U.S. Department of the Interior Bureau of Land Management

Anadromous Fish Habitat Management

Fish & Wildlife 2000

National Strategy Plan Series

Fish & Wildlife 2000

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Waterfowl Habitat Management
Wetlands Environment Today & Tomorrow
Desert Bighorn Sheep Habitat Management
Raptor Habitat Management
Watchable Wildlife
Neotropical Migratory Bird Habitat Conservation
Upland Game Bird Habitat Management
Big Game Habitat Management

Threatened/Endangered Species

Desert Tortoise Habitat Management
Special Status Plant Management
Special Status Fishes Habitat Management

Administrative

Wildlife and Fisheries Information System
Career Management Team Findings for Wildlife and Fisheries Biologists
Training BLM Wildlife and Fisheries Program Personnel
Staffing for the BLM Wildlife and Fisheries Program

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Anadromous Fish Habitat Management on Public Lands

A Strategy for the Future

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Introduction and Purpose

The salmon and steelhead fisheries of the Pacific Northwest are widespread, diverse, and economically significant. Eight species of anadromous salmonids spawn and rear in streams extending from the McKenzie River in northwestern Canada to central California. These fisheries provide employment for thousands of workers in the commercial fishing industry and support an extremely popular sport fishery. Large numbers of salmon are also harvested by Native Americans for subsistence and ceremonial purposes.

Historically, the Pacific Northwest (including Alaska) has been the best salmon and steelhead producing region in the world. Since the 1870's, however, the numbers of these anadromous species have steadily declined. Overharvest of certain fish stocks has been one of the major factors in this decline. Also, the original productivity of many rivers and tributary streams has been substantially reduced due to man's activities and land uses. Construction of hydroelectric and irrigation dams have blocked anadromous fish migrations to spawning and rearing areas. Timber harvest, agricultural development, channel alterations, road building, mining, and dredging and filling of estuaries have all contributed to reduced productivity of anadromous fish habitat.

The Bureau of Land Management (BLM) administers nearly 13,000 miles of spawning and rearing streams for salmon and steelhead trout in five States: Alaska, California, Idaho, Oregon, and Washington (Table 1 and Maps 1-4). Over 58 million pounds of fish spawned on BLM-managed streams are harvested annually by commercial fishermen at a current market value of $40 million. Based on BLM "willingness to pay" statistics and the 1985 National Survey of Hunting and Fishing, over 1.5 million days of recreational fishing takes place each year on BLM lands in these five states worth $24 million in primary benefits to fisherman.

Considerable effort has been expended in the past 20 years to maintain and increase natural production of anadromous fish spawned and reared on Bureau lands, especially in western Oregon. However, these efforts have not been well coordinated as part of a Bureauwide fisheries program. In 1987, the BLM Anadromous Fish Habitat Team was formed to develop a strategy to guide future management actions of the Bureau. This report, which was prepared by the Team, describes anadromous fish resources on public lands, summarizes current management, and outlines a twelve year program (FYs 1989-2000) to maintain, protect, and enhance anadromous habitats through specific management actions and habitat improvement projects. By fully

Table 1 *Anadromous Fish Habitat on Bureau Lands*

State	Miles of Habitat	Major Species
Alaska	10,000*	Chinook, sockeye, chum and pink salmon, steelhead trout, char, cisco, whitefish
California	190	Chinook, coho, steelhead
Idaho	1,300	Chinook, sockeye, steelhead
Oregon	1,432	Coho, chinook, chum, steelhead, sea run cutthroat trout
Washington	51	Steelhead, chinook
Total	**12,973**	

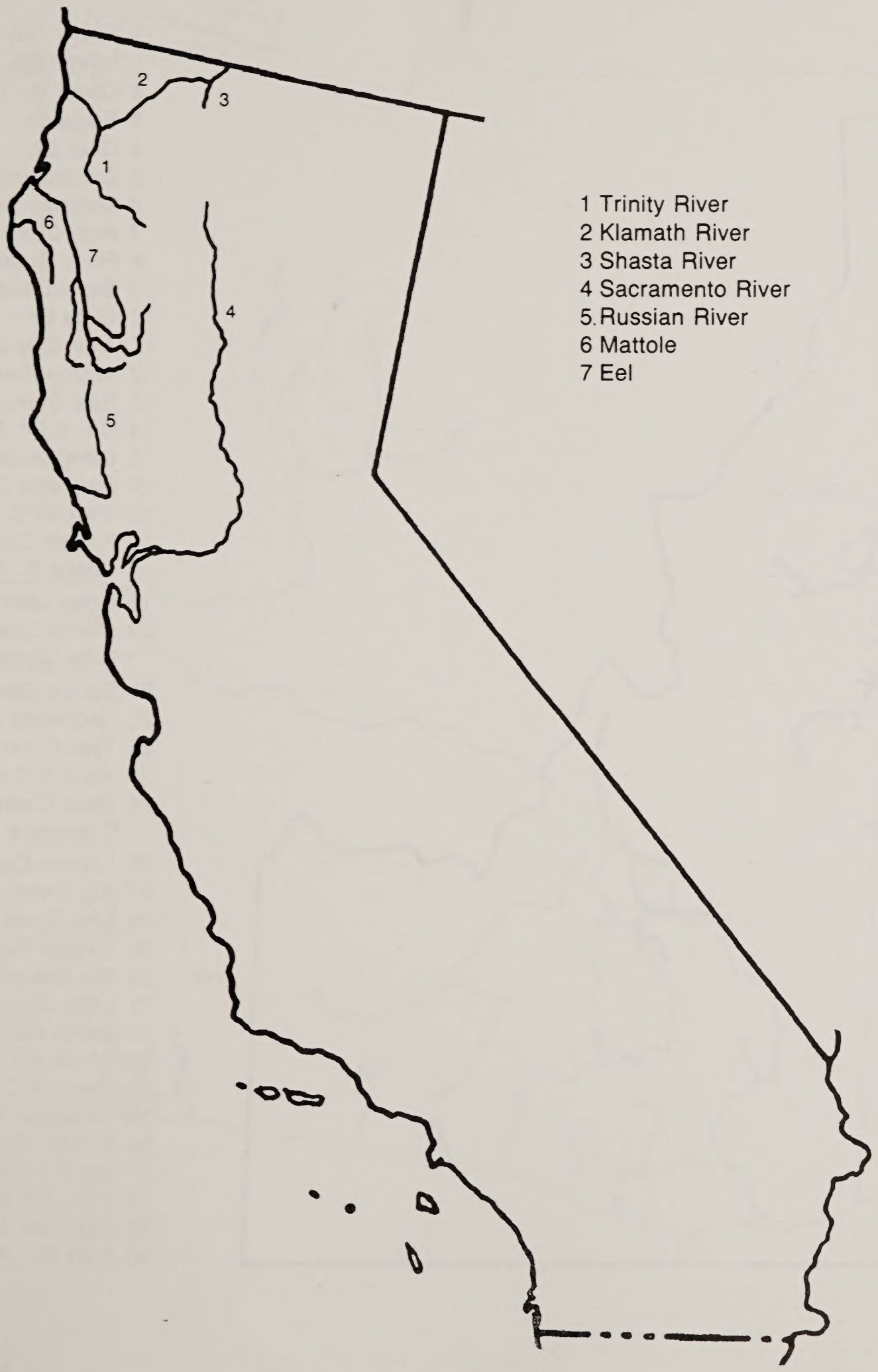
* Actual inventory data of Alaska streams is not available. Estimate of stream miles derived from a variety of sources.

Major BLM Anadromous Fish Streams in Alaska

1 Sagavanirktok
2 Coleville
3 Ikpikpuk
4 Meade
5 Utukok
6 Fish
7 Tubutulik
8 Kuzitrin
9 Koyuk
10 Inglutalik
11 Ungalik
12 Shaktoolik
13 Kateel
14 Honhosa
15 Gisasa
16 North
17 North Fork
18 Chiroskey
19 Old Woman
20 Unalakleet
21 Golsovia
22 Otter Cr.
23 Anvik
24 Yellow
25 Bonasila
26 Tuluksak
27 George
28 Middle Fork
29 Windy Fork
30 Big Salmon Fork
31 S. Fork Koyukuk
32 Jim
33 N. Fork Koyukuk
34 Black
35 Beaver Cr.
36 Gulkana
37 West Fork
38 Middle Fork

Map 1

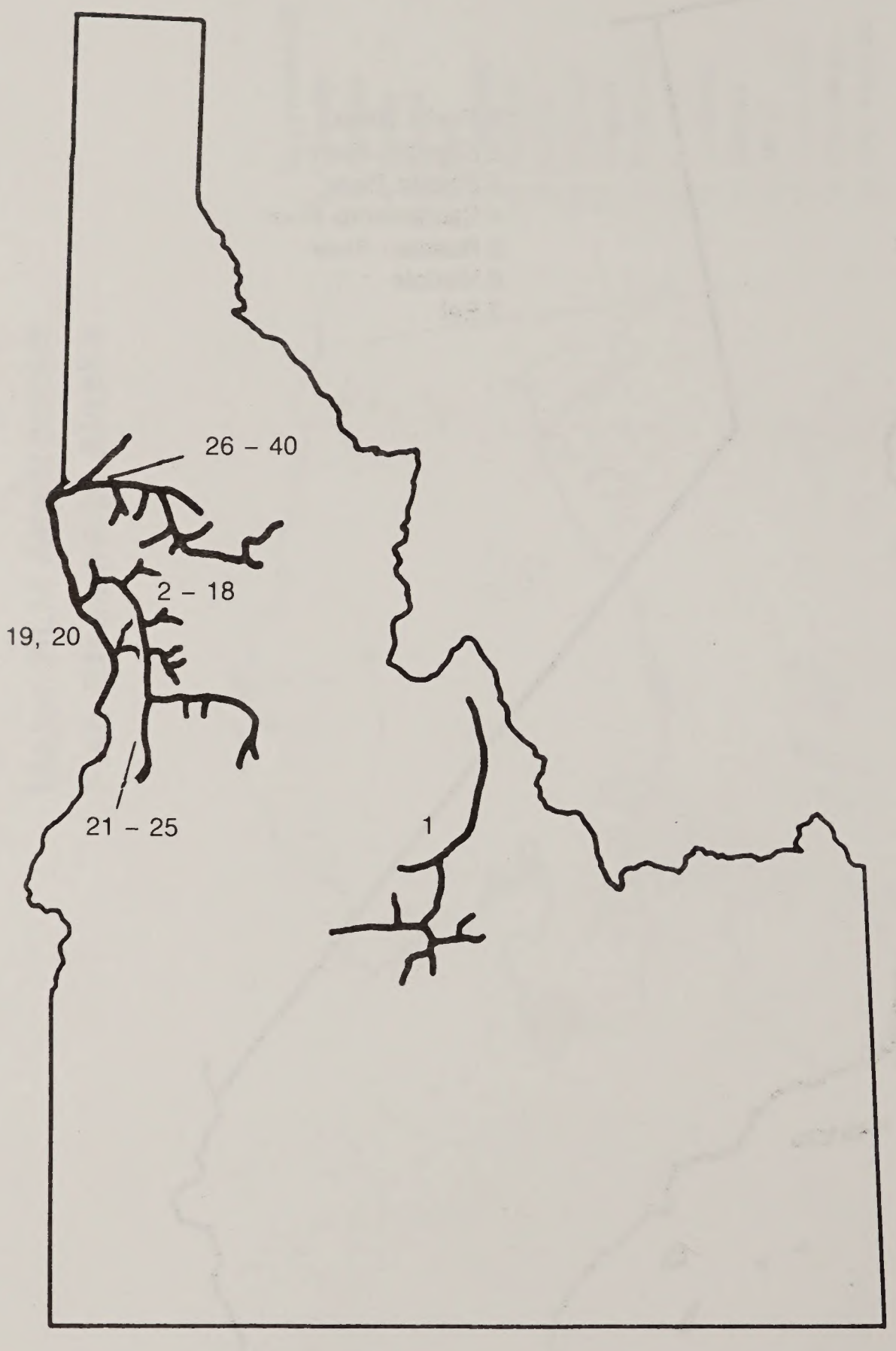
Major BLM Anadromous Fish Stream in Northern California



1 Trinity River
2 Klamath River
3 Shasta River
4 Sacramento River
5. Russian River
6 Mattole
7 Eel

Map 2

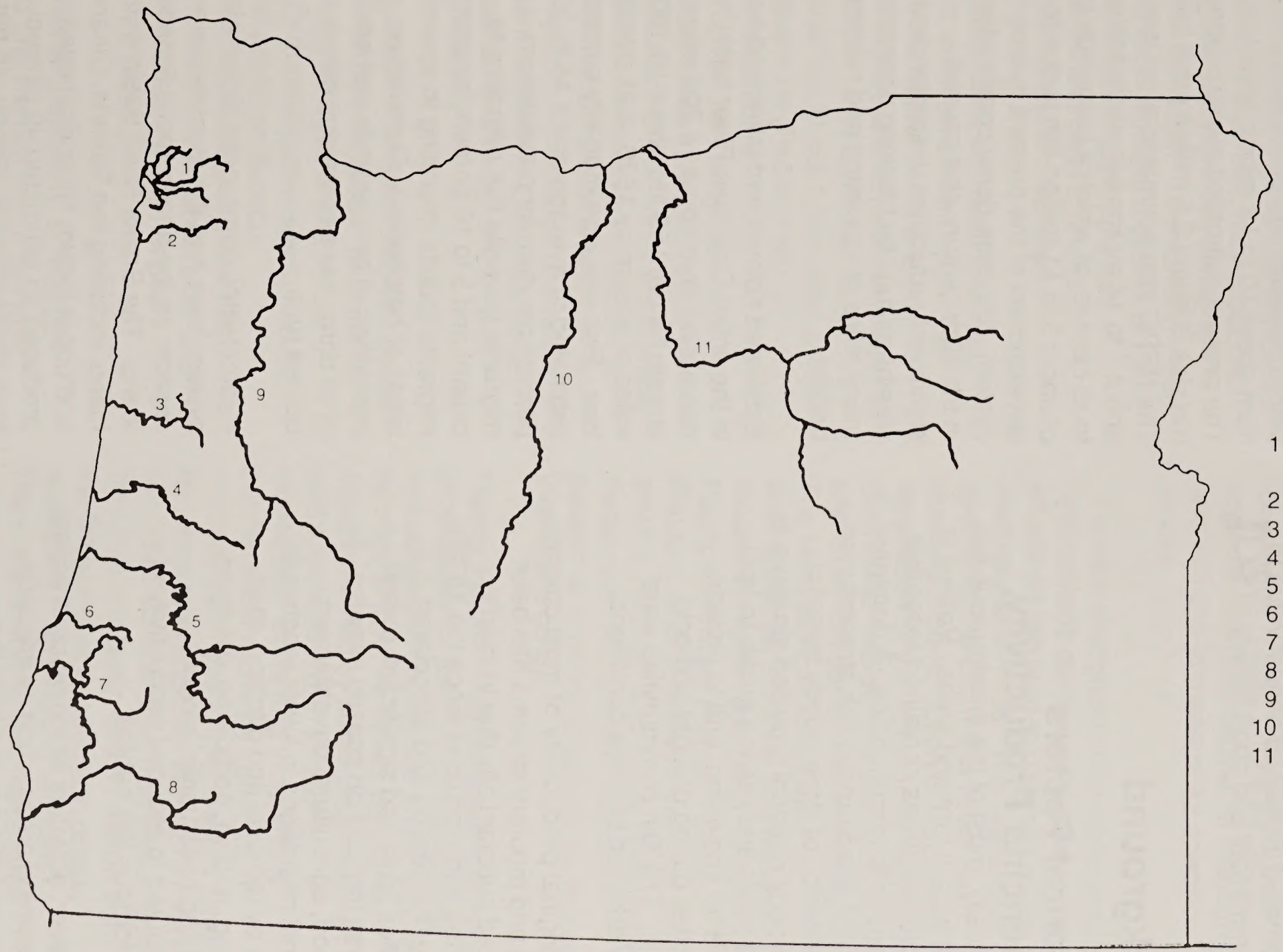
Major BLM Anadromous Fish Streams in Idaho



1 Upper Salmon R. Tribs.
Lower Sal. R. Tribs.
2 China Cr. I
3 Eagle Cr.
4 Deer Cr.
5 Cottonwood Cr.
6 Maloney Cr. (West)
7 Rice Creek
8 Rock Creek
9 Skookumchuck Cr.
10 Slate Cr.
11 John Day Cr.
12 Middle Fork, JDC
13 East Fork, JDC
14 China Cr. II
15 Lake Creek
16 Partridge Creek
17 Elkhorn Cr.
18 French Crk.
Snake R. Tribs:
19 Chap. John Cr.
20 Divide Creek
Little Salmon R. Tribs:
21 Squaw Creek
22 Lockwood Cr.
23 Trail Creek
24 Hazard Creek
25 Hard Creek
Clearwater R. Tribs:
26 Lapwai Creek
27 Big Creek
28 Lolo Creek
29 Lawyer Creek
30 Big Canyon Cr.
31 Little Canyon Cr.
32 South Fork
33 Whiskey Creek
34 Maurice Creek
35 American River
36 Buffalo Gulch Cr.
37 Big Elk Creek
38 Little Elk Cr.
39 Kirk Fork Cr.
40 East Fk., Amer.

Map 3

Major BLM Anadromous Fish Streams in Oregon



1 Tillamook Bay Tributaries
2 Nestucca
3 Alsea
4 Siuslaw
5 Umpqua
6 Coos
7 Coquille
8 Rogue
9 Willamette
10 Deschutes
11 John Day

Map 4

implementing this plan, the Bureau has the opportunity and capability to increase the number of anadromous fish from public lands by 20 percent, resulting in an estimated increased annual value to the commercial and sport fishery of $4.1 million.

Background

Historical Factors Influencing Productivity

Historically, most of the anadromous fish habitat was in forested areas. Valleys in non-forested areas contained extensive riparian forest communities. A dominant feature of anadromous fish streams was the presence of large woody material. This woody material provided structure to create pools and rearing areas, to hold gravels for spawning, and to provide protection during drought and cold winters. The fish communities were highly adapted to these conditions.

The original productivity of most coastal rivers and tributary streams has been reduced substantially due to man's activities and land uses since the 1870's. Timber harvesting and associated activities have had significant overall adverse impacts on coastal streams. In addition, agricultural development, channel alterations in lower reaches of rivers by removal and ditching, road building, mining, and diking, dredging and filling of estuaries have all contributed to reduced productivity of anadromous fish habitat.

However, activities which blocked access to spawning areas, such as irrigation diversions, mining, and later the construction of hydroelectric dams throughout the Columbia Basin since the late 1930's, have had the greatest impact on natural production of anadromous fish. The Northwest Power Planning Council (NPPC) estimated average annual salmon and steelhead runs before development of the basin ranged from about 10 to 16 million adult fish. The present estimated average annual run size is about 2.5 million adult fish. The NPPC also estimated a net loss of about 7 to 14 million fish attributable to all causes, of which a basinwide loss of about 5 to 11 million fish is due to development of the present hydropower system. Irrigation dams constructed early in the 20th century also caused significant reductions in salmon and steelhead runs by blocking access to many miles of spawning and rearing habitat.

Estimated salmon and steelhead habitat in the entire Columbia River basin has decreased from about 14,700 miles of stream before 1850 to about 10,100 miles of stream by 1976, a 31 percent loss. Fish passage mortality currently is estimated to average about 15 to 30 percent per dam for downstream migrants (juvenile fish migrating to ocean) and 5 to 10 percent for upstream migrants (adults migrating to spawning areas or hatcheries). Cumulative mortalities of both juvenile and adult fish at all dams have enormous effects on upriver runs.

Hydroelectric dams in the Columbia River system have had the most detrimental impacts on the anadromous fisheries in Idaho. The Snake River Basin within Idaho, including the Salmon, Clearwater, and upper Snake River drainages, once produced an estimated 40 percent of the total spring chinook salmon, 45 percent of the total summer chinook salmon and 55 percent of the total summer steelhead trout in the Columbia River Basin.

Substantial numbers of sockeye and fall chinook and lesser numbers of coho also were produced. By the late 1970's, naturally produced stocks of salmon and steelhead appeared to be headed toward extinction in Idaho. Hatchery-produced anadromous fish were in a similarly depressed condition. This condition lead to severe restrictions or closures of Idaho fisheries. Popular sport fisheries disappeared and local economies dependent on tourism suffered.

Prior to water developments in central California, chinook salmon spawning habitat in the Sacramento and San Joaquin Rivers systems, was estimated at 6,000 miles. Dams currently block access to all but about 1,000 miles of spawning stream (Pacific Fishery Management Council, 1979). Construction of the Trinity Dam in northern California and diversion of about 85 percent of the Trinity River water into the Sacramento River resulted in a drastic reduction of anadromous fish in that river system. In addition to dams, BLM stream habitats in California have been impacted by mining, timber, and grazing practices.

In Alaska, anadromous fish habitats have been detrimentally impacted primarily by placer mining operations and timber harvest. Fortunately, damage to habitat is not widespread on Bureau-administered lands because most fish producing streams are inaccessible and overall fish production has not been appreciably affected.

Past Management Efforts

Initially, no one worried about fish runs, since they seemed so abundant. However, as runs declined and demand for fish continued, concerns for stocks began. States initiated controls over harvesting, both in seasons and methods. Facilities at dams were constructed to provide for better fish passage. Hatchery production was developed. Later, efforts began to improve instream habitat, to manage for wild fish and to manage for specific stocks.

The early recognition that construction of hydroelectric dams would have adverse effects on fish lead to passage of the Mitchell Act in 1938. This legislation, specific to the Columbia River Basin, resulted in construction of hatcheries, installation of fish screens in migration diversions, habitat improvement projects and other fish conservation measures. The Mitchell Act also allowed for investigations, surveys, and experiments. Since then other legislation, including the Pacific Northwest Electric Power Planning and Conservation Act of 1980 and the Klamath and Trinity River Basin Restoration Act of 1986, has been passed to enhance anadromous fish over their entire range.

During the last three decades, hatchery propagation of salmon and steelhead has continued to produce an increasing number of juvenile fish to supplement stocks affected by substantial declines in wild populations due to habitat alterations. State and federal fish hatcheries and private aquaculture releases of smolts (migrant-sized juvenile fish) now total approximately 219 million fish (1983-85 average); 158 million from the Columbia basin and 61 million from the Oregon and Washington coasts (excluding Puget Sound releases). There are concerns that these large releases of hatchery fish may "dilute" the genetic quality of naturally reproducing salmon. Therefore, State fish managers are attempting to achieve desired harvest

of surplus hatchery adults while trying to protect low populations of wild fish. The large releases of hatchery fish are expected to continue in future years.

Considerable effort has been expended in the last 30 years by state and federal resource agencies and other organizations to maintain and increase natural production of anadromous fish in the Columbia basin and coastal rivers. Stream clearance of logging debris to maintain fish production in historic areas was the major activity in coastal streams. Providing fish passage at natural waterfalls by constructing fishways or blasting jump pools was another type of project that was commonly done to obtain production from formerly inaccessible areas. Relatively few instream habitat enhancement projects were done prior to 1970 because log jam removal and fish passage projects were considered highest priority.

There has also been increased awareness of fisheries and watershed values, and corrective actions have been taken in many instances to protect fish habitat. Early logging practices did not provide for protection of habitat. Erosion was widespread. Much woody debris accumulated in stream, often causing massive jams, silting in habitat, and blocking access for fish. Cleaning of streams was initiated to relieve some of the problems. However, it was carried to the point where some desirable habitat was removed. Now biologists realize the importance of the woody material for fish, and management for woody material is part of our overall habitat management. Some stream habitat improvement work is performed to replace the lost structural materials.

Since the mid 1970's streams have received more protection due to State Forest Practices Acts adopted by Oregon, California, and Washington. In addition, land use allocations and forest management guidelines have been revised by BLM, the Forest Service, and various state agencies to give more consideration and protection to anadromous fish habitats. For example, vegetative strips are routinely left along fish-bearing streams to protect values associated with riparian areas. Practices that might degrade water quality and fish habitats, such as yarding logs through streams, are prohibited. Roads are now designed to minimize the potential for erosion and sedimentation of fish-bearing streams.

The Pacific Northwest Electric Power Planning and Conservation Act of January 1980 (P.L. 96-501) is the most recent, highly significant legislation to provide for enhancement of fish runs in the Columbia River basin. The Act established the Northwest Power Planning Council, (NPPC) which has the responsibility to develope a program to protect and rebuild fish and wildlife of the Columbia River Basin that have been affected by hydroelectric development and operations. This program is funded by Bonneville Power Administration (BPA), and about 25 million dollars was allocated for fish and wildlife habitat improvement projects in FY 1986.

BLM Habitat Improvement Efforts

The BLM, as a land and resource management agency, has the responsibility to maintain and improve habitat conditions for fish populations located on the public lands. State fish and wildlife agencies are responsible for managing fish populations within state waters. Over the past 20 years, many cooperative endeavors between the

Bureau and state agencies relating to salmon and steelhead management and habitat improvements have occurred (e.g., Memorandum of Understandings (MOU's), Cooperative Management Agreements (CMA's), and Sikes Act Habitat Management Plans (HMP's)).

Oregon. The Bureau has had an active fish habitat improvement program in Oregon for the last 15 years. The program has progressed from primarily log/debris jam clearance work and fish passage projects to instream construction to improve or create spawning and rearing areas. A substantial amount of habitat work was done during FY 1981 when about $350,000 was spent for 34 projects to improve habitat conditions and increase subsequent fish production in 50 miles of coastal streams. Because of this past work, relatively few log jam removals or small waterfall passage projects remain to be done on Bureau lands.

During the early 1980's, stream inventories, low catches by coastal fisheries and poor returns of adult spawning coho salmon indicated coastal streams were producing far below full capability due to various factors limiting production. The concerns of many people about the severe economic consequences of depressed wild coho populations resulted in congressional funding to plan and design fish habitat improvement projects on BLM lands in coastal streams during FY 1985. As a result, the "Five-Year Comprehensive Anadromous Fish Habitat Enhancement Plan for Oregon Coastal Rivers" was developed. Anadromous fish habitat projects that could be expected to be accomplished over a 5-year period with no increase in the basic workforce were identified to correct specific factors limiting production of wild anadromous fish populations. The Bureau received $475,000 in FY l986 and $485,000 in 1987 to complete priority projects listed in the five-year enhancement plan. In 1987, the productivity of 14 miles of habitat will be increased by the construction of 600 instream structures, 76 rearing pools, 5 off-channel developments, and one fish passage project. Much of the labor for these projects will be contributed by volunteers from local sportsman groups, Boy Scout troops, and colleges.

BLM-Oregon obtained about $130,000 from BPA for habitat improvement projects to increase wild steelhead production in the John Day River basin during 1983-86. At the present time, BPA is also evaluating for funding barrier removal projects on BLM streams in Idaho.

California. The most significant areas of BLM administered anadromous fish habitat in California are in the Trinity and Mattole River Basins. Public lands in the Trinity River Basin includes about 20 miles of the main Trinity River and 21 miles of its tributaries. Because of the construction of Trinity River Dam in 1963 and diversion of about 85 percent of the Trinity River water into the Sacramento River, a corresponding loss in anadromous fish resources occurred. In 1974, the Trinity River Basin Fish and Wildlife Task Force became active and among other accomplishments developed a comprehensive action plan in 1982 for restoration of the river. The BLM has been an active member of this 14-agency task force. The 1982 program was planned to cover a 10-year period, but funding was piecemeal until 1986, when the entire program was implemented under authority of the Trinity River Basin Fish and Wildlife

Management Program Act (PL-98-541) at an estimated cost of $57 million.

The Bureau also manages the Mattole River estuary and a major sub-basin which contains over 40 miles of tributary streams. Fisheries enhancement objectives for these streams and the estuary have been developed under the authority of the King Range Act. As a result, many specific enhancement actions have been completed by the Bureau, California Department of Fish and Game, California Conservation Corps, local conservation groups, and Humboldt State University. Major BLM fish enhancement projects were started on Indian Creek and Dry Creek in 1968 and on the Trinity River in 1969-70. In all, approximately $400,000 in labor and materials have been expended over the past twenty years on habitat improvement efforts on BLM administered sections of the Shasta River, Weaver Creek and streams in the Kings Range.

Alaska. To date there have been very few habitat improvement projects initiated in Alaska. Efforts have been confined to providing salmon spawning areas in tailing channels left by placer mining activities and improving flows for salmon migrations to spawning areas upstream from mining operations.

Idaho. Habitat management in Idaho has emphasized inventory of fish populations in tributary streams, determining minimum flow requirements, establishing fisheries habitat and water quality/quantity levels for streams threatened by small hydro projects, identification of migration barriers, construction of instream structures including gabions, bank stabilization, habitat rocks, and fencing to control livestock access in stream riparian areas.

Need for Action

Economic and Social Significance

Commercial Values. The gross market value of salmon harvested commercially in the north Pacific Ocean has ranged in recent years from $300-400 million (Huppert et. al, 1985). Although these fish are not harvested on Bureau lands to any significant degree, the Bureau does administer important spawning and rearing streams, and therefore contributes to the numbers of anadromous fish harvested by all user groups. For example, in the Arctic Region of Alaska, where commercial fishing is the primary source of income for residents of the coastal communities, an estimated 70 percent of the salmon harvested spawn and rear in streams administered by the Bureau. Spawning and rearing habitats in Oregon, Washington and Idaho are vital to maintain the salmon and steelhead fishery in the Columbia River system, where an extensive system of hatcheries have been established to augment natural production. In all, it is estimated that at least 10 percent of the salmon and steelhead harvested commercially were spawned and reared in streams administered by the Bureau (calculated from Public Lands Statistics, 1983).

Sport Fishery Value. Sport fishing is second only to swimming as the most popular leisure time activity in America. Sixty million anglers spend nearly 28.2 billion dollars annually in pursuing their sport (1985 National Survey of Fishing, Hunting, and Wildlife Associated Recreation). Demand is expected to increase 90 percent by the year 2030. In Washington, California, and Oregon, an estimated $186 million dollars are

expended for salmon and steelhead fishing trips. Over 1.5 million days were spent by anglers fishing Bureau administered streams for game fish species in the five states included in this report. Based on what anglers were willing to pay for their fishing trip, this amounts to a total of $24 million.

Steelhead fishing, by both residents and nonresidents, has become extremely popular in Idaho due to high numbers of returning hatchery stock. This improved angling has helped relieve pressures of depressed timber markets on a number of northern Idaho communities.

Sport fishing opportunities and harvests are limited on Bureau lands in Alaska primarily because most streams are accessible only by air. In spite of this, angling has more than doubled in some areas during the past ten years, and a major shortfall in sport salmon catches is predicted by the year 2002 for the Gulkana River, the most heavily fished stream administered by BLM in the state. In addition, enactment of the Alaska Native Claims Settlement Act has resulted in many previously public streams becoming unavailable for public access and therefore more sport fishing pressure is expected on the remaining Bureau streams.

Subsistence. Subsistence fishing is important for residents of Alaska and for Native Americans in certain areas of Washington, Oregon, California and Idaho. Federal courts have established historical fishing rights and allocated fish to Native Americans for subsistence, ceremonial, and commercial purposes, e.g., Columbia River Basin, Puget Sound. Fishing rights on the Klamath-Trinity Rivers systems are currently in litigation; but Native Americans have historically harvested about 10 percent of the available stock.

The Alaska National Interest Lands Conservation Act (ANILCA) gives subsistence users preference over other users groups. In general, there are enough fishery resources to satisfy the demands of all user groups. However, in some areas of the State, allocation of anadromous species has been an issue. The relative importance of anadromous fish varies depending upon the region and the location of the village in rural Alaska. But consumption of wild animals and fish by residents in three villages ranged from 738 lbs. to 968 lbs., which compares to the national consumption of meat/fish/poultry of about 255 lbs. Fish, primarily anadromous species, was the largest single food item consumed by residents of two of the villages.

Scientific Values. It is important to provide spawning and rearing habitat for anadromous fish so that the diversity and natural characteristics (i.e., resistance to disease, timing of runs, adaptation to local conditions, etc.) of the wild stocks can be preserved. There is widespread concern that hatchery stocks are depressing the populations of natural stocks, as well as adversely affecting their genetic diversity.

Wild steelhead and salmon are classified as a species of special concern by the Idaho Department of Fish and Game and there is a movement to have these fish listed by U.S. Fish and Wildlife Service (FWS) as a threatened species. Such status could have major effects on fishing, dam operation, and BLM land management activities. It is therefore to the advantage of all concerned to ensure that populations do not fall to the level requiring federal listing.

Legislation and Policy. The following laws, Memoranda of Understanding (MOUs), and cooperative agreements pertain to management of anadromous fish habitat on Bureau administered lands:

- Federal Land Policy and Management Act of 1976.
- Sikes Act of 1960.
- Master MOUs between BLM and State fish and wildlife agencies.
- The King Range Act of 1970.
- The O&C Act of 1937.
- The Mitchell Act of 1938.
- The Pacific Northwest Electric Power Planning and Conservation Act of 1980.
- The Trinity River Basin Fish and Wildlife Management Program Act of 1984.
- The Klamath and Trinity River Basins Restoration Act of 1986.
- The Alaska Native Claims Settlement Act of 1971.
- Alaska National Interest Lands Conservation Act of 1980.

Goals and Objectives

In May 1987, the BLM Director approved "Fish and Wildlife 2000: A Plan for the Future." This document, which received extensive public and internal review and comment, sets forth goals, objectives, and strategies for more efficient management of fish and wildlife resource on public lands. The following goal and objectives were established for anadromous fish habitats:

Goal. Protect and enhance the potential of anadromous fish streams in Pacific Coast drainages so as to further contribute to the public use and enjoyment and to the economic stability of local communities and to the recreational and commercial fishing industry.

Objectives

1. Identify, where it has not already been done, streams that support anadromous fish at the State, District, and Resource Area levels in California, Oregon, Idaho, and Alaska.
2. Increase habitat productivity in streams currently utilized by anadromous fish but producing below potential.
3. Increase the amount of habitat available for producing anadromous fish, especially wild stocks, by completing fish passage projects as stated in fisheries activity plans.
4. Develop interagency habitat management plans for watersheds in California, Oregon, Alaska and Idaho.

Anadromous Fish Team Recommendations. To implement the general goals and objectives in "Fish and Wildlife 2000", the BLM Anadromous Fish Habitat Team developed the following strategy and recommendations to be achieved in the next twelve years (1989-2000):

1. By 1994, inventory and evaluate 3,480 miles of anadromous streams on public lands in Oregon, Washington, California, Alaska, and Idaho for habitat condition and improvement potential.

2. By 2000, improve 464 miles of anadromous streams through development of new habitat improvements and maintenance of existing projects.

3. Enhance or protect all anadromous streams on public lands by implementing land management practices.

4. Prepare HMPs for management of anadromous fish habitats, and develop 15 cooperative habitat management agreements/plans on high priority watersheds in cooperation with major landowners and government agencies and private interest groups.

5. Monitor high priority anadromous fish habitats to provide managers with timely and adequate information needed to make land use allocation decisions.

6. Conduct or support research and studies needed to improve management of anadromous fish habitats and determine the effectiveness of habitat improvements.

7. Acquire 86 miles of important anadromous fish habitat through exchange or other means.

Program Features and Benefits

This section describes the management actions and habitat improvements needed to implement the above objectives. Estimates of the work years, cost and program accomplishments were provided by Resource Area and District biologists in each State and are totals for the 12-year period (1989-2000). These estimates are for additional work that cannot be accomplished with present resources (dollars and people). Excluded from this plan are those projects listed in the "Five-Year Comprehensive Anadromous Fish Habitat Plan for Oregon Coastal Rivers". This plan identified opportunities to improve 177 miles of anadromous fish habitat administered by BLM on the Oregon Coast at an estimated cost of $2.6 million.

Inventory & Evaluation (Objective 1)

Program Features. Inventory information provides the foundation for land use and activity planning, monitoring, and habitat improvement work. In general, baseline inventory information has been collected for most of the major streams in Oregon, California, and Idaho. Therefore, inventories or reinventories are needed in these states to (1) update existing information (2) document known significant changes in habitat condition (3) prepare activity plans, i.e., Habitat Management Plans, Grazing Allotment Management Plans, Timber Management Plans, and others (4) establish baselines for monitoring and (5) identify habitat improvement opportunities.

Baseline inventories on most of the lakes and streams under BLM administration in Alaska have not been conducted because of their remoteness. Since passage of the Alaska Native Claims Settlement Act (ANSCA), the lands under Bureau administration have become much better defined and baseline inventories of fish bearing streams is a high priority. Table 2 identifies the need for inventories or reinventories on about 3,500 miles of anadromous fish streams administered by BLM.

Benefits. Baseline data gathered by inventories will assure timely and adequate input into land use plans by providing managers with information needed to make land use decisions that consider anadromous fish resources with other competing uses. Inventories also aid in identifying habitat improvement opportunities and priorities.

Habitat Improvements (Objective 2)

Program Features. Tables 3 and 4 list the type and number of habitat rehabilitation and enhancement projects needed to increase the productivity of anadromous fish habitats to near full capacity and increase numbers of fish available to the fisheries:

- Many of the projects involve construction of instream structures (11,125) in small tributary streams to replace or imitate large fallen trees and other large woody material that creates desirable spawning and rearing conditions (i.e., gravel riffles and deep pools). These structures include rock-filled gabions, boulder and log weirs, and tree boles.
- Habitat boulders (11,730) are large boulders individually placed in streams, generally in groupings of three or more, to create habitat niches in normally homogeneous reaches of streams.
- Bank restoration (167,640 yds. or 95.3 miles) involves placement of boulder riprap, deflectors, and tree cabling to prevent further erosion of streambanks and/or rehabilitating abandoned road which may be contributing to siltation of spawning and rearing areas.
- Diversion screens (48) would be placed in irrigation diversion to prevent loss of downstream migrants in irrigated fields.
- Fish passage projects (72) include opening adult and young salmon migration routes through small waterfalls, road culverts, small dams, and log jams.
- Gravel restoration (24,130 sq. yds.) involves cleaning spawning beds which have been clogged with silt from road construction, timber harvest practices, mining, etc.
- Off-channel developments (160) are slow, deepwater areas which provide critical rearing habitat for young salmon, especially in the winter months.
- Riparian vegetation enhancement (297,610 yds. or 169.1 miles) includes (1) planting trees and shrubs along streambanks to provide for shade and escape cover and prevent streambank erosion and (2) decreasing the detrimental impacts of livestock grazing on riparian areas and associated fish habitats through fencing, providing alternate water sources, etc.

Table 2. Stream Inventory Needs

State	Major Watershed	No. Streams	Miles of Stream	Estimated Costs Work Years	$ (000)
AK	Koyukuk	40	600	7.0	497
	Ikpikuk				
	Fish				
	Utukok				
	Ungalik	40	700	7.0	527
	Inglutalik				
	Tubutulik				
	Koyuk				
	Kuzitrin				
	Shaktoolik				
	Gisasa				
	Kateel				
	Gulkana	20	300	4.0	270
	Kivchak	40	900	7.0	517
	Gulsovia				
	George				
	Anvik				
	Bonasila				
	Swift				
	Stony				
	Unalakleet				
CA	Sacramento	4	10	0.2	6
	Trinity	5	15	0.2	6
	Shasta	1	2	0.1	3
	King Range	11	40	0.4	11
	Russian	3	5	0.1	3
ID	Upper Salmon	10	43	0.5	15
	Lower Salmon	40	50	0.6	18
	Snake	10	15	0.2	6
	Clearwater	15	30	0.3	9
OR	Siuslaw	60	84	4.0	120
	Umpqua	51	111	2.5	59
	Coos	7	13	0.2	6
	Coquille	7	14	0.2	6
	Rogue	270	424	1.7	26
	Willamette	75	100	5.0	146
	John Day	6	25	0.2	6
	Total	**715**	**3481**	**41.4**	**$2257**

Table 3. Proposed Habitat Improvement Projects

State	Stream	Fish Intro'd #(000)	Instream Structure (Nos.)	Habitat Boulders (Nos.)	Spawning Gravel Restoration (Sq. Yds.)	Fish Passage	Off-Channel Devel. (Nos.)	Riparian Vegetation Enhancement (Yards)	Diversion Screens (Nos.)	Bank/Road Restoration (Yards)	Summary Stream Miles	Est. Cost WYs	$(000)
AK	Tiekel R.	100		20				2,000				2.3	190
	Tuluksak	40	25									2.0	120
	Birch Creek							400				1.8	90
	40-Mile Cr.				200	1						1.5	105
	Beaver							2,000				0.5	80
CA	Trinity River			100			2				1.0	1.0	100
	Canyon Creek			50						100	0.5	0.2	25
	Indian Creek			500			2			1,760	1.0	1.0	100
	SF, Bear Cr.		5			4		8,800		17,600	5.0	0.6	36
	Mattole R. Estuary		20					1,760			1.0	1.0	60
	Honeydew Cr.		4					8,800		1,760	5.0	0.4	5
	Nooning		30								0.1	0.5	5
	Cedar Creek							3,520		8,800	2.0	2.7	82
ID	U. Salmon R. Tribs		21	100	10,000	10		44,000	21	123,200	26.9	5.5	823
	L. Salmon R. Tribs.												
	China Creek I		10		300	2				175	0.5	0.2	27
	Eagle Creek		25		300	2					1.0	0.3	39
	Deer Creek		20	45	400						0.2	0.1	34
	Cottonwood Cr.		25	45	300	1		880			1.4	0.2	52
	Maloney Cr. W.		14		80						0.3	0.1	16
	Rice Creek		3		50						0.2	0.1	5
	Rock Creek		4	40	100			350			0.5	0.2	21
	Skookumchuck Cr.		8		40						0.1	0.1	9
	Slate Creek		4		100						0.2	0.1	18
	John Day Cr.		2		50	1			1		0.1	0.1	18
	Mid. Fk., JDC		2								0.1	0.1	2
	E. Fork, JDC		2								0.2	0.1	2
	China Creek II		2								0.1	0.1	2
	Lake Creek		4	45	100			350			0.4	0.2	27
	Partridge Cr.		10	45	400						2.1	0.1	19
	Elkhorn Creek		6	45	50						1.2	0.1	16
	French Creek		10	45	500						1.4	0.1	19
	Snake R. Tribs												
	Chap. John Cr.		12		100				1	175	0.3	0.2	29
	Divide Creek		2		50						0.1	0.1	8
	Little Salmon R. Tribs:												
	Squaw Creek		8		100	1				175	0.1	0.2	33
	Lookwood Cr.		8		40					175	0.1	0.1	90
	Trail Creek		4		40					175	0.1	0.1	11
	Hazard Creek		2		40					175	0.2	0.1	11
	Hard Creek		10		100	1					0.5	0.2	47
	Clearwater R. Tribs:												
	Lapwai Creek		2					350			0.1	0.1	16
	Big Creek		4		40						0.1	0.1	4
	Lolo Creek		20		400						1.0	0.3	40
	Lawyer Creek		10		400					875	0.2	0.2	30
	Big Canyon Cr.		25	90	400			2,200		175	5.0	0.4	93
	Little Canyon Cr.		15	45	400			1,100			2.0	0.3	55
	South Fork		30	100	350		1	20,000			1.0	3.0	100
	Whiskey Creek		5								1.0	0.1	5
	Maurice Creek		5								1.0	0.1	4
	American River		100	5	1,100		1	40,000		880	7.0	4.8	200
	Buffalo Gulch Cr.				700			20,000		530	1.0	2.7	50
	Big Elk Creek		20	300	1,100			1,100		350	1.9	0.2	56
	Little Elk Cr.				1,100	1		40,000			0.8	0.2	40
	Kirk Fork Cr.		5			1					0.5	0.1	9
	East Fk. Amer.		20			1					1.7	0.1	9
OR	Tillamook Bay Trib.		122	800							4.7	1.2	106
	Nestucca		65	400			4				2.5	0.9	63
	Yamhill				1						1.5	0.2	10
	Alsea		140	300	1						5.6	1.0	104
	Siuslaw		3,660	1,000	200	25	100	55,000			105.0	15.0	2,457
	Umpqua		1,430	350	4,000	4					63.0	5.5	1,686
	Coos		650	35							13.0	2.0	380
	Coquille		714	55		2					19.5	2.2	447
	Rogue		320	100	500						8.0	1.3	275
	Willamette		3,560	1,850		10	50	45,000			103.0	16.9	1,974
	John DAy R.		55	5,600		3			25	10,560	60.2	1.2	1,712
	Total	**11,125**	**11730**		**24,130**	**72**	**160**	**277,410**	**48**	**167,640**	**463.57**	**87.9**	**14393**

• Projects related to enhancing lake habitats are listed in Table 4, including a cooperative project with Alaska State Fish and Wildlife for sockeye salmon introductions.

Benefits. Completion of the anadromous fish habitat improvements outlined in this plan will increase the number of adult salmon and steelhead trout produced on public lands by an estimated 144,000 per year at a cost of $14.4 million. The increased economic values of commercial and recreational fisheries that could be attributed to these projects is significantly greater than estimated costs (see Summary, page 23). In addition, the costs of these projects could be reduced substantially by the use of volunteers and contributed funds from a variety of outside sources. Values that cannot be readily quantified in economic terms will also be realized. For example, wild fish numbers needed to maintain the genetic pool for wild fish stocks would be increased. The social values of anadromous fisheries on public lands, (e.g., "fish watching" and the ceremonial and subsistence fishery for Native Americans) will be improved. Legislative requirements for sustaining the multiple-use values of public resources will be met. "Off-site" mitigation for loss of fish production through hydropower dams, irrigation projects, etc., will be provided. Water quality and quantity will be maintained or improved.

Project Maintenance (Objective 2)

Program Features. The Bureau has had an active fish habitat improvement program for the last 15 years, especially in western Oregon. Table 5 lists the costs to maintain 95 existing stream improvement projects such as gabions, log weirs, riparian fences, etc.

Benefits. Periodic maintenance of existing projects is needed to protect the investment made in previous years.

Management Actions and Practices: (Objective 3)

Program Features. Perhaps the most cost efficient way of improving or maintaining the productivity of anadromous streams is timely and adequate input of fisheries values and concerns into land use allocation decisions. Management actions implemented by other programs can improve degraded stream habitats and maintain those habitats in good condition. Table 6 shows estimates of work months and funds needed in addition to current efforts to adequately represent fisheries concerns related to other land use activities so as to eventually have all streams producing at or near potential. For example,

Table 4. Habitat Improvement Projects - Lake or Pond Enhancement

State	Name of Lake/Pond	Major Watershed	No. Acres	Type of Project	Estimated Costs WYs	$(000)
AK	Monsoon	Gulkana	77	Salmon intro.	I.0	I60
OR	Burma	Rogue	5	Dam repair	0.1	5
			82		**1.1**	**165**

Table 5. Maintenance of Existing Projects

Major Watershed	No. of Projects Maintained	Estimated Costs WYs	Estimated Costs $(000)
Alaska	1	0.1	5
California			
Indian	1	0.1	5
Shasta	3	0.1	5
Dry	1	0.1	3
Weaver	1	0.1	5
Idaho			
Clearwater	4	0.3	12
Upper Salmon	1	0.1	5
Oregon			
Suislaw	3	0.1	3
Umpqua	17	0.7	44
Coos	2	0.7	12
Coquille	2	0.2	12
Rogue	25	0.5	63
Willamette	21	0.2	10
John Day River	13	0.5	20
Total	**95**	**4.5**	**204**

Table 6. Improve or Maintain Habitat Conditions by Management Actions

Activity	Management Actions/Practices	Alaska WYs	Alaska $(000)	California WYs	California $(000)	Idaho WYs	Idaho $(000)	Oregon/Wash. WYs	Oregon/Wash. $(000)
Grazing	Developing riparian mgmt. strategies; administration of grazing leases	--	--	0.4	11	3.9	245	9.0	395
Mining	Adequate stipulation and administration of Plan of Operations; designation of ACEC's (#).	2.5	125	0.4	11	1.5	45	5.5	130
Timber	Adequate timber sales stips and enforcement (roads and logging systems)	--	--	0.6	17	1.0	30	7.5	185
Lands/ROW	Adequate stips and enforcement for roads, power lines, dams, small hydros; acquis. of water rights and angler access, etc.	--	--	0.6	17	9.5	345	0.1	3
Hazardous Waste	Safe location and adequate containment of hazardous chemicals that may affect water quality.	0.5	18	0.4	11	5.0	15	--	--
	Total	**3.0**	**143**	**2.4**	**67**	**20.9**	**680**	**22.1**	**713**
				Grand totals				48.4	1603

interdisciplinary team efforts involving fisheries biologists, range conservationists, foresters, surface protection specialists, managers and others are often needed to ensure that anadromous fish resources are considered in riparian management strategies for administration of grazing, and timber harvest, and mining operations.

Benefits. Implementation of management actions described in this plan will prevent social, biological, and economic losses resulting from degraded fish habitats, thereby reducing the cost and need for future habitat improvements. No historical information is available on which to base estimates of increases in fish production resulting from these management actions. However, it was the consensus of the biologists who prepared this report that fully implementing the management actions in Table 6 would result in at least a 10 percent annual increase in fish production (+24,150 adults) in BLM streams in Oregon, California, Idaho, and Washington. It was assumed that implementing these management actions in Alaska would maintain existing habitat conditions and population numbers. In addition, litigation costs related to loss of fish habitat will be reduced and the Bureau's public image will be improved. Water quality and quantity will be protected.

Cooperative Management Agreements/Plans (Objective 4)

Program Features. Lands administered by the Bureau are often intermingled with other federal, state, and private lands; only rarely does the Bureau have management responsibility for an entire watershed. To provide comprehensive and efficient management of anadromous fish habitats in a watershed, the Bureau enters into cooperative agreements with state and federal agencies, Indian Tribes, and sportsmen and conservation groups. Table 7 lists opportunities for 15 new cooperative management plan and/or agreements and estimated work months and costs involved in preparing these plans.

Benefits. Coordinating management of anadromous fish resources with other agencies and sportsmen and conservation organizations will achieve cost effectiveness and maximize benefits, improve the Bureau's public image, and improve understanding and working relationships with other agencies.

Monitoring (Objective 5)

Program Features. Table 8 lists estimated costs associated with adequate monitoring of general habitat conditions of high priority streams. These costs are in addition to existing monitoring efforts. Also, estimates are provided for the costs to monitor the effectiveness and condition of existing habitat improvement projects so necessary repairs can be scheduled and the design of projects can be improved.

Benefits. Monitoring data will be used to advise managers of the effectiveness of current land management practices in protecting or improving important anadromous fish habitats and identify where changes are needed.

Table 7. Develop New Cooperative Management Agreements/Plans

Major Watershed	# New Plans	Estimated Costs WYs	$000
Alaska			
Beaver	1	0.1	14
Black	1	0.1	4
Kobuk	1	0.2	15
Seventy Mile	1	0.1	4
California			
Trinity	1	0.5	14
Sacramento	2	0.6	16
Idaho			
Upper Salmon	2	1.0	30
Lower Salmon	2	0.4	10
Clearwater	2	0.4	10
Oregon			
Willamette	1	0.4	20
Umpqua	2	0.8	62
Coquille	1	0.4	30
Rogue	2	0.7	51
Total	**15**	**4.9**	**260**

Table 8. Monitoring General Habitat Conditions and Habitat Projects

State	Monitoring of Habitat WYs	$(000)	Monitoring of Projects WYs	$(000)
Alaska	9.0	807	--	--
California	1.0	28	2.0	84
Idaho	5.7	160	7.5	185
Oreg./Wash.	14.0	645	10.4	323
Total	**29.7**	**1,640**	**19.9**	**592**

Research and Studies (Objective 6)

Program Features. The research and studies listed in Table 9 will (1) add to the knowledge base of specific fish populations and habitat requirements and (2) improve the Bureau's ability to predict the effects of land management actions and habitat improvements on anadromous fish resources.

Benefits. Research described in this plan will furnish technical information needed in making sound management decisions and provide future program guidance and direction.

Habitat Acquisition (Objective 7)

Program Features. Opportunities for acquisitions of 58,000 acres of land and

Table 9. Research Studies*

Major Watershed	No. Studies	Type of Research/Studies	Est. WYs	Costs $000
Alaska	-	--	--	--
California				
Mattole Riv. Estuary	1	Salmon juvenile abundance/ life history	0.3	22
Idaho				
	5	Substrate measurements	0.4	25
	2	Macroinvertebrate/ sediment impacts	0.4	15
	2	Fish production/sediment impact	0.5	45
	2	Small hydroelectric	0.7	35
	4	Riparian grazing	1.0	50
	1	Overwintering habitat	0.5	35
	1	Genetic intermixing	0.3	30
Oregon				
Siuslaw	3	Flows, riparian vegetation	0.9	200
Willamette	2	Influences and hab. selection	0.7	150
Umpqua	1	Limiting factors for production, with emphasis on summer & winter survival rates.	0.7	100
Rogue	2		1.0	200
John Day	1	Document increases in steelhead spawning and recovery success	0.5	30
		Total	**7.9**	**937**

*Research/studies would be accomplished by cooperative agreement with State agencies, contract with universities, by BLM employees, etc.

66 miles of streams that would block up important anadromous habitats under BLM administration are listed in Table 10. Acquisition of these habitats would simplify and in some cases improve management, and allow development of habitat improvements throughout a watershed. Private landowners, in most cases, have not been contacted regarding their willingness to sell or trade. Therefore, the first step in pursuit of any of the proposals must be contact with the landowner. Willingness to sell or trade will, of course, be a primary consideration in setting priorities for acquisition.

Benefits. Acquisition of key anadromous habitat will (1) simplify and improve management and (2) make more public fishing waters available to anglers which would benefit local economies.

Summary

The Bureau of Land Management can play a significant role in rejuvenating wild salmon and anadromous trout populations in the Pacific Northwest. Over the past twenty years, Bureau personnel have gained the experience and expertise to construct effective habitat improvement projects and implement sound management practices

Table I0. Acquisition of Important Habitat (Exchange, Purchase, etc.)

Stream	Major Watershed	Habitat Acquired Miles	Habitat Acquired Acres	Estimated Costs WYs	Estimated Costs $(000)
California					
	Shasta	0.5	75	0.5	75
	Trinity	0.2	20	0.2	20
Idaho					
Herd Creek	E. Fork Salmon	3.5	480	0.5	200
Cottonwood Cr	Lower Salmon	6.0	I,000	1.4	350
Partridge Cr	Lower Salmon	2.0	200	0.6	70
French Creek	Lower Salmon	2.0	200	0.6	70
Hazard Creek	Little Salmon	4.0	400	1.1	I40
Hard Creek	Little Salmon	0.5	300	1.0	105
American River	Clearwater	3.5	750	1.8	450
Lolo Creek	Clearwater	7.0	I,500	1.5	525
Big Canyon Cr	Clearwater	15.0	I,000	1.4	350
Elk Creek	Clearwater	4.5	640	1.2	384
Little Elk Cr	Clearwater	3.0	320	0.9	I92
Oregon					
Camp Creek	Umpqua	0.2	40	0.5	I00
Camac Creek	Coquille	0.3	80	I.0	I00
Bear Creek	John Day	I0.0	50,000	I.0	30
Rudio Creek	John Day	I.5	760	0.5	20
Cottonwood Cr	John Day	2.0	240	0.5	20
	Total	**65.7**	**58,005**	**16.2**	**3,201**

Table 11. Summary of Plan Implementation Cost

State	Inventory $000	Stream Projects $000	Lake Projects $000	Project Maint. $000	Mgmt. Actions $000	New Plans $000	Monitoring $000	Research $000	Acquisition $000	Totals $000
AK	1,811	585	60	5	143	37	807	--	--	3,548
CA	29	413	--	18	67	30	112	22	95	786
ID	48	4,181	--	17	680	30	345	235	2,836	8,372
OR	369	9,214	5	164	713	163	968	680	270	12,546
Total	**2,257**	**14,393**	**165**	**204**	**1,603**	**280**	**2,232**	**937**	**3,201**	**25,252**
Wk. Yrs.	**41.4**	**87.9**	**1.1**	**4.5**	**48.4**	**5.7**	**19.9**	**7.9**	**16.2**	**232.2**

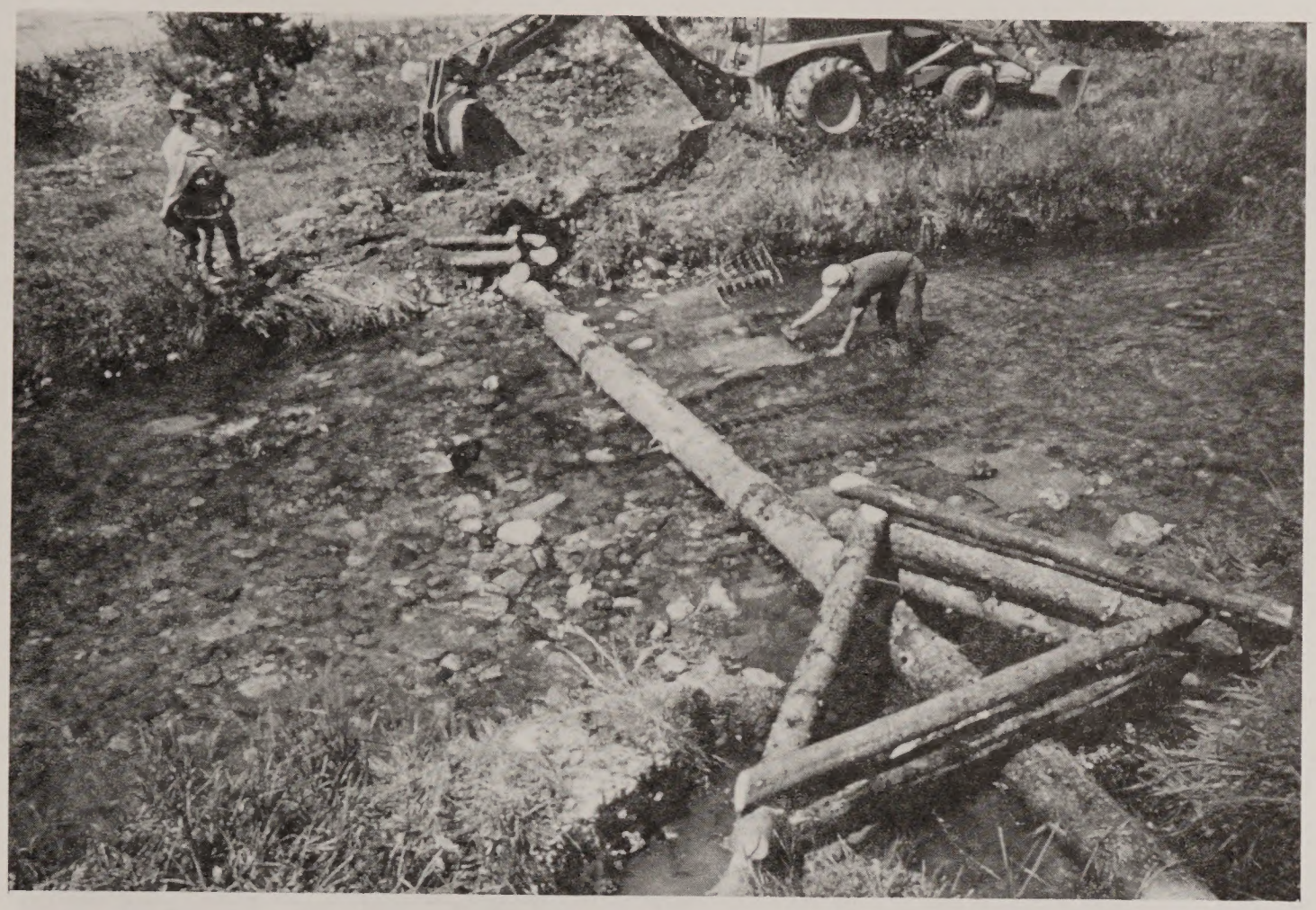
which can enhance the productivity of anadromous fish streams. The costs of the projects and management actions described in this plan would be approximately $25 million over a twelve year period (Table 11). However, these costs could be reduced substantially by the use of volunteers and contributed funds. Full implementation of this plan will increase the number of anadromous fish produced on public lands by 20 percent or 172,000 per year (Table 12), resulting in returns 2.5 times investment costs through benefits to recreational and commercial fishing over 25 years. In addition to direct economic benefits to individuals and local communities, important social, biological, and scientific values will be realized.

Table 12. Adult Fish Produced Per Year as a Result of Plan Implementation

State	Species	Improvement Projects	Management Actions	Acquisitions	Total
Alaska	Chinook	21,000	--		21,000
California	Chinook	26,100	2200	--	28300
	Coho	400	200	--	600
	Steelhead	2,400	600	--	3,000
Idaho	Chinook	13,400	900	700	15,000
	Coho	500	200	--	700
	Sockeye	350	50	--	400
	Steelhead	15,600	900	500	17,000
Oregon	Chinook	5,000	3,600	--	8,600
	Coho	29,000	8,000	1,350	38,350
	Sea-run cutthroat	6,300	3,000	450	9,750
	Steelhead	24,300	4,500	750	29,550
	Total	**144,350**	**24,150**	**3,750**	**172,250**

1. Excessive livestock grazing removes riparian vegetation and damages streambanks, resulting in loss of escape cover for young salmon and siltation of spawning gravels.

2. Juniper trees are cabled along damaged streambanks to trap sediments and provide cover for fish.



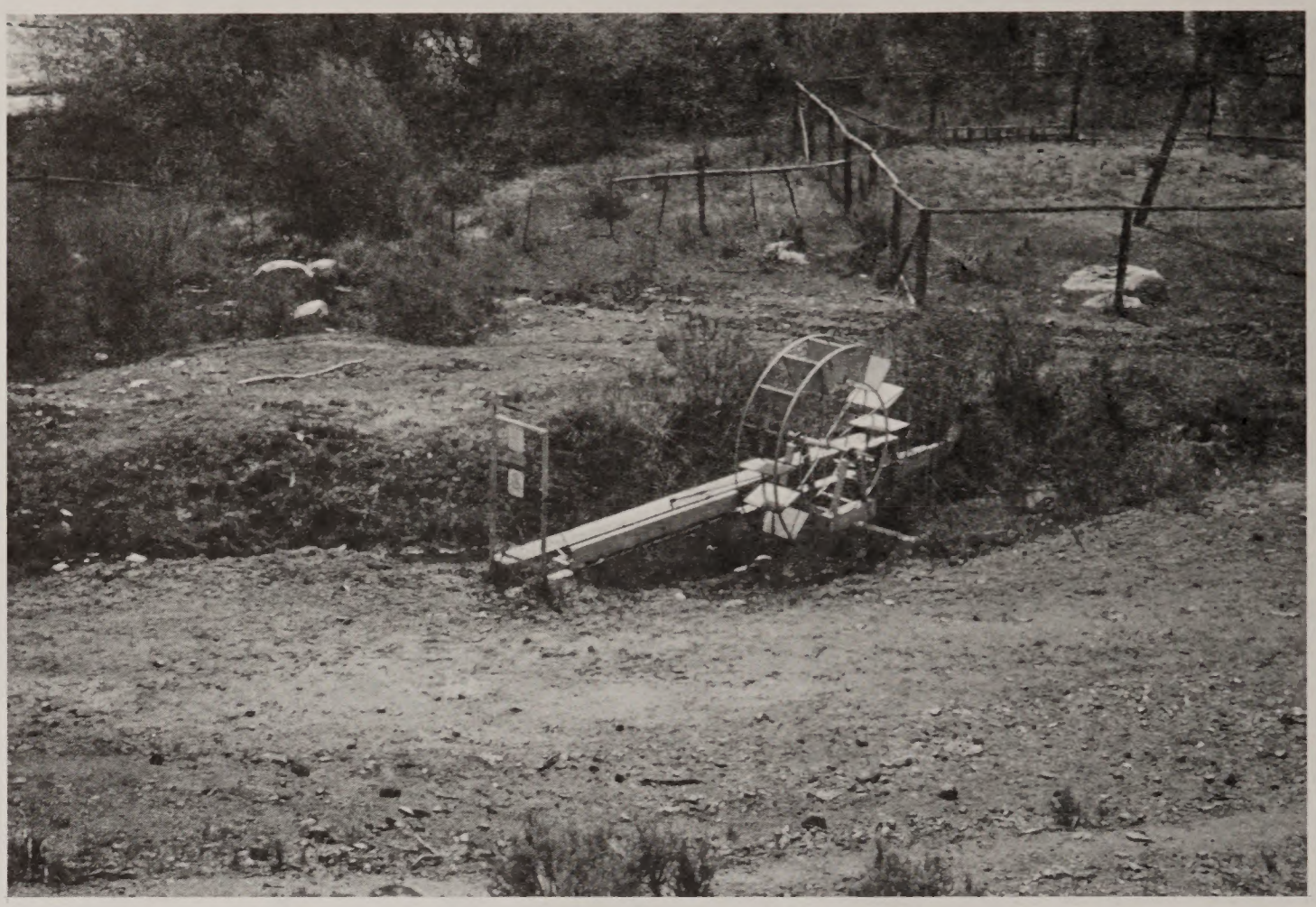
3. "K" dams (instream structures) are constructed to improve anadromous fish habitat in an Idaho stream.

4. Completed "K" dam creates a spawning area above and excellent pool habitat below the dam.

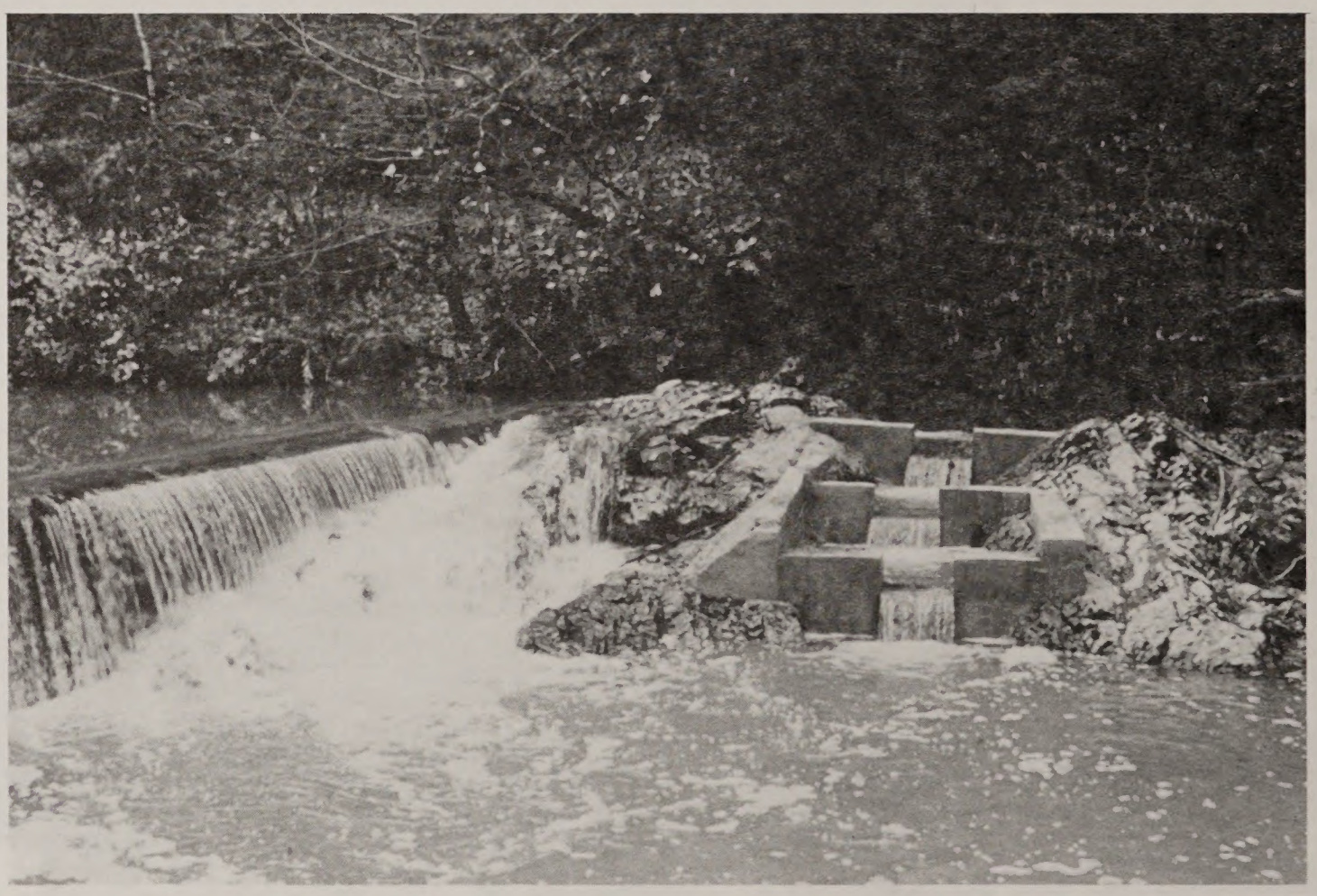
5. Volunteers fill wire gabion baskets with rocks used to create pool and spawning habitats and protect streambanks.

6. Bureau personnel remove woody debris that blocks upstream migration of anadromous fish.

7. Volunteers stand by a series of jump pools they helped construct which will allow adult salmon to negotiate waterfalls and reach spawning areas upstream.



8. Pictured is a fish screen used to keep young salmon and steelhead out of irrigating water diversions. This cooperative project involves BLM, National Marine Fisheries Service, Idaho Department of Fish and Game, and private landowners.



9. This concrete step-and-pool fishway was constructed at a low irrigation dam to provide anadromous fish easy access to upstream spawning areas at all streamflows.

10. Degraded anadromous fish habitat caused by dredging for gold. The stream is shallow and wide; streambanks are mine dredge piles with little soil to support revegation.

11. Gold heap-leaching processing adjacent to an anadromous fish stream is subject to syanide leakage.

12. Large boulders are individually placed by heavy equipment to create pool habitats of young and adult fish.