (Rasmussen and Wright 1989). Breeding and wintering Canada geese, mallards and other dabbling ducks, mink, great blue herons, black capped chickadees, western meadowlark, and yellow warblers were identified in the loss assessments and were used as HEP indicator species.

Review Comments

This is an ongoing project (BPA contract number is 96BI97789). This project has been funded through the Washington Wildlife Agreement. NMFS has identified that this project is a BiOp project.

Budget

FY02	FY03	FY04
$0 Category: High Priority	$253,430 Category: High Priority	$261,880 Category: High Priority

Project: 31032 - Develop a Well Water Supply System for the Hardy Creek Chum Salmon Spawning Channel

Sponsor: U.S. Forest Service (USFS)

Short Description:

Develop a well water supply system for the Hardy Creek chum salmon spawning channel. This system will mimic spring and seepage flow to ensure that water will be provided to the spawning channel during subfreezing weather when Hardy Creek is frozen

Abbreviated Abstract

The U.S. Fish and Wildlife Service (FWS) proposes to install an auxiliary well water system to provide water to the Hardy Creek chum salmon spawning channel. The FWS would use the well water system during periods of subfreezing weather when the stream intake from Hardy Creek is frozen and inoperable. It is critical that water be supplied to the spawning channel during these times to protect chum salmon embryos from freezing. The well water system will also be used to supply artificial seepage and spring flow to the spawning channel to encourage chum salmon spawning.

Relationship to Other Projects

Project #	Title/description	Nature of relationship
200001200	Evaluate Factors Limiting Columbia River Gorge Chum Salmon Populations	A primary objective of this project is to enhance and restore chum salmon production in Hamilton and Hardy Creeks. The proposed well system will contribute to this objective in Hardy Creek.
199900301	Evaluation of Spawning for Fall Chinook and Chum Salmon Just Below the Four Lowermost Columbia River Dams	Data from spawning channel chum salmon will be provided to the participants in this study.

Relationship to Existing Goals, Objectives and Strategies

The Hardy Creek spawning channel was constructed to contribute to recovery of Columbia River chum salmon by increasing available spawning habitat. The proposed well system is needed to ensure that chum salmon successfully spawn and that incubating eggs and fry do not suffer mortality from freezing weather conditions.

Fish and Wildlife Program

The spawning channel will help meet the overarching objectives of the Northwest Power Planning Council's Fish and Wildlife Program. It will help meet the mitigation objective by increasing the spawning population of chum salmon in the Columbia River System. Such an increase would help to offset losses of chum salmon that formerly spawned upstream of Bonneville Dam. Objective 3 is to provide sufficient populations of fish and wildlife for abundant opportunities for harvest. The increased production of chum salmon in the spawning channel would help to meet the long-term goal of recovering this species to a population level where harvest is possible. Objective 4 is the recovery of listed fish and wildlife that are affected by operation of the hydrosystem. The spawning channel is intended to contribute to the recovery of chum salmon.

The Hardy Creek spawning channel also addresses the strategies of the Fish and Wildlife program. Habitat in lower Hardy Creek has been compromised by past land use actions and operation of the hydropower system. The spawning channel will replace spawning habitat, which has been lost.

NMFS Biological Opinion
The Hardy Creek spawning channel responds to RPA Action 157 in the NMFS Biological Opinion for chum salmon. RPA Action 157 directs the Bonneville Power Administration to fund actions to improve and restore tributary and mainstem habitat for Columbia River chum salmon within the reach of river between The Dalles Dam and the mouth of the Columbia River. The Hardy Creek spawning channel addresses this RPA Action by increasing spawning habitat for chum salmon. The proposed well water supply system is essential to ensure that the Hardy Creek spawning channel operates as planned. Lack of a well water supply system could lead to loss of an entire year class of chum salmon production from the spawning channel.

The spawning channel is a component of other efforts to restore chum salmon populations in the Columbia River. The spawning channel would help further these efforts by providing more stable spawning and incubation conditions than are available in the main Columbia River and in unregulated tributaries.

The Bonneville Tributaries Subbasin – Limiting Factors Analysis, Washington State Conservation Commission, 2000.
This analysis notes that there is a limited amount of lower gradient habitat for spawning and rearing of anadromous salmonids, in tributaries between Bonneville Dam and Portland. This report indicates that railroads, State Route (SR)14, dikes, and other artificial structures have reduced or eliminated access to some of the most productive habitat within the subbasin, and have reduced overall habitat quality. The Hardy Creek spawning channel will replace lost spawning habitat for chum salmon.

Review Comments
Budget has been reduced to $69,800 -- see response to the ISRP for an explanation. NMFS has identified that this project is a BiOp project.

Budget

FY02	FY03	FY04
$69,800 Category: High Priority	$5,000 Category: High Priority	$5,000 Category: High Priority

Project: 31033 - Restoration of Columbia River Floodplain Functions to Steigerwald Lake

Sponsor: U.S. Forest Service (USFS)

Short Description:

Reconnect Columbia River flows, restore riparian/wetland ecosystem functions, and improve salmon habitat on Steigerwald Lake and associated floodplain habitat

Abbreviated Abstract

The proposed restoration project would reestablish and/or mimic Columbia River flows and reconnect Gibbons Creek to its historic Steigerwald Lake floodplain on the Steigerwald Lake National Wildlife Refuge near Washougal, Washington. The Steigerwald Lake floodplain was diked by the U.S. Army Corps of Engineers (USACE, Corps of Engineers) in 1965-1966 to provide protection to the Washougal residential, commercial, and industrial communities. The USACE would conduct a feasibility study to determine the best methods for reconnecting the Columbia River to Steigerwald Lake, providing ingress/egress for spawning salmon utilizing Gibbons Creek, and rearing areas for juvenile salmon. The current proposed action includes the following features: construction of a channel connecting Steigerwald Lake with the Columbia River, installation of a controlled inlet/outlet structure capable of passing adult and juvenile salmonids between the Columbia River and Gibbons Creek, relocation of Gibbons Creek from the elevated channel to Steigerwald Lake, construction of interior levees along the upstream and downstream boundaries of the refuge in order to maintain the current level of flood protection for those boundaries outside the refuge, removal of an estimated 1,450 lineal feet of the current elevated Gibbons Creek channel, and possible realignment of Gibbons Creek north of State Route 14. Salmon species to benefit by the proposed action include Chinook, coho and chum salmon, winter steelhead, and Coastal cutthroat trout. This project will also include topographic contouring to mimic historic conditions; restoration, enhancement and maintenance of 300 acres of seasonal and semi-permanent wetland and 60 acres of riparian forest to benefit both wildlife and listed anadromous fish by providing critical off-channel habitat; and monitoring to determine success of the various aspects of this project. The U.S. Corps of Engineers will work with staff from the Ridgefield NWR Complex, USFWS Lower Columbia River Fisheries Program, and Washington Department of Fish and Wildlife in project design and implementation. The US Geological Survey, Biological Services Division, will be responsible for fisheries monitoring, while the US Fish and Wildlife Service will be responsible for habitat and wildlife monitoring. Because project lands are currently within the Steigerwald Lake National Wildlife Refuge, long term habitat management and protection will be assured.

Relationship to Other Projects

Project #	Title/description	Nature of relationship
199003001	Evaluate Spawning for Fall Chinook and Chum Salmon Just Below the Four Lowermost Columbia River Dams.	Monitoring as part of project would assist addressing the need to survey the entire Columbia River downstream from Bonneville Dam for spawning areas outside of Ives/Pierce Island used by fall chinook, bright fall chinook, and chum salmon.
2000012	Evaluate Factors Limiting Columbia Gorge Chum Salmon Populations.	Project would provide increased rearing habitat for chum produced in Hamilton/Hardy Creeks, and benefit WA Department of Fish and Wildlife's efforts to reestablish chum salmon in other lower Columbia River tributaries.
	Sandy River Delta Plan & EIS, 1966, & Sandy River Watershed Analysis,	Project will conduct similar activities across the Columbia River from the Sandy River Delta.

Project #	Title/description	Nature of relationship
	Columbia Gorge National Scenic Area, 1995. Project will restore wetland & associated habitats, & will consider breeching levees to restore sloughs & backwater channels.	

Relationship to Existing Goals, Objectives and Strategies

Benefits of Proposed Project to Real and Prudent Alternatives (RPA's)

Benefits of the proposed project are described for the following Real and Prudent Alternatives (RPA's) from the NMFS 2000 FCRPS Biological Opinion:

RPAs.

- Action 7. The proposed Steigerwald Lake project would help meet the requirement in this RPA for habitat measures that provide offsite mitigation. This project would restore shallow water and wetland habitat along the Columbia River. In addition, Steigerwald Lake NWR is a mitigation site for the Bonneville Dam Second Powerhouse project.
- Action 152. This action calls for the Action Agencies to coordinate their efforts and support offsite habitat enhancement measures undertaken by other Federal agencies, states, Tribes, and local governments by leveraging funding resources through cooperative projects, agreements, and policy development. The proposed Steigerwald Lake Restoration project would be a cooperative project with the Corps of Engineers under its Section 1135 program.
- Action 157. This action calls for improvement and restoration of tributary and mainstem habitat for Columbia River chum salmon between The Dalles Dam and the mouth of the Columbia River. The proposed project has the potential to restore spawning habitat for chum salmon in Gibbons Creek. It will also provide rearing habitat for newly emerged chum salmon fry in both Gibbons Creek and the Columbia River.
- Action 158. This Action requires the Corps and BPA to develop an action plan to rapidly inventory estuarine habitat, …and develop criteria for estuarine habitat restoration. The proposed project would serve as an example of a restoration project that would be used to develop and refine the criteria for future estuarine habitat restoration projects.
- Action 159. The Action requires BPA and the Corps to develop a plan that addresses the habitat needs of salmon and steelhead in the estuary. Restoration of tidally affected floodplain and channels in Steigerwald Lake would serve as an example of a project that addresses several major habitat needs of anadromous fish in the estuary and lower Columbia River: reconnection of spawning and rearing habitat in tributaries with the mainstem river; restoration and reconnection of floodplain habitat with the Columbia River; restoration of rearing habitat and high flow refugia for juvenile salmonids; and restoration of macrodetritus input to the riverine/estuarine system.

- Action 160. This Action would result in development and implementation of an estuary restoration program to protect and enhance 10,000 acres of tidal wetlands and other key habitats in the lower 46 miles of the Columbia River. It also directs the Corps to seek funding for Federal share of the program and the BPA to provide funding for the non-Federal share. This project is located upstream of river mile 46, but we recommend that it be considered as part of the program to enhance tidal wetlands and other key habitats for several reasons. The Conservation of Columbia Basin Fish Basinwide Recovery Strategy for estuary protection and restoration considers the river reach from Bonneville Dam (River Mile 146) to the ocean as the Columbia River Estuary. The Lower Columbia River Estuary Program (LCREP) was accepted into the National Estuary Program (NEP) in 1995. The U.S. Environmental Protection Agency established the NEP under the authority of the Clean Water Act to protect estuaries of national significance that are threatened by degradation caused by human activity. The Clean Water Act extends the definition of estuary to include tidally influenced rivers. The LCREP defines the estuary as the mainstem Columbia River from the Pacific Ocean to Bonneville Dam at River Mile 146 because of the far-reaching effects of the ocean's tides. We also believe that it would be logical to restore habitat throughout the lower Columbia River since migrating fish must travel through the entire reach of river. The Corps of Engineers has already conducted preliminary investigations on the feasibility of this restoration project to provide the Federal portion of its funding.
- Action 161. Action 161 calls for the Corps and BPA between 2001 and 2010 to fund a monitoring and research program to address estuary objectives of the NMFS' Biological Opinion for the FCRPS. Monitoring and evaluation proposed for this project would immediately contribute to this effort by providing baseline information on fish use of the project site before restorative actions. This information would be closely coordinated with the NMFS and the Lower Columbia River Estuary Partnership to ensure that it addresses the estuary objectives.

Regional Programs

The proposed Steigerwald Lake and Gibbons Creek restoration project would address many goals, objectives, and strategies contained in Regional Programs that have been developed to recover anadromous fish in the Columbia River System.

Northwest Power Planning Council Fish and Wildlife Program

The proposed project would meet the strategies and objectives of the Northwest Power Planning Council's (NPPC) Fish and Wildlife Program.

Strategies: The Steigerwald Lake Restoration Project is designed to meet the Fish and Wildlife Program's primary habitat strategy, which is to identify the current condition and biological potential of the habitat, and then protect or restore it. Improvement of fish passage and restoration of the former stream channel will restore spawning and rearing habitat for anadromous salmonids. The proposed project will also restore floodplain rearing and refuge habitat for juvenile salmonids along the mainstem Columbia River.

Objectives:

The proposed project addresses the following NPPC provisional biological objectives for environmental characteristics at the basin level.

Objective 2. Protect and restore freshwater habitat for all life history stages of the key species. Protect and increase ecological connectivity between aquatic areas, riparian, zones, floodplains and uplands. The proposed project addresses several specific tasks that are described to meet this objective. These include: 1) increase the connections between rivers and their floodplains, side channels and riparian zones; 2) manage riparian areas to protect aquatic conditions and form a transition to floodplain terrestrial areas and side channels; and 3) reconnect restored tributary habitats to protected or restored mainstem habitats, especially in the area of productive mainstem populations. This project will increase the connection between the Columbia River and the presently isolated floodplain at Steigerwald Lake. Riparian areas will be enhanced/reestablished along the shorelines of Gibbons Creek and Steigerwald Lake. Habitat in Gibbons Creek will be improved and restored, and connected to the Columbia River to improve fish movement between the creek and the Columbia River and its floodplain.

Objective 3. Allow patterns of water flow to move more than at present toward the natural hydrographic pattern in terms of quantity, quality and fluctuation. The main task addressed by the proposed project is to allow for seasonal fluctuations in flow in an area that has been isolated from natural hydrographic changes by a flood control levee since 1966.

Objective 4. Increase energy and nutrient connections within the system to increase productivity and expand biological communities. The proposed project would address this need by reconnecting the Gibbons Creek, Steigerwald Lake, and the Columbia River. This project is also intended to replace the monoculture of reed canarygrass that dominates portions of Steigerwald Lake with a more diverse assemblage of vegetation native to the Columbia River floodplain.

Objective 5. Allow for biological diversity to increase among and within populations and species to increase ecological resilience to environmental variability. This project would maintain and enhance habitat conditions for naturally spawning populations of coho salmon, steelhead, and cutthroat trout in Gibbons Creek. It also has the potential to restore spawning habitat and access to this habitat for chum salmon, which formerly used this stream.

Objective 6. Increase genetic connections and gene flow within the ecological system to facilitate development, expansion and protection of population structures. The proposed project would help to meet this objective by increasing available spawning and rearing habitat for lower Columbia River for chum salmon.

Objective 8. Enhance the natural expression of biological diversity in salmon and steelhead populations to accommodate mortality and environmental variability in the ocean. Increased populations of coho and chum salmon and steelhead and cutthroat trout in the Gibbons Creek watershed would contribute to the biological diversity of these species in the Columbia River System.

Subbasin Habitat Priorities

The proposed project has been identified as a high priority need in the Lower Columbia River and Columbia Estuary Subbasin Summary report's Bonneville Tributaries Subbasin Stock Summary and Habitat Priorities. This report specifies the following as a high priority Restoration Action to address floodplain condition limiting factors: "Reconnect floodplain habitat in the lower end of Gibbons Creek and on the Columbia River floodplain at Steigerwald Refuge." It also includes the following as a Preservation Action for floodplain condition limiting factors: "Reconnect and preserve off-channel and side channel habitat and associated wetlands wherever they occur. Lower Gibbons Creek, Steigerwald Refuge, Franz Lake, and Grenia Creek wetlands are priorities." The proposed project is intended to address these high priority actions.

In the Research, Monitoring and Evaluation Section of the Lower Columbia River and Columbia River Estuary Subbasin Summary, the Washington Department of Ecology currently has ambient monitoring sites on major tributaries on the Washington side of the Columbia River. The Department of Ecology supports monitoring efforts along the lower Columbia River, and the project includes monitoring water quality of Gibbons Creek at various points in its watershed above where it enters Steigerwald Lake.

The Steigerwald Lake project has been designated a medium priority need to address the Biological Processes limiting factors. The Priority Restorative Action recommended for lower Gibbons Creek is to remove invasive, non-native vegetation and replace it with native species. The proposed project would provide for greater capability to manage the Steigerwald Lake wetlands to favor native species of plants and to reduce the presence of reed canarygrass. This would be accomplished by, among other actions, increasing the period of deeper inundation of Steigerwald Lake, which would reduce the area with favorable shallow water conditions for reed canarygrass.

The Bonneville Tributaries Subbasin – Limiting Factors Analysis, Washington State Conservation Commission, 2000. This analysis notes that there is a limited amount of lower gradient habitat for spawning and rearing of anadromous salmonids in tributaries between Bonneville Dam and Portland. This report indicates that railroads, State Route (SR) 14, dikes, and other artificial structures have reduced or eliminated access to some of the most productive habitat within the Subbasin, and have reduced overall habitat quality. The proposed relocation of Gibbons Creek would reestablish lost habitat on the upstream side of SR 14. Fish passage for anadromous fish, especially chum salmon, into Gibbons Creek would be improved.

The limiting factors analysis also highlighted the limited amount of low gradient floodplain and side-channel habitat available within the Bonneville tributaries subbasin. Transportation corridors and other development along the Columbia have reduced or eliminated already limited floodplain habitat in many of these stream systems. The Steigerwald Lake restoration project would reestablish the connection between a diked and isolated floodplain area and the Columbia River.

Conservation of Columbia Basin Fish Basinwide Recovery Strategy

The Conservation of Columbia Basin Fish Basinwide Recovery Strategy for estuary protection and restoration includes a floodplain restoration component. This identifies removal of structures that inhibit the restoration of floodplain habitat as a means to achieve

this goal. Partial removal of the levee that now isolates the Columbia River floodplain at Steigerwald Lake would meet this part of the Action Plan. It should be noted the river reach from Bonneville Dam (River Mile 146) to the ocean is considered as the Columbia River Estuary in the Basinwide Recovery Strategy.

Lower Columbia River Estuary Program

The Lower Columbia River Estuary Program (LCREP) Management Plan includes 43 actions for the Lower Columbia River Estuary. This Management Plan includes the following habitat related actions that are relevant to the proposed Steigerwald Lake Restoration project: 1) Protect, conserve and enhance identified habitats, particularly wetlands, on the mainstem of the lower Columbia River; 2) Restore 3,000 acres of tidal wetlands along the lower 46 river miles to return tidal wetlands to 50% of the 1948 level; 3) Monitor the effectiveness of habitat protection, restoration and mitigation projects.

The proposed project would help meet the goal of protecting, conserving and enhancing wetlands along the mainstem lower Columbia River by returning the diked and isolated area at Steigerwald Lake to its former condition, which included tidal channels and emergent marsh. Although Steigerwald Lake is located upstream of River Mile 46, we believe that restoration of tidal channels and wetland habitat at this site will benefit anadromous fish resources by providing rearing habitat and a refuge from high flows for juvenile fish.

Review Comments

Portions of this project were originally funded through the Washington Wildlife Agreement. NMFS has identified that this project is a BiOp project.

Budget

FY02	FY03	FY04
$373,000 Category: High Priority	$384,000 Category: High Priority	$921,000 Category: High Priority

Project: 31034 - Salmonid Population and Habitat Monitoring in the Oregon Portion of the Lower Columbia Province

Sponsor: Oregon Department of Fish and wildlife (ODFW)

Short Description:

Implement fish population and habitat monitoring (EMAP) in the Oregon portion of the Lower Columbia Province

Abbreviated Abstract

A coordinated and integrated approach to the monitoring and evaluation of status and trends in anadromous and resident salmonid populations and their habitats is needed to support and evaluate restoration efforts in the Lower Columbia Province. Currently, independent research projects and some monitoring activities are conducted by various state and federal agencies and to some extent by watershed councils or landowners, but there is no overall framework for coordination of efforts or for interpretation and synthesis of results. We propose that the structure and methods employed by the Oregon Plan for Salmon and Watersheds Monitoring Program (Nicholas, 1997a; 1997b; 1999) be extended to Oregon's portion of the Lower Columbia below Willamette Falls (Willamette, Sandy, Lower Columbia Subbasins). This approach, successfully implemented in Oregon's coastal watersheds, applies a rigorous sampling design to answer key monitoring questions, provides integration of sampling efforts, and has greatly improved coordination among state, federal, and tribal governments, along with local watershed groups. ODFW proposes to monitor the status, trends, and distribution in adult coho and steelhead populations, juvenile salmonids populations, and the habitats they depend on at the Provincial and Subbasin scales. The proposed project is high priority based on the elevated level of emphasis the NWPPC Fish and Wildlife Program and Subbasin Summaries, NMFS 2000 FCRPS Biological Opinion, and the Oregon Plan for Salmon and Watersheds have placed on monitoring and evaluation to provide the real-time data to guide restoration and adaptive management in the region.

Relationship to Other Projects

N/A

Relationship to Existing Goals, Objectives and Strategies

The program described in this proposal is consistent with and supports the monitoring needs specified by the amended NWPPC's Columbia Basin Fish and Wildlife Program and Subbasin Summaries, NMFS 2000 FCRPS Biological Opinion, and the Oregon Plan for Salmon and Watersheds. The Fish and Wildlife Program (Chapter 9) calls for monitoring and evaluation of biological and environmental conditions at the scale of provinces and subbasins. The subbasin summaries this proposal addresses (Lower Columbia, Sandy, Willamette) all call for a framework for the coordination and integration of monitoring

efforts and increased monitoring of the status trends in anadromous and resident fish populations and habitats in their respective "Fish and Wildlife Needs" sections. The proposed monitoring program will provide a framework for improved coordination and integration of monitoring efforts. ODFW will monitor and evaluate the status and trends in fish populations (abundance and distribution) and habitat (quantity and quality) at the Province (Oregon Portion) and Subbasin scales. The purpose of the monitoring and evaluation program is to assure that the effects of actions taken under sub-basin plans are measured, that these measurements are analyzed so that we have better knowledge of the effects of the action, and that this improved knowledge is used to choose future actions.

This proposal addresses several action items under the NMFS 2000 FCRPS Biological Opinion. In Section 9.6.5 Research, Monitoring, and Evaluation Plan, the Reasonable and Prudent Alternatives (RPA) require that a comprehensive monitoring and evaluation program be developed to determine the effectiveness of the suite of actions called for under the RPA. The RPA proposes that research, monitoring, and evaluation must address five areas: population status monitoring, environmental status monitoring, effectiveness monitoring, quality of regional databases, and compliance monitoring. The monitoring program described in this proposal will address population status monitoring and the habitat component of environmental status monitoring. Action 174 (Reform of Artificial Propagation) is supported by developing estimates of the abundance and distribution of hatchery fish in natural production areas through counts of adult salmon spawners or redds. Action 180 (Population Status and Environmental Status Monitoring) is fundamentally supported by ODFW's proposed monitoring program. ODFW's monitoring program contains all of the essential elements of NMFS framework for monitoring. Action 184 (Hatchery Reform Monitoring) is partially supported by the proposed monitoring program by estimating the distribution and abundance of adult hatchery fish on spawning grounds Under the Oregon Plan (Coastal Salmon Restoration Initiative, Steelhead Supplement, Executive Order No. EO 99-01) monitoring is one of the four essential elements to implement the Plan. ODFW's monitoring proposal for the Lower Columbia Province Project Selection is consistent and complimentary to the program ODFW has implemented in coastal watersheds. This proposal also supports the implementation of the Oregon Plan statewide for all salmonids at-risk throughout the state.

Review Comments

The cost appears excessive. Could the budget be reduced? This level of effort should be well coordinated with other monitoring efforts throughout the Basin. NMFS has identified that this project is a BiOp project.

Budget

FY02	FY03	FY04
$532,648 Category: High Priority	$559,280 Category: High Priority	$587,244 Category: High Priority

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