Preface

Communication and the Science-Policy Interface

Johnnie Moore, Lead Scientist

Scientists and resource managers ideally depend on each other – scientists for direction as to the most important management issues, and managers for information to inform their decisions. Communication of scientific ideas can be a bottleneck in this scenario. This conference and its summary emphasize the management-relevance of the science presented, as one of the efforts by the CALFED Science Program to help bridge the gap between two dynamic communities.

Science and policy each work at different paces, use different languages, and have different assumptions. Crossing the divide between the two cultures begins with efforts to bring together the practitioners of science with the practitioners of policy. The CALFED Science Conference provides an opportunity to increase communication across the science-policy interface. I hope that scientists and managers alike find this summary useful.

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Introduction:

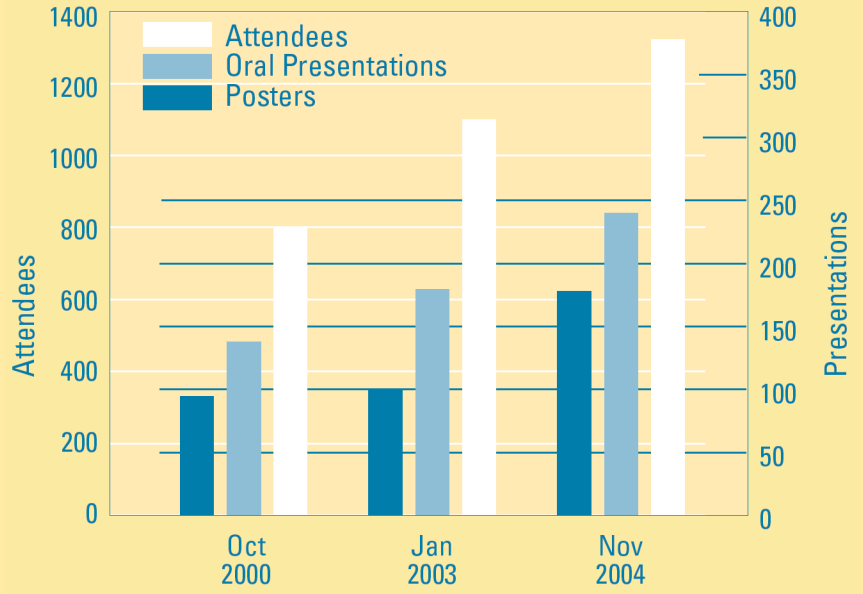
Purpose and Goals of the Science Conference and This Summary

The CALFED Science Conference has become an important showcase for cutting-edge applied science. The science presented at the 2004 CALFED Science Conference is notable for its breadth, quality and quantity. A glance at the appendix list of presentations gives an idea of the amount of effort and progress that is being made to study and understand this system. The number of nationally respected scientists participating in CALFED-relevant science attests to its quality.

The CALFED Record of Decision (CALFED ROD, a document that constitutes the charge for the CALFED Bay-Delta Program) explicitly prescribes use of science in decision-making and decision evaluation. Management decisions can have broad, system-level implications. In order to make these decisions in an informed manner that captures the potentially broad management ramifications, scientific understanding at a systems scale is critical. The title of this three-day conference, "GETTING RESULTS: Integrating Science and Management to Achieve System-Level Responses" reveals the conference focus on integrative work.

This document summarizes scientific results, and relates the science presented to management issues. This summary is integrative both in the interdisciplinary nature of many of the studies presented that address key CALFED knowledge gaps, and in its broader aim of bringing this science into the policy and management communities. Taken as a whole, the work discussed here represents a collective increase in our understanding at the system level. This report is designed as a tool to help facilitate the hard work of integrating that understanding to actual management decisions. To obtain a more complete view of the science presented at the 2004 conference, see "Want more information?" next page.

CALFED Conference Growth



The CALFED Science Conference continued to grow in 2004. More science was presented, and more people attended than in previous years. As in previous years, attendees and presenters were mostly from California, but many attended from out of state as well. This geographically diverse representation at a regional conference attests to the broad national recognition that CALFED science has achieved.

How to Use This Summary

Unlike traditional science conference proceedings, I have divided each subject into sections highlighting new scientific information, and commenting on the implications of new work for resource managers and policymakers in the system. I hope both scientists and managers will not look only at the topics they directly work with, but rather will read broadly in this report. Science often resists categorization, and the best management innovations ideas sometimes come from connecting concepts from disparate fields.

The talks are grouped by the sessions in which they were presented, and sessions are grouped among the broader categories reflected in the original program – some may fit logically into more than one session. Within each session, talks are grouped by topic where appropriate. I introduce the major groupings of sessions with one of the relevant plenary talks.

Background and context for each session are intended to enable a 'big-picture' view even for non-specialists. **Scientific Information**, for brevity and readability, has been heavily condensed to key points, salient conclusions, and important working hypotheses.

Scientists were asked to present their work in light of its management relevance. **Management Implications** are ways in which new science could inform future actions.

But they are just that: implications. They are explicitly not meant as policy prescriptions or normative directives. Clearly, scientific concepts do not automatically roll up to management choices, and in fact many of the implications may turn out to be intractable or nonsensical in the light of constraints ranging from politics to dollars, or indeed, conflicting science. However, managers can act more effectively with a better scientific understanding of the overall system. The CALFED Science Program hopes this volume facilitates such increased understanding.

This summary captures only the main points made at a conference in which a wealth of information was presented. Further, I only report on the oral presentations – lively poster sessions were an important part of the conference as well.

This volume can not be used as a sole source of information, but rather should be used as a reference and starting point. I hope that managers who find relevant material while reading this will be inspired to contact the authors for published material or to talk directly about the science. *As in all conferences, much of the work presented is in preliminary stages, or has not yet been peer-reviewed.* If you have any questions about the data or conclusions presented here, please contact the authors for the latest information.

Want More Information ?

If you would like to know more about any topic, first see the abstract for more in-depth information on the particular talk you are interested in. Abstracts for posters and talks are posted at http://cain.nbii.org/regional/calfed/calfedabstracts. If this does not answer your question, contact the author of the talk. Contact information is given in the appendix.

2004 CALFED Science Conference Student Presentation Awards

There were 26 student oral presentations, and 32 student posters. The winning students were:

Oral Presentation:

David Ostrach, UC Davis: Immunohistochemical Evaluation of P450 Expression and Tissue Distribution in Striped Bass Experimentally Exposed to Beta-Naphthoflavone

Poster:

Craig Swolgaard, CSU Sacramento: Habitat Use of Swainson's Hawk in a Vineyard Landscape in the Lower Mokelumne River Watershed

A Note on Conventions

In this document, the "Estuary" refers to the San Francisco Estuary, which includes San Francisco Bay, San Pablo and Suisun Bays, Suisun Marsh, and the Sacramento-San Joaquin Delta. The Sacramento-San Joaquin Delta is referred to as the "Delta" in this document. The Estuary's tributaries and watersheds play an important role in much of its physical and ecological functioning, and are also an integral part of a system-level understanding.

Citations in the text reference the first author of a talk. Most talks have multiple authors, but I have omitted "et al." for simplicity. See the Appendix for compete citations and author lists.

Conference Organizing Committee

Conference Co-chairs:

Randall L. Brown (CBDA)

Frederic H. Nichols (USGS, retired)

Program Co-chairs:

Anke Mueller-Solger (DWR)

David Schoellhamer (USGS)

Logistics Co-chairs:

Marcia Brockbank (SFEP)

Karen McDowell (SFEP)

Poster Session Co-chairs:

Bellory Fong (CBDA)

Jana Machula (CBDA)

Student Judging Co-chairs:

Joseph Cech (UC Davis)

Ken Hashagen (CDFG, retired)

Ken Lentz (USBR)

Committee Members:

Pat Akers (CDFA)

Rick Breitenbach (CBDA)

Larry Brown (USGS)

Lauren Buffaloe (CBDA)

Mike Connor (SFEI)

Pat Coulston (CDFG)

Roger Fujii (USGS)

Margaret Gidding (CBDA)

Amy Hutzel (CCC)

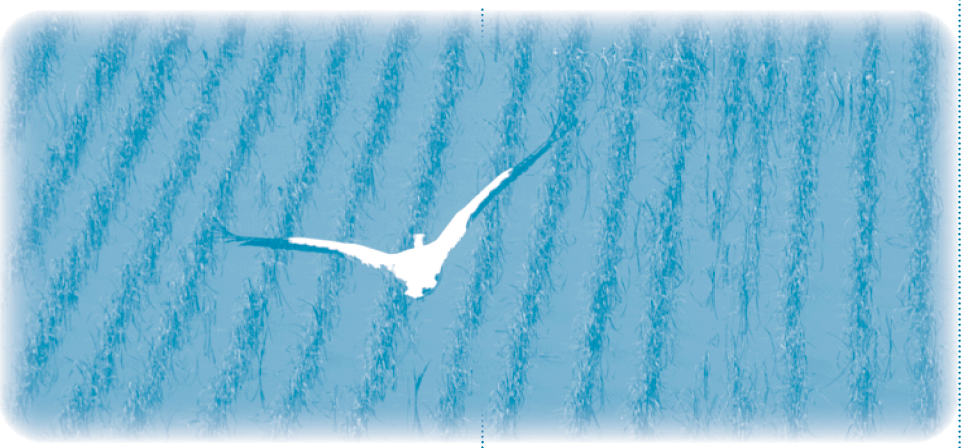
Zachary Hymanson (CBDA)

Diana Jacobs (CDFG)

Rick Morat (USFWS)

Tim Ramirez (CBDA)

Kim Taylor (USGS)



Acknowledgements

This volume represents the collective efforts of many who worked to make the 2004 CALFED Science Conference successful, ensured that information was captured, and reviewed this summary.

I drew, sometimes directly, on the work of note takers for each session, as well as on abstracts and slides. The note takers' work was essential to the task of distilling almost 250 presentations into a single volume. In particular, Eleanor Ely worked with the plenary speakers to write the versions of their talks that are included here. I also thank all of the scientists who generously provided figures. Lauren Buffaloe helped with organizing and planning, and wrote first drafts of Indicators of Wetland Condition, Storing Environmental Data, and Data and Advocacy – the Role for Environmental Justice. The organizing committee for the Special Session on Environmental Justice consisted of Lauren Buffaloe, Margaret Gidding, Jana Machula, Ken McGhee and Donna Podger, and Ken McGhee moderated the discussion session.

Each session was run by one or more Session Chairs, who worked to organize the presenters into coherent themed sessions. In addition to this essential role, the Session Chairs also reviewed the summaries for accuracy.

Darren Campeau provided layout and design artistry, including redesign of many figures obtained from presenters. Un-credited photos within the report are courtesy of the Department of Water resources.

Finally, but certainly not least importantly, Randy Brown and Fred Nichols were the conference co-chairs, and Anke Mueller-Solger and David Schoellhamer served as conference program chairs. The four of them worked hard alongside numerous others on the organizing committee to put together a strong program and make sure that it ran smoothly for over 1200 attendees and presenters. In addition to these efforts, Fred, Anke, and Dave contributed valuable comments in reviews of the final draft. Randy in particular deserves special thanks for a comprehensive review and thorough feedback on the entire report.

Views expressed do not necessarily represent those of the scientists or of the California Bay-Delta Authority. Although all these people played essential roles in the production of this report, responsibility for any errors lies with its author. Funding for this document was provided by the CALFED Science Program.

Michael Kiparsky
Science Program
California Bay-Delta Authority

Science for Dummies—

The Management Connection

Patrick Wright
California Bay-Delta Authority

Since the last conference, there have been some important institutional changes in the CALFED Bay-Delta Program. The biggest is that we have a new leader, Dr. Johnnie Moore, who comes to us after a prestigious career in geology and geochemistry at the University of Montana. He is challenging us to think differently about the role humans play in shaping the future of the planet. He is truly a world-class leader for a world-class effort.

Another key addition to the program is CALFED's Independent Science Board, a group of some of the top scientists in the country, which will help shape and develop the program. The Bay-Delta Authority itself, of course, is also a new player on the stage. With six state agencies, six federal agencies, and public members from each of our regions, we're well-positioned to guide the program into the future, and hopefully the new structure will lay to rest any concerns about the longevity and permanence of the CALFED Bay-Delta Program itself.

These institutional changes are designed to make it easier for the science community to be heard by policymakers and for your work to be incorporated into the daily decisionmaking of agencies. Now of course none of this happens without money, and we are fortunate that the drafters of Proposition 50, the most recent water bond, explicitly recognized the importance of science by including a requirement that projects funded under the bond include funding specifically set aside for monitoring, assessment, and evaluation. Through this provision alone over $40 million will be made available to support science in the program.

"These institutional changes are designed to make it easier for the science community to be heard."

I often think back to the late 1980s, when I started working on water issues. For the 1987 Bay-Delta hearings, agencies and stakeholders literally spent millions of dollars and countless hours blasting each other's testimony, and were cautioned not to share their data because that would undermine their case before the State Water Board. We have surely come a long way since then. Our agencies, stakeholders, and scientists are now collaborating on hundreds of projects.

We've learned that you can't simply turn the clock back. But projects like the Environmental Water Account, the Butte Creek restoration project, and the setback levees on the Sacramento River represent efforts to protect and restore the health of the estuary and bring back sustainable populations while also meeting the state's growing water supply, flood control, and water quality needs. These efforts depend on a close working relationship between scientists, engineers, stakeholders, and local communities. We intend to work with you to make building those relationships our highest priority.

Decker Island restoration site, 2001.

CALFED Science in the Anthropocene

Johnnie N. Moore
California Bay-Delta Authority

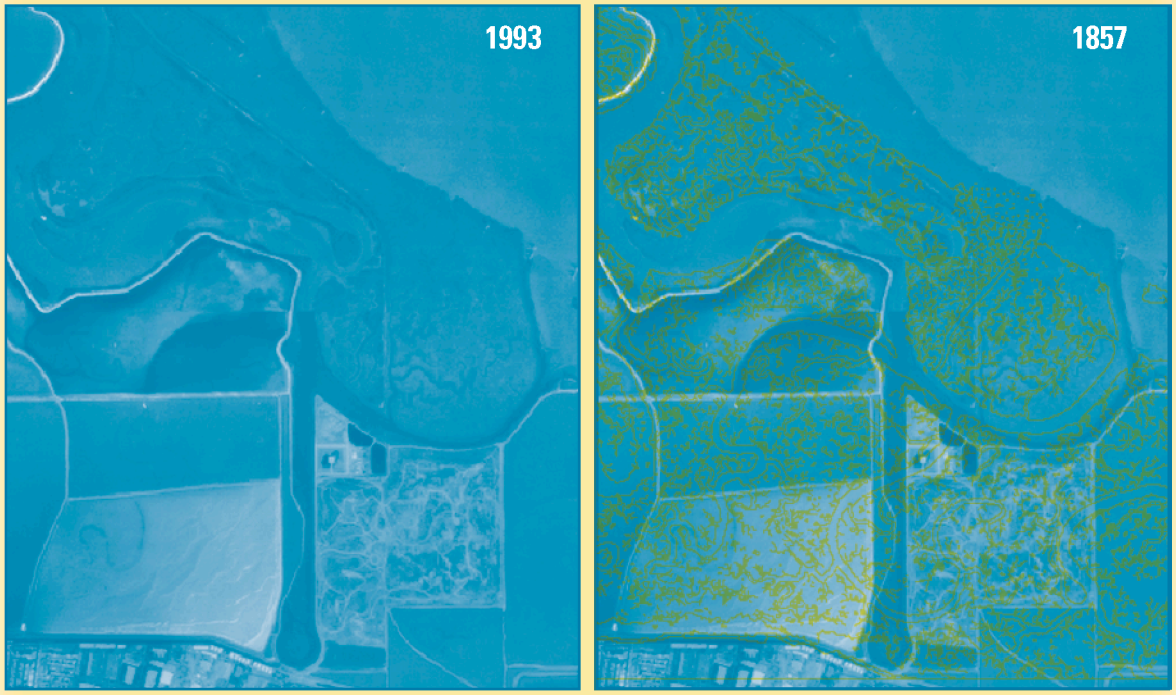
Two hundred years ago we had about 1 billion people on the planet; by 2050 we'll have somewhere around 9 billion. NASA satellite data show that about 10 percent of the surface of the United States now is impervious to infiltration—a situation with a lot of implications for hydrology, surface runoff, and transport of contaminants. Imhoff et al. (Nature 2004) estimated that globally humans are now appropriating about 20 percent of the planet's primary productivity, and in some large urban areas we are consuming on the order of 30,000 to 40,000 percent of net primary productivity.

In what I consider one of the seminal papers showing how important humans have become in modifying the planet, Roger Hooke (GSA Today 1994) estimated that the total amount of material moved at the Earth's surface from geological processes like river transport, glaciers, waves, wind, and continental mountain building is about 45 gigatons/year. Then he estimated how much material humans move (not including agriculture) and arrived at the same figure. Later he repeated his calculations including agriculture and concluded that humans are moving about twice as much material as all geological processes combined.

A few years ago, Dutch Nobel laureate Paul Crutzen declared that humans have become such a major geological force over the past 200 years that we're no longer in the Holocene, and he coined the term "Anthropocene" for the current geological epoch. To put this into perspective, if 46 m (approximately the length of an Olympic-size swimming pool) represents the 4.6 billion years since the origin of the Earth, then 1 cm equals 1 million years, and the last 10,000 years—the Holocene—is about 0.1 mm. The Anthropocene would be about 2 micrometers—about the thickness of a clay mineral. And in that thickness of a clay mineral, which we have to use an electron microscope to image, we're in the process of completely modifying geological and biological processes on the earth. This is an amazing thing.

California, which is probably one of the most modified places on the planet, is a microcosm of the Anthropocene. Modification of our river systems started about 150 years ago with hydraulic mining in the Sierra foothills, which caused tremendous sedimentation downstream that in turn led to the building of levees to protect farm fields. Since that time, exponential population growth (from less than 1 million in the 1850s up to about 36 million now) and the massive development of agriculture have created the need

Decrease in system complexity.



Recent aerial photography (left) overlain by reconstruction of historical marsh channels illustrates one overarching effect of human impacts in the anthropocene: a decrease in the complexity of natural systems (Figures courtesy R. Grossinger. See also Re-Emergence of Shallow Water Ecosystems page 44).

for massive amounts of water transfer. This has led to nearly complete fragmentation of all the channel systems throughout California. Floodplains are disconnected from their channels and main stem rivers are cut off from the natural flow of their tributaries. With all this modification we have dramatically decreased system complexity, and as a result we've lost a tremendous amount of habitat and diversity.

On top of all these local changes, California is also affected by global-scale processes. Carbon dioxide concentration in the atmosphere has increased dramatically over time, with a concomitant increase in global temperature. Modeling by Snyder et al. (Geophysical Research Letters 2002) projected that a doubling of carbon dioxide would increase average annual temperature in many parts of the state on the order of 2°C and decrease snowpack on the order of 6 to 12 cm snow-water equivalents over the next 50 years. In fact, over the past 50 years we're already seeing peak runoff occurring 5 to 20 days earlier (Stewart et al., Climatic Change, 2004). Another global-scale forcing event is sea level rise. Based on the average of 35 different scenarios, we can expect a rise of 30 to 50 cm, which will have a major effect on saltwater intrusion in the Delta.

A geological concept known as "Uniformitarianism" that originated in the 18th century holds that "the present is the key to the past." In our efforts to predict the effects of global change we have relied on the related idea that "the past is the key to the future." But in the Anthropocene, it's not clear that this still holds true. Human actions now are so huge and pervasive compared to geologic actions that we have disconnected the past from the future. This makes it very difficult for scientists who want to help managers and policymakers by predicting what we can expect.

So how can we move forward? First, we need to really understand the basic processes and functions of these complex systems that we have created. Then we need to build models for those systems and test them under present conditions so we know they are robust and we know their limitations. And then we can try to project changes into future scenarios of climate and resource use change.

To gain this understanding and build these robust models will require decades-long monitoring projects so we know what questions to ask. It will require research at a variety of scales, including experiments at the system scale like the Grand Canyon experimental flood. Finally, we will need to build a culture of science and exploration in the broader society by reaching out to citizens and K-12 students and getting them involved in collecting data and doing science with us.

All this is going to be very difficult. But it's crucial. Because if we don't intervene, I think the Anthropocene is going to be fairly short.