

Delta Nutrient-Related Water Quality Problems

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- Review of Water Quality Problems in Sacramento / San Joaquin Delta Related to Excessive Fertilization
- Review of Ability to Relate Nutrient Loads to Water Quality Problems

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Severe Water Quality Problems in Delta Caused by Excessive Nutrients

- Aquatic Plant Nutrients – Nitrogen & Phosphorus
- Excessive Discharges of Aquatic Plant Nutrients from
 - Urban Areas
 - Domestic Wastewaters
 - Stormwater Runoff
 - Agriculture
 - Stormwater Runoff
 - Tailwater
 - Subsurface Drain Discharges

CWEMF Delta Nutrient Water Quality Modeling Workshop

- CWEMF – California Water & Environmental Modeling Forum
 - Develops Workshops on Issues Related to Modeling Water Quality and Water Management
 - Drs. Lee and Jones-Lee Organized CWEMF Workshop to Highlight Water Quality Problems in Delta Caused by Excessive Nutrients
 - Lee Involved in Investigating & Developing Management Programs for Excessively Fertile Waterbodies in Many Parts of US & Other Countries since Early 1960s
 - Involved in Nutrient-Related Water Quality Issues in Delta since 1989
 - Workshop Held March 2008 in Sacramento
 - Program & PowerPoint Slides Available at:
<http://www.cwemf.org/workshops/NutrientLoadWrkshp.pdf>

Nutrient-Related Water Quality Problems in Delta



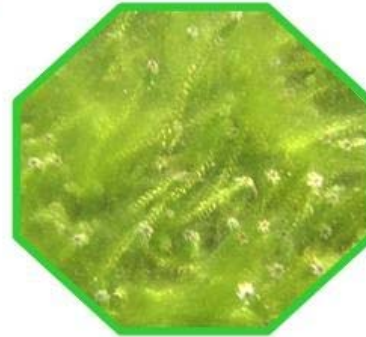
*Water Hyacinth
on Channel*



Tastes & Odors



*Algae-Caused Low
DO — Fish Kills*



Attached Algae

Domestic Water Supply Tastes & Odors

- Algae Release Chemicals That Impart Strong, Unpleasant Odors in Water Supply
 - Geosmin (Earthy Smell), and Others
 - Indicate Potential Public Health Concern for Consumers
 - Cause Public to Complain or Reject Water Supply as “Polluted”
 - Cause Water Utilities to Spend Money to Try to Remove Tastes & Odors

Need for Models to Develop Management Approaches

- Some Models Can Reliably Describe Relationships between Nutrient Discharges and the Algal Growth That Causes Water Quality Problems
- Demonstrated Predictive Capability of Model Crucial
- Reliable Models Can Help Evaluate
 - Type and Amount of Nutrient Control Needed to Manage Water Quality Problems
 - Water Quality Improvements That May Be Expected from Various Control Options

Modeling of Taste & Odor Production by Algae

- Can Effectively Quantitatively Relate (Model) Nutrient Loads to Planktonic Algal Biomass
- Studies by MWD of Southern CA Showed That Algae-Related Tastes & Odors in Waters from Delta Are Associated with Benthic Algae
 - Limited Ability to Reliably Model Relationships between Nutrient Concentrations/Loads and Growth of Benthic Algae-Caused Tastes & Odors

Need to Use Adaptive Management Approach

- Trial & Error to Evaluate Impact of Nutrient Control on Taste & Odor Problems

Toxicity of Bluegreen Algae

- Some Bluegreen Algae, at Some Times, Contain or Release Chemicals to Water That Are Toxic to Animals, Aquatic Life, People
- DWR Studies: Bluegreen Algae in Delta Release Chemicals That Cause Toxicity
 - Concentrations of Toxins < Those Known to Be Toxic to People & Aquatic Life
 - Needs Further Study & Monitoring

Aquatic Weed Problem in Delta

- Several Types of Aquatic Weeds Causing Water Quality Impairment
 - Water Hyacinth, Egeria, Others
 - Adversely Impact Recreation & Aquatic Habitat
 - CA Boating & Waterways Spends \$6-million/yr for Chemicals to Control Water Hyacinth & Egeria in Delta
- Excessive Water Weeds Caused by Excessive Nutrient Discharges to Tributaries & within Delta
 - Water Column & in Sediments

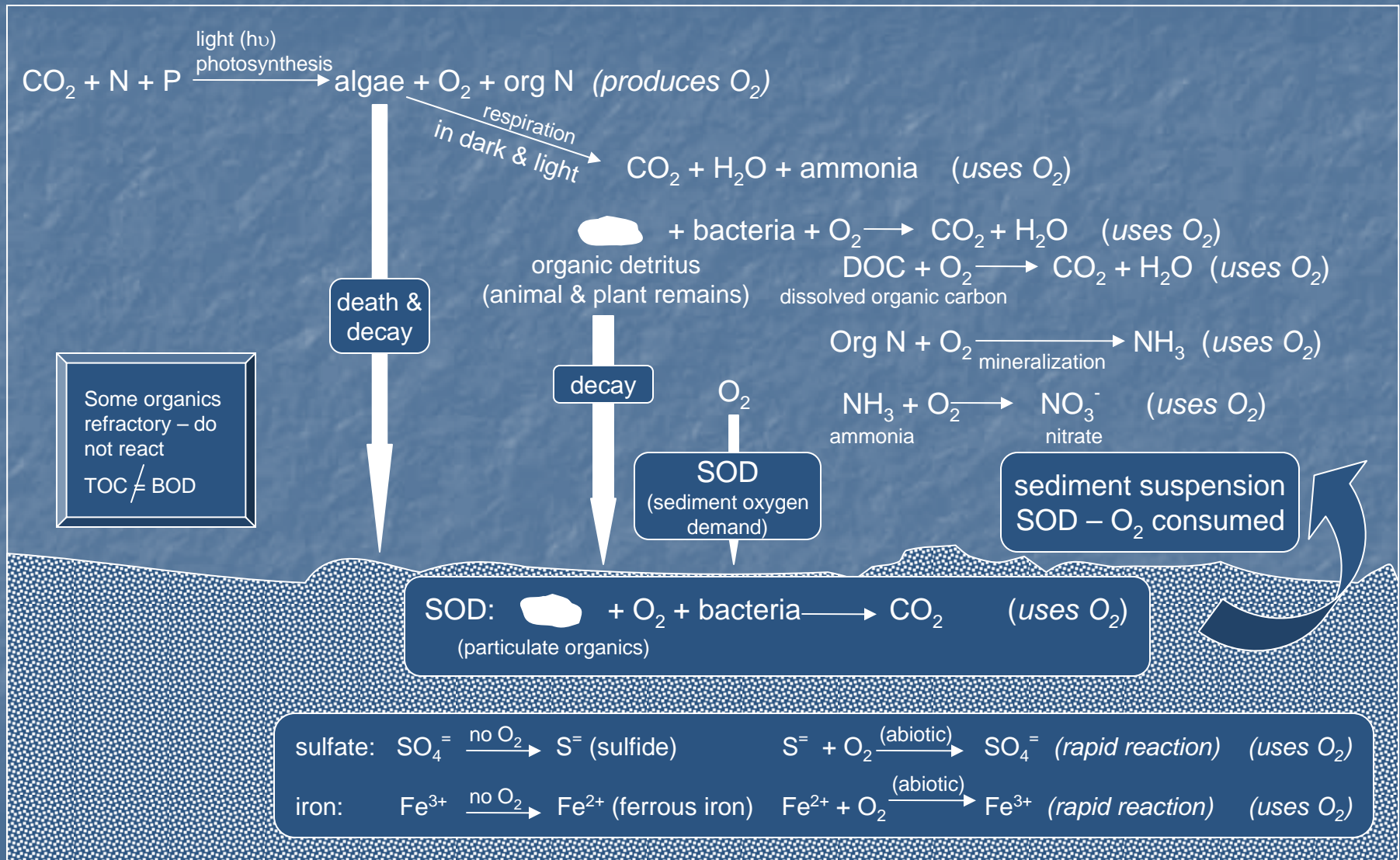
Modeling of Aquatic Weed Growth in Delta

- Quantitative Relationship between Nutrient Loads to Delta & Aquatic Weed Growth in Delta Poorly Understood
 - Difficult to Model
 - Adaptive Management Approach Needed with
 - Adequate Monitoring of Concentrations of Nutrients in Water & Sediments, and Aquatic Weed Biomass

Low-DO Problems in Delta

- Low-DO (Dissolved Oxygen) Problems in San Joaquin River (SJR) Deep Water Ship Channel (DWSC) near Port of Stockton
 - Adverse to Aquatic Life and Habitat
 - Adverse to Home-Stream Migration of Chinook Salmon to SJR Watershed
 - Fish Kills in Some South Delta Channels
- Low DO Caused by Bacterial Decomposition of Dead Algae That Develop in SJR & Delta
- Algal Growth Stimulated by Nutrients in Delta Tributaries & Delta

Algae & Organic Detritus as Sources of Oxygen Demand

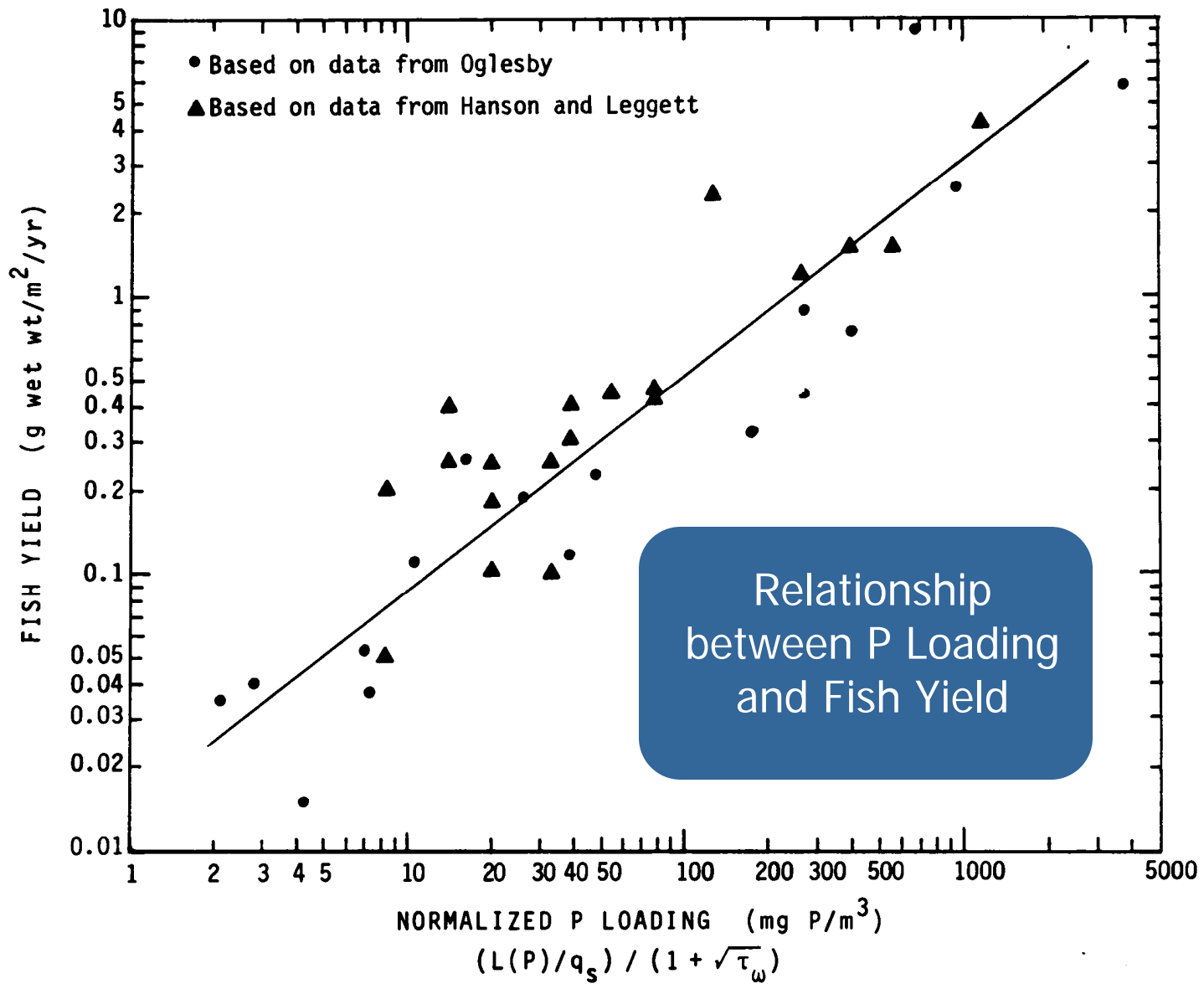


Control of Low DO

- Legislature Made \$35-million Available to Begin to Address Low-DO Problem in SJR DWSC
- Aeration of SJR DWSC to Control DO below Water Quality Objectives
 - Evaluated by DWR & CVRWQCB
- Control of Nutrients in SJR DWSC Watershed Not Likely Effective for Controlling Load to Algae to SJR DWSC That Leads to Low-DO Problem
 - Large Surplus of N & P in SJR Compared with Algal Needs
- Selective P Control May Help Reduce Algal Growth & Reduce Need for Aeration
 - Focus on Sources of Available P That Stimulate Algal Growth Leading to Low-DO in SJR DWSC
 - Don't Focus on Annual P Load
 - Much of Total P Load to SJR Doesn't Lead to Algal Growth Important to Low-DO Problem

Impact of Nutrients on Fish Production in Delta

- Amount of Fish That Develops in Waterbody Depends on Overall Trophic Status (Nutrient Concentrations) of Waterbody
 - More Nutrients → Greater Fish Production



Sacramento Regional Wastewater Treatment Plant Discharges of P

- In 1992 Sacramento Regional WWTP Reduced P Concentrations in Discharge to Sacramento River
- Van Nieuwenhuyse Found Subsequent Reduction in Planktonic Algae in North & Central Delta

Fish Production vs Nutrient-Caused Water Quality Problems

- Fish Production in Delta Limited by Available Nutrients for Planktonic Algal Food Web
- Nutrient Control in Delta Watershed from Ag & Urban Sources for Control of Nutrient-Caused Water Quality Problems in Delta
 - Will Adversely Affect Fish Production
- Must Balance Fish Production with Magnitude of Nutrient Related Water Quality Problems
- Need Reliable Models to Relate These Issues to Develop Appropriate Nutrient Management Programs

Control of Nutrient Sources in Delta

- Good Information Available on Cost of Controlling Nutrients in Domestic WWTP Discharges
- Limited Information on
 - Sources of Nutrients for and within the Delta
 - Ability to Control Nutrients at Ag Sources & Urban Stormwater Runoff
- Need Study of Nutrient Sources in Delta Areas
 - On Monthly Basis
 - To Relate Nutrient Loads to Water Quality Problems & Fish Production

Current Regulatory Agency Actions for Nutrient Control

- SWRCB Developing Water Quality Criteria for Nutrients
 - Based on Site-Specific Evaluation of Sources, Impact & Potential for Control
- CVRWQCB Developing Central Valley Drinking Water Policy
 - Includes Drinking Water Quality Problems Caused by Nutrients
 - Should Consider Cost-Effectiveness of Control of Nutrients at Sources (Ag & Urban) vs Cost for Control of Tastes & Odors at Drinking Water Treatment Plant

Overall

- Nutrients – Major Cause of Water Quality Problems in Delta
- Limited Understanding of Relationship between Nutrient Loads to Delta & Magnitude of Nutrient-Related Water Quality Problems in Delta
 - Needs Attention to Begin to Develop Effective Control Programs
 - Likely Require Adaptive Management Approach
 - Must Include Evaluation of Impact of Nutrient Control on Aquatic Food Web in Delta
 - Balance Nutrient Needs of Food Web with Control of Nutrient-Related Water Quality Problems

Further Information
Consult Website of
Drs. G. Fred Lee and Anne Jones-Lee



<http://www.gfredlee.com>