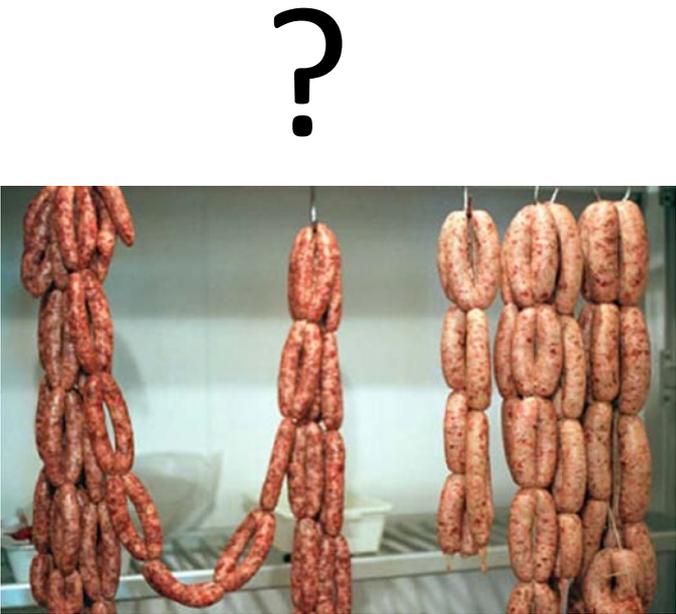
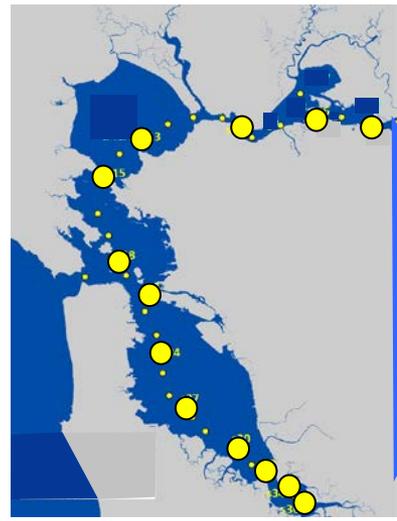


# How do past and current conditions in SFB compare to chlorophyll-a categories?

David Senn, Emily Novick, and Martha Sutula



20-40 years existing data  
USGS

Numbers → Categories

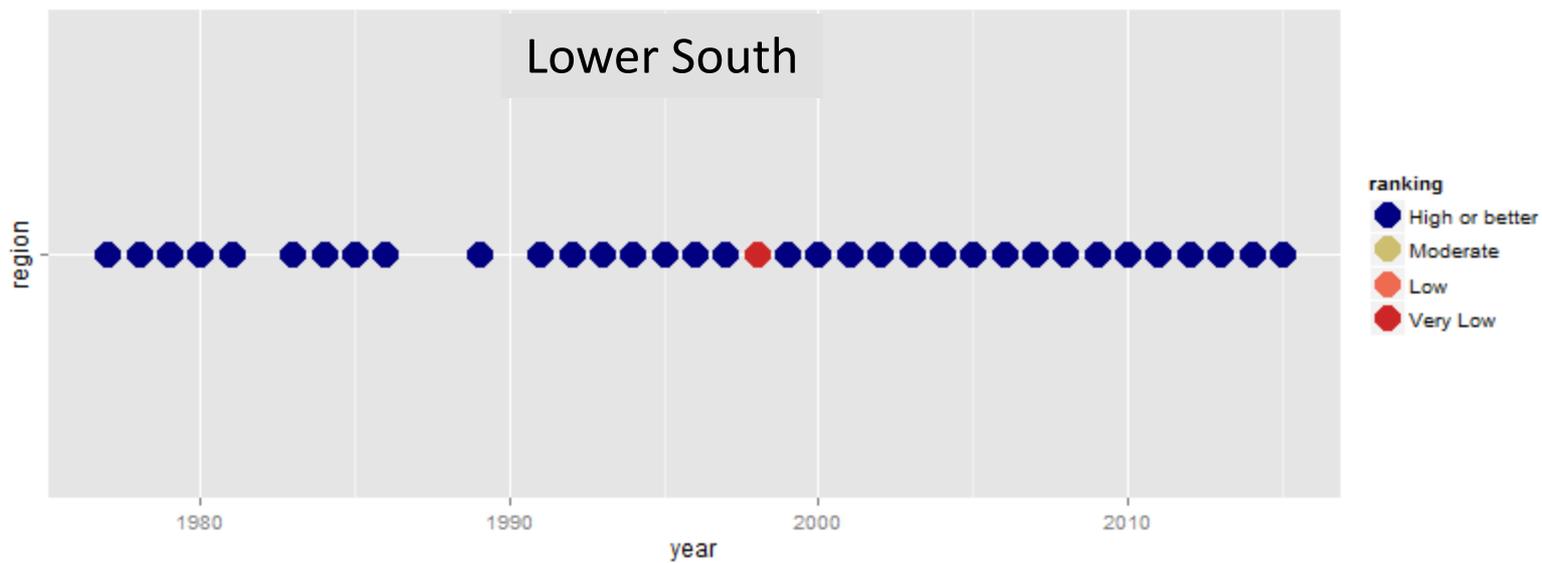
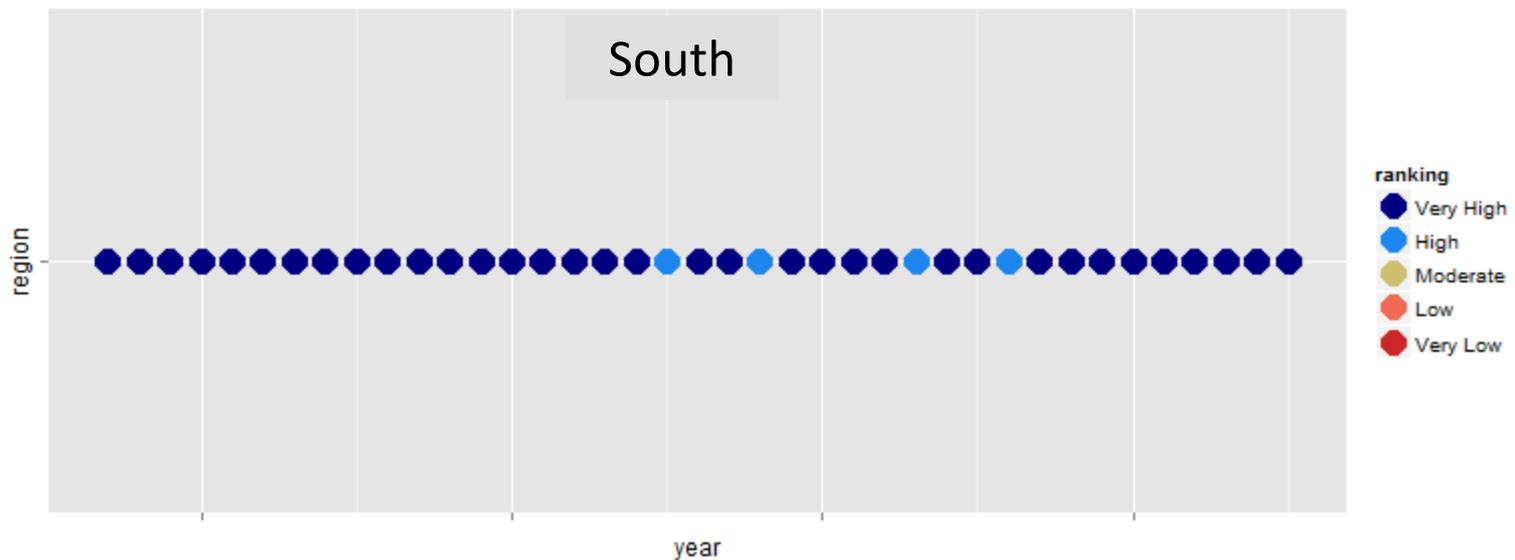
# Chl-DO categories applied to South Bay and Lower South Bay

- Based on Mean February-September chl-a (Integrated measure that influences summertime DO, critical condition)
- Applied at subembayment scale, only to South Bay & Lower South Bay
- Classification bin thresholds derived from mean predicted values from quantile regression (Sutula et al., in prep)

**Table 3.5. Chlorophyll-a Classification Table Based on Risk of Falling Below DO Water Quality Objectives, Based on Annual February-September Mean Chlorophyll-a, for South Bay and Lower South Bay only.**

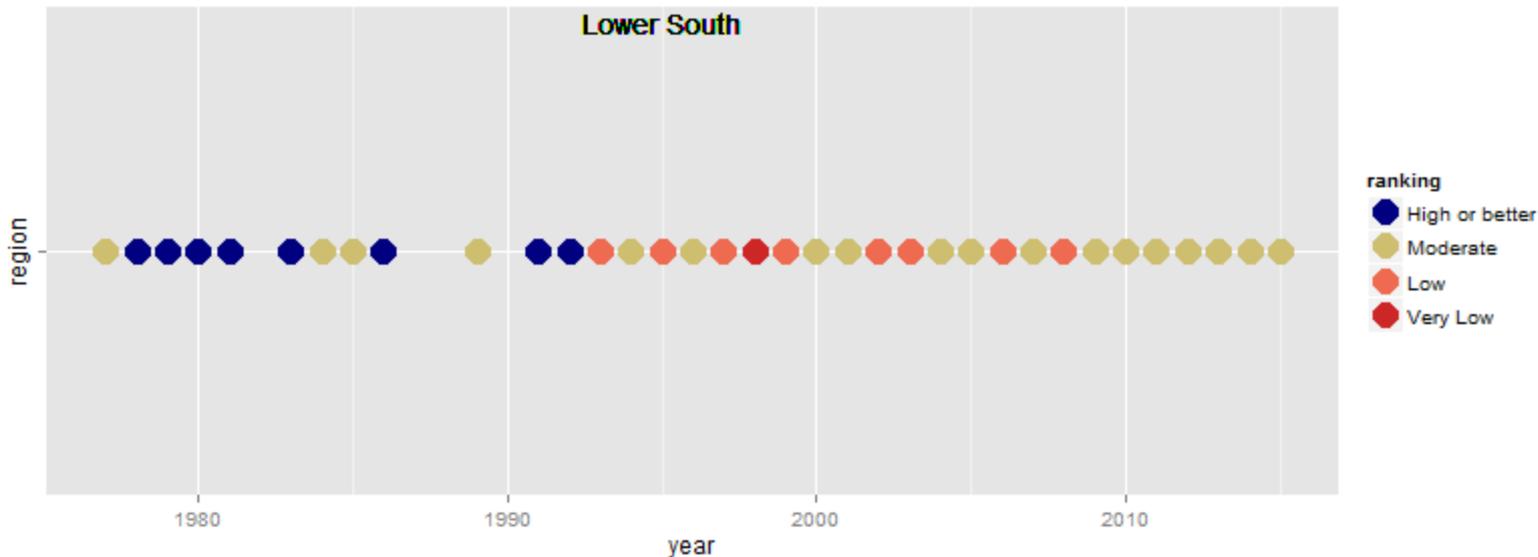
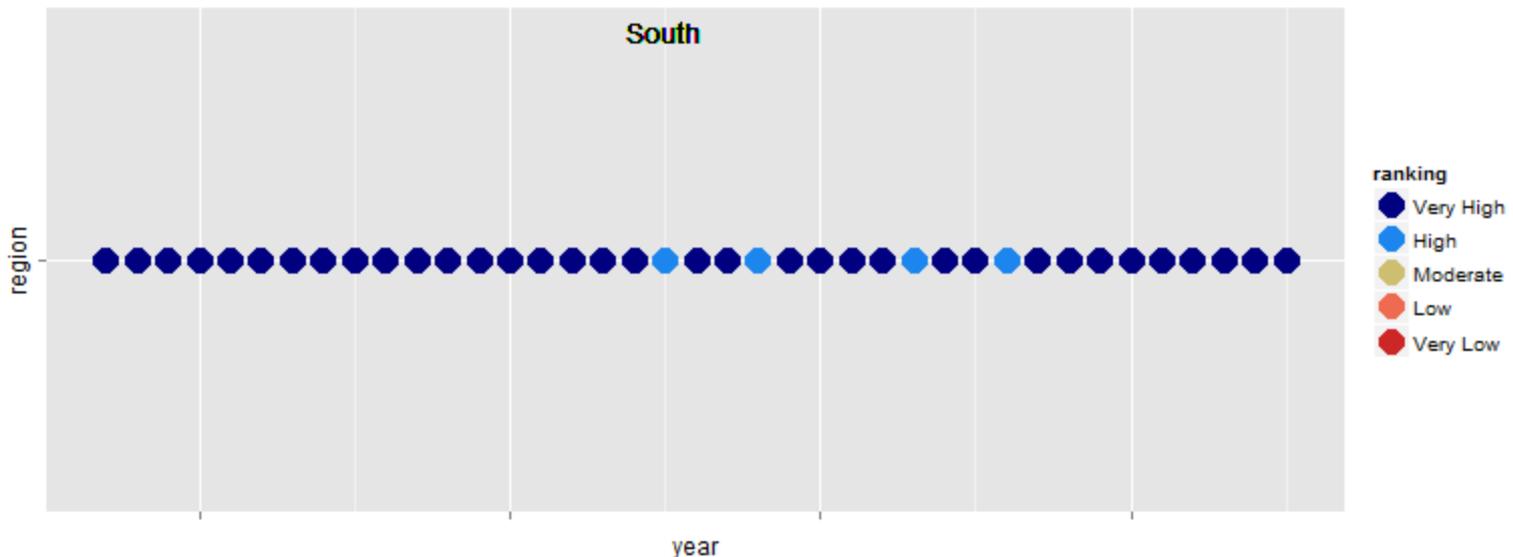
Classification of ecological condition based on mean February - September chlorophyll-a ( $\text{mg m}^{-3}$ ) linked DO benchmarks - South Bay and Lower South Bay Only		
Category	Lower South Bay	South Bay
Very high)	$\leq 25$	$\leq 14$
High		$>14 - 32$
Moderate	$>25 - 36$	$>32 - 44$
Low	$>36 - 51$	$>44 - 58$
Very Low	$>51$	$>58$

# Subembayment – mean of quantile regression

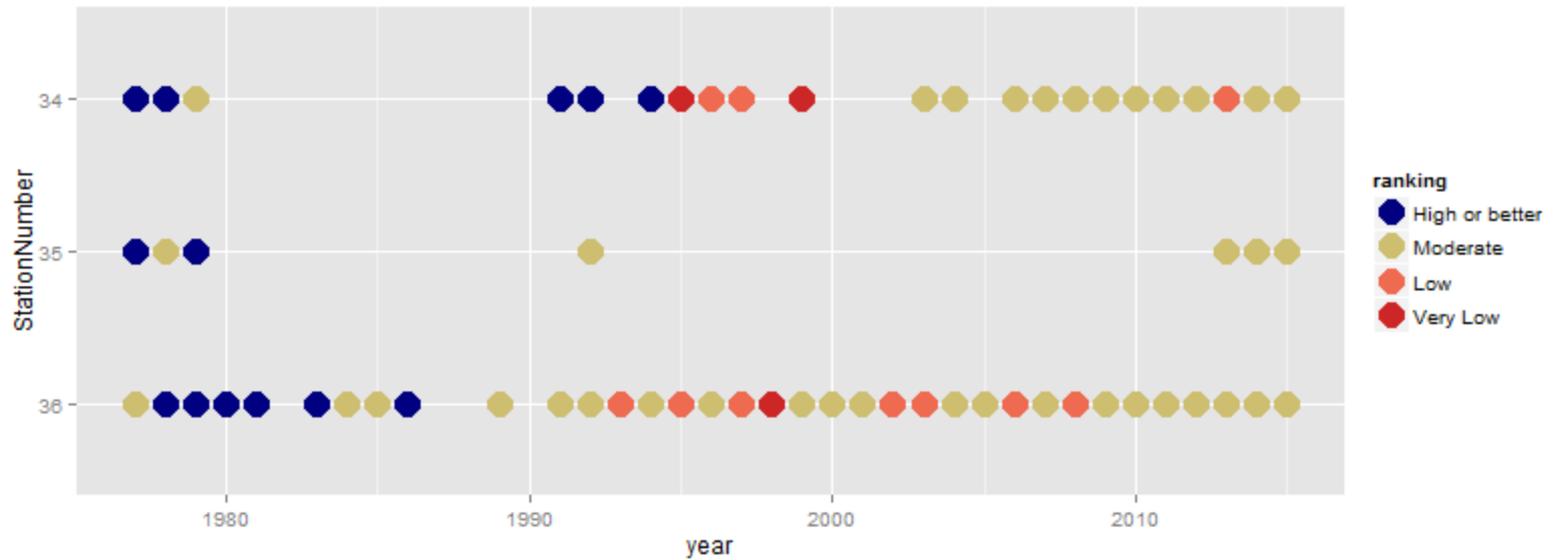
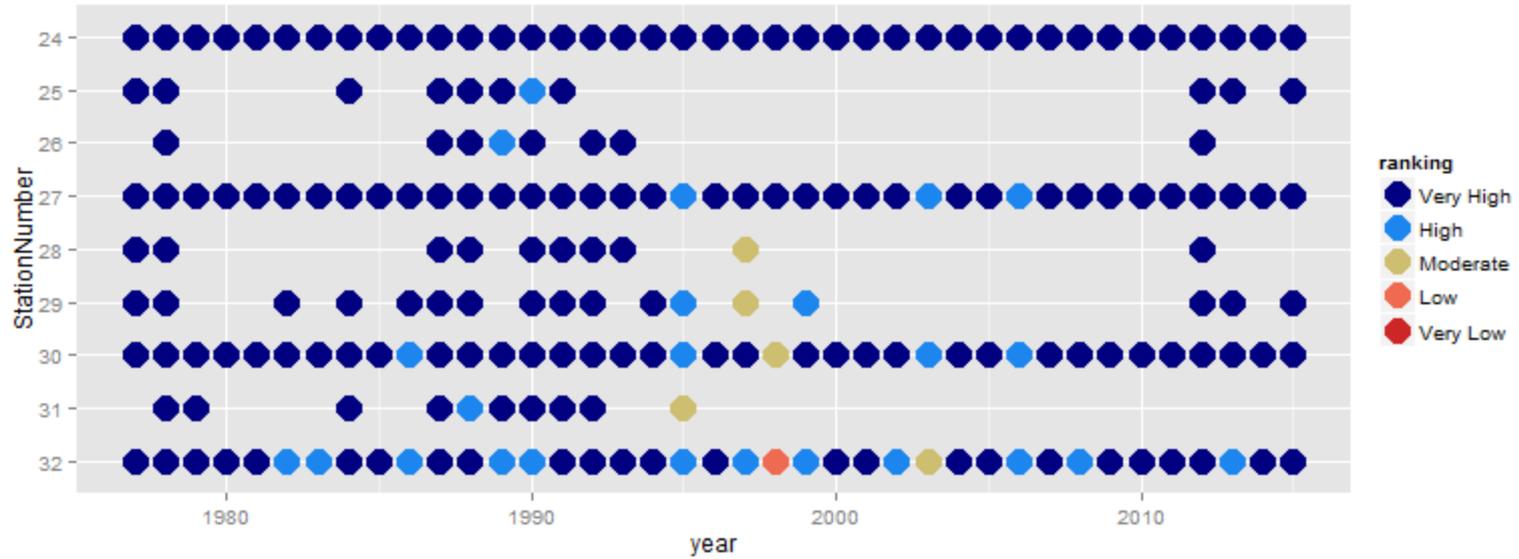




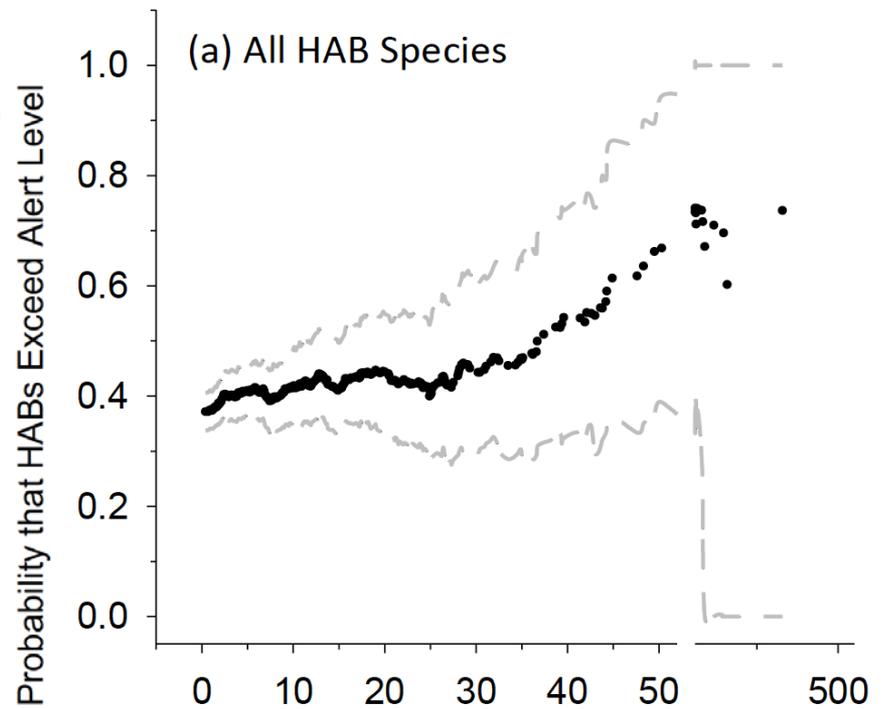
# Chl-DO..More Conservative number (lower 95%ile)



# Individual Stations – lower 95%ile



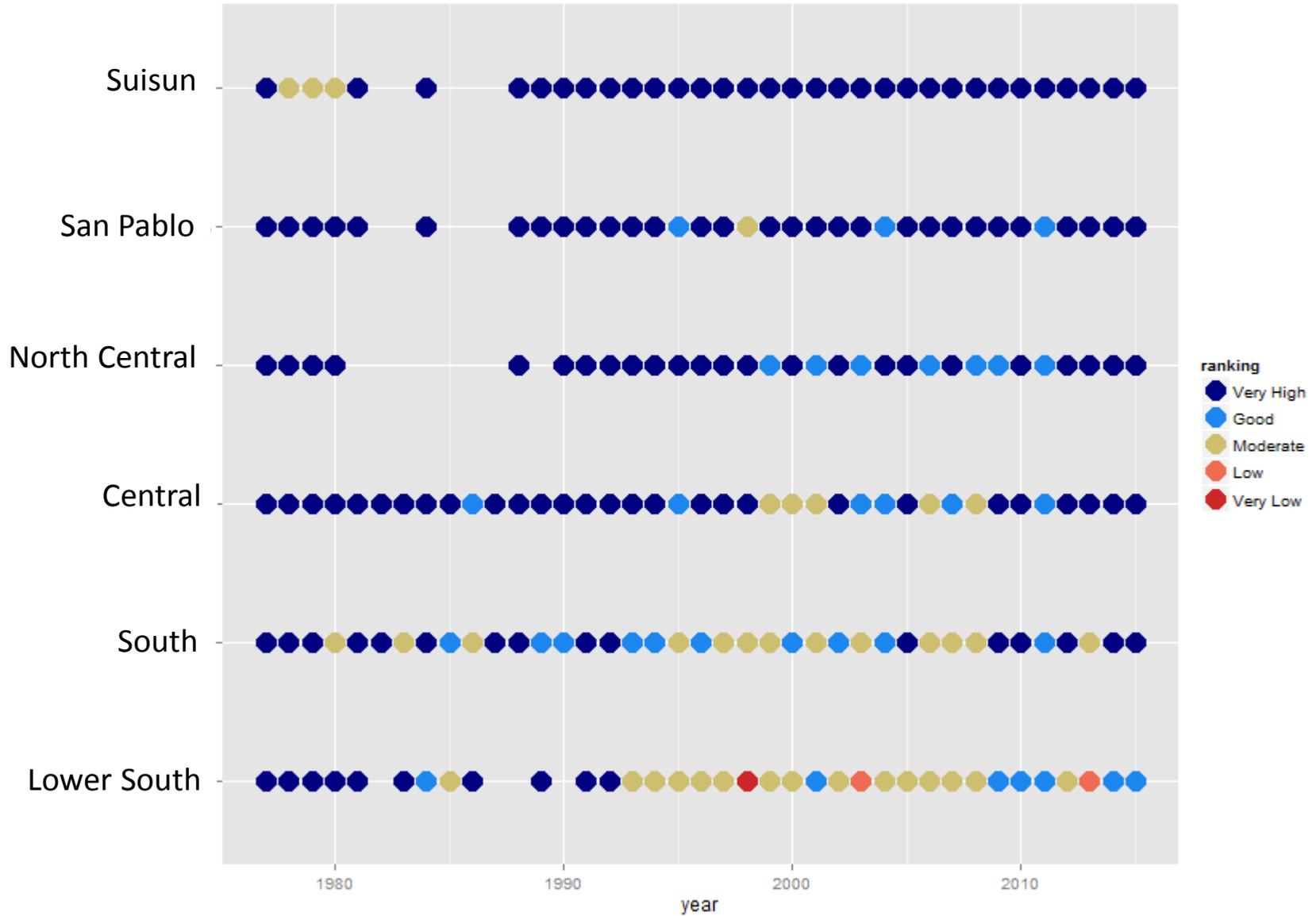
# Exploring the chl-HAB relationship



**Table 3.4. Chlorophyll-a Classification Table Linked to HAB Abundance, Based on Annual Frequency of Occurrence in Monthly Samples. Classification should be applied to each subembayment.**

Subembayment Monthly Mean Chlorophyll-a Linked to HAB Abundance ( $\mu\text{g L}^{-1}$ )	Ecological Condition Based on Annual Frequency of Occurrence in Monthly Samples			
	1 of 12	2-3	4-6	6+
$\leq 13$	Very high	Very high	Very high	Very high
>13 – 25	Good	Moderate	Moderate	Low
>25 – 40	Moderate	Moderate	Low	Very Low
>40 – 60	Moderate	Low	Very Low	Very Low
>60	Low	Very low	Very low	Very low

# Chl-HAB Relationship...Subembayments



# HAB abundance criteria

**Table 3.11. HAB Abundance Classification Table. Classification should be applied to each subembayment. If multiple HABs are detected within a subembayment on an annual basis, lowest rating for the year should be applied.**

## Basis for Alert Level Densities

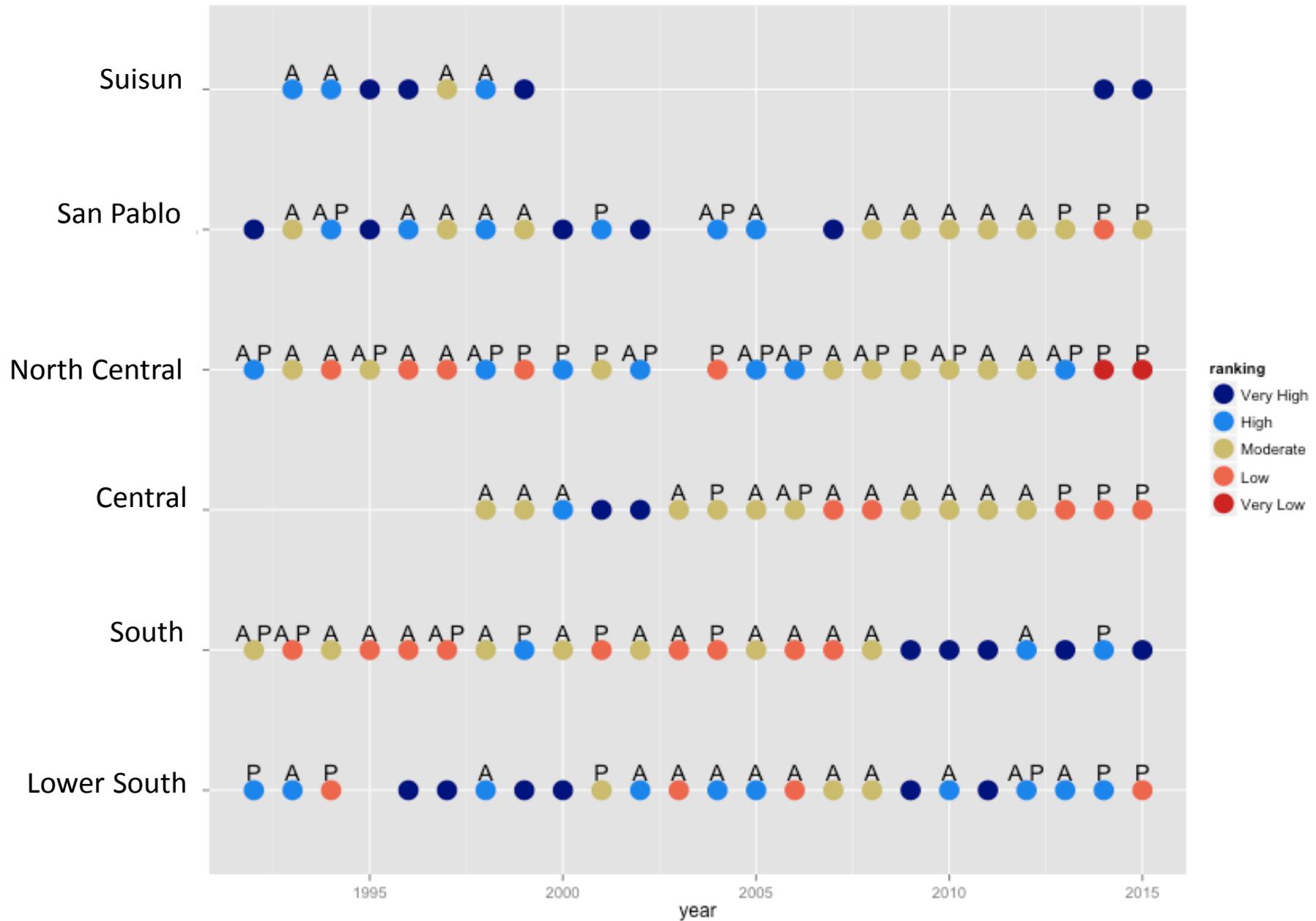
**Table 3.7. Potential HABs from San Francisco Bay,**

Organism	Alert Level (cells/L)	Reference
Alexandrium spp.	Presence	<a href="http://www.s">http://www.s</a>
Blue-Green Algae	20-100X10 <sup>6</sup>	WHO, 2003
Dinophysis spp.	100-1,000	<a href="http://www.s">http://www.s</a> al. 2014
Heterosigma akashiwo	500,000	Expert opinion
Karenia mikimotoi	5,000	National Shellfish Sanitation Program Guide for Control of Molluscan Shellfish, <a href="http://www.issc.org">www.issc.org</a>
Karlodinium veneficum	500,000	Expert opinion
Pseudo-nitzschia	10,000	Cal-HABMAP ; Shumway et al. 1995; Anderson et al. 2009

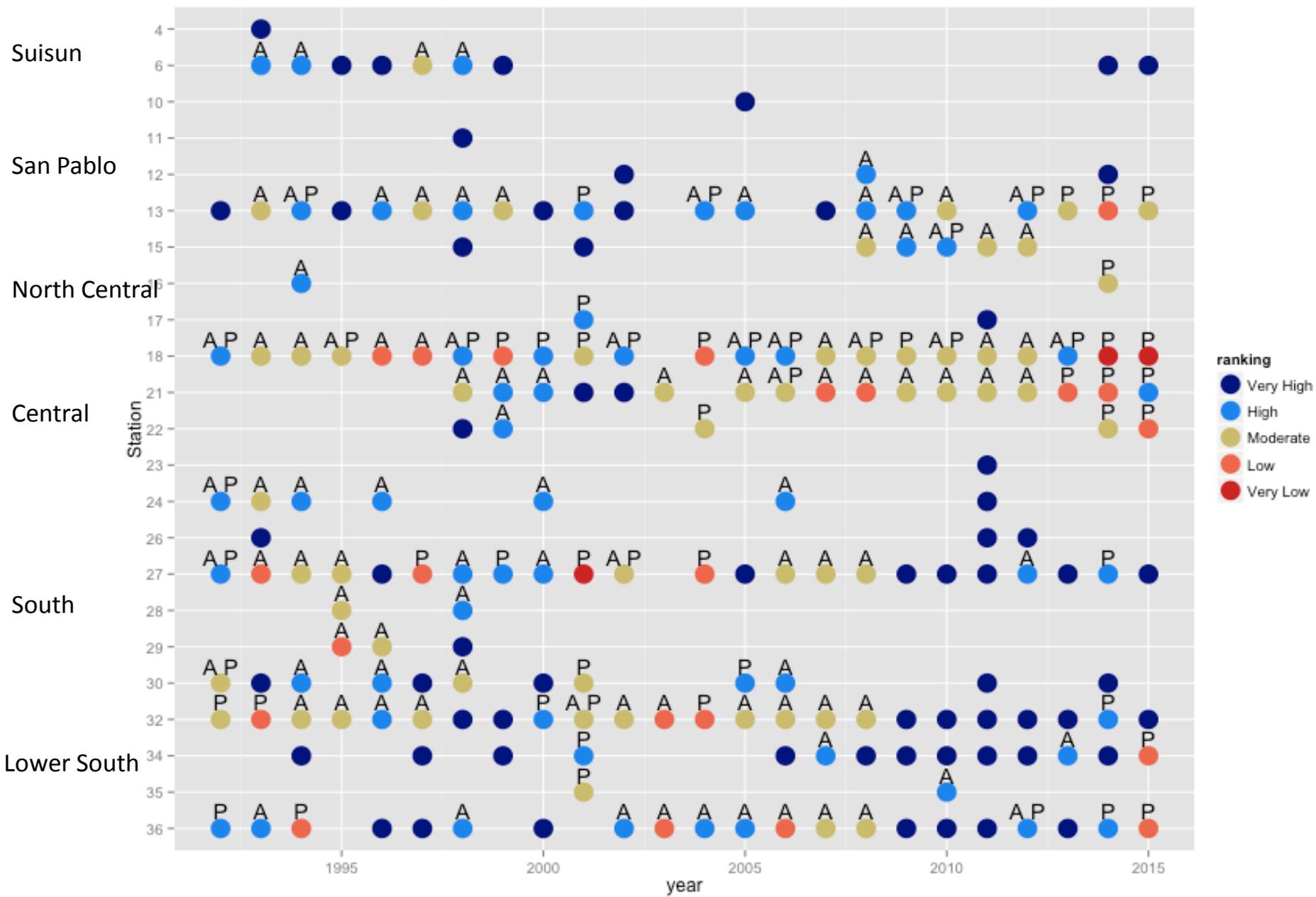
Cell Count By Taxonomic Group	Ecological Condition Based on Annual Frequency of Occurrence in Monthly Samples			
	1 of 12	2-3	4-6	6+
<b>Cyanobacteria</b> <sup>1</sup> . Applies at salinities ≤ 2 ppt.				
Absent to < 20,000 cells per ml	Very high	Very high	Very high	Very high
20,000 – 10 <sup>5</sup> cells per ml	High	Moderate	Low	Very Low
10 <sup>5</sup> – 10 <sup>7</sup> cells per ml	Moderate	Low	Very Low	Very Low
> 10 <sup>7</sup> cells per ml	Low	Very Low	Very Low	Very Low
<b>Pseudo-nitzschia spp.</b>				
<100 cells per l	Very high	Very high	Very high	Very high
100 to 10,000 cells per l	High	High	Moderate	Low
10,000 -50,000 cells per l	Moderate	Low	Low	Very Low
> 50,000 cells per l	Low	Very Low	Very Low	Very Low
<b>Alexandrium spp.</b>				
Non detect	Very high	Very high	Very high	Very high
Detectable to < 100 cells	High	Moderate	Low	Very low
>100 cells	Low	Very low	Very low	Very Low

<sup>1</sup> Cyanobacteria include: *Cylindrospermopsis*, *Anabaena*, *Microcystis*, *Planktothrix*, *Anabaenopsis*, *Aphanizomenon*, *Lyngbya*, *Raphidiopsis*, *Oscillatoria*, and *Umezakia*

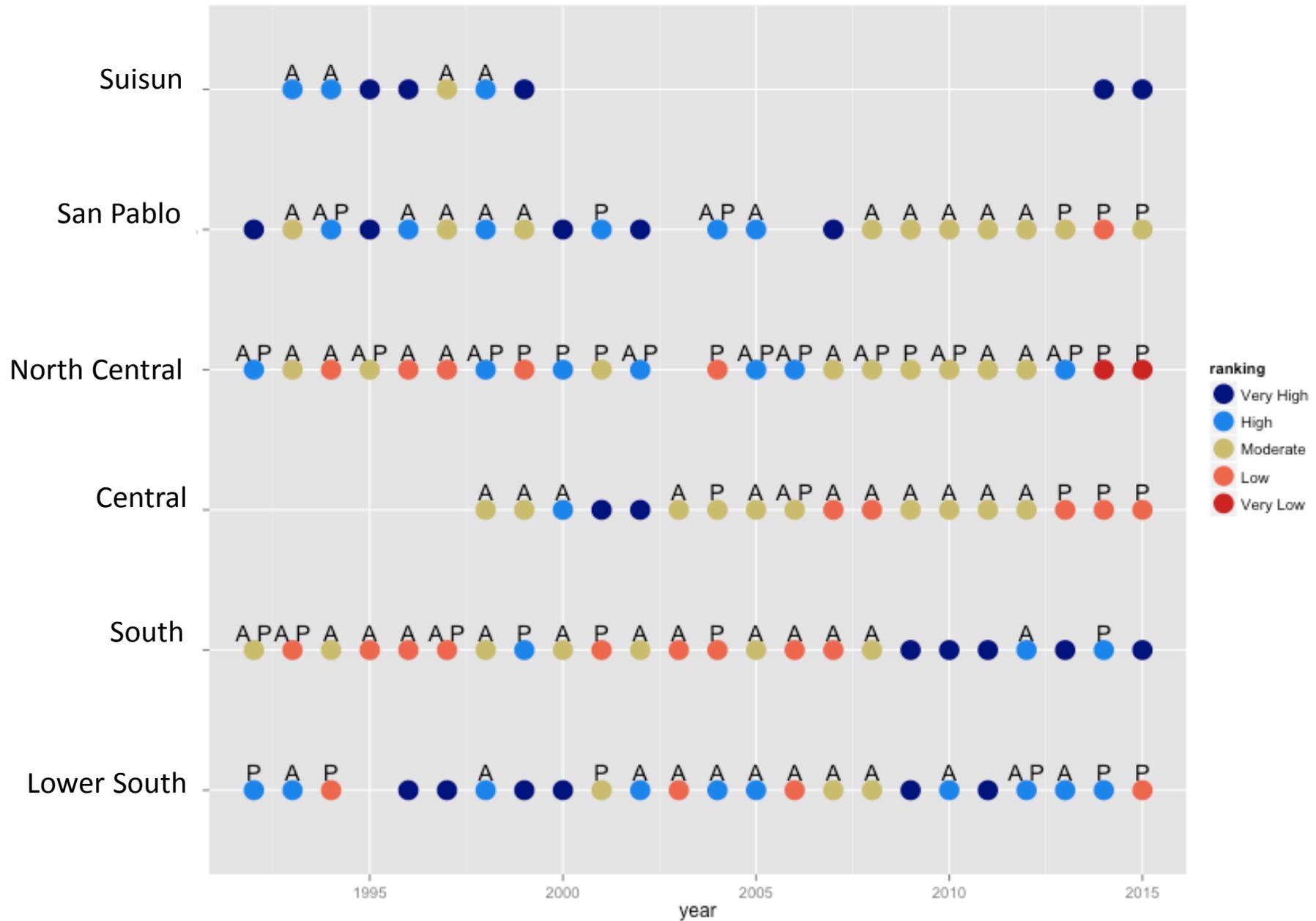
# Subembayments...Microscopy



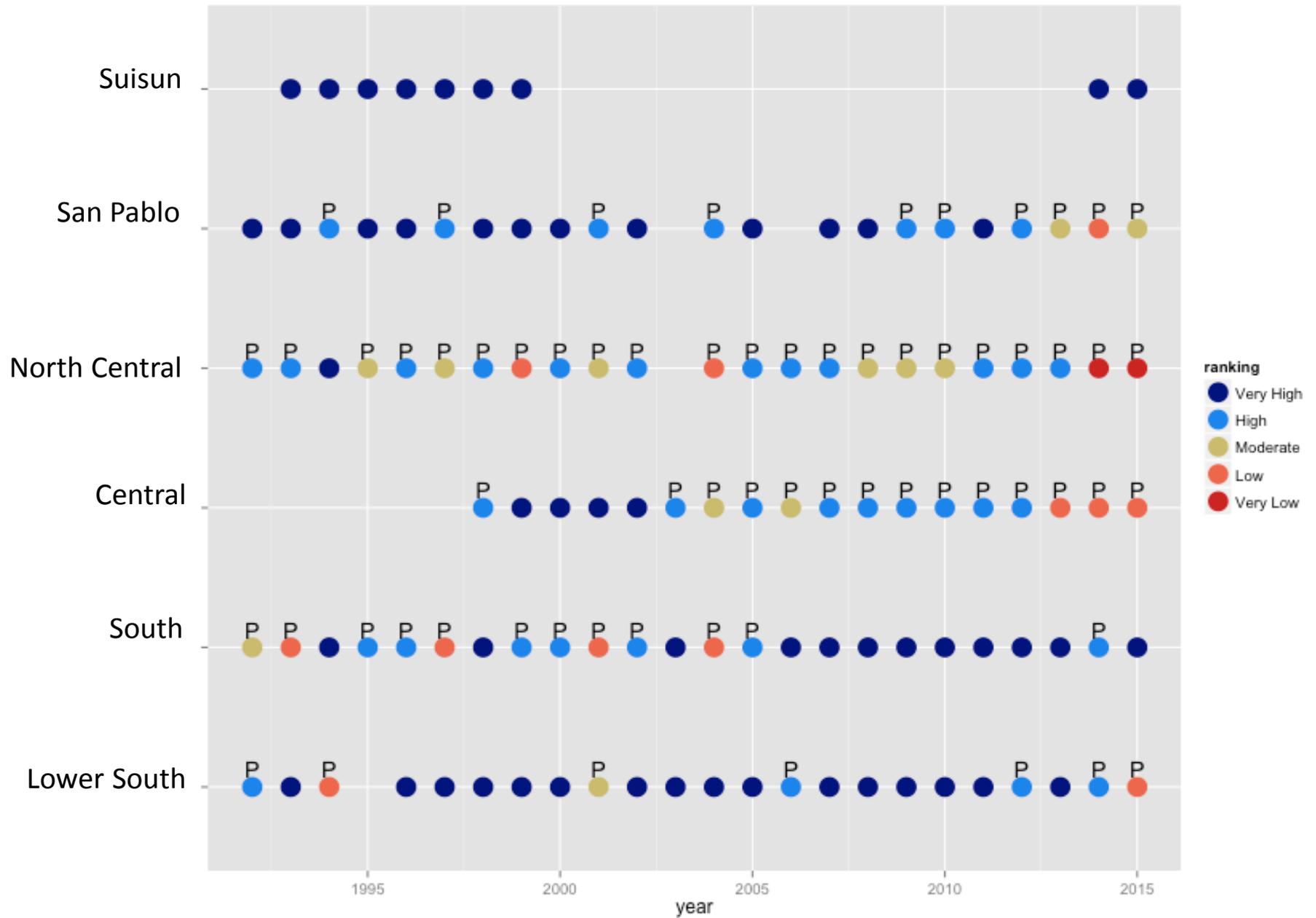
# Individual stations...Microscopy

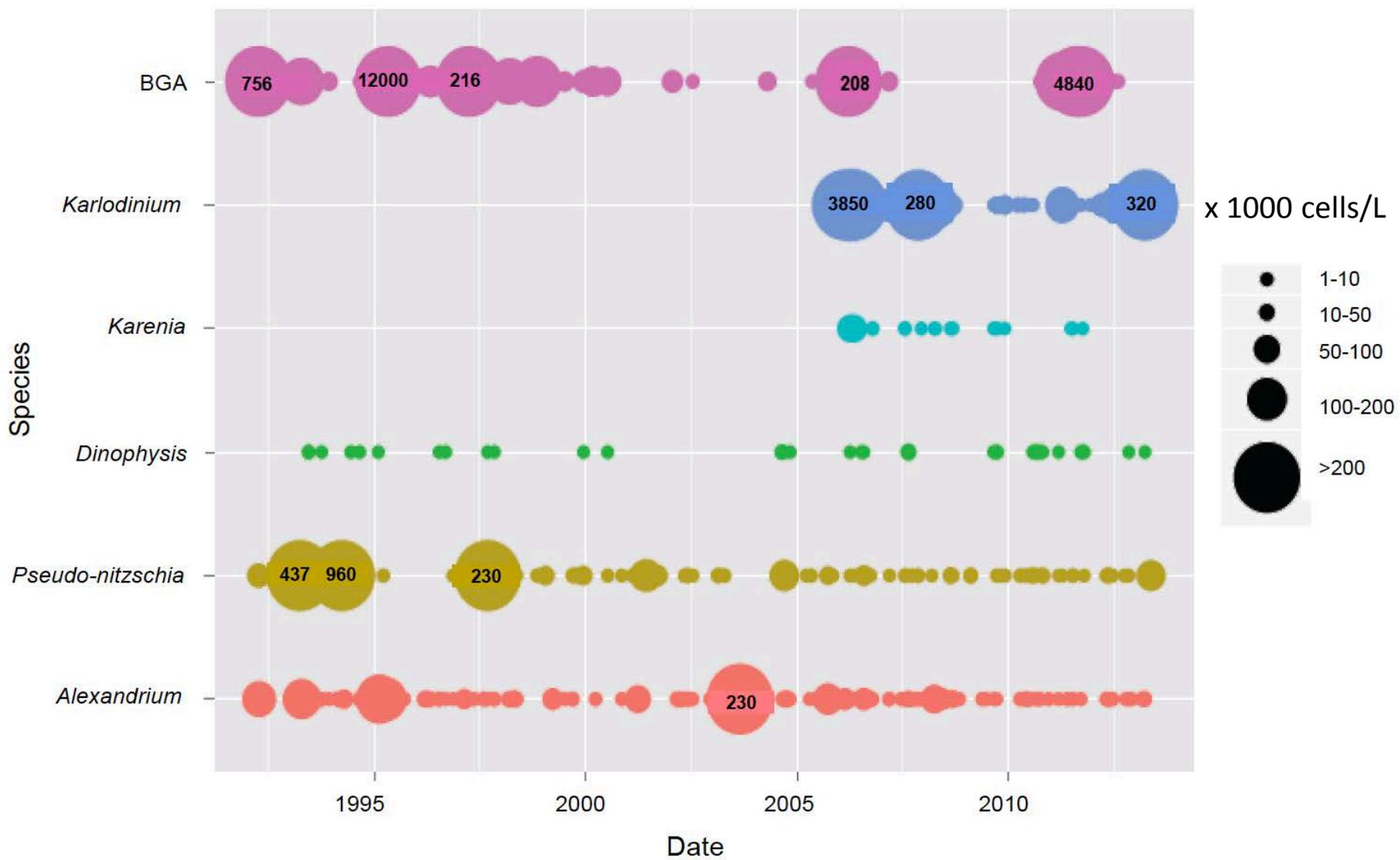


# Subembayments...Microscopy

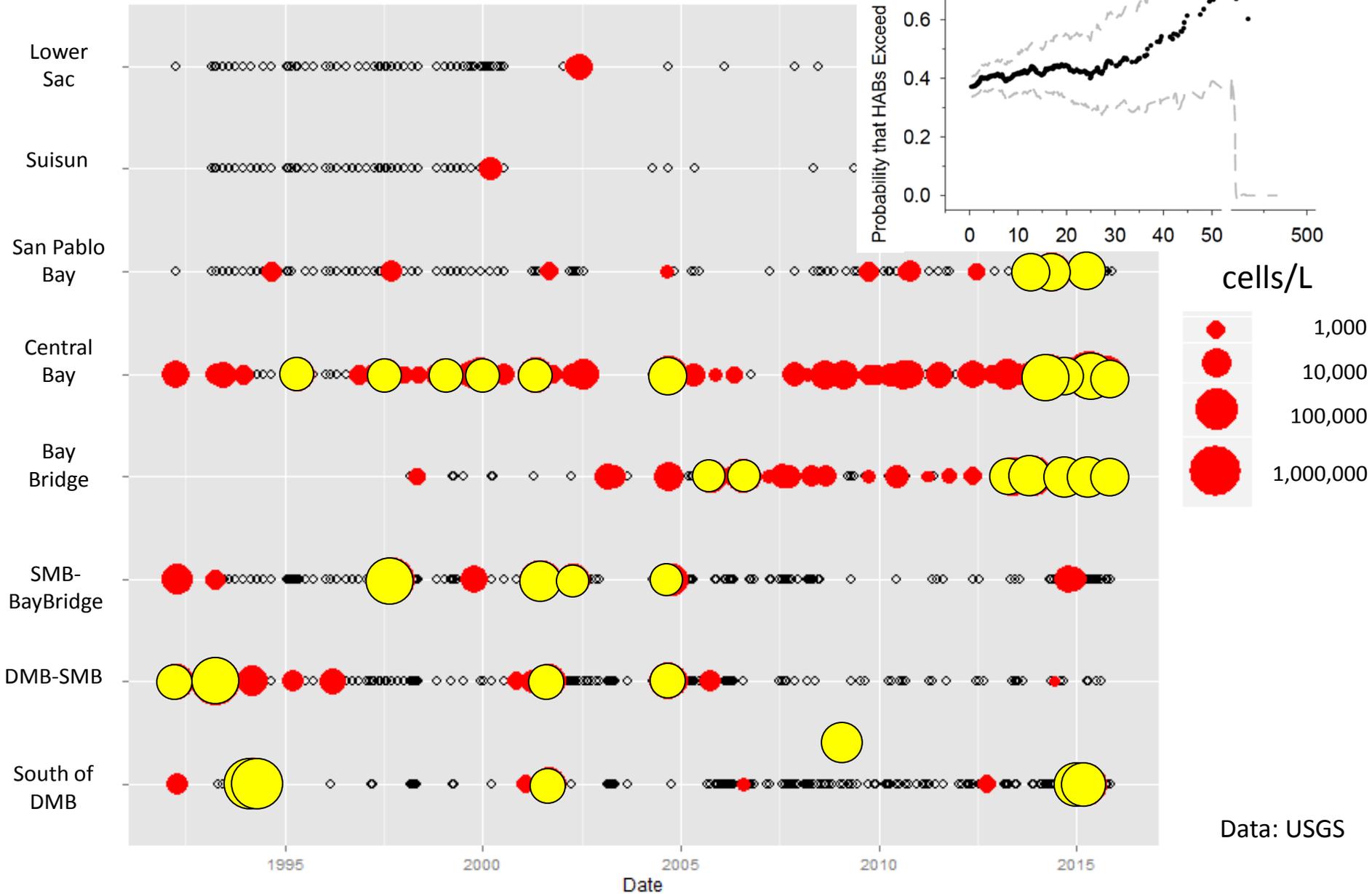


# Subembayments – Microscopy, without Alexandrium

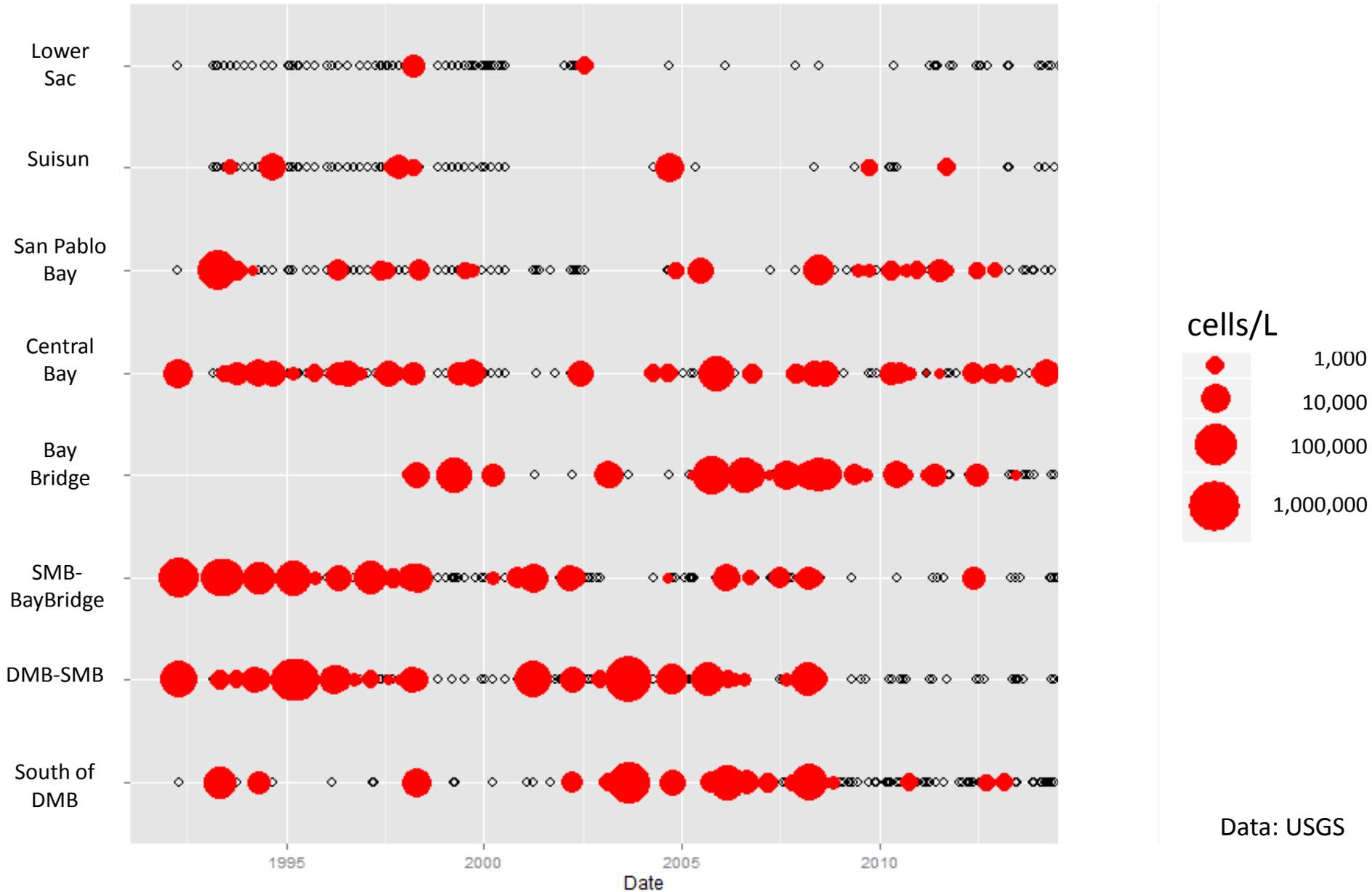




# *Pseudo-nitzschia* spp.



# Alexandrium



Data: USGS

# Summary

## 1. Chl-DO categorization...

- Mean... South Bay, LSB = mostly “high” or “very high” condition
- Lower 95%ile LSB = Moderate to Low

## 2. Chl-HAB categorization

- Central = Very High, High, Moderate
- South = Moderate, High, Very High
- LSB = Low, Moderate, High

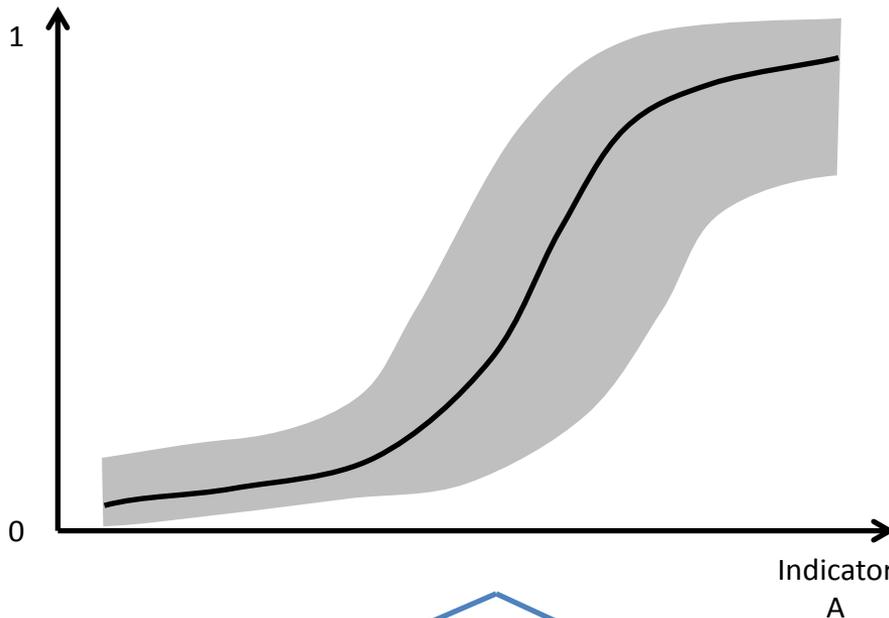
## 3. Using HAB cell counts directly...

- Results in worse condition estimates than with chl-HAB

# On-going Work

Initial hypothesized relationship and existing data

Probability of adverse condition

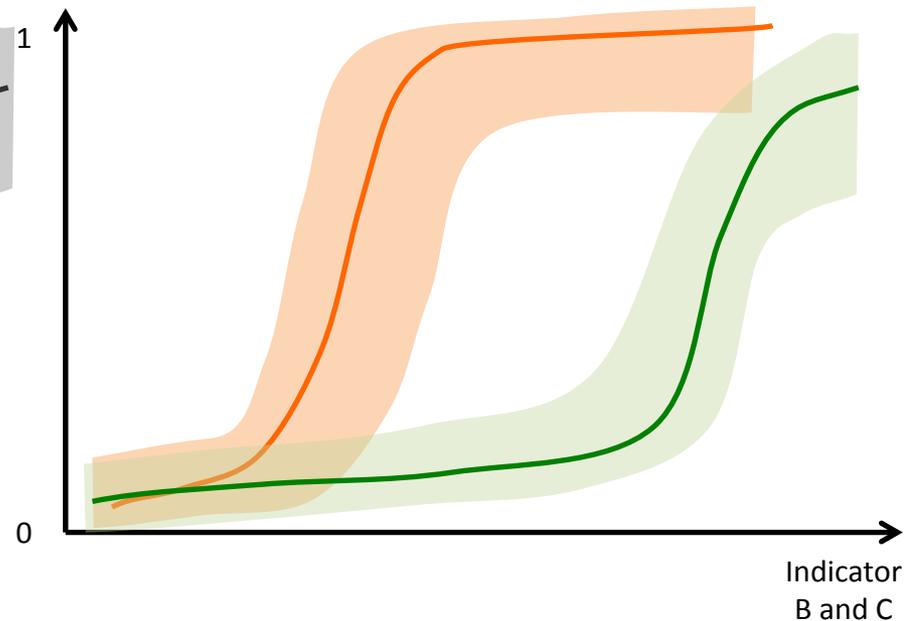
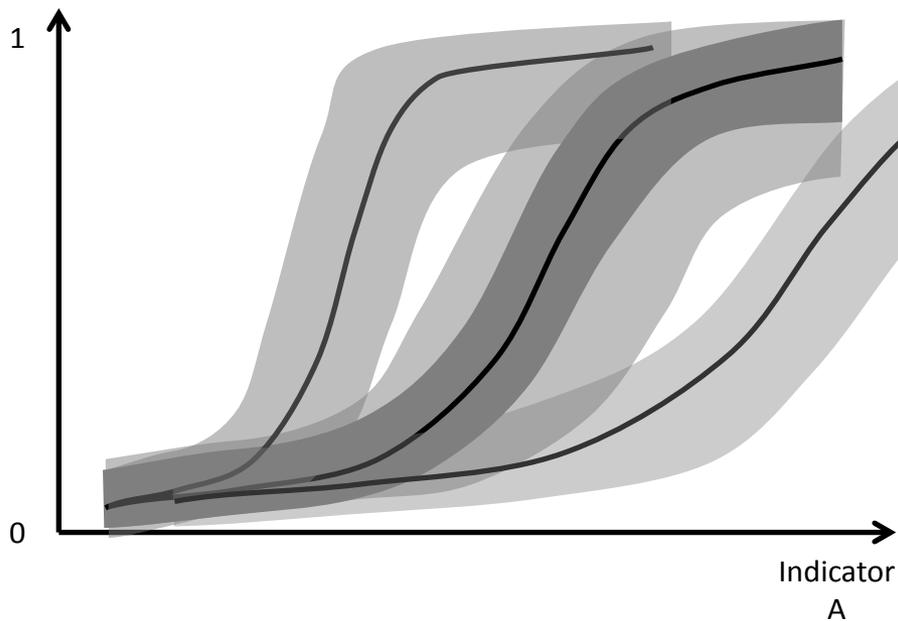


e.g.,  
- smaller confidence intervals  
- refined relationship

ongoing science and monitoring

Indicator A

e.g.,  
- Different metrics



# Toxins in Water...Domoic Acid...spatial average (SPATT)

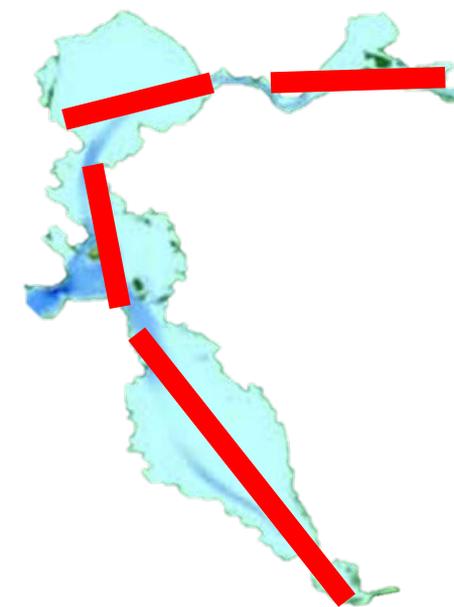
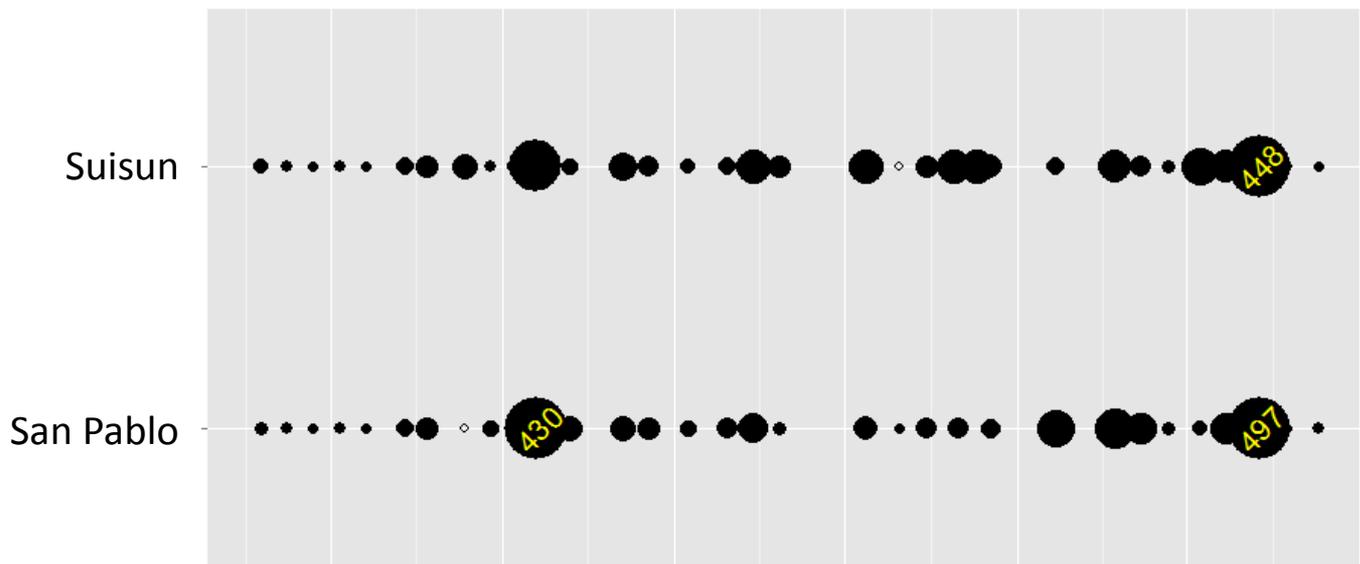
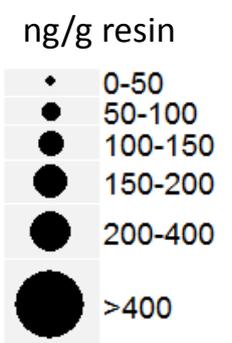
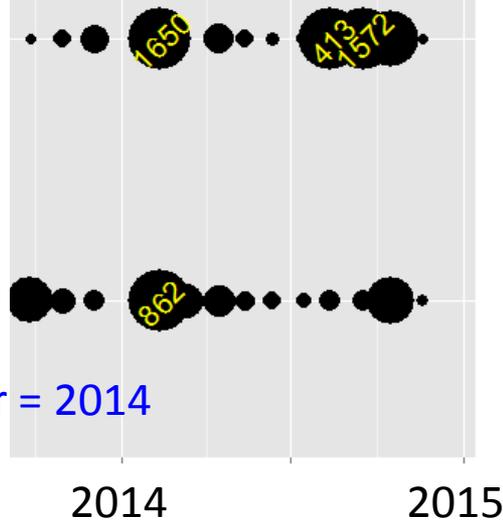
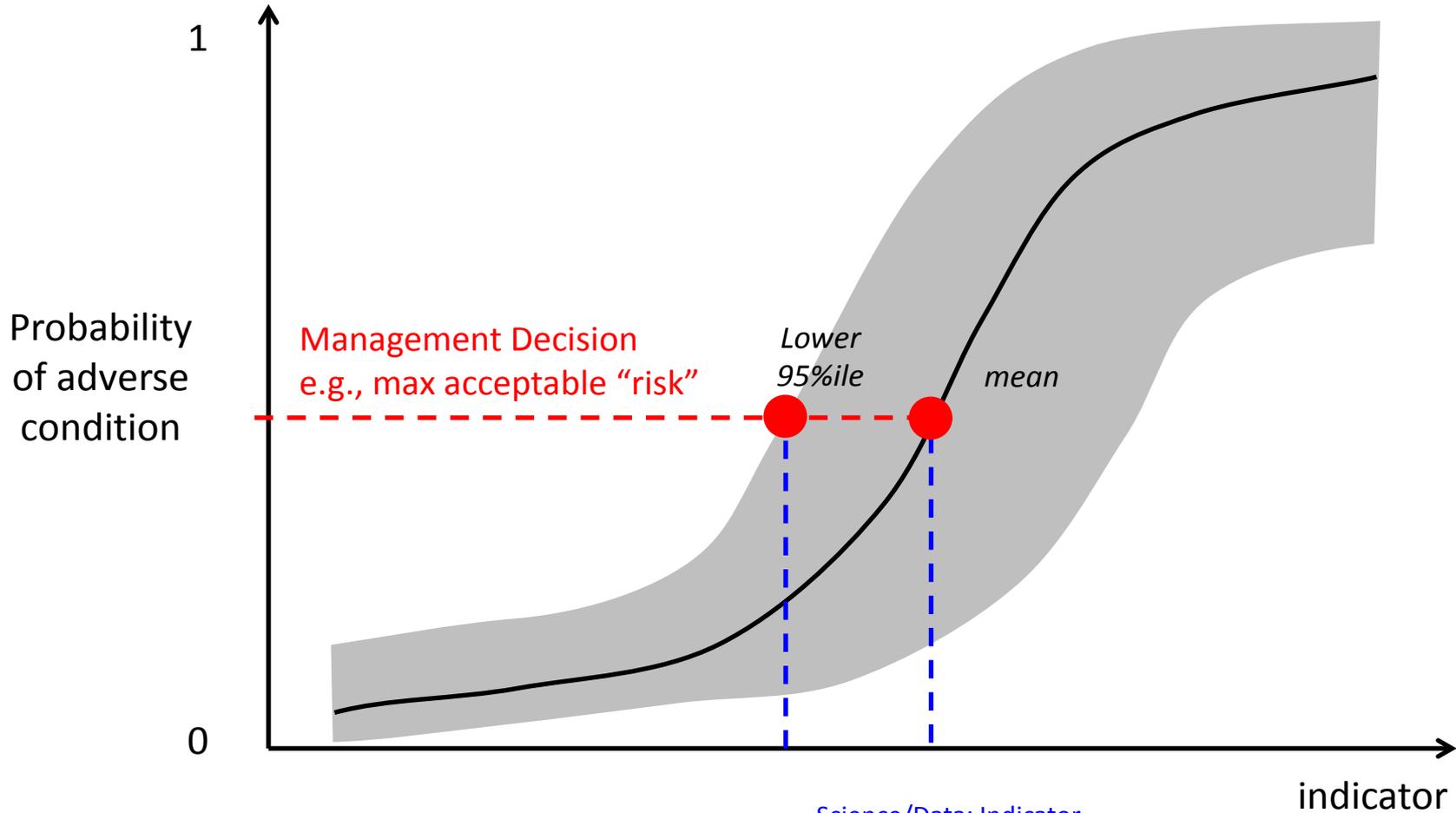


Table 3.9. Toxin Classification Table for Domoic Acid. Classification should be applied to each subembayment. If multiple hits in different media (particulate, SPATT, tissue) are detected within a subembayment on an annual basis, lowest rating for the year should be applied.

Toxin Concentration	Ecological Condition Based on Annual Frequency of Occurrence in Monthly Samples			
	1 of 12	2-3	4-6	6+
<b>Particulate concentration</b>				
Non-detect	Very high	Very high	Very high	Very high
0-100 ug/L	High	Moderate	Moderate	Low
100 - 1000 ug/L	Moderate	moderate	Low	Very Low
> 1000 ug/L	Low	Very Low	Very Low	Very Low
<b>SPATT</b>				
<30 ng/g	Very high	Very high	Very high	Very high
30-75 ng/g	Moderate	Low	Very low	Very Low
>75	Low	Very Low	Very Low	Very Low
<b>Mussel Tissue</b>				
Non-detect	Very high	Very high	Very high	Very high
< 10 ppm	High	Moderate	Moderate	Low
10-20 ppm	Moderate	moderate	Low	Very Low
> 20 ppm	Low	Very Low	Very Low	Very Low





Science/Data: Indicator corresponding to probability threshold, either mean or lower confidence interval

