

# News

**2010 - State Toxicity Plan discussion starts (will replace SIP Section 4)**

**March 2014 – EPA issued “Alternative Test Procedure:”**

- **2-concentration TST**

**July 2014 – EPA Region 9 submitted objection letter to two LACSD permits**

**Nov 2014 - LA Regional Water Board imposed numeric toxicity limits for LACSD: Whittier Narrows & Pomona Water Reclamation Plants**

- ***MMEL & MDEL numeric chronic toxicity limits***
- ***2- concentration TST evaluation only***
- ***No safe harbor during investigation***

**Dec 2014 – LACSD, CASA, BACWA, & SCAP petitioned State Water Resources Control Board**

**Jan 2015 – EPA Region 9 submitted objection to Las Gallinas Valley Sewage Treatment Plant**

- ***MMEL & MDEL numeric chronic toxicity limits***

# Time to Rant

## **Caveats first:**

**Toxicity testing is a good diagnostic tool  
- BUT just one line of evidence**

**TST is not preferable, but it is a valid  
statistical approach**

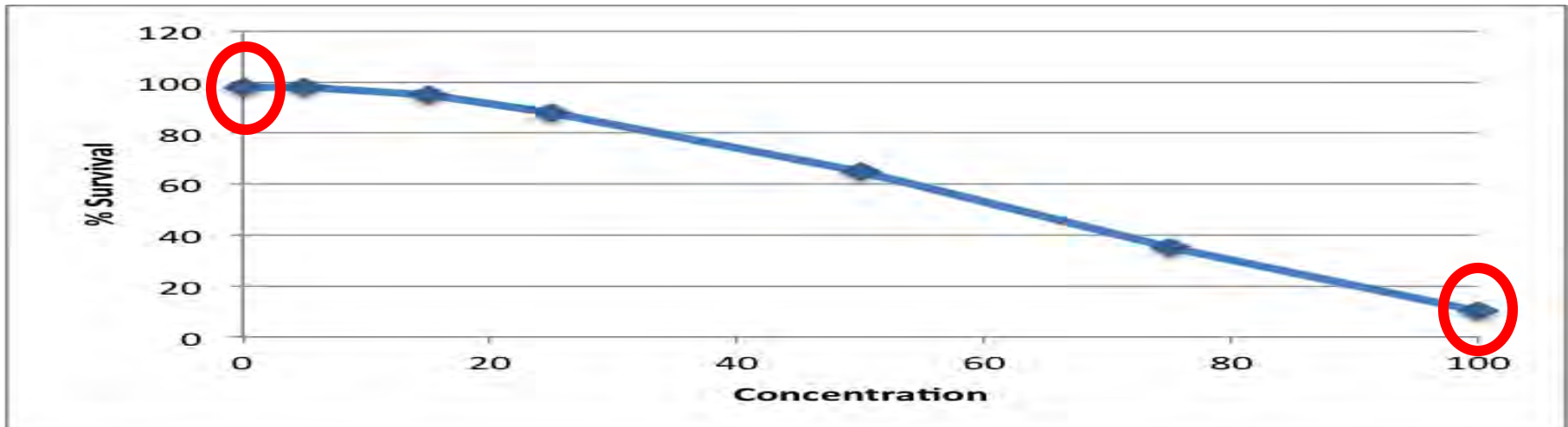
# What is Toxicity?

**Toxicity is an effect.**

- ❖ not a “substance”
- ❖ not a “pollutant”

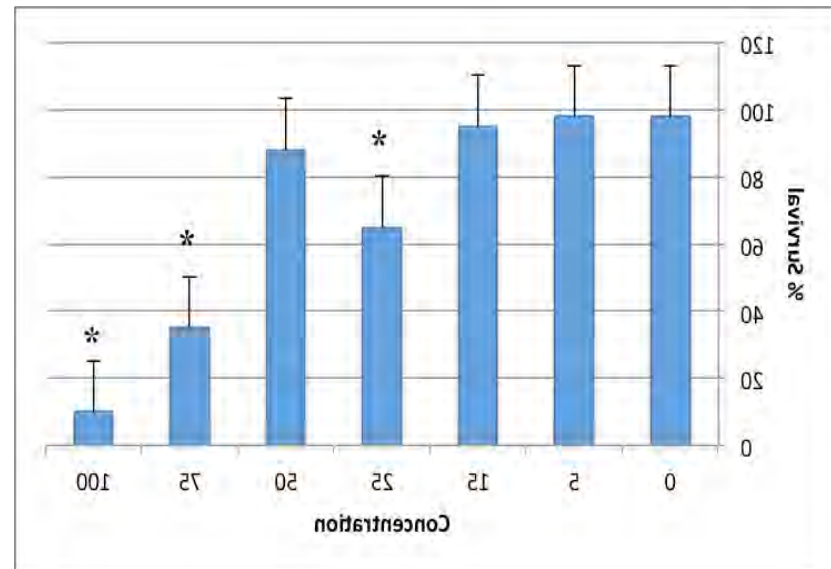
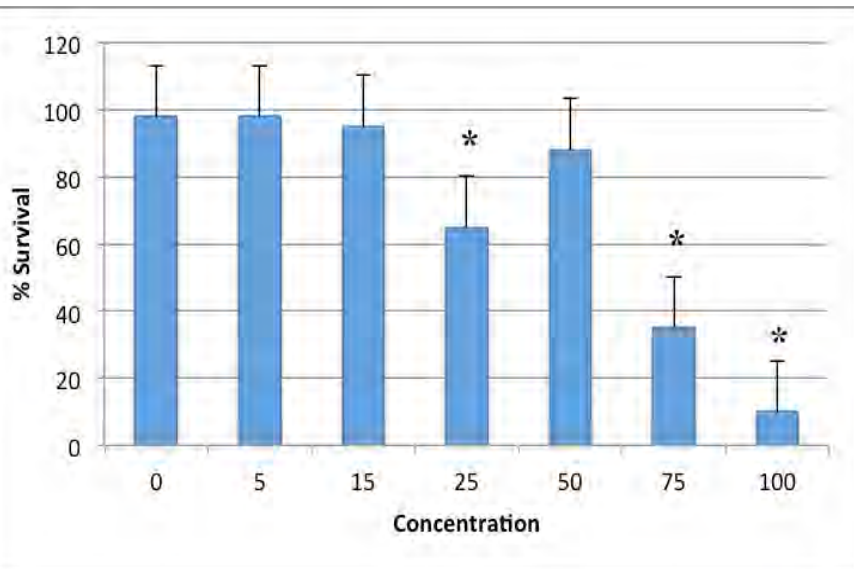
**Core principle of toxicology:**

- **Dose makes the poison.**



# If dose makes the Poison

# How can DNQ be a numeric limit?



# Current Chronic Toxicity Testing Requirements

- Routine static test (2/year, quarterly, or monthly)
  - Triggers for accelerated monitoring
    - 3 sample median over 1 TUC (10 TUC deep)
    - Any sample over 2 TUC (20 TUC deep)
      - If accelerated monitoring does not exceed either trigger, return to routine
  - Trigger for TRE
    - Accelerated testing detects toxicity above triggers
  - Submit TRE workplan within 30 days - conduct TRE



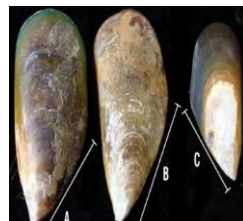
Ceriodaphnia  
dubia



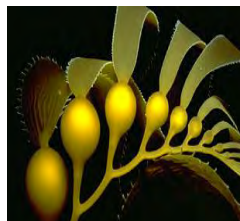
Americamysis  
bahia



Haliotis  
rufescens



Mytilus sp.



Macrocystis  
pyrifera

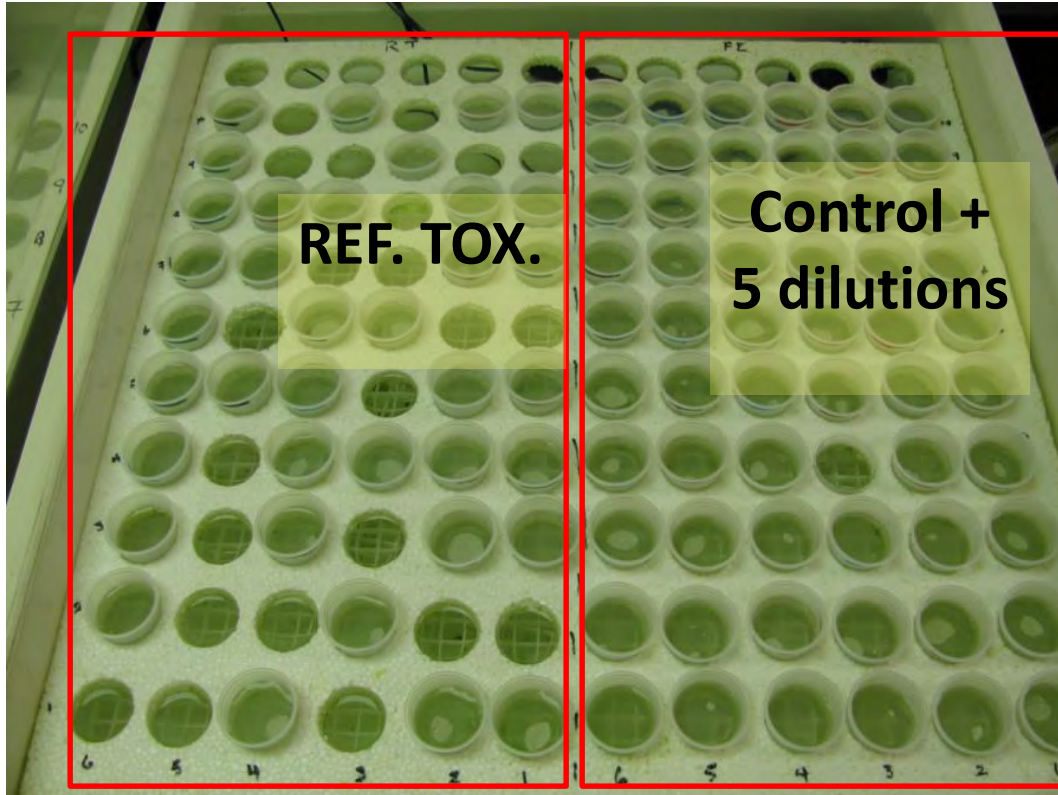


Dendraster  
excentricus



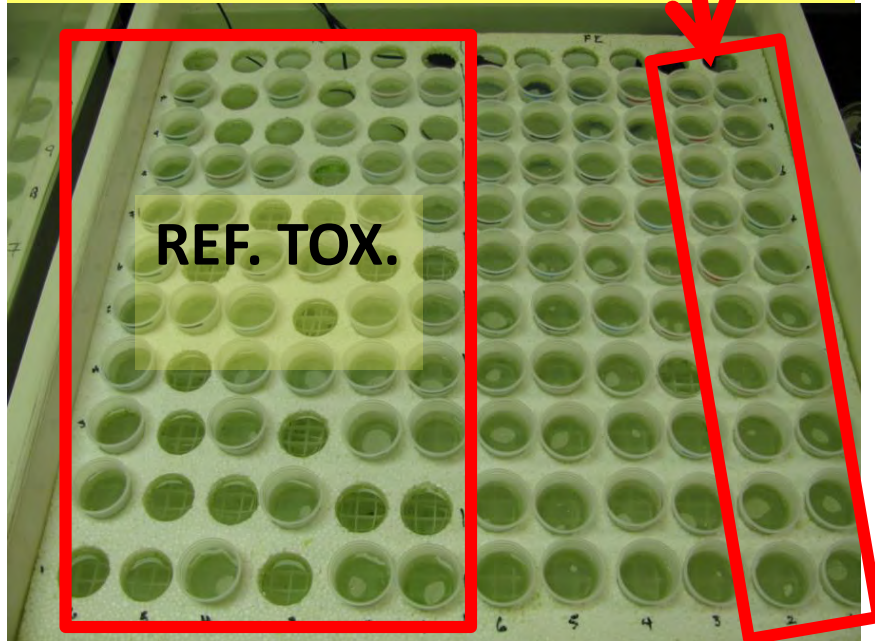
Strongylocentrotus  
purpuratus

# IC-25 Method

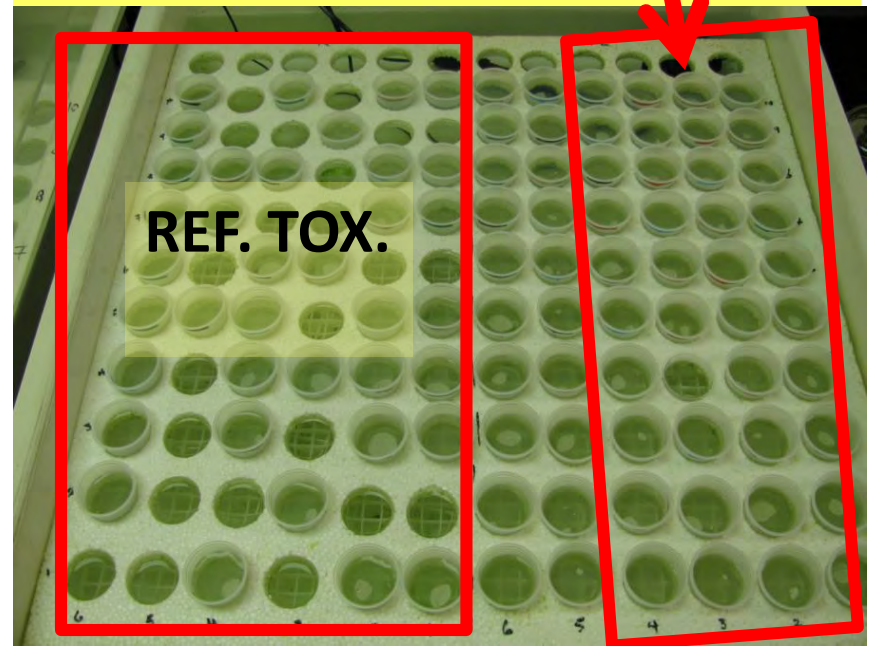


# TST Evaluation

TST evaluates only IWC



Add replicates if variability is high



TST does not save much money in practice

# What Causes a Toxic Response?

- Water Quality
- Food Quality
- Organism



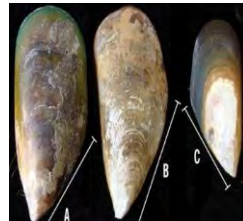
*Ceriodaphnia dubia*



*Americamysis bahia*



*Haliotis rufescens*



*Mytilus sp.*



*Macrocystis pyrifera*



*Dendraster excentricus*



*Strongylocentrotus purpuratus*

# TRE/TIE: an investigation

Tier 1 – Evaluate available data

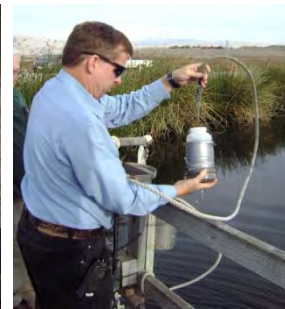
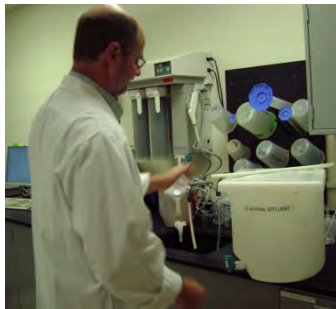
Tier 2 – Evaluate Plant performance

Tier 3 – Toxicity Identification Evaluation (TIE)

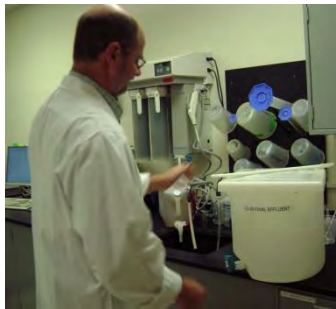
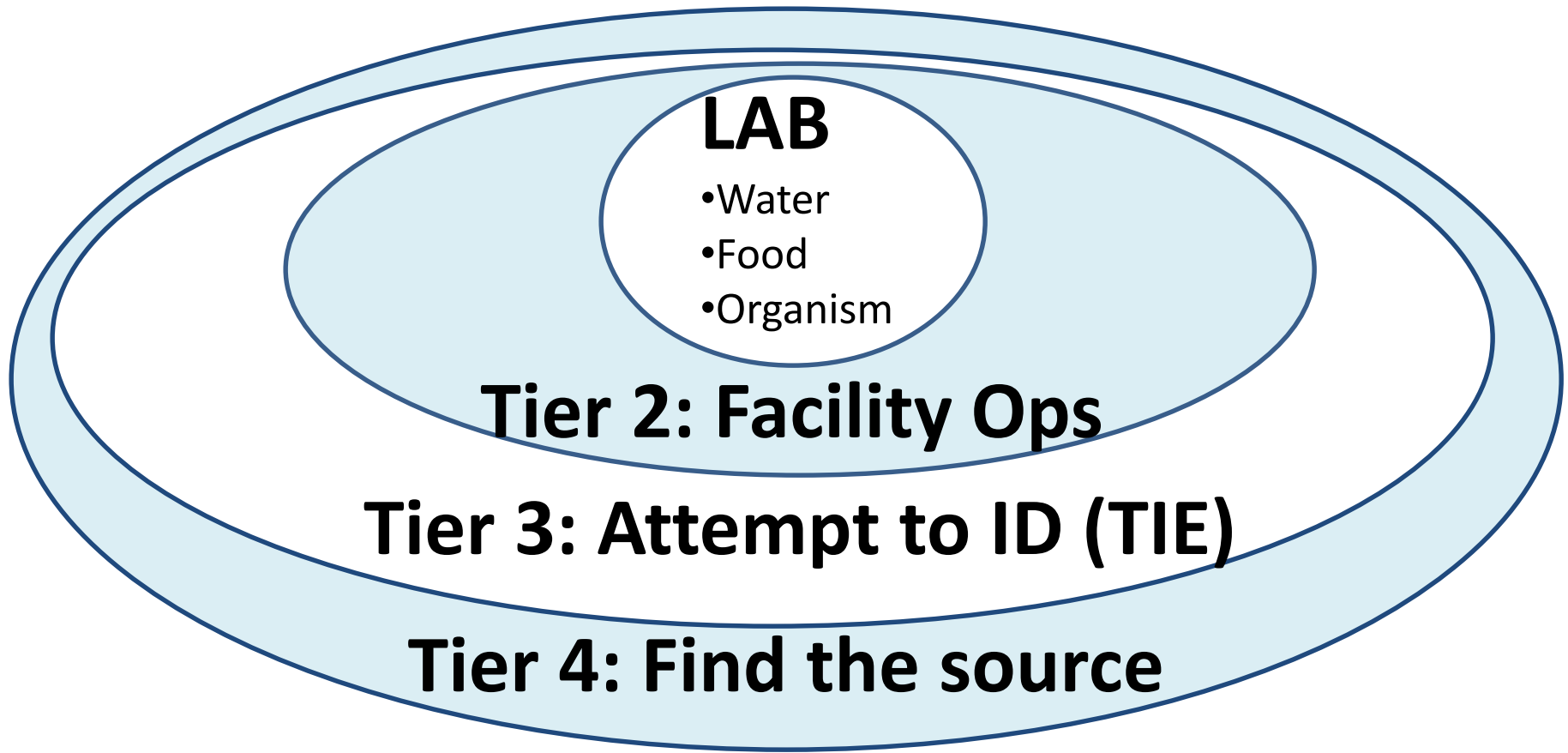
Tier 4 – Toxicity source evaluation

Tier 5 – Toxicity control evaluation

Tier 6 – Toxicity control implementation



# TRE/TIE: an investigation



# SJSC RWF - 44 tests: 7 events (11 detections)

Chronic Toxicity 2009-2010:

Summary Table

Proposed Policy

Sample Date	Test Date	Lab	Result	Comments
7/12/09-7/18/09	7/13/09-7/20/09	ESD	33.5 TUc	
7/28/09-8/1/09	7/27/09-8/3/09	ESD	Not Toxic	
8/12/09-8/17/09	8/13/09-8/19/09	TSI	1.17 TUc	Mean TUc = 1.82
8/13/09-8/19/09	8/14/09-8/21/09	PERL	2.49 TUc	
9/9/09-9/14/09	9/10/09-9/16/09	PERL	Not Toxic	
9/9/09-9/15/10	9/10/09-9/17/09	ESD	Not Toxic	
9/28/09-10/4/09	9/29/09-10/6/09	PERL	Not Toxic	
9/29/09-10/4/09	9/30/09-10/6/09	ESD	Not Toxic	
11/1/09-11/7/09	11/2/09-11/9/09	ESD	Not Toxic	
11/23/09-11/28/09	11/24/09-11/30/09	TSI	Not Toxic	
11/23/09-11/29/09	11/24/09-12/1/09	PERL	Not Toxic	
12/13/09-12/18/09	12/14/09-12/20/09	ESD	5.78 TUc	Mean TUc < 3.39
12/14/09-12/20/09	12/15/09-12/22/09	PERL	<1 TUc	
1/4/10-1/10/10	1/5/10-1/12/10	PERL	Not Toxic	
1/4/10-1/9/10	1/5/10-1/11/10	TSI	Not Toxic	NOEC = 75%; IC25 > 100%
1/15/10-1/21/10	1/16/10-1/23/10	PERL	Not Toxic	
1/15/10-1/20/10	1/16/10-1/22/10	TSI	Not Toxic	NOEC = 75%; IC25 > 100%
1/25/10-1/31/10	1/26/10-2/2/10	PERL	Not Toxic	
1/25/10-1/30/10	1/26/10-2/1/10	ESD	Not Toxic	
2/3/10-2/8/10	2/4/10-2/10/10	A-S	5.2 TUc	Mean TUc = 6.9
2/3/10-2/8/10	2/4/10-2/10/10	ESD	8.5 TUc	
2/21/10-2/27/10	2/22/10-3/1/10	A-S	7.5 TUc	TUc = 7.5
2/21/10-2/28/10	2/22/10-2/28/10	ESD	<1 TUc*	
3/7/10-3/13/10	3/8/10-3/15/10	ESD	Not Toxic	
3/7/10-3/13/10	3/9/10-3/16/10	A-S	Not Toxic	
3/22/10-3/27/10	3/23/10-3/29/10	ESD	Not Toxic	
3/22/10-3/28/10	3/23/10-3/30/10	A-S	Not Toxic	
4/11/10-4/17/10	4/12/10-4/19/10	ESD	Not Toxic	
4/11/10-4/17/10	4/12/10-4/19/10	A-S	No Result	Test Failed Quality Control
4/23/10-5/1/10	4/27/10-5/3/10	ESD	Not Toxic	Mean TUc < 1.27
4/23/10-5/2/10	4/27/10-5/4/10	A-S	1.8 TUc	
4/23/10-5/2/10	4/27/10-5/4/10	PERL	Not Toxic	
5/18/10-5/21/10	5/17/10-5/23/10	ESD	Not Toxic	
5/18/10-5/21/10	5/17/10-5/23/10	PERL	Not Toxic	
6/9/10-6/14/10	6/10/10-6/16/10	ESD	Not Toxic	
6/21/10-6/26/10	6/22/10-6/28/10	ESD	Not Toxic	
7/12/10-7/17/10	7/13/10-7/19/11	ESD	Not Toxic	
8/8/10-8/13/10	8/9/10-8/15/10	ESD	Not Toxic	
9/13/10-9/19/10	9/14/10-9/21/10	ESD	10.4 TUc	
9/29/10-10/4/10	9/30/10-10/6/10	ESD	Not Toxic	
10/18/10-10/24/10	10/19/10-10/26/10	ESD	Not Toxic	
11/7/10-11/13/10	11/8/10-11/15/10	ESD	Not Toxic	
12/8/10-12/11/10	12/7/10-12/13/10	ESD	No Result	Test Failed Quality Control
12/14/10-12/19/10	12/15/10-12/21/10	TSI	Not Toxic	

Violation??

Violation

Violation

Violation

Violation??

Violation

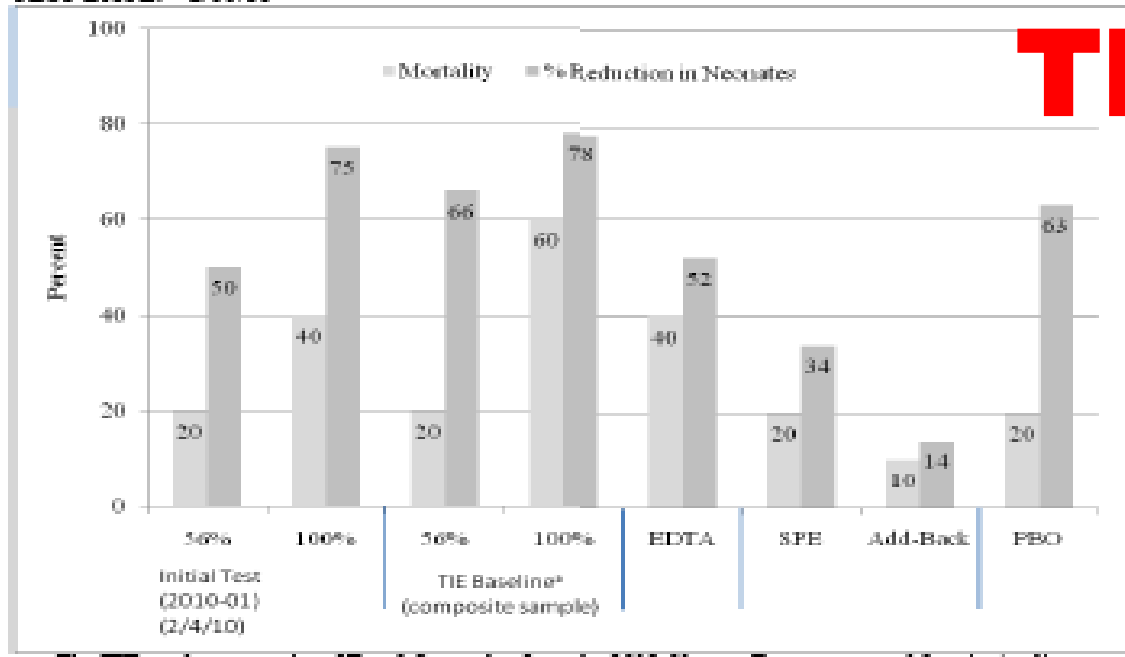
**Labs Did Not Agree**

**\$132K**

\* < 1 TUc - This result was rejected due to an anomalous dose response inversion  
 ESD=ESD Laboratory; A-S=Aqua-Science; PERL=Pacific Eco-Risk Laboratories; TSI=ToxScan Incorporated

**FIGURE 1 SUMMARY OF SJWWTP CHRONIC CERIODAPHNIA DUBIA PHASE I TIE**

TEST DATE: 2/10/10



# TIE Results

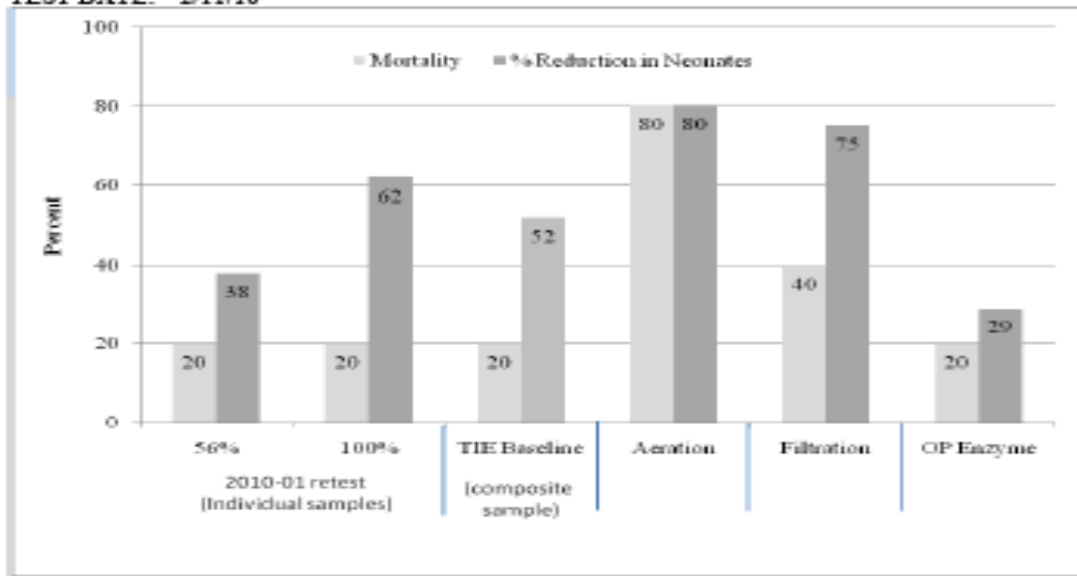
a. The TIE used a composite of Day 0-3 samples from the 2010-01 test. Treatments used 5 cerios/replicate

No conclusion

\$24K+

**FIGURE 2 SUMMARY OF SJWWTP CHRONIC CERIODAPHNIA DUBIA PHASE I TIE**

TEST DATE: 2/11/10





# Second TIE



- Toxicity again detected Sept 2010 ~ 10.4 TUc
- Archived sample sent to contract lab
- TIE manipulations were performed
- Contract lab did not detect toxicity in archived samples.

**NO CONCLUSION**

**\$15K**

**24 hits – 17 years**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1996					1.07 28.7%							17.6 23.9%
1997	1.3 32%	1.2 Pass										
1998	1.4 16.2%	1.3 Pass	1.03 26.0%		1.3 Pass							
1999	2.0 Pass										10.4 92.1%	
2000												
2001												
2002												
2003												
2004				0 24.0%							3.4 34.9%	
2005									5.9 34.5%			
2006												
2007					2.4 32.8%							
2008												
2009							33.5 67.7%	1.82 36/25%				<3.39
2010		6.9 / 7.5		<1.27 24%					10.4 84.8%			
2011					5.5 51.8%	1.4 34.6%						
2012	1.6 61.7%									4.1 24.5%		

**Effects Levels &  
TUC do not Agree**

# Chronic Toxicity Summary 20 Years

Year	# Results Reported	# Results >1 but <2 TUc	# Results >2 TUc
1994	12	0	0
1995	11	0	0
1996	13	1	1
1997	12	2	0
1998	12*	3	0
1999	14	0	2
2000	12	0	0
2001	12	0	0
2002	12	0	0
2003	12	0	0
2004	12	0	1
2005	12	0	1
2006	11	0	0
2007	13	0	1
2008	12	0	0
2009	14*	1	2
2010	19*	3	2
2011	14	2	1
2012	13	1	1
2013	14	4	3
2014	12	1	0

\*

Some tests in 1998, & 2009/10 were duplicate test events.

## Chronic Test Results - 2013 (% Effluent)

TEST START DATE	SURVIVAL		REPRODUCTION			TUc	TST
	NOEC	LOEC	NOEC	LOEC	IC <sub>25</sub>		
1/9/13	100	>100	25	50	58.1	1.7	Fail
2/4/13	100	>100	100	>100	>100	<1	Pass
3/4/13	100	>100	6.25	12.5	9.88	10.1	Fail
4/2/13	100	>100	100	>100	>100	<1	Pass
4/12/13	100	>100	100	>100	84.5	1.2	Fail
5/6/13	100	>100	50	100	42.7	2.3	Fail
6/10/13	100	>100	100	>100	>100	<1	Pass
7/12/13	100	>100	100	>100	>100	<1	Pass
8/1/13	100	>100	50	100	90.7	1.1	Fail
8/5/13	100	>100	100	>100	>100	<1	Pass
9/12/13	100	>100	25	50	34.6	2.9	Fail
10/4/13	100	>100	100	>100	>100	<1	Pass
11/19/13	100	>100	50	100	86.1	1.2	Fail
12/9/13	100	>100	100	>100	>100	<1	Pass

# Bad Year

# Good Year

## Chronic Test Results - 2014 (% Effluent)

TEST START DATE	SURVIVAL		REPRODUCTION			TUc	TST
	NOEC	LOEC	NOEC	LOEC	IC <sub>25</sub>		
1/10/14	100	>100	100	>100	>100	<1	Pass
2/3/14	100	>100	100	>100	>100	1.6	Fail
3/3/14	100	>100	100	>100	>100	<1	Pass
4/8/14	100	>100	100	>100	>100	<1	Pass
5/5/14	100	>100	100	>100	>100	<1	Pass
6/9/14	100	>100	100	>100	>100	<1	Pass
7/14/14	100	>100	100	>100	>100	<1	Pass
8/11/14	100	>100	100	>100	>100	<1	Pass
9/12/14	100	>100	100	>100	>100	<1	Pass
10/3/14	100	>100	100	>100	>100	<1	Pass
11/3/14	100	>100	100	>100	>100	<1	Pass
12/8/14	100	>100	100	>100	>100	<1	Pass

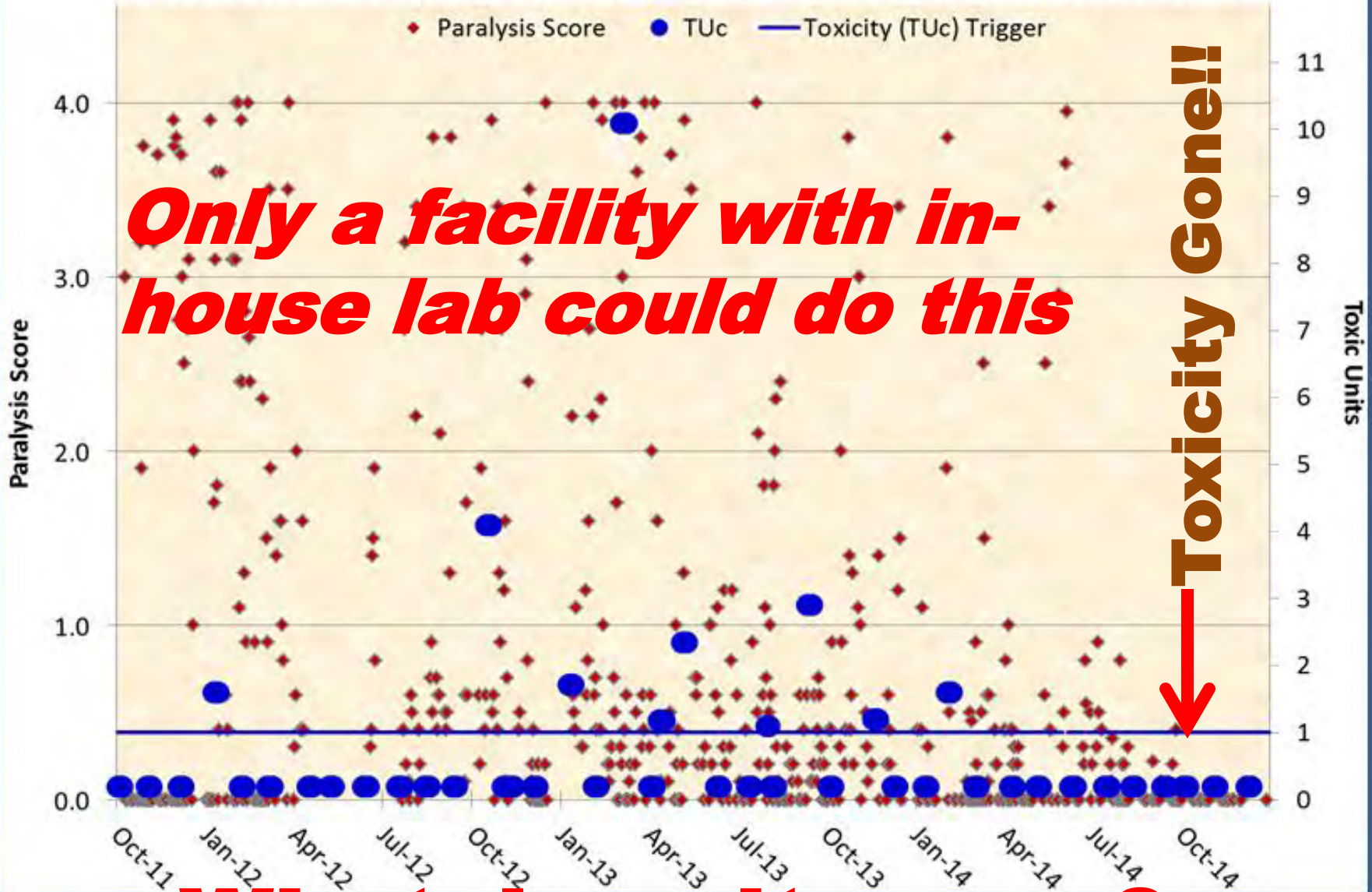
# How would YOU fix this??

## Effluent Toxicity Events & Follow-up Actions (FE=Facility Final Effluent)

Test Date	TUc	Investigative Actions	Results
1/9/13	1.7	Re-screened 1/10/13 sample for paralysis on 1/17/13; no other action taken	Severe paralysis observed in 100% FE on Day 4 of test. Re-screened sample had a paralysis score of 1.6 (max. score = 4.0)
3/4/13	10.1	Analyzed 3/6/13 sample for pyrethroids. Re-screened 4 test samples for paralysis; Completed and submitted revised generic TRE workplan to Water Board.	Aborted broods & paralysis observed concurrently in FE test. One sample (3/6/13) continued to show moderately high paralysis (2.1-3.0) when re-screened 3/11 to 3/12/13. Bifenthrin & cypermethrin at estimated levels only; all other pyrethroids were non-detects.
4/12/13	1.18	No action. A few aborted broods observed in two highest FE concentrations. Significant IC25; NOEC = 100% FE.	Three deaths early in the 100% FE concentration responsible for significant effect on reproduction. Other animals in 100% FE had relatively reproduction.
5/6/13	2.34	Significant reduction in reproduction due primarily to aborted brood. Test animals healthy between broods. Complete Case-specific TRE Workplan.	All 6 FE samples were re-screened for paralysis. Some paralysis observed in samples used late in the test. The aborted broods observed early in test were atypical because paralysis was not present.
8/1/13	1.1	None; Toxicity too low to study	2 <sup>nd</sup> test conducted 8/5-8/12/13 showed no toxicity.
9/12/13	2.9	TIE conducted by Pacific EcoRisk	10 TIE manipulations performed. Baseline was not toxic. Several manipulations increased toxicity over non-toxic baseline. Conclusion: Hydrophobic organic antagonist(s) may lessen toxicity of hydrophilic toxicant(s)
11/19/13	1.2	None; Toxicity too low to study	None

\$20K+

# Ceriodaphnia Toxicity (reproductive inhibition) & Paralysis Tracking



***Only a facility with in-house lab could do this***

**Toxicity Gone!!**

**What does it mean?**



**11-12 December 2014**



## **“Storm of the Decade”**

**TAC is 15 neonates over 3 broods (19-23 is typical)**

- ❑ Brood of the Century = 445 neonates (10 animals X 3 broods)**
- ❑ One animal had 30 neonates in a single brood!**



*We were  
feeling frisky*



**What does it mean?**

**Q: What problem we are trying to solve?**

**A: Impact on receiving water biota**

**Toxicity testing is a good diagnostic tool  
- BUT just one line of evidence**

**After 20 years – what other lines of evidence will help?**

# Other Lines of Evidence being Evaluated

Paralysis Tracking during toxicity tests

Receiving water chemistry, quarterly – In house / \$50K

Receiving water Nutrients, monthly - In house /\$50k

Microbial Monitoring. In-kind with Stanford

Phytoplankton Monitoring. \$10K purchase order with BSA Env. Services

Benthic Monitoring. \$38K joint funding agreement with USGS

Fish Species and Communities Monitoring. \$78K contract with UC Davis / Hobbs  
– in process

Audubon Society Christmas Bird Counts. Free!



SAN FRANCISCO BAY BIRD OBSERVATORY

# We Discharge to Marshes

South Bay Salt Pond Restoration in vicinity of SJ-SC RWF

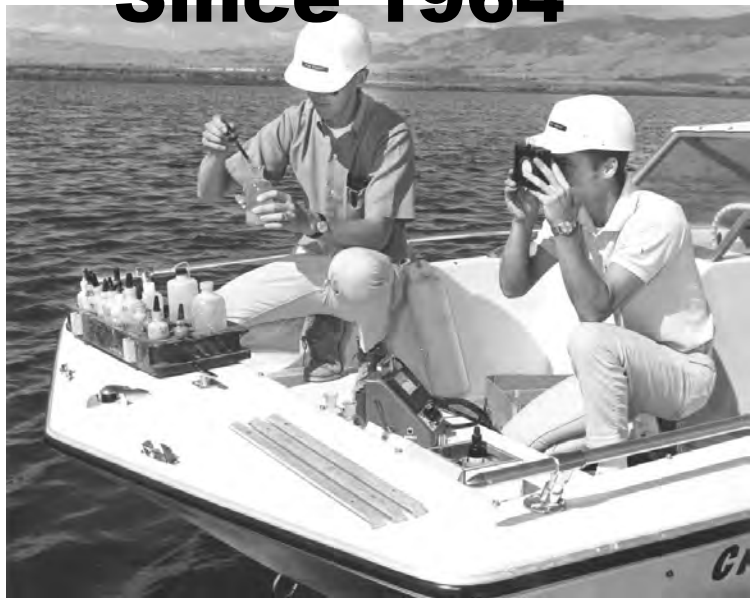
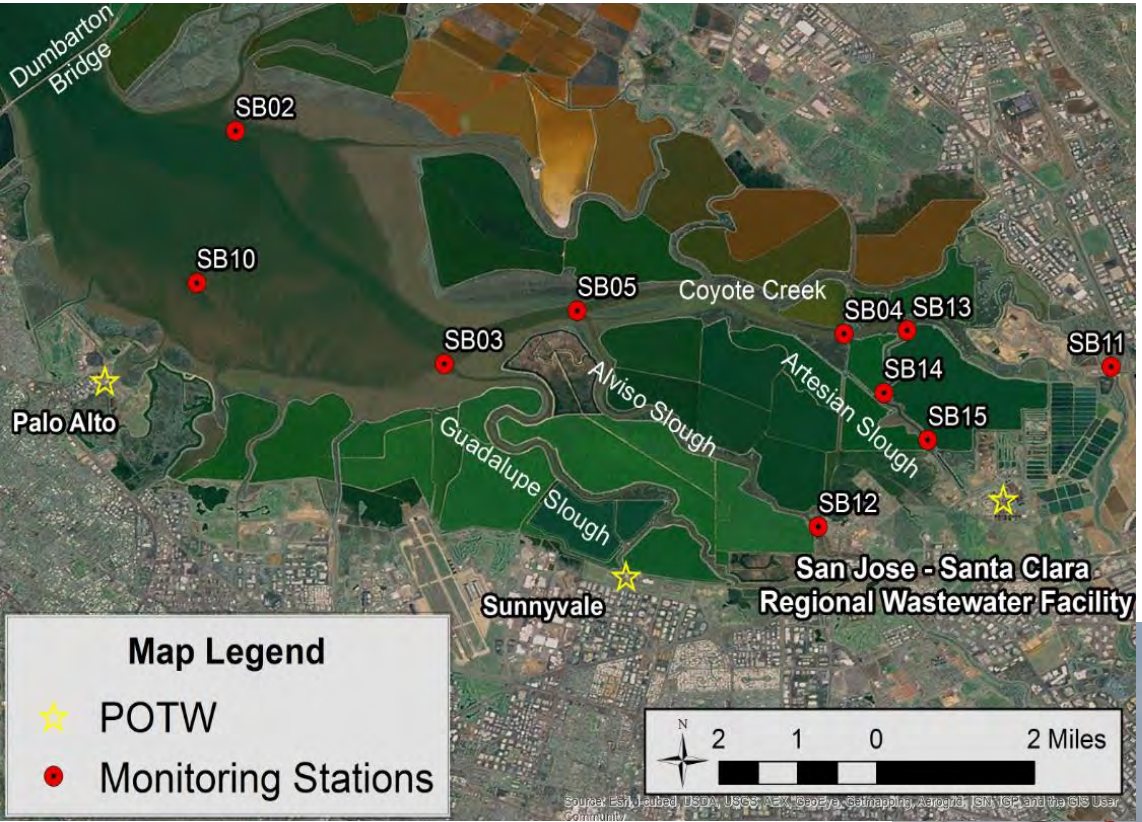
**Acreage under restoration or managed.**

2006:	475
2010:	375
2013:	<u>375</u>
	1225



# Receiving Water Monitoring

Since 1964



**~\$100K**



**\$78K- Free so far**

# Fish Food!

*Our effluent + former salt ponds  
=  
a fish buffet*



**Mysids, Crangon, Isopods**



# July Otter Trawl

2014



**Stomach contents = mysids from  
Artesian Slough & pond complex**



**Anchovies**



**Warm Freshwater Habitat (WARM)**

# Fish Diversity - winter



Bat Ray



White Sturgeon



Longfin Smelt



Staghorn Sculpin



American Shad



California Halibut



Striped Bass

Cold Freshwater Habitat (COLD)

Rare & Endangered Species (RARE)

# Fish Diversity - summer



Bat Ray



Plainfin Midshipman



Striped Bass



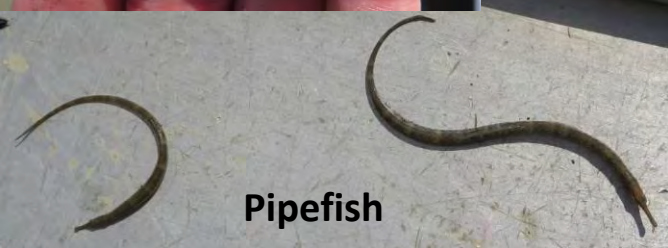
Starry Flounder



Gobies – Various Types



Sanddab



Pipefish



Northern Anchovy



Warm Freshwater Habitat (WARM)

# Fishing & Hunting



**REC-1: Water Contact Recreation**



**Commercial & Sport Fishing (COMM)**

# 2015 Update!

# nting



- ✓ REC-1: Wa
- ✓ Hunters see
- ✓ Commerci



100% Effluent

## Fishing on the Weir

Up to 39 bass  
caught per hour!

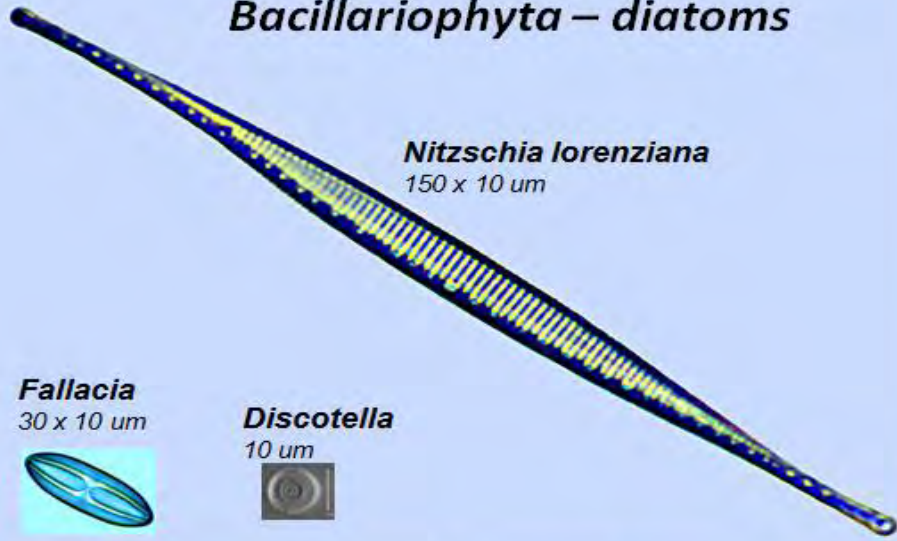


Warm Freshwater Habitat (WARM)



# Phytoplankton Monitoring with BSA Env. Services

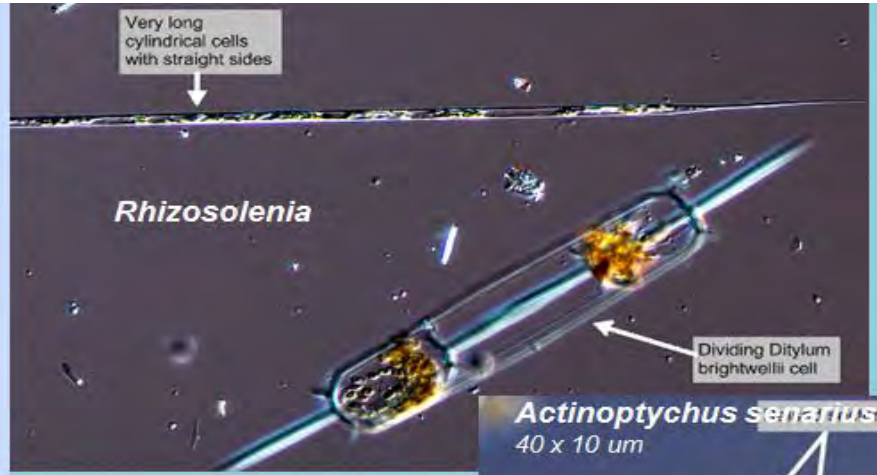
## Bacillariophyta – diatoms



*Fallacia*  
30 x 10 um



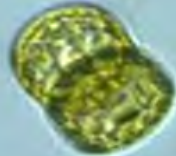
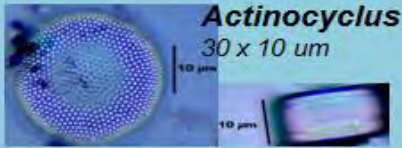
*Discotella*  
10 um



*Actinopterychus senarius*  
40 x 10 um



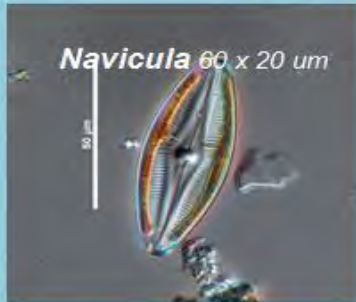
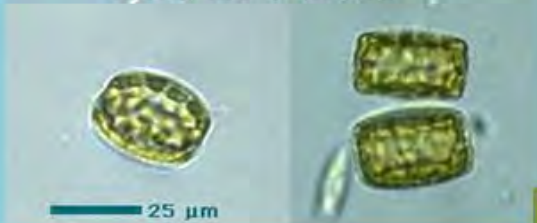
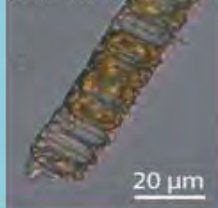
*Crysoococcus*  
10-15 um



*Cyclotella* 25 x 10 um



*Paralia sulcata*  
20 x 10 um



## Cyanobacteria – bluegreen algae



L. Fada, July 2003

## Chrysophyta – golden algae



*Kephyrion*



## Chlorophyta – green algae

*Chlorolobion braunii*

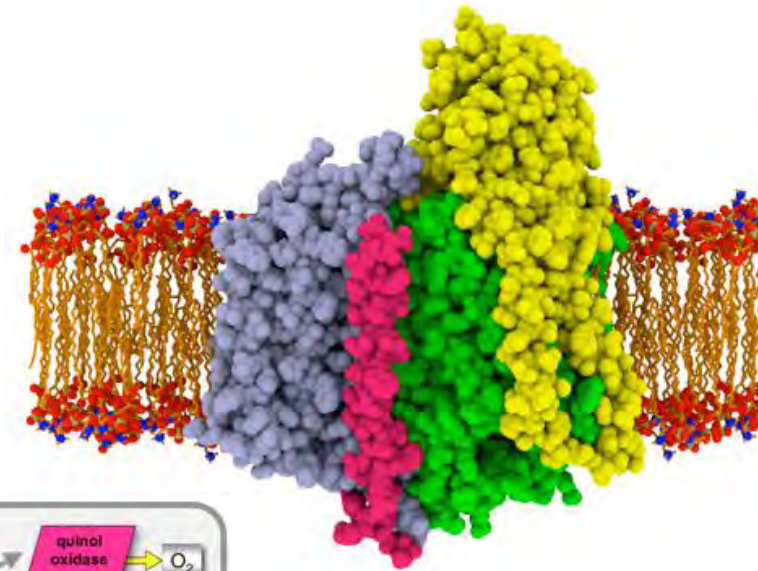


*Kirchneriella conto*

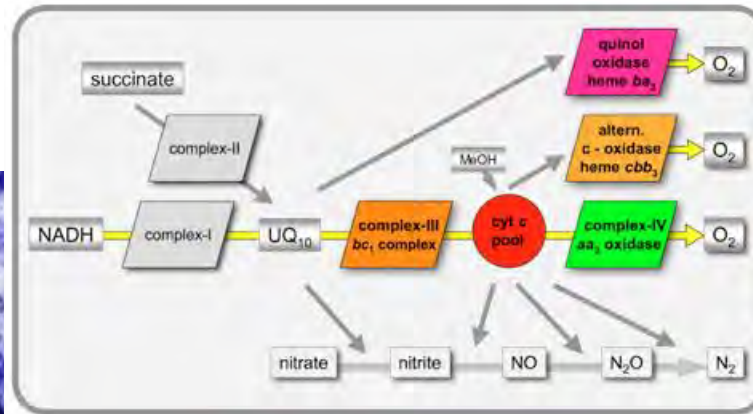


**\$10K**

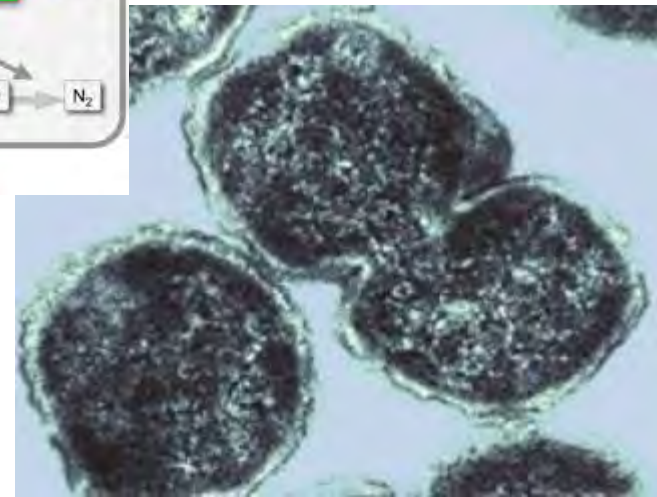
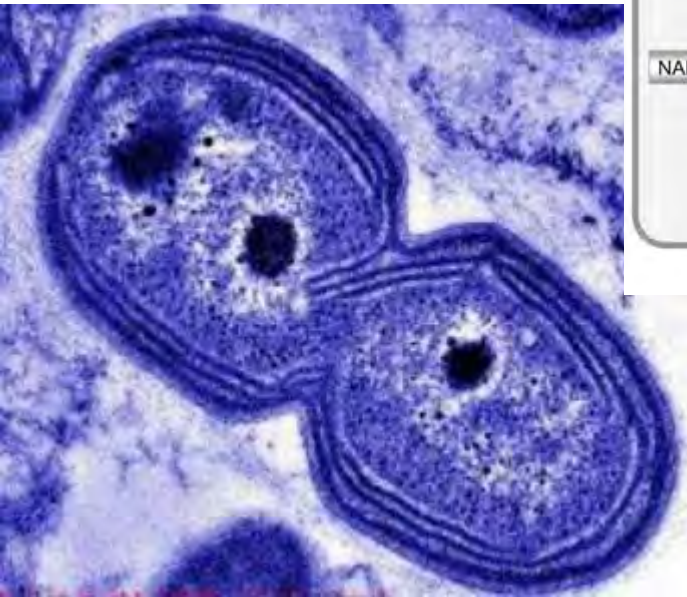
# Microbial Monitoring with Stanford



Structure of the *Paracoccus denitrificans* aa<sub>3</sub> cytochrome c oxidase

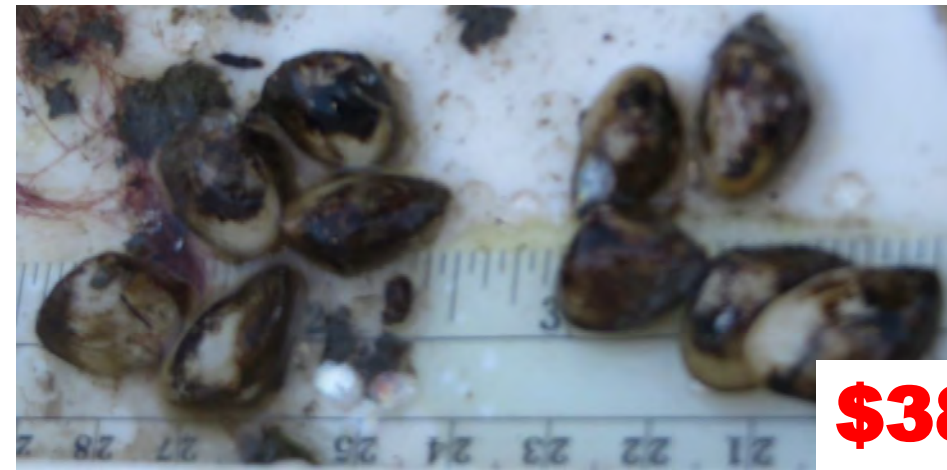


Electron transfer chain in *Paracoccus denitrificans*



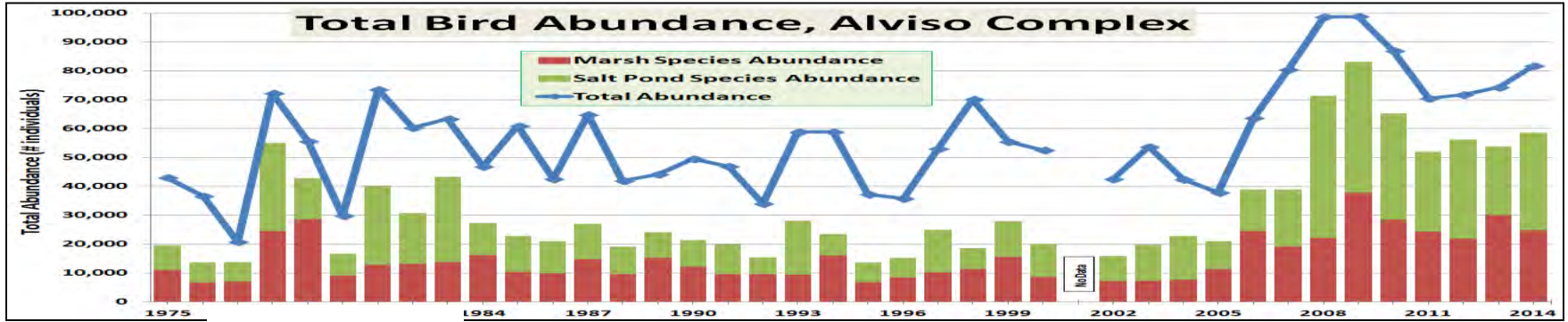
**In kind - Free**

# Benthic Monitoring with USGS

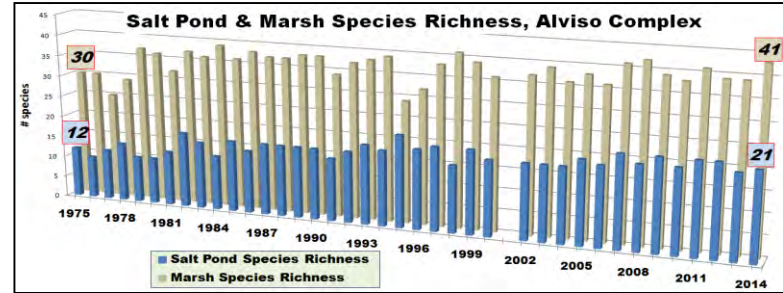


**\$38K**

# Audubon Society Bird Counts



January 21st



**Free**

# SFBBO Avian Botulism Surveys



26 Apr 2014



**\$24K – required by permit**

# Where do you put your money when facing violations & lawsuits?

## Must Do

Permit Fee = \$526K

RMP Fee = \$245K

BACWA Dues = \$186K

Nutrient Surcharge = \$80K

WERF -= \$42

~~NACWA = \$38K~~

CASA = \$19K

BAAQMD Fee = \$66K

AB-32 Cap & Trade = \$300K

SFBBO = \$24K

## Want to Do

Receiving Water Chemistry = \$50K

Receiving Water Nutrients = \$50K

Plankton monitoring = \$10K

USGS Benthic = \$38K

UC Davis Fish = \$78K

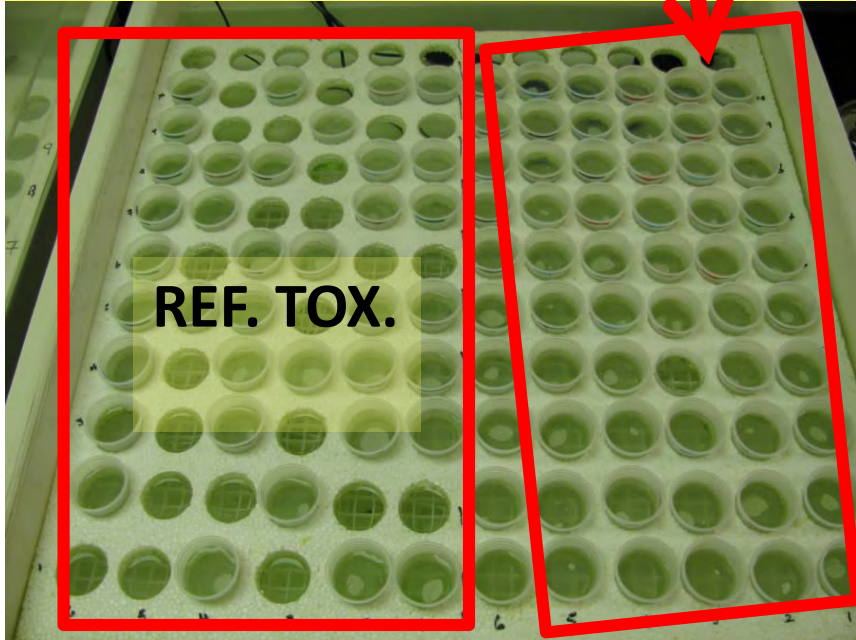
Stanford Microbial Work = free

Audubon Bird Counts = free

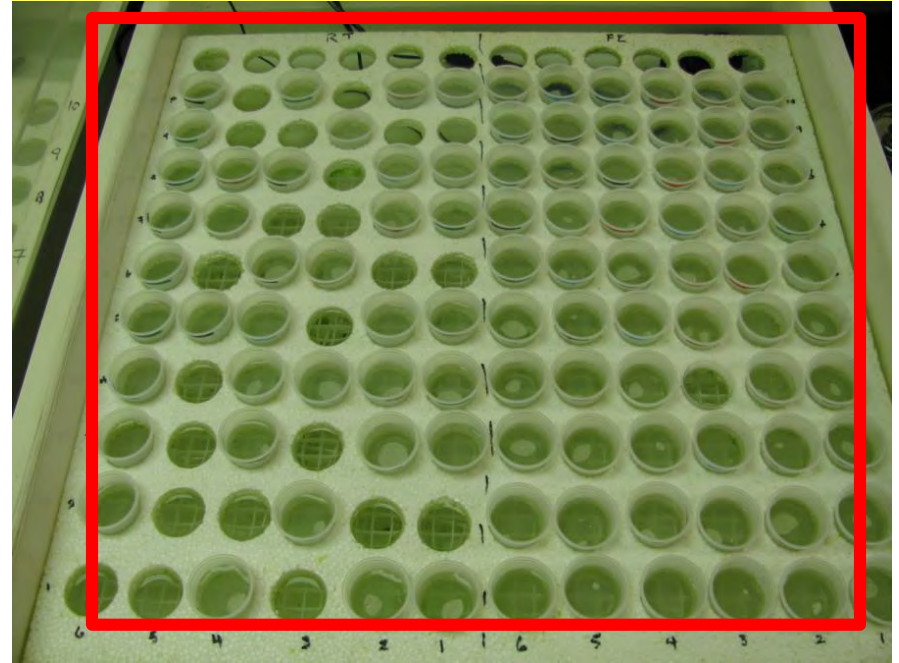
Paralysis Tracking = In house staff

# TST Evaluation when facing violations

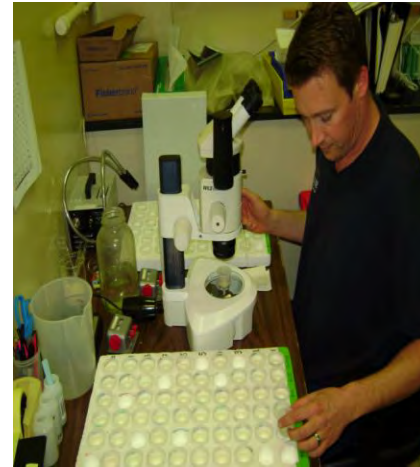
REF TOX + More replicates



And more replicates, if needed



And more staff  
to evaluate all  
the broods




# Worse than you think ..

## Lab A

## Lab B

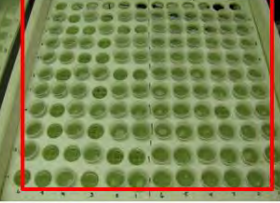
## Lab C

REF TOX + More replicates




REF. TOX.


And more replicates, if needed



And more staff to evaluate all the broods

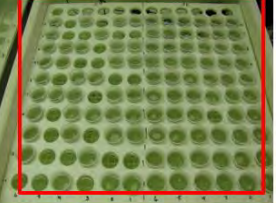


REF TOX + More replicates




REF. TOX.


And more replicates, if needed



And more staff to evaluate all the broods

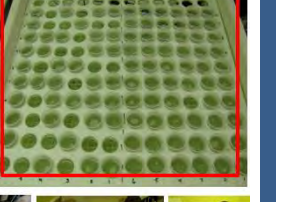


REF TOX + More replicates




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(multiple lines of evidence)

**3/5 odds labs will not agree if toxicity is present**

# End Rant

**Does lab toxicity EFFECT have biological significance in receiving water?**

**How do numeric limits help?**