INTERAGENCY ECOLOGICAL PROGRAM
2012 ANNUAL WORKSHOP

APRIL 18 – 20, 2012
LAKE NATOMA INN
FOLSOM, CA

WORKSHOP AT A GLANCE

All oral presentations will be in the Sierra Ballroom or Sutter Room, and the poster sessions will be held in the pavilion. Lunch will not be provided.

WEDNESDAY, APRIL 18

8:00 – 10:00	IEP Registration and Poster Set-up
10:00 – 10:40	Joint CWEMF and IEP Introduction and Updates
10:40 – 12:30	Session I – Smelt Life Cycle Models
12:30 – 1:40	Lunch
1:40 – 2:40	Session II – Applied Hydrodynamic Modeling and Forecast Tools
2:40 – 3:20	The Delta Science Program Welcomes New Lead Scientist, Peter Goodwin
3:30 – 6:00	Joint CWEMF and IEP Poster Session

THURSDAY, APRIL 19

8:30 – 10:10	Session III – What's New in the Salmon World?
10:10 – 10:30	Break
10:30 – 11:50	Session III (continued) – What's New in the Salmon World?
11:50 – 1:10	Lunch
1:10 – 2:50	Session III (continued) – What's New in the Salmon World?
2:50 – 3:10	Break
3:10 – 3:30	Poster Speed Introductions
3:30 – 4:50	Session IVa - Due North: Cache Slough Complex, Liberty Island and the Deep Water Shipping Channel Session IVb - Water Quality Effects, From Producers to Consumers
5:00 – 7:00	IEP Poster Reception

FRIDAY, APRIL 20

8:30 – 10:10	Session Va – Under the Microscope and Lower Trophic Critters Session Vb – Marking, Counting and Detecting Fish: The Latest and Greatest from Suisun to the North Delta
10:10 – 10:30	Break
10:30 – 12:20	Session VI – Fall Low Salinity Habitat (FLaSH) Studies: Making Sense of Physical and Biological Conditions in 2011
12:20 – 1:30	Lunch
1:30 – 3:30	Session VI (continued) - Fall Low Salinity Habitat (FLaSH) Studies: Making Sense of Physical and Biological Conditions in 2011

GENERAL INFORMATION

Overview: The Interagency Ecological Program (IEP) for the San Francisco Estuary / Sacramento-San Joaquin Delta consists of nine member agencies, three State (Department of Water Resources, Department of Fish and Game, and State Water Resources Control Board) and six Federal (Fish and Wildlife Service, Bureau of Reclamation, Geological Survey, Army Corps of Engineers, NOAA Fisheries, and Environmental Protection Agency). The IEP also partners with the San Francisco Estuary Institute, the Delta Science Program, and many academic and private scientists. The mission of the IEP is, in collaboration with others, to provide ecological information and scientific leadership for use in management of the San Francisco Estuary. More information about the IEP can be found at http://www.water.ca.gov/iep/.

The annual IEP Workshop serves as a focal point for IEP activities. The program for this year's Workshop is diverse, with many oral and poster presentations offering a full spectrum of current IEP activities. After a three-year transition period to a new location, the Lake Natoma Inn in Folsom, CA, this year's Workshop once again features a full three-day program and close coordination with the California Water and Environmental Modeling Forum (CWEMF, http://cwemf.org/). The CWEMF annual meeting is taking place April 16-18 at the Lake Natoma Inn. IEP and CWEMF are holding joint oral sessions on Wednesday, April 18. For the first time, IEP and CWEMF are also holding a joint poster session and reception in the afternoon of April 18. The joint oral and poster sessions on April 18 are open to all registered IEP and all registered CWEMF meeting participants.

Chair, IEP Agency Coordinators: Gregg Erickson (DFG)
IEP Lead Scientist: Anke Mueller-Solger (DSC)
IEP Program Manager: Kelly Souza (DFG)

2012 IEP Workshop Program Committee: Lenny Grimaldo (chair; Reclamation), Josh Israel, (Reclamation), Lori Smith (FWS), Pat Brandes (FWS), Li-Ming He (NMFS), Alex Parker (SFSU), Brett Harvey (DWR), Bill Templin (DWR), Stephanie Fong (CVRWQCB), Christine Joab (CVRWQCB), B.J. Miller (San Luis and Delta Mendota Water Agency), Anke Mueller-Solger (DSC), and Kelly Souza (DFG).

WEDNESDAY, APRIL 18

JOINT CWEMF AND IEP INTRODUCTION AND UPDATES

Moderator: Rich Breuer (DWR)
Location: Sierra Ballroom

10:00-10:10	CWEMF: Highlights 2011 to 2012	Marianne, Guerin, RMA
10:10-10:20	IEP Program Highlights	Kelly Souza, DFG
10:20-10:40	IEP Science Highlights	Anke Mueller-Solger, DSC

SESSION I – SMELT LIFE CYCLE MODELS

Moderator: Lenny Grimaldo (Reclamation)
Location: Sierra Ballroom

10:40-10:50	Understanding Life Cycle Models and Their Applications	Wim Kimmerer, SFSU (RTC)
10:50-11:10	Individual-Based Population Dynamics Model of Delta Smelt: Comparing the Effects of Food Versus Entrainment	Kenny Rose, LSU
11:10-11:30	A State-space Multistage Life Cycle Model to Evaluate Population Impacts in the Presence of Density Dependence: Illustrated with Application to Delta Smelt	Richard Deriso, Tuna Commission
11:30-11:50	A Hierarchical Spatio-Temporal Model for Delta Smelt	Ken Newman, FWS
11:50-12:10	Statistical Modeling of Unnatural Selection, and the Dialectics of Causation in the Decline of Delta Smelt	William Bennett, UCD
12:10-12:30	Development and Application of an Individual Based Model for Longfin Smelt in the San Francisco Estuary	Erik Lobochefsky, UCD

12:30 – 1:40 Lunch

Location: Area restaurants

SESSION II– APPLIED HYDRODYNAMIC MODELING AND FORECAST TOOLS

Moderator: Ben Bray (EBMUD)
Location: Sierra Ballroom

1:40-2:00	Investigating the Effect of Tidal Migration Behavior on Zooplankton Retention	Ed Gross, RMA
2:00-2:20	Forecasting Turbidity in the Sacramento-San Joaquin Delta	John DeGeorge, RMA
2:20-2:40	Climate Change Information for Ecological Modeling	Jamie Anderson, DWR

2:40 – 3:20 THE DELTA SCIENCE PROGRAM WELCOMES NEW LEAD SCIENTIST, PETER GOODWN (DSP)

INTRODUCTION BY: ANKE MUELLER-SOLGER (DSC)

ACCELERATING KNOWLEDGE DISCOVERY THROUGH SCIENCE COMMUNITIES AND EMERGING TECHNOLOGIES

3:30 – 6:00 Joint CWEMF and IEP Poster Session

Location: Pavilion

THURSDAY, APRIL 19

SESSION III – WHAT'S NEW IN THE SALMON WORLD?

Moderator: Jeff McLain (NMFS)
Location: Sierra Ballroom

8:30-8:50	Salmon and IEP: Finding Holistic Approaches for Monitoring, Modeling and Management	Josh Israel, Reclamation
8:50-9:10	From Sabertooth Salmon to Conservation Hatcheries: Managing for Resilient Salmon Population in California's Altered Riverscapes	Rachel Johnson, Reclamation
9:10-9:30	An Integrated System for Storing, Analyzing and Reporting Juvenile Chinook Salmon Data Collected with Rotary Screw Traps	Doug Threloff, FWS
9:30-9:50	Migration Patterns of Juvenile Winter-Run Size Chinook Salmon (*Oncorhynchus tshawytscha*) Through the Sacramento-San Joaquin Delta	Yvette Redler, NMFS
9:50-10:10	Estimates of Hatchery Contribution to California's Central Valley Chinook Results of 2010 Constant Fractional Marking Program Recovery Data	Brett Kormos, DFG

10:10 – 10:30 Break

SESSION III – WHAT'S NEW IN THE SALMON WORLD? (CONTINUED)

Moderator: Ramon Martin (FWS)
Location: Sierra Ballroom

10:30-10:50	Juvenile Salmon Survival Studies in the North Delta	Russ Perry, USGS
10:50-11:10	An Overview of USGS Acoustic Telemetry Studies	Jon Burau, USGS
11:10-11:30	South Delta Salmon Survival Studies	Pat Brandes, FWS
11:30-11:50	Acoustic Telemetry Evaluations of Non-Physical Fish Barriers and Fish Protection Facilities in the Central Valley of California	Mark Bowen, Reclamation

11:50 – 1:10 Lunch
Location: Area restaurants

SESSION III – WHAT'S NEW IN THE SALMON WORLD? (CONTINUED)

Moderator: Josh Israel (Reclamation)
Location: Sierra Ballroom

1:10-1:30	A Juvenile Salmonid Perspective on Delta Hydrodynamics: The Relative Influence of River Inflows, Tides and South Delta Exports	Brad Cavallo, Cramer Fish Sciences
1:30-1:50	Predator Densities and Associated Salmonid Smolt Mortality Around Water Diversions	Cyril Michel, NMFS
1:50-2:10	Who's Your Daddy? Validating Length-Date Run	Brett Harvey, DWR

	Assignments with Genetics for Central Valley Chinook	
2:10-2:30	A Review of the IEP Delta Juvenile Fishes Monitoring Program and the Stockton FWS Salmon Survival Studies	Joe Kirsch (FWS)
2:30 – 2:50	Monitoring, Modeling and Management: How Can We Put it All together to Support Salmonid Conservation in the Central Valley?	Steve Lindley, NMFS

2:50 – 3:10 Break

3:10 – 3:30 Poster Speed Introductions

Moderator: Steve Culberson (FWS)
Location: Sierra Ballroom

CONCURRENT SESSION IVA – DUE NORTH: CACHE SLOUGH COMPLEX, LIBERTY ISLAND AND THE DEEP WATER SHIPPING CHANNEL

Moderator: Ted Sommer (DWR)
Location: Sierra Ballroom

3:30-3:50	Cache Slough Turbidity, Sediment and Salinity Trends in 2011	Tara Morgan-King, USGS
3:50-4:10	CDFG's Monitoring of the Sacramento Deep Water Shipping Channel: Pelagic Fishes, Zooplankton and Their Shared Habitat	Julio Abid-Samii, DFG
4:10-4:30	Dredging Impacts to Delta Smelt and Other Fish Species in the Sacramento Deep Water Shipping Channel	Jordan Gold, Mari-gold Environmental Consulting
4:30-4:50	Larval and Juvenile Fishes of Liberty Island	Lori Smith, FWS

CONCURRENT SESSION IVB – WATER QUALITY EFFECTS, FROM PRODUCERS TO CONSUMERS

Moderator: Stephanie Fong, CVRWQCB
Location: Sutter Room

3:30-3:50	Determining Environmental Controls and Ecological Impacts of CyanoHABs in the San Joaquin-Sacramento Delta – A Multidisciplinary Approach	Raphe Kudela, UCSC
3:50-4:10	Transcriptomics and Delta Monitoring: Accomplishments, Difficulties and Future Prospects	Richard Connon, UCD
4:10-4:30	Contaminant Sources and Toxicity in the Cache Slough Region	Don Weston, UCB
4:30-4:50	Detection and Potential Effects of Pharmaceuticals and Personal Care Products in the Sacramento River	Erika Holland, UCD

5:00 – 7:00 IEP Poster Reception

Location: Pavilion

FRIDAY, APRIL 20

CONCURRENT SESSION VA – UNDER THE MICROSCOPE AND LOWER TROPHIC CRITTERS

Moderator: Alex Parker (SFSU)
Location: Sutter Room

8:30-8:50	The Effect of Ambient Irradiance on Phytoplankton Nutrient Uptake in San Francisco Estuary	Dick Dugdale, SFSU (RTC)
8:50-9:10	Assessing Phytoplankton Communities in the Sacramento and San Joaquin Rivers Using Microscopic and Indirect Analytical Approaches	Erika Kress, SFSU (RTC)
9:10-9:30	Roll of Salinity and Temperature in Corbula amurensis Energetics in the upper San Francisco Bay Estuary	Nate Miller, SFSU (RTC)
9:30-9:50	Abundance, Distribution and Clearance Rates of the Brackish-Water Hydromedusa *Blackfordia virginica*	Jessica Donald, SFSU (RTC)
9:50-10:10	Introduction of the Siberian Prawn, *Exopalaemon modestus*, into the San Francisco Estuary: Ten Years Later	Tiffany Brown, DWR

CONCURRENT SESSION VB – MARKING, COUNTING AND DETECTING FISH: THE LATEST AND GREATEST FROM SUISUN TO THE NORTH DELTA

Moderator: Louise Conrad (DWR)
Location: Sierra Ballroom

8:30-8:50	California Striped Bass: A Species Contested for the Prey it Ingested	Jason DuBois, DFG
8:50-9:10	SmeltCam III: Making Science Fiction a Reality with Fish Species Recognition Technology	Don Portz, Reclamation
9:10-9:30	Genetic Detection of Predation on Larval Delta Smelt in the North Delta	Brian Schreier, DWR
9:30-9:50	Preliminary Evaluation of Individual Identification for Delta Smelt by Means of Natural Marks	Gonzalo Castillo, FWS
9:50-10:10	Laboratory Design and Testing of an Electrical Crowder for Predator Reduction at the Tracy Fish Collection Facility	Mike Horn, Reclamation

10:10 – 10:30 Break

SESSION VI – FALL LOW SALINITY HABITAT (FLASH) STUDIES: MAKING SENSE OF PHYSICAL AND BIOLOGICAL CONDITIONS IN 2011

Moderator: Erwin van Nieuwenhuyse, Reclamation
Location: Sierra Ballroom

10:30-10:40	Introduction to the Fall Low Salinity Habitat Studies of the San Francisco Estuary	Erwin Van Nieuwenhuyse, Reclamation
10:40-11:00	Pelagic Fish Distribution and Growth Patterns	Dave Contreras, DFG
11:00-11:20	FLaSHy Fish Food: Just Add Water!	April Hennessey, DFG
11:20-11:40	What's New on the Menu? Regional Feeding Patterns of Delta Smelt in a Wet Year	Steve Slater, DFG

11:40-12:20	FLaSH: Health and Nutritional Analyses of Delta smelt "Benchmarks for Health"	Jim Hobbs, Shawn Acuna and Saikrithika Gandhi, UCD

12:20 – 1:30 Lunch

Location: Area restaurants

SESSION VI – FALL LOW SALINITY HABITAT (FLASH) STUDIES: MAKING SENSE OF PHYSICAL AND BIOLOGICAL CONDITIONS IN 2011 (CONTINUED)

Moderator: Larry Brown (USGS)

Location: Sierra Ballroom

1:30-1:50	Big Surprises Come in Small Packages: 2011 Phytoplankton Monitoring Results	Anke Mueller-Solger, DSC/IEP
1:50-2:10	Nutrient and Phytoplankton Distributions During the Fall Low Salinity Habitat (FLaSH) Study in Suisun Bay	Frances Wilkerson, SFSU (RTC)
2:10-2:30	Water and Particle Properties as Measures of Habitat Quality	Brian Bergamaschi, USGS
2:30-2:50	Going With the Flow: The Distribution, Biomass and Grazing Rate of *Corbula* and *Corbicula* with Varying Freshwater Flow (May and October 2009-2011)	Jan Thompson, USGS
2:50-3:10	Comparison of Seston Composition and Sources in the Delta During Two High-Flow Falls (2006 and 2011)	Carol Kendall, USGS
3:10-3:30	Synthesis of Studies in Fall Low Salinity Habitat of the San Francisco Estuary	Larry Brown, USGS

2012 IEP Workshop Poster Presentations

Note: A single asterisk (*) signifies posters displayed in both the joint CWEMF/IEP poster session on 4/18/12 and the IEP-only poster session on 4/19/12. A double asterisk (**) signifies posters displayed in the joint CWEMF/IEP poster session only.

***Investigating Infections of Mycobacterium in Delta Smelt (*Hypomesus transpacificus*) from the San Francisco Estuary**

D.V. Baxa[1], S.J. Teh[1], J.C. Lindberg[2], E.P. Scott Weber III[3] [1] School of Veterinary Medicine, Department of Anatomy, Physiology, and Cell Biology, University of California, Davis [2] Department Biological and Agricultural Engineering, Fish Conservation and Culture Laboratory (FCCL), University of California, Davis [3] School of Veterinary Medicine, Department of Medicine and Epidemiology, University of California, Davis

"Bona fide" Scientific Research Permitted Activities

R. Bellmer, D. Kratville, K. Barnes, and S. Rajappa
California Department of Fish and Game, Fisheries Branch

Steelhead Monitoring Program in California: Past, Present and Into the Future

R. Bellmer, J. Nelson, K. Barnes, and R. Fortier
California Department of Fish and Game, Fisheries Branch

Water and Particle Properties as Measures of Habitat Quality

B. Bergamaschi[1], B. Downing[1], M. Sauer[1], P. Hernes[2]
U.S. Geological Survey[1]
University of California, Davis[2]

An Experimental Study of Diuron and Imazapyr Herbicide Effects on Phytoplankton Assemblages in the San Francisco Estuary

S. Blaser, F. Wilkerson, and A. Parker
Romberg Tiburon Center for Environmental Studies, San Francisco State University

***The Toxicity and Interactions Among Common Aquatic Contaminants in Binary Mixtures**

K. Callinan[1], L. Deanovic[1], I. Werner[2], S. Fong[3], S. Teh[1]
[1] School of Veterinary Medicine, Department of Anatomy, Physiology, and Cell Biology, University of California, Davis
[2]Eawag Überlandstrasse 133, Switzerland
[3]Central Valley Regional Water Quality Control Board

****2D Hydrodynamic Modeling in the Yolo Bypass to Support Habitat Evaluation**

C. Campbell, A. Sawyer, and C. Bowles
CBEC, Inc.

****CALVIN Groundwater Update**

H. Chou, P. Zinkalala, C. Buck, J. R. Lund, J. Medellín-Azuara
University of California, Davis

Nutrient Fluxes from San Francisco Bay Delta Sediments

J. Cornwell, M. Owens, P. Glibert, J. Alexander,
University of Maryland Center for Environmental Science, Horn Point Laboratory

***Sacramento River Chinook: Viability in the Face of Environmental Variability**

C. Cunningham[1], R. Hilborn[1], N. Hendrix[2] and R. Lessard[3]
[1]School of Aquatic and Fishery Sciences, University of Washington
2R2 Resource Consultants, Inc.; Affiliate Faculty at University of Washington
[3]Columbia River Inter-Tribal Fish Commission

Survival, Behavior and Feeding of Juvenile Delta Smelt (*Hypomesus transpacificus)*
Under Varied Turbidity Conditions

L. Deanovic[1], D. Markiewicz[1], M. Stillway[1], A. Javidmehr[1], I. Werner[2], S. Teh[1]
[1] School of Veterinary Medicine, Department of Anatomy, Physiology, and Cell Biology, University of California, Davis
[2]Eawag Überlandstrasse 133, Switzerland

The North Delta: Refugia for Native Fishes in the Upper San Francisco Estuary

D. De Carion[1], B. Schreier[2], L. Conrad[2], A. Sih[1]
[1]Department of Environmental Science & Policy, University of California, Davis
[2] Aquatic Ecology Section, California Department of Water Resources

Temperature as a Driver of Cyanobacteria Blooms in the San Francisco Estuary Delta: Evidence from Experimental Enclosures

M. DuBose, A. Johnson, A. E. Parker, F. P. Wilkerson
Romberg Tiburon Center, San Francisco State University

Delta and Longfin Smelt Bioenergetics: Determining Maximum Consumption

K.J. Eder[1], R. C. Kaufman[2], N. A. Fangue[2], and F. J. Loge[1]
[1]Department of Civil and Environmental Engineering, University of California, Davis
[2] Department of Wildlife, Fish and Conservation Biology, University of California, Davis

Advancements in Delta Smelt Acoustic Tagging

K. J. Eder[1], T. Hung[2], D. E. Thompson[1], R. H. Piedrahita[2], and F. J. Loge[1]
[1] Department of Civil and Environmental Engineering, University of California, Davis
[2] Department of Biological and Agricultural Engineering University of California, Davis

The Effect the Pyrethroid Pesticide, Bifenthrin, on Reproductive Endpoints of Steelhead (*Oncorhynchus mykiss*)

K.L. Forsgren, N. Riar, and D. Schlenk
Department of Environmental Sciences, University of California, Riverside

***Use of Two Dimensional Hydraulic and Sediment Transport Modeling in Design of Salmonid Rearing Habitat in the Sacramento River Floodplain**

P. Frank and M. Tompkins, Newfields

***Development of a Modeling Framework for Assessing Flood Management Performance and Floodplain Habitat Creation in the South Delta**

P. Frank, M. Tompkins, and J. Thomas, Newfields

The California Delta: A World-Class Bass Fishery - Adult Largemouth Size and Growth Distribution in the Sacramento-San Joaquin Delta

J. Frantzich and N. Ikemiyagi , Division of Environmental Science, Aquatic Ecology Section, California Department of Water Resources

The Biomass of Invasive Bivalves in the Low Salinity Zone in August 2011
H. Fuller[1], K. Gehrts[1], D. Riordan[1], and J. Thompson[2]
[1]California Department of Water Resources
[2]U.S. Geological Survey

Study on the Effect of Xenobiotics by Using Multiple Biomarkers on Delta Smelt (*Hypomesus transpacificus*)
S. Gandhi and S. Teh
Aquatic Health Program, University of California, Davis

Elevated Ammonium Concentrations Inhibit Total Nitrogen Uptake and Growth, Not Just Nitrate Uptake
P.Glibert[1], J.Alexander[1], D. Dugdale[2], F. Wilkerson[2], A. Parker[2]
[1]University of Maryland Center for Environmental Science, Horn Point Laboratory
[2]Romberg Tiburon Center for Environmental Studies, San Francisco State University

***A Framework for Developing Stream Flow and Thermal Regimes for Multiple Salmonid Species in the Central Valley**
Li-Ming (Lee) He
NOAA's National Marine Fisheries Service, Southwest Region, Central Valley Office

***The Growth and Development of Copepods in the Food Limited San Francisco Estuary**
T. Ignoffo[1], A. Gould[2], A. Slaughter[1]and W. Kimmerer[1]
[1]Romberg Tiburon Center for Environmental Studies, San Francisco State University
[2]University of Michigan

Integrated Regional Water Management Economic Assessments
R. Juricich
California Department of Water Resources

Statewide Water Analysis Network (SWAN)
R. Juricich
California Department of Water Resources

Water Plan Update 2013
R. Juricich
California Department of Water Resources

Water Planning Information Exchange
R. Juricich
California Department of Water Resources

Water Sustainability Indicators Framework
R. Juricich
California Department of Water Resources

An Analysis of Copepod Feeding Using FlowCAM
K. Kayfetz and W. Kimmerer
Romberg Tiburon Center, San Francisco State University

***Factors Influencing Delta Smelt Take During Chinook Salmon Monitoring Near Chipps Island Within the San Francisco Estuary**

J.E. Kirsch, L.M. Smith, G. Castillo, and D.M. Barnard
U.S. Fish and Wildlife Service

***DNA Barcoding of Toxin Producing Cyanobacteria in Clear Lake and Sacramento-San Joaquin Delta**

T. Kurobe[1], D.V. Baxa[1], C. Mioni[2], R. M. Kudela[2], S. J. Teh[1]
[1]School of Veterinary Medicine, Department of Anatomy, Physiology, and Cell Biology, University of California, Davis [2]Institute of Marine Sciences, University of California, Santa Cruz

If We Build It, Who Will Come? Importance of Predator-Prey Habitat Overlap to Restoration

Cynthia LeDoux-Bloom, Ph.D Candidate
Animal Biology Graduate Group, University of California, Davis

***The Importance of Vegetated Ponds to Water Quality and Phytoplankton Carbon Production in Liberty Island, California**

P. W. Lehman[1], S. Mayer[2] and B. A. Larsen[2]
[1]Division of Environmental Services, California Department of Water Resources
[2]North Central Region Office, California Department of Water Resources

***Trends in Microcystis Abundance and Toxicity in San Francisco Estuary, 2004 to 2008**

P. W. Lehman[1], K. Marr[1], G. Boyer[2], S. Acuna[3] and S. Teh[3]
[1]Division of Environmental Services, California Department of Water Resources
[2]College of Environmental Science and Forestry, State University of New York
[3]School of Veterinary Medicine, University of California, Davis

***Isotope Identification of Particulate Organic Matter and Nutrient Sources During *Microcystis* Blooms in San Francisco Estuary**

P. W. Lehman[1], C. Kendall[2], S. Silva[2], M. Young[2] and M. Guerin[3]
[1]Division of Environmental Services, California Department of Water Resources
[2]U.S. Geological Survey, Menlo Park, California
[3]Resouce Management Associates, Fairfield, California

The Effect of Using Yearly-Changing Historical Land Use on DSM2 Simulation of Historical Delta Conditions

L. Liang
California Department of Water Resources

****Integrated Regional Water Management Tool: HydroDMS**

J. Long, S. Najmus, A.Taghavi, Y. Noor, and M. Cayar
RMC

Projected Impacts of Climate Change, Urbanization, and Water Management Scenarios on Ecology and Habitats of Waterfowl and Other Waterbirds in the Central Valley of California

E.L. Matchett[1], J.P. Fleskes[1], M.J. Petrie[2], D.R. Purkey[3], C.A. Young[3], M. E. Reiter[4], and J.M. Eadie[5].
[1] Western Ecological Research Center, U.S. Geological Survey
[2]Ducks Unlimited, Inc, Vancouver, Washington
[3]Stockholm Environment Institute, United States Center
[4]PRBO Conservation Science
[5] Department of Wildlife, Fish & Conservation Biology, University of California, Davis

***Adventures in Multibeam Bathymetry in the Sacramento-San Joaquin Delta**
S. Mayr, S. Flory, W. Pearsall
[1]Division of Environmental Services, California Department of Water Resources

***Stable Isotope Analysis of Historical Zooplankton Samples to Document Food Web and Biogeochemical Changes in the San Francisco Estuary: Effect of Preservation Methods**
J. Modéran and W. Kimmerer
Romberg Tiburon Center for Environmental Studies, San Francisco State University

****Smart Particle Tracking Using DSM2-PTM**
K. Nam
California Department of Water Resources

****Suspended Sediment Predictions in California**
G. Nichol

State Water Project Chloride Modeling Analysis
Sevim Onsoy[1], Les Chau[1], Mike Maley[1], Matt Baillie[1], Lynn Takaichi[1], Dirk Marks[2]
[1]Kennedy/Jenks Consultants, South San Francisco, CA
[2]Castaic Lake Water Agency, Santa Clarita, CA

Modifying Analytical Methods to Keep Up With Changing Pesticide Use in the San Francisco Estuary
J. Orlando, M. Hladik, K. Smalling, and K. Kuivila,
California Water Science Center, U.S. Geological Survey, Sacramento, CA

Temperature Preference – Avoidance Behavior of Adult Delta Smelt (*Hypomesus transpacificus*)
M. O. Park[1], J. Lindberg [2], S.Teh[1]
[1] VM: APCB, University of California, Davis
[2] Fish Conservation and Culture Lab, University of California Davis, Byron, CA

Bird Response to Delta Restoration
A. Pawley and R. Melcer
FloodSAFE Environmental Stewardship and Statewide Resources Office, California Department of Water Resources

Data Management
E. Reddy
Department of Land, Air and Water Resources, University of California, Davis

****Enhancement of the Sacramento-San Joaquin Delta Island Consumptive Use Estimates and Water Quality Redetections**
L. Siegfried and W. E. Fleenor
University of California, Davis

***Predation Impact and Reproductive Rate of *Acartiella sinensis*, an Introduced Predatory Copepod in San Francisco Estuary**
A. Slaughter, T. Ignoffo and W. Kimmerer
Romberg Tiburon Center for Environmental Studies, San Francisco State University

****Towards a Systems Analysis of Yolo Bypass Uses and Opportunities**
R. Suddeth

University of California, Davis

Impact of Groundwater Banking and Extraction Program on Stream-Aquifer Interaction in North American GW Subbasin

A. Taghavi[1], R. Swartz[2] and M. Cayar[1]
[1] RMC
[2] Sacramento Groundwater Authority

****San Joaquin River Restoration Daily Flow Model**

T. Vandegrift
U.S. Bureau of Reclamation, TSC

****Using Nitrate Stable Isotopes to Identify Dominant Nitrate Sources and Processes Impacting Groundwater and Surface Water in the Central Valley, California**

M. Young[1], T. Harter[2], C. Kendall[1], and W. Stringfellow[3]
[1] United States Geological Survey, Menlo Park, California
[2] University of California, Davis
[3]University of the Pacific, Stockton California

IEP NEWSLETTER

The IEP Newsletter is produced quarterly. The sequence of the four issues in a volume (one year) is winter, spring (Status and Trends edition), summer, and fall. IEP staff and several regular contributors are notified one month in advance of the article deadline. If you want to receive these notices, send your request by e-mail to the managing editor, kagehrts@water.ca.gov . Contributions to the newsletter can also be sent directly to the managing editor. All newsletters, the guide to authors and production schedule are available online at: http://www.water.ca.gov/iep/products/newsletter.cfm

Upcoming 2012/2013 submission deadlines:

Issue 2 – April 27, 2012

Issue 3 – June 29, 2012

Issue 4 – Sept 28, 2012

Issue 1 – Jan 18, 2013

ABSTRACTS

IEP PRESENTATIONS

WEDNESDAY 10:50-11:10

Kenneth A. Rose, Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, LA 70803 karose@lsu.edu, Wim J. Kimmerer, Romberg Tiburon Center for Environmental Studies, 3152 Paradise Drive, San Francisco State University, Tiburon, CA 94920 kimmerer@sfsu.edu, Karen P. Edwards, National Centre for Ocean Forecasting, Met Office, FitzRoy Road, Exeter, Devon EX1 3PB, United Kingdom karen.edwards@metoffice.gov.uk , William A. Bennett, Center for Watershed Sciences, John Muir Institute of the Environment, Bodega Marine Laboratory, University of California, Davis, P.O. Box 247, Bodega Bay, CA 94923 wabennett@ucdavis.edu

Individual-based population dynamics model of delta smelt: comparing the effects of food versus entrainment.

Abstract: Actions to protect delta smelt have become increasingly controversial. To address some of the questions related to the causes of the decline, we developed an individual-based population dynamics model. The model tracks thousands of super-individuals on the same spatial grid as the DSM2 hydrodynamics model. Daily water temperature, salinity, and the densities of six zooplankton prey types are represented on the spatial grid. The model follows the reproduction, growth, mortality, and movement of individuals over their entire life cycle. Reproduction is evaluated daily and egg cohorts are tracked until hatching. New model individuals are introduced as individual yolk-sac larvae and tracked through a series of life stages. Growth of feeding stages is based on bioenergetics and zooplankton densities. Mortality includes a stage-specific constant rate, starvation, and entrainment. Movement of individuals is by particle tracking for the larval stages and behavioral algorithms for juveniles and adults. We simulated the population decline using 1995 to 2005 conditions, and explored the relative influence of historical changes in food and entrainment on delta smelt population dynamics. Historical food was simulated using zooplankton data from years during the 1970s to early 1980s matched to recent years by monthly flow or X2 patterns. Entrainment effects were simulated by repeating the 1995 to 2005 simulation but with entrainment eliminated. We repeated the simulations with alternative baseline assumptions of size-dependent mortality, fixed larval stage survival, maturity a function of length, and density-dependent juvenile mortality. Simulations indicated that the effect of entrainment on simulated delta smelt population growth rate was between 50% and equal to the effects of food; thus, both were important to the population decline. Increased understanding of how changes in food and entrainment affect delta smelt population dynamics will inform the protection and restoration of delta smelt.

Statement of Relevance: Quantitative analysis of the contribution of different factors to delta smelt population dynamics focuses the debate on clearly stated assumptions and scientific evidence. The modeling can be used to filter the possible management actions that could be taken, helping to identify effective and efficient options from an ecological perspective.

WEDNESDAY 11:10-11:30

Author: Richard Deriso, Tuna Commission

WEDNESDAY 11:30-11:50

Ken Newman [1], Wim Kimmerer[2], Pete Smith[3], Randy Baxter[4], Emilio Laca[5], Bill Bennett[5], Wendy Meiring[6], Fred Feyrer[7] [1]US Fish and Wildlife Service, Stockton, CA, USA, [2]San Francisco State University, Tiburon, CA, USA, [3]USGS, retired, Davis, CA, USA, [4]California Department of Fish and Game, Stockton, CA, USA, [5]UC Davis, Davis, CA, USA, [6]UC Santa Barbara, Santa Barbara, CA, USA, [7]US Bureau of Reclamation, Sacramento, CA, USA*; USFWS, 4001 N. Wilson* Way, Stockton, CA 95205 209-946-6400 209-946-6355 ken_newman@fws.gov

A hierarchical spatio-temporal model for delta smelt

Abstract: Work in progress on a life history based model for delta smelt is presented. There are several unique features of the modeling approach that distinguish this work. One is the inclusion of space in a model for the population dynamics, thus allowing for region- and time-specific effects. Another is the inclusion of data from multiple fish surveys at a far less aggregated level than previous work. A third feature is the construction of the population dynamics in a building block manner with distinct sub-processes for survival, reproduction, and movement. Lastly, model formulation has been guided by the primary goal of developing a management tool for assessing after-the-fact, and predicting beforehand, the effects of various management actions on population viability.

Statement of Relevance: Model formulation has been guided by management goals, to restore the delta smelt population, and by various management actions aimed at restoration. In particular, the model has been designed to help answer questions about the effects of various management actions on delta smelt viability.

WEDNESDAY 11:50-12:10

Author: William Bennett, UCD

WEDNESDAY 12:10-12:30

Erik Loboschefsky[1], Arash Massoudieh[2], Jiafeng Zhang[3], Ted Sommer[4], Timothy Ginn[5], Kenny Rose[6], Frank Loge[7] [1]Department of Civil & Environmental Engineering, University of California, Davis, One Shields Ave, Davis CA 95616. elobo@ucdavis.edu , 530-848-1041 . [2] Department of Civil Engineering, The Catholic University of America, 620 Michigan Ave., N.E., Washington, DC 20064. massoudieh@cua.edu [3] Department of Civil Engineering, The Catholic University of America, 620 Michigan Ave., N.E., Washington, DC 20064. Jiafeng.p.zhang@gmail.com [4]Department of Water Resources, 3500 Industrial Blvd, West Sacramento CA 95691. tsommer@water.ca.gov [5]Department of Civil & Environmental Engineering, University of California, Davis, One Shields Ave, Davis, CA 95616. trginn@ucdavis.edu [6]Department of Oceanography and Coastal Sciences, Louisiana State University, 2135 Energy, Coast and Environment Building, Baton Rouge, LA 70803. karose@lsu.edu [7]Department of Civil & Environmental Engineering, University of California, Davis, One Shields Ave, Davis, CA 95616. fjloge@ucdavis.edu .

Development and application of an Individual Based Model for Longfin Smelt in the San Francisco Estuary

Abstract: Declines in the abundance of Longfin smelt (*Spirinchus thaleichthys*) in the Sacramento Delta and San Francisco Bay (Bay-Delta) have increased the need for casual identification. We developed an individual-based population life-cycle model (IBM) to integrate field and laboratory data into a quantitative measure of the impact of multiple stressors on Longfin smelt population dynamics. Constitutive relationships utilized in the IBM for the egg and larval life-stages included movement and mortality. Eggs were modeled with low probabilities of movement (i.e., Longfin smelt eggs typical adhere to a surface once laid) while larvae were assumed to be

passively moving particles with their motions controlled by hydrodynamic forces. The Delta Simulation Model II (DSM2), developed by the California Department of Water Resources, was used as the hydrodynamic model to guide the transport of larvae. Mortality of eggs and larvae were modeled as functions of water temperature. Constitutive relationships utilized in the IBM for the post-larval through the adult life-stages included: movement, growth, mortality, and fecundity. Movement was modeled utilizing a two-dimensional biased Gaussian run and tumble approach, where the bias reflects habitat suitability (i.e., food availability, salinity, water temperature, and depth). Growth was modeled through a bioenergetics approach, life-stage specific mortality was modeled following decay rate expressions, and fecundity was modeled based upon empirical relationships between Longfin smelt size and egg production. We present the results of a baseline simulation and a sensitivity analysis of the Longfin smelt IBM.

Statement of Relevance: The development of a Longfin smelt individual based life-cycle model aims to assess the significance of multiple stressors on the Longfin smelt population dynamics, with regards to the observed decline in the abundance indices of Longfin smelt and in context of the Pelagic Organism Decline (POD).

WEDNESDAY 1:40-2:00

Author: Ed Gross, RMA

WEDNESDAY 2:00-2:20

Author: John DeGeorge, RMA

WEDNESDAY 2:20-2:40

Author: Jamie Anderson, DWR

THURSDAY 8:30-8:50

Author: Josh Israel, Reclamation

THURSDAY 8:50-9:10

Author: Rachel Johnson, Reclamation

THURSDAY 9:10-9:30

Douglas Threloff, Comprehensive Assessment and Monitoring Program, U.S. Fish and Wildlife Service, 2800 Cottage Way, Room W-2605, Sacramento, CA 95825, Phone Number: 916-414-6726, Email: doug_threloff@fws.gov, Michael Banach, StreamNet Project, Pacific States Marine Fisheries Commission, 205 SE Spokane Street, Suite 100, Portland, OR 97202, Phone Number: 503-595-3152, Email: mike_banach@psmfc.org, Trent McDonald, Western EcoSystems Technology, Inc., 2003 Central Avenue, Cheyenne, WY 82001, Phone Number: 307-634-1756, Email: tmcdonald@west-inc.com, Connie Shannon, Pacific States Marine Fisheries Commission, 2440 Athens Ave., Redding, CA 96001, Phone Number: 530-225-2155, Email: CShannon@dfg.ca.gov, Karen Wilson, Pacific States Marine Fisheries Commission, 1487 Sandy Prairie Ct., Ste. A, Fortuna, CA 95540, Phone Number: 707-725-7191 Email: KLWilson@dfg.ca.gov

An Integrated System for Storing, Analyzing, and Reporting Juvenile Chinook Salmon Data Collected with Rotary Screw Traps

Abstract : The U.S. Fish and Wildlife Service's Comprehensive Assessment and Monitoring Program (CAMP), Pacific States Marine Fisheries Commission, and Western EcoSystems Technology, Inc. are developing an

integrated system for storing, analyzing, and reporting RST data. This system, once completed, is expected to: (1) assist with data entry in the field and in the office; (2) consolidate existing RST data from different Central Valley watersheds into one comprehensive database that accommodates the various ways data were collected; (3) identify, document, and to the extent practicable, compensate for operational or field conditions that affect RST data analyses, e.g. days when a RST did not operate in an optimal fashion; (4) produce statistically robust production estimates for different juvenile life stages at different temporal scales (daily, monthly, etc.); (5) generate estimates of precision that can be used to determine if statistically significant changes in the production of juvenile salmon from a watershed occurred over time; and (6) produce metadata and documentation describing the processes and procedures necessary to complete items 1 to 5.

After the development of the system is complete, RST data from several locations within the Central Valley will be imported into the system. The system will provide several benefits, including: (1) a completely documented high-quality database for data storage; (2) the development of more robust, consistently summarized data that can be used to evaluate the effects associated with restoration activities; (3) the ability to integrate RST data from multiple locations in a synergistic manner to answer important questions e.g., to what degree are changes in the production of juvenile and adult salmon inter-related; and (4) savings in time and effort because the RST system will automate many of the processes needed to analyze and summarize RST data.

Statement of Relevance: At the present time, there is no mechanism for storing, analyzing, or retrieving Central Valley juvenile Chinook salmon data in a timely, consistent manner. The CAMP's RST system will resolve these issues, and provide data to assess population trends and make inferences about the biological response to habitat restoration activities.

THURSDAY 9:30-9:50

Rosalie B. del Rosario1 and Yvette J. Redler2, National Marine Fisheries Service, 501 West Ocean Blvd, Long Beach, CA 90802, 2650 Capitol Mall, Sacramento, CA 95814, Rosalie.delRosario@noaa.gov , (562) 980-4085, Fax (562) 980-4027 Yvette.Redler@noaa.gov , (916) 930-3683, Fax (916) 930-3629, Ken Newman and Patricia L. Brandes, U.S. Fish and Wildlife Service, 4001 North Wilson Way, Stockton, CA 95205, Ken_Newman@fws.gov , (209)-744-4358, Fax 209-946-6355, Pat_Brandes@fws.gov , (209)-946-6400 X 308, Fax 209-946-6355, Ted Sommer and Kevin Reece, California Department of Water Resources, 3500 Industrial Blvd, West Sacramento CA 95691, tsommer@water.ca.gov , (916) 376-9772, Fax (916) 376-9688 creece@water.ca.gov, (916) 376-9755, Fax (916) 376-9688, Robert Vincik, California Department of Fish and Game, 1701 Nimbus Road, Rancho Cordova, CA 95670, RVINCIK@dfg.ca.gov, (916) 358-2933, Fax (916) 358-2912

Migration patterns of juvenile winter-run size Chinook salmon (*Oncorhynchus tshawytscha*) through the Sacramento – San Joaquin Delta

Abstract: The decline of Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) remains one of the major water management issues in the Sacramento River. Few field studies have been published on winter-run, leaving gaps in our knowledge about their life history. This is especially true in the Sacramento-San Joaquin Delta, which provides essential rearing and migratory habitats for winter-run, and serves as the center of water operations for California. Using long-term monitoring data that identified winter-run using length-at-date criteria, we examined patterns of juvenile migration through the Delta in terms of geographic distribution, timing, numbers, and residence times. We analyzed the role of flow, turbidity, temperature, and adult escapement on migration patterns. Winter-run passed Knights Landing (at RKM 144 or 51 RKM upstream of the Delta) between November and January, with substantial variation in time of entry. The start of winter-run migration past Knights Landing was strongly associated with the first high flows of the migration season. Specifically, the first day of flows of at least 400 $m^3 s^{-1}$ at Wilkins Slough (at 190 RKM) coincided with the first day that at least five percent of the annual total catch was observed at Knights Landing. While the period during which smolts left the Delta

spanned several months based on Chipps Island catch data, the median catch occurred over a narrow window typically in March. Differences in timing of cumulative catch at Knights Landing and Chipps Island indicate that apparent residence time in the Delta ranges from 41-106 days, with residence time being longer for juveniles arriving earlier in the Delta. We discuss the importance of the Yolo Bypass floodplain as an alternative rearing and migratory corridor, which likely depends on the timing, duration, and magnitude of floodplain inundation. These results carry management implications for habitat restoration and management of Sacramento River flows.

Statement of Relevance: Our study identified patterns in timing and duration of winter-run emigration that inform Bay Delta Conservation Plan's water operations and Yolo Bypass management. Specifically, study results guide development of early winter flow protection for juveniles, and patterns of Delta and Yolo Bypass residence can inform future floodplain and water management.

THURSDAY 10:30-10:50

Russell W. Perry[1], John R. Skalski[2], and Patricia L. Brandes[3] [1]U.S. Geological Survey, Western Fisheries Research Laboratory Columbia River Research Laboratory 5501-A Cook-Underwood Road, Cook, WA 98605 509-538-2299 Fax: 509-538-2843 rperry@usgs.gov ; [2]School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA ; [3]U.S. Fish and Wildlife Service, Stockton, CA

Juvenile Salmon Survival Studies in the North Delta

Abstract: We developed a multistate mark-recapture model to estimate 1) survival of juvenile salmon using different migration routes to negotiate the Sacramento-San Joaquin River Delta, and 2) the probability of fish using each route. Since these parameters determine population-level survival, simultaneous estimation of both allowed us to quantify the relative contribution of each migration route to population-level survival. We applied this model to four years of acoustic telemetry data (2007-2010) with releases made when the Delta Cross Channel gates were both open and closed. We identified consistent patterns in survival among migration routes, but substantial variation in survival among releases and years. Specifically, releases in 2008 exhibited lower survival than other years. Despite considerable variation among releases, survival for routes leading to the interior Delta was always lower than for Sacramento River. Fish that migrated through Sutter and Steamboat sloughs had survival probabilities that ranged between that of the Sacramento River and the interior Delta. Because of route-specific differences in survival, the fraction of fish using each migration route will affect population-level survival. The fraction of fish entering each route was generally related to the fraction of discharge, but large deviations from this expected relation suggested other factors also influenced migration routing. We discuss how survival within migration routes interacts with movement among routes to influence population survival.

Statement of Relevance: Water management actions affect both quantity and distribution of river flow among the Delta's complex network of channels. Understanding the response of juvenile salmon to water flow and distribution is critical for quantifying the effect of water management actions on endangered juvenile salmonids.

THURSDAY 10:50-11:10

Jon Burau, Aaron Blake, California Water Science Center, U.S. Geological Survey, Placer Hall, 6000 J Street, Sacramento, CA 95819-6129 (916) 997-4206 Email: jrburau@usgs.gov; Russell Perry, Noah Adams, Marty Liedke, Columbia River Research Laboratory, Western Fisheries Research Center, U.S. Geological Survey, 5501-A Cook-Underwood Rd., Cook, WA 98605-9717 (509) 538-2299 x254, Email: nadams@usgs.gov

An Overview of USGS Acoustic Telemetry Studies

Abstract: The USGS has been studying juvenile salmon outmigration through the delta using acoustic telemetry techniques since 2007. At that time, the California Water Science Center (CAWSC) began working with the Columbia River Research Lab (CRRL) to bring acoustic telemetry technologies and analytical approaches to the delta. These approaches had been pioneered by the CRRL in the Columbia River basin throughout the previous decade. In this talk, we will briefly describe the field experiments we've been conducting over the past few years using acoustically tagged juvenile salmon and then will summarize preliminary highlights from these investigations. The highlights include, (1) what we've learned about day/night salmon behaviors from data collected at Clarksburg Bend in 2007 and the preliminary analysis of 2008/09 data collected at the Delta Cross Channel, and (2) what we've learned about reach specific survival of out migrating salmon and route entrainment, including the possibility of discharge dependent survival in the north delta and its relevance to BDCP and other planning processes.

THURSDAY 11:10-11:30

Pat Brandes, U.S. Fish and Wildlife Service, 4001 N. Wilson Way, Stockton CA 95205, 209-946-6400 X 308, 209-946-6355 (fax), Pat_Brandes@fws.gov

South Delta Salmon Smolt Survival Studies

The escapement of adult salmon to the San Joaquin basin appears to be related to flow during their spring smolt migration period. Studies estimating salmon survival in the south Delta have been ongoing since about the mid - 1980's. The results of early studies indicated that coded wire tagged (CWT) juvenile salmon released in the San Joaquin River just downstream of the junction at the head of Old River (near Lathrop), usually survived at a higher rate to Chipps Island than those released in Old River. Additional studies also indicated that survival to Chipps Island increased as flows increased for CWT fish released near Lathrop, or for CWT fish released at Mossdale or Durham Ferry with a rock barrier at the head of Old River. Survival from Mossdale or Durham Ferry to Chipps Island has been measured using CWT methodology between 1994 and 2006 and has ranged between 0.01 and 0.80. Survival at similar flow levels appears to be decreasing over time. Modeling using the CWT data suggested that survival was higher through the Delta when the rock barrier was installed as it reduced the proportion of water and fish entering Old River where survival was lower. Lastly, survival to Chipps Island was estimated in 2010 using acoustic tags with a non-physical barrier installed at the head of Old River. Survival from Mossdale to Chipps Island in 2010 was estimated at 0.05 when removing detections from suspected predators. Survival was higher in the San Joaquin River compared to Old River for only one of the seven releases in 2010. Results obtained from studies in 2011 and planned studies in 2012, may provide further insight regarding survival through the Delta for juvenile salmon originating from the San Joaquin basin and how survival might be improved in the future.

Statement of Relevance: These studies have estimated salmon smolt survival through the Delta for juvenile salmon originating from the San Joaquin basin for use in modeling and decisions on water and environmental policy and management.

THURSDAY 11:30-11:50

Author: Mark Bowen, Reclamation

THURSDAY 1:10-1:30

Brad Cavallo, Cramer Fish Sciences, 13000 New Airport Road STE 102, Auburn CA 95602, 530.888.1443 ext. 11, 530.888.7774, bcavallo@fishsciences.net

A juvenile salmonid perspective on Delta hydrodynamics: the relative influence of river inflows, tides and South Delta exports

Abstract: The relative influence of tides, river inflows, and South Delta exports on flow patterns in California's Sacramento-San Joaquin Delta continues to be a source of confusion and uncertainty for resource managers. A particle tracking model (PTM) has been used to characterize Delta flow patterns and to evaluate entrainment risks for larval fishes and, recently for the first time to evaluate hydrodynamic effects on juvenile salmonids. While PTM results appear sensitive to net water movements over longer time periods (>days), recent findings from acoustic telemetry studies suggest migrating juvenile salmonids respond to instantaneous hydrodynamics conditions; not to daily average flows. Hydrodynamic mechanisms observed in the analysis of existing acoustic telemetry data indicate that proportion of flow entering a particular route and the proportion of time flows are positive (river discharge influenced), negative (export influenced) or a 50/50 mix of positive and negative flows (tidal influence) may be important drivers of juvenile salmonid route selection, migration time, and survival. The hydrodynamic data of interest are readily available and provided by the "Delta Simulation Model 2 HYDRO" model with considerable spatial-temporal resolution (every 15 minutes for 500+ channel locations). Our analysis indicates that commonly prescribed management actions may not yield desired and expected benefits because actual hydrodynamic conditions differ from conditions which are assumed to exist. For example, we observed little evidence that river inflows or South Delta exports, within the range typically controlled by managers, could substantially alter hydrodynamics along on the mainstem San Joaquin River between Stockton and Jersey Point. Additional acoustic telemetry studies are necessary and underway to more thoroughly test the relative importance of hypothesized hydrodynamic mechanisms. However, our analysis suggests available hydrodynamic data can be used to plan management actions with the greatest potential to enhance juvenile salmonid survival in the Delta.

Statement of Relevance: Biological Opinions, State Water Board flow criteria, and BDCP all propose changes in water management with the intent of improving hydrodynamic conditions for juvenile salmonids. A better understanding for the influence of water project operations on Delta hydrodynamics is essential for planning and implementing effective and successful management actions.

THURSDAY 1:30-1:50

Cyril J. Michel*, Jeremy J. Notch, Sean A. Hayes, Steven T. Lindley, Fisheries Ecology Division, Southwest Fisheries Science Center, NOAA National Marine Fisheries Service, 110 Shaffer Rd, Santa Cruz, CA 95060, *Corresponding author; email: cyril.michel@noaa.gov , voice: 831- 420-3986

Predator densities and associated salmonid smolt mortality around water diversions

Abstract: State-of-the-art fish screens on large water diversions effectively prevent juvenile salmon from being entrained by the diversion, but the physical structure and their prey-concentrating effect may attract predators and create a local predation problem. We are assessing the impact of predation near two large water diversions on Central Valley Fall and Spring run Chinook salmon (*Oncorhynchus tshawytscha*) using a combination of acoustic telemetry, a DIDSON camera, and tethering. We expect to answer these questions:

(1) Does water entrainment and/or the physical structure of the diversions create smolt aggregations?

(2) Is predator density higher near water diversions relative to nearby areas?
(3) Do predators express site fidelity to the diversions? Where do they go when they leave?
(4) Is the relative smolt predation rate near the diversions higher than nearby areas? What about seasonal and diel predation rate dynamics?
(5) What proportion of the predators' diets consists of smolts near the diversions?
(6) All factors combined, does this result in higher than average smolt mortality rates near the diversions?

During a pilot season in 2011 using just one diversion on the Sacramento River, we gained limited insight into these questions. Predator densities were lowest near the diversions, and highest near the riverbank. Striped bass (*Morone saxatilis*) did not seem to express site fidelity while Sacramento pikeminnow (*Ptychocheilus grandis*) did. Finally, relative predation rates around the diversions were near the average, with the highest relative predation rates found near the riverbank.

Statement of Relevance: This project was conceived in response to the knowledge gap regarding how large water diversions influence predator-smolt dynamics; the majority of research on the impacts of diversions on salmonids concentrate on dewatering and lethal entrainment into pumps. This project may also provide valuable information on how to improve future diversions.

THURSDAY 1:50-2:10

Brett Harvey, DWR Division Environmental Services, Aquatic Ecology, 3500 Industrial Blvd., West Sacramento, 95691 916-376-9720 916-376-9688 (fax) bharvey@water.ca.gov

Who's your daddy? Validating length-at-date run assignments with genetics for Central Valley Chinook.

Abstract: The Length-at-Date approach uses fork length and sampling date to assign run-origin to juvenile Central Valley Chinook salmon. Fork length ranges of each run are assumed to vary according to the earliest and latest estimated emergence dates and an estimated average growth rate. Following federal ESA listing of Sacramento River winter-run Chinook salmon in 1990, the Length-at-Date approach was adopted to assess take of winter-run juveniles entrained at federal and state water project facilities in the southern Sacramento-San Joaquin Delta. Soon after, genetic assays to evaluate the accuracy of the Length-at-Date approach were developed. More than 11,000 genetic run-origin assignments have been made since 2003 using the most accurate assays. Length-at-Date assignments conflicted with genetic assignments for nearly half of these genetically tested fish. Only genetic winter run consistently fell within corresponding Length-at-Date size criteria. However, many fish genetically assigned to other runs also fell within winter-run Length-at-Date criteria. All other runs had much lower agreement between genetic and Length-at-Date run assignment. For example, genetically assigned late-fall run was 27 times more abundant than Length-at-Date late-fall run, while genetic spring run was one fiftieth the abundance of Length-at-Date spring run. However, the latter result may reflect the inability of the genetic tests to distinguish phenotypic spring run and fall run in the Feather River, where these two runs have hybridized. Overall, these results do not support two central assumptions of the Length-at-Date approach as applied at the south Delta salvage facilities: (1) for each juvenile Chinook salmon run, average fork length increases with time, and (2) juvenile fork length size ranges of the different runs are segregated. Genetic run assignment provides a more accurate examination of take at water project facilities, and brings into question the use of the Length-at-Date approach for quantifying take for sampling programs throughout the Delta.

Statement of Relevance: ESA listed salmon take based on Length-at-Date run identification is a central factor controlling water export rates at state and federal pumping facilities. Length-at-Date run identification is also central to salmon monitoring programs throughout the Central Valley. Our results suggest a more accurate identification method could alter water export constraints and would improve our understanding of run-specific migration behavior.

THURSDAY 2:10-2:30

Author: Joe Kirsch, FWS

THURSDAY 2:30-2:50

Author: Steve Lindley, NMFS

THURSDAY 3:30-3:50 CONCURRENT SESSION IVA – DUE NORTH SLOUGH COMPLEX, LIBERTY ISLAND AND THE DEEP WATER SHIPPING CHANNEL

Tara L. Morgan-King, David H. Schoellhamer, U.S. Geological Survey, Placer Hall 6000 J. St. Sacramento, Ca 95819 USA, *Corresponding author: tamorgan@usgs.gov phone (916) 278-3162 fax (916) 278-3013

Cache Slough Turbidity, Sediment, and Salinity Trends in 2011 - How do they compare to 2010?

Abstract: The Cache Slough area provides year round habitat to the endangered delta smelt. Since 2008 we have measured turbidity, water flow, and suspended-sediment flux and we have quantified that turbidity is higher in this region than elsewhere in the Delta. High turbidity is maintained by a repetitive cycle of both tidal and wind-wave resuspension. Flood dominant tidal currents, low fresh water flow, a limited tidal excursion, and irrigation pumping are mechanisms that trap sediment in the area. Yolo Bypass discharges into the Cache Slough complex and during water year 2011, the first major release of flood waters flowed through the bypass since the onset of the study. In 2011, more than two and a half times the quantity of water moved seaward through the region than in 2010. Salinity values were comparable and we observed high turbidity throughout the region in both years. Due in part to flows that occurred in the Yolo Bypass, nearly five times the sediment was transported seaward in 2011 as compared to 2010, and at least four times the sediment was retained within the region in 2011. After Yolo Bypass had spilled and deposited sediment in March 2011, wind-wave resuspension on flooded Liberty Island supplied suspended sediment to Cache Slough. In summary, the backwater Cache Slough complex, which contains dead-end channels, traps sediment and is more turbid than the rest of the Delta whether or not the Yolo Bypass spills.

Statement of Relevance: Our project monitors and analyzes turbidity, salinity, and water temperature around Cache Slough, an area known to provide habitat to delta smelt. These physical water quality parameters are all identified as critical within the POD conceptual model. Understanding turbidity and sediment flux dynamics are essential for restoration and Delta management.

THURSDAY 3:50-4:10

Julio Adib-Samii, Environmental Scientist, California Department of Fish and Game Bay-Delta Region, 4001 North Wilson Way, Stockton, California 95205 (209) 932-2396 office (209) 946-6355 fax jadibsamii@dfg.ca.gov

CDFG's monitoring of Cache Slough and the Sacramento Deep Water Shipping Channel

Abstract: Several of the California Department of Fish and Game's (CDFG) long-term monitoring programs have increased their geographic coverage to include sampling within the Cache Slough and Sacramento Deep Water

Shipping Channel (SDWC) region. This increased effort provides baseline monitoring that may help explain the relatively high productivity of the region. Concurrent fish and zooplankton tows were conducted from March through December 2011. Monthly tows were conducted and water quality data, such as water temperature, conductivity, and transparency, were recorded with each sampling event. Consistent catches of fish and zooplankton throughout the sampling period - often at higher relative abundances compared to other regions – make the Cache Slough complex an area of interest for aquatic ecologists and fish biologists. Sampling data suggest conditions that may increase productivity, like higher residence time and stratification.

Statement of Relevance: The data included in this presentation come from federal and state mandated monitoring programs conducted by CDFG. These monitoring programs fulfill requirements set forth by various regulatory documents like the U.S. Fish and Wildlife Service's Biological Opinion for delta smelt and the CDFG's State Water Project's Incidental Take Permit for Longfin smelt. Data from these monitoring programs are used by interest groups to advise the Water Operation's Management Team on the potential species-specific impacts of Central Valley Project and State Water Project operations.

THURSDAY 4:10-4:30

Jordan Gold, Mari-Gold Environmental Consulting, Inc., 25385 South Hughes Lane, Canby, Oregon. 97013 (503) 705-7836 goldfishj@gmail.com , Steven Novotny, Novo Aquatic Sciences, Inc., 716 SE Malden Street, Portland, Oregon 97202, (503) 806-5201 Fax: (503) 914-1462 Steve@novoaquatic.com

Dredging Impacts to Delta Smelt and Other Fish Species in the Sacramento Deep Water Ship Channel

Abstract: Delta smelt, Longfin smelt, green sturgeon and other non-listed fish species have been present around the dredge while conducting fish community monitoring during annual maintenance dredging of the Delta's ship channels. Delta smelt and other species present in the fish community were entrained by the hydraulic cutter-head dredge. This has occurred in the Sacramento deepwater ship channel and other locations. This ongoing monitoring has been conducted since 2006, and data from 2006 through 2011 is presented. This monitoring is conducted for the United States Army Corps of Engineers (USACE) based on consultation with The National Marine Fisheries Service. Additionally, entrainment monitoring was conducted on the federal hopper dredge *Essayons* in 2011 while dredging in Pinole shoals, the Richmond Harbor area, and several locations in Suisun Bay. 20 species of fish were found, including delta smelt and longfin smelt. This monitoring was conducted for USACE at the behest of the California Department of Fish and Game.

Statement of Relevance: Information on dredging impacts to listed and other species is critical to the overall management of ongoing (maintenance dredging) and new dredging projects (Sacramento and Stockton channel deepening). Prior to the initiation of the monitoring program that began in 2006, there was very little current information on impacts to species that utilize the navigation channels when and where active dredging is occurring.

THURSDAY 4:30-4:50

Lori M. Smith; Supervisory Fish Biologist, U.S. Fish and Wildlife Service, Stockton Fish and Wildlife Office, 4001 N. Wilson Way, Stockton, CA 95205 (209)-946-6400 ext. 343 lori_smith@fws.gov

Larval and juvenile fishes of Liberty Island

Abstract: Tidally influenced, freshwater marsh habitat is an important component for the early life stages of many fishes found within the Sacramento – San Joaquin River Delta. Amid possible changes in water development, land-use planning, and levee deterioration this once limited habitat may become more available to native fish species, and in particular, Delta smelt *Hypomesus transpacificus*. Liberty Island is a former artificial island which has been undergoing passive restoration to a freshwater tidal marsh after its levees breached in 1997. The Stockton office of the U.S. Fish and Wildlife Service has been involved with monitoring the fish communities using Liberty Island habitats since the early 2000s. The results of our sampling efforts from 2002 – 2005 indicate that there were significant temporal differences in habitat use by native and non-native fish species of varying life stages. This presentation will examine beach seine and larval trawl data from January 2010 to present. Based on these data we hope to gain a better understanding of the habitat use by native fishes within Liberty Island and to inform future restoration efforts in the Cache Slough and Yolo Bypass areas.

Statement of Relevance: Monitoring the use of Liberty Island habitats by fish communities may provide valuable information for future restoration efforts in the Cache Slough and Yolo Bypass area.

THURSDAY 3:30-3:50 CONCURRENT SESSION IVB – WATER QUALITY EFFECTS, FROM PRODUCERS TO CONSUMERS

Cécile E. Mioni[1], Raphael Kudela[2]*, Dolores Baxa[3], Wim Kimmerer[4], Tomofumi Kurobe[5], Hans Paerl[6], Alexander E. Parker[7]. *Presenting, 1: Ocean Sciences Department, University of California Santa Cruz, 1156 High Street, Santa Cruz, CA 95064; cmioni@ucsc.edu; 831-459-4098, 2: Ocean Sciences Department, University of California Santa Cruz, 1156 High Street, Santa Cruz, CA 95064; kudela@ucsc.edu; 831-459-3290; 831-459-4882 (FAX), 3: University of California, Davis, School of Veterinary Medicine, Department of Anatomy, Physiology, and Cell Biology, One Shields Avenue, Davis, CA 95616; dvbaxa@ucdavis.edu; (530)754-8020, 4: Romberg Tiburon Center, San Francisco State University, 3152 Paradise Drive, Tiburon CA 94920; kimmerer@sfsu.edu; (415) 338-3515. 5: University of California, Davis, One Shields Avenue, Davis, CA 95616; tkurobe@ucdavis.edu, 6: University of North Carolina at Chapel Hill. Institute of Marine Sciences, 3431 Arendell Street, Morehead City, NC 28557; hans_paerl@unc.edu; 252-726-6841, Ext. 133, 7: Romberg Tiburon Center, San Francisco State University, 3152 Paradise Drive, Tiburon CA 94920; aeparker@sfsu.edu; (415) 338-3746

Determining Environmental controls and ecological impacts of CyanoHABs in the San Joaquin-Sacramento Delta – A multidisciplinary approach

Abstract: Harmful cyanobacteria (CyanoHABs), and the toxins they produce are a growing concern as a source of impairment in California water bodies. The potential adverse impacts of the bloom-forming cyanobacteria on the San Francisco Estuary are large. Delta water is used to supply drinking water to 20 million Californians and irrigates 4.5 million acres of farmland. The estuary is habitat for fish, birds, and marine mammals, and contains many threatened and endangered fish, including several species exhibiting population level declines. Total cyanobacteria biomass has increased since 1975 throughout the San Joaquin-Sacramento Delta coincident with a decline in diatom biomass. Recurrence of seasonal CyanoHABs in the Delta since 2000 coincided with the decline of various pelagic organisms and their copepod prey, suggesting that these cyanoHABs may at least in part be responsible for this decline. The increase in CyanoHABs coincided with several environmental changes known to favor their growth including increasing water transparency and temperature. These environmental changes also appear to correlate with the decline of pelagic fish species. In 2011, we initiated a multidisciplinary, collaborative monitoring program in the Delta with the goal of gaining a more complete understanding of the environmental drivers controlling cyanoHAB occurrence and toxicity as well as impacts on the pelagic food web. Here, we present preliminary results from our seasonal monitoring of spatial and temporal distribution of cyanoHAB

species and associated toxins throughout the Delta. Our results indicate that surface water temperature and nutrient availability, especially nitrogen sources, are key drivers of cyanoHAB composition and toxicity, but additional environmental stressors specific to individual cyanoHAB taxa may also play a significant role. In addition to *Microcystis*, other toxin-producing cyanobacteria such *Aphanizomenon*, may be significant contributors to bloom toxicity in the Delta. Furthermore, we find evidence for microbial interactions as mediators of toxin production within the cyanoHAB assemblage.

Statement of Relevance: Cyanobacterial blooms are an increasing threat globally, and have emerged as a serious issue in the San Joaquin-Sacramento Delta. Based on preliminary data from a multidisciplinary monitoring program, we identified surface water temperature and nutrient availability, especially nitrogen sources, as key drivers of cyanoHAB composition and toxicity.

THURSDAY 3:50-4:10

Authors: Richard E.Connon[1], Linda A. Deanovic[1], Erika B. **Fritsch**[1], Matthias Hasenbein[1,2], Alireza Javidmehr[1] and Inge Werner[1,3]. [1] School of Veterinary Medicine, University of California Davis, California. [2] Chair of Aquatic Systems Biology, Department for Ecology and Ecosystem Management, Technische Universität München, Germany. [3] Swiss Centre for Applied Ecotoxicology, Eawag/EPFL, Überlandstrasse 133, CH-8600 Dübendorf, Switzerland. Contact: Richard Connon, reconnon@ucdavis.edu, Tel. (530) 752-3141

Transcriptomics and Delta Monitoring: Accomplishments, Difficulties and Future Prospects

Abstract: Contaminants are known to affect cellular, physiological, and/or immunological effects, and can negatively impact reproduction, behavioral performance, and long-term survival, consequently affecting ecological fitness and population dynamics. Detecting and quantifying such sublethal effects in large water bodies like the Sacramento-San Joaquin Delta is challenging, especially for non-model species, like the delta smelt; *Hypomesus transpacificus*. In 2007 we developed a DNA microarray for delta smelt and subsequently applied this to assess the effect of copper, esfenvalerate and ammonia. In 2008-09, laboratory investigations were conducted to evaluate chemical-related aquatic toxicity of Delta water to early life stages of delta smelt, assessing specific areas of concern in the Delta. We have assessed sublethal responses to exposure using a combination of delta smelt microarrays and a suite of 22 genes of interest, and have been successful in identifying site specific genomic fingerprints. Responses of particular interest correspond to samples from Sacramento River at Hood and the San Joaquin River at Rough and Ready Island. Both these sites are downstream from wastewater treatment plants and populated urban environments, and share significantly similar genomic profiles. Comparisons were made between delta smelt exposed water samples from Hood, to wastewater treatment plant (WTP) effluent and ambient water samples from upstream (Garcia Bend), indicating that responses at Hood are more similar to those from the WTP effluent than they are to samples upstream. Key genes indicated predominant effects acting on development, as well as muscular atrophy, muscle function and effects on swimming performance. However, these responses need to be tested at higher levels of biological organization, to confirm whether or not the level of transcriptional changes carry with them developmental aspects and results in muscle damage. We propose that future studies should include muscle activity assays, in-situ hybridizations and histopathology in conjunction to swimming performance and corresponding physiological studies.

Statement of Relevance: It is important to assess the modes of actions of contaminants and contaminant mixtures, in order to understand their environmental impact. Genomic profiling can not only incorporate this, but can also be utilized to determine contaminant sources. As such these tools will aid monitoring efforts and regulatory agency decision making.

THURSDAY 4:10-4:30

Donald Weston, University of California Berkeley, 1005 Valley Life Sciences Bldg. Berkeley, CA 94720-3140. Phone: 510-665-3421. Fax: 510-665-6790. dweston@berkeley.edu

Contaminant Sources and Toxicity in the Cache Slough Region

Abstract: Monitoring of the water column in the Cache Slough region showed frequent toxicity to the amphipod, Hyalella azteca. The affected area extended from the upper end of Cache Slough, down to the lower reaches of Lindsay Slough, but did not extend into Liberty Island or the Deep Water Ship Channel. Toxicity was consistently observed after rain events, but was never observed during dry periods. Further investigation indicated the cause was usually the pyrethroid bifenthrin. Investigation of many potential sources to the Cache Slough complex indicated that most commonly, the bifenthrin originated as storm runoff from the City of Vacaville, and traveled approximately 12 miles down the length of Ulatis Creek to reach Cache Slough. While the principal threat to Cache Slough appears to be urban runoff, bifenthrin-related toxicity from this source was occasionally compounded by local agriculture-derived inputs of the pyrethroid lambda-cyhalothrin and the organophosphate chlorpyrifos.

Statement of Relevance: Given the importance of the Cache Slough region for delta smelt and other species, this work is intended to better understand the threat contaminants might pose to important invertebrate prey species.

THURSDAY 4:30-4:50

E. Holland-Fritsch[1*], R. Connon[1], I. Werner[1], L. Deanovic[1], M. Stillway[1], A. Bialies[2], H. Schoenfuss[3], D. Riordan[4], and D. Denton[5]. [1]School of Veterinary Medicine, University of California Davis, California, [2]U.S. EPA, Office of Research and Development, National Exposure Research Laboratory, Cincinnati, Ohio, [3]Dept. of Biological Sciences, Aquatic Toxicology Laboratory, St. Cloud State University, Minnesota, [4]Ca. Dept. of Water Resource, Div. of Environmental Services, Bay-Delta Monitoring and Analysis, West Sacramento, California, [5]U.S. EPA, Region IX, Office of Standards and Total Maximum Daily Loads, Sacramento, California. Author Affiliation: Erika Holland-Fritsch, University of California, Davis, Veterinary Medicine: APC, One Shields Ave., Davis Ca. 95616, Phone: (530)752-3141 ebholland@ucdavis.edu

Detection and Potential Effects of Pharmaceuticals and Personal Care Products in the Sacramento River

Abstract: Pharmaceuticals and personal care products (PPCP) are emerging as potential hazards to aquatic wildlife due to their down the drain disposal and known, purposeful, effects in humans. In the Sacramento River, the occurrence of such chemicals presents a particular threat to aquatic organisms inhabiting areas near the outfall of the Sacramento Regional Waste Water Treatment Plant (SRWWTP), a known source of PPCPs. There is currently little information regarding the effects of PPCPs on fish species in general, let alone risks posed to those populations in the lower Sacramento River. Here, a collaborative study utilizing molecular, organismal and ecologically relevant endpoints in fathead minnow (*Pimephales promelas*) exposed to river water from the Hood Field Station and Garcia Bend Park, locations upstream or downstream of the SRWWTP respectively, was conducted to begin addressing the issues outlined above. Weekly water samples, collected in Fall 2008 and Spring 2009, contained a number of PPCPs, of which the most common was the non-steroidal anti-inflammatory Ibuprofen and the fibrate drug Gemfibrozil.

In addition to chemical analyses, water collected at the respective field sites were used as exposure water for larval fathead minnow that then underwent behavioral and molecular assessments. Larvae and adult fish were also exposed at Hood using *in situ* devices and adult fish were assessed for altered vitellogenin levels and gross histological changes. We found that larvae exposed to the two study sites or a laboratory control displayed differential expression of genes associated with endocrine and neuromuscular pathways or general stress responses and demonstrated altered survival, growth and swimming ability. Adults displayed changes in liver histopathology characteristic of pollutant exposure but no changes in vitellogenin levels were seen.

Statement of Relevance: As emerging contaminants to aquatic environments, pharmaceuticals and personal care products often lack thorough risk assessments. To aid regulatory agency decision making, regarding threats to unintentionally exposed organisms, it is important to develop collaborative studies that assess the occurrence, potential sublethal mechanisms of impairment, and ecological implications of PPCPs.

FRIDAY CONCURRENT SESSION VA – UNDER THE MICROSCOPE AND LOWER TROPHIC CRITTERS

FRIDAY 8:30-8:50

Author: Dick Dugdale, SFSU (RTC)

FRIDAY 8:50-9:10

Erica Kress, Msc Marine Biology Candidate, Romberg Tiburon Center for Environmental Studies, San Francisco State University, 3150 Paradise Drive, Tiburon, CA 94920, 818-823-1229, ekress@mail.sfsu.edu, Alexander E. Parker, Ph.D. Romberg Tiburon Center for Environmental Studies, San Francisco State University, 3150 Paradise Drive, Tiburon, CA 94920, 415-338-3746, aeparker@sfsu.edu , Frances Wilkerson, Ph.D. Romberg Tiburon Center for Environmental Studies, San Francisco State University, 3150 Paradise Drive, Tiburon, CA 94920, 415-338-3519, fwilkers@sfsu.edu , Richard Dugdale, Ph.D. Romberg Tiburon Center for Environmental Studies, San Francisco State University, 3150 Paradise Drive, Tiburon, CA 94920, 415-338-3518, rdugdale@sfsu.edu

Assessing phytoplankton communities in the Sacramento and San Joaquin Rivers using microscopic and indirect analytical approaches

Abstract: Long-term monitoring data of phytoplankton community species composition exist for the San Francisco Estuary-Delta (SFE). These data are based on conventional microscopy techniques. In recent years, these efforts have been augmented with new technologies (e.g. spectrofluorometry and flow cytometry) to indirectly monitor phytoplankton communities over broader temporal and spatial scales. River surveys in the Sacramento and San Joaquin Rivers were carried out in spring 2010 to characterize phytoplankton community structure and environmental parameters upstream and downstream of the Sacramento Regional and Stockton Waste Water Treatment Plants. Phytoplankton community composition was assessed using four methods; conventional light microscopy, measurements of size-fractionated chlorophyll-*a* concentrations, flow cytometry and spectrofluorometry (bbe FluoroProbe). From these observations we tested the hypothesis that for use in routine monitoring programs, a combination of indirect approaches may be sufficient to characterize riverine phytoplankton communities. The trends that emerged using the indirect approaches were consistent between the two river environments, with higher overall phytoplankton biomass in the San Joaquin River and a majority of large cells, dominated by the "brown" FluoroProbe group. In contrast, the Sacramento River phytoplankton

biomass was less, the majority of cells were small, and the phytoplankton community was dominated by the "green" FluoroProbe group, containing chlorophytes. These indirect approaches compared well with the direct microscope counts and size fractionated chlorophyll-*a* in that the San Joaquin River was dominated by centric diatoms (*Cyclotella and Melosira*), which fall in the "brown" group, while the Sacramento River had a high proportion of small flagellates, including chlorophytes. While none of the indirect methods used provide the detailed picture of phytoplankton community structure that can be obtained from microscopy, functional groups appear to be reasonably elucidated using a combination of these approaches.

Statement of Relevance: The long term decline of phytoplankton biomass in the SFE-Delta has been proposed as a cause of the Pelagic Organism Decline. This research assessed several approaches for monitoring the phytoplankton community to inform research and policy decisions related to management of the Delta.

FRIDAY 9:10-9:30

Nathan A. Miller*[a] and Jonathon H. Stillman[a,b], a. Romberg Tiburon Center, San Francisco State University, 3150 Paradise Drive, Tiburon, CA 94920, b. Department of Integrative Biology, University of California, Berkeley, 3060 Valley Life Sciences, Bldg #3140, Berkeley, CA 94720-2140 *(415) 435-7113 phone, (415) 435-7120 fax, namiller@sfsu.edu

Role of salinity and temperature in *Corbula amurensis* energetics in the upper San Francisco Bay Estuary

Abstract: Predicting impacts of non-native species on native communities and how this impact is modulated by environmental change requires an understanding of the energy requirements of the community members and how (strength, direction) energy flows through an ecosystem. The Asian clam, *Corbula amurensis*, invaded the San Francisco Estuary (SFE) in 1986 and has been implicated in the decline of native fish species by diverting of pelagic productivity to the benthos. We sought to characterize the energetic demands *C. amurensis* in the field and how they may fluctuate in response to natural seasonal variation in temperature, salinity, and food availability. We found metabolic rates of *C. amurensis* vary seasonally and spatially within the estuary, but temperature, salinity, and food availability explain little of the variability. The insensitivity of metabolism to salinity suggests a re-evaluation of the importance of this environmental factor in determining the distribution of *C. amurensis* in the SFE. Measures of energy storage (glycogen) were equally unrelated to the environmental parameters measured. *C. amurensis* did hyperosmoregulate under low salinity conditions, but the potential costs of this activity were not represented in changes in metabolic rate or energy stores. Our current knowledge suggests that under natural food, temperature, and salinity regimes in the SFE, the distribution of adult *C. amurensis* is likely not a consequence of the energetic costs of salinity tolerance. However, the role that food availability plays in modulating salinity tolerance, especially at different temperatures, deserves additional attention.

Statement of Relevance: The distribution of adult *C. amurensis* is likely not due to limited low salinity tolerance. Consequently, anthropogenic alterations to salinity (at least low salinity) will have little impact on adult *C. amurensis* and do not present a viable strategy for eradicating the adults of this species.

FRIDAY 9:30-9:50

Author: Jessica Donald, SFSU (RTC)

FRIDAY 9:50-10:10

Tiffany Brown, California Department of Water Resources, 3500 Industrial Blvd, West Sacramento, CA 95691 (916) 376-9723, tbrown@water.ca.gov and Kathryn A. Hieb, California Department of Fish and Game, 4001 N. Wilson Way, Stockton, CA 95205 (209) 942-6078 khieb@dfg.ca.gov

Introduction of the Siberian prawn, *Exopalaemon modestus*, into the San Francisco Estuary: Ten years later

Abstract: The freshwater Siberian prawn, *Exopalaemon modestus* (Heller 1862), was first detected in the San Francisco Estuary in 2000, and quickly became established. We summarize data concerning *E. modestus* in California, collected from 2000-2011 by several long-term monitoring projects, special studies, and the public. Since the initial collection, *E. modestus* has rapidly expanded throughout Estuary and into upstream areas, and is now the most common caridean shrimp in the upper Estuary, including the Sacramento-San Joaquin Delta. In some areas it has almost completely displaced another introduced palaemonid shrimp, *Palaemon macrodactylus.* Although the overall effects of this introduced species are still unknown, *E. modestus* is likely to continue its expansion within the Estuary and its watershed and become established in other freshwater areas of California.

Statement of Relevance: Tracking and documenting the effects of invasive species, particularly on native fauna, is crucial to the management of estuarine and ecological resources.

CONCURRENT SESSION VB – MARKING, COUNTING AND DETECTING FISH: THE LATEST AND GREATEST FROM SUISUN TO THE NORTH DELTA

FRIDAY 8:30-8:50

Jason DuBois and Marty Gingras, California Department of Fish and Game, 4001 North Wilson Way, Stockton, CA 95205, 209 932-2395 office, 209 946-6355 fax jdubois@dfg.ca.gov

California Striped Bass: A Species Contested for the Prey It Ingested

Abstract: In February, the FGC opted not to pursue a proposal — developed by DFG in close coordination with NOAA Fisheries — to liberalize the bag and size limits in an effort to reduce the abundance of striped bass as one of many efforts intended to improve the populations of listed fish on which striped bass prey. Though part of a settlement agreement, the proposal was simply the latest in almost 25 years of efforts to address the threat of striped bass predation to Winter- and Spring-run Chinook salmon, Central Valley steelhead, Central Coast steelhead, South/Central Coast steelhead, Central Coast Coho salmon, delta smelt, longfin smelt, and tidewater goby. The proposal was supported by a Staff Report, and the Staff Report summarized the status and trends of listed fishes, the status and trends of striped bass, striped bass predation on listed fishes, and the striped bass fishery. While acknowledging uncertainty about the extent and impacts of striped bass predation, the Department concluded that the populations of each of the listed fish have declined and some are at perilously low levels. Although striped bass abundance has declined in recent decades, the population remains substantial. Studies of striped bass predation show each of the listed species constitute a relatively small part of the striped bass diet, and although the actual level of striped bass predation on these species is unknown and likely unknowable, the enormous volume of fish (estimated at up to 110 million pounds annually) consumed by striped

bass and the widespread distribution of striped bass within the geographic range of the listed species indicate the impact of striped bass predation on the listed species could be substantial. The recreational fishery for striped bass is very popular, and many anglers will harvest substantially more striped bass if they are allowed to keep smaller fish.

Statement of Relevance: A more in-depth understanding of the relation between prey consumption and prey density can further our understanding of the effects of striped bass predation on ESA listed fish. Continued efforts to collect mark-recapture data — coupled with perhaps future diet studies — will provide valuable quantitative metrics.

FRIDAY 8:50-9:10

Donald E. Portz, Bureau of Reclamation, Denver Technical Service Center, Fisheries and Wildlife Resources Group, 86-68290, PO Box 25007, Denver, CO 80225-0007 303-859-9505 dportz@usbr.gov , Darren Odom, SureWorks, LLc., 1607 Ervine Avenue, Longmont, CO 80501

SmeltCam III: Making Science Fiction a Reality with Fish Species Recognition Technology

Abstract: Much is still unknown about actual numbers, trends in abundance, and geographic distribution of rare and patchy pelagic fishes in the San Francisco Estuary and Sacramento-San Joaquin River Delta (Delta). Delta fish species and aquatic organisms are in constant flux and have seen recent declines. To learn more information about these fishes in their natural environment, the Bureau of Reclamation, SureWorks LLC, California Department of Fish and Game, and California Department of Water Resources are developing technology to count and identify pelagic fish species in the Delta using an underwater video imaging system enclosed in a towed submersible. Innovative fish identification methods are necessary to provide more accurate population numbers and locations of occurrence, and more importantly to provide a passive, noninvasive technique that will lessen the impact of current fish monitoring practices. Trawls presently form the foundation of Interagency Ecological Program (IEP) fish monitoring in detecting pelagic organism decline (POD) and population trends for pelagic Bay-Delta fishes. While these long term sampling data have been exceptionally useful in monitoring population trends and abundance, additional sampling is necessary to gain further understanding of the distribution and life histories of rare and patchy species, their ecosystem requirements, and factors that may be correlated with their declines. Pelagic organism declines have led to concern over lethal "take" by traditional trawling methods in a time when more information about sensitive species is needed to advise management decisions and attempt to rescue these organisms in peril. Underwater fish species recognition technology provides a supplemental method to examine pelagic fish distribution and abundance without inadvertently harming or handling threatened and endangered species. The average accuracy of the SmeltCam species classifier was 91% during trawls performed fall 2011. Algorithms in the species recognition model were able to positively identify 88% of delta smelt.

Statement of Relevance: Traditional sampling techniques may inadvertently cause harm to ESA listed fish species and further sampling restrictions may result. Implementing alternative methods of collecting population data that won't harm or increase lethal take is necessary to gain information about Delta fishes and sustain vulnerable fish species.

FRIDAY 9:10-9:30

Brian Schreier, California Department of Water Resources, 3500 Industrial Blvd., West Sacramento, CA 95691 (916) 376-9755 Office (916) 376-9688 Fax bschreie@water.ca.gov, Melinda Baerwald, University of California, Davis, One Shields Avenue, Davis, CA 95616 (530) 754-4155 Office (530) 752-0175 Fax mrbaerwald@ucdavis.edu,

Gregg Schumer, Cramer Fish Sciences, 3300 Industrial Blvd., West Sacramento, CA 95691 (530) 305-7641 Cell (530) 888-7774 Fax greggs@fishsciences.net , Louise Conrad, California Department of Water Resources, 3500 Industrial Blvd., West Sacramento, CA 95691 (916) 376-9759 Office (916) 376-9688 Fax jlconrad@water.ca.gov and Bernie May, University of California, Davis, One Shields Avenue, Davis, CA 95616 (530) 754-8123 Office (530) 752-0175 Fax bpmay@ucdavis.edu

Genetic Detection of Predation on Larval Delta Smelt in the North Delta

Abstract: In the Sacramento-San Joaquin Delta (Delta), delta smelt (*Hypomesus transpacificus*) have experienced recent dramatic population declines and are a species of conservation concern. In contrast, the invasive Mississippi silverside (*Menidia audens*) is increasing in abundance in the Delta and is thought to significantly impact delta smelt populations through intraguild predation, the preying on early life-stages of a competitor while also competing directly with adults. The IEP Pelagic Organism Decline (POD) conceptual model identified predation as a major stressor on delta smelt, and the Bay Delta Conservation Plan (BDCP) identified invasive predator control as a conservation measure to protect native fishes. However, little is known about the prevalence of invasive species predation on larval delta smelt or the environmental conditions associated with that predation. During the spring of 2011, we sampled silversides and other putative predators of larval delta smelt using a combination of spring Kodiak trawls, electro-fishing, and beach seines in Suisun marsh and the north Delta. Predator stomachs were removed and analyzed using species specific Taqman probes to identify delta smelt DNA. A total of 558 silversides, 73 striped bass (*Saxatilis morone*), 44 Sacramento pikeminnow (*Ptychocheilus grandis*), and 30 largemouth bass (*Micropterus salmoides*) of sufficient size to prey on larval fish were collected and analyzed. Of these, 69 silversides (12.4%), 1 striped bass (1.4%), 2 pikeminnow (4.6%), and 2 largemouth bass (6.7%) tested positive for delta smelt DNA in their digestive tracts. Analyses indicated that the occurrence of predation by silversides is widespread in the study area, though modeling results indicated that for some areas, certain environmental variables are predictive of the presence of silversides testing positive for delta smelt DNA. The use of genetic techniques to detect predation on early life-stage delta smelt was both highly efficient and highly sensitive, and future studies building on this method are planned.

Statement of Relevance: Understanding predation patterns on the early life-stages of delta smelt will significantly benefit the planning and implementation of conservation and restoration efforts in the Delta by informing actions that can minimize the spatial, environmental, and habitat conditions that correlate with increased incidence of predation by invasive fish species.

FRIDAY 9:30-9:50

Gonzalo Castillo, U.S. Fish & Wildlife Service, Stockton, CA 95205. Tel 209-946-6400, Fax 209-946-6355, email gonzalo_castillo@fws.gov, Galen Tigan, FCCL. Dept. Biological & Agricultural Engineering, Davis, CA 95616. Tel. 209-830-9803, Fax 209-830-9539, email gttigan@ucdavis.edu, Paul Skvorc, Biopar, LLC, Wasilla, AK 99687. Tel. 907-376-8097, Fax: 907-376-8097, email pskvorc@biopar.com, Joan Lindberg, FCCL. Dept. Biological & Agricultural Engineering, Davis, CA 95616. Tel. 209-830-9803, Fax 209-830-9539, email lindberg@steeper.us

Preliminary Evaluation of Individual Identification for Delta Smelt by Means of Natural Marks

Abstract: The use of external natural marks is a non-invasive approach for identifying individual animals. Natural marks could potentially allow more dependable individual identification for small fish than existing methods. We conducted preliminary tests to evaluate the use of natural marking on adult delta smelt (*Hypomesus transpacificus*). We used cultured delta smelt produced at the Fish Conservation and Culture Lab (FCCL) to evaluate the use of melanophores as natural marks. External examination of adult delta smelt in January 2012

revealed several potential areas of interest (AOI) for natural marks (dorsal view of the head and caudal peduncle, ventral view of the mandible). We selected the dorsal view of the head as the primary AOI, where melanophores are particularly common. To evaluate the short-term effectiveness of natural marks, we tagged fish with an individual alphanumeric code (VIA tags, Northwest Marine Technologies). We used a digital camera equipped with a macro lens to acquire head images. A second digital camera and a flotarium were used to obtain lateral whole body images and preliminary morphometric measurements. Initial evaluation of natural marks involved manual (naked eye) matching of digital images. We developed a qualitative matching-grade criteria to assign a measure of confidence to the manual matching process (4: excellent; 3: good; 2: fair and 1: poor). Initial results using manual evaluation for the head AOI in ten fish showed: 1) high density of pigments and pigmentation patterns, 2) variation in the size and shape of individual pigments over time, 3) a 100% correct matching of images taken one month apart and 4) excellent to good matching-grade for 80% of images and fair matching for the remaining images. These initial results justify the need for further evaluation of natural marks and the development of automated matching algorithms for adult delta smelt.

Statement of Relevance: Availability of dependable marking methods contributes to the effective management of fish populations. We evaluated the use of natural marks as an alternative to the few methods available for identifying small individual fishes such as the delta smelt, a species of environmental and management relevance in the upper San Francisco Estuary.

FRIDAY 9:50-10:10

Connie Svoboda, Hydraulic Engineer, Bureau of Reclamation, Mail code 86-68460, P.O. Box 25007, Denver, CO 80225, phone (303) 445-2152, csvoboda@usbr.gov, Mike Horn, Research Aquatic Scientist, Bureau of Reclamation, Mail code 86-68220, P.O. Box 25007, Denver, CO 80225, phone (303) 445-2203, mhorn@usbr.gov

Laboratory Design and Testing of an Electrical Crowder for Predator Reduction at the Tracy Fish Collection Facility

Abstract: Fish screening facilities in the south Sacramento-San Joaquin Delta can provide favorable habitat for predator fish, primarily striped bass. At Tracy Fish Collection Facility (TFCF), striped bass reside upstream, downstream, and within the facility, feeding on seasonal influxes of smaller entrained fish. This study investigates the use of electricity as a safe and effective way of deterring large predator fish from taking up residency in the TFCF with little or no impact on smaller fish. After examining potential alternatives involving electricity, a fixed rolling electrical crowder was selected for further development in a hydraulics laboratory. The electric crowder consists of an electrofisher unit that transmits pulsed DC to an electrical sequencer. The sequencer is programmed to transmit current to sets of electrode pairs such that the electrical field rolls in the downstream direction at a specified speed. The crowder moves fish through avoidance rather than taxis, so injury to fish is minimized. Electrode spacing, polarity, and field strength were optimized in the model. Laboratory observations show that most adult striped bass in the size range of 285 to 590 mm swam quickly out of the field. Depending on orientation and proximity to electrodes, some striped bass were drawn to an electrode in taxis. Covers should be installed around electrodes to prevent fish from directly contacting electrodes. The crowder must roll more slowly than channel velocity to allow stunned fish to drift out of the field. Channel velocity did not affect response to the crowder; however, lighting conditions had a significant effect on behavior. Juvenile rainbow trout and Chinook salmon in the size range of 88-108 mm were not greatly affected by the electric crowder.

Statement of Relevance: An electrical crowder has the potential to reduce predator loads at the TFCF. Reducing pre-screen loss of salmonids to 10 percent or less was set forth in the 2009 Biological Opinion for the Central Valley Project. If this method is effective at the TFCF, an electric crowder may be employed at other screening facilities for predator management.

SESSION VI – FALL LOW SALINITY HABITAT (FLASH) STUDIES: MAKING SENSE OF PHYSICAL AND BIOLOGICAL CONDITIONS IN 2011

FRIDAY 10:40-11:00

Dave Contreras, California Department of Fish and Game, 4001 N. Wilson Way, Stockton, CA 95205, 209-948-7089 (office number), 209-946-6355 (fax) dcontreras@dfg.ca.gov

Pelagic fish distribution and growth patterns

Abstract: The Summer Townet (STN) and Fall Midwater Trawl (FMWT) are two long term monitoring programs that survey abundance of pelagic fish in the San Francisco Estuary. Abundance indices for delta smelt, age-0 striped bass, American shad, and threadfin shad are calculated using catch data. Fork lengths of fish are also recorded which can be used to examine growth rates (mm/day). The 2011 high outflow wet year resulted in a large low salinity habitat (1-6 ppt) zone and thought to be an important habitat for delta smelt. Abundance and distribution comparisons were made from this year to two relatively dry years, 2005 and 2010, and another wet year, 2006, when outflows were lower. Daily growth rates for delta smelt and age-0 striped bass were also examined and compared to previous years. Fish were primarily distributed in low salinity habitat or upstream in Cache Slough and the Sacramento Deep Water Ship Channel. The 2011 delta smelt daily growth rate is among one of the highest in a decade. Age-0 striped bass growth rate in 2011 was above the overall growth rate average, but lower than years 2006 and 2010.

Statement of Relevance: These fish species were targeted as part of the Fall Low Salinity Habitat (FLaSH) studies initiated in fall/winter 2011/2012 as a result of the delta smelt biological opinion to help manage California state water operations.

FRIDAY 11:00-11:20

April Hennessy, California Department of Fish and Game, 4001 N. Wilson Way, Stockton, CA 95205, Phone (209) 942-6088, Fax: (209) 946-6355 ahennessy@dfg.ca.gov

FlaSHy fish food: Just add water!

Abstract: Zooplankton in the upper San Francisco Estuary (SFE) are an important food for larval and juvenile fishes of many species and adults of planktivores, such as delta smelt and threadfin shad. The California Department of Fish and Game's Zooplankton Study has been sampling zooplankton in the upper SFE since 1972 as a means of monitoring abundance and distribution of fish food resources. Recently the Summer Townet (STN) and Fall Midwater Trawl (FMWT), which survey pelagic fish in the SFE, started zooplankton sampling concurrent with their pelagic fish sampling to better assess fish food resources in summer and fall. Low salinity habitat (1-6 ppt) is important for delta smelt, and the location of that habitat in fall is thought to effect delta smelt abundance and condition. The Fall Low Salinity Habitat study or FLaSH, seeks to analyze biotic and abiotic habitat factors and determine if the location of fall low salinity habitat affects fish abundance and condition. Zooplankton abundance, distribution, and biomass from 2011, a wet year with relatively high flows in fall, were compared to 2006, another wet year, and the drier years 2005 and 2010. During 2011, low salinity habitat was located in Suisun Bay through October before moving upstream into the confluence of the Sacramento and San Joaquin rivers in November and December. Average August through December zooplankton biomass was higher in 2011

than in 2005, 2006, or 2010. However, when examined on a monthly basis, October and November 2011 biomass was much higher than the other years, whereas August and September 2011 zooplankton biomass was very similar to 2010 and December 2011 biomass was similar to 2005.

Statement of Relevance: The FLaSH study was initiated to determine if the location of the low salinity habitat in fall affects fish abundance and condition, which may influence future California state water operations.

FRIDAY 11:20-11:40

Steven B. Slater, California Dept. of Fish and Game, 4001 North Wilson Way, Stockton, CA 95205-2486, Office: (209) 948-7800 Fax: (209) 946-6355 sslater@dfg.ca.gov

What's new on the menu? Regional feeding patterns of delta smelt in a wet year.

Abstract: In 2011, delta smelt collected by Department of Fish and Game (DFG) in August by Summer Townet (survey 6) and September-December by Fall Midwater Trawl were preserved for a suite of physical examinations, including a diet study, as part of the Fall Low Salinity Habitat Study work. The DFG diet study will report feeding incidence, stomach fullness, and prey item composition of delta smelt collected from stations grouped by regions of salinity defined as >6, 1-6, and <1 ppt and also from the Cache Slough/Sacramento Deep Water Ship Channel (CS/SDWSC) region. The results of food use from this study (in the wet year of 2011) are planned for compare/contrast summaries with the previous dry year of 2010 and other paired dry-wet years such as 2005 and 2006. Delta smelt in the fall of 2011 had a high feeding incidence (>98%) from all regions, with only 4 of 261 stomachs found empty. Mean stomach fullness increased August through November and for several months the highest mean fullness occurred in the low salinity zone (1-6 ppt) and the lowest mean fullness occurred in CS/SDWSC. Prey items contributing to stomach contents included a diverse mix of copepods, amphipods, mysids, and cladocerans. Major food items by number were calanoid copepods (*Pseudodiaptomus forbesi* and *Acartiella sinensis*) and cyclopoid copepods (*Limnoithona* spp. and other species). Other numerically important food items included harpacticoid copepods and cladocerans. Amphipods and mysids contributed little to diet composition by number, but being larger than copepods, contributed considerably to diet by weight. Prey use varied by region with CS/SDWSC dominated numerically by calanoid copepods, whereas prey use was more diverse downstream. This work is currently underway and additional results are pending.

Statement of Relevance: This study, as part of the Fall Low Salinity Habitat work, will focus on delta smelt use of available pelagic invertebrate food resources and whether a wet fall provided demonstrable benefits in production of food and condition of fish.

FRIDAY 11:40-12:00

Hobbs, Jim[1], Acuña, Shawn[1], Gandhi, Saikrithika, Baxa, Dolores[1], Javidmehr, Alireza[1], Baxter, Randy[2], Teh, Swee[1], [1]Aquatic Health Program, UC Davis, 1 Shields Ave, Davis, CA 95616; scacuna@ucdavis.edu, sairithika@gmail.com, ajavidmehr@ucdavis.edu, dvbaxa@ucdavis.edu, sjteh@ucdavis.edu, (530) 752-1967, [6]California Department of Fish and Game, 4001 North Wilson Way, Stockton, CA 95205; RBAXTER@dfg.ca.gov, (206) 948-7800
Contact: Swee Teh, sjteh@ucdavis.edu, (530) 754-8183.

FLaSH Fish Health Study: Health and Nutritional Analysis of Delta "Benchmarks for Health"

Abstract: In collaboration with Interagency Ecological Program (IEP) long-term fish monitoring surveys this project was investigating the health of delta smelt, *Hypomesus transpacificus*, occupying three regions in the upper San Francisco Bay Delta Estuary; Cache Slough complex, the Sacramento/San Joaquin river confluence and Suisun Bay during the critical fall period. This study examined the potential effects of water quality, xenobiotics and nutrition on the health of delta smelt. To assess the health of delta smelt a rigorous and comprehensive examination of multiple morphometric, nutritional, histopathologic and enzymatic biomarkers. Results of all univariate analyses showed no significant relationship between any water quality parameter and recorded biomarkers; however using multivariate statistical method has revealed significant correlations of water quality parameters of temperatures, turbidity, and salinity and recorded biomarkers. This study shows that predictors of health indices in Delta Smelt should not be evaluated in isolation. This study also suggests advanced epidemiologic approaches such as multiple logistic regressions to discover the magnitude of each predictor's effect on Delta smelt health and effect of an interaction between predictor factors.

Statement of Relevance: The results from this study will serve as baseline information on the general health status of delta smelt and will provide the essential groundwork for evaluating future changes on the health of these species and the delta ecosystem. Therefore, our study will contribute an essential strategic element to FLaSH goals and objectives of developing science-based techniques to protect the SFE.

SESSION VI (CONTINUED) – FALL LOW SALINITY HABITAT (FLASH) STUDIES: MAKING SENSE OF PHYSICAL AND BIOLOGICAL CONDITIONS IN 2011

FRIDAY 1:30 – 1:50

Anke Mueller-Solger, PhD. , amueller@deltacouncil.ca.gov, Delta Stewardship Council , 980 9th Street, 14th Floor , Sacramento, CA 95814 , (916) 275-8727, Tara Schraga, USGS Menlo Park, Tiffany Brown, DWR. Erwin Van Nieuwenhuyse, Reclamation, Randy Dahlgren, UCD

Big surprises come in small packages: 2011 phytoplankton monitoring results.

Abstract: The fall outflow adaptive management plan included several predictions about phytoplankton biomass and species composition in the low salinity zone of the San Francisco estuary for three different fall outflow scenarios. To evaluate if these predictions were met, we compared phytoplankton biomass (chlorophyll *a*) and species composition data collected during IEP and USGS monitoring surveys among four recent years with different fall outflows, 2005, 2006, 2010, and 2011. The highest fall outflow occurred in 2011 while the lowest fall outflow occurred in 2010. 2005 and 2006 had intermediate fall outflows. Phytoplankton biomass was generally highest in the high fall-outflow year 2011, but was also high in the low-outflow year 2010 and lowest in 2005. 2011 also stood out by having an unusual diatom bloom in the Sacramento River between Rio Vista and Antioch in October-November and by more *Aphanizomenon flos-aquae* than *Microcystis aeruginosa*. In addition to the four year comparison, we also evaluated phytoplankton (chlorophyll *a*) monitoring data collected from 1975 to 2011 by three monitoring surveys with respect to geography (river kilometer), salinity, and the position of the low salinity zone as indexed by X2, the distance of the 2‰ isohaline from the Golden Gate. Results showed that phytoplankton concentrations were generally greatest before 1988 and at salinities of 0 to 12 psu. Fall blooms were virtually absent between 1988 and 1998 except in the most upstream (fresh water, San Joaquin River) and downstream (salinity > 20 psu, toward the Golden Gate) regions of the estuary. In the most recent decade fall phytoplankton biomass has somewhat increased, but remains at a much lower magnitude than before 1988. Over the entire data record of more than 25,000 data points, the highest phytoplankton biomass in low and medium salinity regions (1-12 psu) occurred at X2 values between 73 and 82 km, i.e. a fairly westward low salinity zone.

Statement of Relevance: This work is part of the evaluation of the effects of fall outflow management on water supplies and delta smelt required by the 2008 FWS Delta Smelt Biological Opinion. Results will be used to adaptively manage fall outflow to better protect delta smelt and water supplies in the future.

FRIDAY 1:50-2:10

Frances Wilkerson, Alex Parker, Richard Dugdale, Adam Pimenta, Sarah Blaser Erica Kress and Christina Buck, Romberg Tiburon Center, San Francisco State University, 3152 Paradise Drive, Tiburon CA 94928, (415) 338-3519, (415) 435-7120, fwilkers@sfsu.edu

Nutrient and phytoplankton distributions during the fall low salinity habitat (FLaSH) study in Suisun Bay

Abstract: As part of the FLaSH program we sampled water from Suisun Bay during September to early November 2011 to evaluate how nutrients and chlorophyll responded to the increased freshwater flow and more seaward location of X2. A transect of up to nine stations within the Sacramento River and Suisun Bay between Rio Vista and Avon Pier were sampled on eight occasions for nutrients, dissolved inorganic carbon, chlorophyll, phytoplankton community composition and rates of primary production and nutrient uptake. Continuous underway surface sampling system also measured temperature, salinity and *in vivo* fluorescence. During the last two cruises (October 26 and November 2) a phytoplankton bloom (chlorophyll ~30 µg/L) was observed at Sacramento River stations. The bloom was dominated by the chain forming diatom *Aulacoseira* that had very long chains, typically 15-20 cells per chain. At these stations, nutrients were lower with ammonium concentrations < 2 µM and nitrate ~15 µM. The role of water column light availability was unclear as Secchi depth measurements were similar between bloom and nonbloom stations. Fall blooms are rare for this region of the estuary, and the 2011 bloom may have been a consequence of the increased freshwater flow.

Statement of Relevance: These data will be used to evaluate the hypothesis that river flow and Sacramento River ammonium concentration are significant regulators of primary production and phytoplankton nitrogen uptake in Suisun Bay. The results could be used in adaptive management of fall outflow for delta smelt protection and water supply reliability.

FRIDAY 2:10-2:30

Brian Bergamaschi, Bryan Downing, Michael Sauer, U.S. Geological Survey, 6000 J St, Sacramento CA 95819-6129; p 916.278.3000; f 916.278.3071; msauer@usgs.gov; Peter Hernes, U.C. Davis, 1 Shields Ave, Davis CA 95616; p 530.752.7827; f 530.752.5262; pjhernes@ucdavis.edu

Water and particle properties as measures of habitat quality

Abstract: Aquatic habitat quality in the Delta is determined by interactions between nutrients, suspended sediment, water, and light. Together, these habitat attributes affect the food supply by controlling algal production and species distribution; affect the food web structure by influencing energy transfer and grazer community composition; and affect fish distributions by altering foraging behavior and predation. The variation in these attributes across the Delta is commonly observed as variations in, for example, chlorophyll, turbidity, and Secchi depth, which have been related to algal, zooplankton, and fish abundance. Our project examines these relationships in greater detail using a suite of new optical techniques that directly measure light transmission

properties as well as algal and particle size and abundance. One purpose of the study is to identify the simplest optical water quality measurements that may best be used in a continuous real-time in-situ monitoring network of habitat quality. We conducted profile measurements and collected samples at 25 stations from Suisun Bay to Cache Slough in conjunction with the 2011 Fall Mid-Water Trawl program; sampling at the same time and location as the fish collection activities. We found a large tidal dependency and large spatial variability for the parameters measured. For example, the chlorophyll concentration and median size of large suspended particles (including algae and flocs) increased upstream, in contrast to turbidity and salinity which showed the opposite trend. Distributions and interactions between measured parameters will be presented in combination with results of more traditional water quality measurements and from analysis of discrete water samples. The optical measurements will be used as part of an effort to establish relationships between readily-measured habitat quality indices and direct measurements of fish and community structure.

Statement of Relevance: Study results can be used (1) to develop a monitoring network measuring habitat quality indices continuously at existing flow stations across the Delta, yielding input for decision support models and a real-time Delta habitat index; and (2) to examine spatial and historic patterns through use of remote sensing imagery. This will better inform policy makers and managers about effects of water operations, mitigation actions, and restoration activities.

SESSION VI (CONTINUED) – FALL LOW SALINITY HABITAT (FLASH) STUDIES: MAKING SENSE OF PHYSICAL AND BIOLOGICAL CONDITIONS IN 2011

FRIDAY 2:30-2:50

J. Thompson (presenting), U.S. Geological Survey, 345 Middlefield Rd., MS 496, Menlo Park, CA 94025 650-329-4364 Office 650-329-4327 Fax jthompso@usgs.gov, K. Gehrts, Division of Environmental Services, California Department of Water Resources, 3500 Industrial Blvd, West Sacramento, CA 95691 (916) 375-4825; (916)-376-9688 Fax kagehrts@water.ca.gov, Fax. Parchaso, U.S. Geological Survey, 345 Middlefield Rd., MS 496, Menlo Park, CA 94025, (650)-329-4586 Office (650)-329-4327 Fax parchaso@usgs.gov, and H. Fuller, Division of Environmental Services, California Department of Water Resources , 3500 Industrial Blvd, West Sacramento, CA 95691 (916) 376-9821; 916-376-9688 Fax hfuller@water.ca.gov

Going with the flow: the distribution, biomass and grazing rate of *Corbula* and *Corbicula* with varying freshwater flow (May and October 2009-2011)

Abstract: Biomass and grazing rate have been estimated for bivalves from more than 200 stations throughout the North Bay and Delta in spring and fall 2009-2011. The distribution and magnitude of *Corbicula* and *Corbula* biomass in the estuary showed that at least one of these species was found at most locations. The two species overlapped within the eastern end of the low salinity zone (LSZ) in spring, with the exact location of the overlap being determined by freshwater outflow. *Corbicula* had slightly higher biomass in the LSZ in 2011 than in 2009 and *Corbula* had lower biomass in 2011 than in 2009 as expected if the distributions are determined by salinity. Coincident with increased freshwater flow in spring 2011 was an increase in *Corbicula* biomass in the Cache Slough region but the rest of the Delta had either a slight decrease or similar *Corbicula* biomass in spring 2011 relative to spring 2009 and 2010. *Corbula* declined in spring 2011 in Montezuma Slough in particular, but maintained low biomass beyond the confluence into both the Sacramento and San Joaquin Rivers. *Corbicula* biomass in fall was slightly higher in 2010 than in 2009 and was higher in the lower San Joaquin River and throughout the Sacramento River in 2010, the wetter year. *Corbula* had larger biomass values and occurred

further up the rivers in 2009, the drier year, than in 2010. Fall 2011 samples are being processed and will be presented. Grazing rates, derived from biomass, were sufficient to reduce and possibly limit phytoplankton biomass accumulation throughout the LSZ in fall 2009 and in the central and western region of the LSZ in fall 2010. Spring grazing rates had the potential to limit phytoplankton in the eastern LSZ in 2009 (*Corbicula* grazing) and in the western LSZ in 2010 (*Corbula* grazing).

Statement of Relevance: Understanding when and where bivalve grazing on phytoplankton, bacteria and microzooplankton may limit the food for and the number of larvae of secondary producers in the pelagic food web is critical to our understanding of food web function and of how grazing by bivalves may contribute to the POD.

FRIDAY 2:50-3:10

Carol Kendall, U.S. Geological Survey, 345 Middlefield Rd., MS 434, Menlo Park, CA 94025, 650-329-4576, ckendall@usgs.gov, Megan B. Young, U.S. Geological Survey, 345 Middlefield Rd., MS434, Menlo Park, CA 94025, 650-329-4544, mbyoung@usgs.gov, Steven R. Silva, U.S. Geological Survey, 345 Middlefield Rd., MS 434, Menlo Park, CA 94025, 650-329-4558, srsilva@usgs.gov , Jennifer C. Lehman, U.S. Geological Survey, 345 Middlefield Rd., MS 434, Menlo Park, CA 94025, 650-329-4509, jclehman@usgs.gov, and Calla M. Schmidt, U.S. Geological Survey, 345 Middlefield Rd., MS 434, Menlo Park, CA 94025, 650-329-4509, cschmidt@ucsc.edu

Comparison of Seston Composition and Sources in the Delta during two High-flow Falls (2006 and 2011)

Abstract: As part of several state-funded studies 2005-2011, we have used a multi-tracer, multi-isotope approach to assess biogeochemical processes and the sources of organic matter, nutrients, and water at several score main-channel and tributary sites in the northern Bay, Delta, and Sacramento and San Joaquin Rivers. Since this large dataset overlaps the three main fall habitats of delta smelt (Suisun Bay, the San Joaquin River Confluence, and Cache Slough sites), we are evaluating whether the additional insights provided by a multi-fingerprinting approach might explain more of the variance in smelt presence-absence than the X2-habitat curve approach (Feyrer et al. 2010). The water year types for 2005-2011 range from critically dry to wet. Sacramento River flow was relatively high in the falls of both 2006 and 2011 as a result of the preceding wet springs. To compare the habitat characteristics for these two high-flow falls, bulk seston (POM) was collected on 0.7 micron pre-combusted GFF, and analyzed for bulk $\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$, and C:N. The filtrate was further processed for DOC-$\delta^{13}C$, NO3-$\delta^{15}N$ and $\delta^{18}O$, NH4-$\delta^{15}N$, and water $\delta^{18}O$ and $\delta^{2}H$ analyses; these analyses are in progress. Splits of all samples were analyzed for nutrients, chlorophyll, and other constituents. Many of our studies piggybacked on state-funded monitoring projects which provided the chemical and hydrological data for the sample splits. The dataset for fall 2006 includes the same isotope suite (except for NH4-$\delta^{15}N$) and the same chemical and hydrologic data, but no samples were collected from Cache Slough sites.

This presentation will compare the estimated contributions of POM from (1) different organic matter types (i.e., phytoplankton, bacteria, terrestrial organic matter) and (2) different geographic sources (i.e., Cache/Yolo, Sacramento River, San Joaquin River, Bay) for a range of sites sampled approximately monthly during transects in fall 2011 vs fall 2006.

Statement of Relevance: This study was funded by Delta Science to use the biogeochemical insights provided by our multi-isotope approach to address questions about why 3 regions of the Delta appear favorable for smelt in the fall. This talk provides a preliminary assessment of temporal and spatial variation in habitat characteristics during 2 high-flow falls, to be later compared with data from a wider range of flow conditions.

FRIDAY 3:10-3:30

Larry R. Brown, U.S. Geological Survey, Placer Hall, 6000 J St., Sacramento, CA, 95819, Phone: 916-278-3098, lrbrown@usgs.gov

Synthesis of Studies in Fall Low Salinity Habitat of the San Francisco Estuary

Abstract: In Fall 2011, a number of studies were implemented by the Bureau of Reclamation (Reclamation) in cooperation with the Interagency Ecological Program to explore hypotheses about the importance of low salinity habitat (LSH) and its distribution to the ecology of the Sacramento-San Joaquin Delta (Delta), and specifically the biology of delta smelt *Hypomesus transpacificus*. These studies and other activities were motivated by a Biological Opinion on Central Valley Project and State Water Project operations issued by the U.S. Fish and Wildlife Service in 2008. The results of the studies are intended to inform an adaptive management plan undertaken by Reclamation for management of Fall LSH. Adaptive management includes 6 basic steps: 1) assess the problem; 2) design management actions; 3) implement management actions; 4) monitor the outcomes of management actions; 5) evaluate the results of monitoring; and 6) adjust the adaptive management plan based on the evaluation of outcomes. The purpose of the synthesis report is to integrate the results from the Fall 2011 studies and provide an assessment of whether the data collected support predictions based on the conceptual model developed to guide the adaptive management plan. The report will be reviewed by an independent science panel convened by the Delta Science Program in early June 2012. A final report is expected by late September 2012 with public release by the end of calendar year 2012. The results of the synthesis will contribute to the revision of the conceptual model used to guide the adaptive management plan and identify studies to continue or initiate in future years.

Statement of Relevance: The report described in this talk will provide an integrated assessment of data that is critical for management of delta smelt in the San Francisco Estuary. The report will provide the basis for modifications to the conceptual model currently guiding the adaptive management plan for Fall low salinity habitat.

2012 IEP WORKSHOP POSTER PRESENTATION ABSTRACTS

Note: A single asterisk (*) signifies posters displayed in both the joint CWEMF/IEP poster session on 4/18/12 and the IEP-only poster session on 4/19/12. A double asterisk (**) signifies posters displayed in the joint CWEMF/IEP poster session only.

Investigating infections of *Mycobacterium* in delta smelt (*Hypomesus transpacificus)* from the San Francisco Estuary

DV Baxa[1], SJ Teh[1], JC Lindberg[2], EP Scott Weber III[3] [1] School of Veterinary Medicine, Department of Anatomy, Physiology, and Cell Biology, University of California, Davis, dvbaxa@ucdavis.edu, sjteh@ucdavis.edu[2] Biological and Agricultural Engineering Department, Fish Conservation and Culture Laboratory (FCCL), University of California, Davis, jclindberg@ucdavis.edu [3] School of Veterinary Medicine, Department of Medicine and Epidemiology, University of California, Davis, epweber@ucdavis.edu

Abstract: Investigations on threatened or endangered species seldom consider pathogens, disease, and host health assessments on building a case for factors related to environmental alterations or climate change. Thus, pathogens, diseases, and host health status are one of the least studied stressors affecting threatened species in

the San Francisco Estuary (SFE), but are intricately related to the health of the entire ecosystem. The delta smelt (*Hypomesus transpacificus*) is ecologically and economically important in the SFE hence the focus of intensive studies. In the last decade, the presence of a chronic and untreatable bacterial infection associated with *Mycobacterium* has been observed among delta smelt in production facilities charged with the propagation of refugial populations (Fish Conservation and Culture Lab, UC Davis) and broodstock management (Livingston Stone National Fish Hatchery, Shasta Lake) including laboratory-based research programs. *Mycobacterium* is ubiquitous infecting a wide spectrum of aquatic and terrestrial poikilotherms, birds, and mammals, including humans. In other ecosystems such as the Chesapeake Bay, several *Mycobacterium* species have been implicated as disease agents in striped bass (*Morone saxatilis*) and Atlantic menhaden (*Brevoortia tyrannus*), raising alarms of the health status of the bay. Current reporting of *Mycobacterium* and/or disease prevalence among delta smelt populations is dependent on the detection methods being employed: molecular tools (exposure), bacterial culture (infection), and histopathology (disease). Based on our results and previous studies, this presentation will provide an overview of our current knowledge of exposures to *Mycobacterium* among wild delta smelt populations and how key environmental factors affect the disease progression under captive conditions. Environmental factors may play a critical role influencing the incidence and prevalence of mycobacteriosis throughout this critical ecosystem. By understanding how environmental changes can affect the role disease pathogens play, we may be better able to devise effective mitigation strategies to help save endangered and threatened species.

Statement of Relevance: Knowledge on *Mycobacterium* prevalence in delta smelt provides insights on the pathogen role to fish survival in captivity and in the field. Determining *Mycobacterium* incidence in delta smelt and in other introduced species (e.g. Chinook salmon, striped bass, Sacramento splittail) is relevant to management of aquatic resources in the SFE.

"Bona fide" Scientific Research Permitted Activities

Russ Bellmer, Dan Kratville, Kasie Barnes, and Sunil Rajappa, California Department of Fish and Game, Fisheries Branch, 830 S Street, Sacramento, CA 95814, (916) 327-8850, rbellmer@dfg.ca.gov

Abstract: This poster presentation synthesizes information from the Scientific Collecting Permit database which is comprised of field and laboratory investigations aimed at improving our understanding of the biology and ecology of native fish species in California. Samples of permitted research were collected over a five year period from 2006 to 2011 to develop a comparison of types of activities and species targeted. Types of information gained and how it was used are discussed. The Scientific Collecting Permit review and valuation process is presented along with the importance of accuracy of information in the permit application. Degree of differences between and among researchers in application completeness and accuracy is presented. The value added of some of the research projects is presented along with risk to the native fish being studied.

Statement of Relevance: These results are discussed in the context of the variable risks and benefits to the species involved in these applied and theoretical research studies.

Steelhead Monitoring Program in California: Past, Present and Into the Future

Russ Bellmer, Jonathan Nelson, Kasie Barnes, and Ryan Fortier, California Department of Fish and Game, Fisheries Branch, 830 S Street, Sacramento, CA 95814, (916) 327-8850, rbellmer@dfg.ca.gov

Abstract: The establishment of accurate monitoring of steelhead population abundance and distribution within the State of California is a necessary component for restoration and recovery of the species under the Federal Endangered Species Act recovery plans and State management plans. The large, variable geographic distribution and significant population declines of steelhead throughout the state warranted the creation of a consistent, comprehensive monitoring program to statistically measure population abundance and trends necessary for

effective fishery management on a statewide basis. The monitoring program divides California geographically into three areas based on species composition, abundances, and habitats: the Central Valley and Northern and Southern Coastal Areas. The monitoring plan is science based and statistically sound, with temporal and spatial variability to procure information on adult, juvenile, and smolt life history stages at the population and subpopulation levels for assessment of trends in each Distinct Population Segment (DPS). The data from monitoring sites is recorded into an evolving centralized database for archive and analysis, allowing quality control.

Statement of Relevance: Information gained from monitoring will be used to select restoration and recovery activities that will aid in the reestablishment of self-sustaining steelhead populations. The monitoring program was developed through a collaborative process to ensure that existing and future monitoring sites and data reporting are in compliance with the protocols presented in this plan.

Water and Particle Properties as Measures of Habitat Quality

Brian Bergamaschi, U.S. Geological Survey, 6000 J St, Sacramento CA 95819-6129; p 916.278.3000; f 916.278.3071; bbergama@usgs.gov Bryan Downing, bdowning@usgs.gov Michael Sauer, msauer@usgs.gov Peter Hernes, U.C. Davis, 1 Shields Ave, Davis CA 95616; Office 530.752.7827; Fax 530.752.5262; pjhernes@ucdavis.edu

Abstract: Aquatic habitat quality in the Delta is determined by interactions between nutrients, suspended sediment, water, and light. Together, these habitat attributes affect the food supply by controlling algal production and species distribution; affect the food web structure by influencing energy transfer and grazer community composition; and affect fish distributions by altering foraging behavior and predation. The variation in these attributes across the Delta is commonly observed as variations in, for example, chlorophyll, turbidity, and Secchi depth, which have been related to algal, zooplankton, and fish abundance. Our project examines these relationships in greater detail using a suite of new optical techniques that directly measure light transmission properties as well as algal and particle size and abundance. One purpose of the study is to identify the simplest optical water quality measurements that may best be used in a continuous real-time in-situ monitoring network of habitat quality.

We conducted profile measurements and collected samples at 25 stations from Suisun Bay to Cache Slough in conjunction with the 2011 Fall Mid-Water Trawl program; sampling at the same time and location as the fish collection activities. We found a large tidal dependency and large spatial variability for the parameters measured. For example, the chlorophyll concentration and median size of large suspended particles (including algae and flocs) increased upstream, in contrast to turbidity and salinity which showed the opposite trend. Distributions and interactions between measured parameters will be presented in combination with results of more traditional water quality measurements and from analysis of discrete water samples.

Statement of Relevance: The optical measurements will be used as part of an effort to establish relationships between readily-measured habitat quality indices and direct measurements of fish and community structure.

An experimental study of diuron and imazapyr herbicide effects on phytoplankton assemblages in the San Francisco Estuary

Sarah Blaser[1], Frances Wilkerson[1], and Alex Parker[1, 1]Romberg Tiburon Center for Environmental Studies, San Francisco State University, 3150 Paradise Drive, Tiburon, Ca 94920, (415) 338-3734, sarahblaser@gmail.com

Abstract: Herbicides may be used widely within estuarine watersheds and have the potential to negatively affect estuarine organisms living downstream of the site of their application. Diuron is one herbicide of concern in the northern San Francisco Estuary (SFE) because it is used extensively and persists for long periods in the

environment. Despite measured concentrations in the SFE, little is known about the potential impact of diuron on phytoplankton communities. A second herbicide in use in the SFE is imazapyr, which is applied to marsh habitat for control of invasive plants. Imazapyr is not currently monitored in the SFE. This study investigated the effects of additions of diuron and imazapyr on carbon assimilation, nitrogen uptake and community composition of natural phytoplankton assemblages collected in the SFE. Diuron reduced carbon assimilation at concentrations within the range of diuron concentrations previously reported for the northern SFE. Carbon assimilation was reduced during both acute (t=0hr) and chronic (t=48 hr) diuron exposure treatments. Imazapyr did not negatively affect carbon assimilation during acute exposure, but carbon assimilation decreased with the addition of imazapyr in chronic exposure experiments. Phytoplankton biomass and abundance decreased with increasing herbicide concentration, and the phytoplankton community composition shifted with added diuron and imazapyr. Centric diatoms as a percent of the phytoplankton community decreased while flagellates increased with the addition of diuron or imazapyr.

Statement of Relevance: It is important to understand the effect of pesticides on estuarine organisms and use that information to inform decisions about water quality issues in the San Francisco Estuary, as well as other systems.

***The Toxicity and Interactions Among Common Aquatic Contaminants in Binary Mixtures**

Krista Callinan, 530-752-1967 cfcallinan@ucdavis.edu , Linda Deanovic. 530-754-6772 ladeanovic@ucdavis.edu UC Davis School of Veterinary Medicine Anatomy, Physiology and Cell Biology, One Shields Avenue, Davis, CA 95616; Inge Werner, Eawag Überlandstrasse 133, 8600 Dübendorf, Switzerland +41 Office 58 765 5121 +41 Office 58 765 5863 Fax inge.werner@oekotoxzentrum.ch ; Stephanie Fong. Central Valley Regional Water Quality Control Board, 11020 Sun Center Drive, Suite 200 Rancho Cordova, CA 95670-6114 (916) 464-3291 (916) 464-4645 Fax swfong@waterboards.ca.gov ; Swee Teh,UC Davis School of Veterinary Medicine, Anatomy, Physiology and Cell Biology, One Shields Avenue, Davis, CA 95616, 530-574-8183 Office sjteh@ucdavis.edu

Abstract: Mixtures of pesticides and contaminants are ubiquitous in the aquatic environment, yet their toxic interactions are not well characterized. Toxic stressors can affect organisms directly and indirectly and compromise the health of species and communities. Pyrethroid pesticides are particularly important due to their high toxicity and environmental prevalence. In this study, multiple binary mixtures were tested for toxic effects and interactions on *Hyalella azteca*, including four pyrethroid pesticides in all binary combinations, as well as mixtures of the pyrethroid, bifenthrin, with chlorpyrifos, copper or ammonia. Five replicates of ten amphipods were exposed to variable concentrations of contaminants, both individually and in mixtures. Treatments included seven concentrations per chemical, individually, six equipotent mixture treatments and six non-equipotent mixture treatments. A four-by-four factorial design of mixture treatments was included across the midrange concentrations. Mortality, swimming behavior and growth were measured upon test termination after 10 days of exposure. Mortality data were analyzed for lethal concentrations using CETIS software and for mixture interactions using Generalized Linear Model statistics. Data were further compared against additive toxicity models, including the model of Concentration Addition (CA) and the model of Independent Action (IA). Statistical analyses and comparisons between experimental data and the predicted CA and IA models indicate that mixtures of the neurotoxic pesticides, bifenthrin, permethrin, cyfluthrin, lambda-cyhalothrin and chlorpyrifos follow the model of Concentration Addition, while mixtures of bifenthrin with either copper or ammonia follow Independent Action or result in less than additive toxicity. With the exception of ammonia, all chemicals affected swimming performance and growth in a concentration-responsive manner and the binary mixtures of all chemicals were additive by the model of Concentration Addition on both sublethal endpoints.

Statement of Relevance: Mixture interactions must be characterized to accurately evaluate the environmental risk of aquatic contaminants. As illustrated, contaminant mixtures may not interact as their biochemical

mechanisms would predict, therefore empirical analyses are necessary. Results from this study will inform water quality regulations for the protection of aquatic ecosystems and communities.

****2D Hydrodynamic Modeling in the Yolo Bypass to Support Habitat Evaluation**

Chris Campbell, April Sawyer, and Chris Bowles (cbec, inc.)

Abstract: The Yolo Bypass is a major seasonal floodplain in the Central Valley and the Delta that provides rearing habitat and serves as a migratory pathway for juvenile Chinook salmon and splittail. In support of the Central Valley Flood Protection Plan (CVFPP) Restoration Opportunity Assessment (ROA), two-dimensional (2D) hydrodynamic modeling was performed using MIKE 21 FM to predict seasonal inundation patterns in the Yolo Bypass under a range of flows to understand habitat conditions for juvenile Chinook salmon and splittail. Prior habitat use studies in the Yolo Bypass (e.g., Sommer et. al., 2005) have shown the importance of sustained inundation in the Yolo Bypass, resulting in increased fish residence time. However, the hydrology of the Yolo Bypass is complex with inundation possible from multiple sources with varying degrees of alteration and timing. As such, the aim of this analysis is to investigate habitat evaluation criteria in the Yolo Bypass under a range of flow conditions and in years when spatial and temporal trends in juvenile Chinook salmon use were monitored. Historical hydrology for two high performing years and two low performing years for juvenile Chinook salmon and splittail were simulated and used to test and/or improve existing habitat evaluation criteria and identify differences in high and low performing years.

Fisheries enhancement in the Yolo Bypass is a key component of the BDCP with the goal to improve passage, reduce stranding, and increase floodplain rearing and spawning habitat while maintaining flood control and agricultural functions. Through better understanding of baseline conditions, this study will help inform fisheries enhancement measures.

***** CALVIN Groundwater Update***

Heidi Chou, Prudentia Zinkalala, Christina Buck, Jay R. Lund, Josué Medellín-Azuara (UC Davis)

Abstract: Updates are being made to the CALVIN hydro-economic optimization model of California's intertied water supply and delivery system. These updates better reflect water demands, groundwater availability, and local water management opportunities. This poster will focus on updates to groundwater in CALVIN, which includes changing CALVIN groundwater parameters based on California Department of Water Resources' (DWR) California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) and the United States Geological Survey (USGS) Central Valley Hydrologic Model (CVHM) model inputs and results. Two projects, using the respective groundwater models by DWR or USGS model as a base, are underway to update CALVIN's groundwater representation, specifically basin inflows, reuse, return flows, capacities, and costs. When these sub-projects are completed and analyzed, a CALVIN model with updated groundwater representation based on C2VSIM and CVHM will emerge. For this poster, a preliminary comparison of these sub-projects and a summary comparison between the DWR and USGS models will be presented and discussed.

Nutrient Fluxes from San Francisco Bay Delta Sediments

Jeff Cornwell, Mike Owens, Pat Glibert, Jeff Alexander, University of Maryland Center for Environmental Science, Horn Point Laboratory, PO Box 775, Cambridge MD 21613, cornwell@umces.edu, glibert.umces.edu 410-221-8422

Abstract: Rates of N and P fluxes from the sediment were determined in September 2011, along a transect of 12 sites, from the flooded islands in the Bay Delta to Suisun Bay. Comparisons of NH_4^+ fluxes in the light and dark

showed that fluxes were generally lower in the light than in the dark, reflecting the uptake of N via photosynthesis, with N derived either from interception of DIN effluxes driven by pore water gradients, or by net uptake from the water column. At Sherman Island, there was a net flux of NO3+NO2 out of the sediment in the light; this suggests enhanced nitrification under illumination. With the exception of Mildred Island, all sites exhibited a net flux of N2 out of the sediment in the dark, indicating denitrification. At Mildred, net fluxes were directed into the sediment in the dark, indicating N2 fixation. In relation to the inorganic N flux rates for these sites, approximately 30% of the N was denitrified. Flux rates of SRP were highly variable from site to site. Flux rates in the dark at the two Honker Bay sites, as well as at Franks Tract, Big Break and Sherman Island were negative, likely reflecting adsorption of water column SRP to iron oxides. Fluxes of SRP were higher under illumination than in the dark. It is suggested that high rates of sediment biological activity may have resulted in localized pH changes which resulted in SRP efflux in excess of biological demand. When SRP fluxes were compared to total DIN fluxes for all sites, most of the data approximated Redfield proportions. However, three Bay sites had significant P retention relative to DIN, while all the Delta sites from the light experiments had excess P release relative to N.

Statement of Relevance: Years of nutrient loading may result in large sediment reservoirs of nutrients, particularly phosphorus, for a considerable time after the rate of loading is reduced. Altered sediment biogeochemical pathways serve to provide a mechanism whereby nutrient dynamics supporting trophodynamics are changed.

***Sacramento River Chinook: Viability in the Face of Environmental Variability**

Curry Cunningham[1], Ray Hilborn[2], Noble Hendrix[3], Robert Lessard[4]; 1) School of Aquatic and Fishery Sciences, University of Washington. curryc2@uw.edu 907-360-4217 Fax: 206-685-7471, University of Washington, School of Aquatic & Fishery Sciences, Box 355020. Seattle, WA 98195-5020; 2) School of Aquatic and Fishery Sciences, University of Washington. rayh@u.washington.edu 206-543-3587 Fax: 206-685-7471, University of Washington, School of Aquatic & Fishery Sciences, Box 355020. Seattle, WA 98195-5020; 3) R2 Resource Consultants, Inc.; Affiliate Faculty at University of Washington, nhendrix@r2usa.com 425-556-1288 Fax: 425-556-1290, 15250 NE 95th Street. Redmond, WA 98052; 4) Columbia River Inter-Tribal Fish Commission lesr@critfc.org 503-238-0667 Fax: 503-235-4228, 729 Northeast Oregon Street, Portland, OR 97232

Abstract: Chinook salmon (*Oncorhynchus tshawytscha*) populations spawning in the Sacramento River (CA) and its tributaries have demonstrated high variability, and in some cases significant declines in spawning abundance, during the past 40 years despite restrictions to commercial and recreational fishing activities. Concern over the sustainability of Sacramento River Chinook (SRC) populations has lead to their listing under the Endangered Species Act (Winter-run, "endangered", 1994) and a desire to determine which environmental factors are directly influencing their survival in freshwater and marine environments. Environmental factors under investigation may be broadly categorized as: 1) the result of natural changes in marine productivity, or 2) arising from anthropogenic influences in the system including changes to water flow and temperature, access to rearing habitat, routing of fish passage and water exports or diversions of alternative uses. We are in the process of developing stage-structured population dynamics models that will permit hypotheses to be tested regarding the impact of environmental factors on productivity and capacity in various life-stages, the influence of hatchery production to the system, and competition amongst co-migrating and co-rearing natural and hatchery-produced groups. We have developed population-specific models for winter and spring-run and are currently developing a larger model that includes co-occurring populations of the previous two runs in addition to fall-run.

Statement of Relevance: The purpose of this research is to provide a quantitative framework for assessing the influence of both environmental and anthropogenic factors on the survival of threatened and endanger Chinook salmon populations in the Sacramento River, California, and a means for estimating future changes in abundance under alternative ecological and water use policy scenarios.

Survival, Behavior and Feeding of Juvenile Delta Smelt (*H. transpacificus*) Under Varied Turbidity Conditions

Linda Deanovic, Dan Markiewicz, Marie Stillway, and Alireza Javidmehr, UC Davis School of Veterinary Medicine, Anatomy, Physiology and Cell Biology, One Shields Avenue, Davis, CA 95616 (530) 754-6772 Office (530) 752-0585 Fax ladeanovic@ucdavis.edu . dmarkie@ucdavis.edu , mstillway@ucdavis.edu , ajavid@ucdavis.edu , Inge Werner, Eawag Uberlandstasse 133, 8600 Dubendorf, Switzerland, +41 Office 58 765 5121 Office, +41 Office 58 765 5863 Fax inge.werner@oekotoxzentrum.ch and Swee Teh, UC Davis School of Veterinary Medicine Anatomy, Physiology and Cell Biology, One Shields Avenue, Davis, CA 95616 (530) 754-8183 Office (530) 752-7690 Fax sjteh@ucdavis.edu

Abstract: Although scientists recognize that juvenile delta smelt do not need turbid environments to see their food, turbid waters may provide juveniles with more cover from predation and increase success of feeding. This study evaluated whether variable turbidity affected their swimming behavior or influenced the quantity of food the organisms ingested. Delta smelt juveniles aged 140 days post-hatch (8 replicate 7-L aquaria; 6 smelt per replicate) were exposed over 96 hours to three levels of turbidity (3, 6 and 9 NTU) of two different turbidity types: an algal greening agent and potting soil extract. Four replicates were used to assess swimming behavior, and the second set of four replicates was used to assess turbidity effects on feeding ability. Replicates designated for swimming behavior endpoints were placed in swimming chambers for two minutes of video capture, and their distance moved and swimming velocity were analyzed using behavioral software. Replicates designated for the feeding endpoint (number of *Artemia*/gut) were starved for 23 hours, fed *Artemia* nauplii at a density of 0.26 nauplii/ml for 10 minutes, euthanized, and then subjected to gut content enumeration. All fish survived in every treatment. No significant differences were found in swimming behavior or gut contents among all variations of turbidity. Food was completely absent from the gut in 29% of all test regimes regardless of turbidity levels and types, indicating the possible presence of a stressed condition unrelated to turbidity. Small variations in lighting and adjacency to human activity were analyzed as possible explanations for vacant guts. No statistical differences were observed related to positional effects. These findings lead to the conclusion that variation in turbidity in the 3 - 9 NTU range between green and brown sources of turbidity does not seriously affect the survival, swimming behavior or feeding of juvenile delta smelt.

Statement of Relevance: Identifying feeding and swimming responses of delta smelt juveniles to variation in degree and type of turbidity produces practical information regarding the smelt's responses to changes in environmental conditions and informs management decisions.

The North Delta: Refugia for Native Fishes in the Upper San Francisco Estuary

Denise De Carion, Department of Environmental Science & Policy, UC Davis, One Shields Avenue, Davis, CA 95616, dpdecarion@ucdavis.edu, Brian Schreier, Louise Conrad, Aquatic Ecology Section, California Department of Water Resources, 3500 Industrial Blvd., West Sacramento, CA 95691; and Andy Sih, Department of Environmental Science & Policy, UC Davis, One Shields Avenue, Davis, CA 95616

Abstract: Biological communities within the upper San Francisco Estuary have drastically changed over the last decade, wherein pelagic species have declined and nearshore species have proliferated. Because biological invasions are one potential driver of change in the system, we set forth to systematically document the distribution and abundance of invasive fishes and macrophytes throughout the Sacramento-San Joaquin Delta. We conducted surveys throughout the Delta from 2008-2010, and then focused primarily on surveying the North Delta (Lindsey and Cache Sloughs, Liberty Island, and the Deepwater Ship Channel) from March to June 2011. We evaluated the relationship between community composition and environmental variables using constrained ordination techniques, and conducted spatial analyses of fish assemblages using Geographic Information Systems mapping software. Our findings indicate that the North Delta supports a unique and diverse community of fish taxa, including delta smelt and juvenile Chinook salmon, and therefore may serve as an important refugial habitat for native fishes.

Statement of Relevance: The San Francisco Estuary is a highly altered system inhabited by numerous successful invasive species. Our study demonstrates the importance of the North Delta for maintaining biodiversity, and highlights the utility of further ecological studies in the region for application elsewhere.

Temperature as a driver of cyanobacteria blooms in the San Francisco Estuary Delta: evidence from experimental enclosures

Melissa DuBose, Allison Johnson, Alexander E. Parker, Frances P. Wilkerson, Presenting author: M. DuBose, Corresponding author: A.E. Parker, Romberg Tiburon Center, San Francisco State University, 3150 Paradise Drive, Tiburon CA 94920, USA. 415-338-3746(T) 415.435.7120(f) aeparker@sfsu.edu

Abstract: Blooms of toxic cyanobacteria (cyanoHABs), including the colonial *Microcystis aeruginosa*, have become a regular feature of the summer ecology of the San Francisco Delta since the late 1990s. CyanoHAB appearance in the Delta occurred at the same time as other changes to the ecosystem, including declines in some phytoplankton taxa and reductions at higher trophic levels, including threatened and endangered fish. At present it is unclear what environmental triggers have allowed cyanoHABs to proliferate in the estuary although changes in nutrients, improved water clarity, water residence time and increased water temperature all may be important. A series of 20-L enclosure experiments were conducted during the summer 2011, using water collected at sites within the Delta, with the goal of understanding how temperature (18^{o}C versus 23^{o}C) influences phytoplankton dynamics. Enclosures were monitored for 96-hr for chlorophyll-a, dissolved inorganic carbon (DIC) and nutrients, as well as phytoplankton community composition (for cells >20-µm). Unlike previous years, *Aphanizomenon* and *not M. aeruginosa* was the dominant cyanoHAB in Delta waters. Chlorophyll-a increased in all experimental treatments, but accumulated more quickly at 23^{o}C compared to 18^{o}C. DIC drawdown, indicating primary production, was also greater in enclosures held at 23^{o}C. After 96-hr, diatoms were numerically dominant at 18^{o}C while cyanoHABs were numerically dominant at 23^{o}C. Among the cyanoHABs counted, *Aphanizomenon* was consistently dominant at 18^{o}C, while *M. aeruginosa* dominated at 23^{o}C. Similar experiments were conducted to test the effect of light on phytoplankton, including cyanoHABs, and showed no clear relationships. These results suggest a link between the proliferation of cyanoHABs and Delta water temperatures, and provide clues about how temperature may influence the type of cyanoHAB present in the Delta in the future.

Statement of Relevance: The persistence of summer cyanoHAB blooms in the Sacramento – San Joaquin Delta represent an ecosystem level change in the environment. CyanoHABs have the potential to affect water resources, via production of cyanotoxins harmful to human health, altered foodweb structure, and altered aesthetics.

Delta and Longfin Smelt Bioenergetics: Determining Maximum Consumption

Kai J. Eder[1], Robert C. Kaufman[2], Nann A. Fangue[2], and Frank J. Loge[1, 1]University of California, Davis, Dept. of Civil and Environmental Engineering, 2001 Ghausi Hall, Davis, California 95616. [2]University of California, Davis, Wildlife, Fish and Conservation Biology, 1088 Academic Surge, Davis, California 95616′ Office: (530) 754 6411; Cell: (530) 574 8921 Fax: (530) 752 7872 kjeder@ucdavis.edu

Abstract: Delta and Longfin smelt abundance in the San Francisco Estuary has declined dramatically since the 1980s. Individual-based population life-cycle models (IBMs) were developed for both species to explore the population response to various environmental and management scenarios. However, key data gaps exist for the bioenergetics (growth) components of both IBMs, necessitating laboratory studies to determine the quantity of food consumed by delta and Longfin smelt. The objectives of the first part of this study were to create rearing conditions required to study the temperature-dependent food consumption by various life stages of smelt, and to develop a methodology to estimate the daily food consumption. An aquaculture facility, consisting of three independent recirculating systems with four tanks each, was constructed and tested. Cultured juvenile and adult

delta smelt were used to develop methods to assess diel feeding patterns and gastric evacuation times and rates. Adult and juvenile delta smelt were successfully maintained in the new aquaculture facility. Three experimental groups of adult fish were held simultaneously at water temperatures of 9, 13 and 17°C. Stomach contents from juvenile and adult delta smelt were successfully retrieved by dissection. Both smelt life stages fed actively during multiple feeding events throughout the day, but no consumption occurred during nighttime hours. Gastric evacuation of juvenile and adult delta smelt after satiation feeding was completed after approximately 21 and 28 hours, respectively, and an exponential model was the best fit to describe gastric evacuation over time. Application of a feeding model indicated that daily consumption by adult delta smelt at a water temperature of 10°C averages approximately 1% of the fish wet weight. Methods presented here will facilitate the establishment of temperature and size dependent consumption components of bioenergetics models for both species.

Statement of Relevance: This project is directly related to the IEP goals to investigate and evaluate the causes of the Pelagic Organism Decline (POD). This study was funded by the Bureau of Reclamation, with one of the deliverables being the presentation of findings at the IEP annual workshop.

Advancements in Delta Smelt Acoustic Tagging

Kai J. Eder[1], Tien-Chieh Hung[2], Donald E. Thompson[1], Raul H. Piedrahita[2], and Frank J. Loge[1]
[1]University of California, Davis, Dept. of Civil and Environmental Engineering, 2001 Ghausi Hall, Davis, California 95616. [2]University of California, Davis, Dept. of Biological and Agricultural Engineering, 2030 Bainer Hall, Davis, California 95616, Office: (530) 754 6411; Cell: (530) 574-8921, Fax: (530) 752 7872 kjeder@ucdavis.edu

Abstract: Delta smelt, previously one of the most common resident pelagic fish in the San Francisco Estuary, have dramatically declined in abundance since the 1980s. In order to develop sound management and restoration strategies, critical data gaps concerning delta smelt life history, habitat requirements, and exposure to key environmental stressors need to be addressed. Detailed resolution of fish movement and activity over spatial and temporal scales can be achieved by acoustic telemetry. The aim of this study was to assess the feasibility of tagging adult delta smelt to advance the long-term goal of establishing an estuary-wide smelt acoustic telemetry system. Cultured adult delta smelt (age-1 and age-2) were injected with a low viscosity polyurethane resin in order to determine the volume and shape of the peritoneal cavity. Dimensions of adult delta smelt peritoneal cavities permitted the use of the smallest currently available acoustic transmitter as a prototype for production of dummy tags along a gradient of sizes and weights. Three differently sized transmitters and PIT (Passive Integrated Transponder) tags were surgically implanted into age-1 and age-2 delta smelt to evaluate survival, tag retention, and wound closure over 28 days. Handling and anesthesia did not affect the survival of delta smelt during the study period. Cumulative mortality of all fish implanted with tags was significantly higher than that of the untreated control group, and survival was a function of tag size/weight. However, survival in the PIT-tagged group approached 75% over the 28-day period, emphasizing the potential use of a small, injectable acoustic transmitter – currently under development by the US Army Corps of Engineers - for delta smelt field studies as early as 2014.

Statement of Relevance: This project is directly related to the IEP goals to investigate and evaluate the causes of the Pelagic Organism Decline (POD). This study was funded by the Bureau of Reclamation, with one of the deliverables being the presentation of findings at the IEP annual workshop.

The Effect the Pyrethroid Pesticide, Bifenthrin, on reproductive endpoints of steelhead (*Oncorhynchus mykiss*)

Kristy L. Forsgren, Neeti Riar, and Daniel Schlenk. University of California, Riverside. Department of Environmental Sciences, 2258 Geology, Riverside CA 92521, Office: 562-773-8378, Fax: 951-827-3993, klforsgren@gmail.com

Abstract: The Bay-Delta is an important breeding ground and nursery for many species. Habitat quality and contamination of surface waters and sediments are limiting factors for ESA-listed fish stocks in watersheds with significant land use. Bifenthrin, a 4th generation pyrethroid, has received little attention regarding its effects on

salmonid populations despite being detected in northern California runoff. While the potential for aquatic toxicity is evident, it is unknown what effect bifenthrin exposure has on the reproductive health of fishes. Plasma sex steroids and gonadosomatic index (GSI) were determined in juvenile steelhead exposed to bifenthrin (low: 0.028 ± 0.006 µg/L; high: 0.719 ± 0.073 µg/L) for 14 days. Additionally, gonadal tissue was examined histologically. Females exposed to bifenthrin (high dose) had significantly (P = 0.0251) elevated estradiol-17β (E2) levels. There was no difference intestosterone (T; P=0.1430), 11---ketotestosterone (11---KT; P = 0.0760) or GSI (P = 0.1937). Although ovarian follicle diameter significantly (P<0.0001) increased in bifenthrin---treated fish, widespread atresia was observed throughout the ovary with 91.24 ± 8.89% total atresia after low dose treatment and 82.76 ± 10.84% after the high dose treatment. In male steelhead, sex steroids were not significantly altered (E2 P = 0.0634, T P = 0.0833, 11---KT P=0.3057) after treatment. Although GSI was reduced (P= 0.0231), the testis did not show measurable histological damage. These data indicate potential effects to developing female steelhead. The ecological implications are uncertain, but further study is warranted given the prevalence of pyrethroids in urban runoff, which impacts salmonid habitat.

Statement of Relevance: As a result of urbanization, salmonids migrate waterways that pass through dense urban environments. This research is aimed at understanding the impact of bifenthrin exposure on the reproductive health of salmonids, which will be imperative for improving risk assessment of pesticide use in the Bay-Delta in coming years.

* Use of Two Dimensional Hydraulic and Sediment Transport Modeling in Design of Salmonid Rearing Habitat in the Sacramento River Floodplain

Paul Frank and Mark Tompkins (Newfields Ecosystem Science, Engineering, and Design)

Abstract: Impacts associated with construction of a pump station to replace the Red Bluff Diversion Dam on the Sacramento River will be mitigated through construction of a three-quarter mile long, 23 acre perennial, off-channel open water and riparian wetland habitat in East Sand Slough, an off-channel area immediately adjacent to the Sacramento River. Since the 1960s, East Sand Slough has been inundated annually by backwater from Red Bluff Diversion Dam. The new off-channel habitat area will be connected to the main stem Sacramento River at low flow in three locations. The design for the habitat contains open water, riverine wetlands, and riparian shrub scrub environments intended to support habitat for rearing fish and establish native vegetation communities adapted to the site conditions. The design analyses required an understanding of the complex hydraulic and sediment flow patterns at both these connection sites and in the newly constructed channel to understand habitat conditions and avoid maintenance problems due to erosion or sedimentation that could threaten the long-term viability of the constructed habitat. We used the hydrodynamic and sediment transport modules of the Bureau of Reclamation's SRH2D model to simulate a range of flow events in the proposed design configuration. We were able to validate the hydraulic and sediment transport predictions of the model by comparing existing conditions model results with sediment transport data collected during an approximately 5-year flow event, which occurred on Sacramento River towards the end of the design process (approximately 95,000 cfs in March 2011).

* Development of a Modeling Framework for Assessing Flood Management Performance and Floodplain Habitat Creation in the South Delta

Paul Frank, Mark Tompkins, and Jeremy Thomas (Newfields Ecosystem Science, Engineering, and Design)

Abstract: River-floodplain connectivity is increasingly being recognized as critically important for the survival of native fish species in the San Francisco Bay Delta and for reducing flood risk throughout the Bay-Delta and Central Valley systems. Levee setbacks, bypasses, and off-stream flood storage and attenuation are often proposed as actions that would expand the floodplain habitat and reduce downstream flood risk. However, the complex

network of channels, islands, bridges, and other infrastructure in the Delta makes it difficult to quantitatively assess the improvements proposed actions would actually make.

We present a modeling framework developed with publicly available tools from the USACE Hydraulic Engineering Center (HEC) that is currently being used by multiple stakeholders to simultaneously and quantitatively evaluate the flood attenuation and ecosystem restoration benefit of levee setbacks and bypass channels in the South Delta. Unlike most previous studies, these efforts assign equal weight to flood and ecosystem benefits. Results of these modeling efforts have shown significant improvements in both floodplain habitat and flood management performance in the South Delta, and are informing ongoing planning efforts in the Delta including the Bay Delta Conservation Plan (BDCP).

The California Delta: A World-Class Bass Fishery - Adult Largemouth Size and Growth Distribution in the Sacramento-San Joaquin Delta

Jared Frantzich, and Naoaki Ikemiyagi – Environmental Scientists, California Department of Water Resources, Division of Environmental Services, Aquatic Ecology Section jfrantzi@water.ca.gov (916) 376-9823

Abstract: The Sacramento-San Joaquin Delta has become a largemouth bass (*Micropterus sp.*) angler's dream fishery over the past several decades. Its notoriety for producing largemouth in excess of 10 lbs. has gained national attention and prompted a dramatic increase in largemouth bass tournament activity in the Delta. Tournament reports to the California Department of Fish and Game show a notable increase in average size of trophy largemouth bass. To investigate whether the relatively large body sizes of largemouth bass in the Delta may be due to increased growth rates and/or longevity, we collected 75 scales from adult largemouth bass weighed in at the 2011 Yamamoto Big Bass Challenge to determine age and growth rate. The length-at-age data was further compared with data from largemouth bass collected in electro-shocking surveys in Florida, northern Illinois, South Carolina, and Alabama. We used length-at-age data from these states to compare California Delta largemouth with Northern, Florida and hybrid largemouth populations. Results indicate that largemouth bass weighed in at the Big Bass Challenge were all more than 5 years old and more than half were 7 years old. Length-at-age data show that these fish continued to grow after age 4 at a faster rate when compared to largemouth bass of the same age from our comparison populations. For future work we have recently collected otoliths and scales from adult largemouth bass in the same age-class to validate our aging analysis. Continued assessment of ages and growth rates will be necessary to fully understand how the ages, growth rates and size distributions of largemouth bass in the Delta compare with other populations.

Statement of Relevance: The increased abundance and success of largemouth bass in the Sacramento-San Joaquin Delta, represents an overall shift in the littoral fish assemblages. The analysis of largemouth bass age and growth provides insight into many questions about population production, fish health, prey availability, and how current fisheries management strategies affect population numbers.

The Biomass of Invasive Bivalves in the Low Salinity Zone in August 2011

Heather Fuller, California Department of Water Resources, 3500 Industrial Blvd, West Sacramento CA, 95691 916-376-9821 Office 916-376-9688 Fax hlfuller@water.ca.gov, Karen Gehrts, kagehrts@water.ca.gov, Dan Riordan driordan@water.ca.gov and Jan Thompson, U.S. Geological Survey, 345 Middlefield Rd. MS-496, Menlo Park, CA 94025 (650)329-4364 Office (650)329-4327 Fax jthompso@usgs.gov

Abstract: We conducted a scaled down version of the General Randomized Tessellation Stratified (GRTS) benthic special study to sample bivalves in the low salinity zone (LSZ) of the San Francisco estuary in August of 2011. The purpose of the study was to determine the effects of the high flow events during the spring of 2011 on populations of the invasive bivalves *Corbula amurensis* (*Corbula*) and *Corbicula fluminea* (*Corbicula*) in the LSZ

immediately prior to the fall months. We collected benthic grabs at 141 sites in the upper estuary in mid August 2011. All *Corbula* and *Corbicula* were removed from the samples and measured and preserved. At seven sites we collected an extra grab from which live clams were measured then dried and ashed to determine biomass. Shell length and biomass data from the live sorted clams were used to generate regression equations for converting size classes of preserved clams to biomass. Biomass data for the August sampling event were compared to data from previous GRTS sampling events in May and October of 2009-2011.

Corbula biomass was significantly lower in upper Grizzly and Suisun Bays as well as Montezuma Slough in August 2011 compared to previous GRTS sampling events that occurred in the drier years of 2009 and 2010. *Corbula* biomass at the confluence was significantly lower in August 2011 than in May 2009. There were no significant differences in *Corbula* biomass in lower Grizzly and Suisun Bays. *Corbicula* biomass was not significantly different between sampling events; however, *Corbicula* ranged much farther west in August 2011 compared to previous GRTS sampling events.

Analyses investigating the specific mechanisms that may influence *Corbula* and *Corbicula's* distribution and biomass in wet versus dry years are in progress. Bivalve biomass data from GRTS sampling that occurred in 2007 and 2008 will be available soon, and GRTS monitoring is expected to continue in 2012.

Statement of Relevance: Numerous studies have indicated that primary production lost to invasive bivalve grazing is a key factor limiting productivity in the estuary. Changes in flow patterns due to variability in natural runoff or water management operations alter the distribution and biomass of invasive bivalves and consequently their effects on the food web.

Study on the effect of xenobiotics by using multiple biomarkers on Delta smelt (*Hypomesus transpacificus*)

Gandhi, KrithikaSai, Teh, Swee, Aquatic Health Program, UC Davis, 1 Shields Ave, Davis, CA 95616; Saikrithi@gmail.com, sjteh@ucdavis.edu, (530) 752-1967, Swee Teh: (530) 754-8183

Abstract: The effect of xenobiotics on delta smelt, *Hypomesus transpacificus* in the San Francisco Estuary (SFE) was investigated by using biochemical and histopathologic biomarkers. Acetylcholinesterase (AChE) and Sodium-Potassium-Adenosine Triphosphatase (Na^+K^+ATPase) can be used as biomarker of exposure to metal, organophosphate (OP), and carbamate pesticides contaminants in aquatic biota. These enzymes when combined with histopathology have the potential to serve as a biomarker of toxic stress and to serve as sensitive parameters for testing exposure of organisms to toxicants. At this stage of our study the results obtained showed significant depression in AChE and Na^+K^+ ATPase activity mainly in the fish collected from some sites in Suisan Bay and Honker Bay, indicating the presence of contaminants like OP pesticides and metals in these locations. These results will serve as baseline information to study the health status of delta smelt. Hence further study using other biomarkers such as Glutathione-S-transferase (GST), Ethoxyresorufin-O-deethylase (EROD), Catalase, which could give a better view on the presence of other contaminants in the delta and those affecting the fish health, will be discussed.

Statement of Relevance: This data will be used to help us understand the relative importance of different toxic contaminants that affecting the fish health in the SFE.

Elevated ammonium concentrations inhibit total nitrogen uptake and growth, not just nitrate uptake

Pat Glibert, Jeff Alexander, University of Maryland Center for Environmental Science, Horn Point Laboratory, PO Box 775, Cambridge MD 21613, 410-221-8422, glibert@hpl.umces.edu, Dick Dugdale, Frances Wilkerson, Alex Parker, Romberg Tiburon Center for Environmental Studies, San Francisco State University, 3152 Paradise Drive, Tiburon, CA 94920

Abstract: It has been hypothesized that elevated concentrations of ammonium in the water column depress or inhibit the uptake of nitrate and ultimately primary production. Here, this hypothesis was addressed in a series of experiments in which ammonium and nitrate were manipulated and uptake rates measured using ^{15}N labeled substrates. These experiments confirm that 1) nitrate uptake is inhibited by ammonium and the degree of inhibition increases with ammonium concentration; 2) the decrease in nitrate uptake is not compensated for by increases in ammonium uptake resulting in depression in total nitrogen uptake; 3) the depression in nitrate uptake with ammonium enrichment is not a function of altered cellular stoichiometry, i.e., it is not a consequence of driving the cells into P stress; and 4) biomass accumulation (growth) is depressed when total nitrogen uptake is inhibited.

Statement of Relevance: Ammonium loads are a major stressor of the Bay Delta. Changes in both productivity (rates of growth) and phytoplankton composition due to changing nutrients are thought to be major determinants of the amount and "quality" (i.e., species composition) of the higher food web in the Bay Delta.

***A Framework for Developing Stream Flow and Thermal Regimes for Multiple Salmonid Species in the Central Valley**

Li-Ming (Lee) He. National Marine Fisheries Service, Southwest Region, Central Valley Office, 650 Capitol Mall, Suite 5-100, Sacramento, CA 95814 916-930-5615 Fax: 916-930-3629 liming.he@noaa.gov

Abstract: Stream flow and temperature are critical factors in the conservation, protection, and recovery of endangered or threatened anadromous fish species in the Central Valley. These factors are interrelated as temperature is often controlled by stream flow, particularly in rivers regulated by reservoirs. Flow is a major determinant of physical habitat and transport. We use the flow regime concept for developing instream flows for anadromous fish. The concept recognizes that biologically important flows include not only flow magnitude, but also frequency, timing, duration, and rate of change of flows. Seasonal, interannual, and spatial variability, to which anadromous fish are adapted, are as important as quantity. The flow regime approach also considers flows required for maintaining or improving important ecosystem functions, for example, migration cues, habitat connectivity and diversity, stream channel morphology and geometry, and stream temperature. Water temperature influences growth and feeding rates, metabolism, development of embryos and alevins, timing of life history events, and the availability of food. For protecting and recovering vulnerable populations (e.g., endangered or threatened), we use optimal water temperatures for each of their life stages. These optimal temperatures serve as the base of setting water temperature criteria for the listed species. Water temperature data from monitoring stations are analyzed and compared with temperature criteria. Using statistical or process-based models, we estimate how much water would be required to meet the established temperature requirements. Using developed models and weather forecast, we are able to provide advice for real-time water operations to maintain adequate stream temperatures for anadromous fish. Flows for sustaining optimal water temperatures are particularly important in warm seasons when flow is low and air temperature is high. The final environmental flows are the integration of instream flows derived from the flow regime approach with temperature sustaining flows. In addition, an adaptive management strategy for implementing the recommended flows and assessing the performance of the implementation must be developed to ensure success.

Statement of Relevance: Fish need appropriate water and temperature to grow and reproduce. Water projects and diversions developed in the Central Valley in the past decades have adversely altered stream flow and water temperature for native anadromous fish species. We present here a systematic approach to addressing both flow and water temperature requirements for listed anadromous salmonid species in order to conserve, protect, and recover them.

***The Growth and Development of Copepods in the Food Limited San Francisco Estuary**

Toni Ignoffo[1], Alison Gould[2], Anne Slaughter[1]and Wim Kimmerer[1] [1]Romberg Tiburon Center for Environmental Studies, San Francisco State University, 3152 Paradise Drive, Tiburon CA 94920 USA, tignoffo@sfsu.edu [2]University of Michigan, 830 North University, Ann Arbor, MI 48109 USA

Abstract: Historically, the San Francisco Estuary (SFE) was characterized by low primary productivity resulting from a highly turbid system. In recent years phytoplankton biomass has declined as the result of grazing by an introduced clam and other anthropogenic influences. Coincident with the decline in productivity we observed declines in several species of calanoid copepods. These changes may have facilitated the introduction of the cyclopoid copepod *Limnoithona tetraspina,* which became the most abundant copepod. To investigate the potential impact of phytoplankton declines on copepods we measured the growth of the dominant copepods in the SFE. In spring-summer of 2006 and 2007 we measured *in situ* growth of the calanoid copepods *Eurytemora affinis, Pseudodiaptomus forbesi*, and *Acartiella sinensis* and the cyclopoid copepod *L. tetraspina.* Growth rates were determined through incubation experiments and measured as changes in carbon biomass or development (=molting). All three species of calanoid copepods had growth rates of less than 0.1 day^{-1}, much lower than their potential growth rates of about 0.3 day^{-1} under food saturated conditions. *L. tetraspina* had lower growth rates (0.03 day^{-1}) than all of the calanoid species. The decrease in the abundance of calanoid copepods may be due to food limitation, competition for food with *Limnoithona tetraspina*, and consumption of nauplii by the introduced clam. Despite their low growth rates, *L. tetraspina* remains highly abundant, suggesting low mortality.

Statement of Relevance: By determining how copepod production responds to changes in primary production we hope to acquire a better understanding of fluctuations in available carbon flowing to higher trophic levels, specifically fish.

Integrated Regional Water Management Economic Assessments

R. Juricich, California Department of Water Resource

Abstract: DWR's Economic Analysis Section provides high quality, timely, cost-effective responses to DWR's internal economic analysis needs.

Statewide Water Analysis Network (SWAN)

Rich Juricich (California Department of Water Resources)

Abstract: SWAN serves as the technical advisory group for the California Water Plan to assist DWR with applying collaborative methods to facilitate consensus in the development of existing and new analytical tools and technologies.

Water Plan Update 2013

Rich Juricich (California Department of Water Resources)

Abstract: A summary of the major enhancements underway for Update 2013 of the California Water Plan.

Water Planning Information Exchange

R. Juricich, California Department of Water Resources

Abstract: A federated system for sharing water resources information, which allows data managers to maintain control of their data and serve it to the public through a central web portal.

Water Sustainability Indicators Framework

R. Juricich, California Department of Water Resources

Abstract: Describes a framework underdevelopment by DWR and its partners to help monitor the progress to meeting water sustainability objectives.

An Analysis of Copepod Feeding Using FlowCAM

Karen Kayfetz[1] and Wim Kimmerer[2], Romberg Tiburon Center, San Francisco State University, 3150 Paradise Drive, Tiburon, CA 94920 [1] kkayfetz@mail.sfsu.edu (510) 316-5397 [2] kimmerer@sfsu.edu (415) 338-3515

Abstract: Little is known about the feeding of *Pseudodiaptomus forbesi* and *Limnoithona tetraspina,* the two copepod species that dominate the zooplankton in the Upper San Francisco Estuary during summer. This study aimed to identify the types of prey that these copepod species consume and quantify their feeding rate, in particular to see if they compete for the same prey in the estuary. Copepods were collected from the Upper San Francisco Estuary and incubated for 24 hours in surface water from the collection site, which contains their natural prey. Diatoms and flagellates from incubation bottles with and without copepods were counted using a FlowCAM imaging particle analyzer and clearance rates were calculated. *P. forbesi* cleared diatoms >15µm at about 30-45 mL day^{-1} copepod^{-1} and flagellates >15µm at about 20-30 mL day^{-1} copepod^{-1}. *L. tetraspina* had apparently negative clearance rates on diatoms and flagellates, probably because of a trophic cascade caused by *L. tetraspina* consuming ciliates that feed on smaller plankton. This study indicates that *P. forbesi* consumes a variety of prey types which do not all overlap with the prey consumed by *L. tetraspina*.

Statement of relevance*:* *Pseudodiaptomus forbesi* and *Limnoithona tetraspina* may be important food sources for several fish species in the Upper San Francisco Estuary. Therefore understanding the feeding ecology of these species could have implications for higher trophic levels.

***Factors Influencing Delta Smelt Take During Chinook Salmon Monitoring Near Chipps Island Within the San Francisco Estuary**

Kirsch, J.E., L.M. Smith, G. Castillo, and D.M. Barnard, U.S. Fish and Wildlife Service, 4001 N. Wilson Way, Stockton, CA 95205, 209-946-6400, Fax: 209-946-6355

Abstract: The incidental take of fishes listed under the Endangered Species Act (ESA) is a growing concern to many long-term fish monitoring programs within the San Francisco Estuary, California. Despite ongoing adaptive management efforts by natural resource managers, considerable uncertainty exists regarding the relative roles of habitat, seasonality, and sampling methodologies on the incidental capture of delta smelt while monitoring juvenile salmonids within the San Francisco Estuary. Thus, we evaluated the relative importance of seasons, environmental characteristics, and surface trawl methodology on catches of both delta smelt and juvenile Chinook salmon near Chipps Island within Suisun Bay. Data used for the analysis were collected from July 2001 to December 2011 when fishes were sampled weekly near Chipps Island using identical surface trawl gear. We evaluated the relative support for the influence of factors on delta smelt catch using hierarchical linear regression models and related the most influential factors to juvenile Chinook salmon catch. Preliminary modeling results indicated that the incidental catch of delta smelt near Chipps Island was most influenced by water quality characteristics, tidal stage, sampling methodology, population index, weather, and seasons. The catch of juvenile Chinook salmon near Chipps Island was also influenced by some water quality characteristics, tidal stage, sampling methodology, weather, and seasons. Therefore natural resource managers should consider a variety of factors, including the implications to the catch of targeted fishes, when attempting to modify long-term fish monitoring

methodologies to limit the incidental take of ESA listed fishes.

Statement of Relevance: The data collected by the Juvenile Salmon Monitoring Program has been used to assess and manage water operations within the San Francisco Estuary since the 1960's. The growing concerns of incidental take of delta smelt while monitoring juvenile salmonids in Suisun Bay may cause managers to modify current sampling methodology.

***DNA Barcoding of Toxin Producing Cyanobacteria in Clear Lake and Sacramento-San Joaquin Delta**

Tomofumi Kurobe[1], Dolores V. Baxa[1], Cecile Mioni[2], Raphael M. Kudela[2], Swee J. Teh[1] [1]School of Veterinary Medicine, Department of Anatomy, Physiology, and Cell Biology, University of California, Davis, tkurobe@ucdavis.edu, dvbaxa@ucdavis.edu, sjteh@ucdavis.edu, Phone: (530) 754-8183, Fax: (530) 752-7690 [2]Institute of Marine Sciences, University of California, Santa Cruz, cmioni@ucsc.edu, kudela@ucsc.edu, Phone: (541) 515-0425, Fax: (831) 459-4882

Abstract: Accurate and consistent identification of harmful cyanobacteria using traditional morphological taxonomy is challenging due to the high degree of their phenotypic plasticity in natural assemblages. In this study, we utilized molecular approaches to facilitate the specific identification of cyanobacteria in Clear Lake and in the Sacramento-San Joaquin Delta in Northern California where cyanobacterial blooms have been recurring over the last decades. Algal samples were collected monthly from designated sites during the bloom season from June to October in 2011. Samples containing the most diverse and representative toxin-producing cyanobacteria as identified morphologically (5 from Clear Lake and 3 from the San Joaquin Delta) were chosen for the molecular analyses. The 16S ribosomal RNA genes as well as the adjacent intra transcribed spacer (ITS) regions were amplified from mixed algal samples by PCR with cyanobacteria generic primer sets. Following DNA sequencing of plasmid clones, the obtained sequences were analyzed by similarity search using BLASTN program. Phylogenetic analysis was additionally utilized to differentiate clones for *Aphanizomenon* sp., *Anabaena* sp., and *Lyngbya* sp. that show high degree of sequence similarities. A total 185 plasmid clones were obtained in this study and 77 of them were successfully identified as toxin-producing cyanobacteria at species level: *Anabaena lemmermannii, Aphanizomenon flos-aquae, Lyngbya hieronymusii*, and *Microcystis aeruginosa*. Other key members of the prokaryotic assemblage were also detected via molecular techniques but not by microscopy, including *Synechococcus*, *Bacillus, Paenibacillus, Fluviicola,* alpha-proteobacteria*,* and *Rhodobacter*. This tiered approach combining morphological taxonomy and molecular analysis demonstrates a complementary method for accurate identification and a comprehensive baseline importantly of toxin producing cyanobacteria in the San Francisco Estuary-San Joaquin Delta and Clear Lake.

Statement of Relevance: DNA barcoding is a rapid and specific identification system, and is a relevant management tool for mitigating the adverse impacts of recurring blooms in Clear Lake and in the Sacramento-San Joaquin Delta. Initial barcoding results will lay the groundwork for future development of monitoring tools by molecular techniques.

If We Build It, Who Will Come? Importance of Predator-Prey Habitat Overlap to Restoration

Cynthia LeDoux-Bloom, Yu Zhan, Michael L. Johnson, Dr. Serge I. Doroshov UC Davis, One Shields Avenue, Davis, CA 95616 cledouxbloom@ucdavis.edu (916)813-6731, yzhan@ucdavis.edu (530)754-9292, mbjohnson@ucdavis.edu (530)-400-6725, sidoroshov @ucdavis.edu (530)752-7603, Jennifer Hemmert, Dept. Fish & Game33792 Viewpoint Rd , Winchester, CA 92596 jhemmert@dfg.ca.gov (937)609-7800, Beth Wrege, NOAA Fisheries National Marine Fisheries Service, 650 Capitol Mall, Sacramento, CA 95814 beth.wrege@noaa.gov (916)930-3614, and J. Jeff Isely, and NOAA Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, FL 33149 jeff.isely@noaa.gov (864)506-6070.

***The Importance of Vegetated Ponds to Water Quality and Phytoplankton Carbon Production in Liberty Island, California**

Lehman[1], P. W., S. Mayer[2] and B. A. Larsen[3] [1]Division of Environmental Services, CA Department of Water Resources, 3500 Industrial Blvd, West Sacramento CA, plehman@water.ca.gov, (916) 376-9753 [2]North Central Region Office, CA Department of Water Resources, 3500 Industrial Blvd, West Sacramento CA, smayr@water.ca.gov, (916) 376-9664 [3]2North Central Region Office, CA Department of Water Resources, 3500 Industrial Blvd, West Sacramento CA, blarsen@water.ca.gov , (916) 376-9642

Abstract: Liberty Island is a freshwater tidal wetland that is thought to provide habitat and food resources for the endangered delta smelt. However, little is known about the mechanisms that control environmental conditions and carbon production in the wetland. This study was designed to address the question: Do the small vegetated ponds in the upper portion of Liberty Island contribute significantly to the overall water quality and phytoplankton production of the wetland? To address this question, a suite of physical, chemical and biological variables were measured at four locations in three wetland ponds between 2010 and 2011. Continuous measurements of water temperature, pH, specific conductance, dissolved oxygen, turbidity and chlorophyll *a* fluorescence with YSI 6600 water quality sondes provided information on water quality conditions. Continuous phytoplankton carbon production was predicted from continuous Turner Phytoflash photometers, Li-COR underwater light measurements and chlorophyll *a* fluorescence. Continuous and discrete monthly measurements provided baseline information on nutrient availability. Calibration data were collected semi-monthly to monthly throughout the study. Chlorophyll *a* concentration, water temperature, specific conductance and turbidity were greater in the vegetated ponds. On average, phytoplankton cells were growing at 45% to 48% of their maximum potential yield (Fv/Fm) throughout the ponds. Average daily yield was similar among the three ponds at 0.38 $\pm$ 0.10 to 0.41 $\pm$ 0.11 Fv/Fm and ranged from 70% to 10% of the maximum potential yield. In situ 24 hr light and dark bottle dissolved oxygen incubation studies indicated both the net primary productivity and maximum photosynthetic potential were greater in the vegetated ponds. Phytoplankton production was supported by elevated nitrate, ammonium, soluble reactive phosphorus and silica concentrations that were often greater in the vegetated ponds. Initial findings suggest vegetated ponds are a potential source of suspended solids, salt and phytoplankton carbon to the wetland.

Statement of Relevance: This Breech III study was funded by Delta Science because we needed to gain a better understanding of the mechanisms that affect the production of wetlands and delta smelt habitat for future management of wetlands.

***Trends in Microcystis Abundance and Toxicity in San Francisco Estuary, 2004 to 2008**

P. W. Lehman[1], K. Marr[1], G. Boyer[2], S. Acuna[3] and S. Teh[3] [1]California Department of Water Resources, 3500 Industrial Blvd, West Sacramento, California, plehman@water.ca.gov and kmarr@water.ca.gov , (916) 376-9753. [2]College of Environmental Science and Forestry, State University of New York, Syracuse, New York, glboyer@esf.edu, (315) 470-6825. [3]Department of Veterinary Medicine, University of California, Davis, CA, sjteh@ucdavis.edu, (530) 754-8183.

Abstract: Data collected from research conducted in 2004, 2005, 2007 and 2008 were used to assess if *Microcystis* abundance and toxin concentration increased over time, what factors controlled bloom initiation and persistence and if there was a long term impact of the bloom on mesozooplankton abundance and toxin concentration. *Microcystis* biomass and total microcystins concentration increased over time due to the greater abundance in the dry years 2007 and 2008 than the wet years 2004 and 2005. The bloom had a greater geographical distribution in dry years with maximum biomass occurring in the upstream portions of the delta in the San Joaquin River for all water year types and spreading into the western delta during dry years. Total microcystins toxin concentration in *Microcystis* and mesozooplankton tissue increased with bloom density. The

associations between *Microcystis* abundance and environmental conditions were nonlinear and included threshold, skewed and parabolic responses. Bloom initiation required water temperature above 19^{o}C and photosynthetically active irradiance in the photic zone above 500 µM photons m^{-2} s^{-1}. Persistence of the bloom was associated with pH greater than 7.5, DIN:DIP ratios between 6 and 13, ammonium, nitrate and soluble reactive phosphorus concentration of 0.01-0.08 mg l^{-l}, 0.1-0.4 mg l^{-l} and 0.03-0.09 mg l^{-1}, chloride below 700 mg l^{-1} and streamflows below 80 m^3 s^{-1} in the San Joaquin River past Vernalis and below 600 m^3 s^{-1} in the Sacramento River past Freeport. At individual stations, *Microcystis* was most closely correlated with turbidity and streamflow. In addition, the importance of water temperature and streamflow indicated that the projected increased frequency and severity of drought events in California due to climate change will increase the frequency and severity of *Microcystis* blooms in SFE.

Statement of Relevance: This study was funded by Delta Science because understanding the factors that control *Microcystis* abundance are needed to manage this toxic bloom which threatens food web production and water quality in the estuary.

***Isotope Identification of Particulate Organic Matter and Nutrient Sources during *Microcystis* Blooms in San Francisco Estuary**

P. W. Lehman[1], C. Kendall[2], S. Silva[2], M. Young[2] and M. Guerin[3] [1]Division of Environmental Services, California Department of Water Resources, [2]U.S. Geological Survey, Menlo Park, California, [3]Resouce Management Associates, Fairfield, California

****The Effect of Using Yearly-Changing Historical Land Use on DSM2 Simulation of Historical Delta Conditions**

Lan Liang (California Department of Water Resources)

Abstract: DWR's Delta Island Consumptive Use (DICU) model estimates Delta island agricultural diversions and return flows and assigns these flows and associated water quality concentrations to DWR Delta Simulation Model 2 (DSM2) nodes. DICU defines the Crop Evapotranspiration (ETc) as the total consumptive use in the agriculture fields. ETc is directly related to land use categories. The current use of the DICU model assumes one of two land use sets by water year type: critical and non-critical. Estimated historical yearly land use has been developed and implemented in the DICU model. Its influence on estimated Delta agriculture diversions and returns and DSM2-simulated Delta hydrodynamics and water quality are presented.

****Integrated Regional Water Management Tool: HydroDMS**

J. Long, S. Najmus, A.Taghavi, Y. Noor, and M. Cayar , RMC

Abstract: Integrated Regional Water Management (IRWM) is a collaborative process that crosses jurisdictional boundaries, involves multiple agencies, stakeholders, and groups and attempts to address the issues and different perspectives of all the entities involved through mutually beneficial solutions. The success of the IRWM depends on transparency of data sharing and analysis due to the intensive involvement of multiple stakeholders with multiple perspectives in the IRWM process. In order to facilitate the transparency needs, web-based tools have been recently developed to support the collaborative efforts to manage all aspects of water resources in a region. The Hydrologic Database Management System (HydroDMS) is a comprehensive web-based data management tool that stores water resources and hydrologic data in a relational database management system that may be analyzed and viewed in a map-based Google or ArcGIS interface. The HydroDMS is built upon a state-of-the art system architecture that combines the power of GIS with web technology. It provides a consistent, common database that streamlines reporting and compliance and fosters public outreach and education through a number of interfaces that are tailored to the public users, technical staff, and decision makers. While hiding the

complexity of the database and system architecture, the system provides a suite of easy-to-use comprehensive tools that mimic the user's workflow process while they enter and validate water related data and perform complex analysis. It allows data storage, data sharing, data analysis, and reporting in a cost effective manner among all users and stakeholders. The HydroDMS can also store and display input and output of hydrologic models.

Projected impacts of climate change, urbanization, and water management scenarios on ecology and habitats of waterfowl and other waterbirds in the Central Valley of California.

Elliott L. Matchett[1], Joseph P. Fleskes[1], Mark J. Petrie[2]David R. Purkey[3], Charles A. Young[3], Matthew E. Reiter[4], and John M. Eadie[5]. [1]U.S. Geological Survey, Western Ecological Research Center, Dixon Field Station, 6924 Tremont Road, Dixon, CA 95620 [2]Ducks Unlimited, Inc. Suite 115, 1101 SE, Tech Center Drive, Vancouver, WA 98683 [3]Stockholm Environment Institute, United States Center, 133 D. St., Suite F, Davis, CA 95616, [4]PRBO Conservation Science, 3820 Cypress Drive #11, Petaluma, CA 94954, [5]University of California-Davis, Department of Wildlife, Fish & Conservation Biology, Davis, CA 95616

Abstract: The Central Valley of California contains some of the most important habitats for waterfowl, shorebirds, and other waterbirds in North America. Waterbird habitats in the Central Valley are dependent on precipitation and snow pack for water supplies. Global climate models indicate substantial changes in temperature and timing and amounts of precipitation in watersheds of the Central Valley, translating into temporal and spatial variations in many of the driving forces that define the availability and productivity of waterbird habitats. Food availability is a key factor limiting waterbirds during migration and winter, and impacts body condition and other aspects of waterbird ecology. We developed Central Valley landscape change scenarios based upon precipitation, temperature patterns, and resulting water supplies projected from downscaled climate models, urbanization, and water management scenarios and investigated impacts on habitats and ecology of waterfowl and other waterbirds. For each scenario, we modeled water supplies and demands in the Central Valley using the Water Evaluation and Planning (WEAP) model to quantify future potential water deficit impacting waterbird habitats during migration and winter. WEAP results were translated to available habitat. For each scenario, the computed habitat areas were included in a bioenergetics model to quantify potential waterfowl food deficits. Initial modeling results focusing on Butte Basin indicate that under some scenarios, water supplies will not be adequate to maintain habitat at the levels necessary to support Central Valley Joint Venture goal populations of waterfowl and result in late-winter food deficits for waterfowl and other waterbirds. Of scenarios we investigated, waterbird habitats and food supplies would be impacted the most by a combination of warm, dry future climate, expansive urban encroachment, and a proposed instream flow requirement for protecting migratory salmonids in Butte Creek. We are currently evaluating additional scenarios and anticipate expanding our efforts into other Central Valley regions.

Statement of Relevance: Assist understanding possible consequences of changes in climate, land use, water policy, and water management on wetlands and other important waterbird habitats to help guide water and land management.

***Adventures in Multibeam Bathymetry in the Sacramento-San Joaquin Delta**

Shawn Mayr, Scott Flory, Wyatt Pearsall, California Department of Water Resources, North Central Region Office, Bathymetry and Technical Support Section, 3500 Industrial Blvd., West Sacramento, CA 95691 (916)-376-6029 Shawn Mayr Office Number (916)-376-9676 fax sdmayr@water.ca.gov

Abstract: The underwater world of the Delta is becoming less and less mysterious all the time. New technology is being applied by DWR scientists to map river beds in detail. Underwater sand dunes, scour holes, sunken ships,

and all kinds of interesting features are coming into the light. Data sets that are available include areas in Middle River, Lower Mokelumne, Miner Slough, the Sacramento Deep Water Ship Channel, and other key locations of interest in the Delta.

Statement of Relevance: Bathymetric information is a basic building block for many different environmental, fisheries, hydrodynamic, sediment, geological, and engineering studies and aids project implementation. Hydrodynamic modelers, biologist, engineers, geologists, construction inspectors, reclamation districts, and ecological scientists depend on detailed, up-to-date bathymetric information.

***Stable Isotope Analysis of Historical Zooplankton Samples to Document Food Web and Biogeochemical Changes in the San Francisco Estuary: Effect of Preservation Methods**

Julien Modéran and Wim Kimmerer, Romberg Tiburon Center for Environmental Studies, 3152 Paradise Drive Tiburon, CA 94920 (415) 435-7113 – Fax (415) 435-2100

Abstract: We are using stable isotopes of zooplankton as a bioindicator of the evolution of the trophic status of the San Francisco Estuary (SFE) over the past decades. This retrospective analysis based on the IEP long-term series of zooplankton samples will provide insights into the relative contribution of local and terrestrially-derived organic matter sources to the plankton-based foodweb, trophic levels of the dominant species, trophic interactions among these species and their evolution related to the main environmental changes. Here we present preliminary results from an experiment aimed at validating the use of these archived samples. We tested and measured the impact of common preservation method (freezing *vs.* formalin), and duration of preservation on the stable isotope signature of six copepods and one Mysid species from the SFE. First results after 3 months of preservation indicate for most species a limited impact of formalin preservation on carbon isotopic composition (<1‰), which occurred rapidly after preservation and remained rather constant over time (thus predictable). Although results are more variable with nitrogen (from <1‰ for *Acartiella sinensis* and *Hyperacanthomysis longirostris* to unexpectedly high for *Pseudodiaptomus forbesi*), they are overall encouraging. These results allow for the calculation of correction factors and validate the use of historical samples to help characterize human-induced foodweb and biogeochemical changes in the SFE.

Statement of relevance: Characterizing the long-term trends in the use of organic matter sources in zooplankton consumers, and trophic interactions among them, is ultimately important to understand the role of the food supply in the Pelagic Organism Decline and the trophic effect of human-induced changes in the SFE.

****Smart Particle Tracking Using DSM2-PTM**

K. Nam, California Department of Water Resources

**** Suspended Sediment Predictions in California**

George Nichol

Abstract: A proposed method of predicting the suspended sediment concentrations in the streams and rivers of California's 12 Level III Ecoregions is presented. Existing USGS data sets of flow and suspended sediment concentrations, along with Rapid Geomorphic Assessments, would be used to determine the sediment loads coming from stable and unstable watersheds. This method gives the suspended sediment concentrations coming off of a watershed into a stream. A geomorphic model would then be used to generate the sediment load generated within the stream channel itself, and this load added to that coming from the watershed. A stream

hydrodynamic/sediment transport model would then be used to transport this combined suspended sediment load downstream and give the suspended sediment concentration predictions.

State Water Project Chloride Modeling Analysis

Sevim Onsoy[1], Les Chau[1], Mike Maley[1], Matt Baillie[1], Lynn Takaichi[1], Dirk Marks[2] [1] Sevim Onsoy (*corresponding author*), Kennedy/Jenks Consultants. 303 Second Street Suite 300, South San Francisco, CA 94107 Phone: 415-243-2522; Fax: 415-896-0999; sevimonsoy@kennedyjenks.com ; Les Chau, Phone: 415-243-2496; leschau@kennedyjenks.com ; Mike Maley , Phone: 415-243-2495; mikemaley@kennedyjenks.com ; Matt Baillie, Phone: 415-243-2489; mattbaillie@kennedyjenks.com ; Lynn Takaichi, Phone: 253-952-3435, lynntakaichi@kennedyjenks.com [2] Dirk Marks, Castaic Lake Water Agency, 27234 Bouquet Canyon Road, Santa Clarita, CA 91350, Phone: 661- 297-1600 ext 297 dmarks@clwa.org

Abstract: A spreadsheet-based mass balance model was developed to simulate flow and chloride concentration along the California Aqueduct from the Banks Pumping Plant in the Delta to the end of the West Branch at Castaic Lake. The primary objective of the modeling analysis is to forecast chloride concentrations at Castaic Lake resulting from projected SWP and contractor operations under the recent pumping constraints affecting the SWP operations. The modeling results are intended to assist the Santa Clarita Valley Sanitation District (SCVSD) develop a compliance solution to the Upper Santa Clara River chloride TMDL as about half the waste water treated by the SCVSD originates from the imported water conveyed through Castaic Lake. Of particular concern are the impacts on projected chloride levels at Castaic Lake corresponding to dry hydrologic conditions such as those from the 1987-1992 drought period.

The model domain from Banks Pumping Plant to Castaic Lake was divided into four systems - Delta, San Luis, San Joaquin, and West Branch - to account for monthly inflows and outflows along the California Aqueduct, including SWP and CVP deliveries, groundwater banking operations, and natural conditions. Inflow concentrations were based on available data and outflow concentrations were calculated by the model. A historical model was developed first and calibrated to measured historical records of 1990 to 2010, compiled from DWR and various other sources. The calibrated model was then used as the basis to forecast chloride concentrations in Castaic Lake, based on future projections of SWP/CVP water deliveries and reservoir operations (CalSim II model outputs used in the DWR's 2009 SWP Delivery Reliability Report) and projections of groundwater pump-ins.

Under the future hydrologic conditions similar to the 1987-1992 drought, the model forecasts chloride levels in Castaic Lake mostly from 60-70 mg/L, with the highest near 80 mg/L. The model forecast is lower than the historical range of 100 to 130 mg/L observed in Castaic Lake during the 1987-1992 drought period.

Statement of Relevance: The modeling analysis performed is pertinent to DWR's ongoing modeling analysis with DSM2 and CalSim II. Historical flows, deliveries, and water quality data compiled by DWR for the development of the DSM2 Aqueduct model were provided by DWR and used in support of this modeling analysis.

Modifying Analytical Methods to Keep Up With Changing Pesticide Use in the San Francisco Estuary

James Orlando, Michelle Hladik, Kelly Smalling, and Kathryn Kuivila, U.S. Geological Survey California Water Science Center, 6000 J St., Sacramento, CA, Fax 916-278-3013, jorlando@usgs.gov 916-278-3271; mhladik@usgs.gov 916-278-3183; ksmall@usgs.gov 916-278-3052; kkuivila@usgs.gov 916-278-3054.

Abstract: Current-use pesticides pose a threat to aquatic organisms in the San Francisco Estuary watershed. Pesticide use is constantly changing, presenting a challenge for resource managers and policy makers trying to understand the fate and effects of these contaminants. Less than half of the pesticides currently applied in the watershed are analyzed in monitoring studies, and new pesticides are continually being registered for use. The U.S. Geological Survey Pesticide Fate Research Group routinely updates analytical methods to adapt to changing

pesticide use.

Our updated methods address several key issues relating to pesticide use in the San Francisco estuary. For instance, fungicides are under-represented in monitoring studies, despite high use and little available data on their toxicity to non-target organisms. We have recently added 34 fungicides to our gas chromatography/mass spectrometry (GC/MS) analytical method. Also, pesticide use in California rice has changed considerably over the past decade. Our GC/MS method currently includes all major, active pesticide ingredients, as well as newer rice herbicides, that are increasing in use. Much attention has been focused on replacement of organophosphate insecticides with pyrethroids, but other insecticides, including neonicotinoids, are starting to be applied more frequently. We have developed a liquid chromatography tandem mass spectrometry (LC/MS/MS) method that includes these insecticides. In addition, pesticide degradates have been added to our methods, including three diuron degradates in our LC/MS/MS method.

A recent study of pesticides entering Suisun Bay utilized our updated GC/MS method and new LC/MS/MS method. Water samples were collected weekly from April through June of 2011 at three sites (Sacramento River at Hood, Mallard Island, and Grizzly Bay). In preliminary results, diuron and two of its degradates (3,4-DCA and DCPMU), as well as several fungicides, were frequently detected at low concentrations (<40 ng/L), illustrating the importance of adapting analytical methods to changing pesticide use.

Statement of Relevance: The work describes a new analytical method for current-use pesticides and degradates, and provides results of a study conducted in the Sacramento/San Joaquin Delta in 2011. Many of the pesticides analyzed are not routinely analyzed for in Delta waters. This work provides critical data on the occurrence of these pesticides.

Temperature Preference – Avoidance Behavior of Adult Delta Smelt (*Hypomesus transpacificus*).

Michael O. Park[1], Joan Lindberg [2], Swee Teh[1],VM: APCB, One Shields Ave. University of California Davis, Davis, CA 95616 Tel: (530) 754-8183 Fax: (530) 752-7690 [2] Fish Conservation and Culture Lab, University of California Davis, Byron, CA 94514 Tel: (209) 830-9803

Abstract: Recent evidence has demonstrated that physical habitat parameters, especially water clarity, temperature, and salinity, are strong determinates of delta smelt (*Hypomesus transpacificus*) distribution within the Sacramento-San Joaquin Estuary. To better develop an understanding of the volitional movement patterns of the delta smelt within their environment, we have modified an electronic shuttle box system (Loligo Systems©) to quantify delta smelt preference, avoidance and swimming behavior responses. We have explored a novel epidemiological approach to our study design using an "interventional experiment" to provide us with significant data at a reduced sample size. Preliminary analysis of temperature preference indicates significant differences between static and dynamic systems, verifying delta smelt prefer higher (18.19 °C) temperatures then acclimation (12°C). A historic data set, provided by the DFG Townet Survey, was also compared and concurred that the adult delta smelt are more abundant in a range of 17.84°C to 24.33°C with a mean temperature for historic data of 21.09 °C.

Statement of Relevance: The delta smelt is listed under the Federal and California State Endangered Species Acts; however, little is known about their behavioral responses to naturally occurring physical stimuli. In order to develop strong management tools for delta smelt conservation, it is critical to consider how changes in environmental stimuli may affect their physiology and behavior.

Bird Response to Delta Restoration

Anitra Pawley and Ron Melcer, FESSRO, North Delta Restoration Program, Department of Water Resources. P.O. Box 942836 Sacramento, CA. 94236; apawley@water.ca.gov<mailto:apawley@water.ca.gov>

Abstract: Despite fairly extensive studies of bird populations along the Sacramento and Cosumnes Rivers in the Central Valley, studies of bird populations and their responses to habitat and landscape attributes at interior Sacramento-San Joaquin Delta restoration sites (Grizzly Slough, Decker, Sherman, and Twitchell Islands) are limited. We conducted point count and vegetation surveys at 12 restoration sites (n = 50) located within the west and north Delta during May and June, 2011. Sites included various habitat types including shrub scrub, riparian, and freshwater marsh. We evaluated bird species composition and richness, and also tested regression models that related these variables to 1) fine-scale habitat attributes (tree and shrub species richness, tree and shrub percent cover, herb cover and non-native species richness), 2) landscape attributes (area, area to perimeter ratio, and age), and 3) adjacent land cover (grassland, crop, riparian, wetland and water). Our results indicate low species richness when compared to Sacramento and Cosumnes sites, but a fairly high percentage of native species. Though songbird communities were prevalent, cowbird populations were a particular concern. Bird species abundance and richness were also significantly lower at sites we sampled that were linear versus non-linear, smaller versus larger, younger versus older, and at sites with non-native versus native species. We found fine-scale habitat and landscape attributes to be useful in predicting species abundance and richness, however, adjacent land cover had little effect. These findings are used to provide guidance for restoration design (of interior island and setback levees) to enhance bird populations/communities and also to suggest further research.

Statement of Relevance: Tied to large scale water management and planning efforts, State and federal agencies have proposed to fund significant levels of restoration in the Delta. The evaluation of existing Delta restoration projects using known biological indicators (bird diversity and abundance) can help guide future Delta investments including site location and design.

Data Management

Erin Reddy, Junior Specialist, CERES, 801 K Street, 16th Floor, Sacramento, CA 95814

Abstract: Data management is the development and execution of policies and practices that protect, deliver, and enhance the value of data and information assets. This includes activities such as backups, collaborative work, data security, and archiving. Data sharing reduces costs by avoiding duplicate data collection efforts and data updates. It also promotes coordination and innovation, encouraging improvement and validation of research methods, and fostering scientific inquiry and debate.

In data management, there are roles including data creator and data stewards. The data creator is the owner or author of the data and is usually the best person to complete information such as title, description, location and keywords for the dataset. When records have this data about the data, or metadata, completed, it makes it much easier to find the data in searches. Data stewards might review this metadata, validate the data and its associated services, propose symbology, answer email questions about the data, and announce updates.

In order to promote open access to research data, many agencies require that data be made publicly available. Researchers can comply with these requirements by depositing data into a repository which provides built-in support for good data management practices. For example, the California Environmental Information Catalog (CEIC) is CERES own online directory for reporting and discovery of information resources for California. Participants include cities, counties, utilities, state and federal agencies, private businesses and academic institutions that have spatial and other types of data resources. CEIC is based on the Federal Geographic Data Committee (FGDC) metadata standard. This standard provides a common set of terminology and definitions for the documentation of digital geospatial data.

Statement of Relevance: Most researchers manage various forms of digital data. Often there are multiple copies or versions of data, making it sometimes difficult to find what you're looking for. Through good organization, collaboration and documentation, there is greater efficiency of research and greater reproducibility of outcomes,

enabling easy verification of results.

**** Enhancement of the Sacramento-San Joaquin Delta Island Consumptive Use Estimates and Water Quality Redetections**

Lucas Siegfried and William E. Fleenor (UC Davis)

Abstract: A collaborative, integrated approach was used to predict better Delta Island Internal Use of water (DICU) values and water quality variables, predicting both quantity and quality on a higher resolution time step and basing both diversion and return locations on topography rather than simple geographical approximation. The delta island known as the Fabian Tract was selected for this study based on available data and island accessibility. A combination of historical diversion and return location data, water rights claims, and LIDAR digital elevation model data were used to predict where diversion and return locations are located on the Fabian Tract. The accuracy of the predicted diversion and return locations was analyzed through ground-truthing. To calculate water requirements and runoff returns from agricultural land-use, incorporating soil and land-use characteristics as well as weather data, the IWFM Demand Calculator (IDC) was selected based on model capabilities, ease of use, applicability, and recommendations. For the IDC model, the Fabian Tract was manually divided into subregions, representing fields, levees, ditches, and roads, through the use of ArcGIS. SMS 10.0 was used to generate a grid, representing the Fabian Tract and the developed subregions, to be used in the IDC model. Using ArcGIS, the subregions were joined to form diversion and return watersheds representing the total area supplied by a given water source or the total drainage area for a given return. The IDC model was run for both wet and dry year conditions. The results of each IDC model simulation were joined to the ground-truthed diversion and return subareas in ArcGIS to allocate diversion and return water sources on the Fabian Tract. The IDC model results were then compared to the current DICU estimates used in the DSM2 model and a sensitivity analysis of the IDC model was performed.

***Predation Impact and Reproductive Rate of *Acartiella sinensis*, an Introduced Predatory Copepod in San Francisco Estuary**

Anne Slaughter, Toni Ignoffo and Wim Kimmerer, Romberg Tiburon Center for Environmental Studies, San Francisco State University, 3152 Paradise Drive, Tiburon CA 94920, USA Phone: (415) 338-3548 Fax: (415) 435-7120 aslaught@sfsu.edu

Abstract: San Francisco Estuary (SFE) is a highly invaded ecosystem and most of the zooplankton community of the northern estuary are exotic species. *Acartiella sinensis*, presumed a predatory copepod based on morphology, was introduced from Asia in 1993, and yet little is known about its ecology. It is now one of the numerically dominant copepod species in SFE in summer (max = 3,000 indiv m^{-3}). Predaceous consumers like *Acartiella* can significantly influence the distribution and composition of their zooplankton prey; *Acartiella* may therefore play an important role in regulating community structure. We determined *Acartiella* abundance, feeding and reproductive rates in an effort to understand its role in the SFE foodweb. We examined predation on several life stages of an abundant, co-occurring introduced copepod, *Limnoithona tetraspina*, and the one life stage (nauplius) of *Pseudodiaptomus forbesi*. Adult female *Acartiella* consumed *L. tetraspina* at relatively low rate (predation impact = 0.4-1.8% of the prey population consumed d^{-1}). This predation impact is expected to be higher when *Acartiella* is at peak abundances and when all other copepodite life stages are included. Predation on *L. tetraspina* copepodites and adults was low and variable, suggesting these life stages may be less susceptible to predation by *Acartiella*. *Acartiella* also predated on *P. forbesi* nauplii, at a rate slightly higher than *L. sinensis* (predation impact = 5.3% of prey population consumed d^{-1}). Female *Acartiella* produced an average of 14 eggs $female^{-1}$ d^{-1}, which is higher than two co-occurring calanoids (3-5 eggs $female^{-1}$ d^{-1}). *Acartiella* likely supplements its diet with other prey to support its higher reproductive (growth) rate. These observations have implications for energy transfer to higher trophic levels and point to a significant role of *Acartiella* in secondary production of the

SFE.

Statement of Relevance: The POD has prompted an intense effort to understand the causes of long-term change in the estuarine ecosystem. Evidence for food limitation of planktivorous species suggests a need to examine the abundance and population dynamics of their food.

**** Towards a Systems Analysis of Yolo Bypass Uses and Opportunities –**
Robyn Suddeth (UC Davis)

Abstract: Progress towards a systems model integrating agricultural, wildlife, fish, and flood uses of the Yolo Bypass will be presented.

****Impact of Groundwater Banking and Extraction Program on Stream-Aquifer Interaction in North American GW Subbasin**
A. Taghavi[1], R. Swartz[2] and M. Cayar[1 1] RMC [2] Sacramento Groundwater Authority

Abstract: The Sacramento Integrated Water Resources Model (SacIWRM) is an analytical tool that has been used in the Sacramento region since 1992. Recently updated in 2008, the model is used by water managers and decision makers in Sacramento County to evaluate the impacts and benefits of water resource projects on the groundwater system and on stream-aquifer interaction. For this study, the SacIWRM was utilized to estimate the change in stream-aquifer interaction along the American River, Sacramento River, and throughout the Sacramento Valley resulting from the extraction of banked groundwater in Northern Sacramento County.

To simulate the effects of the extraction of banked groundwater, a SacIWRM model scenario was developed where municipal groundwater production was increased above baseline levels by an additional 16,000 ac-ft for a single dry year. The change in stream-aquifer interaction due to extraction of banked groundwater was estimated by comparing the model scenario with the baseline model. Losses in stream flow to groundwater were considered both for the entire simulation period and only for the periods when the Sacramento Delta was in shortage conditions. To determine the sensitivity of the stream-aquifer interaction due to varying hydrology, three versions of the model scenario were developed with the extraction occurring in different years:

- extraction in 1976 (followed by a critically dry year, then average years),
- extraction in 1987 (followed by several dry years), and
- extraction in 1994 (followed by several wet years).

Simulation results show that there was an increase in stream flow loss to groundwater by 6% – 8% of the additional amount extracted (up to 1,350 ac-ft) for a 5-year period following the extraction of the banked groundwater. Stream flow losses varied by approximately 2% of the amount extracted depending on the hydrology of the subsequent years after extraction occurs. On average, 69% of the total stream flow loss occurred in the lower American River, 23% occurred in the Sacramento River, 3% occurred in other simulated streams and rivers, and an estimated 5% occurred in streams and rivers outside the model area.

**** San Joaquin River Restoration Daily Flow Model**
Todd Vandegrift (USBR, TSC)

Abstract: A daily operations model for the San Joaquin River Restoration Program was developed in RiverWare, a versatile hydrologic modeling software package. The model simulates hydrology along the San Joaquin restoration reaches from Millerton Lake to the Merced River, and along the Chowchilla and Eastside Bypasses. Daily Friant Dam operations are modeled as well as downstream routing, losses, and operations (bifurcations, diversions,

etc.). Daily inflows are identical to those used in the Daily Disaggregation Tool and match CalSim II. Monthly diversions and some downstream inflows are taken from CalSim II results, with monthly to daily flow patterning applied where appropriate. Daily Friant releases are modeled independently from CalSim II, including restoration release flow schedules and flood control. The model has the ability to schedule restoration releases in differing patterns, following the constraints defined in the Settlement. The model simulates the operational challenges associated with forecast error and its effects on restoration allocations and scheduling, and flood control operations. The model results include Millerton parameters such as storage, pool elevation, and releases, and downstream river flows on a daily timescale. Currently, results are being used in the Reach 2B and Reach 4B site specific studies, and the CVHM groundwater modeling studies.

**** Using Nitrate Stable Isotopes to Identify Dominant Nitrate Sources and Processes Impacting Groundwater and Surface Water in the Central Valley, California**

Megan Young (USGS), Thomas Harter (UC Davis), Carol Kendall (USGS), and William Stringfellow (University of the Pacific)

Abstract: The dual stable isotopic composition of nitrate ($\delta^{15}N$ and $\delta^{18}O\text{-}NO_3$) can be used to identify dominant sources and processes controlling the distribution of nitrate in groundwater and surface water systems. Elevated nitrate concentrations are found in many drinking water wells throughout the Central Valley, California, and rivers in this area also receive nutrients from various anthropogenic sources. Nitrate derived from animal and human waste tends to have distinctly higher $\delta^{15}N\text{-}NO_3$ values in comparison to nitrate derived from synthetic fertilizers, providing a way to distinguish between dominant nitrate sources in a water sample if biological processes have not significantly altered the nitrate concentration. Since biological processes cause predictable shifts in both the $\delta^{15}N$ and $\delta^{18}O$ of the nitrate, coupled to decreases in nitrate concentrations, water samples collected across spatial and/or temporal gradients can be used to determine if source signals or biological processing is the dominant control on nitrate concentrations within a given area.

We have conducted extensive nitrate isotope sampling in locations throughout the Central Valley, including first-encounter groundwater directly beneath dairies, 200 domestic drinking water wells, and surface waters of the San Joaquin River and tributaries in order to better understand the sources and processes controlling nitrate concentrations. By using a combined isotopic and geochemical approach, the impact of manure-derived nitrate could be clearly seen in the first-encounter groundwater beneath dairies. However, nitrate isotopes indicated that although manure-derived nitrate appeared to be present in some of the domestic drinking water wells, the dominant source of nitrate to the majority of the drinking water wells was synthetic fertilizer. In the surface waters of the San Joaquin River and tributaries, nitrate isotope compositions and concentrations varied significantly with season, flow, and location, reflecting the influences of changing biological processes, water sources, and surrounding land use.

Correctly identifying nutrient sources to groundwater and surface water is critical to making effective water management decisions. Nitrate isotopes provide information about sources and biological processes controlling dissolved nitrate concentrations, and therefore can be used to identify critical contamination sources to surface and groundwater and to test nitrate distribution models.