

## **Background on the Algal Issues in the Delta:**

In the Bay-Delta Estuary, there has been a shift in algal species abundance and algal community composition. Two hypotheses - the ammonia paradox and ecological stoichiometry - have been advanced to explain why this change has occurred. The ammonia paradox hypothesis (by Dr. Dick Dugdale) states that elevated ammonia levels in the system have reduced the growth rate of diatoms, which are the most common phytoplankton species, and caused a shift to blue-green algae and flagellates, which are better able to grow under elevated ammonia levels. The ecological stoichiometry hypothesis (by Dr. Patricia Glibert) states that changes in the nitrogen to phosphorus (N:P) ratios has also contributed to changes in species compositions. Studies conducted in the lab and field by numerous local researchers have had conflicting results.

Over the past several years, these theories have impacted policy decisions throughout the Delta and have resulted in the large expenditure of funds by municipal wastewater dischargers. The goal of the joint workshop is to move our understanding forward on the science with which to base management decisions on, so the questions have been developed to facilitate that goal rather than focus on the conflicts between studies.

There is going to be a state change (i.e., a unidirectional, reduction in nitrogen and phosphorus loads, including a consistent shift in ammonia concentrations) in the system because of the upgrades being made to the Regional San municipal wastewater treatment plant and the new proposed municipal wastewater recycling projects at Regional San (South County Ag Program) and Modesto, Ceres and Turlock (North Valley Regional Recycled Water Project). Projected decreases of TP and TN in the system due to permitted NPDES upgrades and water recycling are anticipated to be between 16% and 26% respectively. This projected change in the loads of nutrients presents an opportunity to test the ammonia paradox and ecological stoichiometry hypotheses in the field. The purpose of the workshop is to have a panel of outside technical experts review the scientific literature of local researchers, listen to researcher's presentations and then write a white paper that identifies what research strategies they would recommend to evaluate the effects of this state change, along with additional studies that would help us resolve conflicting results. The product of the workshop is a white paper that would include their recommendations, which would be evaluated by the STAG for inclusion in the Nutrient Research Plan.

## **Overarching Question for the Workshop:**

*Please review the draft overarching question and sub set questions that the planning subcommittee has developed, and provide us with your comments and edits.*

TN and NH<sub>4</sub> loads are expected to decrease in the Delta over the next decade as a result of upgrades to Publically Owned Wastewater Treatment Plants and new water recycling projects. This expected nutrient state change may present a unique opportunity to test the NH<sub>4</sub> Paradox and Nutrient Stoichiometry hypotheses in the field. What questions and research strategies should be employed to evaluate the effect of the nutrient state change in the Delta and in Suisun Bay?

### Sub Set Questions for the Workshop:

1. NH<sub>4</sub> paradox and nutrient stoichiometry presenters will be asked to make predictions in their oral presentations about how the Delta and Suisun Bay will respond to the expected nutrient state change and to describe experiments to test the predictions. The panel will review and comment on the appropriateness of both the predictions and experimental design.
2. What nutrient monitoring, special studies, and modeling should be conducted to track the change in nutrient levels in the Delta?
3. Conflicting results have been presented for the NH<sub>4</sub> Paradox. What factors (e.g., light levels, temperature, duration of experiment, pH, salinity, grazing, initial conditions) may explain the different results? What strategy should be employed to resolve differing inter-laboratory results?
4. What bench-scale/mesocosm/field experiments should be conducted to test the NH<sub>4</sub> paradox hypothesis in the Delta and in Suisun Bay? Could these experiments be used to inform nutrient management?
5. What bench-scale/mesocosm/field experiments should be conducted to test the nutrient stoichiometry hypothesis in the Delta and in Suisun Bay? Could these experiments be used to inform nutrient management?
6. What are the appropriate and ecologically relevant temporal scales (hours, days, weeks) at which to evaluate the NH<sub>4</sub> Paradox and Nutrient Stoichiometry hypotheses in the Delta?
7. What other hypotheses/models should be evaluated to explain future changes in phytoplankton biomass and community composition?
8. What is the desired outcome, regarding biological impacts, of future management in the Delta? i.e., what does success look like, in terms of phytoplankton abundance, biomass, species composition, and what are the justifications for the outcome? What does success look like in terms of higher levels of the food web such as zooplankton and native fish species?
9. How do the Delta and Bay fit into the global spectrum of high-nutrient estuary systems, across multiple parameters? Based on the unique combination of characteristics of the Bay-Delta (e.g., habitat types, morphology, flow/tidal flux/retention time, light/turbidity, seasonal nutrient loads and forms, food web components)? What can we anticipate about the Bay-Delta's response, in comparison with responses to changes in nutrient loads observed in other estuaries?

**Areas of Expertise Identified for Panel Members (4 panel members plus the white paper author):**

*Each Panel member can have overlapping experience in more than one of the areas of expertise identified below. However, we want to ensure that panel members selected have a strong background (educational and work experience) in at least one of the areas of expertise.*

1. Phycologist with expertise on:
  - a. Algal species composition;
  - b. Biomass in the Bay-Delta Estuary;
  - c. Understanding on how algal species composition and biomass have changed over the last half century;
  - d. Harmful algal blooms.
2. Phycologist with expertise on:
  - a. Biochemistry and physiology of nutrient uptake;
  - b. Effect of nutrient concentrations, forms and ratios on carbon synthesis and biomass production;
  - c. Laboratory culture of algae and measurement of primary production;
  - d. Phytoplankton nutrient uptake rates;
  - e. Harmful algal blooms;
  - f. Understanding the big picture on likely ecological response at the base of the food web to a state change in nutrient concentrations.
3. Phycologist with expertise on:
  - a. Measurement of primary production in the laboratory and field;
  - b. Knowledgeable on how physical and chemical factors influence production and species composition in the field;
  - c. Knowledgeable of how the phytoplankton community is likely to change in response to nutrient concentration changes.
4. Ecologist with expertise on:
  - a. Zooplankton culture and zooplankton nutrition;
  - b. Capable of evaluating the effect of changing N:P ratios on algal food quality for zooplankton production and recommending follow-up studies to resolve uncertainties.
5. Local Expert with expertise on:
  - a. Knowledgeable about the Bay-Delta including its hydrology, lower food chain, and the Governor's California Water Fix and EcoRestore projects;
  - b. Individual should be perceived as neutral and unbiased.

### Potential Candidates for the Local Expert panel member:

Below is a list of three technical experts that have been proposed for the "Local Expert" position on the panel. These names are listed in the order of preference as ranked by the Workshop Planning Subcommittee. Please review the list and let us know if you have a serious concern or issue with any of the proposed candidates and then how you would rank them in order of preference (1=first contact...4=fourth contact). Also, please let us know if you have any other additional names you would like us to consider, keeping in mind the criteria that the "*Individual should be perceived as neutral and unbiased*".

1. **Dr. Wim Kimmerer** – Research Professor from the Romberg Tiburon Center for Environmental Studies, San Francisco State University  
Curriculum Vitae: <http://rtc.sfsu.edu/kimmererwww/Kimmererweb/CV.html>
2. **John Durand** – Researcher at University of California, Davis  
Curriculum Vitae (after clicking link scroll down below the notice that says you need permission. His CV is listed below that notification): <https://sites.google.com/site/ucdjrurand/curriculum-vitae-1>
3. **Jon Burau** – Project Chief at the U.S. Geological Survey  
Curriculum Vitae:  
[http://www.waterboards.ca.gov/waterrights/water\\_issues/programs/bay\\_delta/deltaflow/docs/exhibits/swrcb/burau.pdf](http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/swrcb/burau.pdf)
4. ~~**Anke Mueller Solger** – Associate Director for Projects at the U.S. Geologic Survey (prior to moving to USGS, she was the Interagency Ecological Program's (IEP) lead scientist for six years)~~  
Curriculum Vitae: not available *Anke has informed us that she is interested but not available.*

Below is the list of potential White Paper authors. The names appear in the order of preference ranked by the Workshop Planning Subcommittee members. Three tiers have been identified. Tier I indicates the candidates with the strongest support from the Subcommittee. Within each tier, the letters "a" and "b" denote an additional ranking with candidates ranked as "a" showing the strongest support; however, the ordering of the names within "a" and "b" do not signify preference. Please review the list and let us know if you have a serious concern or issue with any of the proposed candidates and then how you would rank them in order of preference.

Name	Tier/Rank	Justification	Curriculum Vitae /Background Links
Anton Post	I/a	Very research focused; knows the literature well; has worked in marine environment and Great Lakes; research includes nitrogen assimilation pathways in cyanobacteria.	<a href="http://www.mbl.edu/jbpc/files/2012/06/Post_CV_2013.pdf">http://www.mbl.edu/jbpc/files/2012/06/Post_CV_2013.pdf</a>
Paul Harrison	I/a	Although retired he is still actively researching and publishing; does appear to be based at least in part in Hong Kong; Research includes phytoplankton species composition, field methods, ammonium uptake in laboratory cultures; N:P ratios and cyanobacteria in coastal waters; papers available on ResearchGate.	<a href="http://www.eos.ubc.ca/about/emeritus/P.Harrison.html">http://www.eos.ubc.ca/about/emeritus/P.Harrison.html</a> ; <a href="http://www.researchgate.net/profile/Paul_Harrison7">http://www.researchgate.net/profile/Paul_Harrison7</a>
Hans Paerl	I/b	Very knowledgeable of literature; worked in inland, estuarine and coastal waters; familiar with Delta from graduate work; has participated on other panels associated with impairments related to nutrients (e.g., dissolved oxygen and cyanobacteria blooms). A concern identified with Subcommittee members is that he is solely focused on nutrient control. Need assurance that he would be open-minded to other solutions based on primary drivers. If selected, balance panel with algal physiology experience.	<a href="http://www.unc.edu/ims/paerllab/CURRICULUM_VITAE_2015.pdf">http://www.unc.edu/ims/paerllab/CURRICULUM_VITAE_2015.pdf</a>
Jan Stevenson	I/b	Breadth of experience from algal taxonomy to assessing ecosystem changes to nutrient criteria development for EPA and other states. Significant field monitoring and design experience, but mainly (exclusively?) inland streams/rivers.	<a href="https://www.msu.edu/~rjstev/cv.pdf">https://www.msu.edu/~rjstev/cv.pdf</a>
Robert Twilley	I/b	Significant experience with review papers and panels; concerned with effects of climate change. Tidal ecosystem work - mainly Gulf coast, mangroves. Research includes nitrogen biogeochemistry. If selected, balance panel with expert in phytoplankton species composition and taxonomy. Aside – he may be too busy, as he directs a Sea Grant program.	<a href="http://www.gulfbase.org/person/view.php?uid=rtwilley">http://www.gulfbase.org/person/view.php?uid=rtwilley</a>

Robert Sterner	II/a	Significant research experience in ecological stoichiometry, N:P ratio, nitrogen cycling. Focus of work is lakes, not estuaries. Strongly recommend for panel if not white paper author.	<a href="http://www.d.umn.edu/llo/people/bsterner.html">http://www.d.umn.edu/llo/people/bsterner.html</a>
Amelia Ward	II/a	Panel member in the 2009 CALFED review. She is retired and we are uncertain if she is still actively involved in research, publishing papers, or participating on panels. Extensive experience in the fresh-to-estuarine large river systems.	<a href="http://bsc.ua.edu/about/faculty-directory/amelia-ward/">http://bsc.ua.edu/about/faculty-directory/amelia-ward/</a>
Deborah Bronk	II/b	Focuses on bioavailability and uptake of nitrogen. Research is mainly marine environment; strong field monitoring experience. Uncertain if she has participated on panels. If selected, balance panel with experience in evaluation of N:P ratios and algal physiology.	<a href="http://www.vims.edu/people/bronk_da/index.php">http://www.vims.edu/people/bronk_da/index.php</a>
Michael Kennish	II/b	Experience in broad assessments of ecological effects, monitoring design, HAB, global climate change, nitrogen measurements, and wide range of estuarine and coastal areas. If selected, balance panel with phycologist.	<a href="http://marine.rutgers.edu/main/media/downloads/cv/cv_kennish_jun2015.pdf">http://marine.rutgers.edu/main/media/downloads/cv/cv_kennish_jun2015.pdf</a>
Antionietta Quigg	III/a	Research in algae growth, physiology, and toxicology. Experience in marine waters, brackish marsh. Wide interest, but possibly not depth because relatively early in her career.	<a href="http://www.tamug.edu/phytoplankton/People/Antionietta_Quigg.html">http://www.tamug.edu/phytoplankton/People/Antionietta_Quigg.html</a>
Cynthia Heil	III/a	Interests similar to Debra Bronk; Research is mainly marine environment; strong field monitoring experience. Has extensive experience with cyanobacteria in marine environment. Uncertain if she has participated in similar panels; relatively early in career.	<a href="https://www.bigelow.org/research/srs/cynthia-heil1/#">https://www.bigelow.org/research/srs/cynthia-heil1/#</a>
William Cochlan	III/b	Focus is marine systems, particularly nitrogen and cyanobacteria blooms. Uncertain if she has participated in similar panels.	<a href="http://online.sfsu.edu/cochlan/Bills_2012_Site/CV.html">http://online.sfsu.edu/cochlan/Bills_2012_Site/CV.html</a>
Mike Mallin	III/b	Research interests on cause and effect of eutrophication, sources and impacts of urban pollution on water quality, and nutrient and plankton ecology of coastal ocean environment; Research Coordinator for Lower Cape Fear River Program and Wilmington Watersheds Program. Uncertain about experience with stoichiometry or phytoplankton physiology.	<a href="http://uncw.edu/bio/faculty_mallin.html">http://uncw.edu/bio/faculty_mallin.html</a>

Below is the list of additional panel candidates. These names have not been discussed and ranked yet by the Planning Subcommittee members. These names are being provided to you for STAG review. Please review the list and let us know if you have a serious concern or issue with any of the proposed candidates. Please remember that all white paper author candidates (shown above) are also being considered as potential candidates for the remaining three panel seats.

Name	Affiliation	Curriculum Vitae / Background Links
Amy Rosemond	Odom School of Ecology, The University of Georgia	<a href="http://www.ecology.uga.edu/facultyMember.php?Rosemond-36/">http://www.ecology.uga.edu/facultyMember.php?Rosemond-36/</a>
Jacques Finlay	University of Minnesota, College of Biological Sciences	<a href="https://cbs.umn.edu/contacts/jacques-c-finlay">https://cbs.umn.edu/contacts/jacques-c-finlay</a>
Chris Gobler	Stony Brook University, School of Marine and Atmospheric Sciences (Long Island)	<a href="http://www.somas.stonybrook.edu/people/gobler.html">http://www.somas.stonybrook.edu/people/gobler.html</a>
John Berges	University of Wisconsin-Milwaukee	<a href="http://uwm.edu/biology/wp-content/uploads/sites/21/2014/05/Berges_John_CV.pdf">http://uwm.edu/biology/wp-content/uploads/sites/21/2014/05/Berges_John_CV.pdf</a>
David Kimmel	East Carolina University, Department of Biology (North Carolina)	<a href="http://www.ecu.edu/cs-cas/biology/kimmel_dave.cfm">http://www.ecu.edu/cs-cas/biology/kimmel_dave.cfm</a>
James Elser	Arizona State University, School of Life Sciences	<a href="https://sols.asu.edu/sites/default/files/people/cv/ElserCV.pdf">https://sols.asu.edu/sites/default/files/people/cv/ElserCV.pdf</a>
Susan Kilham	Drexel University, College of Arts and Sciences (Pennsylvania)	<a href="http://www.drexel.edu/coas/faculty-research/faculty-directory/Kilham/">http://www.drexel.edu/coas/faculty-research/faculty-directory/Kilham/</a>