Geographic Information System

Fragmentation and insufficient quantity and diversity of remaining habitats is resulting in loss of species numbers and community diversity.

Background

Lack of knowledge as to existing riparian areas, wetlands, protected areas, and urban areas, as well as current zoning in the San Joaquin Basin, limits the ability to develop riparian protection and enhancement plans and community planning consistent with riparian preservation goals.

Project

Define existing GIS capabilities of the various agencies. Develop standard GIS maps representing vegetation and habitat types in the San Joaquin River Management Program study area, including riparian habitats, wetlands, and agricultural lands. Develop overlay maps of elements such as locations of species of concern, land use and land ownership, and locations of proposed development projects. Use overlays to examine species diversity and to determine areas that need protection.

Benefits

GIS maps and overlays will allow gap analyses, which will indicate areas of high wildlife diversity, areas not presently protected, and areas that need protection (for example, area generally identified in the Central Valley Habitat Joint Venture Implementation Plan). Maps will serve as a baseline biological inventory that will indicate sensitive areas that should be avoided. The maps will assist in restoration planning, such as showing where corridors should be established to reduce the effects of habitat fragmentation. GIS maps will also indicate areas that have been invaded by non-native vegetation and will assist in restoring native vegetative communities.

Costs and Funding Sources

Costs and funding sources have yet to be determined. It is the intent of this program to network with existing systems and encourage development of necessary information whenever possible.

Geographic Information System

Related Activities

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Aquatic Resource Database	14

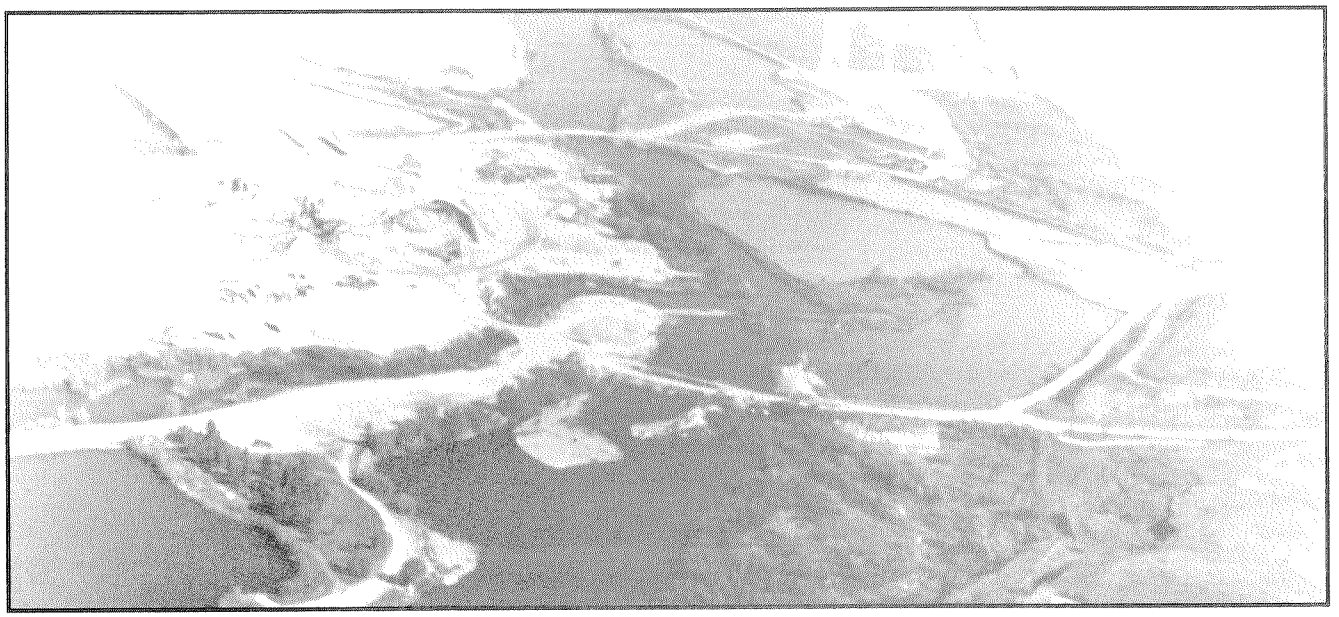
This project should be coordinated with the U.S. Bureau of Reclamation and other state and federal GIS mapping efforts. This project will use existing biological surveys such as the San Joaquin Valley Endangered Species Recovery Planning Program, the Department of Fish and Game Wildlife Habitat Relations Database, Natural Diversity Database, and others.

Conflicts and Resolutions

There were no conflicts associated with this proposal during San Joaquin River Management Plan discussions.

Implementation

A report summarizing existing state/federal/private capabilities for the San Joaquin system and making recommendations should be completed in one year. Compilation of existing capabilities should be implemented in fiscal year 1996.



Gravel operations on the San Joaquin River below Friant Dam.

In-Channel Aggradation Control (Demonstration Project)

The Corps of Engineers has determined that flow capacity in most reaches of the mainstem San Joaquin River has been substantially reduced by aggradation. An inexpensive and environmentally benign method is needed to retard this aggradation and supplement efforts to reduce erosion.

Background

Surveys and reports indicate that the average rate of aggradation of the floodway along the mainstem San Joaquin River on the valley floor substantially exceeds 2 million yards per year.

Project

A demonstration project at two or three sites will remove sediments from the San Joaquin River channel. The Department of Water Resources and The Reclamation Board will provide environmental documentation and protection, obtain permits, and then recover the costs involved by selling the commercial right to remove the sediments in the proscribed manner for use in the commercial market.

This project will test the market for these sediments, verify what mitigation might be required, and establish permit requirements and costs. It will also determine the extent to which sediments moving down the river will drop out in the resulting channel depressions for repeated removal at the same sites.

Benefits

Benefits will be determined by the demonstration.

Costs and Funding Sources

An estimated cost of $20,000 per site includes HECII analysis, permits, monitoring, and biological surveys.

In-Channel Aggradation Control (Demonstration Project)

Related Activities

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Sediment Removal from San Joaquin Mainstem	108

Conflicts and Resolutions

Any alteration that prevents establishment of new sand and gravel bars and overbank deposition of sediment will also interfere with establishment and development of plant communities that make up riparian habitat.

Implementation

This demonstration project was approved by the Advisory Council in mid-1991. Two sites have been selected and examined. Work plans and permit applications are being developed by the DWR San Joaquin District. No legislation is expected to be needed. The Department of Water Resources has indicated a willingness to provide the up-front costs, which are expected to be recovered. This project should be continued in a timely manner.

San Joaquin River (left) and Chowchilla Bypass, a contributor of sediments to the mainstem.

Incentive Payments to Landowners

Quantity and quality of wetland habitat are insufficient to support wetland-dependent wildlife.

Background

The Central Valley historically provided over 4 million acres of wintering habitat for migratory waterfowl of the Pacific Flyway. This acreage provided ideal wintering habitat for more than 60% of Pacific Flyway waterfowl — representing 25% of the continental waterfowl population — and also for a wide array of other water-dependent species, including shorebirds, wading birds, amphibians, reptiles, fish, mammals, invertebrates, and numerous plant species. Today, largely due to conversion to agriculture, flood control projects, and urban expansion, only about 300,000 acres of this habitat remains. The significant decline in critical wetland habitat has resulted in a considerable decrease in populations of waterfowl and other wetland-dependent species.

Concern over this decline has led the governments of the United States, Canada, and Mexico to develop and sign the North American Waterfowl Management Plan, which provides a broad framework for waterfowl conservation and management based on populations and habitat goals needed to meet public demand. The North American Waterfowl Management Plan established a continental breeding population goal of 62 million ducks and a fall flight of 100 million during years of average environmental conditions.

Implementation of the North American Waterfowl Management Plan is the responsibility of designated joint ventures, in which agencies and private organizations collectively pool their resources to solve waterfowl habitat problems. In the Central Valley, this effort is guided by the Central Valley Habitat Joint Venture, which has established a goal to protect, maintain, and restore habitat necessary to increase waterfowl populations to include a peak population of 4.7 million ducks and 865,000 geese and swans. Although the primary focus of both entities is waterfowl, achievement of Central Valley Habitat Joint Venture objectives will benefit a wide array of wetland-dependent species.

In developing its goals and objectives, the Central Valley Habitat Joint Venture recognized that programs should be guided by the habitat needed to meet the energetic requirements of the proposed waterfowl populations. Because the remaining 300,000 acres of Central Valley wetlands cannot, by itself, supply the food and cover necessary to sustain these populations, Central Valley waterfowl must also depend heavily on harvested grain fields for food and wheat, hay, and set-aside fields for nesting cover.

Incentive Payments to Landowners

To offset this shortfall in food and nesting requirements, the Central Valley Habitat Joint Venture has established an objective to enhance waterfowl benefits offered on 443,000 acres of agricultural land through changes in land management practices during production and after harvest. Such changes can be achieved in a variety of ways. For example, because large blocks of agricultural lands are covered under provisions of current governmental price support and crop reduction programs, stipulations that encourage specific wildlife considerations on private agricultural land may be used.

The 1985 and 1990 Food Securities Acts and their companion agricultural crop reduction programs included provisions for enhancing agricultural lands for use by waterfowl. Before 1988, many county Agricultural Stabilization and Conservation Service committees required set-aside lands to be burned, tilled, or mowed annually to control noxious weeds. The State revised this policy to encourage: seasonal flooding or irrigation for up to 6 months; planting small grains for wildlife consumption; planting cover crops and trees; refraining from tilling, burning, or mowing; leaving lands fallow; leasing land for hunting; leaving the same tracts of land in set-aside for more than 1 year; and receiving compensation from non-ASCS sources for efforts expended for wildlife enhancement. These practices are now voluntary, changes could be made in the 1995 Farm Bill to strongly encourage landowners who participate in government subsidy programs to manage their set-aside lands in a manner that increases benefits to waterfowl and other water-dependent wildlife.

In addition to these programs, additional waterfowl/wildlife benefits could be achieved on private agricultural and by offering farmers incentives to:

- Defer tillage of harvested croplands in the fall and winter.
- Defer harvest of croplands in spring and summer.
- Flood harvested fields from fall through late winter.
- Leave set-aside lands fallow and encourage dense nesting cover.
- Flood land to provide waterfowl breeding and brood habitat.

Incentive Payments to Landowners

Project

Incentive Program 1 (deferred tillage) would pay a per-acre incentive to landowners who defer tillage of harvested grain fields, specifically rice and corn, until at least February 15. Participating landowners would be allowed to burn fields in accordance with regulations. Location of deferred-tillage acreage within a basin would be based on proximity to existing and planned wetlands, waterfowl concentration areas traditionally used by geese, and past history of fall tillage.

Incentive Program 2 (deferred harvest) would pay a per-acre incentive to farmers who delay until July 1 harvest of agricultural fields (specifically wheat, oats, and barley) that are within 1 mile of waterfowl breeding and brood water. The intent would be to provide the nests of upland nesting birds protection until their young can leave the nest.

Incentive Program 3 (spring and summer flooding) would pay a per-acre incentive to farmers who flood fields within or adjacent to cropland or set-aside fields to create spring and summer breeding and brood habitat. Each year such areas would be flooded by February 1, and ponded water would be maintained at specified depths through mid-July.

Incentive Program 4 (fall and winter flooding) would pay a per-acre incentive to maintain post-harvest flooding on lands with a history (3 of the last 5 years) of fall and winter flooding. For lands without a history of winter flooding, owners would receive a per-acre incentive to flood and would be paid for the cost of their water, up to a predetermined maximum per acre. The goal is to maintain acreage of harvested grain fields in deferred tillage and winter flooding and to encourage farmers who have traditionally flooded their fields to continue to do so.

Incentive Program 5 (nesting cover) would pay a per-acre incentive to encourage dense nesting cover on set-aside lands. Distribution of set-aside lands in the San Joaquin Basin would be based on landowner participation and proximity to wetlands where pre-breeding and brood-rearing food and cover are provided.

Benefits

This project would increased habitat and provide more favorable conditions for waterfowl and other water-related birds and mammals. The increased habitat would, in turn, result in decreased chance of disease outbreaks due to overcrowding, increased food supply for migratory birds, and increased waterfowl production.

Costs and Funding Sources

Costs and funding sources have not yet been determined. Additional funding is needed for annual incentive payments. Funding could be sought from federal, state, or nonprofit agencies and organizations.

Incentive Payments to Landowners

Related Activities

- Refer to the pilot study initiated in 1989 for the entire Central Valley through the Central Valley Habitat Joint Venture.
- San Joaquin River Management Plan effort should focus attention on the San Joaquin Basin and make modifications as necessary.
- Stand Land Retirement Program, authorized under California Water Code, Section 14900, through the San Joaquin Valley Drainage Relief Act of 1992.
- Federal Land Retirement Program, authorized under Central Valley Project Improvement Act, Section 3408(n).
- 1994 Hydrologic Unit Area Project of the USDA Soil Conservation Service.

Conflicts and Resolutions

Potential conflicts may exist with regard to instream flow needs and ponding of return flows. Potential public health issues related to possible increased populations of mosquitoes would need to be addressed.

Implementation

Incentive programs for farmers in the San Joaquin Basin have been implemented intermittently by federal and state agencies and by nonprofit organizations such as Ducks Unlimited and California Waterfowl Association.

An annual acreage objective needs to be developed for the San Joaquin Basin regarding Programs 1 and 2.

Mainstem Levee Design Correction

Design of some levees, including "project levees", along the mainstem San Joaquin River are inadequate to withstand design flow stages. This has caused levee failures that are not due to poor maintenance or over-topping, but to sloughing or break-throughs under the levee.

Project

Review the history of levee failures and near-failures. Improve levee cross sections or provide other corrective measures.

Benefits

The project should eliminate levee failures at or below design flood stages caused by inadequate levee design.

Costs and Funding Sources

Cost of determining work needed is estimated at $2 million. Project costs are estimated at $54.3 million; real estate is estimated at $8.05 million; and mitigation costs are estimated at $14.3 million.

The U.S. Army Corps of Engineers would need funding to carry out the work.

Related Activities

San Joaquin River Management Plan Recommendation	Page in This Report
Dual-Purpose Floodway Proposal	36

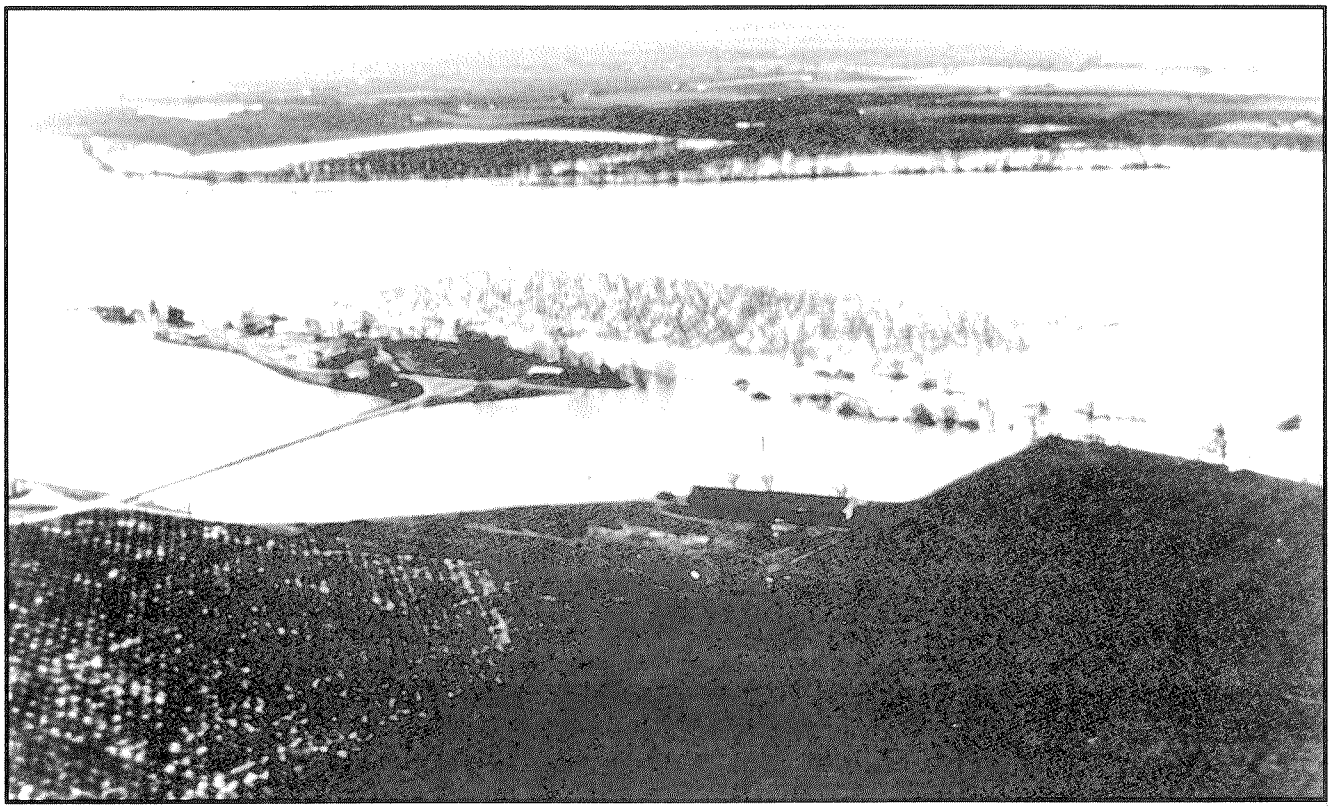
Mainstem Levee Design Correction

Conflicts and Resolutions

In some reaches, alterations to the floodway may result in levee relocation or change in river stage.

Implementation

It is not clear whether any environmental documentation or legislation would be required. Levee relocation would require environmental documentation and permits.



Flooded agricultural land.

Mendota Dam Replacement

Mendota Dam needs to be replaced for reasons of dam safety, to provide fish passage, to better regulate water levels in Mendota Pool Wildlife Area, to avoid flushing accumulating sediments downstream, to facilitate use of excess Friant releases and distribution of floodflows, and occasionally to provide high quality water to replace lower quality Delta-Mendota Canal water.

Background

Mendota Dam is located on the Fresno/Madera county line just downstream of the confluence of the San Joaquin River and Fresno Slough. The pool behind the dam serves as a redistribution facility to deliver water through Delta-Mendota Canal to canals that convey water for agricultural use.

The water level in the pool is maintained by control boards, which cannot be removed or installed during high flood conditions. The boards must be removed in advance of early winter storms. This process lowers the water level in the pool, reduces the refuge habitat value, and hinders distribution of any excess river flows.

Central California Irrigation District, owner and operator of the dam, commissioned a reconnaissance-level study[1] of a new dam about 400 feet downstream of the present site.

Project

Determine multi-purpose benefits and identify sponsors and funding sources for a replacement dam. Initiate a feasibility study. Assess environmental impacts and determine mitigation measures.

Costs and Funding Sources

The reconnaissance study estimated the new dam would cost about $1.2 million. Based on that estimate, engineering and related studies (including EIR and permits) are expected to cost about $400,000.

Potential funding sources will depend on identifying beneficiaries.

1 Summers Engineering, Inc. July 1988. *Reconnaissance Report — Mendota Dam Relocation.* Prepared for Central California Irrigation District.

Mendota Dam Replacement

Related Activities

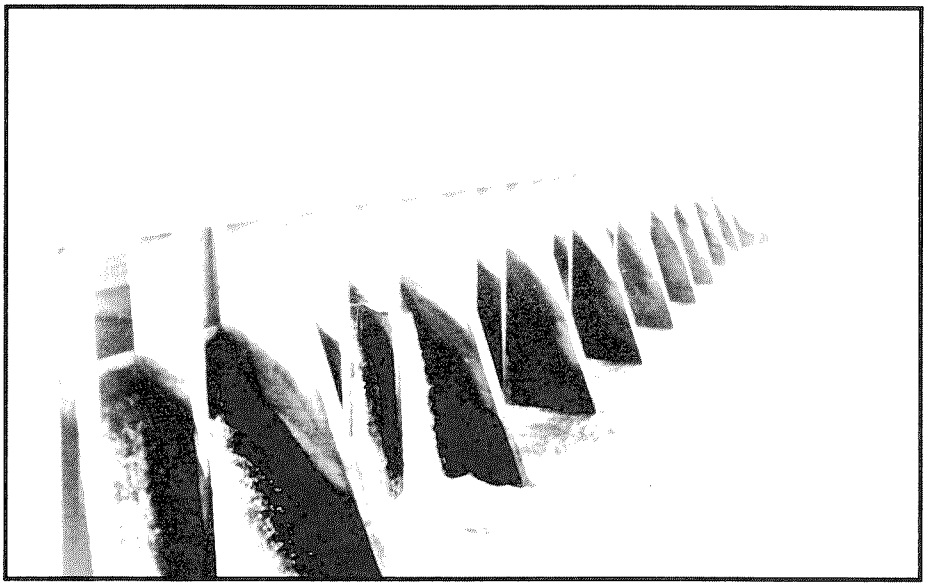
- San Joaquin River fishery water releases.
- Timed water releases for water quality improvement.
- Flood control considerations related to sediment removal.

Conflicts and Resolutions

The U.S. Fish and Wildlife Service has concluded that the new dam would cause permanent loss of 2.55 acres of permanent riparian forest and 0.20 acre of upland downstream of the existing dam. To compensate for the lost habitat, 2.77 acres of riparian forest and 1.20 acres of upland need to be created. The Fish and Wildlife Service also concluded that creating an additional 2.70 acres of lacustrine habitat would benefit fish. Almost 2,310 acres of seasonal wetlands would benefit from the reduced frequency and duration of lowering the Mendota Pool for maintenance and safety inspections.

Implementation

Central California Irrigation District is the most likely implementing agency. DWR Division of Dam Safety inspections will be mandated.



Mendota Dam.

Multi-Species Recovery Plan

The number of species listed as endangered is increasing every year in response to increased development and land conversion.

Background

As of 1990, the Federal Government had listed about 14 species in the study area as endangered. In addition, the Fish and Wildlife Service had identified about 20 species as candidate species, indicating information is available to possibly warrant listing. Most of California's unique species live in restricted habitats, under special conditions to which they have been adapting for hundreds or thousands of years. As people change or destroy these habitats, some of the native species die or fail to reproduce. Major threats to remaining habitats in the basin include conversion of undeveloped land to agricultural, residential, industrial, or recreational use.

Project

Coordinate with the ongoing recovery planning program to develop and implement a multi-species recovery plan for listed, proposed, and candidate species in the San Joaquin Valley. Contribute to the San Joaquin Valley Endangered Species Recovery Planning Program's synthesis of new and existing biological information. Cooperate with the San Joaquin Valley Interagency Team and San Joaquin Valley Regional Association of County Supervisors Task Force (or San Joaquin Valley Regional Consortium) to develop a regional strategy to conserve listed, proposed, and candidate species and biological diversity. Work with San Joaquin Valley Interagency Team to streamline permit processes and standardize mitigation measures.

Benefits

Benefits would be ongoing recovery strategy that provides long-term habitat protection for special-status species in balance with economic and community stability. This action would greatly reduce the cost, time, and effort needed to develop and approve habitat conservation Plans.

Cost and Funding Sources

The San Joaquin Valley Endangered Species Recovery Planning Program is a cooperative effort that currently receives funding from the U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service. It has also received grants from the Department of Fish and Game, Bureau of Land Management, and others.

Multi-Species Recovery Plan

Related Activities

- San Joaquin Valley habitat conservation plans.

Conflicts and Resolutions

The plan should address rights of private landowners.

Implementation

The project will be implemented under the Endangered Species Act.

Chinook salmon carcass, Stanislaus River 1972.

Real-Time Water Quality Management Network, Phase 1

During some seasons and in some reaches, water in the San Joaquin River has salt and trace element concentrations that may harm beneficial uses.

Background

This proposal represents a collaborative approach that encourages and facilitates participants in the San Joaquin River Management Program, under their existing authority, to voluntarily reduce water quality impacts on one another. The collaboration is encouraged but not required by the enabling legislation. Real-time management uses actual measured streamflow and salinity information from telemetered gages and computer models to estimate current overall water quality conditions. Based on estimated conditions at discharge and diversion points, a project manager could advise water users when they could modify their activities to minimize harm to one another's interests.

Project

Assign a project manager and install telemetry devices at three key sites on the San Joaquin River and tributary channels.

Benefits

Implementation of this project is expected to provide small improvements in average water quality and to dampen existing wide water quality fluctuations now experienced over short periods at Vernalis and points upstream.

Costs and Funding Sources

Total costs for this phase will be about $300,000.

Potential funding sources are existing water quality data gathering programs of participating agencies and grants from agencies interested in water quality.

Related Activities

- Fish and waterfowl managers would be advised of opportunities to coordinate their releases to minimize water quality fluctuations.
- Drainage dischargers would be advised of opportunities to use their limited operational flexibility to adjust discharges so as not to exceed the assimilative capacity of the river.
- Diverters would be advised when to adjust diversions, within facility limits, to avoid reducing the assimilative capacity of the river or to avoid diverting an excessive amount of the salt load and outmigrant salmon onto croplands.

Real-Time Water Quality Management Network, Phase 1

Conflicts and Resolutions

Water managers are accustomed to focusing on their use as the only basis for water management decisions. Often they are unaware of other uses harmed by their activity. For example:

- Wetland releases are made when waterfowl plants are expected make the optimum response, but also at a convenient time.
- Fishery managers ask for reservoir releases when the largest proportion of young salmon are believed to be physiologically prepared to make a transition to the estuary.
- Irrigators divert water when crops and orchards have high water demand.
- Drainage system managers drain saline ground water as it accumulates in tile drains.

This proposal assumes that if all these interests can be informed of one another's plans and actions, they will adjust their operation schedule to minimize conflicts. If conflicts continue in spite of reliable information on the adverse effects, a regulatory approach could be called for by interests whose uses are harmed.

Implementation

Phase 1 is currently being implemented as a cooperative effort by the Department of Water Resources, U.S. Bureau of Reclamation, Panoche Regional Water Quality Control Board, U.S. Environmental Protection Agency, Grasslands Water District, Department of Fish and Game, U.S. Geological Survey, and City of Stockton.

This is a short-term proposal. The three sites would significantly improve the accuracy and utility of existing models that would let the manager produce better forecasts of water conditions and the effect of changed operations in the basin. To be more effective, a second phase is proposed.

As a demonstration and data-gathering project, Phase 1 is categorically exempt under Section 15306, Class 6, of the California Environmental Quality Act. No legislation would be required.

Real-Time Water Quality Management Network, Phase 2

During some seasons and in some reaches, water in the San Joaquin River has salt and trace element concentrations that harm beneficial uses.

Background

Under Phase 1 of the real-time water quality management network, a grant proposal was prepared to provide funds to the Central Valley Regional Water Quality Control Board to assign a project manager and install telemetry devices at three key sites on the San Joaquin River and tributary channels. The three sites would improve the accuracy and utility of existing models and enable better forecasts of water conditions and effects of basin operations. Based on forecasted conditions at discharge and diversion points, a project manager could advise water users when they could modify their activities to minimize harm to one another's interests.

Project

Install three telemetry devices in addition to the three installed under Phase 1. Use measured streamflow and salinity information from telemetered gages and computer models to estimate the current overall water quality conditions in the San Joaquin Basin. Water managers will be able to access this information to determine effects of their own and others' water management decisions.

Benefits

Implementation of this project is expected to provide small improvements in average water quality and to dampen existing wide water quality fluctuations now experienced over short periods at Vernalis and points upstream.

Costs and Funding Sources

Total costs for this phase will be about $600,000.

Potential funding sources are existing water quality data gathering programs of participating agencies and grants from agencies interested in water quality.

Real-Time Water Quality Management Network, Phase 2

Related Activities

- Fish and waterfowl managers would be advised of opportunities to coordinate their releases to minimize water quality fluctuations.
- Drainage dischargers would be advised of opportunities to use their limited operational flexibility to adjust discharges so as not to exceed the assimilative capacity of the river.
- Diverters would be advised when to adjust diversions, within facility limits, to avoid reducing the assimilative capacity of the river or to avoid diverting an excessive amount of the salt load and outmigrant salmon onto croplands.

Conflicts and Resolutions

This proposal assumes if all these interests can be informed of one another's plans and actions, they will adjust their operation schedules to minimize conflicts. If conflicts continue in spite of convenient, reliable information on the adverse effects, a regulatory approach could be called for by interests whose uses are harmed.

Implementation

In 1994, the U.S. Bureau of Reclamation approved a grant proposal for this project. This is a short-term proposal. The three additional sites and the interface would significantly improve the accuracy and utility of existing models and allow the manager to produce better forecasts of water conditions and effects of changed operations in the basin.

As a demonstration and data-gathering project, Phase 2 is categorically exempt under Section 15306, Class 6, of the California Environmental Quality Act. No legislation would be required.

Potential implementing agencies are the Department of Water Resources, Regional Water Quality Control Board, and other participants in the San Joaquin River Management Program.

Reservoir Flood Release Coordination

Peak flood releases from more than one reservoir sometimes arrive at a given reach of the mainstem San Joaquin River at the same time, causing a peak flow large enough to produce flood impacts.

Background

The U.S. Army Corps of Engineers has used some discretion managing releases during major floods. However, there is no established commitment or methodology for analyzing and determining the feasibility of such coordination under the wide range of possible circumstances. Furthermore, such coordination could reduce seepage damage, flooding of recreation facilities and trailer parks, and other impacts of lesser floods. Feasibility of coordinated operation is also greater during these lesser floods.

Project

Develop criteria and methodology for coordinating releases among dams on the San Joaquin River system so that releases to evacuate or manage the use of dedicated flood space are optimized and balanced in achieving several objectives:

① Maintain the design level of flood protection in each tributary.

② During high-flow situations (consistent with the first objective), manage arrival time and magnitude of tributary flows into the mainstem to minimize downstream peak flows and flood damage where tributary flows merge along the mainstem.

③ In preparation for later events, releases are often made to evacuate or maintain designated flood space at times when the need or potential for such a release can be recognized at least a few days in advance. When this is the case, agencies with salt management problems (such as westside irrigation districts) should be given advance notice so that salts stored in shallow ground water or ponds can be discharged to the river while adequate dilution water is available. Drainage discharges should not be artificially augmented when floodflows are above the warning stage. The ability to take advantage of these opportunities should be enhanced by improved mechanisms for storage, extraction, and rapid discharge of drainage water to the river.

Reservoir Flood Release Coordination

④ Objectives 1-3 should be balanced with the need to manage flows throughout the system to minimize losses due to stranding of adult and (especially) juvenile salmon and other native fish. In some situations, this objective may be aided by modifying channel configurations.

⑤ Investigate increased water availability of existing projects through modification of flood control requirements without sacrificing flood protection.

Fishery interests will have to better define Objective 4 to permit appropriate analyses and balancing with Objectives 1-3.

Benefits

A full assessment of the degree of benefit from this proposal would be difficult due to the wide variety of weather and reservoir situations that can occur. However, the benefits will be substantial relative to costs.

Costs and Funding Sources

Estimated cost of this project is $300,000. Funding sources have not been identified.

Related Activities

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Friant Reservoir Release Schedule Revision	44
Real-Time Water Quality Management Network, Phases 1 and 2	62, 64
Salmon Stranding Loss Reduction	94
Salt Export Enhancement — Wet Year Water Delivery Manipulations	98

Conflicts and Resolutions

The proposal is framed to protect individual interests and provide the balance needed to avoid conflicts.

Implementation

The project is believed to be within existing authority of the U.S. Army Corps of Engineers, but it will require funding. It should be possible to develop and implement the project in 1 or 2 years when funding is available.

Restoration of Converted Wetlands

As of 1989, more than 90 percent of California's historical wetlands had been lost, mainly to reclamation and flood control activities. Restoration of wetland habitat is needed to improve fish and wildlife habitat, retain flood waters, increase ground water recharge, and improve water quality.

Background

Wetlands act as primary producers in the food chain, help retain flood water, recharge and discharge ground water, act as water quality filters, provide recreational and scenic values, and harbor threatened and endangered plant and animal species. In 1993, California adopted a Wetlands Conservation Policy to reverse the decline of wetland habitat. A primary objective of the policy is to ensure no overall net loss of existing wetlands and to achieve a net gain in the quantity, quality, and permanence of wetland acreage and values.

Another significant wetland restoration effort is the Central Valley Habitat Joint Venture, established in 1988 to protect, maintain, and restore habitat to increase waterfowl populations to desired levels in the Central Valley consistent with other objectives of the North American Waterfowl Management Plan. The United States and Canadian governments adopted the North American Waterfowl Management Plan to reverse the decline of duck populations. The plan proposed creation of regional joint ventures as the method of implementation. The Central Valley Habitat Joint Venture adopted an implementation plan in 1990 that identifies six objectives, one of which is wetland restoration.

Actions

Adopt the wetland restoration objective of the Central Valley Habitat Joint Venture as a minimum goal. Because the San Joaquin Regional Management Program has a broader mandate than the Central Valley Habitat Joint Venture, additional acreage may need to be restored or the design and management of the restored habitat may need to be modified to achieve other wetland benefits, such as threatened and endangered species habitat, flood control, improved water quality, and ground water recharge.

The Central Valley Habitat Joint Venture implementation plan divides the Central Valley into eight basins and specifies protection and restoration objectives for each basin. The San Joaquin Regional Management Program covers two basins — the Delta and the San Joaquin Basin — although most of the study area is in the San Joaquin Basin. The Central Valley Habitat Joint Venture restoration goal for the San Joaquin basin is 20,000 acres. Preliminary information indicates that for the San Joaquin basin, the restoration objective is close to being met and, in fact, the restored acreage may significantly exceed 20,000 acres. As of February 1994, preliminary data indicated 17,500 acres had been restored; another 25,000 acres had been acquired but not yet restored. If all restoration is completed, the total increase in wetland acreage for this objective will be 42,000 acres. In the Delta, the Central Valley Habitat Joint Venture restoration goal is also 20,000 acres. As of February 1994, only 5,000 acres had been acquired and only 1,000 acres of that had been restored.

Restoration of Converted Wetlands

Benefits

Benefits will be:

- Additional habitat, and corresponding increase in populations, for wintering waterfowl, threatened and endangered species, and other water-related plants and animals.
- Possibility of improved flood control, ground water recharge, and surface water quality.

Costs and Funding Sources

Costs will depend on the acreage acquired and restored. Funding sources will likely be a combination of state, federal, and non-profit sources targeted at habitat protection, but sources targeted at flood management and water management should also be sought. Funding opportunities may include the Central Valley Project Improvement Act, Bay-Delta Water Quality Standards, and U.S. Army Corps of Engineers habitat restoration activities.

Related Activities

San Joaquin River Management Plan Recommendation	Page in This Report
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Geographic Information System	48
Multi-Species Recovery Plan	60
Restoration of Riparian Corridor	70
San Joaquin River Overflow onto Riparian and Wetland Areas	102
Land Retirement	140
Other Aquatic Species	146

Conflicts and Resolutions

The Water Supply subcommittee expressed concern that restoring agricultural lands to wetlands might require more water. Before acquisition and restoration of wetlands, the impact on surface water and ground water supplies, as well as other impacts such as fishery impacts, should be evaluated. Restoration efforts should seek to minimize or avoid any net negative impact on water supply, water quality, and fisheries.

Potential public health impacts that could result from a possible increase in mosquito populations would need to be addressed.

Implementation

Implement this plan in conjunction with the Multi-Species Recovery Plan, San Joaquin Valley Interagency Team, or San Joaquin Valley Regional Consortium's regional strategy as implemented by governments and organizations.

Restoration of Riparian Corridor

Fragmentation and insufficient quantity and diversity of riparian habitat is resulting in loss of species numbers and community diversity.

Background

Under pre-settlement conditions, riparian forest and woodland in the San Joaquin Valley covered more than 900,000 acres. This has been reduced by an estimated 96%, and at least half of the remaining riparian vegetation has been disturbed or degraded. Although efforts are underway to reduce losses and revitalize existing riparian habitat, the decline in habitat quality and diversity continues. Major threats to riparian habitat in the basin include conversion of undeveloped land to residential, industrial, and recreational use and flood control activities such as riprap bank stabilization, levee construction, and levee maintenance.

Project

Develop a plan to restore and manage the riparian corridor of the San Joaquin River and its tributaries. Corridors would include areas on both sides of rivers where flood frequency is sufficient to sustain riparian vegetation. The plan would have two components:

- Restore areas where the corridor is gone.
- Develop action items for riparian vegetation where value for fish and wildlife is reduced by land use practices such as agricultural conversion, mining, and poorly-managed grazing.

Benefits

The project will help in determining future management of the riparian corridor. Benefits include habitat improvement for resident and migratory birds, additional resting and nesting sites for raptors, increased habitat value for vertebrate species, and improved aquatic ecosystem conditions.

Costs and Funding Sources

Costs are estimated at $44.3 million, which includes $20.3 million for land acquisition. Funding sources have not yet been identified.

Related Activities

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- Wildlife Conservation Board's *State Riparian Protection Plan.*
- California Riparian Habitat Joint Venture.

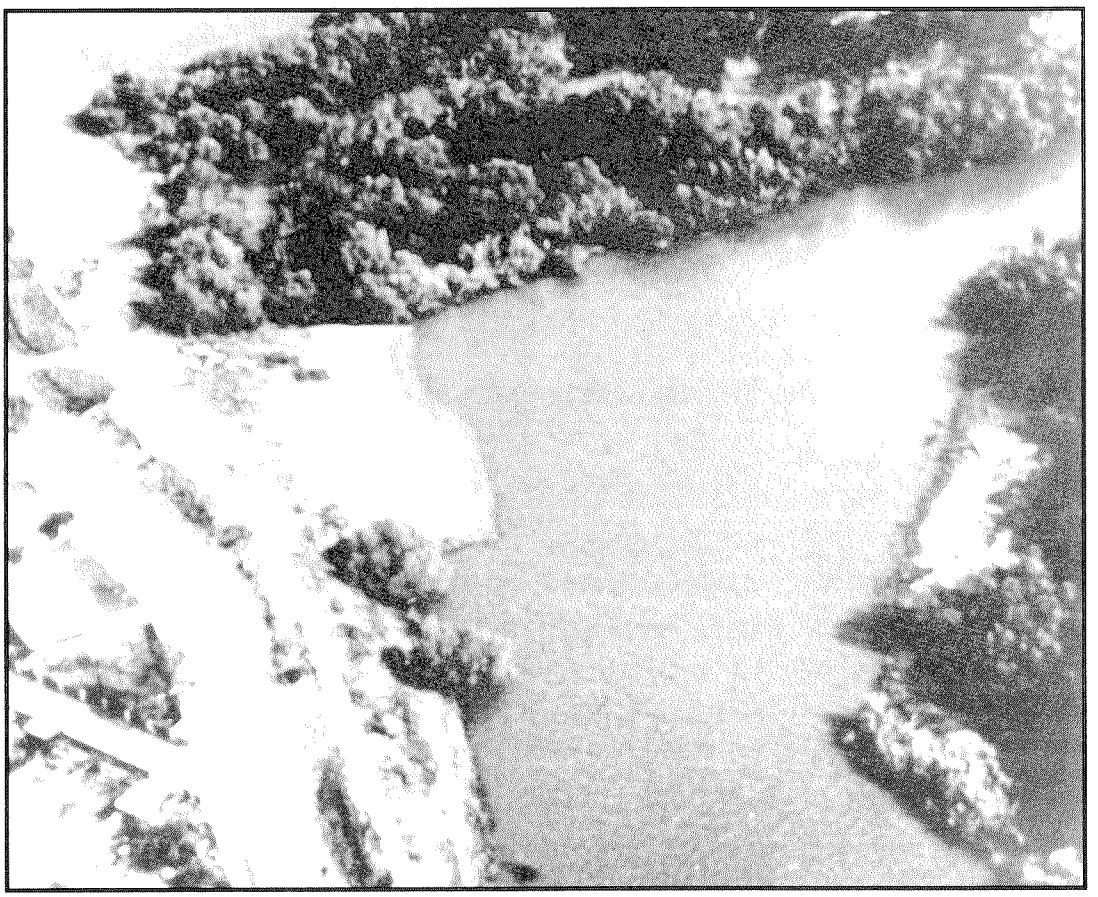
Restoration of Riparian Corridor

Conflicts and Resolutions

The Flood Control subcommittee requested that the program be developed to be compatible with restoration and maintenance of the design floodflow capacity in each reach of each river, as designated at the time flood control facilities were authorized.

Implementation

This is a new, long-term project. This effort should be coordinated with the California Riparian Habitat Joint Venture. Established in 1993, the Riparian Habitat Joint Venture brings together state and federal agencies and non-profit organizations that have the common goal to conserve, increase, and improve riparian habitat throughout California.



Fragmented riparian habitat near Firebaugh.

Riparian Diversions — Pilot Screening Projects

Unscreened riparian diversions on the San Joaquin, Stanislaus, Tuolumne, and Merced rivers entrain and reduce survival of outmigrating Chinook salmon smolts.

Background

A large number (150) of riparian diversions on the Stanislaus, Tuolumne, Merced, and San Joaquin rivers are unscreened. Loss of juvenile salmon to entrainment has not been quantified but is believed to be substantial.

Project

Initiate a screening program based on pilot programs of the U.S. Bureau of Reclamation on the Sacramento River and Department of Water Resources in the Sacramento-San Joaquin estuary. Initially, diversions would be located and inventoried, prioritized, and selected as candidates. Participation would be voluntary, although if evaluation documented that mortality of salmon smolts is reduced substantially by screening, a mandatory program should be considered. A long-term maintenance program will be necessary as the number of fish screens increases.

Benefits

If successful, this project would increase survival of outmigrating salmon smolts. This, in turn, could:

- Increase numbers of adult salmon returning to spawn in the Stanislaus, Tuolumne, and Merced rivers.
- Provide angling and viewing opportunities for residents of and visitors to Stanislaus, Tuolumne and Merced counties and associated benefits to local economies.
- Result in recreational and economic benefits related to increased ocean commercial and recreational harvest.

Full benefits may not be realized unless programs to prevent stranding, mortality due to high temperatures, and losses at the CVP/SWP pumping plants are implemented simultaneously.

Costs and Funding Sources

Costs are yet to be determined, although simple screens may cost $5,000 to $10,000 per cubic foot/second diverted. Long-term operation and maintenance of a major fish screen program will require consistent funding, probably to the Department of Fish and Game.

Funding may be available through the Central Valley Project Improvement Act.

Riparian Diversions — Pilot Screening Projects

Related Activities

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- Central Valley Project Improvement Act:
  - Anadromous Fish Restoration Program [3406(b)(1)].
  - Fish and wildlife restoration flows (800,000 acre-feet) [3406(b)(2)].
  - San Joaquin River Comprehensive Plan [3406(c)(1)].
  - Unscreened Diversions [3406(b)(21)].
- DFG fish screen and habitat restoration projects.

Conflicts and Resolutions

Conflicts will arise if the expense of installing and maintaining screens is prohibitive. Mechanisms to share costs may alleviate these conflicts. Proven screen designs are not available for typical submerged turbine pumps in shallow water. Returning screened fish and disposing of vegetation may be impractical for small diversions, especially in backwater areas and where exotic plants are prevalent.

Implementation

This project should begin immediately and will probably be completed over 5 years. Screening all diversions that impact fish may be a long-term project. Maintenance will be an ongoing effort. Environmental documentation will be required. Legislation will be required if the State intends to provide funding.

Logical implementing agencies are the U.S. Bureau of Reclamation, which has a pilot program on the Sacramento River, and the Department of Fish and Game, which has started to inventory San Joaquin Basin diversions.

Salmon — Artificial Production

Natural Chinook salmon production in the San Joaquin River drainage has been highly variable and extremely low following normal or drier water years.

Background

Consecutive low spawning escapement associated with drought and poor habitat conditions result in extended periods of under-used nursery habitat and attenuation of low salmon production cycles. Stringent regulations have been established to protect the few spawning fish that remain. Salmon angling opportunity in the San Joaquin drainage has been reduced. The contribution of San Joaquin Chinook salmon to the sport and commercial fishing industries of the California coastline is limited due to the cyclic, but low salmon production levels since 1986.

In January 1993, the Advisory Council published *An Action Plan for San Joaquin Fall-Run Chinook Salmon Populations*. In November 1993, the Department of Fish and Game published *Restoring Central Valley Streams: A Plan for Action*. Both documents describe factors constraining salmon production in the San Joaquin drainage. Many actions are proposed that focus on improving natural production of salmon in each tributary. Planning, design, and funding of additional hatcheries is also recommended to supplement natural salmon production. Due to the limited production at Merced River Hatchery, supplementation in the Tuolumne River and Stanislaus River has been minimal. Of importance from the standpoint of genetics, most of the supplementation in the Tuolumne and Stanislaus rivers from this hatchery is from Merced River stock.

Project

In Phase 1, design, construct, and operate a relatively small hatchery on the Tuolumne River near La Grange capable of spawning, incubating, rearing, and supplementing natural anadromous fish populations with up to a million salmon smolts, a half-million yearling salmon, and 20,000 steelhead trout yearlings to help restore and maintain fisheries in the Tuolumne River.

In Phase 2, design, construct, and operate a salmon and steelhead trapping, spawning, and imprinting station on the Stanislaus River near Twomile Bar. This Stanislaus River Fish Facility would be operated in conjunction with the Merced and Tuolumne hatcheries and natural production to help restore and maintain the fisheries of each unique river in the San Joaquin system. Adult salmon and steelhead would be trapped and spawned, eggs would be incubated at the Merced or Tuolumne hatcheries, and the offspring would be kept separate and returned to this facility to be imprinted in Stanislaus River water before being released.

Salmon — Artificial Production

Benefits

Hatchery supplementation and related activities on the Tuolumne and Stanislaus rivers, in conjunction with actions to improve natural production, will help maintain more viable recreational and commercial fisheries for salmon in California. Angling opportunity in the San Joaquin Valley can be improved. Cultural, educational, and societal values will accrue. As fisheries recover, other industries associated with conveyance and use of water from natural channels and reservoir systems will benefit from less impaired water operations. Genetic maintenance will be provided.

Costs and Funding Sources

Phase 1 cost for a small hatchery near La Grange is estimated at $9.5 million. The annual operating budget is estimated at $400,000. Funding for the facility and operations is expected from the Delta Pumps Fish Protection Agreement and the Tracy Pumps Mitigation Agreement, which provide mitigation funding for direct losses of salmon at the SWP and CVP facilities in the southern Delta. A specific federal appropriation may be necessary for operation and maintenance. The Department of Fish and Game has prepared a land acquisition proposal to purchase the proposed site.

Phase 2 cost for the Stanislaus River fish facility have not been developed but would be substantially less than for Phase 1. This facility would be staffed only during fall and spring operations.

Salmon — Artificial Production

Related Activities

Extensive physical habitat improvement projects have been built and others are planned to help restore salmon spawning and nursery habitats in the Merced, Tuolumne, and Stanislaus rivers. Other projects are planned to reduce predation losses by isolating gravel mine pits or other predator habitats. Still other projects are planned to reduce juvenile salmon entrainment and entrapment losses in riparian diversions throughout the San Joaquin drainage. Regulations have been changed to reduce legal harvest and additional enforcement effort has been deployed to curb illegal take of adult salmon. Numerous actions are underway to improve minimum instream flow allocations below major reservoirs on the tributaries. Planning is being initiated to resolve temperature problems. Various programs are underway to help solve the fish passage problems in the Delta. Educational programs are increasing public awareness of the problems and encouraging support for salmon restoration efforts. Start-up date of Phase 1 and Phase 2 facilities is crucial to avoid genetic impacts on the fishery.

Conflicts and Resolutions

Fishery agency policies, genetic concerns, funding, environmental permits and documents, and the need to proceed with natural fish improvements concurrent with development of the proposed hatchery may result in conflicts. Resolution will be pursued through communication, a thorough review of the literature, and assessments based on management experience in the San Joaquin drainage and elsewhere. Operational and strategic plans for the new facility can be developed. This plan could define such features as constant fractional marking programs, monitoring genetic variability, controls on mating pair combinations, selective harvest of hatchery fish, *etc.* An adequate operating budget will be necessary to support state-of-the-art management to avoid genetic concerns. Information and communication should help resolve some conflicts. Concurrent improvements in instream flow, continued habitat improvement efforts, and fish screening will help restore natural production and minimize conflicts associated with hatchery supplementation.

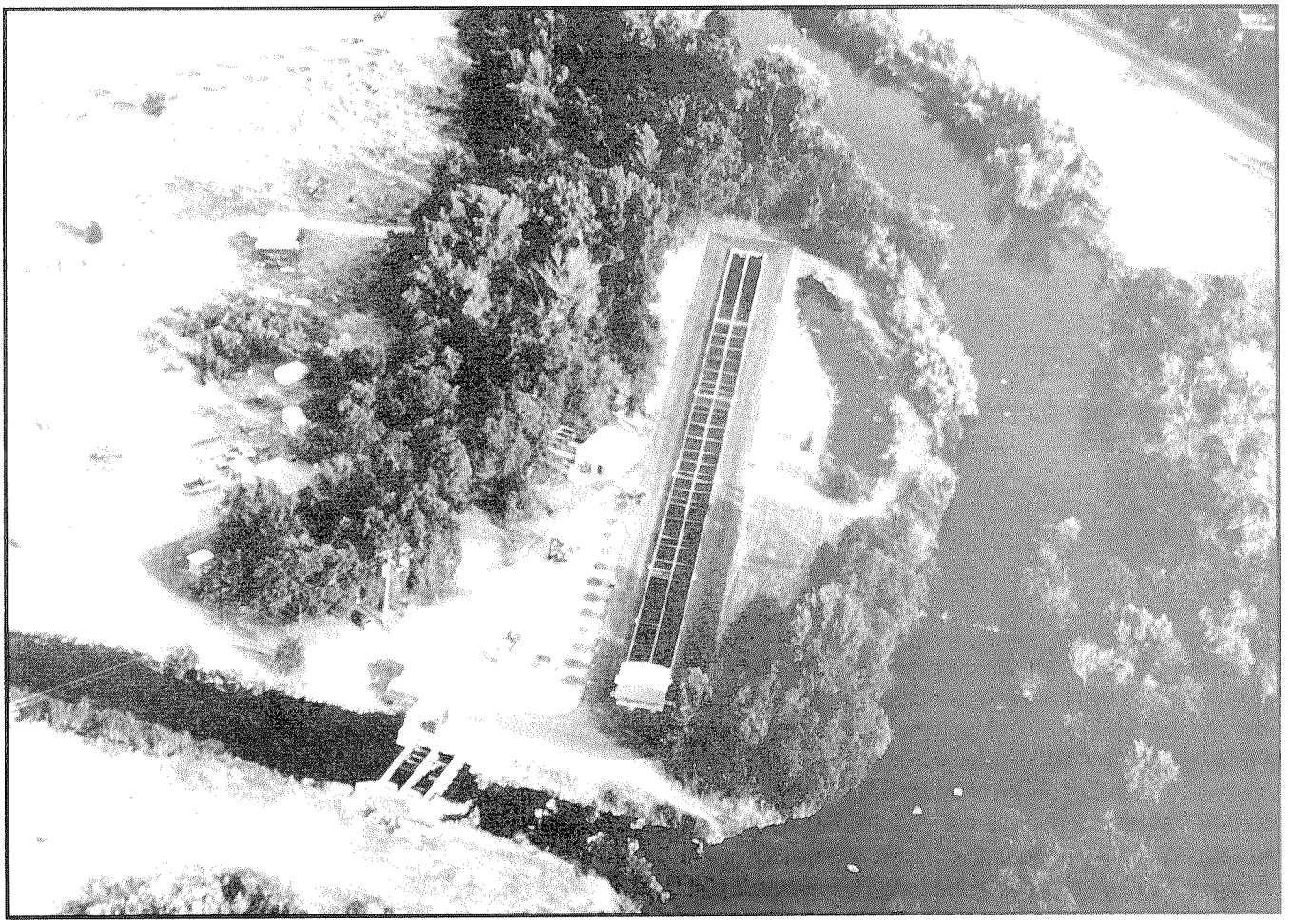
Salmon — Artificial Production

Implementation

Phase 1 site acquisition, definition of funding, and necessary easements are proposed for fiscal year 1995. Environmental documents, permits, and initial design plans are proposed for FY 1996. Final design, bid specifications, awarding contracts, and construction would begin in FY 1997. Construction would occur in FY 1998. The facility would be in operation by FY 1999.

Phase 2 development would follow a similar time schedule, and might be operational by 2004.

The Department of Fish and Game and Department of Water Resources would be co-lead agencies. If Federal funding is involved, the U.S. Bureau of Reclamation would help prepare a joint EIR/EIS. The Department of Fish and Game would operate the facility.



Aerial view of the Merced River Fish Facility, near Snelling.

Salmon Attraction / Migration / Spawning Flows (Fall)

During the fall, flows are often inadequate to attract adult fish or to maintain suitable dissolved oxygen concentrations and water temperature, hampering migration and possibly resulting in straying and delays.

Background

Regulating the San Joaquin River and its tributaries to meet the increasing demands of agricultural and urban water users has altered the timing and magnitude of streamflows. During the fall, flows are often insufficient to attract adult Chinook salmon into spawning streams, which may result straying between tributaries and into sloughs and canals that do not provide spawning habitat. Also when flows are low in the fall, high water temperatures and low dissolved oxygen concentrations develop, which may function as barriers to migrating fish.

Project

Increase fall flows in the Stanislaus, Tuolumne and Merced rivers to levels adequate to attract and provide access to adult Chinook salmon. Maintain suitable water temperature for spawning through physical or operational changes in reservoirs. In determining levels of flows to be implemented for particular tributaries, data collected through studies by the U.S. Fish and Wildlife Service, the Department of Fish and Game, and other agencies should be taken into consideration. The U.S. Bureau of Reclamation temperature model for the Stanislaus River (SNTEMP) or other available temperature models should be used as well.

Evaluate the potential for using flow in conjunction with physical/mechanical solutions such as a barrier at the head of Old River, the aeration device at Rough and Ready Island to improve guidance flows, and water quality in the lower San Joaquin River. Determine the factors causing low dissolved oxygen in the Stockton turning basin each fall.

Salmon Attraction / Migration / Spawning Flows (Fall)

Benefits

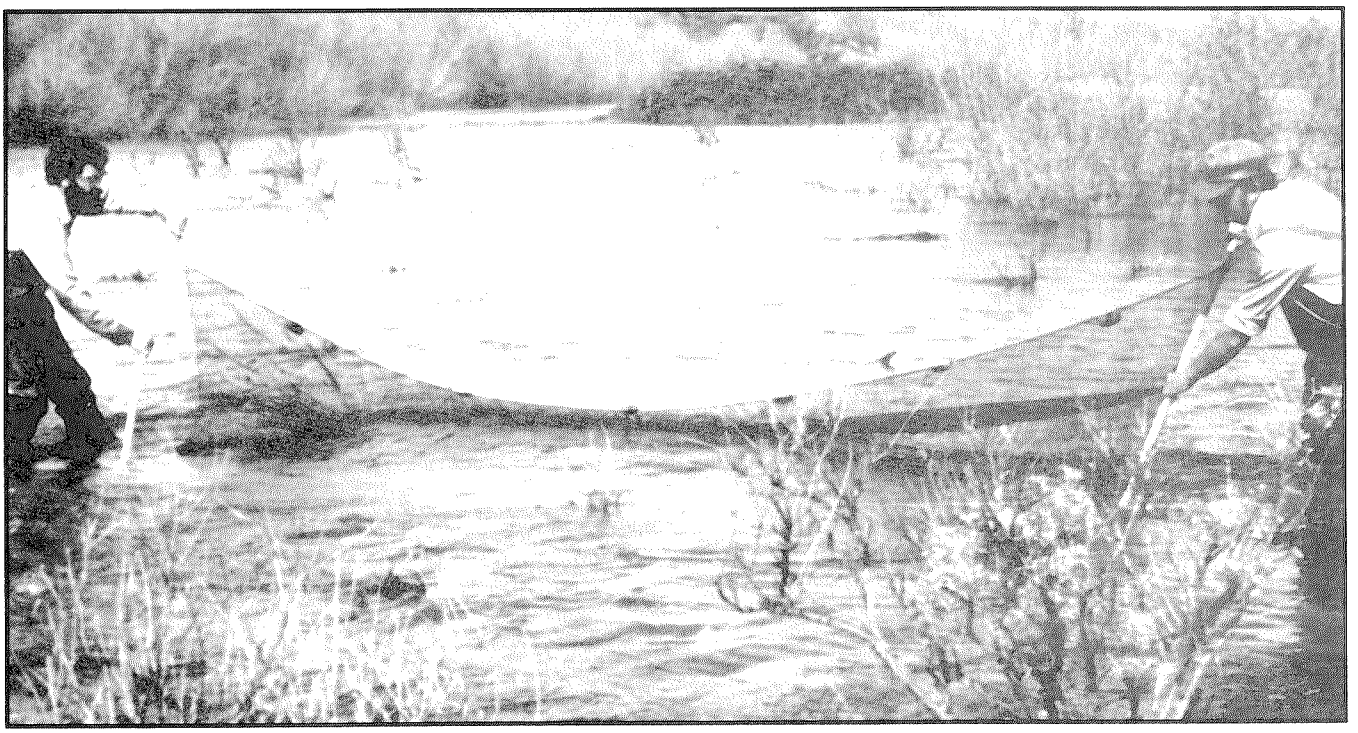
As this project increases spawning success, subsequent Chinook salmon escapement will increase. Ultimately, recovery of salmon populations will:

- Provide angling and viewing opportunities for residents of and visitors to Stanislaus, Tuolumne and Merced counties and associated benefits to local economies.
- Result in recreational and economic benefits related to increased ocean commercial and recreational harvest.

These actions may be more effective if measures are implemented to improve survival of outmigrating smolts each spring.

Costs and Funding Sources

Costs, yet to be determined, would include costs associated with reduced water supplies to urban and agricultural water users. Funding may be available through the Central Valley Project Improvement Act. Water transfers and exchanges are a reasonable method to implement these improvements when there are willing sellers and buyers.



Beach seining to determine habitat use and relative abundance of juvenile salmon, Tuolumne River.

Salmon Attraction / Migration / Spawning Flows (Fall)

Related Activities

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- Central Valley Project Improvement Act:
  - Anadromous Fish Restoration Program [3406(b)(1)].
  - Fish and wildlife restoration flows (800,000 acre-feet) [3406(b)(16)].
  - San Joaquin River Comprehensive Plan [3406(c)(1)].
  - Voluntary flow contribution in above-normal or wet years.
  - Cooperative habitat improvement projects involving conjunctive use of surface and ground water.

Salmon Attraction / Migration / Spawning Flows (Fall)

Conflicts and Resolutions

Conflicts may occur if recommended increases in fall flows reduce water supplies available to users. This might be resolved by purchase of water from willing sellers, water augmentation projects, or additional storage to increase export flexibility. Water augmentation and additional storage facilities would, in turn, have to be evaluated in terms of potential detrimental effects on flow and habitat. In the long term, riparian restoration efforts have the potential to increase streamflow and reduce the volume of water that must be released from dams.

Implementation

Studies to define streamflow needs are nearly complete. Management and coordination of flows will be an ongoing project. Depending on actions to increase fall flows, environmental documentation and administrative actions would be required. Legislation would not be required for study but might be required to fund projects to facilitate coordination of flows. AB 3030 ground water basin management should be implemented and may help avoid conflicts with other water users.

This project will be a multi-agency effort, entailing cooperation between the U.S. Bureau of Reclamation, Department of Water Resources, U.S. Fish and Wildlife Service, Department of Fish and Game, and numerous water and irrigation districts. Water transfer/exchange opportunities should be explored through the State Water Bank and other parties.

Salmon Harvest Management

Legal harvest of salmon in rivers and the ocean has important short-term and long-term effects on salmon population size, structure, and genetic aspects. If catch is too high, harvest can result in too few salmon returning to spawn *(escapement)*. Selective harvest of older age classes can shift the age structure to a younger, less productive population. Indiscriminate mixed-stock fisheries sustained by northern hatcheries can result in over-harvest of wild stocks in the San Joaquin system. "Shaker"[1] losses may be an important mortality source.

Background

California stopped inland commercial gill-net fishing in 1957. Today ocean salmon trolling is limited by zone regulations along the California coast. Average size and age of salmon in harvest and spawning runs have declined in recent decades. Except for regulated harvest in ocean management zones, there is no selective harvest for either specific Central Valley stocks or for hatchery fish. Extensive restrictions on inland sport harvest are in effect in certain areas to protect spawners. Specific escapement goals have not been used as a management strategy for San Joaquin Basin salmon.

Project

Evaluate:

- Ways to protect San Joaquin Chinook salmon stocks in the ocean and estuarine fisheries.
- Marking all hatchery-produced salmon and selective harvest.
- "Shaker" mortality.
- An immediate-tag regulation patterned after deer hunting regulations.
- Sea lion predation problem.

Request the California Fish and Game Commission to:

- Extend the salmon inland harvest closure to San Joaquin River mile zero (near Antioch).
- Close the open season on tributaries on October 1 and maintain the zero-salmon limit all year.
- Consider sport fishing gear restrictions such as single, barbless hooks and artificial lures to protect juvenile salmon.

1 "Shakers" are undersized fish caught on and physically released from a hook and line in the ocean, so named because they are "shaken" from the hook.

Salmon Harvest Management

Benefits

Restore reproductive potential and life history diversity by providing for:

- Older age-class survival.
- Long-term restoration of spawning runs with reinstatement of inland sport fishery.
- Sustainable ocean harvest levels that do not suppress San Joaquin Basin wild spawning stocks.
- Better use of salmon as a commercial and sport resource.

Costs and Funding Sources

Costs and funding sources are still unknown.

Related Activities

- San Joaquin River Management Program *Salmon Action Plan*, Section 1 (a-c).
- Central Valley Project Improvement Act, Section 3406(g)(7).
- Stream restoration and improvement.

Conflicts and Resolutions

Salmon harvest management actions are often contentious issues. Resolution is most likely if the long-term interest of the resource is explained and kept at the forefront throughout the process. It is crucial that measures to improve spawning, incubation, rearing, and outmigrant salmon survival be implemented in concert with regulation changes.

Implementation

This is a long-term project because evaluations recommended in the project need to be performed, management actions must be developed and implemented, and changing conditions will require ongoing response and refinement. Environmental documentation and regulation changes would include requirements of the Pacific Fisheries Management Council and the California Fish and Game Commission. Required legislation is unknown, but it may help implement changes.

The Pacific Fisheries Management Council and California Fish and Game Commission are the primary implementing agencies.

Salmon Operating Criteria

State and Federal water export facilities in the southern Delta cause juvenile salmon losses by direct entrainment.

Background

Tracy Pumping Plant since 1951 and Banks Pumping Plant since 1968 have fish screening and salvage facilities to reduce impacts related to water diversion from the Delta. Screen efficiencies and approach velocity criteria have been determined for juvenile salmon and other species.

Project

During April and May, use optimum operational criteria for screening salmon at the SWP/CVP facilities to reduce entrainment losses of smolts outmigrating from the San Joaquin and Sacramento basins.

Benefits

Salvage and survival of salmon smolts associated with Delta export facilities will increase.

Costs and Funding Sources

This project will result in no additional costs or changes in funding responsibility.

Related Activities

- San Joaquin River Management Program *Salmon Action Plan*, Section 4(h).
- Central Valley Project Improvement Act Section 3406(b)(4).
- Old River temporary barrier (spring).

Salmon Operating Criteria

Conflicts and Resolutions

Criteria for other fish species can be different than for salmon, so determining the timing of species presence and relative abundance will aid in establishing priorities for operations. Reasonable and prudent alternatives in biological opinions for endangered or threatened fish may conflict.

Implementation

This is an ongoing, long-term operational issue. Environmental documentation requirements are unknown. No legislation would be required.

The U.S. Bureau of Reclamation and Department of Water Resources are the responsible agencies, with assistance from the Department of Fish and Game and U.S. Fish and Wildlife Service.

Salmon Outmigration Flows (Spring)

During spring, flows in the San Joaquin River are often too low to stimulate or provide adequate conditions for successful outmigration of Chinook salmon smolts. Operation of SWP and CVP pumping plants causes high mortality of smolts that do migrate downstream and reach the Delta.

Background

Regulating the San Joaquin River and its tributaries to meet the increasing demands of agricultural and urban water users has altered the timing and magnitude of streamflows. Reduced spring outflow frequently results in stranding, high water temperatures, and other factors that contribute to high mortality of outmigrating Chinook salmon smolts. Exports at CVP/ SWP pumping plants cause additional mortality directly, by entrainment, and indirectly, by delaying migration and increasing exposure to other mortality factors. Since 1992, a barrier has been installed at the head of Old River during the spring to guide smolts farther down the San Joaquin River, away from the pumping plants.

Project

Establish spring pulse flows, in conjunction with a barrier at the head of Old River, and monitor the increase in survival of outmigrating Chinook salmon smolts. The project would be complemented by alternatives proposed by the State Water Resources Control Board, which include:

- A 30-day pulse flow, with allocation between the San Joaquin, Stanislaus, Tuolumne and Merced rivers, as proposed by the Department of Fish and Game at the Bay/Delta water right hearings.
- Longer, lower flows similar to those provided by the U.S. Bureau of Reclamation, Merced Irrigation District, Modesto Irrigation District, and Turlock Irrigation District. Until the San Joaquin River Comprehensive Plan [CVPIA 3406(c)(1)] and Congress complete a determination on releases from Friant Dam, mainstem San Joaquin River flow contribution could be provided from New Melones Dam, from San Luis Reservoir via the Newman/ Volta Wasteways, or by water transfers under CVPIA Section 3405. CVPIA water transfer provisions are also a potential source of funding for additional spring releases from New Don Pedro and New Exchequer dams.

Salmon Outmigration Flows (Spring)

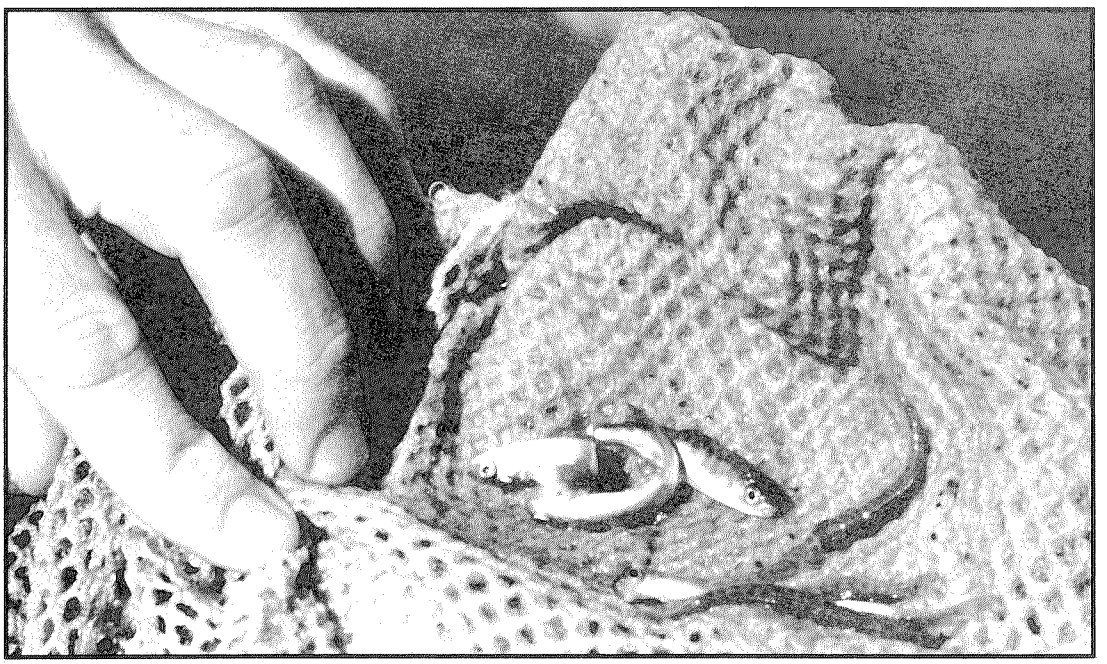
Benefits

If this project substantially improves survival of outmigrating Chinook salmon smolts, and if measures are implemented on an annual basis, near-term benefits will be increased numbers of Chinook salmon returning to spawn in the San Joaquin basin. If this contributes to recovery it may avoid implementation of more extreme and more costly measures. Ultimately, recovery of salmon populations will:

- Provide angling and viewing opportunities for residents of and visitors to Stanislaus, Tuolumne and Merced counties and associated benefits to local economies.
- Result in recreational and economic benefits related to increased ocean commercial and recreational harvest.

Costs and Funding Sources

Costs are yet to be determined but would include costs associated with reduced water supplies to urban and agricultural water users. Funding may be available through the Central Valley Project Improvement Act. If there are willing sellers and buyers, there may be no cost except for monitoring the benefits. Modifying projects such as the Calaveras/Stanislaus conjunctive use study, temporary barriers project, and interim South Delta project could provide funding.



San Joaquin fall-run Chinook salmon fry.

Salmon Outmigration Flows (Spring)

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- Central Valley Project Improvement Act:
  - Anadromous Fish Restoration Program [3406(b)(1)]
  - Fish and wildlife restoration flows (800,000 acre-feet) [3406(b)(2)]
  - San Joaquin River Comprehensive Plan [3406(c)(1)]

Salmon Outmigration Flows (Spring)

Conflicts and Resolutions

Conflicts may occur if releasing pulse flows reduces water supplies available to users. This might be resolved by purchase of water from willing sellers, water augmentation projects, or additional storage to increase export flexibility. Water augmentation and additional storage facilities would, in turn, have to be evaluated in terms of potential detrimental effects on flow and habitat. In the long term, riparian restoration efforts have the potential to increase streamflow and reduce the volume of water that must be released from dams. Effective and efficient coordination of flows and exports has the potential to avoid more extreme and costly flow and export requirements for salmon restoration and protection. Fishery biologists recommend increasing outflows during spring, but water management officials question the magnitude and duration of the recommended flow increases.

Implementation

The project should begin as soon as possible. Management and coordination of flows will be an ongoing project. Depending on actions taken to increase spring flows, environmental documentation would probably be required. Legislation would not be required for study but might be required to fund projects to facilitate coordination of flows.

This multi-agency effort will entail cooperation among the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, Department of Water Resources, Department of Fish and Game, and numerous water and irrigation districts.

Salmon Predation Reduction (Juveniles)

Predation by other fish is an important cause of juvenile salmon mortality in the San Joaquin system.

Background

Due to channel modifications, low flows, aquatic plant growth, and warm water, there are large populations of warmwater game fish in the San Joaquin River tributaries. Studies have found relatively low survival of smolts under some conditions. Other studies have identified large populations of potential predators, primarily introduced largemouth and smallmouth bass, sunfish, and catfish. The large standing crop of predators and near ideal conditions for predator growth during most of the year is suspected to result in high mortality of juvenile salmonids.

Project

Undertake measures to reduce predator populations and their predation ability. Measures include encouraging predator harvest, increasing flows during spring outmigration, reducing water temperature in summer, increasing turbidity during outmigration, removing predator-concentrating features, and modifying channels to isolate predator habitat. Continue focused efforts at sites such as Clifton Court Forebay.

Benefits

Reducing predation on juvenile salmon will help population recovery, increase harvest opportunities, and contribute to higher long-term population levels.

Costs and Funding Sources

Costs and funding sources are unknown.

Salmon Predation Reduction (Juveniles)

Related Activities

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- San Joaquin River Management Program *Salmon Action Plan*, Sections 3(e) and 4(j).
- Central Valley Project Improvement Act, Section 3406(b)(8).
- Department of Fish and Game *Central Valley Stream Action Plan*.

Conflicts and Resolutions

Reduced warm-water fishery could be supplanted by cold-water opportunities. Flow requirements will require a balanced and coordinated approach. Increasing turbidity, although temporary, will need to be monitored. (See related action items.) Public interest in angling opportunity for predator species must be considered.

Implementation

This is a long-term, ongoing project. Environmental documentation will be required for some components of the project. Legislation is discussed for related action items.

Implementing agencies are the Department of Fish and Game, Department of Water Resources, Federal Energy Regulatory Commission, State Water Resources Control Board, and U.S. Fish and Wildlife Service.

Salmon Rearing Flows

At some times and in some areas, salmon-rearing flows may not be optimal — or may even be unsuitable.

Background

San Joaquin basin fall-run Chinook salmon generally rear from January to early June. Some juveniles remain through summer if conditions are right. Instream rearing habitat, including water temperature, varies with flow, and needs of salmon fry and juveniles change with growth and season. Some studies have been completed or are in progress.

Project

Complete instream flow incremental model (IFIM) studies and temperature models for tributary and mainstem reaches. Annually monitor juvenile salmon distribution, growth, and abundance, as well as water temperatures. Identify optimal rearing flows for varying conditions and life stages. Incorporate results into flow schedule considerations.

Benefits

Conditions for salmon growth and survival will improve. Related benefits could be better food production and reduced predation.

Costs and Funding Sources

Costs are unknown, but would include completing studies/models and monitoring. Existing funding mechanisms will allow completion of initial modeling.

Additional funding might be provided under the Central Valley Project Improvement Act, license requirements, and other mitigation and restoration sources.

Salmon Rearing Flows

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- San Joaquin River Management Program *Salmon Action Plan*, Section 3b.
- Central Valley Project Improvement Act, Sections 3406 (b)(1)(B)(16), (e)(1,6), (g)(4,5,6).
- Department of Fish and Game *Central Valley Stream Action Plan.*

Conflicts and Resolutions

Instream flows are often controversial, and this project will need to take into account other needs and uses, including other life stages.

Implementation

Studies and models could be completed within 2 or 3 years, but monitoring of salmon benefits and temperatures would be ongoing. No known environmental documentation is required. Legislation could help provide long-term funding.

The Federal Energy Regulatory Commission, State Water Resources Control Board, and the Interior Secretary can require specific flows. The Department of Fish and Game, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, and Department of Water Resources are involved in studies and monitoring.