Science News

News from the CALFED Science Program

Late-spring flowers bloom along a levee near Suisun Bay.

Value of a Variable Delta:
CALFED Science Program Workshop

In the past, water management decisions in California were determined primarily by the demands of agriculture, industry, and urban residents. Now, increasingly, water management decisions are being dictated by conservation of species in the Sacramento-San Joaquin Delta that are listed as threatened or endangered under state and federal law. The recent shutdown of pumps that export water from the Delta to farmers and 23 million Californians is a good example of the effect these species can have on water management.

One species in particular, the Delta smelt, has figured largely in recent decisions. Smelt numbers have been declining rapidly for a number of years, despite numerous changes in water management intended to prevent further decline. Smelt numbers are the lowest

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ISB Establishes Foresight as Key Role

The CALFED Independent Science Board spent much of their June 7-8 meeting identifying how they can add value and understanding to California's complex water system. Looking at their roles in the Delta smelt crisis, the process of critically examining science reviews, and the Delta Vision process, the ISB identified foresight as a key strength they could provide to policymakers and resource managers for addressing future critical issues.

See **ISB Meeting** *page 4*

Sharing National Ecosystem Experiences

The CALFED Program was highlighted at a national conference that utilized a unique forum to give leaders in science and resource management the opportunity to deliberate about large-scale ecosystem restoration programs. The National Conference on Ecosystem Restoration held April 23-27 in Kansas City, Missouri, held informal "coffee house" forums that allowed a candid exchange of ideas on what practices and processes are used for dealing with large-scale multiple-year projects; conversations addressed what worked, what did not work, and why. Large-scale programs were chosen because as restoration programs expand new challenges

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Science News
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Also In this Issue

CALFED Science Program

Establishing a Body of Knowledge

The CALFED Science Program's mission is to integrate peer reviewed science into every aspect of the CALFED Bay-Delta Program. The Science Program is establishing the best scientific information possible to guide decisions and evaluate actions critical to the CALFED Program's success.

The long-term goal of the Science Program is to establish an unbiased, relevant and authoritative body of knowledge integrated across program objectives and communicated to the scientific community, agency managers, stakeholders and the public.

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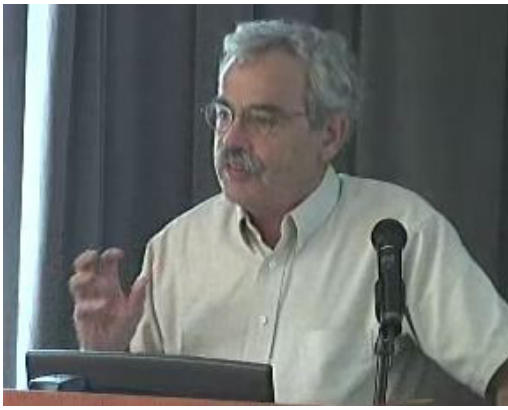
Variable Delta: *Continued from front page*

ever recorded and evidence that they were being pulled into the export pumps was the trigger for shutting the pumps down. But smelt are not the only species in trouble in the Delta.

"We have to not be bound by the past, but use things as models for what we would like to have, and think of what they might be in the future."

– Peter Moyle

Scientists have been working to understand why these species continue to decline despite management efforts to reverse the declines. Although the data are by no means conclusive, a number of knowledgeable and respected Delta scientists are starting to argue that the threatened species could be helped by creating greater habitat variability in the Delta. This was one of the prescriptions for a sustainable Delta put forward in the Public Policy Institute of California report, *Envisioning Futures for the Sacramento-San Joaquin Delta*. The report authors argue that a more variable Delta could greatly benefit native species, control invasive species, and still allow water conveyance through the Delta. But exactly what should vary, where, and how much was not clearly defined. Nor was the scientific basis for the hypothesis clearly laid out, leading to lots of debate and confusion. To clarify what was meant by a variable Delta and lay out the scientific evidence, the CALFED Science Program hosted a workshop *Defining a Variable Delta to Promote Estuarine Fish Habitat*, on June 11. A panel of scientists presented the ideas and the scientific evidence and debated the potential benefits and costs of making the Delta environment more variable with an audience of more than 130 public participants (70 more watched the workshop by webcast). The consensus



Peter Moyle

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PPIC Report: Why a Fluctuating Delta?

The Public Policy Institute of California's *Envisioning Futures for the Sacramento-San Joaquin Delta* defined several alternatives for the Delta. The underlying assumption of their report was that the current Delta, designed to serve as a freshwater conveyance system, is unfavorable to native fisheries. Endemic native species, like the Delta smelt, developed to thrive in a much different, more diverse ecosystem. These species require significant seasonal and interannual fluctuations between freshwater and tidal flows. The PPIC report argues that a variable, mixed system – in both space and time – would more likely support native species while simultaneously disrupting invasive species.

To achieve this end, the PPIC report put forth three "fluctuating" or variable Delta alternatives. These alternatives all share in promoting changing environmental conditions in the Delta, especially through the management of salinity exchanges in the western Delta. To accomplish this, each of the three alternatives tries to break the dependency of water conveyance from the Delta by either: routing water around the Delta, or reconstructing through-Delta conveyance to isolate and protect the western Delta. Isolating the western Delta from water conveyance will allow more diverse, fluctuating habitats without compromising water quality for southern export. The PPIC authors argue that all of these alternatives are capable of handling current water export needs for the south-state by being less dependent upon Delta conditions and more upon north-state water supplies.

The argument for a fluctuating Delta is two-fold. First, a Delta with fluctuating patterns of salinity would be more hospitable for native species and less for invasive species. Second, the Delta would provide a mosaic of habitats for species, much different form uniform habitat found throughout today's Delta.

The PPIC report argues that fluctuation in Delta salinity could occur in several ways, either seasonally, or over longer multiple year periods. One argument for reducing Brazilian waterweed as well as Asiatic and overbite clams is to allow salt to penetrate deeply into the central and western region of the Delta during annual low flow periods but during high flow periods release more water through the Delta to push the salt wedge far seaward to create variable salinity over a wide area. During wet periods the salt intrusion will be less (the Delta will be essentially fresh year round) and during dry periods the intrusion will be greater. The premise for this approach is that salinities must rise to 10-12 parts per thousand (ppt) over large areas for up to 4 months to affect waterweed and clams significantly, (for comparison seawater is 35 ppt and freshwater is less than 3 ppt).

Variable Delta: *Continued from previous page*

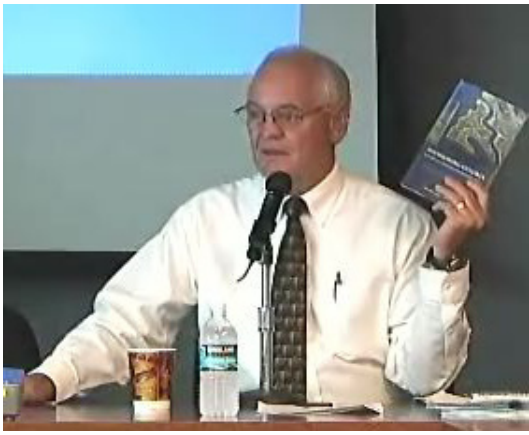
of the workshop was that increasing variability in salinity, water residence time, and other habitat variables could benefit valued species but many uncertainties remain to be worked out.

Variability in the Delta includes such factors as water velocity, nutrients, temperature, salinity, and water residence times. Water residence time is an important descriptor because longer residence time increases the time for food production, population growth, or exposure to sunlight, contaminants, predators, or grazing. The current Delta configuration, however, promotes uniformity in water residence time and, consequently, uniformity of habitats. Jon Burau, US Geological Survey, argued that the original Delta had a dendritic, or branching, treelike form that promoted diversity in water residence time and other factors and allowed species to make use of different habitats during their different life stages. The current Delta, however, has a geometry of interconnected "loops" that mixes and unifies the Delta into a single habitat type. Species no longer have the choice of habitats they had in the past. Although there have been many human caused changes in the Delta over the past 200 years, Burau argued that changes to the Delta's configuration from agricultural reclamation and conveyance had the greatest effect on creating Delta uniformity.

Variation in salinity, how much it varied in the past, and how much it should vary to benefit listed species, received considerable discussion. It was generally agreed that variation in salinity alone is insufficient to generate needed habitat diversity, although it is an important factor, particularly in its potential impact on invasive species. Peter Moyle, University of California, Davis, argued that varying salinity in parts of the Delta could create waterweed and clam free zones. Jan Thompson, US Geological Survey, however, stated that the clams are very adaptable and would probably always be in the Delta. This was particularly the case because, of the two species that cause the greatest problems, the Asian clam (*Corbicula fluminea*) prefers fresh water and the overbite clam (*Corbula amurensis*) prefers salty water. The Delta already varies in salinity spatially and temporally. However, seasonal patterns have changed, transitions are now more abrupt, and changes occur more frequently. For example, historically Suisun Marsh experienced five to six months of freshwater allowing species like the Delta smelt to grow to maturity there before returning upstream to spawn. Now, Suisun Marsh is fresh for only a few weeks in fall. In the future, the scientists predict that salt water will encroach further into the west Delta as sea level rises and the result will be even less variability. Several speakers noted that the Delta is somewhat saltier now than in historic times. However, the scientific panel felt that history needs to be thought of as a guide and not a goal.

"It is only now that we can begin to engage in the difficult questions. Ten years ago we were not yet ready."

– Jan Thompson



CALFED Deputy Director of Science, Ron Ott opens the workshop referencing the PPIC report that argues, in part, for a variable Delta.

The workshop participants also concluded that planning and management for aquatic and terrestrial ecosystems need to be better integrated. The potential conflict is illustrated by Suisun Marsh. Suisun Marsh is currently managed as a freshwater wetland and is regarded by terrestrial biologists as a bird habitat of international importance. However, fisheries biologists view tidal marsh restoration in Suisun Marsh as having a significant potential to benefit desirable fish species.

A question from a member of the audience illustrated the complexity of any attempt to address the Delta ecosystem's problems. He asked whether white sturgeon could be used to help manage the invasive clams. The invasive clams are highly productive and aggressive competitors for the limited phytoplankton produced in the Delta and estuary. White sturgeon, a species native to the Delta, eats clams and can be an important predator in controlling their numbers. However, the clams contain high levels of selenium that inhibits sturgeon reproduction. Thompson noted that this was a great example that there are few easy answers to the problems in the Delta, and that caution is needed so that we do not create new problems with our solutions. Introduced species and contaminants will continue to confound our ability to make predictions about how the Delta system will respond to management.

Overall, there was a strong consensus that a more variable Delta had the potential to improve conditions for endangered native species and should be seriously considered in developing scenarios for a sustainable Delta.

A report on the outcomes of the Variable Delta workshop will be produced by the Science Program, and should be available in early July. For more information, visit: *http://science.calwater.ca.gov.* The webcast is available for viewing at: *http://www.visualwebcaster.com/event.asp?regd=y&id=40345*.

ISB Meeting: Continued from front page

ISB Chair Jeff Mount identified the ISB's role in three categories: *oversight* to ensure the quality of science used in program planning and implementation; *insight* of Board members' expertise to advise the Program; and *foresight* where the board can foresee future issues for California's water system and promote early science efforts to help prepare policymakers for later actions.

Board members agreed that the ISB needs to be a more proactive body in providing foresight and that the board, as currently structured, is not designed to deal with crisis issues like the decline of the Delta smelt.

The ISB will emphasize foresight during their August meeting. They will hear two oral presentations from individual ISB members on anticipated future issues and science needs. The ISB will also emphasize foresight into their examinations of how programs use science. The ISB assessment of the Environmental Water Account technical and comprehensive reviews will include recommendations for addressing scientific issues if a future EWA-style program is considered.

Delta Vision Executive Director, John Kirlin briefed the board on the use of science in the Delta Vision processes. The ISB agreed to participate in evaluation of the Delta Vision assessment template for appraising competing Delta Vision scenarios. The process, while not yet formalized, will likely use expert opinion to compare and rank scenarios developed by the Delta Vision Task Force based on a list of 11 general attributes. These attributes include environmental and economic aspects of sustainability, and should form the basis of the evaluation.

Whether to address the dramatic decline of the Delta smelt was also of concern for the ISB. During the public comment period, Senior Attorney, Katherine Poole with the Natural Resources Defense Council asked the ISB to call for the convening of the EWA's Tier 3 independent science panel to examine why Delta smelt have dramatically decreased this year. After consultation with legal counsel the ISB determined that they could not take action at this meeting because the request was not shown as an action item on the agenda.

Also during the meeting, the ISB was briefed on current water and CALFED issues by Deputy Secretary for Water Policy and Director of the California Bay-Delta Authority, Joseph Grindstaff. They were briefed on the status of the Science Program's State of the Science for the Bay-Delta report, and about performance measures for CALFED resource management objectives, where they provided comments and suggestions for improving performance reporting.

The ISB will meet again via conference call in mid-July, with their next scheduled meeting August 28-29. For more information, visit: *http://science.calwater.ca.gov/ISB*.

Nobriga and Culberson Recognized for POD Work

CALFED Science Program scientists Matt Nobriga (l) and Steve Culberson (r) were recognized by Steve Ford (c) and the Department of Water Resources, for their contributions to the Pelagic Organism Decline work team over the past two years.

Upcoming Science Program Events

ISB Conference Call

July 17, 2007, 10am-1pm

For more information, visit: *http://science..ca.gov/ISB*.

ISB Meeting

August 28-29, 2007

CALFED, 650 Capitol Mall, 5th floor, Sacramento, CA.

For more information, visit: *http://science.calwater.ca.gov/ISB*.

8th Biennial State of the Estuary Conference

October 16-18, 2007

Scottish Rite Center, 1547 Lakeside Drive, Oakland, CA.

For more information, visit: *http://sfep.abag.ca.gov/soe*.

Upcoming Events of interest

Delta Vision Blue Ribbon Task Force

July 19-20, 2007

Humphrey's on the Delta
One Marina Plaza, Antioch, CA

For more information on Delta Vision events, visit: *http://www.deltavision.ca.gov*.

Still Battling the Inland Sea

July 24-26, 2007

Holiday Inn, Capitol Plaza, Sacramento, CA

For more information, visit: *http://www.samesacramento.org/*.

Water Education Foundation: Delta Vision Workshop

July 27, 2007

Fresno Convention Center, 848 M Street, Fresno, CA

For more information, visit: *http:www/watereducation.org/DeltaflyerforJuly27.pdf*.

Coffee Houses: Continued from front page

arise. The intent of the coffee houses was to build a shared knowledge base for more sustainable solutions.

There were three restoration Coffee House sessions: "Defining Success," "Setting Priorities," and "Measures for Determining Success." Each session tracked efforts of four major restoration programs: the California Delta (CALFED), Missouri River, Chesapeake Bay, and the Florida Everglades, and offered an opportunity for these national programs to evaluate and synthesize useful information. These programs were chosen because of their multiple jurisdictions, either political or by watershed, and range of expenditures from multiple millions to billions of dollars. All programs shared having pressures from both politicians and the public to show early successes for costs. The projects had a common experience – one shared by many smaller restoration efforts – that if they spent restoration dollars ahead of scientific understanding of the environmental issues, e.g., research, they had to backtrack to prove that they were reaching their intended goals.

The first session "Defining Success" discussed a major question for any restoration effort: What will a successful implementation of a program look like? This question is even more critical for larger ecosystem programs that include numerous groups of invested stakeholders, a broad range of expectations for the program, and rely heavily on early agreements for planning. "Defining Success" evaluated and discussed how building agreements and support was achieved, as well as how success is measured. Diana Jacobs, retired deputy director for California Department of Fish and Game, represented CALFED in this session.

This Coffee House showed that various programs measure success differently. The Everglades program, for example, defined success as a balance between negotiating the competing strategies of either getting the hydrology correct and accepting whatever ecosystem comes out, or setting endpoints for what species were wanted and working to them. Other programs saw success as achieving broad agreements during the early stages. Lessons learned include: begin work from a broad, well-defined, guiding image; the program has to be bigger than any one leader because of the threat of political upheaval and governmental changes; and, while science is very important, the data maybe interpreted to tell many different stories.

CALFED Deputy Director for Science, Ron Ott moderated the second session "Setting Priorities" with CALFED representation by Denise Reed, advisor to the Delta Regional Ecosystem Restoration Implementation Plan. This session looked at how priorities were set and adapted for the multi-year restoration projects in addition to the problems encountered in meeting those priorities. Of particular interest was how managers, faced with different technical, financial, and political pressures on programs, adapted priorities and what methods they used for allowing adaptability. Chesapeake Bay used ecological priorities and biological opinions to set their program's blueprint. CALFED relied heavily on scientific evaluation and targeted research, while the Everglades used annual adjustments to budget and schedules.

NCER Restoration Coffee House, Setting Priorities. Pictured from left to right, Frank Dawson, Chesapeake Bay, moderator Ron Ott, CALFED, Mike George, Missouri River, and Denise Reed, University of New Orleans, CALFED.

Lessons learned from this session included the importance of setting early priorities based on reaching specific targets or a direction. Individual program priorities are also important in setting national priorities and receiving national support. While each successive stage of the implementation plan sets priorities in larger units of time, the use of smaller targets allows better buy-in among stakeholders and politicians.

The final coffee house session identified "Measures for Determining Success." CALFED Science Program Manager Lauren Hastings represented the California Delta in this session, in a program that looked at performance measures for assessing results and using outcomes to guide adaptive management decisions. Of concern was whether such measures – important for public accountability – were appropriately designed or if the information was helpful for project managers. CALFED, for example, propses to use indicators to monitor how well the system is doing and performance measures to show how well the program is meeting its objectives. Panelists stressed during the Coffee House that there is a need to make performance measures understandable to the public, and available for analysis by stakeholders. Regardless, the opinion was that the public only wants to see successes. One way to assure such success was to highlight accomplishments of a keystone species or simplified indicator.

The NCER intends to publish the conclusions reached during the restoration Coffee Houses as a "restoration strategies" white paper in mid-summer.

Delta Smelt's Size Also in Decline

While the numbers of Delta smelt have declined dramatically over the past few years with this year's count at only 7 percent of normal, such low numbers are only part of the troubling times for Delta smelt. Their actual size and variability maybe shrinking too.

William Bennett, of the University of California Davis' Center for Watershed Sciences and Bodega Marine Laboratory, has observed a trend of declining size and viability in Delta smelt for the past ten years. Although the reasons for this decline are not known for certain, Bennett speculates it may be resulting from selective removal of the largest females by the large export pumps near Tracy. Bennett's argument is that high flow pumping in the late winter and early spring occurs precisely when the largest and most fit Delta smelt are spawning. Pumps do not necessarily take these larger smelt, but they can take larvae that are born 10-14 days after spawning that drift downstream with the water currents.

By mid-April, pumping is decreased as part of the Vernalis Adaptive Management Program to protect juvenile Chinook salmon migrating from the San Joaquin River. This is the same time that slower growing and possibly less-fit Delta smelt spawn. Although these smelt lay smaller, fewer, and less viable eggs, their larvae can survive entrainment because of the reduced pumping flows. The problem becomes – only the weakest are surviving – a Darwinian debt that could take some time to correct.

Bennett argues that the accidental and prolonged loss of larvae produced by bigger females was enough to reduce the average size of adult Delta smelt, and may reflect an adverse effect of water exporting activities on the population. The implications for the smelt population are serious. Small females lay small eggs that produce small larvae and fry that are less hardy and more vulnerable to predators and environmental changes. Removing the large smelt may also be affecting the genetics of the stock that keeps it healthy and resilient.

Such a problem is not unique to Delta smelt. Human-related pressures have been noted as causes for declines in size and viability for other species. Fishing pressures on walleye, a common cold water lake fish, have threatened the age diversity of spawning fish, an important characteristic for producing a resilient stock. Paul Venturelli with the University of Toronto found that it is this breadth of age that affects both the size and viability of the walleye. Older, larger walleyes produce more and larger eggs with higher survival rates for the larvae. Removing older fish reduces the ability of walleye to replenish their populations.

Healthier, faster growing offspring of older fish are also getting penalized evolutionarily for becoming large enough to get caught earlier. According to Steven Berkeley, fisheries research biologist with the University of California, Santa Cruz's Institute of Marine Science, it is the older black rockfish that produce larger offspring with a greater ability to survive environmental changes. Eggs from older fish have more energy-rich food for their larvae. These food reserves increase the larvae's ability to both resist starvation and to grow larger and faster then rockfish with smaller food supplies. But, as they grow faster, they are also getting caught younger and not replenishing the older fish stock. Berkeley argues that fisheries management could help by changing regulations on size limits of catches to include a maximum size limit to allow the largest fish to survive and breed.

Given the current perilous situation of Delta smelt, the declining size of adults needs to be taken seriously. One recommendation is to change the timing of water exports. However, even if this trend of declining size for Delta smelt is stopped, there is little selective pressure to force Delta smelt back to larger more resilient individuals. Further, the size of Delta smelt may be a moot point. Low population numbers reported this year may mean an even greater problem - removal from the wild. While Delta smelt are very resilient, able in most cases to bounce back quickly from a drop in numbers, the concern is that there may be too few smelt to allow pairing for spawning.

Delta Smelt

Delta smelt (*Hypomesus transpacificus*) are unique to the Sacramento-San Joaquin Estuary. They are on average 2-3 inches long, though some historically reached 5 inches. Typically living only one year, their range extends from San Pablo Bay to Sacramento, and Moss Landing on the San Joaquin River. They commonly inhabit brackish water with salinity levels of less than two parts per thousand. However, Delta smelt are tolerant of a wide range of salinity and can occasionally be found in areas with levels above 14 parts per thousand. Delta smelt are an open-water (pelagic) species living in the water column above the estuary bottom.

Considered an indicator species for the health of the Delta system, Delta smelt represent the decline of many Delta fish, including stripped bass, threadfin shad, and longfin smelt. In 1982, the smelt's population began a steep drop and in 1993 it was listed as "threatened" by the US Fish and Wildlife Service. Since then, the population of the Delta smelt has continued to decline. In 2005, Delta smelt abundance was 2.4 percent of 1993 numbers and this year's count is estimated at 8 percent of 2005.

Spawning success for Delta smelt may be influenced by lunar phases, a specific water temperature range, and eggs deposited on suitable sediment. Delta smelt feed nearly exclusively on copepods, a minute crustacean and a dominant zooplankton of the estuary. For Delta smelt to thrive, an abundance of copepods must be available to Delta smelt as they travel during particular life stages.

CALFED Science Program Represented at National Conference

Members of the CALFED Science Program participated in the second National Conference on Ecosystem Restoration, a meeting that offered scientists and resource managers from around the nation the opportunity to deliberate about ecosystem restoration. The conference, titled "Spirit of Cooperation," had more than 750 attendees representing 20 major ecosystem projects from throughout the United States, and was held April 23-27 in Kansas City, Missouri.

Deputy Director **Ron Ott** served on the planning and "Coffee House" committees for the CALFED Science Program. Presentations where made by several CALFED scientists: **Lauren Hastings** presented findings evaluating how adaptive management is working for the CALFED program; **Rebecca Fris** presented the lessons learned from ecosystem restoration projects for Butte Creek, Clear Creek, and Battle Creek; and **Darcy Jones** presented adaptive management of the California Delta using conceptual models developed for evaluating restoration actions by the Delta Regional Ecosystem Restoration Implementation Plan.

CALFED scientist also participated in the poster session. **Barbara Marcotte** presented a poster about "Integration of Science and the TMDL Framework," **Jana Machula** presented a poster about the "CALFED Science Fellows Program: Improving Science Application and Integration in Resource Management," and **Michelle Shouse** presented a poster entitled "View from a Mudflat: Benthic Community Recovery from Trace Metal Contamination in South San Francisco Bay." **Steve Culberson** served as moderator for "Structural Considerations for Restoration," and **Ladd Lougee** moderated "Restoration of Western Lands."

The NCER was formed to help integrate, share, and communicate scientific information into resource management decisions. The first NCER conference was held December 2004 in Orlando, Florida, and jointly sponsored by the U.S. Army Corps of Engineers and the U.S. Geological Survey. This year's event included many more sponsors, including the CALFED Bay-Delta Program. For more information, visit: *http://conference.ifas.ufl.edu/NCER2007*.

BDCP Lead Scientist Named

The Steering Committee for the Bay Delta Conservation Plan has named **Denise Reed** as BDCP lead scientist. The lead scientist serves to guide the science advisors to the BDCP Steering Committee as well as assigning research and analysis required by the committee.

Also named were **Bruce DiGennaro** and **Wayne Spencer** as co-facilitators. Facilitators act as liaisons between the Steering committee and the science advisors as well as providing support to the science advisors. The facilitators will also provide communications between the lead scientist and science advisors with the Steering Committee during the science advisors' deliberation period.

First steps for the facilitation team in coordination with the lead scientist are developing communication guidelines, identifying additional science advisors, and a schedule for independent science input to BDCP. The roles of lead scientist and the facilitation team was identified and approved by the BDCP Steering Committee. For more Information, visit: *http://resources.ca.gov/bdcp*

Past issues of *Science News* are available at:
http://science.calwater.ca.gov/sci_news.shtml

Lead Scientist Recruitment

The Independent Science Board has begun recruiting a new lead scientist for the CALFED Science Program. Current Lead Scientist **Michael Healey's** term ends December 31, 2007. The lead scientist provides independent nonpartisan direction to the CALFED Science Program and its development of a peer-reviewed knowledge base for guiding policy and decision makers regarding ecosystem and water management of the California water system. The lead scientist serves a term of two years. For more information about the lead scientist recruitment, visit: *http://science.calwater.ca.gov/.*

Staff News

Acting Deputy Director Named

The CALFED Science Program has announced that **Lauren Hastings** will become acting deputy director for the program. Hastings will take over the position for retiring Deputy Director **Ron Ott** July 1st.

Steve Culberson has accepted new responsibilities as the Science Program's modeling coordinator covering Delta hydrodynamics and water operations modeling efforts. In this role, he will be the Science Program's liaison to the California Water and Environmental Modeling Forum. Culberson will continue working on the State of Science for the Bay-Delta System report. **Matt Nobriga** will take on the role as Science Program liaison to the Interagency Ecological Program in addition to his Environmental Water Account duties.