model. These are necessary because these mechanisms are always working—they are the fundamental equations of the ecosystem. In any given time and place not all of them will be simultaneously equally important in determination of the dominant dynamics of a particular state variable. However, although empirical data can sometimes give an indication of which have been important at particular areas of the state space of (time, place, species, etc.), it is impossible to second-guess which will be important in the future. If some of these mechanisms are unimportant in a particular analysis, then the analysis will show it. I have seen criticisms that food web models show the food web to be important because the model emphasizes the food web. The point is to build a model which places appropriate emphasis on all the mechanisms influencing the variables of interest where "appropriate" is determined by knowledge of the system.

Model predictions in a system as proposed will likely be subject to "critical sensitivity to parameters and initial conditions"—what this means is that the system dynamics will sometimes be "chaotic," or highly variable, like a computer's random number generator. Does this mean that the system will not be predictable? No more or less so than reality is, ultimately, predictable. What it does mean is that those aspects of the real ecosystem which are predictable can potentially be captured reliably by this approach. If specific population values at specific times and places are not predictable, then patterns, frequencies and envelopes of variability likely will be predictable, and the model will also predict exactly how likely. Even a random number generator follows a distribution function and has frequency characteristics. I look at a weather prediction model on the Internet almost every day (http://wxp.atms.purdue.edu/maps/eta/eta_pres_4panel.gif) and sometimes its right and sometimes not. However the pattern of weather which it predicts is virtually identical to the pattern which I experience—in that sense this ecosystem model will have prediction capability.

The development and configuration of a research tool of this complexity is something which no one person can accomplish— it requires too many different disciplines of knowledge and must be responsive to too many varieties of analysis. A team approach is needed. The management of that team must be capable of mobilizing its resources and simultaneously avoiding the pitfalls of "design by committee".That calls for, in addition to a lot of hard work, a critical mix of willful self-determination and sacrifice of ego and opinion by the team members. The EET and the community of researchers, engineers and managers involved in the Bay/Delta certainly have the expertise to accomplish the task.

Romberg Tiburon Center Introduces New Staff

Alissa J. Arp, RTC Director, San Francisco State University

Many readers of this newsletter are probably familiar with some of the work that has been done at the Romberg Tiburon Center for Environmental Studies (RTC). RTC is an academic research and educational facility on San Francisco Bay operated by San Francisco State University. In particular, Wim Kimmerer and Steve Obrebski of RTC and Tim Hollibaugh, formerly of RTC and now at the University of Georgia, have been involved in numerous IEP projects. The purpose of this article is to introduce you to some of the other RTC researchers, our teaching activities, and some of our plans for the future of the center.

RTC is in a formative stage, revitalized and energized by new researchers and increased university and grant support. Much has happened in the last few years—we have attracted new scientists, increased the number of graduate students on site to 18, intensified our coastal research and course offerings, broadened and strengthened our ties to our community, and initiated work on our physical facility that will allow us to continue our momentum.

RTC scientists Richard Dugdale and Frances Wilkerson, both NSF, ONR- and DOE-funded biological oceanographers who recently joined us from USC, wrote a paper for *Nature*. In that paper, they laid out their explanation for the widespread and puzzling oceanic condition in which plankton productivity remains low despite high nutrient levels. The paper, based on research in upwelling waters of the equatorial Pacific, appeared in the January 15 issue, along with a companion review from a prominent German oceanographer.

Steve Bollens, a newly-hired Associate Professor of Biology and currently an ONR Young Investigator, is a zooplankton ecologist and fisheries oceanographer formerly of Woods Hole Oceanographic Institution. Steve made national news last fall when he reported on the status of a study he and East Coast researchers are carrying out as part of the GLOBEC program. They discovered that tiny predatory hydroids are floating by the millions off a large region of the New England coast, where they compete with, and perhaps prey upon, cod and haddock larvae.

Neo Martinez, a recently hired Assistant Professor of Biology, from the University of California at Berkeley (UCB), is a theoretical ecologist studying food web structure. While much of his work in this area is theoretical and synthetic, part of his research involves developing biomolecular techniques that would enable empiricists to identify and quantify gut contents using DNA signatures. Neo was recently invited to become an affiliated member of the Energy and Resources Group at UCB.

Iceworms resided at RTC for awhile after David Julian, RTC postdoctoral associate from UCSF, and I returned from a NOAA-sponsored expedition to the Gulf of Mexico last summer. The worms turn out to be a new species living on toxic methane ice mounds. Our research group focuses on the ecological physiology of marine invertebrates living in challenging environments such as these hydrocarbon cold seeps, deep sea hydrothermal vents and sulfide-enriched estuarine mud.

Our newest RTC scientist is biological oceanographer Bill Cochlan, who just joined us in March from USC by way of the Antarctic. His focus on microbial ecology and physiology is a great complement to our existing strengths at the larger phytoplankton and zooplankton level. Bill's NSF funded research will carry on the strong tradition of expertise in microbial ecology established during Tim Hollibaugh's time at RTC.

Wim Kimmerer continues in his roles as chair of the IEP Estuarine Ecology Team, lead PI of the Entrapment Zone study, PI of a study of the zooplankton of the lower estuary, and participant in the Yolo Bypass study. He has provided a long history of expertise in biological oceanography, with particular emphasis on zooplankton ecology and computer modeling.

Steve Obrebski, an aquatic ecologist and population biologist, has been associated with RTC since 1985 and has been a strong contributor to the educational program both in the classroom and as a research mentor. He is currently working with RTC scientists Trish Foshi, Terry Irwin, Mike McGowan, and graduate student Jennifer Pearson, on a California Department of Boating and Waterways funded project to study the biological effects of controlling the invasive weed *Egeria*, which blocks important waterways, greatly increasing the costs of pumping water in the San Francisco Bay/Delta.

Mike Josselyn, Professor of Biology, continues his state-funded studies to establish the viability of restoring wetlands to stabilize both the physical and biological condition of the bay. Mike maintains an active research program receiving grants and contracts from federal and state agencies to investigate issues on wetland restoration effectiveness, wetland and riparian habitat management plans, and general wetland ecology.

We are currently conducting a search for a tenure track faculty member with expertise in physical oceanography who will be based at RTC but associated with the Department of Geosciences on the main campus. We're looking for a scientist with a strong field component to their research who has experience working in coastal waters and an interest in estuarine processes. Someone with a focus on transport processes, such as particle/organism transport, will add considerable strength and round out the RTC team. Three additional tenure track hires are planned over the next few years.

Our research vessel the R/V Questuary underwent a recent engine upgrade and we were recently awarded a $99,000 NSF-Field Stations and Marine Laboratories (FSML) grant, matched with $25,000 from SFSU, to upgrade scientific and navigational equipment on shipboard. Ship time is a hot commodity, as the boat is heavily used for collecting bay specimens, water sampling, and for other research and classroom uses. A previous NSF-FSML award is funding the renovation of the old Commodore's residence on site into a Guest Center which will house visiting scientists and students in the future.

Our education mission is to provide undergraduate and graduate courses in biology, geography, and geology that promote learning in the fields of marine and estuarine biology and ecology, oceanography, and limnology. There is also a growing summer education program that provides introductory and general interest courses for the surrounding community. We have increased the breadth of our course offerings to our SFSU students and have added a shuttle service from the main campus. We have also added new summer courses such as Plant Communities of Marin County, Biological Oceanography, and Aquatic Toxicology.

This year, we are celebrating our 20th anniversary and are gearing up to enter a major capital campaign, scheduled to begin this fall. An award from the Marin Community Foundation will help us launch a professional feasibility study, and we will be hiring a Director of Development to add life and direction to the campaign effort. Our goal is to shape and implement a capital

campaign to enable us to complete the renovations to our main research building. This renovation is underway, but is only partially funded by a major NSF Academic Research Infrastructure award and university match, and is necessary for our continued success and productivity.

With its specialized niche as an estuarine educational and research center, RTC is growing into a dynamic community of scientists with a mission and momentum. Recent activities have collectively brought a new enthusiasm to the RTC community, resulting in expanding course offerings, increasing use of the newly refitted R/V Questuary, and an upsurge in collaborative science. For more information please check out the RTC web site at ttp://thecity.sfsu.edu/~rtces.

Suisun Ecological Workgroup Update

Eliza Sater, DWR

In the 1995 Bay/Delta Plan, SWRCB directed DWR to convene an interagency workgroup to evaluate the technical basis of the Suisun Marsh water quality objectives and their effects on beneficial uses. Consequently, the Suisun Ecological Workgroup (SEW) was formed in May 1995, to recommend salinity objectives to protect the beneficial uses of the Suisun Marsh. SEW envisioned this evaluation as a two-step process. The first step involved evaluating the impact of various salinity regimes on ecosystem components, such as brackish marsh vegetation, wildlife, waterfowl, and fish. This process, though continuing, was largely completed in March 1998. Findings from these evaluations, which included identification of significant data gaps, recommendations for long-term monitoring programs, special studies, water quality objectives and protective measures for special status species, were presented at an all-day workshop in March.

SEW is now embarking on the second step of the evaluation process. The workgroup is now examining the effect of various salinity regimes on the Marsh ecosystem. SEW approached this task by crafting conceptual models of each ecosystem component and attempting to link them with an ecosystem-based conceptual model. In this way, SEW is attempting to tease apart the effects of salinity, hydrology, wetland management actions and availability of habitat on ecosystem health.

Evaluating the impact of increasing the variability of the salinity regime in the Suisun Marsh is of primary interest to SEW. Proponents suggest that a variable salinity regime may match historic conditions more closely, thus supporting native species and possibly promoting species diversity by decreasing the abundance of nonnative species that can establish competitive dominance. Concern exists, however, that the Marsh has been altered to such an extent that an increase in variability of the salinity regime may not have this beneficial effect and may negatively impact the managed wetlands in the Marsh.

To evaluate these issues, SEW has been comparing the effect of various combinations of salinity regime components. The main components being evaluated are: (1) current Suisun Marsh conditions (X2 standard, Suisun Marsh Salinity Control Gate operation, interior numeric standards for the Marsh); (2) current Suisun Marsh conditions, with actions in the proposed Suisun Marsh Preservation Agreement (SMPA) Amendment Three; (3) X2, SMPA Amendment Three limited to management actions, and limited SMSCG operations; and (4) X2, with limited SMSCG operations and no interior Marsh numeric salinity standards. The group is evaluating model data, simulating flow and salinity in the Suisun Marsh with and without gate operations, as part of this process.

Lack of available data and the confounding question of how to balance competing resource needs continue to complicate SEW's evaluation. Consequently, the workgroup is reconsidering the October 1998 deadline for completion of its final report. SEW may hold a public workshop during the late summer or early fall 1998 to present findings and draft recommendations. For more information on this workshop or the workgroup in general, please contact Eliza Sater at (916) 227-0179 or check out SEW's website at http://iep.water.ca.gov/sew/.

Chinook Salmon Passage at the Suisun Marsh Salinity Control Gates Assessed

Heidi Rooks, DWR

Resource agencies have been concerned that operating the Suisun Marsh Salinity Control Gates (SMSCG) causes a delay or may block adult chinook salmon migrating upstream through Montezuma Slough (Figure 1). A multi-agency SMSCG Steering Group was formed to address this concern, assess the information available, and propose a solution, if needed. The group completed its assessment and proposed a solution which, if all goes well, should be in place with evaluations beginning by September 1998.

The SMSCG Steering Group was formed because two items—the US Army Corps of Engineers permit for the SMSCG and the National Marine Fisheries Service Biological Opinion for winter-run chinook salmon—specify that investigations must be designed to address passage of upstream migrating adults at the SMSCG. According to the Corps permit, mitigation is to be accomplished by modifying the operation or design of the SMSCG (Figure 2).

DWR and DFG, in conjunction with the Steering Group, conducted tagging studies in 1993 and 1994 to determine the success and duration of adult fall-run chinook salmon passing through the SMSCG. These experiments were conducted to determine which feature or operational configuration was responsible for delaying passage (Tillman et al. 1996; Edwards and Urquhart 1996). After considering potential population-level impacts (DWR 1997a), the Steering Group concluded from the studies that operation of the SMSCG delays and blocks the upstream migration of all runs of chinook salmon along this migratory route, at a minimum, for 12 hours each tidal cycle (6 hours two times a day), and delays passage even when just the flashboards are installed and the three radial gates are held open.

The Steering Group agreed that there are two objectives for a solution to the blockage: (1) to provide an opportunity for all races of chinook salmon and steelhead to pass unimpeded (when the flashboards are installed and the gates are operating); and (2) to not compromise the ability of DWR and USBR to meet SWRCB channel water salinity standards.

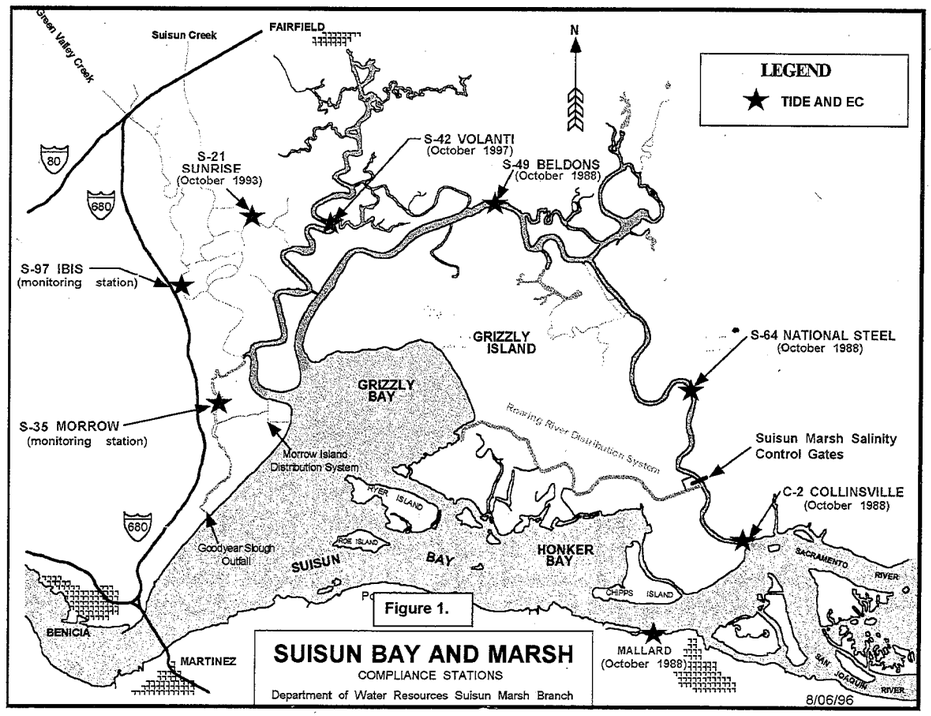

Figure 1.