Science News

News from the CALFED Science Program

The sun sets over the Delta

Science: Key to the Delta's Future

A new science center dedicated to informing public policy and supporting sustainable management of the Delta is needed to ensure that attempts to oversee this vital area and its critical resources succeed. This is the recommendation of Dr. Michael Healey, former CALFED Lead Scientist and advisor to the Delta Vision Blue Ribbon Task Force, a panel charged with developing a vision and strategic plan for the Delta's future. Recognizing the critical role that science plays in efforts to protect and manage the Delta, the Task Force asked Healey to recommend a structure and function for such a center.

In his response to the Task Force's request, Healey proposed the Delta Center for Science in Public Policy. To be based on the successful CALFED Science Program, the Center would be modified in several ways to strengthen the efficiency and effectiveness of Delta science, as well as the interpretation and delivery of scientific results to policy-makers and the interested public. The proposed Center, which remains under consideration by the Task Force, would go a long way toward ensuring that high-quality science remains integral to Delta management.

The proposed center's functions would include helping to integrate adaptive management into water and ecosystem management, undertaking integrative synthesis and modeling to address ecosystem and water-supply issues, and providing a point of access to databases for the California Delta.

A primary purpose of the Center would be improving communication efforts, with the goal of clearly and concisely identifying knowns and unknowns of scientific understanding for multiple

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CALFED Welcomes New Lead Scientist

Continuing to pursue strong science with an eye to improving the communication of its findings, Dr. Clifford Dahm has firmly taken the reins of the CALFED Science Program. Dahm, an internationally recognized expert in aquatic ecology, climatology, and restoration biology, has been appointed to lead the CALFED Science Program. Dahm began his tenure on July 1, replacing Dr. Michael Healey, who served as lead scientist from January 2007 through June 2008.

Before joining the CALFED Science Program, Dahm was a biology professor at the University of New Mexico. He served as director of the Freshwater Sciences Interdisciplinary Doctoral

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Come to the CALFED Science Conference

October 22-24, 2008

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A publication of the CALFED Science Program

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Science News October 2008

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 science 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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Science Program Supports High-Priority Research

CALFED Science Augments Ongoing Delta Studies

The CALFED Science Program recently provided more than $2 million in new funding to further ongoing research in the Delta related to such critical topics as climate change and the biology of at-risk fishes (e.g., salmon and delta smelt). This work will leverage existing studies, providing important additional information to inform the decision-making process.

Funding scientific research is a critical component of the CALFED Science Program's mission to establish unbiased, authoritative knowledge directly relevant to the Bay–Delta system. CALFED Science recently funded supplemental grant proposals to enhance ongoing research by some of the approximately 20 existing Science Program grantees. Continued funding of these efforts advanced the understanding of our complex environment, aiding managers and decision-makers.

Seventeen proposals totaling more than $4.2 million in requested funds were submitted in response to the 2007 Supplemental Proposed Solicitation Package (PSP). All proposals underwent rigorous independent review that resulted in the selection of the nine proposals listed in the table below.

More information about the selected proposals and the 2007 Supplemental PSP is available at *http://www.science.calwater.ca.gov/psp/psp_package_2007.html*.

Principal Investigator(s)	Lead Institution or Agency	Funding	Supplemental Proposal Title
James Cloern	United States Geological Survey (USGS)	$166,117	CASCaDE: Computational Assessments of Scenarios of Change for the Delta Ecosystem
Judy Drexler	USGS	$283,063	Salinity Fluctuations During the Last 7000 years in the Sacramento–San Joaquin Delta
Richard Dugdale/ Anke Mueller-Solger	San Francisco State University/California Department of Water Resources	$338,377	Comparison of Nutrient Sources and Phytoplankton Growth and Species Composition in Two Rivers: Their Roles in Determining Productivity and Foodweb Conditions in Suisun Bay and the Delta
Thomas Dunne	University of California (UC) Santa Barbara	$150,000	How Abiotic Processes, Biotic Processes, and Their Interactions Sustain Habitat Characteristics and Functions in River Channels and Their Floodplains: An Investigation of the Response of How a Reach of the Merced River Responds to Restoration
Noble Hendrix	R2 Resource Consultants, Inc	$296,442	A Statistical Model of Central Valley Chinook Incorporating Uncertainty
Lynn Ingram	UC Berkeley	$228,092	The Role of the San Francisco Bay–Delta in Juvenile Rearing for Winter and Spring Run Chinook Salmon, to be Determined by Otolith Microchemistry
Wim Kimmerer	San Francisco State University	$299,872	Foodweb Support for the Threatened Delta Smelt and Other Estuarine Fishes in Suisun Bay and the Western Sacramento–San Joaquin Delta
Peter Klimley	UC Davis	$256,676	Supplement: Survival and Migratory Patterns of Central Valley Juvenile Salmonids
Marc Mangel	UC Santa Cruz	$194,620	Life History Variation in Steelhead Trout and the Implications for Water Management: Supplemental Grant Application

2009 CALFED Science Fellows Announced

Thirteen new researchers recently won the prestigious CALFED Science Fellows award to conduct innovative research on ecosystem and water-supply reliability issues in the San Francisco Bay–Delta and Estuary. Beginning in 2009, these seven postdoctoral fellows and six doctoral students will work closely with CALFED Program agency scientists and senior research mentors to ensure scientific excellence and management relevance.

For a list of the fellows and their individual research efforts, as well as more information regarding the CALFED Science Fellows Program, please visit *http://www.science.calwater.ca.gov/research/research_fellows.html*.

CALFED Science Conference 2008:

Global Perspectives and Regional Results: Science and Management in the Bay–Delta System

October 22–24, 2008
Sacramento Convention Center
1400 J Street
Sacramento, CA 95814

Science with a "sizzle" is in store for the expected 1,000 plus attendees of the Fifth Biennial CALFED Science Conference. The conference will feature scientist-turned-filmmaker Randy Olson of *Sizzle: A Global Warming Comedy* fame and the announcement of the first-ever Brown–Nichols Science Award. Olson will conduct a screening of his film Wednesday evening and also will speak at lunch Wednesday about communicating scientific information to the public. The Brown–Nichols Science Award will be given to recognize a scientist for his or her substantive scientific contributions to the Bay–Delta community, and to honor the achievements of Drs. Randall Brown and Frederic Nichols for whom the award is named. These are just two events of a 3-day conference packed with scientific information.

The conference highlights the most up-to-date scientific information and ideas on water resources in the California Bay–Delta, its watershed, and the adjacent coastal ocean. To this end, the CALFED Science Program will unveil, on the evening of October 21st, the full version of *The State of Bay–Delta Science 2008: Summary for Policymakers and the Public*, a new report highlighting important new perspectives on water management in the Bay–Delta system. The program also will feature poster and oral presentations that describe scientific advances in ecosystem restoration, improving levee system integrity, water quality, water supply reliability, and more. The goal of the conference is to make new information available to the broad community of scientists, engineers, managers, and stakeholders working on Bay–Delta issues.

Plenary speakers at this year's conference are:

Mary D. Nichols, Director, California Air Resources Board
"Reducing California's Carbon Footprint—Toward a Clean Energy Future"

Clifford N. Dahm, CALFED Lead Scientist
"Freshwater Ecosystems in a Variable and Changing Climate: Perspectives from New Mexico, Florida, and Queensland Australia"

James Cloern, United States Geological Survey
"Think Globally and Think Locally: A Key to Building Future Visions of the Bay–Delta Ecosystem"

Amy Luers, Google.Org
"The Science and Politics of Managing Climate Risk: A Local and Global Perspective"

Dan Schlenk, University of California, Riverside
"Are Steroids the Primary Cause for the Feminization of Fish? TIE Analyses of Surface Water and Sediment Extracts Throughout North America"

For more information see the Science Conference website at:
http://198.31.87.66/sciconf_08/sciconf_register.shtml

State of Bay-Delta Science 2008 Report Available at CALFED Science Conference

The CALFED Science Program is pleased to announce that it will release *The State of Bay–Delta Science 2008* in conjunction with the CALFED Science Conference at the Sacramento Convention Center, October 22–24, 2008. *The State of Bay-Delta Science 2008* represents an extensive effort to compile, synthesize, and summarize the current scientific understanding of the San Francisco Bay and Sacramento–San Joaquin Delta (Bay–Delta) system. Intended for resource managers, policymakers, and the public, the report provides the scientific foundation for decision-making in the Delta.

Stop by the CALFED Science Program table at the conference for your complimentary copy, or check out our website after October 22: *http://www.science.calwater.ca.gov*.

The Delta Dialogue: Perspectives on Science and Policy

A Panel Discussion
October 21
Noon to 1:45 p.m.
MU II Memorial Union Building,
University of California, Davis

Join us for an opportunity to hear three past and present CALFED Lead Scientists and the Chair of the CALFED Independent Science Board (ISB) discuss water and environmental management in California within the context of the debate over the Delta's future. The prestigious positions of CALFED Lead Scientist and ISB Chair are unique in that they report directly to the key decision-makers who set California's water policy, providing a formal linkage between scientific research and policy. They will bring their distinctive perspectives to a discussion of critical emerging issues regarding the Bay–Delta and the role that science and scientists can play as future policies unfold. The panel discussion is hosted by the John Muir Institute of the Environment and the CALFED Science Program. For more information, please visit *http://johnmuir.ucdavis.edu/news/jmie_events.html#881*.

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target audiences. Policy implications of the science would be communicated to policy-makers, legislators, and the public.

Because the Delta is a dynamic system subject to multiple forces driving change, including earthquakes, sea-level rise, floods, and invasive species, continued research is needed if managers are to respond to these inevitable changes. To stimulate new science to inform policy, the Center would furnish research grants on a competitive basis, while also supporting fellowship programs for doctoral and post-doctoral students researching topics relevant to the Delta. The Center would have staff available with the expertise to help agencies develop and implement effective monitoring and adaptive management programs, increasing efficiency and accountability. The Center would also facilitate access by scientists and decision-makers to databases containing important Delta information.

Independent scientific review is a key component of efforts to evaluate how science is incorporated into water and ecosystem management. Through a network of specialists in many scientific fields, the Delta Center for Science in Public Policy would assemble teams of experts to review programs and projects. Through workshops, symposia, or direct data analysis, Center staff would assess and synthesize the science relevant to significant emerging management issues.

Like the current CALFED Science Program, the proposed Center would be led by an independent lead scientist educated in a field of science related to water and ecosystem management in the Delta. Sufficiently staffed by employees with diverse technical backgrounds, the Center would be well-positioned to coordinate and communicate the diverse scientific and engineering activities aimed at ensuring a viable future for the Delta.

The full text of Dr. Healey's memo on a Delta Center for Science in Public Policy is available at *http://www.science.calwater.ca.gov/delta_vision/dv_index.html*.

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Program and the Sevilleta Long-Term Ecological Program. A broadly trained interdisciplinary scientist, Dahm has conducted research in the areas of climate change, aquatic ecology, stream water/ground water interactions, microbial ecology, stream and river restoration, biogeochemistry, geomicrobiology, ecohydrology, and evapotranspiration.

A chemistry graduate from Boise State University, Dahm received his master's degree in chemical oceanography and his Ph.D. in oceanography/aquatic ecology from Oregon State University. Dahm is married to Rhea Graham, a geologist and water resources specialist, and the couple has two daughters in college, Katharine and Kristina.

During his second week on the job, Science News caught up with Dahm to inquire about his motivation for joining the CALFED Science Program as well as his vision and goals for his new role.

Science News: What prompted you to seek the lead scientist position?

Dahm: In the work that I have done, both in the mid-90s and more recently with some interdisciplinary education and research initiatives, the emphasis of working at the interface between science and policy has become of more interest to me. I thought this would be an exceptional opportunity to pursue this interest.

Science News: What are your goals for the CALFED Science Program?

Dahm: It's early for me to articulate clearly delineated goals, but certainly continuing the strong science program that CALFED has established is one goal. The second goal is to improve the science communication component of what we do. And then a third goal is to bring an ecosystem perspective—including both biological and abiological effects on aquatic systems—to bear on some of the questions and problems that we study here in the Bay–Delta region.

Science News: In terms of your background, are there areas of your expertise that you particularly expect to emphasize or focus on?

Dahm: One is certainly the role of climate change and variability on aquatic ecosystems. These are big issues as we face fire, drought, warming temperatures, and changing snow-melt dynamics. These are things that have to be factored in to managing these systems into the future. It's not business as usual anymore.

Science News: Aside from climate change, are there other key issues that you see looming as challenges for the Science Program to address?

Dahm: Certainly there are some very clear, ongoing problems related to contaminants and nutrient loading. And there are also significant problems involving endangered species, as well as non-native species, including non-native fishes and vegetation. The San Francisco Bay and Delta have been invaded by more non-native species than practically any other ecosystem in the United States.

The California Bay–Delta is one of the most challenging science and management puzzles in the world. I hope to be part of some of the emerging solutions that the people of California are actively pursuing.

Artificial Propagation of Native Fish: Can It Save At-Risk Species?

The imperiled delta smelt

With delta smelt and other fish species native to the Delta facing extinction, some resource managers have heralded artificial propagation (hatcheries) as a way to maintain populations of such species to prevent their extinction. Can this approach work? Could artificial propagation do more harm than good? To investigate these and other questions, the CALFED Science Program held a workshop in July on the use of artificial propagation in conserving delta smelt and Central Valley salmonids.

Artificial propagation has been used for some time to restore populations of winter run Chinook salmon; however, the technique has not been used to augment delta smelt numbers in the wild. Legislation (SB 994) introduced during California's last legislative session would have directed the California Department of Fish and Game to commence artificial propagation of delta smelt.

A major concern regarding artificial propagation has to do with whether the practice may compromise the genetic fitness of the populations to be restored. In other words, fish raised in hatcheries can develop traits that help to ensure their survival in captivity, while losing traits that help them survive in the wild. When captive-raised fish are released into the wild, they reproduce with wild fish, potentially diminishing the overall fitness of the species.

At the July workshop, scientists from around the western U.S. and experts on artificial propagation reached three main conclusions. First, artificial propagation is a proven conservation tool that can provide a critical, short-term "insurance policy" against extinction. Artificial propagation has been an integral part of comprehensive efforts to restore wild populations of a variety of fish species throughout the country. However, in most cases, the degree to which artificial propagation was responsible for the success of those programs, as opposed to other efforts such as habitat restoration or control of non-native species, has yet to be scientifically established. Second, reduced genetic fitness associated with artificial propagation will increase with every hatchery generation. Third, artificial propagation has only succeeded when it has been coupled with efforts to address the underlying cause of the decline, such as restoring degraded habitat, removing non-native predators, or changing harvest regulations.

Given these conclusions, fishery managers seeking to boost threatened and endangered fish populations must weigh carefully the potential benefits and drawbacks associated with artificial propagation.

Wastewater: A Factor in the Delta's Declining Fish Populations?

Scientists have known for years that fish populations in the Delta have been declining, but the reasons for this trend have remained unclear. Studies conducted by Richard Dugdale and colleagues at the California State University, San Francisco, that were funded by the CALFED Science Program in 2006, have raised the possibility that nitrogen-laden wastewater may be contributing to this phenomenon.

Dugdale's research focuses on how phytoplankton growth is influenced by nitrogen compounds dissolved in the water, such as ammonium and nitrate. Phytoplankton consists of microscopic organisms that drift in water and provide the foundation of the food web for fish and other aquatic life. For example, phytoplankton is consumed by drifting animals known as zooplankton, which in turn are eaten by fish. Ammonium and nitrate are forms of nitrogen commonly found in high concentrations in urban and agricultural wastewater. Traditionally, both forms of nitrogen are considered important nutrients for phytoplankton and plants. In the turbid, nutrient-rich waters of the Delta and San Francisco Bay, light, not nutrient availability, is generally thought to limit phytoplankton growth.

In their previously funded study, Dugdale and his colleagues found that even with sufficient light, some types of phytoplankton grew very poorly in Suisun Bay water when ammonium concentrations were high, but grew better when ammonium concentrations were low. In particular, high ammonium levels prevented

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Conveyance Modeling: Assessing the State of the Science

As the Delta's future moves toward the increased likelihood of major changes in the way water is moved through and/or around its borders, there is an urgent need to better understand how the Delta's ecosystem and water supply would be affected.

The work of the Delta Vision Blue Ribbon Task Force has made it acutely apparent that there is an unmet need for more comprehensive models capable of simulating complex interactions among the Delta's physical (flow speed and volume, temperature, levees, etc.) and biological (fish, plants, food webs, etc.) components. The Task Force needs to be able to assess the impacts of different scenarios for conveying water in and around the Delta. State-of-the-art mathematical models that accurately inform how the Delta and its ecosystem will respond to possible changes in hydrodynamics (how water moves) and water quality are much needed.

The extent to which existing models currently provide these types of information was the subject of two workshops conducted by the CALFED Science Program last spring. The workshops evaluated hydrodynamic models and their ability to simulate the effects of conveyance alternatives on the Delta's water supply. The workshops also explored how hydrodynamic models and ecosystem responses were linked.

Participants concluded that while existing hydrodynamic models provide highly reliable information on potential conveyance alternatives, the same is not true for models designed to simulate the Delta's ecological responses to conveyance alternatives. This is largely because the level of investment in the development of hydrodynamic models has been much greater than that for ecosystem models.

Three hydrodynamic models identified by workshop participants (DSM2, RMA2, UnTRIM) can provide the Task Force with reliable information regarding the effects of different conveyance approaches on the Delta's water flows and levels. Although the models contain some room for improvement, their various limitations are well understood.

By contrast, models for predicting ecosystem dynamics are not nearly as robust. Workshop participants noted that existing ecosystem models tend to address specific questions about certain species or specific ecological functions. These models do not yet provide a holistic approach that assesses how multiple components of the Bay–Delta ecosystem might respond to possible future conditions. Ecosystem-model-development efforts will be the subject of two sessions at the CALFED Science Conference scheduled for October 22–24 in Sacramento.

Memos from former CALFED Lead Scientist Michael Healey to Phil Isenberg, chair of the Delta Vision Blue Ribbon Task Force, summarize the outcomes of the spring workshops and are available for downloading at *http://www.science.calwater.ca.gov/events/workshops/workshop_dcm.html#dcm2*.

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spring blooms of large, nutritious phytoplankton. The absence of such blooms can be detrimental to the entire food web, including fish. In addition to this indirect effect on fish via phytoplankton and the food web, ammonium and especially another closely related form of nitrogen—un-ionized ammonia—can also be directly toxic to fish.

To better understand the ecological impacts and significance of ammonia pollution upstream of Suisun Bay, the CALFED Science Program has increased its funding to Dugdale and colleagues to determine the effects of ammonium on phytoplankton throughout the Delta. In addition, the State Water Resources Control Board and the Department of Water Resources are funding studies about direct toxic effects of wastewater ammonia on local fish and phytoplankton.

Dugdale's team will evaluate the extent to which differences in the concentration of ammonium and nitrate in treated wastewater discharged from two major treatment facilities are contributing to differences in phytoplankton growth and species composition in the Sacramento and San Joaquin rivers, the central Delta, and Suisun Bay.

The different wastewater treatment facilities in Dugdale's study produce different types and amounts of nitrogen, thus allowing a comparison of sites and providing increased learning opportunities. Specifically, the Stockton wastewater treatment plant (WWTP) recently adopted more advanced treatment techniques. It is now discharging relatively low amounts of ammonium with higher amounts of nitrate into the San Joaquin River. Higher levels of nitrate can increase phytoplankton growth and also affect the types of phytoplankton. The shift in the type of dissolved nitrogen in the Stockton WWTP discharge could thus affect the food web within the San Joaquin River and beyond. Meanwhile, the Sacramento Regional WWTP continues to discharge high amounts of ammonium and relatively low amounts of nitrate into the Sacramento River.

Using cutting-edge techniques to measure phytoplankton growth responses and monitor phytoplankton populations in real-time, the researchers will compare the growth and composition of the phytoplankton communities within the San Joaquin and Sacramento rivers. The research will shed some much-needed light on what may be one of the more intricate reasons behind the Delta's diminishing fish populations.

Additional discussion on this topic will occur at CALFED Science's 5th Biennial Science Conference (see page 3 for a description).

SFEWS Reminder Latest Issue Available

The latest issue of *San Francisco Estuary and Watershed Science* (SFEWS) can be downloaded at *http://repositories.cdlib.org/jmie/sfews/vol6/iss2/*. The SFEWS is a peer-reviewed quarterly journal that publishes research about science and resource management of the San Francisco Bay, the Sacramento–San Joaquin Delta, and upstream watersheds.

Volume 6, Issue 2 (June 2008) contains five informative papers:

- **Wildlife Response to Riparian Restoration on the Sacramento River.** Millions of dollars have been spent to restore habitat on the Sacramento River, yet few studies of wildlife responses to these efforts have been published. Researchers from conservation groups, academic institutions, and government agencies present their findings from a suite of studies that assessed responses of insects, birds, bats, and rodents. In aggregate, the findings provide convincing evidence that restoration along the Sacramento River has successfully restored riparian habitats for a broad suite of faunal species.
- **Losses of Sacramento River Chinook Salmon and Delta Smelt to Entrainment in Water Diversions in the Sacramento–San Joaquin Delta.** Pumping at the water-export facilities in the southern Sacramento–San Joaquin Delta kills fish at and near the associated fish-salvage facilities. Wim J. Kimmerer, a researcher at San Francisco State University, estimates the proportional losses of Sacramento River Chinook salmon (*Oncorhynchus tshawytscha*) and delta smelt (*Hypomesus transpacificus*) to place these losses in a population context.
- **Habitat Associations and Behavior of Adult and Juvenile Splittail (*Cyprinidae: Pogonichthys macrolepidotus*) in a Managed Seasonal Floodplain Wetland.** Researchers from the California Department of Water Resources examined the use of managed seasonal wetlands to support spawning and rearing of Sacramento splittail, a California and federal Species of Special Concern. Wild adult splittail were captured and transferred to an engineered wetland where successful spawning occurred, and use of wetland habitat by both adult and young splittail was characterized.
- **A Note on the Effect of Wind Waves on Vertical Mixing in Franks Tract, Sacramento–San Joaquin Delta, California.** Although shallow-water habitat is central to the ecological processes of the Sacramento–San Joaquin Delta/San Francisco Estuary system, data on the structure of flows and mixing in shallow waters are extremely limited. To augment existing data, researchers from the University of Western Australia, United States Geological Survey (USGS), and Stanford University used a one-dimensional model that simulates the effects of white-capping waves to investigate the importance of these waves to vertical mixing within a site in the Sacramento–San Joaquin Delta.
- **Internalizing Climate Change—Scientific Resource Management and the Climate Change Challenges.** Current projections of climate change present a number of challenges to scientists and decision-makers. In the face of these challenges, researchers from the USGS and the CALFED Science Program offer recommendations on strategic approaches that the CALFED Science Program and the scientific and public-policy communities in Central California, in general, could pursue.

Question: How do scientists know if a salmon was born in a hatchery?

Answer: Hatchery-born salmon can differ from their wild counterparts in ways obvious and not so obvious.

Let's start with the most obvious difference. Tags identifying when and where salmon were spawned are sometimes placed inside hatchery fish. Central Valley hatcheries most commonly use a small piece of wire known as a coded wire tag. Injected into a salmon's snout when it is very young, this tag has a microscopic code etched on it. To alert scientists to the presence of the tags, hatcheries typically remove a young salmon's adipose fin—a small, fleshy fin between the dorsal fin and tail—after inserting a tag into the fish. In this way, the presence of a tag can be detected without sacrificing the fish. Unfortunately, a fish must be sacrificed to remove and read the tags.

Now for the less obvious distinction. A salmon's otolith or earbone can be cut and read like tree rings. In fact, an otolith adds a new ring each day of a salmon's life. Because the otolith of a hatchery salmon differs from that of a wild salmon in several ways, scientists can examine these features to learn if a salmon was born in a hatchery. For instance, the spacing between the rings on hatchery salmon otoliths is typically larger than on wild salmon otoliths. However, the length of the otolith's center region, or nucleus, is usually longer in wild salmon. Also, the point at which salmon started feeding is usually more clearly visible on the otoliths of hatchery salmon than on those of wild salmon.

Do you have a science question about the Delta you would like answered?

To have your question considered for *Science News*, e-mail Ladd Lougee at *llougee@calwater.ca.gov*.