Westlands Water District
3130 N. Fresno Street, P.O. Box 6056, Fresno, California 93703-6056, (559) 224-1523, FAX (559) 241-6277

April 25, 2011

Via Federal Rulemaking Portal
www.regulations.gov (Docket No. EPA-R09-OW-2010-0976)

United States Environmental Protection Agency
Attn: Erin Foresman
75 Hawthorne Street
San Francisco, CA 94105

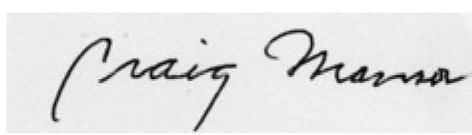
Re: Comments of Westlands Water District on EPA's Advanced Notice of Proposed Rulemaking Regarding Water Quality Challenges in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, 76 Federal Register 9,709 (February 22, 2011), Rulemaking Docket No. EPA–R09–OW–2010–0976

Dear Ms. Foresman:

Please find enclosed the comments of the Westlands Water District (Westlands) regarding EPA's Advanced Notice of Proposed Rulemaking regarding Water Quality Challenges in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Westlands appreciates this opportunity to provide input on these important issues.

Do not hesitate contact me should you have any questions.

Sincerely yours,



Craig Manson
General Counsel

Westlands Water District
3130 N. Fresno Street, P.O. Box 6056, Fresno, California 93703-6056, (559) 224-1523, FAX (559) 241-6277

April 28, 2011

www.regulations.gov (Docket No. EPA-R09-OW-2010-0976)

United States Environmental Protection Agency
Attn: Erin Foresman
75 Hawthorne Street
San Francisco, CA 94105

Re: Comments of Westlands Water District on EPA's Advanced Notice of Proposed Rulemaking Regarding Water Quality Challenges in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, 76 Federal Register 9,709 (February 22, 2011), Rulemaking Docket No. EPA–R09–OW–2010–0976

Dear Ms. Foresman:

As indicated in footnote 17 of Westlands Water District Comments regarding EPA's Advanced Notice of Proposed Rulemaking regarding Water Quality Challenges in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Document EPA-R09-OW-2010-0976-0037.1), Westlands encloses a compact disc containing copies of several of the scientific studies and papers cited in Westlands' comments that do not appear to be in the administrative record for this matter. Please add these documents to the administrative record.

Do not hesitate contact me should you have any questions.

Sincerely yours,

Craig Manson

Craig Manson
General Counsel

Westlands Water District's Comments on EPA Advanced Notice of Proposed Rulemaking Regarding the Water Quality Challenges in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary

76 Federal Register 9709 (February 22, 2011)

Docket Number: EPA-R09-OW-2010-0976

Submitted – April 25, 2011

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I. Introduction

Westlands Water District (Westlands) appreciates the opportunity to comment on the EPA Advanced Notice of Proposed Rulemaking (ANPR) regarding the Water Quality Challenges in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary ("Bay-Delta Estuary"). 76 Fed. Reg. 9709 (Feb. 22, 2011). In addition to these comments, Westlands is a member of the San Luis & Delta-Mendota Water Authority, which will be submitting a separate set of comments along with a group of other water agencies, authorities and associations. Westlands joins in and fully supports those comments.

Westlands is a water district established under California law. Formed in 1952, Westlands is the largest single agricultural water district in the United States, encompassing more than 600,000 acres of farmland in western Fresno and Kings counties. The District supplies water to serve farmers who produce dozens of high quality commercial food and fiber crops sold for the fresh, dry, canned and frozen food markets, both domestic and export, that generate more than $3 billion annually in agricultural-related economic activity. Westlands also supplies water to families, businesses, municipalities, and industrial users in the Central Valley.

Westlands has a very direct and significant interest in this ANPR. Westlands receives water through the Central Valley Project (CVP), a federal water project that stores water in large reservoirs in Northern California for use throughout the State. After water is released from CVP reservoirs, the water flows to the Delta. From there, water is pumped through the Delta-Mendota Canal for direct use or to the San Luis Reservoir for later use by our farmers. Many communities depend on the agricultural economy that relies on the water provided by Westlands, including Mendota, Huron, Tranquility, Firebaugh, Three Rocks, Cantua Creek, Helm, San Joaquin, Kerman, Lemoore and Coalinga. More than 50,000 people live and work in these communities and depend on the water provided by Westlands for their livelihoods.

Westlands acknowledges that water quality and aquatic resources in the Bay-Delta Estuary are under serious stress. The estuary and many of its tributaries are listed as impaired under the Clean Water Act, and the populations of both pelagic and anadromous fish have suffered serious decline in recent years. 76 Fed. Reg. 9710. Sound scientific research has not established a singular cause for this decline. As EPA has stated it in this ANPR: "Current research findings do not support the idea that a 'single stressor' is responsible for the ecological changes in the Bay Delta Estuary." Water Quality Challenges in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, Unabridged Advanced Notice of Proposed Rulemaking at 10 (Feb. 2011) (hereinafter "Unabridged ANPR").

To date, however, federal and state authorities have not looked seriously at multiple stressors but instead have focused their response to the decline in the Bay-Delta Estuary on exports to Westlands and other water agencies, imposing draconian restrictions on the ability to operate pumps to bring water that flows through the Delta to the people of California. These pumping restrictions have had a substantial, direct, and severe adverse impact on the ability of Westlands to serve the many people who depend on them for water service and resulted in severe human hardship, irretrievable resource losses, economic loss, and environmental harms.

Federal regulators primarily imposed conditions that restrict water flows out of the Delta due to the decline in delta smelt and Chinook salmon that regulators claimed was caused by exporting water from the Delta.[1] These harsh restrictions on water supply – imposed at the time of a severe drought – hit hard the agricultural economy that Westlands serves. Westlands has challenged the restrictions in federal court because the limitations are not based on sound science, and the court has largely agreed with Westlands.[2] Moreover, as the court found, during the drought, the restrictions would "contribute to and exacerbate the current catastrophic situation" faced by Westlands and other member agencies of the Authority, "whose farms, businesses, water service areas, and impacted cities and counties, are dependent, some exclusively, upon CVP" and "other restricted water deliveries."[3] Overall, the water restrictions caused destruction of permanent crops, fallowed lands, destruction of farming businesses, as well as increased groundwater consumption, land subsidence, reduction of air quality, and social disruption and dislocation.[4]

The single-minded focus on water users has resulted in great human hardship, but has not led to a solution or any real improvements in the smelt, salmon or other aquatic life of the Bay-Delta Estuary. Quite simply, pumping restrictions have failed, as the fish and the Bay-Delta Estuary remain in peril. As such, this ecosystem demands that regulators take off their blinders and use a wide-angle lens to bring the multiple stressors at work in the Bay-Delta Estuary into focus. As EPA again acknowledges: "Most research supports the idea of multiple stressors interacting in concert, as the cause of the Bay Delta Estuary ecosystem decline." Unabridged ANPR at 10. Solving the issues presented by this complex estuary therefore requires a holistic, multi-faceted solution. At the same time, solutions for the Bay Delta must be based on sound scientific analysis that look beyond the tired approaches that have focused exclusively on water exports and flow.

As EPA moves forward on the issues raised in the ANPR, it must remember its duty to rely on the best available science and the scientific method. This duty is established by the Clean Water Act and other laws. Several provisions of the Clean Water Act require EPA to ensure that its decisions under the Act comport with the "latest scientific knowledge." *See, e.g.*, 33 U.S.C. § 1314(a)(1). This requirement is supplemented by the Information Quality Act (IQA),[5] which requires federal agencies to inject a review process of information used to support a rulemaking

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[1] *See* U.S. Fish and Wildlife Services, Biological Opinion on the Proposed Coordinated Operations of the Central Valley Project and State Water Project at pp. 279-285 (Dec. 15, 2008) (Smelt BiOp), available at http://www.fws.gov/sacramento/es/documents/SWP-CVP_OPs_BO_12-15_final_OCR.pdf; see also National Marine Fisheries Service, Southwest Region, Endangered Species Act Section 7 Consultation Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project at pp. 581-659 (June 4, 2009), available at http://swr.nmfs.noaa.gov/ocap.htm .

[2] *See, e.g.*, *Delta Smelt Consolidated Cases*, No. 1:09-cv-00407 (and consolidated cases) (E.D. Cal.), Memorandum Decision re Cross Motions for Summary Judgment (Dec. 14, 2010).

[3] *Delta Smelt Consolidated Cases*, No. 1:09-cv-00407 (E.D. Cal.), Findings of Fact and Conclusions of Law Re Plaintiffs' Request for Preliminary Injunction Against Implementation of RPA Component 2, at page 73 (May 27, 2010).

[4] *See id.* at pages 72-87.

[5] Section 515(a) of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Pub. L. No. 106-554).

to ensure that the information is based on sound, objective and transparent science. That is, Federal agencies must maximize and ensure the quality, objectivity, utility, and integrity of information they disseminate. The Office of Management and Budget (OMB) and EPA have both issued IQA guidance.[6] Under these guidelines, objectivity includes (a) ensuring accurate, reliable, and unbiased information and (b) ensuring the information is presented in an accurate, clear, complete and unbiased manner and within a proper context. 67 Fed. Reg. at 8459. "In a scientific . . . context, the original and supporting data shall be generated, and the analytic results shall be developed, using sound statistical and research methods." *Id.* The utility criteria requires the agency to make sure that the information presented is useful from the perspective of the agency, "but also from the perspective of the public." *Id.* Transparency is vital to allow the public to determine whether the information is being presented in an accurate, clear, complete and unbiased manner, as well as ensuring that the science itself is sound. *Id.*

To ensure these obligations are met here, EPA must assess all new studies and evaluate them together with older scientific studies to ensure any actions it take with respect to the Bay-Delta Estuary "accurately" reflect the latest scientific thinking and are "useful" to the decision at hand. In other words, EPA must present all of the relevant information objectively and fully and evaluate both the strengths and weaknesses of these new studies against the older studies. Only then can EPA draw "accurate" and "useful" conclusions regarding the current state of the science and actions that should be taken to address the water quality and environmental status of the Bay-Delta Estuary.

In addition, in taking any action, EPA must fully consider its obligations under Executive Order 13132, which directs federal agencies who formulate and implement policies that have federalism implications to be guided by "fundamental federalism principles." Exec. Order No. 13132, Sec. 2. One such example of fundamental federalism principles is that "[p]olicies of the national government should recognize the responsibility of – and should encourage opportunities for – individuals, families, neighborhoods, local governments, and private associations to achieve their personal, social, and economic objectives through cooperative effort." Exec. Order No. 13132, Sec. 2(g). Order 13132 also requires federal agencies to be "deferential to the States when taking action that affects the policymaking discretion of the States and should act only with the greatest caution where State or local governments have identified uncertainties regarding the constitutional or statutory authority of the national government." Id. at Sec.2(i). That is why Order 13132 requires that "to the extent practicable and permitted by law, no agency shall promulgate any regulation that has federalism implications, that imposes substantial direct compliance costs on State and local governments, and that is not required by statute. . ." Exec. Order No. 13132, Sec. 6(b). Order 13132 has particular relevance here in light of the long-standing and significant responsibilities of the State and local authorities with respect to the Bay-Delta Estuary.

Westlands commends EPA for proposing to take a broad look at the Bay-Delta Estuary. We recognize this process as the first of several that must happen to address the issues presented for the Estuary, including potentially further administrative action, and, where appropriate,

[6] *See* 67 Fed. Reg. 8452 (Feb. 22, 2002); EPA, Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by EPA, EPA/260R-02-008 (Oct. 2002) ("EPA IQA Guidelines").

enforcement action. Westlands looks forward to working with EPA as a key stakeholder and is standing by to bring its expertise to the Agency at the earliest opportunity.

II. EPA should use its authority under the Clean Water Act to implement policies and promulgate regulations to ensure that point source discharges which diminish the viability of fish species are fully addressed

Westlands supports the ANPR's request for comment on steps EPA should take to address the excessive nutrients that are discharged into the Bay-Delta. Literally, millions of pounds of untreated ammonium are discharged every day into the estuary and its tributaries by municipal wastewater treatment plants.

Most prominently is the Sacramento Regional County Sanitation District, whose treatment plant is dumping *14 tons of untreated ammonium* and other nutrients into the Sacramento River and Delta. That is equivalent to lining up dozens of 1,000-gallon tanker trucks to pour ammonia into the Sacramento River *every day*. As can be seen from the following figures, this amount has been increasing over time.

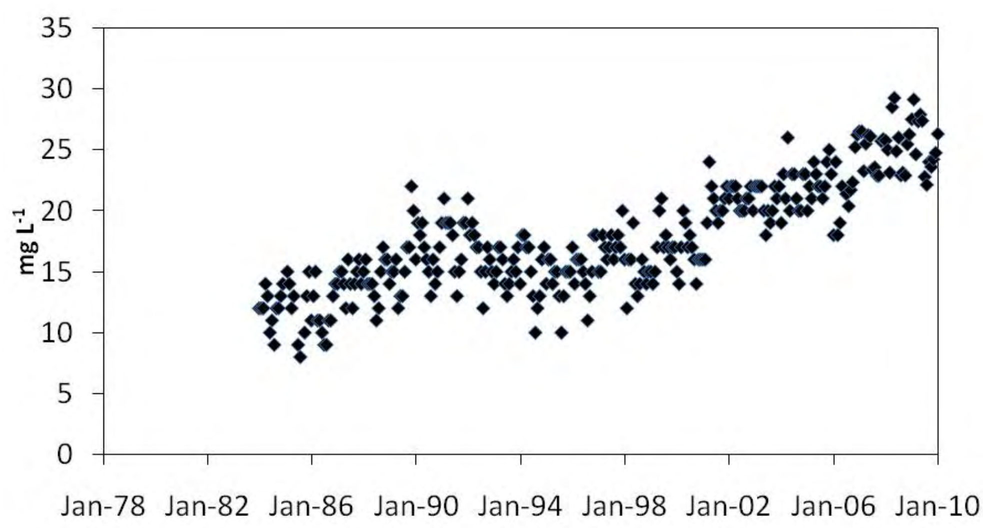

Figure 1 Change in effluent ammonium concentration (mg L^{-1}) over time, based on data reported to the Central Valley Regional Board. All data are monthly averages.

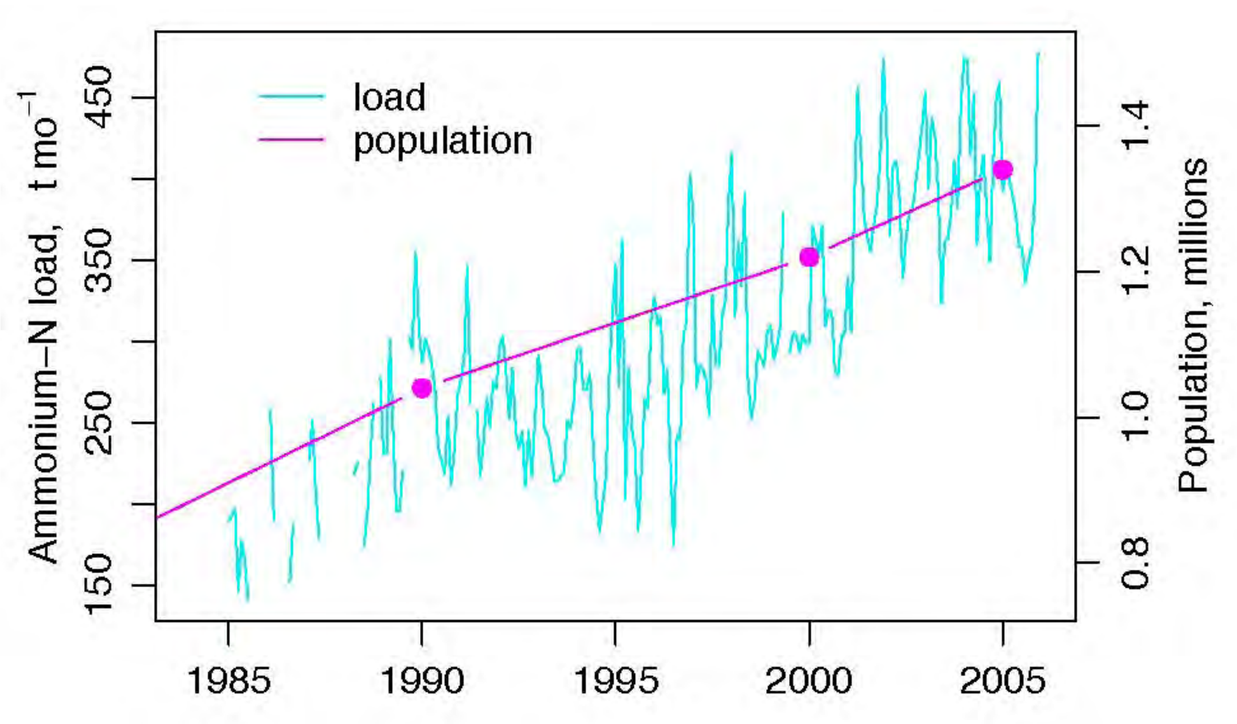

Figure 2 - Monthly load of ammonium in wastewater from the Sacramento Regional County Sanitation District, with Sacramento County population data, from 1982 to 2005.[7]

The Sacramento Regional Treatment Plant collects sewage from a 437-square-mile service area for partial treatment and discharge into the Sacramento River near the town of Freeport, which is within the Sacramento-San Joaquin River Delta (Delta), which flows into San Francisco Bay (Bay-Delta). The Treatment Plant currently is permitted to discharge up to 181 million gallons per day of partially treated sewage, at elevated temperatures, into the Sacramento River and Delta at a point that is squarely within the designated critical habitat for threatened and endangered fish species. The decline of those fish species has resulted in catastrophic reductions in the availability of fresh water supply from the San Francisco Bay Area to the Central Coast and San Joaquin Valley. The degradation of water quality due to the Treatment Plant's discharge and the water supply reductions arising from efforts to protect Delta fish species directly affect more than 2 million acres of farm land and more than 25 million Californians living in two-thirds of the state's households.

Elsewhere, EPA has recognized that nutrient loadings are impacting water quality and aquatic life across the United States.[8] The Bay-Delta is no exception. On the contrary, recent

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[7] See Jassby, A., "Phytoplankton in the Upper San Francisco Estuary: recent biomass trends, their causes, and their trophic significance." *San Francisco Estuary and Watershed Science*. 6(1): Article 2, February 2008 ("Jassby 2008") (available at http://escholarship.ucop.edu/uc/item/71h077r1#page-1) at Figure 15.

[8] "Nutrient pollution, especially from nitrogen and phosphorus, has consistently ranked as one of the top causes of degradation in some U.S. waters for more than a decade. Excess nitrogen and phosphorus lead to significant water quality problems including harmful algal blooms, hypoxia and declines in wildlife and wildlife habitat. Excesses have also been linked to higher amounts of chemicals that make people sick." http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/

scientific literature and research founded on well-established scientific principles, demonstrates that the ongoing, dramatic infusion of nutrients from wastewater treatment plants across the region is a major stressor specifically contributing to the decline of the food web that supports aquatic life in the Bay-Delta. The primary productivity and phytoplankton biomass in the Bay-Delta estuary are among the lowest of all major estuaries in the United States[9] – and declines in several important zooplankton species have followed the observed declines in biomass. Research indicates that Delta-wide biomass levels are now low enough to limit zooplankton abundance,[10] and zooplankton are an essential prey item for endangered fish species in the Bay-Delta, including the delta smelt.[11]

To date the federal government's energies regarding the Bay-Delta have been almost exclusively focused on water exports. Other stressors must be addressed and addressed aggressively. Accordingly, we urge EPA, consistent with principles of federalism, to use its authorities to demand aggressive and expeditious action by the State and other federal authorities to reduce the nutrient loadings from wastewater treatment plants into the Delta ecosystem.

A. Available data and scientific literature demonstrate restrictions on nutrient discharges from point sources would improve aquatic life in the Delta

As an initial matter, the data and scientific literature demonstrate the harm to the Delta caused by the millions of pounds of nutrient loadings contributed to the Delta by wastewater treatment plants. Westlands has previously joined or provided comments in other proceedings which detail how total ammonia-nitrogen load, largely in the form of ammonium, is causing toxic effects on aquatic species in the Delta and altering the aquatic food web—the foundation of the Delta ecosystem. *See e.g.*, Proposed NPDES Permit Renewal and TSO, Sacramento Regional County Sanitation District, Water Agencies' Testimony before Central Valley Regional Water Quality Control Board Meeting (December 9, 2010) (Water Agencies' Testimony); Comments on the Tentative Waste Discharge Requirements Renewal for the Sacramento Regional County Sanitation District Sacramento Regional Wastewater Treatment Plant (Oct. 8. 2010); [12] Comments of Westlands Water District (Westlands) and the San Luis & Delta-Mendota Water Authority (Authority) on Tentative Waste Discharge Requirements Renewal (NPDES Permit No. CA0077682) for Sacramento Regional County Sanitation District, Sacramento

[9] Proposed NPDES Permit Renewal and TSO, Sacramento Regional County Sanitation District, Water Agencies Testimony before Central Valley Regional Water Quality Control Board Meeting (December 9, 2010) at Slide 41 (collecting references). Some 90% of the world's 100+ largest estuaries have a higher production rate than the Bay-Delta. *See* Excerpt from Presentation by Central Valley Regional Water Quality Control Board Meeting (December 9, 2010) (Slide 88).

[10] Müller-Solger, A., A.D. Jassby and D.C. Müller-Navarra. 2002. Nutritional quality of food resources for zooplankton (*Daphnia*) in a tidal freshwater system (Sacramento-San Joaquin River Delta). *Limnol Oceanogr.* 47(5):1468-1476.

[11] Sommer. T, C. Armor, R. Baxter, R. Breuer, L. Brown, M. Chotkowski, S. Culberson, F. Feyrer, M. Gingras, B. Herbold, W. Kimmerer, A. Mueller-Solger, M. Nobriga and K. Souza. 2007. The Collapse of Pelagic Fishes in the Upper San Francisco Estuary. *Fisheries* 32(6):270-277.

[12] http://www.swrcb.ca.gov/centralvalley/board_decisions/tentative_orders/1012/sac_regional/srcsd_com_wateragencies.pdf

Regional Wastewater Treatment Plant (Oct. 8, 2010);[13] San Luis Delta-Mendota Water Authority and State Water Project Comments on Draft Report Titled "Nutrient Concentrations and Biological Effects in the Sacramento-San Joaquin Delta" (June 14, 2010); Water Agencies' Comments on Aquatic Life and Wildlife Preservation Issues Concerning the Sacramento Regional Wastewater Treatment Plant NPDES Permit Renewal (June 1, 2010). We hereby incorporate by reference the data and scientific literature catalogued in those comments.

We urge EPA to consider four core scientific propositions that may be drawn from the existing literature and research:

1. Excessive ammonium is toxic to copepods

Recent studies indicate that ammonia/um at concentrations present in the Sacramento River, Delta and Suisun Bay is acutely toxic to the native *Pseudodiaptomus forbesi*, a copepod central to the food web that supports aquatic life, including the endangered Delta smelt. Specifically, Dr. Swee Teh of the University of California at Davis[14] has found that ten percent mortality occurred in invertebrate species exposed to ammonia concentrations present in the Sacramento River using a 96-hour toxicity test.[15] Criticized that his initial testing did not apply a pH level representative of the average pH in the River,[16] Dr. Teh repeated his analysis and again observed that comparable toxic effects occurred at a pH of 7.8.[17]

Dr. Teh has likewise conducted life cycle tests to assess the impacts of different concentrations of ammonium on the ability of the copepod to reproduce and thrive. Dr. Teh found that ammonium impacted adult *P. forbesi* reproduction at concentrations greater than or equal to 0.79 mg L^{-1}, while nauplii and juveniles are affected at ammonium concentrations as

[13] http://www.swrcb.ca.gov/centralvalley/board_decisions/tentative_orders/1012/sac_regional/srcsd_com_westlands.pdf

[14] Dr. Teh is a Ph.D in Comparative Pathology and a Research Toxicologist and Pathologist in the Department of Anatomy, Physiology, and Cell Biology at the University of California - Davis. He serves as the Interim Director of the Aquatic Toxicology Laboratory at the UC-Davis School of Veterinary Medicine, and is a UC-Davis Faculty Member for the Graduate Group in Ecology, the Center for Aquatic Biology and Aquaculture, the Center for Health and the Environment, and the John Muir Institute of Environment. Dr. Teh conducted his work under the auspices of the Central Valley Board.

[15] Werner, et al., Pelagic Organism Decline (POD): Acute and Chronic Invertebrate and Fish Toxicity Testing in the Sacramento-San Joaquin Delta 2008-2010, Final Report Submitted to the California Department of Water Resources (July 24, 2010) (http://www.science.calwater.ca.gov/pdf/workshops/POD/Werner%20et%20al_2010_POD2008-2010_Final%20Report.pdf); Ammonia Summit at Central Valley Regional Water Board (http://www.waterboards.ca.gov/centralvalley/water_issues/delta_water_quality/ambient_ammonia_concentrations/index.shtml.) on August 18-19, 2009

[16] The criticism is not valid as the lower pH Dr. Teh first tested was within the range found in the River more 20% of the time.

[17] Teh, S. et al., Final Report, Full Life-Cycle Bioassay Approach to Assess Chronic Exposure of *Pseudodiaptomus forbesi* to Ammonia/Ammonium – Submitted to C. Foe and M. Gowdy (March 4, 2011). Westlands will collect and submit under other cover all data and studies cited in these comments not easily accessible to the public.

low as 0.36 mg L^{-1}.[18] Dr. Teh likewise repeated the life cycle testing and confirmed his results, which are now compiled in a report to the Central Valley Board staff.[19]

The toxic effect of ammonium is a major stressor on aquatic life that has a pervasive impact across the Bay-Delta. Ammonium concentrations above 0.36 mg L^{-1} were measured by the Central Valley Board all the way to Isleton. Ammonium exceeded 0.36 mg L^{-1} in *44% of the samples* collected at stations between the Hood and Isleton stations located along the Sacramento River in 2009-2010.[20]

The implications of these impacts as the toxic wastewater spreads throughout the Delta are dramatic and central to understanding the true source of the decline of the productivity of the Delta: the discharges depress the food supply for the Delta smelt and other fish, and reduce fisheries yields in critical habitat for federally-listed fish, including the winter and spring-run Chinook salmon, the Delta smelt, and green sturgeon.

2. The excess ammonium is inhibiting nitrogen uptake by diatoms and reducing diatom primary production in the Bay-Delta.

In addition to toxic effects, the ammonium loadings are disrupting the food supply by inhibiting nitrogen uptake by diatoms in the Bay-Delta. The phytoplankton that form the base of the food web are essential to a healthy aquatic ecosystem in the Bay-Delta, as generally speaking, phytoplankton produce much of the bioavailable carbon in the Bay-Delta Estuary. Primary consumers, including copepods (such as *P. forbesi*) rely on that primary production by phytoplankton as their main source of food, which, in turn, serve as food source for other aquatic life. In recent research, Dr. Richard Dugdale and others have found that excessive ammonium from treatment plant discharges is inhibiting nitrogen uptake by diatoms and contributing to reduced diatom production in the Delta.[21]

More specifically, in ongoing research, the Dugdale Lab at San Francisco State University's Romberg Tiburon Center for Environmental Studies, has found that the

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[18] Teh, S. Full Life-Cycle Bioassay Approach to Assess Chronic Exposure of *P. forbesi* to Ammonia/Ammonium to the Delta Pelagic Organism Decline Contaminants Work Team (July 6, 2010).

[19] Teh, S. et al., Final Report, Full Life-Cycle Bioassay Approach to Assess Chronic Exposure of *Pseudodiaptomus forbesi* to Ammonia/Ammonium – Submitted to C. Foe and M. Gowdy (March 4, 2011)

[20] Data collected by Dr. Chris Foe, Central Valley Regional Water Quality Control Board, from between March 2009 and February 2010.

[21] *See e.g.*, Parker, A.E., A.M. Marchi, J.Drexel-Davidson, R.C. Dugdale, and F.P. Wilkerson. "Effect of ammonium and wastewater effluent on riverine phytoplankton in the Sacramento River, CA. Final Report to the State Water Resources Control Board; Wilkerson, F.P., R.C. Dugdale, V.E. Hogue and A. Marchi, 2006. Phytoplankton blooms and nitrogen productivity in San Francisco Bay, Estuaries and Coasts 29(3): 401-416. ; Dugdale, R.C., F.P. Wilkerson, V.E. Hogue and A. Marchi. 2007. The Role of ammonium and nitrate in spring bloom development in San Francisco Bay. *Estuarine, Coast and Shelf Science* 73: 17-29 ; Sommer, T., C. Armor, R. Baxter, R. Bruer, L. Brown, M. Chotkowski, S. Culberson, F. Feyrer, M. Gingras, B. Herbold, W. Kimmerer, A. Mueller-Solger, M. Nobriga and K. Souza. 2007. The Collapse of Pelagic Fishes in the Upper San Francisco Estuary, *Fisheries* 32(6):270-277; Glibert, P. 2010a. "Long-term changes in nutrient loading and stoichiometry and their relationships with changes in the food web and dominant pelagic fish species in the San Francisco Estuary, California," *Reviews in Fisheries Science.* 18(2):211 – 232.

concentrations of ammonium observed in the Bay-Delta are inhibiting nitrogen uptake and thereby the formation of phytoplankton blooms in the Bay-Delta.[22] Historically, substantial phytoplankton blooms were common and an essential part of a healthy estuary.[23] For example, spring blooms were common from 1969-1977[24] before the Sacramento Regional treatment plant went online when ammonium concentrations were low (1.8 μmol L^{-1} during summer and 4.0 μmol L^{-1} during winter).[25] Indeed, more recent data confirm the strong relationship between removing ammonium and return of the spring phytoplankton bloom. In Suisun Bay, a diatom bloom reached chlorophyll concentrations of 30 μg L^{-1} during spring 2000 when ammonium concentrations declined to 1.9 μmol L^{-1}.[26] Similarly, chlorophyll concentrations in Suisun Bay reached 35 μg L^{-1} during spring 2010 when ammonium concentrations declined to 0.5 μmol L^{-1}. Accordingly, removing the excessive ammonium would remove a central impediment to the recovery of the Bay Delta.

This is true even if other factors also were to impede phytoplankton blooms, such as the presence of invasive clams during summer and fall. The life cycles of aquatic organisms are often tied to the timing of when there is appropriate food supply. In the case of Delta smelt, the spring is considered an important time for spawning and rearing, and thus restoring the spring food supply (by restoring the spring diatom blooms when clams are not prevalent) that existed before the ammonium levels increased would be extraordinarily valuable to restoring the Bay-Delta ecosystem.

The direct reductions in productivity caused by ammonium that the Dugdale Lab has observed in the data are striking. For example, parallel tests measured the effect of ammonium and wastewater treatment effluent on primary production and phytoplankton nitrogen uptake.[27] Compared to controls, primary production and ammonium uptake rates were reduced 20 to 36% and phytoplankton nitrate uptake was reduced 80% when exposed to the ammonium-laden effluent. The data show similar results when ecosystem health is measured by reference to chlorophyll production. It has been observed that chlorophyll production declined by up to 75% downstream of the Sacramento Regional treatment plant discharge, when compared to chlorophyll production above the Sacramento Regional discharge.[28]

While these data are new, the fact that excessive ammonium loading will inhibit nitrogen uptake by phytoplankton is not a new proposition, but has long been established by research

[22] Marchi, A. 2010. “Spring 2010 phytoplankton blooms in Northern San Francisco Estuary: influences of climate and nutrients.” Oral Presentation at 6th Biennial Bay-Delta Science Conference, Sacramento, CA, Sept. 27-29, 2010; Parker, et al. 2010; Wilkerson, et al. 2006; Dugdale, et al. 2007.

[23] Ball, M. and J. Arthur, Planktonic Chlorophyll Dynamics in the Northern San Francisco Bay and Delta, in T. Conomos, San Francisco Bay: The Urbanized Estuary. Pacific Division, American Association for the Advancement of Science, San Francisco at 265-285 (1979).

[24] Ball and Arthur. 1979.

[25] Cloern, J.E. and R.T. Cheng, 1981. Simulation model of *Skeletonema constatum* population dynamics in Northern San Francisco Bay, California. *Estuarine, Coastal and Shelf Science.* 12:83-100.

[26] Wilkerson, et al. 2006.

[27] Parker, et al. 2010

[28] *Id.*

done over many decades and in a variety of systems. Indeed, decades of scientific research confirm that ammonium suppresses algae productivity, a factor which was first observed by researchers as far back as the 1930's.[29] Some of the early field demonstrations were by MacIsaac and Dugdale (1969, 1972),[30] followed by research in the Chesapeake Bay by McCarthy *et al* (1975).[31] Lomas and Glibert (1999a) describe the threshold for inhibiting nitrate uptake at approximately 1 µmol L^{-1} (0.014 mg L^{-1}), well below the levels observed in the Bay Delta.[32]

3. The nutrients in the Bay-Delta are contributing to a shift in algal communities by changing the nutrient ratios to favor harmful, invasive species.

Further, research demonstrates that excessive ammonium discharges have adversely impacted aquatic life in the Bay-Delta by increasing the ratio of nitrogen to phosphorus in the receiving water which triggers impacts to the food web on which aquatic life depends. Increasing ammonium discharges, particularly when phosphorus discharges have been declining, degrades water quality by changing the ratio between dissolved inorganic nitrogen and phosphorus – the "DIN:DIP" ratio – as well as the total nitrogen (N) to total phosphorus (P) ratio – the ("N:P") ratio. These ratios are known to have profound influences on food webs.[33]

Recently, Dr. Patricia Glibert, a renowned scientist from the University of Maryland,[34] has examined the nutrient loadings from wastewater treatment in the Delta, the shifting nutrient

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[29] *See, e.g.*, Ludwig, C.A. 1938. The availability of different forms of nitrogen to a green alga (Chlorella) Am.J.Bot. 25:448-458; Harvey, H.W. 1953, Synthesis of Organic Nitrogen and Chlorophyll by Nitzschia Closterium. J. Mar.Biol. Res. Assoc. U.K. 31:477-487

[30] MacIsaac, J.J. and R.C. Dugdale, 1969. The kinetics of nitrate and ammonium uptake by natural populations of marine phytoplankton. Deep-Sea Res. 16:45-67; MacIsaac, J.J. and R.C. Dugdale, 1972. Interactions of light and inorganic nitrogen controlling nitrogen uptake in the sea. Deep-Sea Res. 19:209-232.

[31] McCarthy, J.J., W.R. Taylor and J.L. Taft, 1975. The dynamics of nitrogen and phosphorous cycling in the open water of the Chesapeake Way. In: T.M. Church (ed.) Marine Chemistry in the Coastal Environment. American Chemical Society Symposium Series 18. Washington D.C., pp. 664-681.

[32] Lomas, M.W. and P.M. Glibert. 1999a. Interactions between NH_4 and NO_3 uptake and assimilation: comparison of diatoms and dinoflagellates at several growth temperatures. Marine Biology 133:541-551. In the case of Sacramento Regional, the current average discharge concentration is 24 mg L^{-1} NH_4 which equates to 1,713 µmol L^{-1}

[33] Sterner, R.W. and J.J. Elser. 2002. Ecological stoichiometry: The biology of elements from molecules to the biosphere. Princeton University Press, Princeton, N.J. Sterner and Elser (2002), state that, "Stoichiometry can either constrain trophic cascades by diminishing the chances of success of key species, or be a critical aspect of spectacular trophic cascades with large shifts in primary producer species and major shifts in ecosystem nutrient cycling."

[34] Dr. Glibert is an aquatic ecologist and nutrient bio-geochemist with over 30 years of experience working on issues related to nutrient loading, nutrient ratios, eutrophication, changes in trophic dynamics, harmful algae, and management implications of nutrients loading all over the world. She has a Ph.D. from Harvard University and will be awarded an honorary doctorate degree from Linnaeus University, Sweden next month. http://lnu.se/about-lnu/1.45678/linnaeus-university-has-appointed-four-hon. She has studied and published widely on nutrients and food web dynamics in systems covering phytoplankton nutrient uptake and photosynthesis, nutrient excretion by zooplankton, harmful algal physiology, nutrient preferential use by phytoplankton taxa, eutrophication, and global nutrient modeling. Her field investigations span the globe – including the Chesapeake Bay, Long Island Sound, Florida Bay, Australia, Brazil, the Baltic Sea, East China Sea, Kuwait Bay, Gulf of Oman, and Hong Kong coastal

ratios, and the composition of the base of the food web and documented several significant trends.[35] Dr. Glibert reports that there has been a measureable change in the N:P ratio in the Bay-Delta due to an increase in total N loading and a decrease in total P loading. These nutrient variations are in turn related to variations in the base of the food web, primarily the community composition of phytoplankton,[36] to variations in the community composition of zooplankton, and to variations in the abundance of several fish species. Thus, this research strongly suggests that changes in Delta smelt and several other fish species' abundance are ultimately related to changes in ammonium load from wastewater discharge in the upper Sacramento River. Glibert concluded that "[r]emediation of pelagic fish populations should be centered on reduction of nitrogen loads and reestablishment of balanced nutrient ratios delivered from point source discharges."[37]

The data also indicate that the algal communities in the food web have been shifting at the same time that the nutrient ratios have been changing.[38] This is seen, for example, in the shift in the algal composition from diatoms that are nutritious to the zooplankton that support the pelagic food web including the endangered Delta smelt, to smaller, lower quality, less nutritious species such as flagellates, cryptophytes and cyanobacteria and invasive macrophytes, such as *Egeria densa*.[39] The growth of these nuisance cyanobacteria and flagellates results in species like *Anabaena flos-aquae, Microcystis aeruginosa, and Aphanizomenon flos-aquae* which are known to produce neurotoxins that are toxic to humans, fish, and wildlife.

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waters, as well as many other sites, including San Francisco Bay Delta. She serves as the co-chair of the U.S. National HAB Committee, chair of the committee on eutrophication for the international GEOHAB Programme, and co-chair of the international SCOR/LOICZ Working Group on HABs and Eutrophication. She has consulted with the governments of Kuwait and Oman on issues related to nutrient pollution, served as an independent advisor to the Chinese Academy of Sciences on their studies of eutrophication, served on numerous panels and advisory boards related to nutrient management for the federal government and the states of Florida and Maryland.

[35] Glibert, P. 2010a.

[36] Glibert, P. 2010b. Changes in the quality and quantity of nutrients over time and the relationships with changes in phytoplankton composition. Oral Presentation at 6th Biennial Bay-Delta Science Conference, Sacramento, CA, September 27-29, 2010

[37] *Id.*

[38] Glibert, P. 2010a; Glibert, 2010b.

[39] Lehman, P. W. 2000. The influence of climate on phytoplankton community biomass in San Francisco Bay Estuary. *Limnol. Oceanogr*. 45: 580–590; Lehman, P. W., G. Boyer, C. Hall, S. Waller and K. Gehrts. 2005. Distribution and toxicity of a new colonial *Microcystis aeruginosa* bloom in the San Francisco Bay Estuary, California. *Hydrobiologia* 541:87-99; Lehman, P.W., S.J. The, G.L. Boyer, M.L. Nobriga, E. Bass, and C. Hogle. 2010. Initial impacts of *Microcystis aeruginosa* blooms on the aquatic food web in the San Francisco Estuary. *Hydrobiologia* 637:229-248; Jassby et al., 2002; Glibert. 2010a; Sommer, et al. 2007; Nobriga, M.L., F. Feyrer, R.D. Baxter, and M. Chotkowski. 2005. Fish community ecology in an altered river delta: spatial patterns in species composition, life history strategies, and biomass. *Estuaries* 28(5):776-785; Jassby, A. 2008. "Phytoplankton in the Upper San Francisco Estuary: recent biomass trends, their causes, and their trophic significance." *San Francisco Estuary and Watershed Science*. 6(1): Article 2, February 2008.

Studies have also suggested that the increased N:P ratio altered the native submerged aquatic vegetation in the Bay-Delta.[40] Native vegetation has largely been replaced by invasive vegetation, including the Brazilian waterweed, *Egeria dense*, and the water hyacinth, *Eichhornia crassipes*. Although the water hyacinth was introduced some time ago,[41] it has increased in abundance significantly in recent decades,[42] as has the Brazilian waterweed,[43] after phosphate removal and an increase in the N:P ratio. The waterweed (*Egeria*) can reach high biomass levels and is also well suited to thrive in a higher N:P environment.[44]

Further, scientific literature suggests the recent invasive *Microcystis* blooms in the Bay-Delta are attributable to shifts in nutrient ratios. *Microcystis* tolerates elevated N:P levels, and thus its dominance under higher nutrient ratios may also reflect the decline in other species without such tolerances. Dr. Glibert also observed highly significant correlation between ammonium concentration and changes in cyanobacteria occurrence.[45] Other research supports this observation. Based on stable isotope analyses of particulate organic matter and nitrate, Dr. Carol Kendall of the U.S. Geological Survey observed that ammonium, not nitrate, is the dominant source of nitrogen utilized by *Microcystis* at the Antioch and Mildred Island sites in the summer 2007 and 2008.[46]

These findings in the Bay-Delta are not based on novel science. To the contrary, the fact that nutrient ratios materially impact the underlying food web is well established in the scientific literature studying ecosystems here and around the world. In fact, the N:P ratio has specifically been shown to influence phytoplankton composition and the presence – or absence – of native species and vegetation. Extensive studies have repeatedly demonstrated this relationship in study after study across a range of systems in the United States – such as in Florida, Michigan, North Carolina, Tampa, and Washington, DC – and around the world – in Denmark, Germany, Hong Kong, Japan, Korea, Norway, Spain, and Tunisia. For example:

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[40] Glibert, P. 2010c. Nutrients and the food web of the Bay Delta. Oral Presentation to the National Academy of Sciences Committee on Sustainable Water and Environmental Management in the California Bay-Delta, Sacramento, CA. July 13, 2010.

[41] Finlayson, B.J. 1983. Water hyacinth: Threat to the Delta? Outdoor California 44: 10-14; Gopal, B. 1987. Aquatic plant studies. 1. Water hyacinth. Elsevier Publishing, New York.

[42] *Id*; Toft, J.D., C.A. Simestad, J.R. Cordekk and L.F. Grimaldo. 2003. The effects of introduced water hyacinth on habitat structure, invertebrate assemblages and fish diets. *Estuaries* 26: 746-758; Finlayson, 1983, *supra* (By the early 1980s, hyacinth covered approximately 500 ha, or about 22% of the waterways, in the Bay Delta).

[43] Jassby, A.D. and J.E. Cloern. 2000. Organic matter sources and rehabilitation of the Sacramento-San Joaquin Delta (California, USA). *Aquat. Conser: Mar. Freshw. Ecosyst.*, 10:323-352; Anderson, L.W.J. 1999. *Egeria* invades the Sacramento-San Joaquin Delta. *Aquatic Nuisance Species Digest*. 3: 37-40.

[44] Reddy, K.R., J.C. Tucker, and W.F. Debusk. 1987. The role of *Egeria* in removing nitrogen and phosphorus from nutrient enriched waters. *J. Aquat. Plant Management* 25: 14-19; and Feijoo, C., M.E. Garcia, F. Momo, and J. Tpja. 2002. Nutrient absorption by the submerged macrophyte *Egeria dense* Planch: Effect of ammonium and phosphorus availability in the water column on growth and nutrient uptake. *Limnetica* 21: 93-104.

[45] Glibert, P. 2010a.

[46] Kendall, C. 2011. Use of stable isotopes for evaluating environmental conditions associated with Microcystis blooms in the Delta. Oral Presentation at the 2011 IEP Annual Workshop, Folsom, CA, March 30, 2011; Kendall, C. 2010b. Use of stable isotopes for evaluating environmental conditions associated with *Microcystis* blooms in the Delta. Oral Presentation at the 6th Biennial Bay-Delta Science Conference, Sacramento, CA, September 27-29, 2010.

- Invasive vegetation and species have been observed in other ecosystems that experienced an increase in the N:P ratio.[47] The Potomac River was invaded by submerged aquatic vegetation, *Hydrilla* and clams, *Corbicula*, when the N:P ratio of effluent discharged by the large Blue Plains sewage treatment facility increased in the 1980s.[48] In the Ebro River estuary in Spain, as well, both *Hydrilla* and *Corbicula* invaded shortly after phosphorus was removed from effluent.[49]

- Studies in Korea and Japan have also related increasing N:P ratios, with increasing abundance and toxicity of *Microcystis*. In Daechung Reservoir, Korea, researchers found that toxicity was related to an increase in N in the water and the cellular N content, in a phosphorous limited environment.[50] Similar relationships were reported for a field survey of the Hirosawa-no-ike fish pond in Kyoto, Japan, where the strongest correlations with microcystin were high concentrations of nitrate and ammonium and the seasonal peaks in *Microcystis* blooms were associated with extremely high N:P ratios.[51]

- Studies of the Neuse River in North Carolina likewise found that a change in ratio resulted in a shift to non-native plankton species.[52] There, as in the Bay-Delta, phosphorus was controlled when phosphates were removed from detergents, but there was no contemporaneous reduction in nitrogen. The estuary ceased to function as an effective filter,[53] resulting in the displacement of nitrogen loads downstream and enhancement of cyanobacterial dominance in the plankton.[54]

- Scientific literature based on studies in Hong Kong, Tunisia, Germany, and Florida, likewise reports on the consequences of shifting the N:P ratio too low. In Tolo Harbor, Hong Kong, nutrient loading, particularly phosphorus loading, increased due to population increases in the late 1980's. The result was that a distinct shift from diatoms

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[47] Glibert, P. 2010c.

[48] Ruhl, H.A. and N.B. Rybicki. 2010. Long-term reductions in anthropogenic nutrients link to improvements in Chesapeake Bay habitat. (www.pnas.org/cgi/doi/10.1073/pnas.1003590107).

[49] Ibanez, C., N. Prat, C. Duran, M. Pardos, A. Munne, R. Andreu, N. Caiola, N. Cid, H. Hampel, R. Sanchez, and R. Trobajo. 2008. Changes in dissolved nutrients in the lower Ebro river: Causes and consequences. *Limnetica.* 27(1):131-142.

[50] Oh, H-M., S.J. Lee, M-H. Jang and B-D. Yoon. 2000. Microcystin production by *Microcystis aeruginosa* in a phosphorus-limited chemostat. *Appl. Envir. Microbiol*. 66: 176-179. A recent report by van de Waal (2010) demonstrated in chemostat experiments that under high CO_2 and high N conditions, microcystin production was enhanced in *Microcystis*. van de Waal, D.B., L.Tonk, E. van Donk, H.C.P. Matthijs, P. M. Visser and J. Huisman. 2010. Climate Change and the Impact Of C:N Stoichiometry On Toxin Production By Harmful Cyanobacteria. Oral Presentation at the 14th International HAB Conference, Greece.

[51] Ha, J.H., T. Hidaka, and H. Tsuno. 2009. Quantification of toxic Microcystis and evaluation of its dominance ratio in blooms using real-time PCR. *Envir. Sci. Technol*. 43: 812-818

[52] Paerl, H.W. 2009. Controlling Eutrophication along the Freshwater–Marine Continuum: Dual Nutrient (N and P) Reductions are Essential. *Estuaries and Coasts* 32:593–601.

[53] Cloern, J.E. 2001.

[54] Paerl, H.W. 2009.

to dinoflagellates was observed in the harbor.[55] Once the phosphorous was removed from the sewage effluent that was being discharged into the harbor and stoichiometric proportions were re-established, there was a resurgence of diatoms and a decrease in dinoflagellates.[56] In Tunisian aquaculture lagoons, dinoflagellates have been shown to develop seasonally when N:P ratios decrease.[57] Comparable results have been observed in systems in Germany and along the coast of Florida.[58]

- In Norway, researchers monitored lakes for many years and found that different zooplankton tend to dominate under different N:P ratios, due to the different phosphorus content of different species found in the lake.[59] Hessen (1997), for example, showed that a shift from calanoid copepods to *Daphnia* tracked N:P; calanoid copepods retain proportionately more N, while *Daphnia* are proportionately more P rich. Studies from experimental whole lake ecosystems found that zooplankton size, composition and growth rates changed as the N:P ratio varied.[60]

Collectively, these and other scientific papers demonstrate that what Dr. Glibert has reported squares with the research from systems around the globe. As such, EPA must consider this enormous wealth of understanding about nutrients and nutrient systems in deciding which stressor is in fact the primary reason for the decline in the Bay-Delta Estuary and how to address that stressor.

4. Where implemented in impacted ecosystems, nutrient removal has improved the natural ecosystem and aquatic life.

Requiring nitrification and denitrification of wastewater treatment plant effluent would help restore the health of the ecosystem and aquatic life in the Bay-Delta. Again, the literature is clear that requiring nutrient removal on wastewater treatment plants has proven to be effective at reversing the harmful effects of previously undertreated discharges and restoring native eco-systems. For example:

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[55] Hodgkiss, I.J. and K.C. Ho. 1997. Are changes in N:P ratios in coastal waters the key to increased ref tide blooms?. *Hydrobiologia.* 352:141-147; Hodgkiss, I.J. 2001. The N:P ratio revisited. In: K.C. Ho and Z.D. Wang (Eds.), Prevention and Management of Harmful Algal Blooms in the South China Sea. School of Science and Technology, Open University of Hong Kong.

[56] Lam, C. W. Y. and K. C. Ho. 1989. Red tides in Tolo Harbour, Hong Kong, p. 49–52. In T. Okaichi, D. M.Anderson, and T. Nemoto (eds.), Red Tides: Biology, Environmental Science and Toxicology. Elsevier, New York.

[57] Romdhane, M.S., H.C. Eilertsen, O.K.D. Yahia, and Y.N.D. Daly. 1998. Toxic dinoflagellate blooms in Tunisian lagoons: causes and consequences for aquaculture. In: *Harmful Algae* Edited by B.Reguera, J.Blanco, M.L.Fern'andez & T.Wyatt, Xunta de Galicia and Intergovernmental Oceanographic Commission of UNESCO, pp. 80–83.

[58] *See* Water Agencies' Comments on Aquatic Life at 18-19.

[59] Hessen, D.O.. 1997. Stoichiometry in food webs – Lotka revisted. *Oikos* 79: 195-200.

[60] Schindler, D. W. 1974. Eutrophication and Recovery in Experimental Lakes: Implications for Lake Management. *Science*. 184(4139):897-899; Sterner and Elser. 2002.

- Nutrient removal at the Blue Plains treatment plant in Washington DC has reduced the N:P ratios in the Potomac River, reduced the invasive species and begun to restore the native vegetation in the river. Once a nitrification/denitrification system was installed at Blue Plains in the 1990s, within several years, the abundance of the invasive *Hydrilla* began to decline and the abundance of native grasses increased.[61]

- Tampa Bay provides another important example. Eutrophication problems in the Bay were severe in the 1970's, with nitrogen loads approximating 24 tons per day.[62] Full nitrification and denitrification of the discharge was required at the regional treatment plant in the 1980s, and P was also reduced due to other best management practices. The native sea grass increased following nutrient removal, but it took several years.

  The Tampa Bay study highlights that it will take time to see improvements in an impacted ecosystem, because there are internal, existing loads of nutrients in sediment reservoirs from historic discharges. These historic loadings can therefore effectively prolong the system's responsiveness to external reductions of total nitrogen. This highlights the need to act expeditiously, as further discharges will only make restoring the Bay-Delta all the more difficult.

- Lower nutrient discharges also had positive effects on the coastal waters around the island of Funen, Denmark.[63] Since the mid 1980s, there has been a roughly 50% reduction in the loading of N to P in the region due to point source reductions. Again, native grasses returned, and low oxygen problems were reversed.

These examples of successful nutrient removal are not provided to predict with certainty that the ecosystem of the Bay-Delta would return to exactly what existed before the impacts began. Researchers have surveyed the literature for systems that have undergone nutrient loading and nutrient reductions and the trajectories of response varied.[64] Yet, however difficult it may be to predict exactly how an individual system will respond, studies have found that "efforts to reduce nutrient inputs to eutrophied coastal ecosystems have indeed delivered important benefits by either leading to an improved status of coastal ecosystems or preventing damages and risks associated with further eutrophication."[65]

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[61] Ruhl and Rybicki, 2010; *see* Water Agencies' Testimony, slide 50.

[62] Greening, H. and A.Janicki. 2006. Toward reversal of eutrophic conditions in a subtropical estuary: Water quality and seagrass response to nitrogen loading reductions in Tamp Bay, Florida, USA. *Environ. Mgt.* 38(2):163-178.

[63] Rask, N., S. E. Pedersen, and M. H. Jensen. 1999. Response to lowered nutrient discharges in the coastal waters around the island of Funen, Denmark. *Hydrobiologia* 393: 69–81.

[64] Duarte, C.M., D.J. Conley, J. Carstensen, and M. Sánchez-Camacho. 2009. Return to Neverland: Shifting Baselines Affect Eutrophication Restoration Targets. *Estuaries and Coasts*. 32:29–36.

[65] *Id.*

B. There are steps EPA can and should take within its statutory authority to ensure expeditious action by the State

In light of this demonstrated relationship between excess nutrients and the observed decline in aquatic life in the Bay-Delta, EPA can and should pursue steps, consistent with principles of federalism, to address nutrient pollution. EPA can and should pursue those steps aggressively in order to begin the process of recovery as soon as possible. In urging EPA to act, Westlands recognizes that some steps have been taken by state officials in California, as a number of municipalities that discharge to the Bay-Delta have been required to reduce their discharge by implementing full nutrient removal. Others have taken partial measures, removing the ammonium through nitrification, but have not undertaken full nutrient removal by denitrifying the effluent to remove the nitrates. The largest discharger, Sacramento Regional,[66] has refused to act, and although a permit has been issued,[67] the discharger has appealed to the State Board.

Still, more can and should be done by EPA to encourage the State and Regional Boards to move aggressively to address the millions of pounds of nutrients continuing to pour in the Delta. All of these dischargers, including Sacramento Regional, have used the waters of the United States to dilute and treat their sewage. These dischargers have relied on the bacterial action of the Delta and its tributaries as their sewage treatment, rather than investing in full nutrient removal at their treatment plants. Dilution alone, however, is not a satisfactory approach.

1. EPA should continue to urge the State to move ahead expeditiously with the Sacramento Regional permit

Critical to any strategy in the Bay-Delta Estuary is the control of the Sacramento Regional discharge, and the permit issued by the Central Valley Regional Water Quality Control Board is a very positive development. While Westlands would have greatly preferred more expeditious action by the State, we commend the Regional Board's decision and EPA's support for the action to date; however, we urge EPA, consistent with principles of federalism, to actively support the SRCSD Permit through the appeal process and until the required upgrades are built and implemented.

Sacramento Regional has been provided more than enough time to reduce its ammonia/um discharges. While the permit imposes full nitrification and denitrification, Sacramento Regional has been given ten years to implement those measures. During that time, massive additional loadings of ammonia/um and other nutrients will be added to the Delta. For example, the Permit sets an interim daily ammonium limit of 45 mg/L and a mass limit of just less then 68,000 pounds per day. The daily mass limit – which equates to almost 34 tons per day

[66] According to the State, Sacramento Regional is the single largest discharge of municipal wastewater to the Sacramento-San Joaquin Delta, discharging more than all other Delta wastewater treatment plants combined.

[67] Waste Discharge Requirements for the Sacramento Regional County Sanitation District Sacramento Regional Wastewater Treatment Plant Sacramento, Order No. R5-2010-0114 and 0115 (December 9, 2010) (SRCSD Permit), published at http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/sacramento/r5-2010-0114_npdes.pdf

– would allow the discharger to more than double its current discharge, which is generally in the range of 14 tons per day. The Regional Board based this limit on the maximum concentration measured on one single day out of nearly 1,000 measurements over the last 9 years.[68]

The permit requires the discharger to study and propose interim measures to reduce its discharge.[69] This is an avenue to enhance the recovery of the Bay-Delta, and thus it would be appropriate for EPA to monitor this process closely and use its review and oversight powers to ensure that, in the interim, all reasonable measures are taken to reduce the nutrient loadings. Of course, EPA cannot participate in every Clean Water Act permit issued by a delegated state. This, however, is not just any permit. It demands the attention of federal regulators to participate directly in the process to ensure that meaningful measures are proposed, considered and implemented, rather than allowing another decade of uncontrolled discharges without any restrictions on the impacts to aquatic life in the Bay-Delta.

2. EPA should conduct a full review of POTW discharge limits and seek an expedited process to reduce ammonium and nitrate discharges to the Delta

EPA has authority to request delegated states to re-open NPDES permits based on new information. *E.g.*, 40 C.F.R. § 122.62. The expanding evidence of the specific impacts of nutrients on the Delta certainly rises to that level. Further, California, like any state that is delegated the authority to issue NPDES permits, is subject to EPA's oversight over the delegation, and EPA retains the ultimate authority to withdraw this delegation in full or in part. 33 U.S.C. §1342(c) ("Whenever the Administrator determines after public hearing that a State is not administering a program approved under this section in accordance with requirements of this section, he shall so notify the State and, if appropriate corrective action is not taken within a reasonable time, not to exceed ninety days, the Administrator shall withdraw approval of such program"). EPA, consistent with and cognizant of principles of federalism, should be prepared to exercise that authority if California does not cooperate fully and expeditiously in efforts to aggressively address nutrient discharges from wastewater treatment plants. Specifically:

a. Take expedited action on existing permits. EPA should direct the State to expedite consideration of known POTW permits that are currently up for renewal. For example, EPA properly noted in the ANPR that Vallejo Sanitary Flood Control (permit due to be issued September 2011) and Central Contra Costa WWTP (permit due to expire March 2012) are two larger wastewater treatment plants that should be required to upgrade their treatment to full nutrient removal. In the case of Sacramento Regional, the permit expired in 2005, but a new permit was not issued by the Regional Board until December 2010. With the long lead time to install treatment – as noted, ten years in the case of Sacramento Regional – EPA cannot and should not countenance that type of delay for these and other dischargers.

b. Conduct a comprehensive permit review. EPA should, with the State, commence an immediate review of the NPDES discharge permits for all POTWs that discharge into the Bay-Delta or any of its tributaries. The permits should be evaluated to assess the level of treatment and limits imposed on both ammonium and total nitrogen. Based on that

[68] *See* Water Agencies' Testimony, slide 47-48 (compiling and charting Sacramento Regional data).

[69] SRCSD Permit at 34 (required "Pollution Prevention Program").

review, EPA should identify those permits that lack full nitrification and de-nitrification or that do not impose sufficiently stringent limits on both ammonium and total nitrogen.

c. Reconsider existing permits. Based on the permit review, EPA should direct the State to re-open permits that do not provide for sufficient treatment of nutrients, including ammonium and total nitrogen. The State should be given a firm deadline for re-opening these permits, with interim deadlines established to stage the process as needed.

d. Evaluate the cumulative impacts of nutrient discharges. While review and diligence on individual permits and discharges of ammonia/um is a start, EPA needs to also examine the larger picture by evaluating their cumulative impact to the Bay-Delta ecosystem. Such an evaluation could identify weaknesses or other problems that can not be adequately appreciated in focused evaluations on individual sources.

e. Require full nutrient removal, as appropriate. As appropriate, full nitrification and de-nitrification of wastewater should be required as part of the permit renewal process. If de-nitrification is not required, the State should be directed to explain why less than full nutrient removal is acceptable, as nitrification would treat the ammonia, but produce high levels of nitrate in the discharge. As such, the total nitrogen level and the associated nutrient N:P ratio will remain high. Only by requiring de-nitrification, will the full benefit to the ecosystem and aquatic life be realized. This is particularly true given the substantial reductions in phosphate that continue to (quite correctly) be imposed. As such, while the City of Stockton made substantial progress by nitrifying the discharge from its wastewater treatment facility, EPA should direct the State to evaluate whether de-nitrification to remove nitrates is needed.

These proposed steps would be fully consistent with an effort that is currently underway in EPA Region V. In a January 21, 2011 letter from EPA Region V to the Illinois Environmental Protection Agency, EPA is requiring the state to ensure that state-issued permits contain numeric limits sufficient to prevent excursions from the state's narrative criteria. The agency is also requiring state officials to reconsider 20 existing discharge permits to ensure they include numeric limits that attain the state's narrative water quality criteria for nutrients. The Region also asked the state to provide to EPA any permits it issues after June 30 for new or modified sources so EPA can ensure they include adequate numeric limits.[70]

3. Ammonium toxicity standards should be updated to reflect current information

There are many state water quality objectives that are still narrative objectives, including, in particular, the water quality objective for toxicity. The State can and should be directed to complete the process of finalizing numeric criteria for that objective.

It is equally incumbent on EPA to undertake to complete its own work in this area to facilitate the work of California (and other states). This is because the Clean Water Act contemplates that when there are narrative criteria, one option for states to follow when setting a water quality based effluent limit is to use EPA's criteria guidance. Specifically, the permitting

[70] Letter from T. Hyde to M. Willhite, Illinois EPA (January 21, 2011)

authority is to set the effluent limit following one of three options, including "(B) … on a case-by-case basis, using EPA's criteria guidance under CWA section 304(a), supplemented where necessary by other relevant information…" 40 C.F.R. § 122.44(d)(1)(vi)(B).

As an example, EPA should act expeditiously to complete the process of updating its Ambient Water Quality Criteria for Ammonia. The last update is more than a decade old. *See* EPA, 1999 Update of Ambient Water Quality Criteria for Ammonia EPA-822-R-99-014 (Dec. 1999).[71] The draft criteria document for aquatic life has been pending for over a year now, in a process that has been ongoing since 2004. *See* Draft 2009 Update Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater EPA-822-D-09-001 (December 2009).[72] EPA had agreed to consider additional comments,[73] but the time has come to conclude that process and issue the updated criteria document. Accordingly, we urge EPA to:

a. Issue the updated criteria document. Without an updated document, the State is left to use the 1999 Guidance for setting Water Quality Based Effluent Limitations, absent other criterion. In the case of the Sacramento Regional permit proceeding, the Regional Board has appropriately chosen to consider the draft guidance and its scientific analysis as part of its permitting process, but the discharger has challenged that approach.[74] A final document will ease that process. The updated criteria document which reflects an additional decade of science should be issued.

b. Delta specific criteria. After issuing the criteria document, EPA should consider the available data and assess whether additional site-specific criteria for the Delta are appropriate. That may be an appropriate outcome from EPA's review of the data submitted as part of this ANPR process. For example, there are no current standards that protect the Bay-Delta Estuary from the inhibitory effects of ammonium observed by Dugdale, Wilkerson and Parker, as described here. EPA should develop or participate in the development of nutrient standards to protect the Bay Delta Estuary from the inhibitory effects of ammonium.

There are likewise no current standards that protect the Bay Delta Estuary from the shifts in the composition of the aquatic community precipitated by the excessive nutrient loadings. EPA should develop or participate in the development of nutrient standards for the Bay Delta Estuary that restore nutrient forms and ratios to levels that were observed before the changes in community composition in the Bay-Delta Estuary occurred.

There are tools available to EPA to develop specific standards, as necessary. Dugdale *et al*. (2010)[75] developed a model that can be used to calculate numeric criteria for total ammonia

[71] http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/pollutants/ammonia/upload/2005_05_06_criteria_ammonia_99update.pdf

[72] http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/pollutants/ammonia/upload/2009_12_23_criteria_ammonia_2009update.pdf

[73] 75 Fed. Reg. 8698 (Feb. 25, 2010).

[74] Permit at F-56, J-8 to J-10.

[75] Dugdale, R., A. Parker, A. Marchi, and F. Wilkerson. 2010. "Criteria for the occurrence of spring blooms in Suisun Bay." Oral Presentation at 6th Biennial Bay-Delta Science Conference, Sacramento, CA, September 27-29, 2010.

nitrogen to protect against the inhibitory effects of ammonium. There are two principal criteria that must be met in order for primary productivity to be unimpaired by ammonium. First, ammonium concentration must be below the level that inhibits phytoplankton from assimilating nitrate (Inhibition Criterion: 4 µmol L^{-1}).[76] Second, ammonium loading must be less than what phytoplankton are able to assimilate; otherwise, the ammonium concentration will continue to increase (Loading Criterion for Suisun Bay: 0.49 mmol m^{-2} d^{-1}).[77]

Nitrogen and phosphorus levels from times and places when or where the Bay Delta Estuary aquatic community resembled more desirable, balanced food web could be used to determine numeric criteria for the appropriate ratios. For example, according to Glibert, diatoms began to decline in the Suisun Bay area around 1982[78]; therefore, restoring nutrient conditions to those that existed prior to 1982 could be an appropriate target. Alternatively, N:P conditions upstream of major anthropogenic inputs of nutrients into the system could be used as a target.

c. <u>Schedule for implementation.</u> Upon issuing the updated criteria document, EPA should set an expeditious schedule for states, including California, to issue water quality standards that reflect the updated criteria document and incorporate the new standard into permits for dischargers. The new criteria should be implemented promptly.

III. EPA should urge the Army Corps of Engineers to begin a consultation process to evaluate the impacts of Sacramento Regional and other dischargers on species listed under the Endangered Species Act

EPA should urge the U.S. Army Corps of Engineers to initiate a consultation process under the Endangered Species Act (ESA) to evaluate the full extent of the impacts caused by discharges from wastewater treatment plants, such as Sacramento Regional, that receive permits from the Corps under Section 10 of the Rivers and Harbors Act. 33 U.S.C. § 403. If invoked, the ESA would provide for the impacts on the listed species to be analyzed using the best available science. 16 U.S.C. § 1536(a)(2).

The Bay-Delta Estuary provides critical habitat for species listed under the federal Endangered Species Act. The Delta is home to the delta smelt and spring-run Chinook salmon (threatened), the winter-run Chinook salmon (endangered), and the fall- and late fall-run Chinook salmon (species of concern).[79] Moreover, the area of Sacramento Regional's discharge—in the Sacramento River at a point just south of the Freeport Bridge—is within the

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[76] Wilkerson, et al. 2006; Dugdale, et al. 2007.

[77] Based on data from Wilkerson et al. 2006, a value of 0.49 mmol m^{-2} d^{-1} was determined to be the maximum ammonium loading to Suisun Bay that will not overwhelm the ability of the phytoplankton to assimilate and control the ammonium environment of the Bay and prevent the reduction of ammonium concentrations to bloom forming levels (i.e. <4µmol L^{-1}).

[78] Glibert, P. 2010a.

[79] *See* U.S. Fish & Wildlife Service Sacramento Fish & Wildlife Office Species Account, available at www.fws.gov/sacramento/es/animal_spp_acct/delta_smelt.pdf; Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead, available at www.nwr.noaa.gov/Publications/Biological-Status-Reviews/loader.cfm?csModule=security/getfile&pageid=21346

designated critical habitat for the delta smelt.[80] In fact, the location of the Sacramento discharge is "just upstream of where delta smelt have been observed to congregate in recent years during the spawning season."[81]

As outlined above and in referenced comments, there is considerable and compelling science that suggests the nutrient loadings from POTWs, most prominently Sacramento Regional, are impacting these listed species and their habitat. The scientific studies show that the historic and ongoing discharges, particularly of ammonia/um, are causing acute and/or chronic toxicity and significant habitat modification and degradation that is harming the delta smelt's food sources and thereby injuring and killing members of the species.

Yet, in the case of Sacramento Regional, the Permit will not only let similar discharges continue for an entire decade, the interim limits for ammonia would allow a doubling of ammonia during that time. This discharge has the potential to directly (through increased toxicity) and indirectly (through adverse habitat modification and degradation) injure or kill delta smelt.

Also, the Permit would allow for discharges that increase the temperature in the Sacramento River to levels near lethal or lethal to delta smelt, multiple runs of salmon, and steelhead, which, even if not fatal, could significantly degrade the habitat such that the temperature would harm or harass them or interfere with the timing of spawning. Delta smelt spawn just downstream of Sacramento Regional's outfall. Under the Permit, however, temperatures due to the discharge would be permitted to rise to levels lethal to delta smelt, salmon, and steelhead and could have chronic impacts on their essential behavioral patterns, such as the timing of spawning and migration.[82] The technical reviews explain that the thermal effect of the discharge could have adverse effects on the physical habitat for delta smelt, salmon, and steelhead that could render spawning conditions unsuitable, on water quality conditions that could negatively affect all life stages, and/or on river flow that could inhibit larval and juvenile transport and adult migration. [83]

These and other impacts demand that the bright spotlight of the ESA be shined on Sacramento Regional and other POTWs that discharge to the Bay-Delta. Although EPA may have no direct authority to require a consultation in this context under the Endangered Species Act, there are avenues open to other federal agencies – in particular the United States Army Corps of Engineers – to initiate the consultation process to study and address the effects of the discharge. EPA should use its considerable powers of persuasion to encourage the Army Corps to evaluate outstanding permits for the largest sources which have their discharge pipe in a water of the United States, and as appropriate, to begin the consultation process under Section 7 of the

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[80] It is also critical habitat for the winter- and spring-run Chinook salmon (Oncorhynchus tshawytscha), steehead (O. mykiss), and green sturgeon (Acipenser medirostris).

[81] Smelt BiOp, supra at 245.

[82] *See* Entrix, R. Thomson & J. Baldrige, Review of the Sacramento Regional Wastewater Treatment Plant's Tentative Order and Thermal Exemption Technical Report's Temperature Impact on Delta Smelt (Oct. 6, 2010); Cramer Fish Science, S. Cramer, P. Gaskill & J. Vaughan, Impact of Sacramento Regional Wastewater Treatment Plant, Effluent Discharges on Salmonids Technical Review Report (September, 2010).

[83] *Id.*

Endangered Species Act. That would set in motion a formal, science-based federal process to study the effects of nutrient discharge on the Delta.

The basis for the consultation process would be as follows: The Army Corps permits structures or other obstructions that may interfere with navigation in the "navigable waters of the United States" under Section 10 of Rivers and Harbors Act. 33 U.S.C. § 403; 33 C.F.R. Parts 322, 325. The regulations give the Corps discretion to reevaluate the conditions of Section 10 permits based on "the public interest." 33 C.F.R. § 325.7(a) ("*General.* The district engineer may reevaluate the circumstances and conditions of any permit, including regional permits, either on his own motion, at the request of the permittee, or a third party, or as the result of periodic progress inspections, and initiate action to modify, suspend, or revoke a permit as may be made necessary by considerations of the public interest."). In determining whether to re-open a permit, "the factors to be considered" also include "whether or not circumstances relating to the authorized activity have changed since the permit was issued or extended." 33 C.F.R. § 325.7(a).[84]

Issuing a modified Section 10 permit under the Rivers and Harbors Act would be a federal action that triggers the Corps' duty under Section 7 of the ESA. If the Corps' permit is being reopened, then consultation as part of that new permit would be required, as a matter of law, if certain conditions arise. Specifically, "reinitiation of formal consultation is required" when "new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered." 50 C.F.R. § 402.16(b).

As such, we suggest that EPA follow a straightforward process. First, in cooperation with the Corps and the State, EPA should determine which among the largest POTWs that discharge to the Bay-Delta or its tributaries have Section 10 permits for structures obstructing navigable waters. Second, EPA should request that the Corps promptly initiate or re-initiate the consultation process to evaluate the effects of the discharge on endangered species.

At a minimum, given the magnitude and scope of the Sacramento Regional discharge and the already compelling evidence of its potential to impact listed species, EPA should urge the Corps to start the consultation process for that plant promptly. Westlands learned in response to its Freedom of Information Act requests that the Corps issued a permit to Sacramento Regional for the large diffuser that is located on the bottom of the Sacramento in 1976.[85] To our knowledge, Sacramento Regional has not received a Section 10 permit that would authorize any take of an endangered species. It likewise does not appear that the Corps or any other Federal agency has ever consulted with the Fish and Wildlife Service or the National Marine Fisheries Service over the impacts of the discharges from Sacramento Regional that are authorized by the Corps. In response to Westlands' FOIA requests, the Corps did not have or provide any evidence of any consultation since that time.

Moreover, unquestionably, circumstances have changed dramatically over the past four decades. The conditions in the Bay-Delta Estuary have declined dramatically, as EPA has noted

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[84] There may also be "re-openers" in an individual permit that specify when that permit could be reconsidered.

[85] Department of the Army Permit, Application No. 5049A, issued to County of Sacramento Department of Public Works (effective date, March 31, 1976) ("to accommodate installation of a 120" diameter multiport diffuser")

in its ANPR. Moreover, the state of scientific knowledge has likewise changed dramatically – as "new information" unquestionably "reveals effects of the" discharge of ammonia and other nutrients "may affect listed species or critical habitat in a manner or to an extent not previously considered."

IV. Science does not support the use of X2 as a tool for regulatory action by EPA or other federal agencies

The ANPR asks for comment on the topic of the low salinity zone as measured by the location of the 2 ppt salinity gradient or "X2." Unabridged ANPR at 52. EPA suggests that X2 "plays a large role, both historically and recently" in the health of estuarine species. Westlands strongly disagrees with that proposition. Having examined the scientific data with care in this and other proceedings, there is no sound scientific basis for EPA's conclusions about the importance of X2. We therefore urge EPA not to take any action to adjust the flow of water in an effort to achieve a particular X2. Indeed, EPA's authority under the Water Act does not extend to imposing flow restrictions.

A. Available scientific data do not show that X2 causes harm to the aquatic ecosystem of the Bay-Delta

There is insufficient scientific evidence regarding the mechanisms by which X2 could affect the Bay-Delta ecosystem to support its use as a regulatory tool to improve the estuarine ecosystem. While studies purport to show a *correlation* between X2 and abundance of several species, the authors of the key papers published on this subject have concluded that the uncertainty and lack of knowledge about how X2 might affect those species makes it impossible to reach any conclusions about whether X2 *causes* these effects. Moreover, there are significant weaknesses in the work purporting to find even a correlation between X2 and species abundance. As such, there is insufficient scientific support to rely on X2 as a basis for imposing restrictions on water flow.

1. The work of Jassby, Kimmerer and Feyrer do not support a causal relationship between X2 and harm to the ecosystem.

Research done over the past two decades by key researchers in the field, including Jassby, Kimmerer and Feyrer, all demonstrate that current scientific knowledge does not support the conclusion that X2 causes harm to the estuarine ecosystem. Specifically:

- <u>X2 correlations are insufficient basis for flow restrictions.</u> Jassby recognized that the winter and spring X2 correlations vs. abundance do not consider other variables; thus, there is an insufficient basis on which to set restrictions to manage flow. Moreover, in light of unexplained variations in the data, flow restrictions could lead to "biased management policies." As Jassby explains:

> By ignoring variables other than X2 (or Q_{out}) we could therefore be in danger of imposing inappropriate standards, either too stringent or too lenient. The mere fact of a correlation between some ecosystem property and an indicator such as X, is therefore not

> sufficient grounds for using the indicator as a policy variable. The presence of much unexplained variation is one signal that an existing model can lead to unacceptably biased management policies, and should result in a search for alternative and additional variables.[86]

- There are substantial uncertainties in the predictive nature of the winter/spring X2 correlations. Jassby also found that the substantial uncertainties in policy variables make predicting whether a particular X2 might result in improved survival rate problematic. As he explains:

> It is important to distinguish the problem of predicting a resource level from that of setting a management goal for that resource. In the case of striped bass survival, for example, the problem of predicting survival is different from that of choosing X2, to attain some target survival value. As Walters (1986) concludes: '… it is quite possible for a very good predictive model (low s2) to give very poor (highly uncertain) estimates for key variables of policy interest.' In order to evaluate the utility of a particular model for pursuing policies, one must therefore examine the uncertainty in choosing a management goal and not simply how well the model accounts for variability in the resource level.[87]

- The correlations are also insufficient because the fundamental mechanism by which X2 affects survival of estuarine species is unknown. As Kimmerer notes, the apparent relationship between species abundance and flow "may be due to several potential mechanisms, each with its own locus and period of effectiveness, but no mechanism has been conclusively shown to underlie the flow relationship of any species."[88] As such, there is an insufficient basis to draw a causal relationship to warrant a particular X2 level.

- Flow restrictions have not been effective. Importantly, Kimmerer looked at the actual data and found that while flow restrictions were imposed, those restrictions have not been shown to be effective. This is further evidence that the correlation is not sufficient to establish a causal relationship or to rely on winter/spring X2 as a basis to restrict flow. As such, further research is required to evaluate whether X2 really has any merit as a regulatory management tool.

> Several flow-based management actions were established in the mid-1990s, including a salinity standard based on these flow effects, as well as reductions in diversion pumping during critical

[86] Jassby A.D., Kimmerer W.J., Monismith S.G., Armor C., Cloern J.E., Powell T.M., Schubel J.R., Vendlinski T.J. 1995. Isohaline position as a habitat indicator for estuarine populations. Ecol Appl 5:272-289.

[87] *Id.*

[88] Kimmerer, W.J. 2002. Physical, biological, and management responses to variable freshwater flow into the San Francisco estuary. Estuaries Vol. 25, No. 6B, p. 1275–1290.

> periods for listed species of fish. The effectiveness of these actions has not been established. To make the salinity standard more effective and more applicable to future estuarine conditions will require investigation to determine the underlying mechanisms.[89]

Some Delta species are not well correlated with winter/spring X2 or Delta outflow. Most notable is the delta smelt. Chlorophyll a, a source of primary production, also is not well correlated with X2 or flow.

Kimmerer analyzed the abundance data again, this time to try to determine if physical habitat was the mechanism by which flow, as defined by X2, affected species abundance.[90] In this study, Kimmerer compared the physical habitat versus flow to the species abundance versus flow. He concluded for only two species were the slopes similar, and "[t]herefore, other mechanisms must underlie responses of abundance to flow for most species."[91]

- <u>X2 cannot explain the step change reducing several pelagic species abundance, indicating other factors are at work.</u> It is clear that there is no good correlation between X2 and the long-term of the entire pelagic abundance data set. To address this deficiency, Kimmerer divided the data set into two.[92] This division was based on Kimmerer's reasoning that an introduced clam, Corbula amurensis, became abundant after 1987 and "apparently had a substantial grazing impact on phytoplankton and reduced zooplankton abundance through both predation and competition (Alpine and Cloern 1992; Kimmerer et al. 1994; Kimmerer and Orsi 1996; Orsi and Mecum 1996)."[93] This resulted in pre- and post-divide correlations for most species that had similar slopes. But, the regressions for delta smelt (which Kimmerer split between 1981 and 1982) flip-flopped. and they were not similar in the pre- and post-division periods. Despite Kimmerer's attempt to divide the data set to find some correlations that might work, his work demonstrates that X2 alone cannot explain the step change of reduced pelagic abundance.

Feyrer also divided the abundance data set into two; pre- and post-1986, but he found no statistically significant regression models with the earlier data set.[94] Feyrer thus recognized that (a) the step change in pelagic abundance cannot be explained only by X2 and (b) additional study is required:

> However, the degree to which EQ could be used for management purposes remains unclear. Flow standards in San Francisco

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[89] *Id.*

[90] Kimmerer, W. J., E. S. Gross, M.L. MacWilliams. 2009. Is the Response of Estuarine Nekton to Freshwater Flow in the San Francisco Estuary Explained by Variation in Habitat Volume? Estuaries and Coasts. 32(2):375-389 (http://www.springerlink.com/content/26pr3h5574605083/).

[91] *Id.*

[92] Kimmerer, W.J. 2002.

[93] *Id.*

[94] Feyrer, F., M.L. Nobriga, T.R. Sommer. 2007. Multidecadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, USA. Can. J. Fish. Aquatic. Sci. 64: 723- 734.

> Estuary are based largely on a surrogate for salinity (Xl)' particularly during winter and spring. While X2, is a valuable generalized variable that is relatively easy to measure and is correlated with long-term abundance trends of multiple species (Jassby et al., 1995; Kimmerer, 2002), the recent step change in the abundance of pelagic fishes suggests that salinity alone may not be sufficient to explain long-tern trends in estuarine management…..Moreover, for the water quality data to be most effective for species management, additional information is needed to better define the mechanisms for the effects of water quality variables on aquatic organisms.[95]

See also Feyrer, et al. 2008[96] ("the specific mechanisms by which X2 affects delta smelt remain poorly understood").[97]

There is a statistical concern regarding the Feyrer, et al.(2007) association between fall X2 and delta smelt abundance. In the FWS' Biological Opinion Effects Analysis, the authors cautioned that the residuals from the analysis were not normally distributed, and may need some transformation. The independent science panel review of the Biological Opinion, however, commented it is the model itself, and not the data, that may be inappropriate:

> The third step of the habitat analysis was to examine the relationship between fall X2 and smelt abundance. Specifically, fall X2 and fall MWT index were used as predictor variables with summer townet index as the response variable. The EA points out that the residuals from this analysis are not normally distributed and that some transformation might be required. We suspect that a few of the data points may have high influence on the outcome. These results together suggest that the model may be inappropriate for the data being used.[98]

Given the deficiencies in the attempts to correlate X2 with species abundance, it is imperative that other factors that can help to explain the step change be examined. Moreover, the weakness of the correlation means that X2 cannot be relied upon as a management tool.

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[95] *Id.*

[96] Feyrer, F., Newman, K., Nobriga, M., Sommer, T. 2008. Modeling the effects of water management actions on suitable habitat and abundance of a critically imperiled estuarine fish (delta smelt Hypomesus transpacificus). Manuscript in preparation. Finlayson, B.J. 1983. Water hyacinth: Threat to the Delta? Outdoor California 44: 10-14.

[97] The court, in the Delta Smelt Consolidated Cases, also raised questions about reliance on Feyrer, et al. 2007's analysis of X2 to justify operational restrictions on water withdrawals in light of the weak statistical correlation and the Service's failure to consider other factors which might account for Delta Smelt abundance. *See Delta Smelt Consolidated Cases*, No. 1:09-cv-00407 OWW DLB, et al., Memoranda Decision Re Cross Motions for Summary Judgment, at 112-113 (E.D. Cal. Dec. 10, 2010).

[98] Rose KA, Kimmerer WJ, Leidy GR, Durand J. 2008. Independent peer review of USFWS's draft effects analysis for the operations criteria and plan's biological opinion. Report prepared for U.S. Fish and Wildlife Service dated 10/23/2008 (PBS&J, 2008).

2. The National Research Council and others recognize that there are insufficient data to establish a defensible nexus between X2 and a healthy ecosystem.

The National Research Council (NRC) within the National Academy of Sciences (NAS) reviewed the United States Fish and Wildlife Service's 2008 Biological Opinion for the Proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP) for delta smelt. In March 2010, the NRC commented on the lack of understanding of the mechanisms upon which X2 affects the ecosystem. The NRC found that the "weak statistical relationship between the location of X2 and the size of the smelt populations make the justification for this action difficult to understand. In addition, although the position of X2 is correlated with the distribution of salinity and turbidity regimes, the relationship of that distribution and smelt abundance indices is unclear."[99] The NRC explained that the relationship between X2 and smelt abundance was based on:

> a series of linked statistical analyses (e.g., the relationship of presence/absence data to environmental variables, the relationship of environmental variables to habitat, the relationship of habitat to X2, the relationship of X2 to smelt abundance). Each step of this logical train of relationships is uncertain. The relationships are correlative with substantial variance left unexplained at each step, yet the analyses do not carry the uncertainty at each step to the next step. The action also may have high water requirements and may adversely affect salmon and steelhead under some conditions.[100]

In a subsequent report, the NRC emphasized that the uncertainties concerning the location of fall X2 were so great that they were not the appropriate to use alone for management purposes.[101]

The Delta Science Program coordinated an independent science review of the 2005 Pelagic Organism Decline Synthesis Report and reached similar conclusions as the NRC. Among the weaknesses the panel found were:

(1) The step-like decline in abundance of delta smelt and other pelagic species in 2001 has been interpreted as a recent shift in environmental or biological conditions, and is driving much of the recent research effort. However, the evidence is not convincing and the interpretation is open to question.

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[99] National Research Council. 2010. A scientific assessment of alternatives for reducing water management effects on threatened and endangered fishes in California's Bay-Delta. National Academies Press, Washington, D.C. ("NRC, March 2010").

[100] *Id.*

[101] Anderson, James A., R.T. Kneib (Chair), S. A. Luthy, P. E. Smith. Report of the 2010 independent review panel (IRP) on the reasonable and prudent alternative (RPA) actions affecting the operations criteria and plan (OCAP) for state/federal water operations. Prepared for: Delta Stewardship Council, Delta Science Program 12/9/2010. ("NRC, Dec. 2010").

(2) Key pieces of basic information appear to be lacking on the habitat requirements and early life stages of pelagic species of interest. For example, there is very little information on where the eggs of delta smelt can be found in the system. Likewise, there are few reliable estimates of vital rates (e.g. stage-specific growth and mortality rates) required to adequately model spatially-explicit population dynamics of pelagic species under different scenarios.

(3) The data analyses and dynamic models lack the sophistication to match the complexity of the dynamics in the hydrological and population/community dynamics of the Bay-Delta system.[102]

To its credit, EPA appropriately acknowledges these uncertainties in the ANPR and the conclusions of the NRC's analysis. EPA notes that NRC "questioned the basis for the exact targets specified in the Opinion and supported the requirement for intensive study and monitoring of the effects of the requirement. The NAS review also questioned the predictive nature of the relationship for delta smelt abundance. Recent litigation over the ESA biological opinion on water export operations raised similar issues on the X2 approach." Unabridged ANPR at 55. EPA needs to emphasize and truly account for these uncertainties as it moves forward with the ANPR.

3. Variables other than X2 or Delta outflow must be evaluated.

As demonstrated above, X2 not only cannot easily be correlated with species abundance, the data are too weak to provide a causal link between X2 and species abundance. For that reason, other factors affecting species abundance must be considered. Several studies examine these other factors. To reiterate:

- <u>Nutrient loadings are correlated with species abundance and composition</u>. As explained above in Section I of these comments, Glibert evaluated nitrogen and phosphorous changes over time in the estuarine habitat, and their relation to species composition and abundances.[103] Glibert concluded "Changes in nutrient loadings and forms were related to changes in the phytoplankton assemblage, which in turn were related to changes in zooplankton, and in turn, related to clam abundance, and to the abundance of various fish species."[104] Diatoms were negatively related to (*i.e.*, less abundant due to) ammonium (NH_4); in contrast, the cyanobacteria and flagellates (which may produce harmful blooms and are less readily available for assimilation into the foodweb) were positively correlated with NH_4. The invasive Corbula (clam) was positively related to NH4 and N:P ratio. Delta and longfin smelts and striped bass were negatively related to NH4 and N:P ratio, whereas largemouth bass, inland silverside, threadfin shad, and sunfish were positively related to NH_4 and N:P ratio. These relationships are inclusive of the entire

[102] Bertness, M. D., S. M. Bollens, J. H. Cowan, Jr., R. T. Kneib, P. MacCready, R. A. Moll, P. E. Smith, A. R. Solow, R. B. Spies. Review panel report (19 Dec 2005) San Francisco Estuary Sacramento-San Joaquin Delta Interagency Ecological Program on pelagic organism decline. Prepared for California Bay-Delta Authority, dated 12/19/2005 ("2005 POD Synthesis Report Review Panel Report")

[103] Glibert, P. 2010a.

[104] *Id.*

data sets, including the "regime shift" (used by Kimmerer and Feyrer to develop species correlations with X2), whether it is between 1981/1982 or 1986/1987 or 1987/1988. The importance of Glibert's analyses is that it explains changes in the entire historical data set. Feyrer, et al. cautioned that "the recent step change in the abundance of pelagic fishes suggests that salinity alone may not be sufficient to explain long-term trends in estuarine management."[105] Glibert's nutrient analyses point to one of those factors which may explain the long-term trends.

- <u>High concentrations of nitrogen adversely impact phytoplankton.</u> Similarly, as also outlined above, Dugdale, et al.[106] have studied the effect of different forms of nitrogen on phytoplankton growth in the estuary. The Dugdale team has concluded concentrations of ammonium-nitrogen inhibited phytoplankton use of the nitrate form of nitrogen much of the year.

4. Life Cycle Models provide a tool to evaluate potential causal mechanisms.

The simple statistical correlations employed by Kimmerer and others have not been able to identify the specific causes for species decline. Life cycle models may provide a better tool.

The NRC independent science review panel, in fact, identified such models as important to determine what factors affect an organism at each life stage, whether there are density dependent factors, and where bottlenecks occur. The NRC reviewers explained:

> Nonlinear and compensatory relationships between different life history stages are common in many fish species. Moreover, many life-history traits exhibit significant patterns of autocorrelation, such that changes in one life-history trait induce or cause related changes in others. These patterns can most effectively be understood through integrated analyses conducted in a modeling framework that represents the complete life cycle……Similarly, a better life-cycle model for delta smelt is critically needed (PBS&J, 2008). Such life-cycle models for delta smelt are currently under development. The committee recommends that development of such models be given a high priority within the agencies. The committee also encourages the agencies to develop several different modeling approaches to enable the results of models with different structure and assumptions to be compared. When multiple models agree, the confidence in their predictions is increased.[107]

[105] Feyrer, et al. 2007.

[106] Dugdale, et al. 2007.

[107] NRC, March 2010.

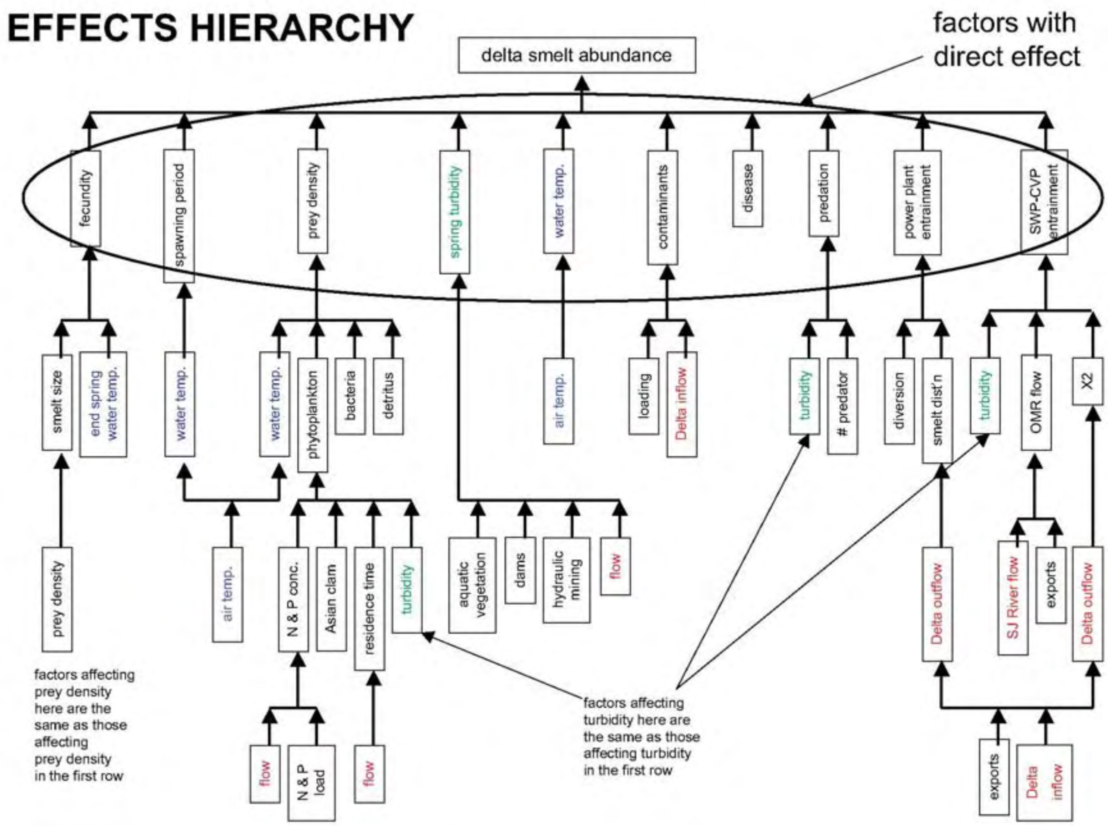
Judge Wanger, in the Delta Smelt Consolidate Cases, also concluded that "[i]t is undisputed that application of a quantitative life cycle model is the preferred scientific methodology."[108]

Miller, et al. (in review) developed the Effects Hierarchical Conceptual Model to determine the mechanisms that affect estuarine habitat; a mechanistic hierarchical model. Figure 3 is an illustration of the Effects Hierarchy for delta smelt. Miller et al. (in review). This work shows that only a few factors have direct effects, while most factors act through the factors with direct effects.

The hierarchy is constructed based on the mechanism by which each factor acts. The hierarchy is not based on the importance of effects, only on their mechanisms. The most important factors, the ones driving abundance and worthy of management attention, may be positioned near the bottom of the hierarchy. The effects hierarchy conceptual model serves to identify, first, the most important factors with direct effect, and then factors significantly affecting the most important factors with direct effect, and so forth. It allows environmental factors that do not show evidence of direct effects on the desired fishes to be analytically ruled out, thereby narrowing the search for the mechanistic cause(s) of the pelagic fishes' declines. By segregating the analysis into a series of separate analyses, it reduces the number of factors being analyzed at each step, and reduces the possibility of spurious correlations caused by chance occurrence or by the phenomenon of multicollinearity and differential measurement error (see Zidek 1996). It allows for identification of the mechanistic cause(s) of the fishes' declines, rather than surrogates for the mechanistic cause(s).

[108] *Delta Smelt Consolidated Cases*, No. 1:09-cv-00407 (and consolidated cases) (E.D. Cal.), Memorandum Decision re Cross Motions for Summary Judgment (Dec. 14, 2010) at 57.

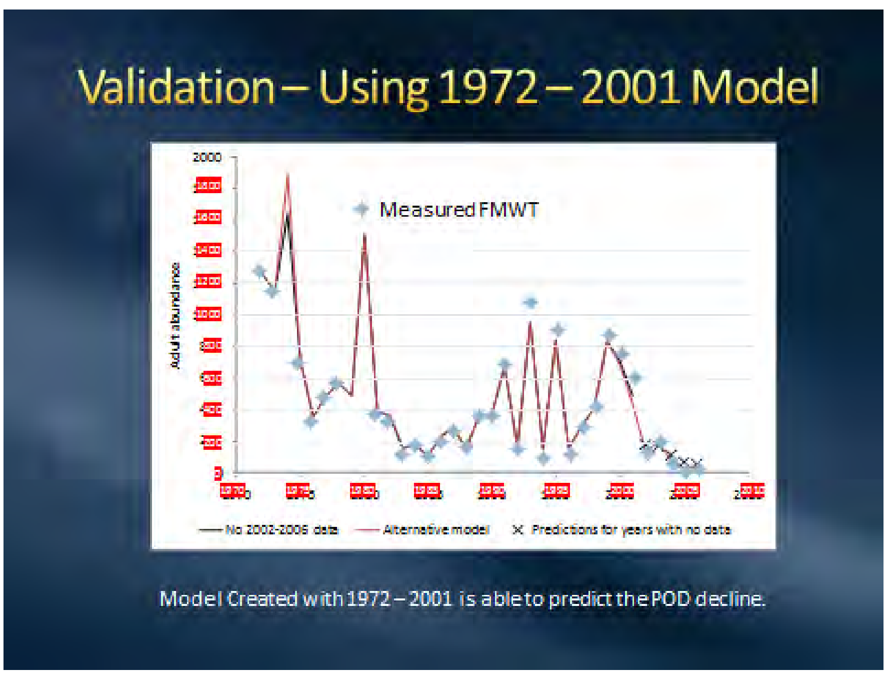
Chart 27



The effects hierarchy conceptual model can be used to assess the roles of environmental factors in determining population sizes and trajectories in each of the four pelagic fishes. The Environmental Protection Agency has developed a method for identifying important factors affecting aquatic species. It is an adaptation of the "weight of evidence" approach and is referred to as "The Causal Analysis/Diagnosis Decision Information System" (CADDIS, http://www.epa.gov/caddis/). This method could also be used without regard to the effects hierarchy, but would be more effective if used in conjunction with the effects hierarchy, to lessen the chances of spurious correlations. Use of CADDIS and its insistence on rigorous analysis of spatial and temporal coincidence of causes and effects might resolve uncertainties; thus CADDIS, appropriately, does not permit a hypothesis of undetectable effects acting over the decades to produce obvious effects in recent years.

Miller, et al. (in review) developed a multivariate delta smelt life cycle model. The purpose of the multivariate analysis is to identify those factors most important to population levels of delta smelt. An additional result of the analysis is to identify factors for which there is little evidence of importance. Annual values of covariates were estimated for 1972 through 2006. These estimates incorporated co-occurrence, the weighting of factor values in different sub-regions of the estuary by the fraction of the population of delta smelt in each sub-region. Estimates of food availability incorporated information on prey selectivity and focused on those species selected by different life stages of delta smelt. Estimation of process errors revealed these to be low, making simple regression analyses the appropriate analytical method. Regression analysis was used to identify the most important factors having direct effects on the survival of delta smelt from fall to summer, summer to fall, and fall to fall. Results indicated strong evidence of density dependence and evidence that the density of the fish's zooplankton prey was the most important environmental factor from 1972 to 2006 in determining delta smelt abundance and the factor primarily responsible for the sharp decline in abundance in the early 2000s to record low levels. Predation and water temperature in the spring showed some importance. Proportional entrainment of delta smelt at state and federal pumping plants showed some importance for adult-to-juvenile survival, but not over the annual life cycle. Other factors, including the volume of water with selected abiotic attributes, did not explain variation in abundance beyond that accounted for by prey density and entrainment.

Maunder and Deriso (2010, in review)[109] developed a state-stage life cycle model for delta smelt. They concluded that the primary factors affecting delta smelt abundance are food abundance, water temperature, predator abundance and density dependence. They found strong evidence for density dependence in survival from juveniles to adults, some evidence for density dependence for the stock-recruitment relationship from adults to larvae, and evidence against density dependence in survival from larvae to juveniles. They noted at recent abundance levels, density dependence is likely not having a significant effect. Maunder and Deriso (2010, in review). The variables they have included in their model explain the regime shift step change in the mid-1980's, and recent decline in delta smelt abundance since 2000. The Figure below is an illustration of the model fit and validation to the recent 2002-2006 decline.



[109] Maunder MN, Deriso RB. Submitted. A state-space multi-stage lifecycle model to evaluate population impacts in the presence of density dependence: Illustrated with application to delta smelt.

B. EPA lacks authority to regulate river flows.

In any event, EPA's authority under the Clean Water Act is carefully circumscribed and does not include authority to regulate river flows.

Under the Clean Water Act, the Agency is charged with providing national direction to states through the publication of effluent guidelines for conventional and toxic pollutants and water quality criteria. *See* 33 U.S.C. §§ 1311(b) and (d), 1314(b), 1317(a) (effluent guidelines); 1314(a) (water quality criteria). States are given primary responsibility for permitting point source discharges within their borders, setting water quality standards (subject to review and approval by EPA) and controlling nonpoint source pollution. *Id.* §§ 1342(b) (permitting discharges); 1313(a)-(c) (establishing and assuring maintenance or achievement of water quality standards); 1311(a) and 1362(7) (nonpoint sources). If states fail to meet the minimum federal standards, EPA may take over the permitting function. *Id.* § 1342(c)(3). Thus, the Act sets a federal "floor" for water quality degradation—the minimal water quality protections that dischargers and states must both observe. Through their water quality standards, however, states remain free to impose more stringent water quality protections within their respective borders, id. § 1370, and all dischargers—including the federal government—must observe these requirements. *Id.* § 1341(a), (d); *S.D. Warren Co. v. Maine Bd. Envtl. Protection*, 547 U.S. 370, 382–87 (2006); *PUD No. 1 of Jefferson County v. Washington Dept. Ecology*, 511 U.S. 700, 711–13 (1994).

In enacting the Clean Water Act, Congress expressly reserved to the States the power to regulate the flow and allocation of waters within their borders. Section 101(g) of the Act, known as the "Wallop Amendment" provides:

> It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated or otherwise impaired by this chapter. It is the further policy of Congress that nothing in this chapter shall be construed to supersede or abrogate rights to quantities of water which have been established by any State. Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources.

33 U.S.C. § 1251(g). As explained by Senator Wallop, "Water quality and interstate movement is an acceptable Federal role and influence. But the States [sic] historic rights to allocate quantity, and establish priority usage remains inviolate because of this amendment." *See* 123 Cong. Reg. 39,212 (1977), *reprinted in* 3 Comm. on Environment and Public Works, 95th Cong., 2d Sess., Legislative History of the Clean Water Act of 1977 at 552.

Section 510(2) of the Act amplifies the reservation of water quantity and flow issues to the states (and the implied restriction on EPA's authority described in section 101(g)), stating nothing in the Act shall "be construed as impairing or in any manner affecting any right or jurisdiction of the States with respect to the waters . . . of such States." 33 U.S.C. § 1370(2). These provisions together make clear that EPA may not take action to supersede, abrogate or otherwise impair the authority of States over water rights, including efforts to establish water quality criteria or standards by limiting water flow or withdrawals. To be sure, states may take such action, as the Supreme Court made clear in *PUD No. 1*, where it held that the Act did not prohibit a state from imposing limits on flow to ensure water quality. *Se*e 511 U.S. at 720 ("Sections 101(g) and 510(2) preserve the authority of each State to allocate water quantity as between users; they do not limit the scope of water pollution controls that may be imposed on users who have obtained, pursuant to state law, a water allocation."). The Ninth Circuit confirmed that the Clean Water Act gives states exclusive authority to control flow and water withdrawals. *See Great Basin Mine Watch v. Hankins*, 456 F.3d 955, 963 (9th Cir. 2006) ("[i]n the absence of state law to the contrary, water withdrawals are not subject to the requirements of the Clean Water Act").

In short, despite EPA's significant responsibilities under the Clean Water Act, it may not directly impose restrictions on water withdrawals and flows in the Delta.

V. The Evidence Does Not Show That Water Withdrawals Have Adversely Affected Fish Migration Corridors

The ANPR asks for comment on the topic of "fish migration corridors" and suggests that it may be appropriate to draw causal link from the exports of water from the Bay-Delta to a change in water quality to the survival of certain migrating adult salmon. Unabridged ANPR at 57-58. The literature cited by EPA does not support the conclusion that water exports, as opposed to the "many stressors" present in the Bay-Delta, have impaired adult salmon migration. Unabridged ANPR at 58.

The Unabridged ANPR misconstrues Messick (2001), on which it primarily relies to support its assertions about the potential link between water exports, water quality and survival of migrating adult salmon. Messick presents a re-analysis of data collected and reported by Hallock (1970), as well as the author's own analysis of coded wire tagged (CWT) San Joaquin Basin origin hatchery Chinook returning as adults to the San Joaquin and Sacramento rivers and hatcheries.[110]

First, the Hallock study cannot be used to evaluate the issue of whether any changes to the physical or chemical gradient from water withdrawals affected San Joaquin Basin origin adult Chinook homing behavior to the San Joaquin River.[111] The adult Chinook tagged by Hallock were of unknown origin. They were most likely fall run from the Central Valley, based on timing, but could have originated from anywhere in the Central Valley system. While the Hallock study might be useful for evaluating the effect of Delta hydrodynamics on upstream migration speed and/or timing, it cannot be used to reach conclusions regarding Chinook originating in the San Joaquin Basin.

[110] Messick, C. 2001. The effects of San Joaquin River flows and Delta export rates during October on the number of adult San Joaquin Chinook salmon that stray. In R. Brown (ed.) Contributions to the Biology of Central Valley Salmonids. Fish Bulletin 179: Volume Two, pp. 139-162.

[111] Hallock, R.J., R.F. Elwell, and D.H. Fry, Jr. 1970. Migrations of adult king salmon, *Oncorhynchus tshawytscha*, in the San Joaquin Delta. California Fish and Game 151. Sacramento. 92 p.

Second, while the CWT recovery analysis by Messick (2001) theoretically is an appropriate type of analysis to evaluate the effect of a change to physical or chemical gradient to the homing behavior of San Joaquin Basin origin adult Chinook to the San Joaquin Basin, the data presented and relied upon by Messick are insufficient to reach any conclusions. The limitations of these data and his analysis were emphasized by Messick in the report. At the outset, inspection for CWT data in the returning adult Chinook in both the rivers and hatcheries was inconsistent and non-systematic throughout the years. Table 2 in the Messick paper presents the adult recovery effort by year. The Table reveals that many years are missing either in the rivers or at the hatcheries. Messick made his best effort to piece the information together, but cautioned

> The coded-wire-tag (CWT) recovery data may not have been appropriate for a straying analysis because there are no clear records of the number of fish examined for tags during the carcass surveys. Not all fish counted for the carcass survey were examined for tags. These recovery data are necessary to accurately compute the total number of adult salmon with tags in each river.[112]

Furthermore, according to Messick "[a] casual inspection of the CWT recovery data suggests that . . . straying rates increased as the percentage of San Joaquin flow exported by the CVP and SWP pumping facilities increased, . . . [but r]ather than trying to determine the exact nature of the relationship based on existing data the uncertainty regarding the true number of fish examined for tags should be resolved first."[113] EPA needs to recognize the limitations of these data and Messick's analysis.

In sum, the available data are insufficient to demonstrate that gradients in physical and chemical constituents of water in the Bay-Delta Estuary and San Joaquin River Basin affect the migratory corridor for salmon.

Certain of the other items that the ANPR discusses also do not support further action by EPA in this context. For example, EPA refers to conclusion of the Vernalis Adaptive Management Program (VAMP) and to the recent recommendation by the State Water Board to set an October flow rate, with accompanying reductions in water exports to the water users. Unabridged ANPR at 60. Westlands has participated in the VAMP and has commented on the Delta Flow Criteria (and incorporates its comments here). As indicated, Westlands disputes the flow-centric approach to protecting and restoring the Delta ecosystem that is neither sustainable nor feasible."[114] Any focus on flow, to the exclusion of the other "many stressors," has already

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[112] Messick. 2001.

[113] Messick. 2001.

[114] Comments of Westlands Water District (July 29, 2010), http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/comments072910/thomas_birmingham.pdf *see also* Comments of San Luis Delta Mendota Water Authority (July 29, 2010) http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/comments072910/daniel_nelson.pdf, and Comments of State and Federal Contractors Water Agency (SFCWA) (July 29, 2010) http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/comments072910/byron_buck.pdf

been shown to be a failed approach. Indeed, even as the State's final report set restrictions, it had to acknowledge that the "effects of non-flow changes in the Delta ecosystem, such as nutrient composition, channelization, habitat, invasive species, and water quality, need to be addressed and integrated with flow measures." [115]

There is, however, no need for EPA to participate in that ongoing process – nor should it as a matter of law, for the reasons outlined above. However, if EPA were to participate, we urge that its views be guided by sound science and demand that a causal relationship between flow and asserted harms be proven before rushing into new restrictions on water use critical to farmers and families in Central California. For example, the data collected by the VAMP "experiment" should be analyzed with care with appropriate peer and data quality review before any further restrictions on exports is based on the VAMP program. Moreover, consistent with the premise outlined in the ANPR, EPA should not look at flow, without considering the contributions and impacts caused by entire range of other stressors, including, most importantly, nutrients.

If EPA were to propose or take any other action on fish migration corridors at this juncture, it should, as a preliminary matter, conduct its own direct additional studies instead of relying on the inadequate CWT recovery studies that have been done to date. Further, EPA has ample authorities to take action to address the other stressors identified in the ANPR. For example, EPA can enforce the dissolved oxygen TMDL in the Stockton Deep Water Ship Channel. As EPA acknowledges "low dissolved oxygen" is one of the stressors impacting migrating salmon. Unabridged ANPR at 58. EPA should use its Clean Water Act authorities to enforce the Act and ensure the TMDL is being achieved. In addition, EPA should enforce temperature requirements in discharge permits and urban stormwater requirements. These are also properly identified as stressors in the ANPR that impact salmon migration. *Id*. Like dissolved oxygen, enforcement of permitting requirement fall squarely within the scope of EPA's Clean Water Act enforcement authority.

VI. The ANPR's Focus on the Adverse Ecological Effects of Pesticides is Appropriate

The ANPR contains a lengthy discussion regarding pesticides and provides a good summary of existing information regarding the real and potential impacts of pesticides on aquatic resources within the Bay Delta Estuary. Unabridged ANPR at 36-47. EPA properly notes that certain pesticides have caused or contributed to impairments of designated uses in Bay Delta Estuary waterways, including upstream tributaries. *Id.* at 37. Westlands supports EPA's request for comments regarding pesticides and encourages EPA to use its Clean Water Act and FIFRA authorities to reduce pesticide inputs into the Bay Delta Estuary. Westlands will focus its comments on the impacts and sources of pyrethroid pesticides and steps EPA can take to reduce inputs of these pesticides because of their demonstrated toxicity and potential to adversely impact the Bay Delta Estuary aquatic ecosystem.

[115] State Water Resources Control Board California Environmental Protection Agency, Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem Prepared Pursuant to the Sacramento-San Joaquin Delta Reform Act of 2009 at 4 (Aug. 3, 2010), http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/final_rpt080310.pdf

A. Pyrethroid Pesticides are Toxic to Aquatic Organisms.

The toxicity of pyrethroid pesticides to aquatic biota is well documented. Studies have consistently shown that aquatic invertebrates and fish are highly susceptible to pyrethroids. Werner and Moran[116] describe the toxicity of these pesticides, explaining that exposed organisms exhibit a variety of symptoms, including hyperexcitation, tremors, convulsions, followed by lethargy and paralysis. Shahim, et al.[117] provide a similar overview of the ecological effects of pyrethroids. Siegfried[118] analyzed the comparative toxicity of pyrethroids, concluding that aquatic insects were generally more susceptible to toxic effects than terrestrial insects. Other studies reached similar conclusions.[119] EPA's registration of synthetic pyrethroids also acknowledges the toxicity of these pesticides.[120] In short, there can be no debate that pyrethroids have the potential to be toxic to and to adversely affect aquatic organisms in the Bay Delta Estuary.

B. Studies Show That Urban Runoff and WWTPs are Significant Sources of Pyrethroids to the Bay Delta Estuary.

Urban stormwater discharges and wastewater treatment plants (WWTPs) are significant sources of pyrethroid pesticides to the Bay Delta Estuary. A recent study by Weston and Lydy[121] demonstrates this point. The study involved comprehensive sampling in 2008 and 2009 of agricultural pump stations, urban runoff pump stations or storm drains, municipal WWTPs and the Sacramento and San Joaquin Rivers as they enter the Delta, as well as several smaller tributaries. The sampling demonstrates that urban and WWTP discharges are major sources of pyrethroids to the Delta:

- Urban Runoff: Virtually all urban runoff contained pyrethroids, typically in concentrations toxic to aquatic organisms. Bifenthrin and cyfluthrin were the pyrethroids of greatest toxicological concern in urban runoff, and both are used by professional pest control firms and are available in retail stores. The consistency of results from all the urban areas studies suggests that these conclusions can be extrapolated to urban runoff in general.

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[116] Werner, I. and K. Moran. 2008. Effects of Pyrethroid Insecticides on Aquatic Organisms. 310-334. *In* Gan, J., et al. Synthetic Pyrethroids. ACS Symposium Series. American Chemical Society. 2008.

[117] Shamim, M.T., M.D. Hoffmann, J. Melendez and M.A. Ruhman (2008). Ecological Risk Characterization for Synthetic Pesticides. 257-309. *In* Gan, J., et al. Synthetic Pyrethroids. ACS Symposium Series. American Chemical Society. 2008.

[118] Siegfried, B.D. (1993). Comparative Toxicity of Pyrethroid Insecticides to Terrestrial and Aquatic Insects. J. Environ. Tox. Chem. 12:1683-1689.

[119] Yang, W., F. Spurlock, W. Liu and J. Gan. 2006. Inhibition of aquatic toxicity of pyrethroid insecticides by suspended sediments. J. Enivron. Tox. Chem. 25:1913-1919; Yang, W., F. Spurlock, W. Liu and J. Gan. 2006. Effects of dissolved organic matter on permetrhin bioavailability to Daphnia species. J. Agric. Food Chem., 54:3967-3972.

[120] *See* http://www.epa.gov/oppsrrd1/reevaluation/pyrethroids-pyrethrins.html#epa.

[121] Weston, D. and M. Lydy. 2010. Pyrethroid Insecticides to the Sacramento-San Joaquin Delta of California. Environ. Sci. Technol. 44:1833-1840.

- Municipal WWTPs: Pyrethroids were present in about two-thirds of the WWTP effluent samples, often in concentrations toxic to aquatic organisms. Toxicity was seen in every sample from the Sacramento WWTP, but never in Stockton's WWTP. The Sacramento WWTP was the largest single discharge of pyrethroids among all Delta discharges studies, usually releasing at least 10 g/day.

- Agriculture: Agricultural discharges only occasionally contained detectible pyrethroids, and very few at levels which cause toxicity.

Weston and Lydy conclude from their study that the contribution of pyrethroids from urban centers could adversely affect water quality.

Weston and Lydy's work builds on other studies which have evaluated urban and WWTP contribution of pyrethroids in the Delta and elsewhere. For example, Holmes, et al.[122] conducted an investigation of California urban creek sediments to examine the spatial occurrence and magnitude of sediment toxicity in California urban creeks. Central Valley urban creeks were among the sites found to be most contaminated with pyrethroids at levels sufficient to exhibit toxicity to aquatic organisms. Similarly, Oros and Werner[123] prepared a white paper summarizing available information on the use, distribution, potential toxicity and fate of pyrethroid insecticides in the Bay Delta.

Weston, et al.[124] evaluated the toxicity of pyrethroids resulting from the use in suburban residential areas by sediment sampling in creeks around Roseville, California, near Sacramento. They concluded that the primary source of pyrethroids was from structural pest control by professional applicators and/or homeowner use of insecticides, particularly in lawn care products. They also concluded that the results seen in the Roseville area would be typical of other suburban and residential areas. Amweg, et al.[125] confirmed that pyrethroid-associated toxicity in sediment is common in urbanized watersheds throughout Northern California.

Collectively, these studies demonstrate that pyrethroids, particularly when considered with other stressors, have the potential to adversely impact aquatic biota in the Bay Delta Estuary. This information provides a sufficient basis for EPA to take action to control pyrethroid inputs.

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[122] Holmes, R.W., et al. 2008. Statewide Investigation of the Role of Pyrethroid Pesticides in Sediment toxicity in California's Urban Waterways. Environ. Sci Technol. 42:7003-7009.

[123] Oros, D. R. and I. Werner. 2005. Pyrethroid Insecticides: An Analysis of Use Patterns, Distributions, Potential Toxicity and Fate in the Sacramento-San Joaquin Delta and Central Valley. White Paper for the Interagency Ecological Program. SFEI Contribution 415. San Francisco Estuary Institute, Oakland, CA.

[124] Weston, D.R., R.W. Holmes, J. You, and M.J. Lydy. 2005. Aquatic Toxicity Due to Residential Use of Pyrethroid Insecticides. Environ. Sci. Technol. 39:9778-9784

[125] Amweg, E.L., D.P. Weston and N.M. Ureda. 2005. Use and toxicity of pyrethroid pesticides in the Central Valley, California, USA. J. Environ. Tox. Chem. 24:966-972.

C. Inputs of Pyrethroids to the Bay Delta Should Be Limited

The studies and data summarized above all suggest that efforts are needed to control inputs of pyrethroid pesticides to the Bay Delta. EPA can and should assist in its effort through the exercise of its authorities under the Clean Water Act and FIFRA.

1. EPA Should Take Steps to Ensure Control Stormwater and WWTP Discharges of Pyrethroids

The ANPR asks whether EPA should take further action under the Clean Water Act to control the discharges of pesticides to the Bay Delta Estuary. Unabridged ANPR at 47. With respect to pyrethroids, the answer to these questions is unequivocally yes, consistent with and cognizant of the principles of federalism.

First, there is more than sufficient data to support EPA's exercise of its residual authority under section 402(p)(2)(E) of the Clean Water Act, 33 U.S.C. § 1342(p)(2)(E), to control discharges from currently unregulated stormwater sources in urban areas, including small MS4s. Second, EPA has sufficient information to require that California permitting authorities impose restrictions on larger stormwater sources – industrial, construction, and larger MS4s – that act to limit or reduce the discharge of pyrethroids into the Bay Delta Estuary. MS4s in particular can be required to impose restrictions on the application of these pesticides or to require appropriate safeguards by professional applicators to prevent the pesticides from making their way into stormwater. Third, in light of the fact that WWTPs are significant contributors of pyrethroids, EPA should require that California permitting authorities impose restrictions on WWTPs that work to reduce pyrethroid discharges. All these actions, moreover, may trigger EPA's obligations under section 7 of the ESA.

2. EPA Should Exercise its FIFRA Authority and Complete Consultation with the Resource Agencies to Limit Inputs of Pyrethroids to the Bay Delta Estuary

EPA should also take action under FIFRA to supplement its efforts to control stormwater contributions of pyrethroids. Most importantly, EPA should ensure that it has complied with the ESA in the registration or re-registration of the pyrethroid pesticides. Accordingly, EPA should consult with the National Marine Fisheries (NMFS) Service as required under section 7 of the ESA, 16 U.S.C. § 1526, and, where appropriate, implement the Reasonable and Prudent Alternatives and Measures identified by NMFS to minimize contributions of pyrethroids to the Bay Delta Estuary.

VII. Conclusion

Westlands appreciates this opportunity to present its comments to EPA. As we have explained, EPA, other federal agencies and their state counterparts have for too long inappropriately focused their regulatory responses to the decline in pelagic and anadromous fish in the Bay-Delta Estuary almost exclusively on water exports by Westlands and others. The ANPR appropriately recognizes, and these comments conclusively demonstrate, that the best and most up-to-date science support the view that blame cannot be pinned on, and a solution cannot be found by focusing on, a single stressor, such as water exports. Rather, multiple stressors are at work, and it is this broader set of causes that an effective regulatory response must address. Stressors that deserve particular focus are ammonia/um discharges from WWTPs and pyrethroid pesticide contributions from WWTPs and urban runoff. Moreover, available science does not support reliance on X2 as a regulatory tool, nor is there compelling evidence that water exports have adversely affected fish migration corridors.

Westlands stands ready to work with and bring its expertise to EPA as a key stakeholder as EPA moves forward in response to the ANPR.

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