27th Annual Conference

AMERICAN FISHERIES SOCIETY

California- Nevada Chapter

WORKING WITH SYSTEMS PHYSICAL, BIOLOGICAL AND POLITICAL

FEBRUARY 6 - 8, 1992

Red Lion Inn
Redding, California

CONFERENCE SCHEDULE

THURSDAY FEBRUARY 6

8:00-5:00 Eel River System Symposium - Workshop

5:30 Business Meeting in Siskiyou Room

6:30 Beer Tasting in Executive Suite

FRIDAY FEBRUARY 7

7:00 Registration

8:15 General Session in Sierra Room

11:30 **Lunch**

1:30 Technical Session 1 in Trinity Room
Technical Session 2 in Cascade Room
Technical Session 3 in Siskiyou Room

6:30 Wine Tasting in Executive Suite

7:30 Banquet, raffle and dance in Sierra Room

SATURDAY FEBRUARY 8

8:30 General Session in Cascade - Siskiyou Room

12:00 **Lunch**

1:30 Technical Session 4 in Trinity Room
Technical Session 5 in Cascade Room
Technical Session 6 in Siskiyou Room

CALIFORNIA-NEVADA CHAPTER

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1992 PROGRAM COMMITTEE

PROGRAM COMMITTEE

Program Coordinator ..... Thomas L.Taylor
Symposium Coordinator ..... Ken Aasen
Saturday General Session ..... Monty Knudsen
Technical Session 1 ..... Betsy Bolster
Technical Session 2 ..... Christopher Mobley
Technical Session 3 ..... Robert N. Lea
Technical Session 4 ..... Dave Vogel
Technical Session 5 ..... Nick Villa
Technical Session 6 ..... Dennis Mc Ewan
Exhibits ..... Steve Parmenter
Local Arrangements ..... Ralph Hinton
Photography Contest ..... Bob Reavis
Raffle ..... Nick Villa, Alan Pickard, Kevan Urquhart

CALIFORNIA-NEVADA CHAPTER
1992 EXECUTIVE COMMITTEE

OFFICERS

President ..... Larry Week
President-Elect ..... Thomas L. Taylor
Past President ..... Don C. Erman
Secretary ..... Chuck Knutson
Treasurer ..... Dave Lentz

COMMITTEES

Awards ..... Kevan Urquhart
Policy and Resolutions ..... Seth MacInko
Bylaws and Nominations ..... Alan Baracco
Membership ..... Jean Baldridge
Conservation ..... Peter Alexander
Continuing Education ..... Susan Ellis
Finance ..... Tom Lambert
Exhibits ..... Steve Parmenter
Sacramento Subunit ..... Martin Brittan
Local Arrangement ..... Ralph Hinton
Photography Contest ..... Bob Reavis
Pisces Editor ..... Nick Villa

REGISTRATION

All attendees must register. Registration fees are $45 for AFS members, $50 for non-members, $15 for students, and $5 for guests of a paid registrant. Banquet tickets are $20. The registration desk is located in the Exhibit Area of the Red Lion Inn.

GENERAL INFORMATION

AFS BANQUET

The banquet will be held in the Sierra Room, Friday beginning at 7:30 p.m. The banquet will be followed by our raffle. Dancing to tunes provided by Andre Wright will conclude an evening that is sure to be fun!

CONCURRENT SESSIONS

These sessions will be run on similar time schedules to allow you to change sessions between talks. Please avoid entering or leaving sessions while a talk is in progress.

EXHIBITS

Commercial exhibits are in the Exhibit Area

AFS ANNUAL BUSINESS MEETING

The annual business meeting will begin promptly at 5:30 on Thursday, February 6 in the Siskiyou Room.

SOCIAL HOURS

Cal-Neva AFS will host a beer tasting in the Executive Suite, Thursday, February 6, 6:30 - 7:30 p.m., featuring the Sierra Nevada Brewery. A wine tasting in the Executive Suite on Friday, February 7, 6:30 - 7:30 p.m., featuring the all natural wines from Paradise Vintners will precede the banquet.

FRIDAY MORNING

GENERAL SESSION

APPROACHES TO THE RESTORATION OF RIVER SYSTEMS

Moderator: Thomas L. Taylor, California Department of Parks and Recreation, Sacramento

SIERRA ROOM

8:15 **Welcoming Address and Opening Remarks -** Larry Week, President, Cal - Neva Chapter

8:30 **Introduction - Zen and the Art of Instream Structures** - Kristy Vyverberg, Engineering Geologist, California Department of Parks and Recreation, Sacramento

8:50 **The Role of Habitat Structures in River Restoration:Where are Structures Worth the Effort ?** - Michael E. McCain, Fishery Biologist, U.S. Forest Service, Six Rivers National Forest, Gasquet

9:25 **Cantera Spill Recovery Options: Where Do We Go From Here?** - David Hoopaugh, Fishery Biologist, California Department of Fish and Game, Redding

10:00 **Break**

10:20 **Restoring the Merced River in Yosemite Valley: Managing for Natives and Repairing the Banks** - Louise Johnson, Natural Resource Specialist, Yosemite National Park

10:55 **Understanding and Properly Applying Fundamentals of River Systems and Their Application to Restoration -** Dave Rosgen, Consulting Hydrologist, Wildland Hydrology, Inc., Pagosa Springs, Colorado

11:30 **Lunch**

FRIDAY AFTERNOON

TECHNICAL SESSION 1

MANAGING CALIFORNIA'S NATIVE AQUATIC SPECIES OF SPECIAL CONCERN

Moderator: Betsy Bolster, California Department of Fish and Game, Rancho Cordova

TRINITY ROOM

1:30 **Aquatic Amphibians and Reptiles of Concern in California: What Species are in Trouble and What Can We Do to Help Them?** - Dr. Mark Jennings, Department of Herpetology, California Academy of Sciences, San Francisco

2:00 **Tidewater Gobies - Status, Impacts, and Recommendations for Management** - Karen R. Worchester, California Department of Fish and Game, Morro Bay

2:30 **Los Angeles Basin Fish Species of Special Concern** - Thomas R. Haglund, Department of Biology, University of California, Los Angeles

3:00 **Break**

3:30 **Declining Amphibians in California: Real Crisis - Potential Opportunity** - Hartwell Welch, U.S. Forest Service, Redwood Sciences Laboratory, Arcata

4:00 **Management of Owens Pupfish and its Habitats in Owens Valley, Calfornia** - June Mire, Department of Integrative Biology and Museum of Vertebrate Zoology, University of California, Berkeley

4:30 **Distribution, Ecology, and Management of the Endangered California Freshwater Shrimp** - Larry Serpa, The Nature Conservancy, Tiburon

FRIDAY AFTERNOON

TECHNICAL SESSION 2

CALIFORNIA AQUATIC DATA BASES: WHERE ARE WE TODAY, WHERE DO WE WANT TO BE TOMORROW ?

Moderator: Christopher T. Mobley, National Marine Fisheries Service, Santa Rosa

CASCADE ROOM

1:30 **Methods for Capturing, Defining and Making Available Distributed Fisheries Data and Computer Applications -** Stan Allen, Idaho Department of Fish and Game, Boise

2:00 **Natural Heritage GIS Database for California -** Darlene McGriff, California Department of Fish and Game, Sacramento

2:30 **The Open Geographic Information System: Research and Directions at U. C. Berkeley -** Kenn Gardels, Center for Environmental Design Research, U. C. Berkeley

3:00 **Break**

3:30 **The Klamath Coordinated Information System -** Ron Iverson, U.S. Fish and Wildlife Service, Eureka

4:00 **Biological and Data Management Aspects of the National Water Quality Assessment Program in the San Joaquin-Tulare Basins, California -** Larry R. Brown, U. S. Geologic Survey, Sacramento

4:30 **Fish Habitat Relationships and Habitat Typing Database -** Jerry Boberg, U. S. Forest Service, Six Rivers National Forest, Eureka

FRIDAY AFTERNOON

TECHNICAL SESSION 3

MARINE CONSERVATION ISSUES - OUR FUTURE ???

Moderator: Robert N. Lea, California Department of Fish and Game, Monterey

SISKIYOU ROOM

1:30 **Status of California Estuarine Fishes** - Camm C. Swift, Natural History Museum of Los Angeles County

2:00 **San Francisco Bay Fishery Resources - Good News, Bad News** - Kathy Hieb, California Department of Fish and Game, Stockton

2:30 **Ocean Climate and Recruitment Variability in Exploited Ecosystems** - Jerrold Norton, Pacific Fisheries Environmental Group, Southwest Fisheries Science Center, Monterey

3:00 **Break**

3:30 **Sanctuary Protection: Myth or Model?** - Edward Ueber, Gulf of the Farallones and Cordell Bank National Marine Sanctuaries, San Francisco

4:00 **Marine Debris: Is an End in Sight?** - Daniel V. Richards, Channel Islands, National Park, Ventura

4:30 **Management and Conservation of Pacific Coast Sharks** - Dennis Bedford, California Department of Fish and Game, Long Beach

SATURDAY MORNING

GENERAL SESSION

PANEL: LEGISLATION, LAWS, AND CONSERVATION BIOLOGY

Moderator: Monty Knudsen, U.S. Fish and Wildlife Service, Washington, D.C.

CASCADE - SISKIYOU ROOM

8:30 **Opening Remarks and Introduction of Paul Brouha, AFS Executive Director** - Larry Week, President, AFS Cal Neva

9:00 **Panel Discussion**

Mr. Dan Beard
Staff Director , Committee on Interior and Insular Affairs for U.S. House of Representatives

Mr. Tom Jensen
Counsel to the U.S. Senate Subcommittee on Water and Power

Mr. Mike Chrisman (Invited)
The Resouces Agency, State of California

Mr. Jack Burke (Invited)
Regional Solicitor, U.S. Department of the Interior, Pacific Southwest Region

10:00 **Break**

10:20 **Panel Discussion continues**

12:00 **Lunch**

SATURDAY AFTERNOON

TECHNICAL SESSION 4

RESOLVING WATER PROJECT AND FISHERY RESOURCE NEEDS

Moderator: Dave Vogel, CH2M Hill, Redding

TRINITY ROOM

1:30 **WIN - win Perceptions and Evolving Resource Management Responsibilities -** William E. Loudermiilk, San Joaquin River Management Program, California Department of Fish and Game, Fresno

2:00 **Resolving Water Project and Fishery Resource Conflicts: A Federal Water Development Agency Approach -** Kenneth M. Lentz, U.S. Bureau of Reclamation, Sacramento

2:30 **Resolving Water Project and Fishery Resource Conflicts: An Urban Water Wholesaler's Approach -** Richard C. Clemmer, Metropolitan Water District of Southern California, Los Angeles

3:00 **Break**

3:30 **Resolving Water Project and Fishery Resource Conflicts: A Consultant's Approach -** David A. Vogel, CH2M HILL, Redding

4:00 **The Need to Reauthorize the Federal Central Valley Project to Protect Fish Habitat and Other Designated Instream Beneficial Uses of Water -** William M. Kier, William M. Kier Associates, Sausalito

4:30 **Resolving Water Project and Fishery Resource Conflicts: A Public Policy Approach -** L. Tim Wallace, Universtiy of California, Berkerley

SATURDAY AFTERNOON

TECHNICAL SESSION 5

CONTRIBUTED PAPERS

Moderator: Nick Villa, California Department of Fish and Game, Rancho Cordova

CASCADE ROOM

1:30 **Ecology, Life History and Status of the Shasta Crayfish of Northeastern California** - Theo Light, Chris Myrick and Don C. Erman, U.C. Berkeley

2:00 **Growth and Condition of Juvenile Salmonids in the Lower American River** - Daniel T. Castleberry, Joseph J. Cech, Jr., Michael K. Saiki and Barbara A. Martin, U.S. F.W.S. Fisheries Contaminant Research Center, Dixon, and U.C. Davis

2:30 **A Field Test of Artificial Redds for Quantifying the Early Survival of Salmonids** - Michael K. Saiki, Daniel T. Castleberry and Barbara A. Martin, U.S.F.W.S. Fisheries Contaminant Research Center, Dixon

3:00 **Break**

3:30 **Physiological Comparisons of Northern Squawfish and Rainbow Trout** - J.J. Cech, Jr., D.T. Castleberry, T.E. Hopkins and J.H. Peterson, U.C. Davis and U.S.F.W.S. Columbia River Field Station, Cook, Washington

4:00 **Distribution Ecology of Bat Rays in Tomales Bay** - Todd E. Hopkins, and Joseph J. Cech. Jr., U.C. Davis

4:30 **Ice in Stream Pools in California's Central Sierra Nevada: Spatial and Temporal Variability and Reduction in Habitat Availability** - Neil Berg, U.S. Forest Service, Berkeley

SATURDAY AFTERNOON

TECHNICAL SESSION 6

STATUS AND MANAGEMENT OF ENDANGERED, THREATENED AND DEPLETED SALMONIDS

Moderator: Dennis McEwan, California Department of Fish and Game, Sacramento

SISKIYOU ROOM

1:30 **Design and Construction of a Natural, Native Trout Hatchery in Nevada** - Dave Rosgen, Wildland Hydrology Consultants, Inc., Pagosa Springs, Colorado

2:00 **The Definition of "Species" Under the Endangered Species Act: Application to Pacific Salmon** - Robin S. Waples, National Marine Fisheries Service, Seattle

2:30 **Spring-Run Chinook Salmon: Current Status and Factors Affecting Their Presence in Summer Holding Pools** - Elizabeth Campbell and Peter B. Moyie, U. C. Davis

3:00 **Break**

3:30 **Status and Management of Coho Salmon in California** - Thomas J. Hassler, U.S.F.W.S., Cooperative Fisheries Unit, Humbolt State University

4:00 **Status of Winter Run Chinook Salmon** - Mark Pisano, California Department of Fish and Game, Fresno

4:30 **Status and Management of Coastal Cutthroat Trout Stocks** - Eric Gerstung, California Department of Fish and Game, Rancho Cordova

TECHNICAL SESSION SCHEDULE

FRIDAY

TECHNICAL SESSION 1 Trinity Room

1:30	**Aquatic Amphibians and Reptiles of Concern** Dr. Mark Jennings
2:00	**Tidewater Gobies** - Karen Worchester
2:30	**Los Angeles Basin Fish Species** Tom Haglund
3:00	**Break**
3:30	**Declining Amphibians in California** Hartwell Welch
4:00	**Management of the Owens Pupfish** June Mire
4:30	**California Freshwater Shrimp** Larry Serpa

SATURDAY

TECHNICAL SESSION 4 Trinity Room

1:30	**Resource Management Responsibilities** William E. Loudermilk
2:00	**A Federal Water Development Agency Approach** - Kenneth M. Lentz
2:30	**An Urban Water Wholesaler's Approach** Richard C. Clemmer
3:00	**Break**
3:30	**A Consultant's Approach** - David A. Vogel
4:00	**Reauthorize the Federal Central Valley Project** - William M. Kier
4:30	**A Public Policy Approach** - L. Tim Wallace

TECHNICAL SESSION SCHEDULE

SESSION 2 Cascade Room

Fisheries Data and Computer Applications
Stan Allen

Natural Heritage GIS Database - Darlene McGriff

The Open Geographic Information System
Kenn Gardels

Break

Klamath Coordinated Information System - Ron Iverson

National Water Quality Assessment Program - Larry R. Brown

Fish Habitat Relationships
Jerry Boberg

SESSION 3 Siskiyou Room

Status of California Estuarine Fishes
Camm C. Swift

San Francisco Bay Fishery Resources
Kathy Hieb

Ocean Climate and Recruitment
Jerrold Norton

Break

Sanctuary Protection: - Edward Ueber

Marine Debris: - Daniel V. Richards

Pacific Coast Sharks - Dennis Bedford

SESSION 5 Cascade Room

Status of the Shasta Crayfish California - Theo Light et al

Juvenile Salmonids in the American River - Daniel T. Castleberry et al

Artificial Redds - Michael K. Saiki et al

Break

Physiology of Northern Squawfish and Rainbow Trout - J. J. Cech, Jr. et al

Ecology of Bat Rays in Tomales Bay
Todd E. Hopkins & Joseph J. Cech, Jr.

Ice in Stream Pools - Neil Berg

SESSION 6 Siskiyou Room

Native Trout Hatchery in Nevada
Dave Rosgen

Pacific Salmon and Definition of "Species"
Robin S. Waples

Chinook Salmon: Summer Holding Pools
Elizabeth Campbell and Peter B. Moyle

Break

Coho Salmon in California
Thomas J Hassler

Status of San Joaquin Chinook Salmon
Mark Pisano

Coastal Cutthroat Trout Stocks
Eric Gerstung

ABSTRACTS

ALLEN, STAN T.
Idaho Department of Fish and Game, Bureau of Resource Planning and Program Coordination, 600 S. Walnut, P.O. Box 25, Boise, ID 83709
(208) 334-3098

Methods for Capturing, Defining and Making Available Distributed Fisheries Data and Computer Applications.

The 1980's were years of data proliferation. They were also years of personal computers (PC) and "individual" data input. The onslaught of PC's available to the individual biologist brought rewards as well as pitfalls. One of the biggest pitfalls was decentralization of valuable fisheries data and information to the point where it has become extremely difficult to know what is happening outside of an individual projects "four-walls". To combat this potential for loss of data, information and knowledge, the Idaho Department of Fish and Game has initiated or is involved in several major projects to capture, define, and make available widely distributed fisheries data and computer applications. These efforts include involvement in developing and maintaining the Northwest Environmental Database (NED), a long-term four state (Idaho, Montana, Oregon, and Washington) effort to provide natural resource, recreation, and hydropower information quickly and reliably. The NED also takes advantage of geographic information system technology. It has become increasingly important to not necessarily have a centralized "storehouse" of data, but to know that data you are interested in have been collected, where they are located, and how you can access the data, either electronically or by contacting the appropriate source. Begun in 1991, the Coordinated Information System (CIS) is an effort to develop an information system pointing users to sources of data/information regarding Columbia River Basin anadromous fish and their habitat. Both the NED and CIS are funded by the Bonneville Power Administration. Internally, the Idaho Department of Fish and Game has developed an updatable hard copy product titled the "Computer Applications Catalog". The contents of this catalog provide users an indexed guide to electronic data sets and program applications (eg. information systems, computer programs, models, etc.) in use or available within the Department. Through programs such as these, the benefits provided by decentralization can be realized without losing valuable data, information, and knowledge.

BEDFORD, DENNIS W.
California Department of Fish and Game, Marine Resources Division, 330 Golden Shore, Suite 50, Long Beach, CA 90802 (310) 590-5171

Management and Conservation of Pacific Coast Sharks.

Elasmobranch fishes, the sharks and rays, exhibit reproductive attributes more similar to marine mammals than to teleost fishes. Reproduction in sharks follows one of three possible strategies. Either a small number of well-developed eggs are laid, or pups are live born, after a long gestation, with or without umbilical attachment to the mother. In all cases, the number of pups is relatively few. An apparent disregard for this single fact has lead to repeated failures, worldwide, to develop sustainable shark fisheries. Attempts to manage the development of shark fisheries along the U.S. west coast have proven to be no exception. During each attempt, the initial growth of the fishery was not restricted. It was incorrectly assumed that data derived from the fishery could subsequently be used to adjust the total fishing effort to some acceptable level, and/or that the population distribution of the shark species in question was so broad as to provide a buffer against over-fishing. Empirical evidence has demonstrated both assumptions to be deleterious to the fishery and wrong. As resource managers, we must rethink our approach to the exploitation of shark species. Life history parameters, such as those involved with age and growth, reproduction, distribution, and migration must be defined before a fishery is begun. Such research could be expensive. These costs must be weighed against the benefits of developing a shark fishery at all. Previous strategies have not worked and if continued will result in the loss of our most valued shark resources.

BERG, NEIL
United State Forest Service. POB 245, Berkeley, CA 94701 (510) 486-3456

Ice in Stream Pools in California's Central Sierra Nevada: Spatial and Temporal Variabilily and Reduction in Habitat Availability.

Twenty-seven pools at eight sites along an elevational transect in California's central Sierral Nevada were monitored during winter 1990-1991 for ice accumulation, pool coverage by ice, and below-ice water depth. Both the ice thickness and duration in pools generally increased with site elevation. Because minimum water

depths were below a 6 cm criterion for adult trout movement only for a 10 day period in one pool, physical exclusion of fish habitat by ice was not concluded to be a problem in this study.

BOBERG, JERRY A.
Six Rivers National Forest- USDA, 500 S Street, Eureka, CA 95501 (707) 442-1721

Fish Habitat Relationship and Habitat Typing Database.

Habitat classification and inventory systems applied at different scales or levels can provide basic Information as to the availability and relative importance of habitats to fish. The development of fish-habitat relationship models will demonstrate the value of habitat information in assessing the function of physical and biological parameters in the ecology of stream fishes.

In 1987, Six Rivers National Forest adopted a stream habitat inventory procedure that classifies fish habitat in terms of channel features. Main channel features, along with other features formed by small scale localized effects (e.g. logs, logjams, and slides), can be described as distinct channel units or habitat types. The habitat classification system provides quantity and quality descriptors of these morphological features basic to stream channels. The system currently in use has 24 habitat types delineated.

To facilitate the storage and analysis of the data obtained through the habitat typing classification system, a system of datafile structures, queries, and report generators were developed using dBase III+ software. This system was upgraded with the release of dBase IV. Also added to the system was a menu-driven application operating within dBase IV that allows users to easily enter and edit data, and to generate basic summary reports.

BROWN, LARRY
U.S. Geological Survey, 2800 Cottage Way, Room W-2233, Sacramento, CA 95825 (916) 978-4648

Biological and Data Management Aspects of the National Water Quality Assessment Program in the San Joaquin-Tulare Basins, California.

The U.S. Geological Survey (USGS) is presently implementing the National Water Quality Assessment Program (NAWQA). The San Joaquin-Tulare basins study unit is 1 of 20 study units selected for the initial phase of the NAWQA program. One of the goals of the NAWQA

program is to use biological monitoring of fishes, aquatic invertebrates, and algae to establish the status and trends in surface-water quality throughout the Nation. The biological data will be supplemented by data on concentrations of contaminants in water, sediments, and within selected organisms. Data from all study units will be collected according to uniform, national protocols. The National Synthesis teams will compile the data for national-level assessment of selected topics. As a result, the NAWQA program will generate data on the distribution and relative abundance of organisms and contaminants that will be of interest to national, regional, and local water-resource managers. The data will be entered into a USGS database called NWIS II (National Water Information System), which is presently being developed. The NWIS II system is being designed with the capability to output data in formats compatible with various software ranging from geographic information systems to simple spreadsheets. These capabilities will make the data accessible to all interested parties.

CAMPBELL, ELIZABETH A., and PETER B. MOYLE
Department of Wildlife and Fisheries Biology, University of California, Davis, CA, 95616 (916) 752-0205

Spring-Run Chinook Salmon: Current Status and Factors Affecting Their Presence in Summer Holding Pools.

Spring-run chinook salmon have an unusual life history pattern in that they move into their spawning streams in the spring, hold there all summer in deep pools, and then spawn in the fall. Populations in the Sacramento-San Joaquin and Klamath-Trinity drainages have declined dramatically in recent years perhaps due to their exceptional vulnerability to the negative effects of water diversions (e.g. low flows/high temperatures) and human disturbance in their stream habitat. More than 20 historically large California populations have been extirpated or reduced to nearly zero. Furthermore, four of eight populations for which we have sufficient data for analysis have exhibited statistically significant declines since about 1940. The remaining large populations tend to be supported by hatchery stocks.

For one population, we have examined the limits of pool holding capacity under varying conditions of temperature, flow, and human use. Repeated counts of adult spring-run chinook salmon in a 2-mile study stretch of Deer Creek (Tehama County) from May through August 1991 have provided some evidence of continual upstream movement during this period. Number of adult salmon present in

pools may also change as habitat quality (e.g. temperature) changes over the summer. Physical characteristics of pools may affect the accuracy of adult salmon counts.

CASTLEBERRY, DANIEL T. [1,2], **JOSEPH J. CECH, JR.**[2], **MICHAEL K. SAIKI** [1], **and BARBARA A. MARTIN** [1].

1. U.S. Fish and Wildlife Service, National Fisheries Contaminant Center Field Research Station, 6924 Tremont Road, Dixon, CA 95620 (916) 756-1946

2. Department of Wildlife and Fisheries Biology,, University of California, Davis, CA 95616 (916) 752-3103

Growth and Condition of Juvenile Salmonids in the Lower American River.

We measured the growth rate and condition of juvenile chinook salmon, *Oncorhynchus tshawytscha*, and steelhead trout, *O. mykiss*, in the lower American River at two week intervals from late February to June 1991. We also monitored environmental conditions. Growth rates were estimated from otolith readings, and from RNA/DNA ratios. Conditions of fish was assessed by measuring lipid content, gill Na+ - K+ ATPase activities, and critical swimming velocity.

Water temperatures in the American River varied daily and seasonally. Water flow (discharge) rates increased in May and June. Flow had a major effect on temperature, with high flow coinciding with lower water temperature. Chinook salmon fry emerged from redds prior to March and into May. Steelhead trout fry emerged from early April through early May. RNA/DNA ratios in both chinook salmon and steelhead trout were not affected by changes in the water temperature at which fish were collected. RNA/DNA rations were lowest in chinook salmon immediately after they emerged. The lipid content and gill Na+ -K+ ATPase activity increased with fish size. ATPase activities either leveled-off or decreased in chinook salmon over 80 mm SL. The critical swimming velocity of chinook salmon shorter than 50 mm SL and steelhead trout shorter that 70 mm SL increased at higher temperatures. In larger fish (especially steelhead trout), critical swimming velocity did not increase at temperatures above 20-22C. The critical swimming velocity of chinook salmon longer than 50 mm SL decreased as fish size increased.

CECH, JOSEPH J.,JR.,[1]DANIEL T.CASTLEBERRY,[1,2] TODD E. HOPKINS[1,2] and J. H. PETERSON [2]
1. Department of Wildlife and Fisheries Biology, University of California, Davis, CA 95616 (916) 752-3103
2. U.S. Fish and Wildlife Service, Columbia River Field Station, Star Route, Cook, WA 98605 (509) 538- 2299

Physiological Comparisons of Northern Squawfish and Rainbow Trout.

Northern squawfish, *Ptychocheilus oregonensis*, (live mass range: 0.444-1.973 kg) from the Columbia River were held in continuous-flow tanks at 9, 15, 18, or 21 C°. Oxygen consumption rates were measured at 90 min intervals for >24 h using temperature-controlled flow-through respirometers incorporating an automated dissolved oxygen measuring system. Mean(+/-SE, n = 14 - 18) mass-independent, standard oxygen consumption rates increased with increasing acclimation temperature: 24.3+/-1.2 at 9 C°, 49.1 +/- 3.4 at 15 C°, 75.0 +/- 4.4 at 18 C° and 89.4 +/- 14.3 at 21 C°. These rates compare more closely with literature-derived values for rainbow trout than for other cyprinid fishes which have been measured. Comparisons of body cross sections of comparable size northern squawfish and rainbow trout showed proportionally more red muscle in squawfish, indication of an enhanced aerobic swimming potential. Squawfish blood-oxygen equilibrium curves showed comparable Bohr effects to published rainbow trout data, but relatively enhanced blood oxygen affinities.

CLEMMER, RICHARD C.
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Resolving Water Project and Fishery Resource Conflicts: An Urban Water Wholesaler's Approach.

Catch "22" — Fix the fish before you build anything; you can't fix the fish without building something. This has been the 20-year dilemma since the State Water Project began pumping water from the Delta. Fishery resources are depressively low and water needs for people are dramatically increasing. Traditionally, interests on both sides stand cross-armed across rooms and confront each other. It is a lose-lose way of addressing fishery/water supply related issues. Resolving these problems involves risk taking on both sides. Addressing issues to solve specific problems can work if both sides are willing to share the

risk of partial successes and partial failures. If a DFG designated fish screen doesn't work, the water diverter still can't avoid the mitigation responsibility. The water diverter must understand that it is in his best interest to fix the fishery problems and the resource protector must understand that much more can be accomplished with the help of the water diverter than without it. What is needed are attitudinal changes on both sides, uncrossed arms and rolled-up sleeves, money, and a willingness to try, try again.

GARDELS, KENN
GIS Research Coordinator, Center for Environmental Design Research, University of California, Berkeley, CA 94720 (510) 642-9205

The Open Geographic Information System: Research Directions at UC Berkeley.

As costs of computer hardware and software for geographic information systems (GIS) decline, resource managers are paying increasing attention to maximizing the value of environmental data. Much work to date has been done in the areas of standardized data development, distribution of digital information, and format translation. Less effort has been directed toward the exchange of information between Inventory-based GIS applications and analytical tools such as statistical analysis, process modeling, and pattern recognition. Future success of GIS as a technology and as a paradigm of spatial understanding will depend on the seamless Integration of diverse methods into a comprehensive system for scientific investigation and environmental planning.

These needs are leading to the concept of the open GIS now being investigated by researchers in REGIS, the Research Program in Environmental Planning and Geographic Information Systems at UC Berkeley. The fundamental requirements of the open GIS are:

- shared data space- a generic data model supporting a variety of analytical and cartographic applications
- layered application environment- a user workbench that can be configured to use the specific tools and data necessary to solve a problem
- repository browser- a method for exploring the information and analytical resources available on a network

Presently, specific research projects are advancing these concepts by integrating various public domain/research based systems, including the GRASS GIS, the Postgres database management system,

the IPW image processing system, and environmental models such as San Francisco Bay/Delta hydrodynamics and global circulation.

This paper will present the open GIS concept and then will discuss the requirements incumbent upon information managers to participate in the open GIS, specific criteria for data and methods, and supporting technology. On-going research efforts in the area of global change, oil spill prediction, hazardous waste investigation, and others will be described.

GERSTUNG, ERIC R.
California Department of Fish and Game, Inland Fisheries Division, P.O. Box 944209, Sacramento, CA (916) 739-3415

Status and Management of Coastal Cutthroat Trout Stocks.

Coastal cutthroat, *Oncorhynchus clarki*, are restricted in California to a narrow coastal strip 5 to 30 miles wide extending north from the Eel River Delta. Limited information regarding occurrence and relative abundance has been obtained as a byproduct of anadromous fish sampling and habitat surveys. Estimates of angling use and harvest are limited to the Smith River drainage where much of the angling effort for this fish occurs. Biological information is restricted to limited age and growth, genetic, and food habitat studies. Little information exists regarding migratory behavior or use of ocean waters. Management efforts have been limited to coastal lagoons where juvenile cutthrout are sometimes stocked. Stocking success is currently being evaluated at Stone Lagoon, Humboldt County. Coastal cutthroat appear to be declining in abundance as a result of widespread habitat degradation. The California Department of Fish and Game lists the coastal cutthroat trout as a Species of Special Concern.

HAGLUND, THOMAS R.
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Los Angeles Basin Fish Species of Special Concern.

Coastal and inland southern California has a distinctive, endemic native freshwater fish fauna. This fauna is one of the smallest faunas in the United States, apparently because of climatic and geological constraints. Today, all extant native freshwater species and some of the euryhaline forms are severely reduced within their native ranges. Many other species have been extirpated. Virtually all extant forms

have been recommended for special conservation status within California. Management of existing stocks is complicated by unresolved taxonomic problems, prior introductions and dwindling habitat in the face of a rapidly growing urban population. Action is urgently needed to preserve the remnants of this unique fauna.

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Status and Management of Coho Salmon in California.

Coho salmon, *Oncorhynchus kisutch*, a species of concern in California, are anadromous along the Pacific coast and spawn in coastal streams along California from the Smith River to the Big Sur River. The Sacramento River basin supported coho salmon but fish were extirpated in the 19th century. In 1956-58, large numbers of coho fry were stocked into the basin. Coho returned to spawn but did not maintain a run. An estimated 3,700 miles of stream habitat were available to coho for spawning and rearing in 1965. Available habitat at that time was probably not much different from that available in the early 1800s as few dams have been constructed on the north coast. Salmon habitat has declined since 1965 due to degradation. In 1940, it was thought that about 1 million coho spawned in the state, in 1965, the estimate had dropped to 100,000 fish. However, since 1965, hatchery fish have made up a higher percentage of the run each year. In the 1980s, the run was estimated to average about 34,000 fish (57% hatchery fish). Since 1987, probably less than 5,000 wild coho spawn in California each year. The largest concentration of wild fish are thought to occur in the South Fork of the Eel River. In the 1980s, along the California, Oregon, and Washington coast 9.7% of the commercial coho salmon catch and 6.5% of the ocean sport catch were caught off California. Coho salmon are managed as a unit from the Columbia River to the U.S.-Mexico border (Oregon Production Index area) because these fish are intermixed in the ocean fisheries. Most of the production of coho salmon in California is from hatcheries, which produce about 1 million of the 63 million juvenile coho salmon produced annually in hatcheries in the Index area.

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San Francisco Bay Fishery Resources Good News, Bad News.

Trends In abundance of San Francisco Bay marine and estuarine species have differed in recent years. The abundance of several marine species including white croaker, *Genyonemus lineatus*, bay goby, *Lepidogobius lepidus*, and the blacktail bay shrimp, *Crangon nigricauda*, has increased over the last four to six years. The abundance of other marine species appears to be related more to ocean than in-Bay conditions and these species have had low and high Bay abundance in recent years. Included in this group are California halibut, *Paralichthys californicus*, English sole, *Parophrys vetulus*, and Dungeness crab, *Cancer magister*.

Populations of several estuarine dependent species have recently reached record low levels in the San Francisco Bay Estuary. Declines are best documented for Delta smelt, *Hypomesus transpacificus*, and striped bass, *Morone saxatilis*. The primary reasons for the decline of these species are a decrease in the amount of nursery habitat due to storage and diversion of fresh water during the critical spring-early summer period and loss of eggs, larvae, and juveniles via diversions. Three estuarine dependent species that have had relatively low abundances in the Bay during the drought are the California bay shrimp, *Crangon franciscorum*, longfin smelt, *Spirinchus thaleichthys*, and the starry flounder, *Platichtys stellatus*. Populations of the California bay shrimp and longfin smelt, species with short life spans, will most likely increase when the drought ends. The future for starry flounder is less predictable, as it appears that the Bay population was declining prior to the 1980's. With the increasing human demands upon California's water supply, the probability of recovery of these estuarine species to historic levels remains uncertain.

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Distributional Ecology of Bat Rays in Tomales Bay.

We have been investigation the effects of temperature and salinity on the distribution of elasmobranchs in Tomales Bay since August 1990. Monthly longline sets have shown that bat rays are the dominant elasmobranch in the bay, numerically and by biomass, and that their abundance is seasonal. Out-migration during 1990 occurred during November when bay water temperatures dropped below 10 C^0. Intermittent sonic tracking of rays for 12 months indicates that they utilize the entire bay but that they frequent the mid-bay area. Rays tended to move North-South with predominant tidal currents and moved laterally into shallower areas during incoming or high tide. Blood oxygen binding (in Vitro) was found to be virtually temperature independent with the maximum Bohr effect at 14 C^0. Laboratory determined resting metabolic rates were significantly different for rays at 8, 14, 20, and 26 C^0 with a Q 10 = 3.18 over the 8-26 C^0 range.

JENNINGS, MARK R.
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Aquatic Amphibians and Reptiles of Concern in California: What Species Are in Trouble and What Can We Do to Help Them?

During 1988-1991, review of the California herpetofauna by examining museum records, field surveys, and information from over 150 naturalists revealed 47 unlisted taxa of amphibians and reptiles which warrant protection by the State as Special Concern, Threatened, or Endangered species. Of these 47 taxa, 20 (3 salamanders, 14 frogs and toads, 2 turtles, and 1 snake) are considered "aquatic" and thus are of concern to those responsible for managing aquatic resources. Limited past efforts in protecting amphibians and reptiles have centered largely around the protection a particular species and its habitat. This study revealed that we must consider aquatic amphibians and reptiles as a part of the whole ecosystem in order to assure their long-term survival. Efforts by policy makers and resources

managers should be centered around preserving entire drainage basins and limiting the deleterious effects of humans on riparian ecosystems, especially during critical periods like catastrophic floods and drought. For example, continued livestock grazing; construction of hydroelectric, recreational, or water storage reservoirs of significant size; removal of ground and surface water near or beyond recharge or volume capacities; placement of recreational facilities, use of streambeds by Off Road Vehicles (ORV's), and the introduction of exotic species with which the native aquatic fauna frequently cannot coexist, are the uses that most severely affect aquatic habitats and their contained species. Resource managers need to reevaluate the concept of "multiple-use" as it applies to the aquatic herpetofauna and begin to adequately fund issues related to this group of neglected animals. If adequate steps are not taken soon, many of these taxa will cease to be part of California's unique herpetofauna.

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The Need to Reauthorize the Federal Central Valley Project to Protect Fish Habitat and Other Designated Instream Beneficial Uses of Water.

For more than 40 years, efforts to protect instream beneficial uses from the federal Central Valley Project's (CVP) destructive operations in the Sacramento and San Joaquin river basins have been met by fierce opposition from the project's proponents. Recently, however, driven by declining public support for the CVP's principal constituency, irrigated agriculture, project proponents have suggested that the needs of fish resources can be met by the repair or modification of dysfunctional CVP structures and by increasing artificial fish propagation. At the same time, the project's proponents continue to battle proposals to allocate surplus project yield to improve instream fish habitat destroyed by the project. The situation has compelled commercial fishermen and others to request that Congress reauthorize the CVP to make the project's duty to protect fish resources crystal clear. Congress has been responsive and the stage is set to resolve the long-running debate concerning the CVP's responsibility for the protection of instream beneficial uses of water, which include the habitat of California's most valuable fish resources.

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Resolving Water Project and Fishery Resource Conflicts: A Federal Water Development Agency Approach.

The Bureau of Reclamation operates the Central Valley Project (CVP), which consists principally of dams and associated water storage reservoirs and hydroelectric generating facilities on the Trinity River, Sacramento River, American River and San Joaquin River, a gravity-flow diversion dam on the Sacramento River and a water export pumping facility in the Sacramento-San Joaquin Delta. The Bureau operates the CVP as a multiple-purpose system to meet a number of sometimes competing needs. The combined presence and operation of the CVP has resulted in substantial changes in the hydrology in the affected river basins, with subsequent accompanying changes in the fish populations. The Bureau is involved in a variety of activities to identify and implement solutions aimed at improving conditions for the affected fish populations, while at the same time accomplishing other purposes of the CVP.

LIGHT, THEO, CHRIS MYRICK, and DON C. ERMAN
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Ecology, Life History, and Status of the Shasta Crayfish of Northeastern California.

The shasta crayfish *Pacifastacus fortis* is a federally listed crayfish found only in the midreaches of the Pit River drainage of northeastern Shasta County. Surveys of its distribution and status in 1978-1980, 1985 and 1990 indicate a declining population and shrinking range, particularly in areas invaded by the introduced signal crayfish, *Pacifastacus leniusculus*. In June-August 1991, we studied Shasta crayfish populations at 8 sites, including 3 where it co-occurred with the signal crayfish. Population sizes estimated at 3 sites by mark-recapture, were significantly higher at some sites than previous estimates using other methods. Size structure (from carapace length measurements) of Shasta crayfish populations suggested a fairly even distribution among 7 or more year-classes at most sites. At the site most influenced by the signal crayfish, this distribution was trun-

cated, with almost no representatives of the first and second year classes. Feeding observations supported earlier hypothesis that periphyton and encrusting organisms are a major food source for Shasta crayfish. A significant factor influencing microhabitat selection was the presence of adequate large rocks for cover. Experimental habitat manipulations at two sites showed that Shasta crayfish would use added rocks for shelter, though longterm effects on crayfish density are unknown.

LOUDERMILK, WILLIAM E.
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WIN - win Perceptions and Evolving Resource Management Responsibilities.

The mission of the Department of Fish and Game is to preserve fish and wildlife for their intrinsic values and for public use and enjoyment. Many fisheries have declined and our focus is changing from preventing wanton destruction to insuring continued existence (viable gene pools). California's population continues to grow and solutions are growingly complex. The Department's review comments and recommendations are more frequently becoming subservient to requirements under Endangered Species Act(s). Perhaps for different reasons, this trend concerns fish and water managers. Restoring fish populations and their habitats can help reverse this trend. Legal and administrative processes, as well as WIN-WIN (not WIN-win) solutions are all valuable tools in restoration efforts. Every situation is unique but good communication between management agencies, user and interest groups, consultants and academic institutions help solve conflicts.

MCGRIFF, DARLENE
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Natural Heritage GIS Database for California.

The Natural Diversity Data Base (NDDB) is a continually refined and updated, computerized inventory of location information on California's sensitive animals, plants, and natural communities. It was established by legislation in 1981 and is now a unit of the Department of Fish and Game's Natural Heritage Division. The blueprint used to

set up the NDDB was developed by The Nature Conservancy (TNC). This "Heritage Methodology" has been used to set up similar programs in all 50 states and several foreign countries. Currently the NDDB is collecting location information on 565 native animals, Including 66 fish taxa, 38 amphiblans and 33 reptiles. At the present time the NDDB has no information on aquatic communities In the system. There are plans to reestablish the Aquatic Communities shop within the NDDB. We will be using "A Conservation-Oriented Classification System for the Inland Waters of California" by Moyle and Ellison (In press), to Inventory aquatic communities.

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Management of the Owens Pupfish, and its Habitats in Owens Valley, California.

The Owens pupfish, *Cyprinodon radiosus*, is endemic to Owens Valley, California, and is listed as endangered by both State and Federal agencies. A 4-year field study of the behavior and ecology of several populations of this species was conducted. The study focussed on reproductive activity, habitat use, and interspecific interactions with mosquitofish, *Gambusia affinis*, crayfish, *Procambarus clarkii*, and dragonfly larvae. Populations were studied at Warm Springs, BLM Spring, Owens Valley Native Fish Sanctuary (Fish Slough) and at the newly built White Mountain Research Station (WMRS) refugium. Timing of reproductive activity, as measured by egg production, varied among habitats. The significance of the timing of reproduction to habitat management is addressed. Detailed patterns of habitat use are described for the Warm Springs and WMRS populations. Surprisingly, even In relatively small habitats, panmixis is not easily achieved. Of note at Warm Springs is the recent appearance of a filamentous green algae, probably Splrogyra, that has covered about 80% of what used to be bare silt. Cursory inspection of this habitat since the algae appeared suggests that it has increased cover and spawning substrate, and has encouraged mixing of previously isolated subpopulations. The role of emergent vegetation is controversial. Interactions between pupfish and mosquitofish were minimal, consisting of possible competition during certain types of foraging. No interference of pupfish spawning was attributed to mosquitofish. Crayfish were more directly disruptive, but only to a minor degree.

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Ocean Climate and Recruitment Variability in Exploited Ecosystems.

Variations of two to ten fold in apparent first year survival success of exploited species correspond to warm or cool years. This may suggest that in heavily fished ecosystems, environmental conditions become relatively more important in determining year class strength. An increased importance of environmental changes relative to biological interactions may cause some populations and the fisheries they support to respond rapidly to various scales of climate change.

Year-to-year variations in seasonal ocean temperature approaching the magnitude of the mean annual cycle are common in the California Current Region. Recruitment success among indigenous groundfishes appear related to these anomalously warm or cool periods. However, warm and cool anomalies reflect the result of many interrelated physical processes making the task of understanding step-by-step linkages between physical and biological processes difficult. Some success has been achieved in relating recruitment success of several species of groundfish to warm and cool periods in the California Current Region. These studies suggest that similar species may have specific adaptations that give them different survival changes during warm and cool environmental periods. Series of years characterized by either warm or cool environmental events might favor development of some fisheries because of increased species abundance.

At present it is not possible to predict precisely what the combined affects of a warm or cool climate period and variable exploitation intensity will be, but it may be possible to assemble broad scenarios that will describe present events and will also serve as hypothesis for testing during future changes in climate and exploitation.

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Status of San Joaquin Chinook Salmon.

Fall-run chinook salmon, *Oncorhynchus tshawytscha,* populations in the San Joaquin River system have declined by over 85% since the 1940's. The development of water storage projects on the San Joaquin, Merced, Tuolumne and Stanislaus rivers have significantly altered natural streamflow patterns and have reduced quality salmon habitat. Spring-run chinook salmon were extirpated from the drainage after 1949 as a result of the construction of Friant Dam and the operation of the Central Valley Project. Spawning gravel limitations, inadequate streamflows during spawning, rearing and outmigration, high water temperatures, and water diversions are but of few of the factors affecting current salmon population levels. Effort is underway in the basin to restore habitat conditions in order to meet legislative mandates and Department objectives.

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Marine Debris: Is an End in Sight?

Marine Debris is an environmental problem of global concern. While plastic debris washing ashore is unsightly, at sea it poses significant entanglement and ingestion hazards to marine animals. Protected coastal areas can serve as ideal laboratories for assessing region wide changes in the abundance, composition, and accumulation rates of human-generated marine debris. One such program has been ongoing in the U.S. National Park Service since 1988. A total of 42 permanent 1 kilometer-long beach transects in eight units of the National Park System, located on the Atlantic, Gulf, and Pacific coasts, are surveyed quarterly to determine the type, abundance, and seasonal trends of marine debris. Plastic debris generally accounts for 80 to 90 % of the total debris. While evidence of entanglement is low, entangling debris makes up 1 to 15% of the total debris. Some interesting regional trends in debris types indicate different sources of debris in different areas.

ROSGEN, DAVE
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Design and Construction of a Natural, Native Trout Hatchery in Nevada.

The author will describe the development of a natural, native trout hatchery on Maggie Creek Ranch near Lamoille Creek in the Ruby Mountains of North Central Nevada. The project involves design and construction of brood ponds, rearing ponds, spawning channels, and diversion works that will be used to rear two species of native trout: Lahontan cutthroat and redband trout. Brood sources will be provided by the Nevada State Department of Fish and Game in exchange for a supply of juvenile fish for reintroduction into public waters. This is not a commercial hatchery, but an effort to develop a trophy trout fishery on a catch-and-release basis on private lands.

SAIKI, MICHAEL K., DANIEL T. CASTLEBERRY, and BARBARA MARTIN
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A Field Test of Artificial Redds for Quantifying the Early Survival of Salmonids.

We assessed the use of artificial redds for monitoring the early survival (embryo-to-button-up-fry stages) of salmonid fishes. Artificial redds were constructed in spawning gravel on the upper Sacramento River and Clear Creek (a tributary of the Sacramento River). Each redd was constructed by placing a known number of either newly fertilized eggs or eyed embryos of rainbow trout, *Oncorhynchus mykiss*, into modified Whitlock-Vibert boxes (WVBs) or into bags made of nylon netting, then burying these enclosures under 10-20 cm of gravel. By using the modified WVBs and the bag we hoped to learn if different types of enclosures enhanced survival of embryos and fry, and reduced escapement of the live fry. At appropriate times, selected redds were excavated to count the numbers of live and dead embryos and fry. Our results suggested that survival to the button-up stage was higher when redds were planted with eyed embryos than with newly fertilized eggs. When planted with newly fertilized eggs , the yields of eyed embryos, yolk-sac fry (alevins), and button-up fry were higher in redds from Clear Creek than in redds from the

Sacramento River. The numbers of live embryos and fry recovered from redds in the Sacramento River did not vary significantly among different types of enclosures. We originally expected to estimate the escapement of fry from the different types of enclosures by equating the escapees to "missing fry" (i.e., the difference between numbers of eggs initially planted and numbers of live and dead embryos and fry subsequently recovered). However, such estimates were not made because we now suspect that the "missing fry" included dead embryos and fry that disappeared after undergoing decomposition. Overall, artificial redds seem to be useful for detecting unfavorable environmental conditions in the spawning grounds of salmonids. Future studies should compare the survival of embryos and fry in artificial redds with those in natural redds, and test improved designs for enclosures that eliminate escapement of fry.

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Distribution, Ecology, and Management of the Endangered California Freshwater Shrimp.

The California freshwater shrimp, *Syncaris pacifica,* is a detritus feeder endemic to perennial lowland streams in Sonoma, Napa and Marin counties. Before human related impacts, the shrimp was probably common in the three-county area. Channelization, introduced fish predators, pollution and water withdrawal have subsequently eliminated them from most of their original habitat. Its only close relative, the Pasadena freshwater shrimp, *Syncaris pasadenae,* was native to southern California, and became extinct sometime in the 1930's. Populations of the California freshwater shrimp are now known to occur in 13 streams, but it could be extirpated from several of them at any time. The current drought has placed even more pressure on the species. Private landowners, The Nature Conservancy, and government agencies have worked successfully to help preserve the remaining habitat and manage the species in some of the streams. However, much more work and cooperation is necessary before the future of the shrimp is secure.

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Status of California Estuarine Fishes.

California estuaries have experienced wholesale changes in their physical structure that has affected the fish population in major ways. For the last million years or so most of these estuaries have been rising rapidly and were coastal lagoons and brackish marshes until the arrival of European civilization (Santa Margarita River, Mugu Lagoon, Ten Mile River, Lake Earl). Conversely, a few are flooded river valleys and often have changed less drastically (Noyo, Navarro, and Garcia Rivers, San Francisco Bay). About 30 species of estuarine dependent fishes are known from California and an additional 10 or so taxa of fishwater and migratory fishes also depend on estuaries during part of their life cycle. About one-fourth of these taxa are extirpated, rare, or endangered in California, and several others are known to be declining in numbers. The integrity of estuarine systems must be maintained or restored to sustain or increase populations of these species, some of which are commercial and sport species.

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Sanctuary Protection: Myth or Miracle.

In 1972 Congress passed the Marine Protection, Research and Sanctuaries Act (MPRSA). Today there are seven sanctuaries which protect roughly 5,000 square miles of ocean. Another seven are in the process of being designated. These seven will more than double the area protected by the MPRSA. However, many people who live adjacent to or work within the Sanctuaries are unaware of their existence or protective status. Others who know about the Sanctuary still do not have a firm knowledge of how the Sanctuaries protect.

Sanctuary personnel are often asked many rudimentary questions. Some of these questions are: What does a Sanctuary do? How does it protect? What does it protect? Has the protection been effective? These and other questions will be discussed in relationship to the Gulf of the Farallones (950 square miles) and Cordell Bank (400 square

miles) National Marine Sanctuaries. Major conflicts, controversies and conditions within these two sanctuaries will be presented. The resource conservation issues of each item will be delineated and the protective methods either being considered or implemented will also be discussed.

VOGEL, DAVID A.
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Resolving Water Project and Fishery Resource Conflicts: A Consultant's Approach.

Today's biological consultant is faced with increasing challenges to help resolve extremely complex issues associated with water projects and fishery resources. Traditional approaches have sometimes resulted in ultimate harm to fishery resources or cannot be used in the present day because of social, political, and biological complexities. Innovative approaches have to be employed to ensure that water projects do not adversely affect fishery resources. Formal policy and position statements, if not properly phrased, can stifle the creativity necessary to resolve resource conflicts. On many occasions, the role of a consultant is to serve as a liaison or "interpreter" between natural resource agencies and water development interests to ensure good communication toward problem resolution. Although many approaches appear to be biologically "correct", they are difficult to implement because their proponents fail to influence the decision-making process. Problem identification is essential at the onset to allow focused attention on the important issues and enable development of sound biological and political solutions to the conflicts. A scientific approach is imperative, but is most effective if presented in a non-controversial, non-confrontational manner to avoid polarization of the issues and interest groups.

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Resolving Water Project and Fishery Resource Conflicts: A Public Policy Approach.

Assuming a mutual desire to resolve conflict, most differences can be lessened by clearly identifying the goals, expectations, desires and concerns of the participants. Group process and individual percep-

tions emerge as key resolution factors. Data can be helpful or an overload depending on ones's view of the specific situation. Personal values, respect, individual and organizational integrity, and a feeling of outcome control also play important roles in achieving an effective lowering of adversarial relationships.

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Declining Amphibians in California: Real Crisis—Potential Opportunity.

Researchers are presently documenting a worldwide decline in amphibians. These declines appear to result from two distinct categories of causes: (1) atmospheric or climatic perturbations, and (2) habitat destruction. Documented declines in amphibian populations throughout the State are reviewed by region. Three cases of declines in northwestern California are examined in more detail. Evidence is presented of declines in numbers in populations of the tailed frog, *Ascaphus true*, the Olympic salamander, *Rhyacotriton variegatus*, and the Del Norte salamander *Plethodon elongatus*. Aspects of the ecology of these species are reviewed in the context of the two general models of amphibian population decline. A case is presented for the model of habitat destruction as the probably cause for the declines in these populations. Attributes of the biology of amphibians are reviewed as they apply to the potential of these species as bioindicators or subjects for long-term environmental monitoring.

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Tidewater Gobies—Status, Impacts, and Recommendations for Management.

Tidewater gobies, *Eucyclogobius newberryi*, have been lost from a large number of localities from which they have historically been known. Recent population losses resulting from drought, water diversion, and other impacts have prompted the U.S. Fish and Wildlife Service to evaluate whether they warrant listing as threatened or

endangered. In some areas they appear to have been almost entirely extirpated, such as in most San Francisco Bay drainages. However, they have been observed recently in several localities from which they were thought to have been lost. Tidewater gobies have been seen to survive extremely adverse conditions, Including very low water availability. Laboratory studies have shown them to be highly tolerant of both fresh and hypersaline conditions. Although this environmental flexibility aids in their survival they must contend with a large number of environmental impacts in most coastal lagoons, particularly water diversion. In managing this species, their annual life cycle, specific needs for brackishwater habitat and spawning substrate requirements in particular should be considered. Specific measures taken by CDFG to protect populations of concern have included construction of holding pools adjacent to work sites, removal of subsamples of populations to refugia, promotion of innovative construction techniques to avoid impacts to substrate and water quality and quantity, and avoidance of habitat impacts during spawning season. Specific examples of these methods are taken from San Luis Obispo County, where drought, water diversion, siltation, and bridge construction have threatened a number of local populations.

WAPLES, ROBIN S.
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Pacific Salmon and the Definition of "Species" Under the Endangered Species Act.

For purposes of the Endangered Species Act (the Act), a "species" is defined to include "any distinct population segment of any species of vertebrates, the scope of the Act extends beyond the traditional biological definition of species to include smaller biological units. However, the Act provides no guidelines for determining what constitutes a "distinct population segment," and Federal agencies charged with carrying out the provisions of the Act have struggled for over a decade to develop a consistent approach to the problem of vertebrate populations. This paper suggests such an approach and explains in some detail how it can be applied to ESA considerations of anadromous Pacific salmonids. The approach is concepturally simple, yet flexible enough to provide guidance in dealing with a number of topics of particular concern for Pacific salmonids (anadromy/nonanadromy, differences in run-timing, the role of hatchery fish in ESA considerations, introduced populations, and historic population size).

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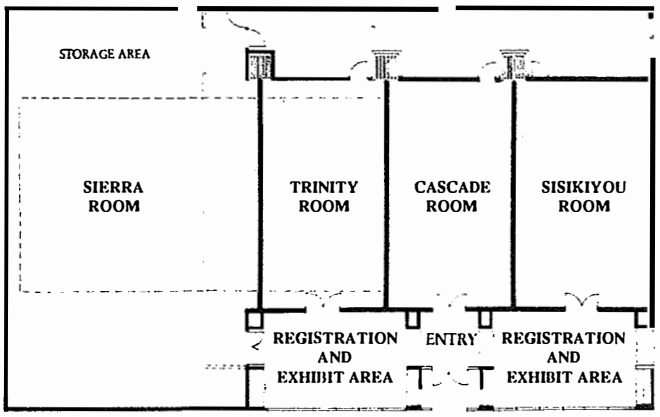

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