CALIFORNIA'S
SALMON AND STEELHEAD TROUT

A RESEARCH AND EXTENSION PROGRAM

WILDLAND RESOURCES CENTER
DIVISION OF AGRICULTURE AND NATURAL RESOURCES
UNIVERSITY OF CALIFORNIA

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CALIFORNIA'S
SALMON AND STEELHEAD TROUT

A RESEARCH AND EXTENSION PROGRAM

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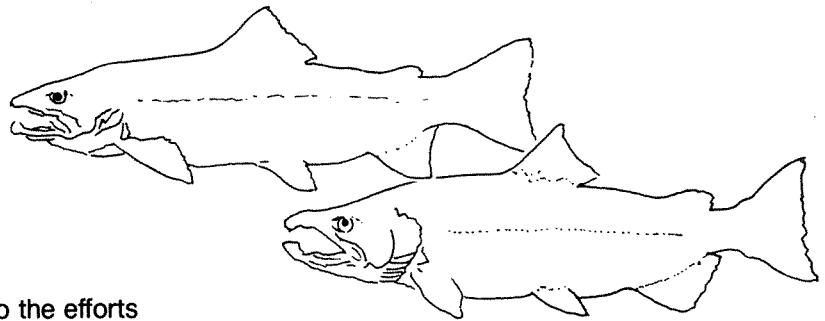University of California

Preface

In the fall of 1986 the California Advisory Committee on Salmon and Steelhead Trout asked the Wildland Resources Center, of the University of California, to organize a workshop to address researchable questions for the preservation, protection, restoration, and enhancement of salmon and steelhead trout resources in California. On March 25 and 26, 1987, commercial and sport fishermen, government resource managers, university scientists, and consultants met at the University of California, Davis, to define the needs and costs of a 10-year research, development, and extension program for salmon and steelhead trout.

Acknowledgements

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Executive Summary

Salmon and steelhead trout have played an important role in California's history. The commercial and sport-fishing industries and native Americans depend on these valuable resources; however, populations of salmon and steelhead trout have declined significantly over a century of exploitation. Continued harvest of fish and deterioration of habitat resulting from human activities have dramatically reduced yields. The decline in numbers of salmon and steelhead must be stopped and reversed if these fisheries are to continue to play a role in California's economy. Reversing the decline depends, in part, upon having new technology to improve management of these fisheries and that technology would be produced and applied by a strong research development, and extension (RD&E) program.

Three species of anadromous salmonids are present in California. These migratory species have complex life cycles which include periods in fresh water, the Pacific Ocean, and a return to fresh water. The spatial and temporal requirements of the species vary among races within a species. Due to the variability and complexity in their life histories many gaps exist in our knowledge of habitat requirements for anadromous salmonids.

The California legislature's Joint Fisheries and Aquaculture Committee reestablished a special advisory committee to develop a plan to reverse the decline in salmon and steelhead trout. As part of a comprehensive plan to meet the challenge of restoring and enhancing the anadromous salmonid populations in California, the advisory committee sponsored a workshop to identify problems facing salmon and steelhead trout and to develop an RD&E program to solve these problems.

The workshop, attracting 54 participants, was presented by the Wildland Resources Center of the University of California on the Davis campus on 25 and 26 March 1987. Forty technical experts and users of technology, working in small groups, revised a working list of 139 problems needing solutions and established the priority of each problem. Thirty users of technology—commercial and sport fishermen, managers of public and private resources, employees of state regulatory or service agencies, and representatives of professional societies—rated the priority of 116 problems on the revised list during the second session of the workshop. These users rated 18 problems as urgent to critical and 60 problems as important to urgent.

Following the users' priority ratings, small teams of experts outlined a research, development, and extension (RD&E) program and estimated costs to solve 35 of these problems within a 10-year period. Their program featured 10 targets, 18 subtargets and a year-by-year schedule of 102 activities to achieve the solution of the subtargets.

Costs for the program were estimated from the schedule of activities to resolve each subtarget. Solving the 35 problems rated as highest priority would cost an estimated $8.4 million the first year and $90.9 million over a 10-year period. Because of the social and economic importance of salmon and steelhead trout resources to California's economy, the recommended RD&E program should be a worthwhile public investment.
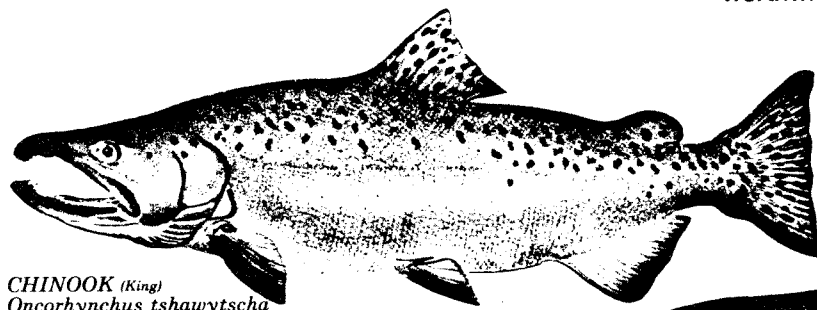
CHINOOK *(King)*
Oncorhynchus tshawytscha
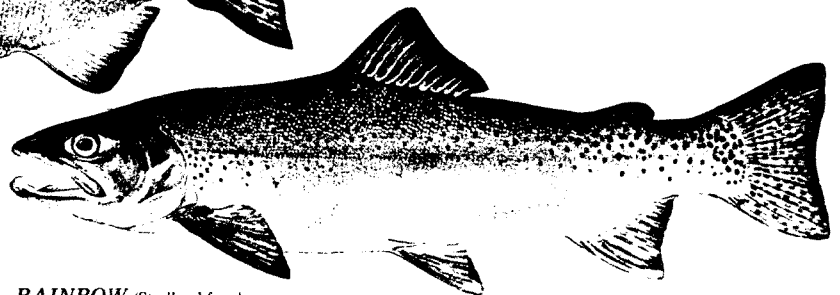
RAINBOW *(Steelhead form)*
Salmo gairdneri

Introduction

The Resource

Salmon and steelhead trout have played an important role in California's history. Many people, especially commercial fishermen, native Americans, and sport fishermen, rely on this valuable and renewable resource. The health and future of the fishing industry is tied to the well-being of stocks of salmon and steelhead trout.

Populations of salmon and steelhead trout have been declining for decades. When Europeans first arrived in California salmon and steelhead trout were abundant. Human activities, beginning with the mining of gold in the mid 1800's followed by logging, irrigated agriculture, hydroelectric power generation, and many other practices in managing water and land, have seriously reduced or degraded habitats for salmon and steelhead. As habitats deteriorated, stocks of salmon and steelhead trout declined. The commercial salmon fishery has faced continued reductions in fishing opportunity and harvest. The sport fishery has also been seriously curtailed. The trend must be stopped and reversed if these fisheries are to continue to play a significant role in the state's economy.

Three major anadromous salmonids are found in California: chinook (king) and coho (silver) salmon and steelhead trout. These migratory species have evolved complex life histories. They require two primary habitats: freshwater streams and the Pacific Ocean. Salmon and steelhead trout generally reproduce in streams flowing from forested watersheds, spend the first part of their lives in freshwater streams, migrate to the estuaries for an undetermined period, then move into the ocean, where they mature. When they return to fresh water to to spawn, a strong homing instinct leads them back to their natal stream. The chinook and coho salmon die soon after spawning. Steelhead trout return to the ocean and can return to fresh water to spawn again.

The spatial and temporal habitat requirements of these species vary considerably, even among races within a species; therefore, the life history of each group is unique and complex. Although, salmon and steelhead trout are well studied, the complexity and variability of their life histories leave many gaps in our knowledge base.

Goals and Objectives

In response to public concern about the decline in numbers of salmon and steelhead trout the California legislature's Joint Fisheries and Aquaculture Committee reestablished a special advisory committee. This committee was directed by the legislature to develop a comprehensive management plan for the preservation, protection, restoration, and enhancement of salmon and steelhead trout in California.

In order to meet the challenge of restoring and enhancing these fisheries, the committee has proceeded along several avenues. One approach was to present a workshop designed to identify researchable questions and generate a research and development plan to address these questions. The purpose of the RD&E plan was to provide knowledge and methods to protect, restore, and enhance salmon and steelhead trout populations in California.

Problems Needing Solutions

Attempts to halt the decline of salmon and steelhead trout in California have met and will continue to meet immense difficulty. The difficulty stems from the complex life history and number of stocks of these fishes. At least three habitats are required for spawning, rearing, and migration in fresh water. The factors limiting production in the streams may be the result of poor management practices, water policies, dams, unscreened or poorly screened diversions, or natural processes such as severe flooding.

Habitat improvement programs have been instituted based on current knowledge and methods. However, these habitat improvement programs often lack adequate understanding of the needs of fish or factors limiting their production in a given situation. The result has often been inefficient utilization of funds allocated for habitat enhancement.

Artificial propagation programs have rarely been satisfactory as mitigation of lost spawning habitat. In some cases hatchery releases may even have been counter-productive through their competition with natural stocks. Advances in genetic identification, breeding, and proper husbandry practices in hatcheries are needed if mitigation levels are to be met. More information on the timing of hatchery releases and smoltification could potentially increase the survival of artificially propagated stocks.

Processes controlling distribution and abundance of salmon and steelhead trout in estuaries and the ocean are poorly known. Great costs and difficulty of data acquisition under oceanic conditions have been and will continue to be factors in understanding marine life histories. However, data must be collected to establish the long-term relationships of oceanic conditions with fluctuations in growth, survival, and probability of spawning for salmon and steelhead trout.

Three recent workshops (Pearcy 1983, Lisle 1984, Everest 1986) summarized current research questions in freshwater and marine habitats for California and the Pacific Northwest. Using these sources, as well as soliciting responses from commercial and sport fishermen, government resource managers, university scientists, and consultants, we compiled a working list of 139 problems needing solutions.

Organization of the Workshop

To outline a research, development, and extension program aimed at solving these problems, a workshop was convened on 25-26 March on the campus of the University of California at Davis. The three-part workshop involved groups of technical experts and users of technology. The technical group consisted of scientists, specialists, and consultants. Fishermen, representatives of landowners, resource managers, governmental regulatory and service agencies made up the group of users. The 54 participants represented a broad spectrum of people and organizations concerned with salmon and steelhead trout in California (Appendix A).

The first half-day session of the workshop was designed to review and revise the working list of problems needing solutions. Working in seven small groups the participants revised the list of problems and rated each of the problems. Their ratings of priority used this scale:

1. Marginal. Research, development or extension is needed, but the problem is not important over the next 10 years. The problem should receive very low priority in allocating new funds or retaining funds at existing levels.

2. Moderate. The problem is more than marginal in importance with regards to needs over the next 10 years but is definitely not very urgent. The problem should have low priority for funding.

3. Important. The problem is definitely of priority in terms of needs over the next 10 years. Not undertaking work on the problem would significantly limit ability to manage salmon and steelhead trout. The problem should receive priority for funding.

4. Urgent. The problem is very important, and work not being undertaken would have serious adverse effects on efficient management of salmon and steelhead trout. It is urgent that activities in this area be expanded.

5. Critical. The problem is definitely of extreme importance over the next 10 years. The urgency of the problem and the possibility that solution promises significant benefit warrant giving the problem the highest priority. It is extremely urgent that activities in this area be expanded.

The priority assigned by the small groups was the mean rating of only those who felt that they understood the significance of the technical problem. Some participants, feeling uninformed or otherwise not wanting to rate a problem, assigned a zero or null priority. These null priorities were not included in the mean priority ratings. The average ratings for the revised list of problems ranged from 1.5 to a highest possible 5.0 (Appendix B).

The second half-day session of the workshop gave users of technology as a group their chance to rate the priority of each of 116 problems. The same scale as above was used, priorities established by users in this session ranged from 1.8 to 4.5 (Appendix B).

All participants attending the second half-day session were asked to declare their affiliations on their ballots. The largest group represented were commercial fishermen with 13, followed by 8 from professional societies, 4 sport fishermen, 3 public land owners or managers, and 3 from other governmental agencies. Participants tended to trickle in and out of the workshop, so the total number of ratings for the problems ranged between 27 and 30. Ratings by each group are presented in Appendix C.

The ratings for the commercial fishermen were compared with the mean ratings for all participants. This group was selected because they are the primary end users of research, development, and extension programs and because they were represented by the largest number of participants. Representatives of the commercial fishermen rated several problems higher than the total voting body. Problems they considered important were 1-4; 2-10; 3-12; 8-2 and 14; 9-1; and 12-1, 3, and 5. Prob-

lems 1-4, 2-10, and 9-1, were rated by the commercial fisherman in the urgent-critical range (ratings between 4.0 and 4.5), These problems dealt with identifying water sources to increase flows during emigration, estimating lifestyle values associated with commercial fishing, and determining long-term relationships between oceanic conditions and salmonid production. Several problems were rated lower by commercial fishermen than the overall average. These were 3-4, 7, 8, 13, 14, and 21; 4-13; and 7-4. Of these problems only 3-11 and 14 were rated as important by all second-session participants (Appendix C). Problem 3-11 dealt with micro- and macrohabitat partitioning among species of juvenile salmonids, and problem 3-14 concerned the relationship of woody debris to fish habitat.

Priority Problems

Participants at the second session overall rated 18 problems as urgent to critical (ratings between 4.0 and 4.5) and 60 problems as important to urgent (ratings between 3.0 and 3.9); therefore, the participants rated at least 78 problems as deserving inclusion in a research, development, and extension program. In the critical category were these problems:

1. Water

1-1 Analyze and propose revisions of water policy, laws, and institutional arrangements as they affect habitats for anadromous fish Priority 4.3

1-5 Identify impacts on salmon and steelhead trout of contracting and delivering more than a million acre feet of "surplus" water from within the Central Valley Project Priority 4.5

1-6 Identify regimes of natural or regulated stream flow to meet in-basin requirements of salmon and steelhead trout Priority 4.2

1-9 Analyze effects of constitutional and statutory preferential treatments for irrigated agriculture, hydroelectric power generation, and other water developments on salmon and steelhead trout protection Priority 4.1

1-12 Reassess the risk to fisheries of the "safe yield basis" for estimating water

surpluses in California Priority 4.3

2. Economics

2-1 Determine socioeconomic contributions of salmon and steelhead trout to local and statewide economies Priority 4.3

2-9 Establish credible methods for establishing non-market values of salmon and steelhead trout Priority 4.3

3. Habitat Requirements and Limiting Factors in Fresh Water

3-16 Evaluate existing methods and structures and establish performance criteria for in-stream habitat improvements, especially those designed to increase production of smolts Priority 4.0

3-22 Determine behavioral interactions of hatchery-reared and wild stocks and whether presence of hatchery-reared fish influences survival of wild fish Priority 4.0

4. Natural Processes

4-11 Determine how changes in inputs of sediment and associated changes instream channels affect fish habitats under varying watershed conditions Priority 4.0

4-14 Develop methods to schedule releases of impounded water during peak flows to flush fine sediment and maintain fish habitats Priority 4.0

5. Land-Use Relationships and Effects

5-6 Evaluate effects of water quality, especially such sediment-borne constituents as heavy metals and pesticides, on critical life stages of salmon and steelhead trout Priority 4.1

5-8 Determine human impacts, such as urbanization, sedimentation, pollution, and coastal engineering, on fish habitats in lower rivers and estuaries Priority 4.2

5-22 Identify and assess cumulative effects of timber harvest on erosion, hillslope stability, stream-flow, and sediment in stream channels Priority 4.1

5-28 Evaluate potential effects of installing additional riprap along the Sacramento River and other streams having salmon and steelhead trout Priority 4.1

11. Education

11-2 Define, develop, and present a program for education, in the broadest sense (e.g., schools, universities, special-interest groups, etc.) that emphasizes the utilization, conservation, restoration, and enhancement of anadromous salmonid resources and habitat Priority 4.5

12. Passage Facilities

12-4 Improve and evaluate screening systems to make fish safe from pumps Priority 4.0

12-6 Evaluate and recommend on current operations of major screening systems as they relate to mortality by entrainment and impingement of salmon and steelhead trout Priority 4.3

An RD&E Program to Solve Problems

The third workshop session reconvened the small technical teams to propose the content and estimate costs of a program to solve the highest-rated problems. The workshop took the tack of developing a program based on one to six of the highest priority problems from each of the 12 major categories, except for categories 4 and 6. In some categories the problems were rated urgent to critical while others were rated important to urgent. The participants of the third session consisting mostly of the technical experts, formed into small groups. Their challenge was to outline a RD&E program that would solve the problems in 10 years and would provide managers of California's fisheries and habitat the technology required to restore and enhance salmon and steelhead trout populations.

The teams outlined targets, subtargets, and activities to approximate solutions to the problems (Appendix D). Activities to fulfill the subtargets were scheduled for periods of time ranging from one to 10 years (Appendix E).

The research phases of the program were not restricted by particular location. Instead locations would be dictated by programmatic need. For particular subtargets, however, the technical experts suggested focusing the research on a limited number of watersheds to be determined at a later date.

Targets for an RD&E Program

Target 1 - Provide fresh water needed for fisheries. Assess current status of contractual arrangements for and delivery of promised water resources and relevant policies, regulations, and laws; identify problems and propose resolutions related to these contracts to reassess the risk to fisheries of the "safe yield basis" for estimating water surpluses; identify extant water sources to increase stream flows during fish emigration; and analyze effects on salmon and steelhead trout of preferential treatment of irrigated agriculture, hydroelectric power generation, and other water development.

Target 2 - Understand social and economic significance of fisheries. Develop methods to determine the economic contribution of salmon and steelhead through local and state markets; establish the nonmarket values of salmon and steelhead trout to all state residents, but particularly to native Americans; estimate values associated with the lifestyle of commercial fishing; develop methods to assess the costs and benefits of restoring and enhancing stream habitats; and compare costs and benefits associated with salmon and steelhead trout to other resources.

Target 3 - Determine requirements and limiting factors in fresh water. Determine requirements and limitations of stream habitat—including cover, substrate, and water flow—in relation to spawning, rearing, and migration; determine requirements of juveniles related to food, water quality, competition, and predation; evaluate existing methods and structures designed to improve habitat for salmon and steelhead trout; and establish criteria for judging performance of instream habitat improvements, especially those designed to increase

the production of smolts.

Target 5 - Determine relationships between alternative uses of land and effects on freshwater habitats. Determine reactions and relations of fish to sediment, woody debris, and channel changes; identify sources, nature, amount, and routing of sediments and woody debris in four representative basins; determine characteristics and changes of stream channels and the resulting effects on fish in these same basins; model cumulative effects of land use on fish production in the four basins; determine seasonal populations and patterns of migration of juveniles and smolts as well as distribution and characteristics of holding areas for adults; determine the interactions of salmon and steelhead trout with other species; reconstruct history of lower rivers and estuaries to better evaluate growth and survival of smolts in relation to bank clearing, riprapping, channelization, water development, and water quality; evaluate environmental and economic costs and benefits of alternative regulations affecting lower rivers and estuaries.

Target 7 - Provide systems for classification and inventory of resources. Determine short- and long-term variations in escapement and spawning by adults; examine relationships among watersheds and production of juveniles; develop methods to estimate the origins of fish caught in the ocean, e.g., electrophoresis of allozymes, patterns on scales or other body parts, physical tags, or mitochondrial DNA.

Target 8 - Improve technology related to artificial propagation. For one targeted watershed and species, determine the environmental, genetic, and physiological factors influencing time of smoltification and emigration; develop criteria for scheduling the release of hatchery-reared fish to maximize survival in the ocean; develop a genetics, breeding, and husbandry program to insure long-term maintenance of populations and optimization of production.

Target 9 - Understand effects of ocean conditions on fish. Determine long-term relationships between oceanic conditions and fluctuations in growth, survival, and age at maturity of fish; determine differences in oceanic survival between wild and hatchery-reared stocks by marking wild and hatchery-reared fish in a coordinated release program.

Target 10 - Understand the significance of estuaries and ocean inlets to salmon and steelhead trout. Determine impacts of estuarine habitats on productivity of salmonids in two or three selected estuaries in relation to size class and density.

Target 11 - Support a statewide educational program on salmon and steelhead trout. Find a governmental agency or other organization willing to accept the responsibility for a state-wide educational program on salmon and steelhead trout; devise a program, which can be developed into a formal, state-wide educational program to increase the public's general awareness of the scientific, social, and political issues related to the resource and its utilization, conservation, restoration, and enhancement.

Target 12 - Improve facilities for passage and screening to protect migrating fish. Improve systems to decrease fish mortality associated with screens at water diversions and dams.

Costs for an RD&E Program

Activities to achieve these targets and subtargets were spelled out by the small groups of technical experts in the third workshop session. These activities provided a basis for estimating the professional effort and capital investments required for a 10-year RD&E program (Appendix E). The activity schedules provided a framework for estimating costs in scientist-years and extension-years to solve each target problem.

Cost per year of a scientist in a university or governmental setting was assumed to be $140,000. This total cost includes salaries, travel, equipment, rent, utilities, supporting technical and clerical workers, and program administration. Also included are the costs of an extension program to transmit the research and development findings to the users of this technology. The full cost per year of an extension specialist or advisor was assumed to be $100,000.

The costs for the first year of the full program would be about $8.4 million. Costs for the program would increase from the first to fourth year to approximately $12 million a year. Thereafter, costs would decline to about $5.5 million per year. Total costs for a 10-year RD&E program would be $90.9 million.

The total cost reflects the funding needed to resolve 35 problems which received ratings ranging from important to critical. Forty-six important problems were not addressed by the proposed program. If they were to be included in a comprehensive RD&E program, the overall cost would perhaps double.

Conclusions

California salmon and steelhead trout populations have been in decline for decades. Agencies charged with managing salmon and steelhead trout resources have been faced with multiple problems of inadequate understanding of habitat requirements, population levels, and decline of habitats where the fish can spawn and rear. Numerous specific problems, identified by technical experts and users of technology, need to be solved if the decline in salmon and steelhead trout populations is to be stopped and reversed. An RD&E program to solve 35 of the most critical problems facing anadromous salmonids has been outlined. Costs for this RD&E program would be $8.4 million the first year and $90.9 million during 10 years. Salmon and steelhead trout contribute substantially to the economy of California through the commercial and sport

fishing industries, and they are part of the subsistence of many native Americans. Due to these needs the RD&E program proposed for salmon and steelhead trout would seem to be a necessary and worthwhile investment for the public good.

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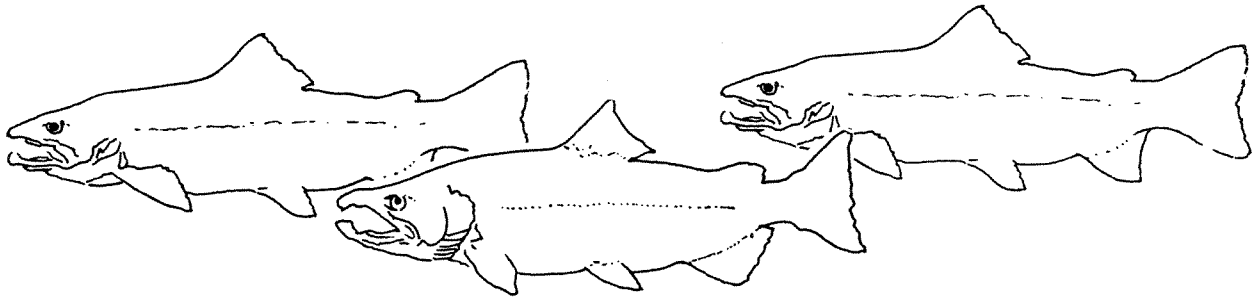
Appendix A: Participants registered at the workshop on salmon and steelhead trout, Davis, California, 25-26 March 1987

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Appendix B: Problems and ratings of priority[1] for a research, development, and extension program for salmon and steelhead trout in California.

Average ratings of priority by		Problem	
Users	Specialists	Number	

Topic 1 - Water

4.3	4.3	1-1	Analyze and propose revisions of water policy, laws, and institutional arrangements as they affect habitats for anadromous fish (2)[2]
3.6	3.0	1-2	Propose remedial alternatives for mitigation of inadequate water projects or diversions
3.0	2.0	1-3	Assess the projected water consumption in California in the short term (20 years) and in the long term in terms of potential impacts on salmon and steelhead (13)
3.9	4.3	1-4	Identify extant water sources to increase downstream flows during emigration in the Sacramento, San Joaquin, Klamath, and Trinity River systems (13)
4.5	5.0	1-5	Identify impacts on salmon and steelhead of contracting and delivering more than 1 million acre feet of "surplus" water from within the Central Valley Project (14)
4.2	4.1	1-6	Identify regimes of natural or regulated stream flow to meet in-basin requirements of salmon and steelhead (29)
4.1	4.0	1-9	Analyze effects of constitutional and statutory preferential treatments for irrigated agriculture, hydroelectric power generation, and other water developments on salmon and steelhead protection (29, workshop)
3.4	3.1	1-11	Examine institutional and technical requirements to restore winter-run chinook salmon in the Sacramento River (31, workshop)
4.3	4.7	1-12	Reassess the risk to fisheries of the "safe yield basis" for estimating water surpluses in California (workshop)
3.9	3.7	1-13	Identify future statewide needs for water for salmon and steelhead (workshop)

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[1] Priority rating scale:

1. Marginal. Research, development, or extension is needed, but the problem is not important over the next 10 years. The problem should receive very low priority in allocating new funds or for retaining funds at *existing levels of funding.*

2. Moderate. The problem is more than marginal in importance in terms of needs over the next 10 years but is definitely not urgent. The problem should have low priority for funding.

3. Important. The problem is definitely of priority in terms of needs over the next 10 years. Not undertaking work on the problem would significantly limit ability to manage lands or resources. The problem should receive priority for funding.

4. Urgent. The problem is very important and work not being undertaken would have serious adverse effects on ability to manage lands or resources. Urgent that activities in this area be expanded. The problem is of high priority for funding.

5. Critical. The problem is definitely of extreme importance over the next 10 years; the urgency of the problem and the possibility that solution promises significant public benefit warrant giving the problem highest priority. Extremely urgent that activities in this area be expanded.

[2] Parenthetic numbers refer to sources for problem statements. Sources are listed on page 33.

Average ratings of priority by		Problem	
Users	Specialists	Number	

Topic 2 -Social and Economic Considerations

Users	Specialists	Problem Number	
4.3	4.0	2-1	Determine socioeconomic contributions of salmon and steelhead to local and statewide economies (2)
3.6	3.7	2-2	Establish credible procedures for estimating costs and benefits of anadromous fish habitats versus other resources (1)
3.3	2.4	2-3	Determine economic costs and benefits of maintaining the genetic diversity of wild stocks (12)
3.9	3.9	2-4	Develop methodology for analyzing costs and benefits of restoring and enhancing habitats in streams (20)
3.4	3.6	2-5	Identify incentives for private property owners to conserve land and water (13)
3.2	3.5	2-6	Explore alternative incentives to make erosion control for protection of salmon and steelhead more attractive to private landowners (5)
2.8	2.8	2-7	Determine economics of alternative grazing methods for rehabilitation of watersheds important for spawning and rearing of juveniles (1)
3.0	2.4	2-8	Develop reliable, cost-effective methods for rehabilitating forest and rangeland riparian habitats (1)
4.3	5.0	2-9	Establish credible methods for establishing non-market values of salmon and steelhead (workshop)
3.7	4.9	2-10	Develop suitable methodology and estimate values associated with the lifestyle of commercial fishing (workshop)
3.8	4.9	2-11	Establish methods and estimates of values of salmon and steelhead to indian peoples (workshop)

Topic 3 - Habitat requirements and limiting factors in freshwater

Users	Specialists	Problem Number	
1.9	2.0	3-1	Identify how requirements for spawning, rearing, and migrating change within the range of a particular species and how behavioral factors are responsible for the differences (1)
2.9	2.7	3-2	Identify factors affecting emigration of salmon and steelhead down various rivers (8,20)
3.1	3.0	3-3	Identify factors affecting selection of spawning sites, especially as they relate to instream flows (8)
2.9	2.3	3-4	Determine whether salmon and steelhead are limited by the number of adults spawning, at least in selected streams (20)
3.8	4.1	3-5	Identify limitations due to habitats on all life stages, but particularly on juveniles (2,11,16,17,18,19,20,21,28)
3.0	2.6	3-6	Determine the relationship between survival and duration of rearing in streams (12)
2.6	2.9	3-7	Identify how required habitats for rearing change with respect to seasonal conditions (1)
2.3	2.6	3-8	Evaluate required habitats for rearing with respect to winter conditions in ponded areas in main channels and off-channel areas (1,6)
2.4	2.2	3-9	Identify behavioral changes related to changes in temperature and turbidity (6)
2.5	2.8	3-10	Correlate number and size of juveniles being reared in summer habitats with primary production of invertebrates (12)

Average ratings of priority by Users	Specialists	Problem Number	
3.1	4.0	3-11	Determine use and partitioning of micro- and macrohabitats among species of juvenile salmonids (1)
3.2	2.9	3-12	Determine whether populations are limited by availability of habitats for adults returning to spawn (12)
1.8	2.2	3-13	Determine causes and temporal patterns of movements by adults among holding pools (12)
3.2	3.8	3-14	Disseminate information concerning relationships of woody debris to fish habitat (1)
3.6	3.3	3-15	Establish roles of natural stream structures (organic debris, logs, and rocks and boulders) as well as of man- made structures (gabions), in creating pool habitats favorable for juveniles (1)
4.0	4.3	3-16	Evaluate existing methods and structures and establish performance criteria for in-stream habitat improvements, especially those designed to increase production of smolts (2,4,9,13,19,21)
3.0	2.8	3-17	Determine relationships of cobble imbeddedness and presence of sediment to habitat selection by all life stages. (1)
2.8	2.4	3-18	Relate survival of fish embryos to conditions within gravels (1)
2.6	2.1	3-19	Determine how competition from other fishes and amphibians influences growth and survival to the smolt stage (4)
2.8	3.0	3-20	Evaluate impacts of predation by mammals, birds, and fish and effects of habitat on predation, especially for smolts (6,20)
2.0	1.6	3-21	Determine behavior of other members of the aquatic community in cold pools and how their behavior affects salmon and steelhead (7)
4.0	3.7	3-22	Determine behavioral interactions of hatchery-reared and wild stocks and whether presence of hatchery-reared fish influences survival of wild fish (4,16,17,24)
1.8	1.8	3-23	Relate sources and sinks of organic material and areas producing aquatic invertebrates during winter to habitats used by salmon and steelhead (6)
3.6	3.8	3-24	Compare and model relationships between escapement and smolt production (2,21)
3.6	3.3	3-25	Determine how low flows of water limit productivity in streams during late summer (4,17,26)
3.4	3.7	3-26	Determine how high flow and low temperature in streams during winter affect growth and survival to the smolt stage (4,17,26)
3.1	3.1	3-27	Determine how water flow influences survival of fish embryos and determine potentials for increasing productivity by stabilizing flow (28)
3.5	4.2	3-29	Develop multivariate models to predict relationships between production of smolts and flow in streams (18)
3.7	4.0	3-30	Determine best emigration routes and stream-flow regimes for survival of chinook salmon smolts from the San Joaquin drainage (29, workshop)
3.1	3.7	3-31	Determine the extent to which partial barriers, such as bedrock ledges, restrict upstream movement of adults during low flow of water (workshop)

Topic 4 - Physical processes in streams

2.2	2.5	4-10	Determine how pools holding cold water are formed during summer low flows and whether cold water in these pools increases growth and survival of fish (workshop)

Average ratings of priority by		Problem Number	
Users	Specialists		
4.0	4.3	4-11	Determine how changes in input of sediment and associated changes in stream channels affect fish habitats under varying watershed conditions (workshop)
3.2	3.3	4-12	Develop a model for predicting responses of fish to sedimentation in different stream types (workshop)
2.6	2.7	4-13	Determine how habitats and their use by fish vary with different land types (workshop)
4.0	4.5	4-14	Develop methods to schedule releases of impounded water during peak flows to flush fine sediment and maintain fish habitats (workshop)

Topic 5 - Land-use relationships and effects

4.1	4.2	5-6	Evaluate effects of water quality, especially such sediment-borne constituents as heavy metals and pesticides, on critical life-stages of salmon and steelhead (23)
4.2	4.3	5-8	Determine human impacts, such as urbanization, sedimentation, pollution, and coastal engineering, on fish habitats in lower rivers and estuaries (4)
3.2	3.2	5-9	Determine effects on fish habitats of existing management of grazing in riparian areas on fish habitats (1)
2.5	2.3	5-11	Develop models for predicting responses of fish habitats to grazing (1)
3.6	3.7	5-15	Develop and extend methods to predict and monitor effects on salmon and steelhead of diversions of water for irrigation and small hydroelectric projects (7)
3.7	3.7	5-16	Determine past and current effects of diversions of water on escapement of late-run fish (12)
3.7	4.0	5-20	Evaluate effects of land uses, including timber management, urbanization, and agriculture on the amount, distribution, and timing of large woody debris entering streams (workshop)
3.8	4.2	5-21	Establish how riparian vegetation and large woody debris affect fish habitat in various stream types (workshop)
4.1	4.7	5-22	Identify and assess cumulative effects of timber harvest on erosion, hillslope stability, streamflow, and sediment in stream channels (workshop)
3.5	3.8	5-23	Develop and test methods for evaluating success of watershed stabilization projects (workshop)
3.6	4.2	5-24	Establish criteria for maintenance of spawning gravel below impoundments or structural diversions (workshop)
3.9	4.0	5-25	Determine local and downstream effects of gravel mining in streams used by salmon and steelhead (workshop)
3.6	4.0	5-26	Develop methods to predict and monitor effects of gravel mining in streams used by salmon and steelhead (workshop)
3.3	3.7	5-27	Develop methods to assess and monitor local and downstream effects of suction dredging (workshop)
4.1	4.2	5-28	Evaluate potential effects of installing additional riprap along the Sacramento River and other streams having salmon and steelhead (workshop)
3.5	3.7	5-29	Develop criteria for enforcement of mitigation where riprapping is or will be allowed through the permit process (workshop)

Average ratings of priority by		Problem	
Users	Specialists	Number	

Topic 6 - Interagency coordination

Users	Specialists	Number	
2.8	2.3	6-1	Evaluate needs for a statewide plan for coordinating management and research on fish habitats with other resource management activities (2,20)
2.8	1.7	6-5	Establish uniform and coordinated methods for use by various agencies and groups to collect data on fisheries, and provide for reasonable access to and exchange of data on local fisheries (17)

Topic 7 - Inventory and classification

Users	Specialists	Number	
3.1	2.9	7-1	Develop standardized, quantitative, and replicable methods to document abundance of fish and habitat conditions (1,4,17,19)
2.6	2.6	7-3	Develop methods to classify aquatic habitats as a basis for developing fish-production models. (1)
2.4	1.8	7-4	Improve capabilities for measuring physical variables in streams with the help of fluvial geomorphologists (7)
3.2	3.8	7-5	Determine how factors other than habitat (such as, but not limited to, disease, genetics, weather, and ecological relationships) influence populations of fish (1)
3.8	4.4	7-6	Assess current capacities of stream basins for natural spawning and determine the short- and long-term effects of variation in escapement of spawning adults on structure and viability of populations (workshop)
3.5	4.0	7-7	Assess current methodologies and develop improved methodology for estimating numbers of adults spawning (workshop)
3.4	4.1	7-8	Develop and evaluate biochemical and other methods of estimating origins or sources of salmon and steelhead caught in ocean and inland fisheries (7,12,17,20,21,24)
--	3.3	7-9	Expand California Department of Fish and Game's Central Valley Project for fall-run and winter-run chinook to estimate inland sport harvest, returns of marked fish, ages of returning adults, and success of emigration by juveniles (workshop)

Topic 8 - Artificial propagation

Users	Specialists	Number	
1.9	1.7	8-1	Develop strategies, based on sound biological data, for assessing achievability of goals and objectives both for mitigating and for enhancing production levels (2)
3.6	5.0	8-2	Develop genetics, breeding, and proper husbandry as part of applied hatchery programs, to ensure long-term, maintenance of salmon and steelhead populations and optimize salmon production. (24, workshop)
3.2	3.5	8-5	Determine biological and economical feasibility of citizen-operated propagative programs and develop an information dissemination program (3, workshop)
2.3	2.0	8-6	Determine implications on the north-coast fisheries of public and private salmon ranching (17)
3.9	4.7	8-7	Develop criteria for determining optimal timing of release so that emigration and entry into saltwater occur at times which maximize oceanic survival (22, workshop)
2.6	3.0	8-12	Determine whether exposure of smolts to seawater under controlled conditions before releases into the ocean may substantially increase survival (7)

Average ratings of priority by Users	Specialists	Problem Number	
2.8	3.5	8-13	Determine nutritional effects of diets at hatcheries on oceanic survival (7, workshop)
2.8	3.0	8-14	Isolate and identify potential bacterial, viral, and protozoan pathogens of fish, determine their effects on oceanic survival, and develop vaccines against important marine pathogens (7, workshop)
2.7	4.7	8-19	Develop environmental, physiological, and genetic methods to alter time of smoltification and emigration (workshop)
3.0	4.2	8-20	Develop methods for preservation and propagation of identified strains of salmon in hatcheries (workshop)

Topic 9 - Oceanic effects

3.9	4.5	9-1	Determine long-term relationships between oceanic conditions and fluctuations in growth, survival, and probability of spawning of salmon and steelhead; develop a usable model (7)
2.7	2.8	9-2	Develop an economical plan to provide data on year-to-year variations in upper ocean conditions (7)
2.2	1.5	9-4	Improve our understanding of oceanic distribution of specific stocks through the use of discriminant function analysis of patterns on scales or otoliths (7)
2.7	3.5	9-5	Determine interactions in the ocean among stocks and species of salmonids (7)
3.0	3.3	9-6	Determine density-dependent effects within a salmonid stock in the ocean (7)
3.2	3.8	9-9	Relate the age and size of fish caught in the ocean over time to long-term effects of oceanographic conditions (15)
3.6	4.3	9-11	Determine distribution, abundance, and migration of smolts early in their oceanic life near the coast (15)
3.6	3.8	9-12	Determine variability of oceanic survival of wild and hatchery-reared stocks from a particular region (7)
3.6	3.3	9-13	Identify locations in estuaries or in the ocean and the related life-stages where mortality occurs (7)
3.3	3.8	9-14	Determine interactions among salmonids and all other species. Complete a multi-species evaluation of California fisheries that includes the impact of fishing on salmonids and their forage species (16)
2.9	3.3	9-15	Determine distribution, abundance, and migration of adults late in their oceanic life (workshop)

Topic 10 - Estuaries and inlets

3.8	3.3	10-1	Determine present and historic roles of lower rivers and estuaries in productivity of smolts (4,13,20,21,26)
3.8	3.0	10-3	Determine amount of estuarine habitat available statewide and its contribution to salmon and steelhead production compared with historical conditions (6,26)
2.8	2.5	10-4	Determine sizes and numbers of fish emigrating from selected estuaries (7)
2.9	3.0	10-5	Determine effects of physiological variables on mortality of smolts (e.g., smoltification on feeding readiness) (7,18)
3.7	3.5	10-7	Determine how size and density of smolts when they enter estuaries and duration and place of residence in estuaries affect survival (7,18)

Average ratings of priority by		Problem Number	
Users	Specialists		

Topic 11 - Education

3.8	4.2	11-1	Examine and upgrade the aquatic portion of Project Wild, administered by the California Departments of Education and of Fish and Game, to include anadromous salmonids (2, workshop)
4.5	5.0	11-2	Define, develop, and present a program for education, in the broadest sense (e.g., schools, universities, special-interest groups, etc.) that emphasizes the utilization, conservation, restoration, and enhancement of anadromous salmonid resources and habitat (13,17,20, workshop)
3.7	4.5	11-3	Evaluate the need for a newsletter covering scientific, social, and political issues (utilization, conservation, restoration, and enhancement) relating to salmon and steelhead (workshop)
3.7	5.0	11-4	Identify an agency, organization, or consortium to supervise and coordinate the educational programs outlined in 11-1,2,3 (workshop)

Topic 12 - Passage facilities and screening systems

2.1	1.6	12-1	Evaluate potentials for construction of channels for fish to pass from a dam to streams entering a reservoir (25)
1.9	1.7	12-3	Evaluate potentials for construction of elevators or lifts to transport fish up the face of dams to a reservoir or fish-passage facility (25)
4.0	3.2	12-4	Improve and evaluate screening systems to make fish safe from pumps (30, 31, workshop)
2.7	1.8	12-5	Evaluate new designs for fish ladders (31, workshop)
4.3	---	12-6	Evaluate and recommend on current operations of major screening systems as they relate to mortality by entrainment and impingement of salmon and steelhead trout (workshop)

Appendix C: Average ratings of priority[1] by individuals representing groups of users for attention to 116 problems[2] related to salmon and steelhead trout

Problem	Fishing Commercial Prior.	No.	Sport Prior.	No.	Public Land Owner/Mgr. Prior.	No.	Other Gov't Prior.	No.	Professional Societies Prior.	No.	Individuals Prior.	No.	Not Rating
1-1	4.4	13	5.0	4	4.5	2	4.0	3	3.7	6	4.3	29	0
1-2	3.7	13	3.5	4	3.5	2	4.3	3	3.2	6	3.6	29	0
1-3	2.9	13	2.5	4	3.0	2	4.0	3	3.3	6	3.0	29	0
1-4	4.5	12	4.3	4	4.0	2	4.0	3	2.5	6	3.9	28	1
1-5	4.9	13	4.8	4	4.5	2	4.7	3	3.3	6	4.5	29	0
1-6	4.5	13	4.5	4	4.0	2	4.0	3	4.0	6	4.2	29	0
1-9	4.2	13	4.3	4	3.5	2	4.7	3	3.8	6	4.1	29	0
1-11	3.2	13	3.8	4	3.5	2	3.7	3	3.3	6	3.4	29	0
1-12	4.4	13	4.8	4	4.5	2	4.3	3	3.5	6	4.3	29	0
1-13	4.2	13	3.8	4	4.5	2	4.0	3	3.3	6	3.9	29	0
2-1	4.4	12	5.0	4	4.0	2	4.5	2	4.0	6	4.3	27	0
2-2	3.3	11	4.3	4	4.5	2	3.5	2	3.5	6	3.6	26	1
2-3	3.3	12	4.0	4	3.0	2	3.5	2	2.8	6	3.3	27	0
2-4	4.1	12	4.0	4	4.0	2	4.5	2	3.3	6	3.9	27	0
2-5	3.4	12	3.8	4	4.0	2	3.5	2	3.0	6	3.4	27	0
2-6	3.3	12	3.5	4	4.5	2	2.5	2	2.8	6	3.2	27	0
2-7	2.6	12	3.3	4	3.0	2	3.5	2	2.8	6	2.8	27	0
2-8	2.6	12	3.3	4	4.0	2	4.0	2	3.2	6	3.0	27	0
2-9	4.2	11	4.8	4	4.0	2	5.0	2	4.2	6	4.3	26	1
2-10	4.1	12	4.5	4	2.0	2	3.5	2	2.7	6	3.7	27	0
2-11	3.8	12	4.8	4	3.5	2	3.5	2	3.2	6	3.8	27	0
3-1	1.5	11	1.8	4	1.5	2	2.0	3	2.7	6	1.9	27	1
3-2	3.1	12	2.5	4	3.0	2	3.3	3	2.8	5	2.9	27	1
3-3	3.4	12	3.0	4	2.5	2	2.7	3	3.0	6	3.1	28	0
3-4	2.5	12	2.5	4	2.5	2	3.7	3	3.8	6	2.9	28	0
3-5	3.8	12	3.5	4	4.5	2	3.7	3	4.2	6	3.8	28	0
3-6	2.8	11	3.0	4	2.5	2	3.3	3	3.5	6	3.0	27	1
3-7	1.7	11	2.5	4	4.0	2	3.7	3	3.2	6	2.6	27	1
3-8	1.7	11	2.3	4	4.0	2	2.0	3	3.2	6	2.3	27	1
3-9	2.2	12	2.5	4	1.5	2	2.7	3	2.8	6	2.4	28	0
3-10	2.3	11	2.5	4	2.5	2	2.7	3	3.0	6	2.5	27	1
3-11	2.7	11	3.0	4	5.0	2	3.3	3	3.3	6	3.1	27	1
3-12	3.6	12	3.0	4	2.0	2	2.7	3	3.2	6	3.2	28	0
3-13	1.5	12	2.0	4	1.5	2	1.7	3	2.3	6	1.8	28	0
3-14	2.7	12	3.8	4	4.0	2	3.0	3	4.2	6	3.2	28	0
3-15	3.3	12	4.0	4	5.0	2	3.7	3	3.7	6	3.6	28	0
3-16	3.8	12	3.5	4	5.0	2	4.3	3	4.3	6	4.0	28	0
3-17	2.7	12	2.5	4	4.0	2	3.3	3	3.5	6	3.0	28	0
3-18	2.8	12	3.3	4	2.0	2	3.0	3	2.7	6	2.8	28	0

[1] Priority rating scale:
1. Marginal. Research, development, or extension is needed, but the problem is not important over the next 10 years. The problem should receive very low priority in allocating new funds or for retaining funds at *existing levels of funding.* **2. Moderate.** The problem is more than marginal in importance in terms of needs over the next 10 years but is definitely not urgent. The problem should have low priority for funding. **3. Important.** The problem is definitely of priority in terms of needs over the next 10 years. Not undertaking work on the problem would significantly limit ability to manage lands or resources. The problem should receive priority for funding. **4. Urgent.** The problem is very important and work not being undertaken would have serious adverse effects on ability to manage lands or resources. Urgent that activities in this area be expanded. The problem is of high priority for funding. **5. Critical.** The problem is definitely of extreme importance over the next 10 years; the urgency of the problem and the possibility that solution promises significant public benefit warrant giving the problem highest priority. Extremely urgent that activities in this area be expanded.

[2] Problems are described in Appendix B.

	Fishing				Public Land Owner/Mgr.		Other Gov't		Professional Societies		Individuals		
	Commercial		Sport										
Problem	Prior.	No.	Prior.	No.	Prior.	No.	Prior.	No.	Prior.	No.	Prior.	No.	Not Rating
3-19	2.3	12	2.8	4	2.5	2	3.7	3	3.0	6	2.6	28	0
3-20	3.0	12	2.8	4	3.0	2	3.0	3	2.7	6	2.8	28	0
3-21	1.6	11	1.5	4	1.5	2	2.0	3	3.2	6	2.0	28	0
3-22	3.9	12	4.3	4	3.5	2	3.7	3	4.5	6	4.0	28	0
3-23	1.6	11	1.3	3	1.5	2	2.0	3	2.7	6	1.8	26	2
3-24	3.6	12	3.8	4	4.0	2	3.3	3	3.7	6	3.6	28	0
3-25	4.0	12	2.5	4	3.0	2	3.7	3	4.0	6	3.6	28	0
3-26	3.3	12	3.3	4	4.0	2	2.3	3	4.2	6	3.4	28	0
3-27	3.4	12	2.5	4	2.5	2	3.7	3	2.5	6	3.1	28	0
3-29	3.6	12	3.5	4	3.5	2	4.0	3	3.2	6	3.5	28	0
3-30	4.0	10	3.0	4	3.5	2	3.7	3	4.3	5	3.7	28	3
3-31	3.3	12	3.3	4	2.5	2	3.7	3	2.8	6	3.1	28	0
4-10	2.2	13	2.3	4	1.5	2	2.3	3	2.5	6	2.2	29	0
4-11	3.8	13	4.5	4	4.5	2	3.7	3	4.2	6	4.0	29	0
4-12	3.0	13	3.5	4	3.5	2	2.7	3	3.7	6	3.2	29	0
4-13	2.1	12	2.5	4	4.0	2	2.3	3	3.5	6	2.6	28	1
4-14	4.2	13	4.0	4	4.0	2	3.7	3	3.8	6	4.0	29	0
5-6	4.3	12	4.3	4	3.0	2	4.0	2	4.0	6	4.1	27	0
5-8	4.4	12	4.5	4	3.5	2	3.5	2	4.2	6	4.2	27	0
5-9	3.0	12	3.3	4	3.0	2	4.0	2	3.5	6	3.2	27	0
5-11	2.3	11	2.5	4	2.5	2	2.5	2	2.8	6	2.5	26	1
5-15	3.8	12	3.0	4	4.0	2	3.5	2	3.7	6	3.6	27	0
5-16	3.7	12	3.8	4	3.5	2	3.5	2	3.8	6	3.7	27	0
5-20	3.7	12	3.8	4	4.0	2	3.0	2	4.2	6	3.7	27	0
5-21	3.7	12	4.0	4	4.0	2	3.5	2	4.0	6	3.8	27	0
5-22	3.9	12	4.8	4	3.5	2	4.5	2	4.0	6	4.1	27	0
5-23	3.4	12	3.3	4	3.5	2	3.5	2	3.8	6	3.5	27	0
5-24	4.0	11	3.5	4	3.5	2	4.0	2	3.0	6	3.6	26	1
5-25	3.8	11	4.7	3	4.0	2	4.0	2	3.9	9	3.9	28	0
5-26	3.5	11	4.7	3	3.0	2	3.5	2	3.8	9	3.6	28	0
5-27	3.4	11	3.7	3	2.5	2	3.0	2	3.3	9	3.3	28	0
5-28	4.2	11	4.3	3	4.0	2	4.0	2	4.0	9	4.1	28	0
5-29	3.9	11	4.0	3	3.5	2	3.5	2	3.0	9	3.5	28	0
6-1	2.7	10	3.0	5	4.0	2	2.5	2	3.0	6	2.8	26	1
6-5	2.5	10	2.6	5	3.5	2	3.0	2	3.2	6	2.8	26	0
7-1	2.9	11	2.8	4	4.5	2	3.0	2	3.6	8	3.1	28	1
7-3	2.5	12	2.0	4	4.0	2	2.5	2	3.0	8	2.6	29	0
7-4	1.8	10	1.8	4	3.0	2	1.5	2	3.8	8	2.4	27	2
7-5	3.2	12	3.3	4	2.5	2	3.5	2	3.6	8	3.2	29	0
7-6	3.6	12	4.0	4	5.0	2	4.0	2	4.0	7	3.8	28	1
7-7	3.7	11	3.8	4	3.5	2	3.5	2	3.3	8	3.5	28	1
7-8	3.6	11	3.0	4	3.0	2	3.0	2	3.5	8	3.4	28	1
8-1	2.1	11	2.0	3	1.5	2	2.0	2	1.7	6	1.9	25	5
8-2	4.1	13	4.0	4	4.0	2	4.0	2	2.6	8	3.6	30	0
8-5	3.1	11	3.8	4	3.5	2	3.0	2	2.9	8	3.2	28	2
8-6	2.4	13	2.5	4	2.0	2	2.0	2	2.5	8	2.3	30	0
8-7	4.2	13	4.8	4	4.0	2	4.0	2	3.3	8	3.9	30	0
8-12	2.8	13	3.0	4	1.5	2	2.5	2	2.5	8	2.6	30	0
8-13	3.1	13	3.0	4	2.0	2	3.0	2	2.4	8	2.8	30	0
8-14	3.2	13	2.5	4	2.0	2	3.0	2	2.4	8	2.8	30	0
8-19	2.8	12	3.3	4	2.0	2	4.0	2	2.3	8	2.7	29	1
8-20	2.9	11	3.8	4	3.5	2	3.5	2	2.9	8	3.0	28	2
9-1	4.5	11	4.3	4	3.5	2	3.0	2	3.6	8	3.9	28	1
9-2	3.0	11	2.8	4	2.5	2	2.5	2	2.5	8	2.7	28	1
9-4	2.2	12	1.7	3	1.5	2	2.0	2	2.9	8	2.2	28	1

Problem	Fishing Commercial Prior.	No.	Sport Prior.	No.	Public Land Owner/Mgr. Prior.	No.	Other Gov't Prior.	No.	Professional Societies Prior.	No.	Individuals Prior.	No.	Not Rating
9-5	2.9	11	3.3	4	1.0	2	2.5	2	2.7	7	2.7	27	2
9-6	3.3	12	3.3	4	3.5	2	2.0	2	2.9	7	3.0	28	1
9-9	3.2	12	3.0	4	3.0	2	4.0	2	3.5	8	3.2	29	0
9-11	3.9	11	4.3	4	3.0	2	3.0	2	3.6	8	3.6	28	1
9-12	3.7	11	3.8	4	2.5	2	4.0	2	3.6	8	3.6	28	1
9-13	3.7	12	3.8	4	3.5	2	3.5	2	3.6	8	3.3	29	0
9-14	3.5	11	2.8	4	3.0	2	3.0	2	3.6	8	3.3	28	1
9-15	3.2	11	3.0	4	2.0	2	2.5	2	2.9	8	2.9	28	1
10-1	3.6	12	4.5	4	3.0	2	3.0	2	4.5	8	3.8	29	0
10-3	3.7	12	4.3	4	3.5	2	3.5	2	4.3	8	3.8	29	0
10-4	3.0	11	2.5	4	1.5	2	2.5	2	3.0	8	2.8	28	1
10-5	3.1	10	3.3	4	2.0	2	3.0	2	2.8	8	2.9	27	2
10-7	3.8	10	4.0	4	4.0	2	3.0	2	3.6	8	3.7	27	2
11-1	3.8	12	4.5	4	4.0	2	3.5	2	3.5	8	3.8	29	0
11-2	4.3	12	4.8	4	5.0	2	4.5	2	4.8	8	4.5	29	0
11-3	3.8	12	4.3	4	3.0	2	3.5	2	3.6	8	3.7	29	0
11-4	3.7	11	4.8	4	3.5	2	3.5	2	3.1	7	3.7	27	2
12-1	2.7	12	2.0	3	1.0	2	1.0	2	1.9	7	2.1	27	1
12-3	2.3	12	2.0	3	1.0	2	1.0	2	2.0	7	1.9	27	1
12-4	4.3	12	4.0	3	2.5	2	4.0	2	4.0	7	4.0	27	1
12-5	3.1	12	2.3	3	1.5	2	2.5	2	2.7	7	2.7	27	1
12-6	4.5	11	4.0	3	4.5	2	4.0	2	4.3	7	4.3	26	2

Appendix D: A plan for research, development and extension related to salmon and steelhead trout in California

Goal: Provide to managers of California's fisheries and habitats for salmon and steelhead trout the technology required to restore and enhance these fisheries and habitats.

Target 1.* Provide fresh water needed for fisheries

Subtarget 1.1 Suggest improvements for policies, regulations, laws, and arrangements related to delivering water affecting habitats and migration of fish (Problems 1-4,5,9,12,13) (Yr. 1, $770,000; 10-yr, $5,260,000) (Priority 4.5)

Activities

1.1.1	Assess current status of contractual arrangements for and delivery of promised water resources and of relevant policies, regulations, and laws
1.1.2	Identify problems and propose resolutions related to contracts, delivery, policies, regulations, and laws
1.1.3	Reasses the risk to fisheries of the "safe yield basis" for estimating water surpluses in California
1.1.4	Identify potential impacts on salmon and steelhead trout of contracting and delivering more than 1 million acre-feet of "surplus water" from the Central Valley Project
1.1.5	Identify extant water sources to increase stream flows during emigration of fish in the Sacramento, San Joaquin, Klamath, and Trinity River systems
1.1.6	Identify future statewide needs for water for salmon and steelhead trout
1.1.7	Analyze effects on salmon and steelhead trout resources of constitutional and statutory preferential treatment of irrigated agriculture, hydroelectric power generation, and other water developments
1.1.8	Convey findings and recommendations to affected special-interest groups

Target 2. Understand social and economic significance of fisheries

Subtarget 2.1 Develop credible social and economic data related to salmon and steelhead trout (Problems 2-1,4,9,10,11) (Yr. 1, $310,000; 10-yr, $5,640,000) (Priority 4.3)

Activities

2.1.1	Develop methodology and determine the economic contributions of salmon and steelhead trout through local and statewide markets
2.1.2	Develop and use new methods to establish the nonmarket values of salmon and steelhead trout
2.1.3	Establish methods and estimate values of salmon and steelhead trout to indian people
2.1.4	Develop suitable methodology and estimate values associated with the lifestyle of commercial fishing
2.1.5	Develop and apply methodology to assess the costs and benefits of restoring and enhancing habitats in streams
2.1.6	Compare costs and benefits associated with salmon and steelhead trout to costs and benefits associated with other resources
2.1.7	Disseminate new methodology and findings

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*Target numbers relate to topic numbers in Appendix B.

Target 3. Determine requirements and limiting factors in fresh water

Subtarget 3.1 Identify limitations due to habitats on all life stages (Problem 3-5) (Yr. 1, $1,590,000; 10-yr, $10,850,000) (Priority 3.8)

Activities

3.1.1 Determine requirements and limitations for immigration of adults including barriers, passages, holding areas, and water flow

3.1.2 Determine requirements and limitations related to spawning including cover, substrates, and water flow

3.1.3 Determine factors affecting survival and hatching of eggs, including gravels and water flow

3.1.4 Determine requirements of juveniles related to food, water quality, competition, and predation

3.1.5 Determine factors affecting smoltification and emigration including passage problems, flow and quality of water, and predation

Subtarget 3.2 Evaluate existing methods and structures and establish criteria for judging performance for instream habitat improvements, especially those designed to increase production of smolts (Problem 3-16) (Yr. 1, $320,000; 10-yr, $1,770,000) (Priority 4.0)

Activities

3.2.1 Summarize and disseminate available information

3.2.2 Determine choices among macrohabitats and microhabitats by each life stage

3.2.3 Measure parameters of microhabitats in relation to uses by different life stages

3.2.4 Survey to determine relative availability of microhabitats and macrohabitats

3.2.5 Determine structure of populations at intervals with respect to age, density, and species

3.2.6 Determine growth rate during each life stage for each species

Target 5. Determine relationships between alternative uses of land and effects on fresh water habitats

Subtarget 5.1 Provide land managers with methods to predict cumulative effects of timber management on production of fish (Problems 5-20,21,22) (Yr. 1, $680,000; 10-yr, $11,360,000) (Priority 4.1)

Activities

5.1.1 Define the problem; summarize and extend available information

5.1.2 Classify land areas by soil and sediment types and select sites for studies

5.1.3 Determine reactions and relations of fish to sediment, woody debris, and channel changes

5.1.4 Identify sources, nature, amount, and routing of sediments and woody debris in four representative basins

5.1.5 Determine characteristics and changes of channels and resulting effects on habitats for fish in four representative basins

5.1.6 Model cumulative effects of land use on fish production in four representative basins

Subtarget 5.2 Provide those responsible for selected lower rivers and estuaries an understanding of when, where, and how anadromous salmonids use them (Problem 5-8) (Yr. 1, $490,000; 10-yr, $5,230,000) (Priority 4.2)

5.2.1 Summarize and disseminate existing and new information

5.2.2   Determine seasonal populations and patterns of emigration of juveniles and smolts in selected main-stem rivers

5.2.3   Determine growth and survival of smolts in estuaries

5.2.4   Determine distribution and characteristics of holding areas for returning adults

5.2.5   Determine biological interactions among anadromous salmonids and other species

Subtarget 5.3 Provide to those responsible for selected lower rivers and estuaries an understanding of changes in habitats for anadromous salmonids in these areas (Problems 5-6,8) (Yr. 1, $490,000; 10-yr, $6,170,000) (Priority 4.2)

Activities

5.3.1   Reconstruct the chronology of human events on selected rivers and estuaries since 1850 and estimate effects of these events

5.3.2   Determine effects of riprapping on the Sacramento River and other rivers having extensive and ongoing riprapping

5.3.3   Determine effects of bank clearing, channelization, and sedimentation on physical habitats used by fish in lower rivers

5.3.4   Determine effects of sedimentation and coastal engineering on estuaries

5.3.5   Determine effects of water developments and pollution, other than sediment, on quality of water required by anadromous salmonids

5.3.6   Model responses of fish to existing and improved conditions of habitats

5.3.7   Evaluate environmental and economic costs and benefits of alternative regulations affecting lower rivers and estuaries

5.3.8   Provide procedures and standards for monitoring the status of anadromous salmonids and their habitats in lower rivers and estuaries

Target 7. Provide systems for classification and inventory of resources

Subtarget 7.1 Provide technology for determining short- and long-term variations in escapement and spawning by adults (Problems 7-6,7) (Yr. 1, $370,000; 10-yr, $5,660,000) (Priority 3.8)

Activities

7.1.1   Summarize and disseminate available information

7.1.2   Evaluate current methodologies for estimating escapement and spawning by adults

7.1.3   Determine relationships among watersheds, spawning, and production of juveniles

7.1.4   Determine short- and long-term variations in escapement and spawning by adults and in structure and viability of populations

7.1.5   Develop methods for monitoring recruitment of spawning adults and production of juveniles

7.1.6   Develop standards and guidelines for applying new methods

Subtarget 7.2 Develop biochemical and other methods for estimating origins of fish caught in the ocean (Problem 7-8) (Yr. 1, $650,000; 10-yr, $3,220,000) (Priority 3.4)

Activities

7.2.1   Evaluate existing and potential uses of electrophoresis of allozymes

7.2.2   Evaluate existing and potential uses of patterns on scales or other body parts

7.2.3   Evaluate existing and potential uses of physical tags

7.2.4 Evaluating existing and potential uses of mitochondrial DNA

7.2.5 Disseminate findings from evaluations to managers of fisheries and hatcheries, scientists, and client groups

7.2.6 Develop applications of optimum methods for use in managing fisheries

7.2.7 Plan long-term monitoring using improved methods

Target 8. Improve technology related to artificial propagation

Subtarget 8.1 For one target watershed and species, determine the environmental, genetic, and physiological factors influencing time of smoltification and emigration, and develop criteria for scheduling release of hatchery-reared fish to maximize survival in the ocean (Problems 8-7,19) (Yr. 1, $750,000; 10-yr, $12,150,000) (Priority 3.9)

Activities

8.1.1 Summarize and disseminate available information

8.1.2 Document behavior at various times in natural populations

8.1.3 Document past and present schedules and condition of fish when they are released from hatcheries

8.1.4 Identify factors influencing timing of smoltification and emigration

8.1.5 Develop new procedures to alter timing of smoltification and emigration

8.1.6 Determine competition and other impacts of releasing hatchery-reared fish on different schedules

8.1.7 Put new procedures and schedules into use

Subtarget 8.2 Develop genetics, breeding, and husbandry to insure long-term maintenance of populations and optimization of production (Problem 8-2) (Yr. 1, $280,000; 10-yr, $10,370,000) (Priority 3.6)

Activities

8.2.1 Summarize and disseminate available information

8.2.2 Establish pedigreed populations of target species and estimate genetic parameters

8.2.3 Develop physical facilities (est. cost, $2.5 million) and management practices to maintain pedigreed populations

8.2.4 Design and implement a breeding program to enhance and maintain genetic variability and optimize survival in the ocean

8.2.5 Evaluate impacts and responses of alternative strategies for breeding and selecting to enhance oceanic survival

8.2.6 Develop and implement procedures for incorporating data on oceanic harvests into breeding programs

Target 9. Understand effects of oceanic conditions on fish

Subtarget 9.1 Determine long-term relationships between oceanic conditions and fluctuations in growth, survival, and age at maturity of fish (Problem 9-1) (Yr. 1, $80,000; 10-yr, $450,000) (Priority 3.9)

Activities

9.1.1 Gather relevant information from existing data bases

9.1.2 Summarize and disseminate available data

9.1.3 Evaluate completeness of data; identify voids or weaknesses

9.1.4 Collect missing data

9.1.5 Develop a model that depicts and predicts the status of fish in the ocean

9.1.6   Extend use of the model among users and clients

Subtarget 9.2 Determine differences in oceanic survival between wild and hatchery-reared stocks from a selected river system (Problem 9-12) (Yr. 1, $60,000; 10-yr, $1,420,000) (Priority 3.6)

Activities

9.2.1   Summarize and disseminate available information

9.2.2   Select a river system and mark wild populations and hatchery-reared stocks for coordinated release

9.2.3   Sample returning fish to estimate number of adults both escaping capture and spawning

9.2.4   Estimate long-term survival of wild and hatchery-reared stocks

Target 10. Understand the significance of estuaries and ocean inlets to salmonids

Subtarget 10.1 Determine impacts of estuarine habitats on productivity of salmonids (Problems 10-1,7) (Yr. 1, $80,000; 10-yr, $1,250,000) (Priority 3.8)

Activities

10.1.1   Summarize and disseminate available information

10.1.2   Select two or three estuaries and survey the habitats they provide for salmonids

10.1.3   Determine at suitable times the size classes and densities of smolts within each estuary

10.1.4   Provide guidelines and suggest plans for managing estuarine habitats in order to maximize production of salmonids

Subtarget 10.2 Provide to those responsible for selected lower rivers and estuaries an understanding of changes in habitats for anadromous salmonids in these areas (see subtarget 5.3)

Target 11. Support a statewide educational program on salmon and steelhead trout

Subtarget 11.1 Internalize the lead responsibility for a statewide program in a governmental agency or other organization (Problem 11-2) (Yr. 1, $210,000; 10-yr, $1,250,000) (Priority 3.7)

Activities

11.1.1   Survey existing and past educational programs

11.1.2   Find and negotiate with an agency or organization willing to accept the lead responsibility

11.1.3   Provide summaries of information on current issues and programs and potentials for the future

Subtarget 11.2 Devise a program to increase the public's general awareness of the scientific, social, and political issues related to the resource and its utilization, conservation, restoration, and enhancement (Problems 11-2,3) (Yr. 1, $670,000; 10-yr, $4,020,000) (Priority 4.5)

Activities

11.2.1   Create a newsletter

11.2.2   Start a series of public service announcements an television and radio

11.2.3   Provide displays for showing at the state fair, county fairs, and other public gatherings

11.2.4   Build a bureau of speakers and other services to provide interpretive and issue-oriented presentations by volunteers, interns, etc.

11.2.5   Create a media center to facilitate education and information transfer

Subtarget 11.3 Develop formal educational programs (Problems 11-1,2) (Yr. 1, $380,000; 10-yr, $2,210,000) (Priority 4.5)

Activities

11.3.1 Incorporate salmon and steelhead trout into the Department of Fish and Game's Project Wild and develop similar curricula for kindergarten through 12th grade

11.3.2 Provide a program of minicourses and workshops for continuing education of professionals and users

11.3.3 Provide for training of trainers and interpretive speakers for appearances at fairs, service clubs, etc.

Target 12. Improve facilities for passage and screening to protect migrating fish

Subtarget 12.1 Improve systems to screen fish from danger at water diversions and dams (Problems 12-4,6) (Yr. 1, $210,000; 10-yr, $2,740,000) (Priority 4.3)

Activities

12.1.1 Summarize and disseminate available information

12.1.2 Inventory diversions of water and interview people involved with screening

12.1.3 Estimate season and causes of losses

12.1.4 Determine how fish behave in relation to screens at pumps and spillways

12.1.5 Improve designs and operation of screens

Appendix E: Estimated costs for a research, development, and extension program to solve urgent problems related to salmon and steelhead trout in 10 years

Targets* Subtargets Activities	Problems	1	2	3+4	5+6	7+8	9+10	1-10
Target 1	Provide fresh water needed for fisheries	770	730	1,310	1,070	930	450	5,260
Subtarget 1.1	Improve policies, regulations, laws, arrangements	770	730	1,310	1,070	930	450	5,260
1.1.1	Assess current status	280	40	60	30	30	30	470
1.1.2	Identify problems; propose resolutions	30	170	280	280	280	200	1,240
1.1.3	Reassess risk to fish of "safe yield bases"	210	140	140	--	--	--	490
1.1.4	Impacts of delivering surplus water from CVP	100	--	--	--	--	--	100
1.1.5	Identify extant water to increase stream flow	30	40	350	350	350	--	1,120
1.1.6	Identify future statewide needs of fish	70	100	70	70	70	70	450
1.1.7	Analyze effects of subsidies and preferences	--	140	210	140	--	--	490
1.1.8	Convey findings to those affected	50	100	200	200	200	150	900
Target 2	Understand social and economic significance of fisheries	310	700	1,460	1,430	1,290	450	5,640
Subtarget 2.1	Develop social and economic data	310	700	1,460	1,430	1,290	450	5,640
2.1.1	Determine values in local and statewide markets	70	140	240	--	--	--	450
2.1.2	Determine nonmarket values	100	140	350	420	280	280	1,570
2.1.3	Estimate value to indian peoples	140	210	420	420	420	--	1,610
2.1.4	Evaluate the commercial fishing lifestyle	--	140	140	280	280	--	840
2.1.5	Assess costs and benefits of habitat improvements	--	70	140	140	140	--	490
2.1.6	Compare with other resources	--	--	140	140	140	140	560
2.1.7	Convey methods and findings to others	--	--	30	30	30	30	120
Target 3	Determine fresh water requirements and limiting factors	1,910	1,970	3,660	3,430	1,200	450	12,620
Subtarget 3.1	Identify factors affecting all life stages	1,590	1,740	3,160	2,900	1,070	390	10,850
3.1.1	Determine factors related to return of adults	190	220	390	360	80	60	1,300
3.1.2	Determine factors related to spawning	190	290	570	630	60	60	1,800
3.1.3	Determine factors related to eggs	280	310	620	330	330	40	1,910
3.1.4	Determine factors related to juveniles	500	580	930	930	510	110	3,560
3.1.5	Determine factors related to smolts	430	340	650	650	90	120	2,280
Subtarget 3.2	Evaluate improvements of instream habitats	320	230	500	530	130	60	1,770
3.2.1	Summarize and disseminate available information	100	--	40	70	130	60	400
3.2.2	Determine choices among macrohabitats	70	70	140	140	--	--	420
3.2.3	Measure use and parameters of microhabitats	70	70	140	140	--	--	420
3.2.4	Determine availability of habitats	30	40	70	70	--	--	210
3.2.5	Determine how populations are structured	40	40	80	80	--	--	240
3.2.6	Determine growth rates during life stages	10	10	30	30	--	--	80
Target 5	Relate alternative uses of land to fish production	1,660	2,930	5,430	4,940	5,330	2,470	22,760
Subtarget 5.1	Predict cumulative effects of timbering	680	1,260	2,380	2,720	2,720	1,600	11,360
5.1.1	Summarize and extend available information	190	--	--	270	270	270	1,000

*Target numbers relate to topic numbers in Appendix B.

Targets* Subtargets Activities	Problems	Years						
		1	2	3+4	5+6	7+8	9+10	1-10
5.1.2	Classify soils and sediment production	210	--	--	--	--	--	210
5.1.3	Determine responses to sediments and channels	140	560	1,190	1,250	1,250	690	5,080
5.1.4	Identify sources and routing of sediments	--	560	560	560	560	280	2,520
5.1.5	Determine effects of changes in channels	140	140	560	560	560	280	2,240
5.1.6	Model cumulative effects of timbering on fish	--	--	70	80	80	80	310
Subtarget 5.2	Understand fish in lower rivers and estuaries	490	990	1,620	860	830	440	5,230
5.2.1	Summarize and disseminate existing information	140	140	80	80	120	120	680
5.2.2	Determine seasonal populations and migrations	170	420	840	420	420	210	2,480
5.2.3	Determine growth and survival of smolts	110	220	420	220	220	110	1,300
5.2.4	Determine attributes of holding areas	70	140	140	--	--	--	350
5.2.5	Determine interactions among species	--	70	140	140	70	--	420
Subtarget 5.3	Understand habitats in lower rivers and estuaries	490	680	1,430	1,360	1,780	430	6,170
5.3.1	Summarize and disseminate existing information	100	50	100	100	100	150	600
5.3.2	Reconstruct human events and their effects	140	70	--	--	--	--	210
5.3.3	Determine effects of riprapping on habitats	40	140	210	--	--	--	390
5.3.4	Determine how other actions affect habitats	70	140	280	280	280	--	1,050
5.3.5	Determine effects of sediment. and coastal eng.	70	140	280	280	280	--	1,050
5.3.6	Determine effects on quality of water	70	140	560	420	140	--	1,330
5.3.7	Model responses of fish to conditions of habitats	--	--	--	280	560	140	980
5.3.8	Evaluate alternatives for regulations	--	--	--	--	280	--	280
5.3.9	Provide procedures and standards for monitoring	--	--	--	--	140	140	280
Target 7 Provide systems for classification and inventory		1,020	1,080	1,990	2,590	1,440	760	8,880
Subtarget 7.1	Provide methods to measure critical life stages	370	420	1,190	1,600	1,320	760	5,660
7.1.1	Summarize and disseminate available information	20	--	--	200	200	200	620
7.1.2	Evaluate current methods	70	140	70	--	--	--	280
7.1.3	Relate watersheds to spawning and juveniles	280	280	560	560	560	280	2,520
7.1.4	Determine variation in populations by life stages	--	--	560	560	560	--	1,680
7.1.5	Develop monitoring of spawning and juveniles	--	--	--	280	--	--	280
7.1.6	Develop standards and guidelines for applications	--	--	--	--	--	280	280
Subtarget 7.2	Develop methods to estimate origins of fish at sea	650	660	800	990	120	--	3,220
7.2.1	Evaluate electrophoresis of allozymes	280	280	280	200	--	--	1,040
7.2.2	Evaluate patterns on scales or other body parts	140	140	140	100	--	--	520
7.2.3	Evaluate physical tags	70	70	--	--	--	--	140
7.2.4	Evaluate mitochondrial DNA	140	140	280	220	--	--	780
7.2.5	Disseminate findings	20	30	100	120	60	-	330
7.2.6	Develop applications of optimum methods	--	--	--	180	30	--	210
7.2.7	Plan long-term monitoring	--	--	--	170	30	--	200
Target 8 Improve technology for artificial propagation		1,030	1,880	6,530	3,990	4,360	4,720	22,450
Subtarget 8.1	Understand and manipulate smoltification	750	1,280	2,390	2,210	2,580	2,940	12,150
8.1.1	Summarize and disseminate available information	190	20	--	--	--	--	210
8.1.2	Document behavior in natural populations	280	280	580	20	--	--	1,160
8.1.3	Document schedules for releases	140	140	--	--	--	--	280
8.1.4	Identify factors influencing timing	--	560	1,120	1,120	1,120	840	4,760
8.1.5	Evaluate new methods to alter timing	--	--	280	840	840	1,400	3,360
8.1.6	Determine impacts of varying release date	140	280	310	30	--	--	760

Targets* Subtargets Activities	Problems	Years						
		1	2	3+4	5+6	7+8	9+10	1-10
8.1.7	Implement new procedures and schedules	--	--	100	200	620	700	1,620
Subtarget 8.2	Develop methods to increase productivity	280	610	4,140	1,780	1,780	1,780	10,370
8.2.1	Summarize and disseminate available information	70	50	100	100	100	100	520
8.2.2	Establish populations and estimate parameters	210	420	840	--	--	--	1,470
8.2.3	Develop a facility to maintain populations	--	--	2,500	--	--	--	2,500
	and practices to maintain populations	--	140	280	280	--	--	700
8.2.4	Implement a breeding program	--	--	280	1,120	1,120	1,120	3,640
8.2.5	Evaluate alternatives for breeding and selecting	--	--	--	--	280	280	560
8.2.6	Include oceanic survival in breeding programs	--	--	140	280	280	280	980
Target 9	Understand effects of oceanic conditions on fish	140	340	390	410	330	260	1,870
Subtarget 9.1	Determine oceanic effects on fish	80	130	100	100	20	20	450
9.1.1	Gather relevant existing information	60	10	--	--	--	--	70
9.1.2	Summarize and disseminate available data	20	20	--	--	--	--	40
9.1.3	Evaluate completeness and weaknesses of data	--	30	--	--	--	--	30
9.1.4	Collect missing data	--	20	80	80	10	10	200
9.1.5	Develop a preductive model	--	30	10	10	--	--	50
9.1.6	Extend use of the model to clients	--	20	10	10	10	10	60
Subtarget 9.2	Determine oceanic survival of different stocks	60	210	290	310	310	240	1,420
9.2.1	Summarize and disseminate available information	20	--	10	20	20	20	90
9.2.2	Mark wild and hatchery-reared fish	40	210	280	--	--	--	530
9.2.3	Sample to estimate return of adult fish	--	--	--	290	290	150	730
9.2.4	Estimate survival of stocks	--	--	--	--	--	70	70
Target 10	Understand significance of estuaries and inlets	80	180	250	290	280	170	1,250
Subtarget 10.1	Determine productivity of estuarine habitats	80	180	250	290	280	170	1,250
10.1.1	Summarize and disseminate available information	50	--	10	10	20	30	120
10.1.2	Select estuaries and survey habitats	30	40	--	--	--	--	70
10.1.3	Determine sizes and densities of smolts	--	140	210	210	170	140	870
10.1.4	Provide guidelines and suggest management	--	--	30	70	90	---	190
Target 11	Support a statewide educational program	1,260	760	1,450	1,440	1,250	1,320	7,480
Subtarget 11.1	Internalize responsibilities of leadership	210	100	200	270	200	270	1,250
11.1.1	Survey existing and past educational programs	110	100	200	200	200	200	1,010
11.1.2	Find and negotiate with a willing leader	30	--	--	--	--	--	30
11.1.3	Provide summaries of information	70	--	--	70	--	70	210
Subtarget 11.2	Devise a public awareness program	670	430	850	770	650	650	4,020
11.2.1	Create a newsletter	170	100	200	200	200	200	1,070
11.2.2	Start public service announcements by media	120	50	100	100	100	100	570
11.2.3	Build and loan displays	170	50	100	170	100	100	690
11.2.4	Establish a speakers bureau with volunteers	70	30	50	50	50	50	300
11.2.5	Create media center for education	140	200	400	250	200	200	1,390
Subtarget 11.3	Develop formal educational programs	380	230	400	400	400	400	2,210
11.3.1	Build educational units for K through yr.12	140	160	200	200	200	200	1,100

Targets* Subtargets Activities	Problems	Years						
		1	2	3+4	5+6	7+8	9+10	1-10
11.3.2	Provide a program for continuing education	100	--	100	100	100	100	500
11.3.3	Train trainers and interpreters	140	70	100	100	100	100	610
		210	420	980	760	340	30	2,740
Target 12	Improve passage facilities and screening systems							
		210	420	980	760	340	30	2,740
Subtarget 12.1	Improve screening systems at pumps and dams							
12.1.1	Summarize and disseminate available information	40	--	--	30	60	30	160
12.1.2	Survey water diversions	70	--	--	--	--	--	70
12.1.3	Estimate season and causes of losses	20	140	140	70	--	--	370
12.1.4	Determine how fish behave at screens	40	140	280	100	--	--	560
12.1.5	Improve designs and operations of screens	40	140	560	560	280	--	1,580

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