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**Western CEDAR**

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Salish Sea Ecosystem Conference

2014 Salish Sea Ecosystem Conference  
(Seattle, Wash.)

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May 2nd, 10:30 AM - 12:00 PM

## **Multiple stressors on the potential toxicity of *Heterosigma akashiwo*, a fish-killing flagellate in the Salish Sea.**

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*San Francisco State University*

Charles Trick  
*Western University*

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Matheson, Julia; Cochlan, William; and Trick, Charles, "Multiple stressors on the potential toxicity of *Heterosigma akashiwo*, a fish-killing flagellate in the Salish Sea." (2014). *Salish Sea Ecosystem Conference*. 50.

<https://cedar.wwu.edu/ssec/2014ssec/Day3/50>

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Julia Matheson  
May 2<sup>nd</sup>, 2014  
Salish Sea Conference 2014

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# Multiple stressors on the potential toxicity of *Heterosigma akashiwo*, a fish-killing flagellate in the Salish Sea

**Julia R. Matheson**

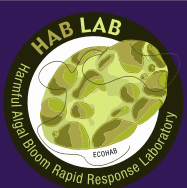
Department of Biology, Western University, London, Ontario, Canada

**Charles G. Trick**

Department of Biology, Western University, London, Ontario, Canada

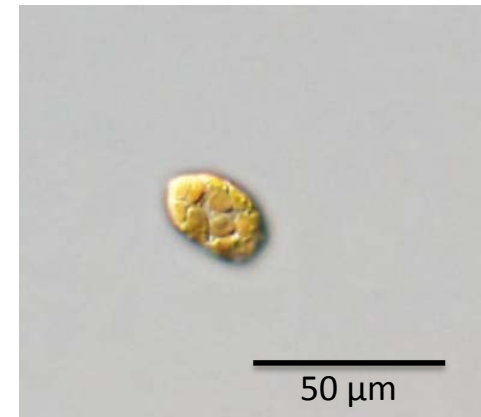
**William P. Cochlan**

Romberg Tiburon Center for Environmental Studies,  
San Francisco State University, Tiburon, California, USA



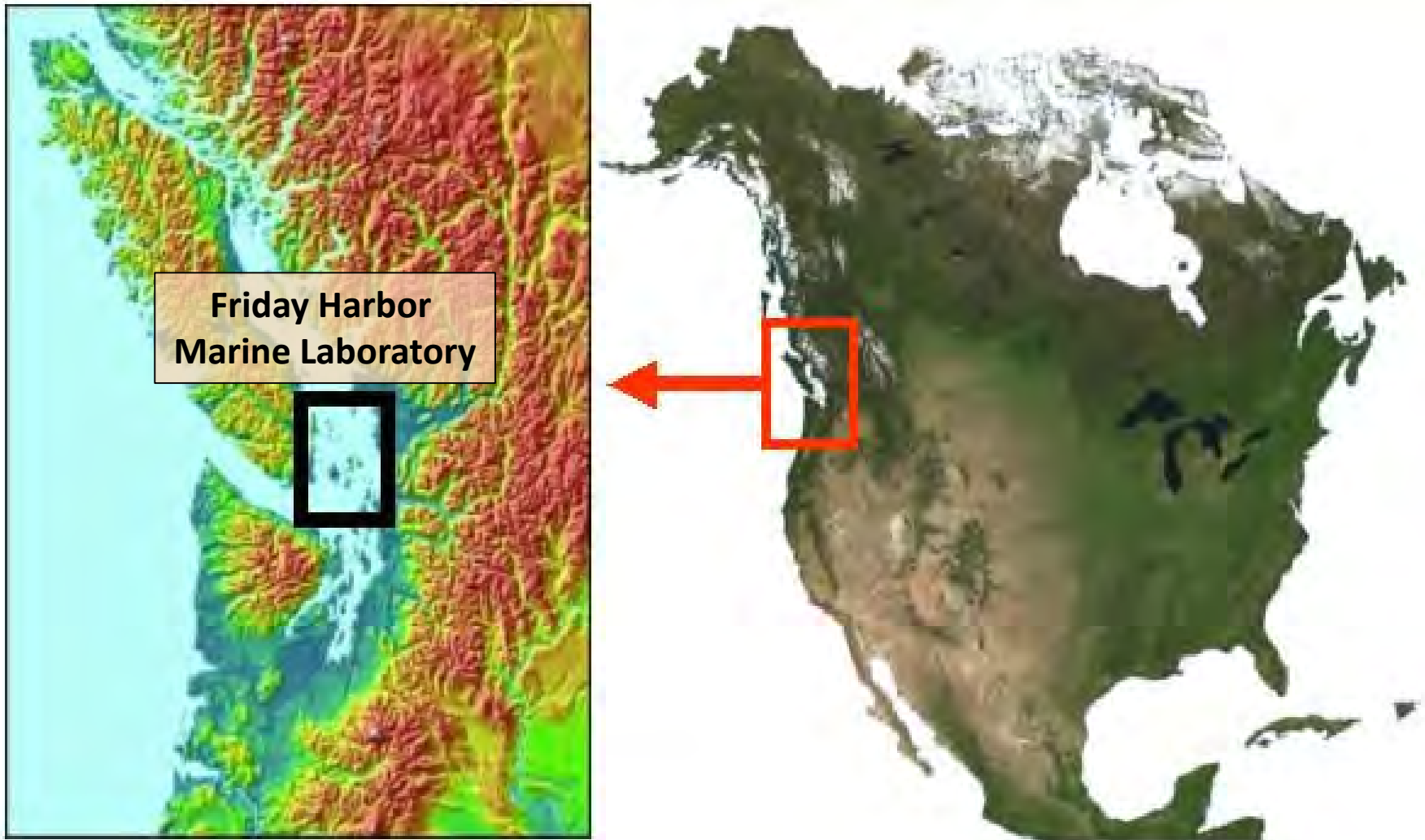
# Physical Characteristics of *Heterosigma akashiwo*

- Responsible for massive fin-fish mortality in aquaculture operations worldwide including the Salish Sea
- Estimated \$2 million USD in losses per blooming event in Puget Sound.
- Environmental conditions that promote variably ichthyotoxic cells is not clearly understood
- Environmental conditions within the Salish Sea are unique – upwelling zone + anthropogenic inputs
- **How *H. akashiwo* responds to nutrient-rich, acidified ocean conditions projected for future coastal zones is unknown.**



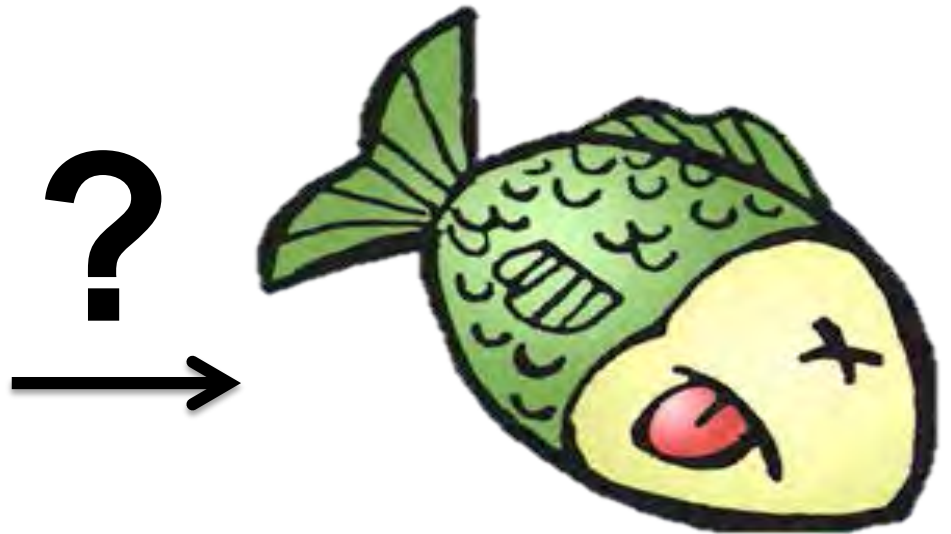
*Heterosigma akashiwo*

# Salish Sea Study Site



# My Research Question

Will future coastal waters promote the formation of **toxic** HABs of *Heterosigma akashiwo*?



# My Hypothesis

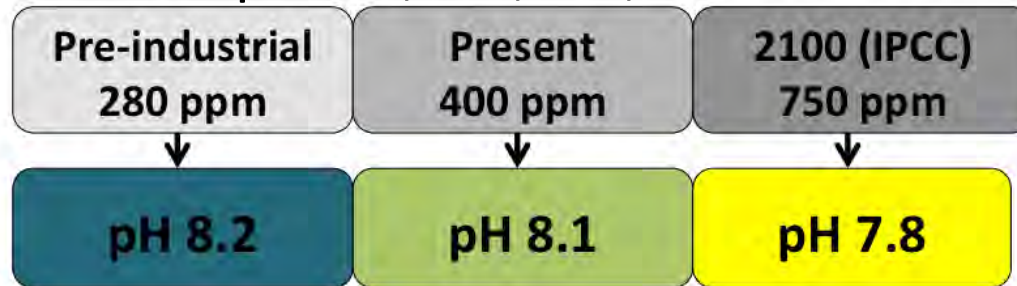
I hypothesize that *Heterosigma akashiwo* can remain a potential HAB species under new ocean conditions.

## ***Heterosigma akashiwo***

- ✓ Growth Rates
- ✓ Toxicity

# Methodology

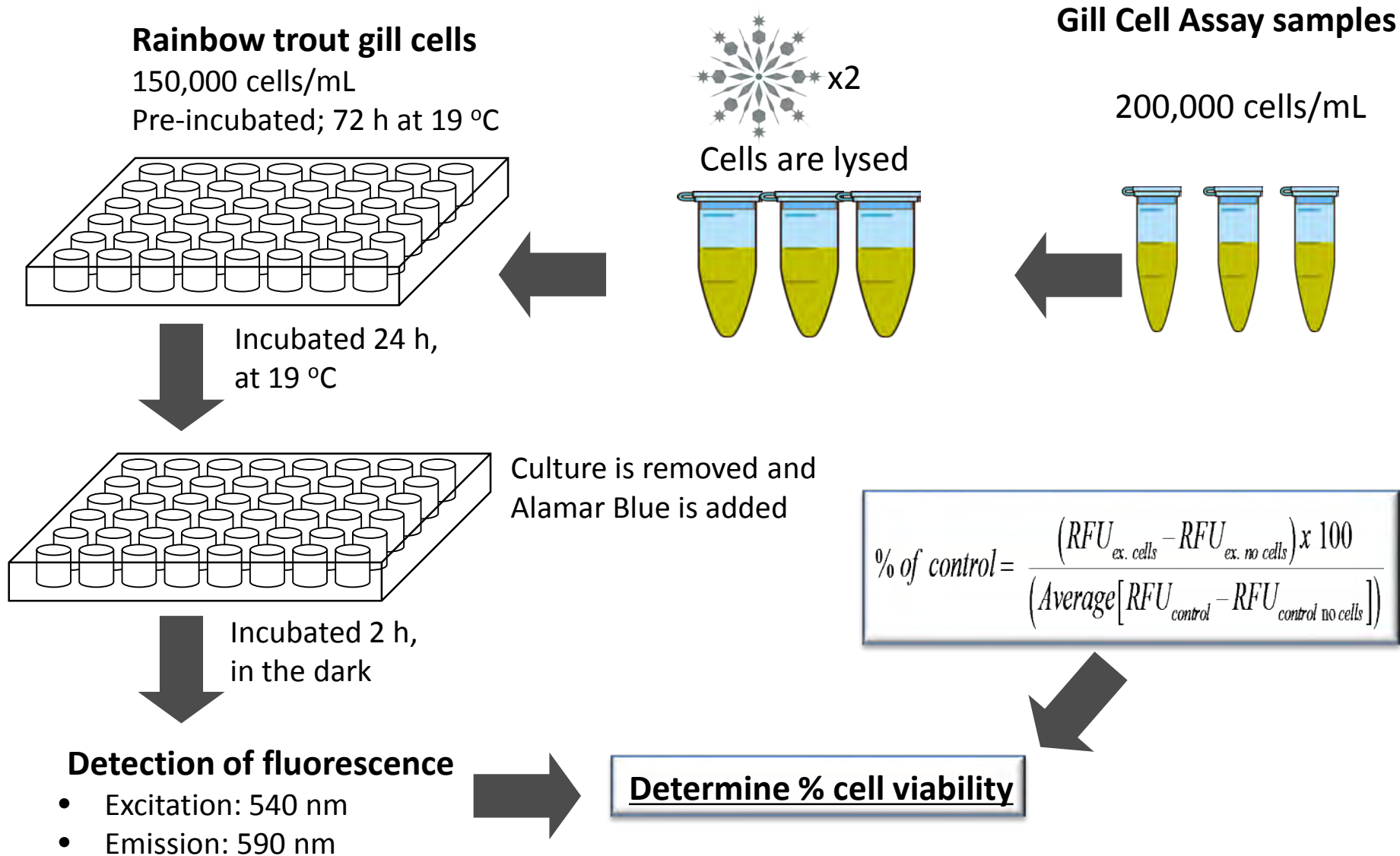
- Batch cultures of *H. akashiwo* (isolate 513):
  - ESAW salts enriched with f/2 nutrients
    - titrated to pH 8.2, 8.1, 7.8, 7.4



- Growth Rates:
  - Cell counts using the flow cytometer
  - Validated with hemocytometer counts
- Toxicity:
  - Rainbow trout gill cell assay (RTgill-W1)



# Gill Cell Assay



Modified from Chris Ikeda [from Schirmer et al., 1997; Dayeh et al., 2005; Dorantes et al., 2011]

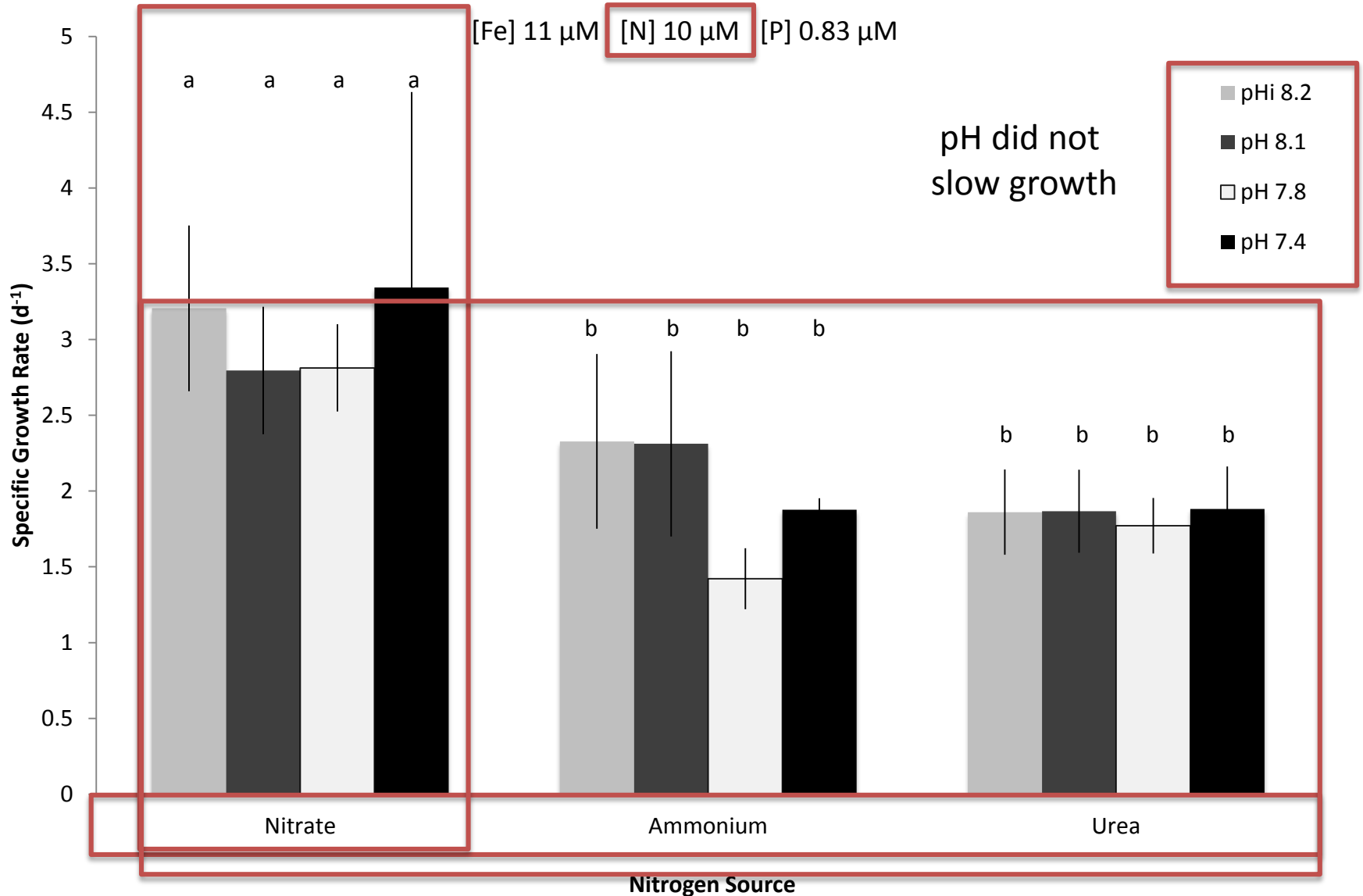
# GROWTH RATES

Will *Heterosigma akashiwo* maintain their presence in the future ocean?



*Heterosigma akashiwo*

# Growth Rates



Error bars +/- SD

n=9

P < 0.0001

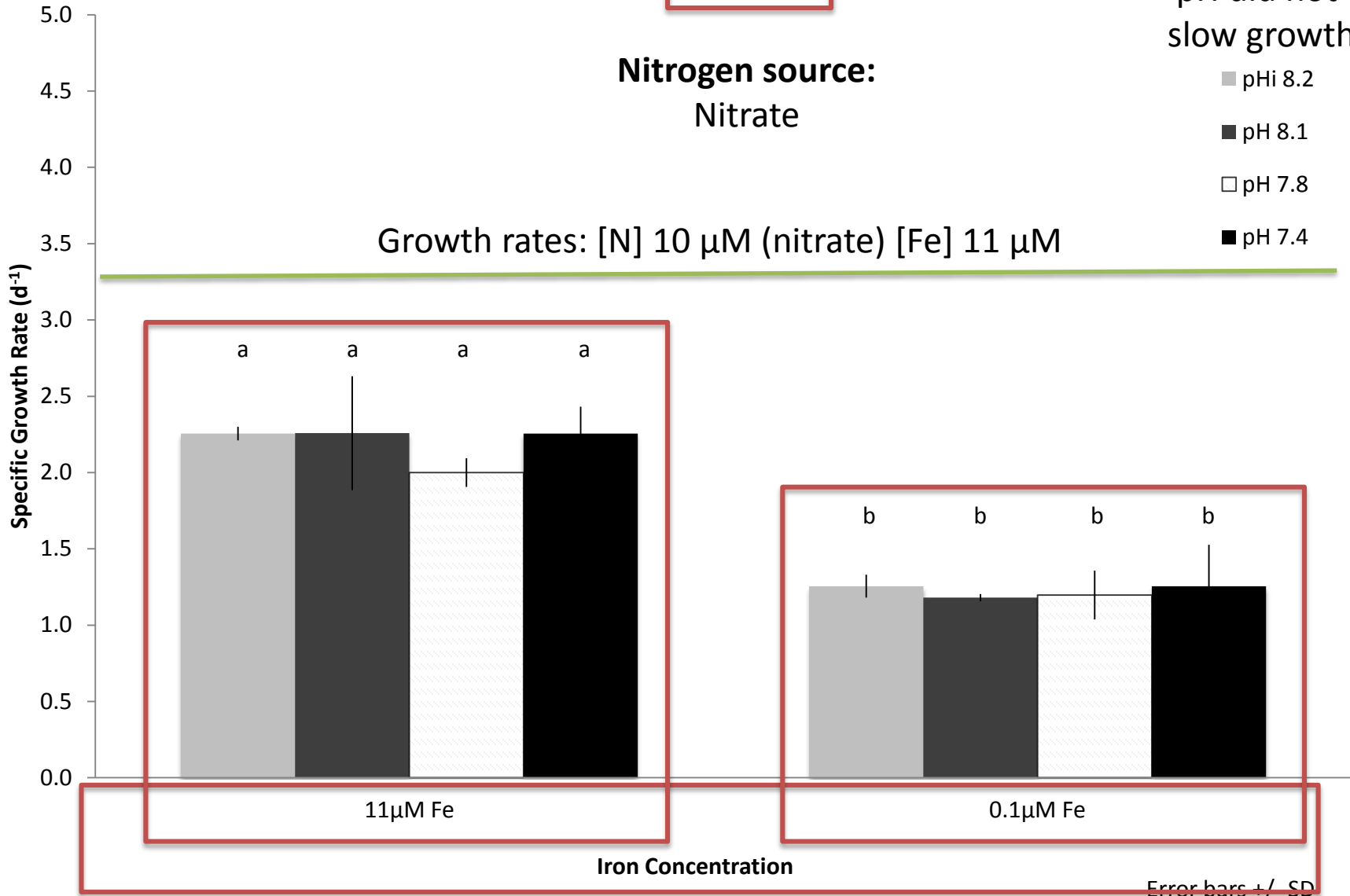
# Growth Rates

[Fe] 0.1/11  $\mu\text{M}$  [N] 880  $\mu\text{M}$  [P] 37  $\mu\text{M}$

pH did not  
slow growth

Nitrogen source:  
Nitrate

Growth rates: [N] 10  $\mu\text{M}$  (nitrate) [Fe] 11  $\mu\text{M}$



Error bars +/- SD

n=6

P < 0.0001

# GROWTH RATES

Will *Heterosigma akashiwo* maintain their presence in the future ocean?



- Cells grew well on 3 forms of nitrogen
- **Resilient to changes in pH**
- Showed maintained growth rates across a range of N and P concentrations

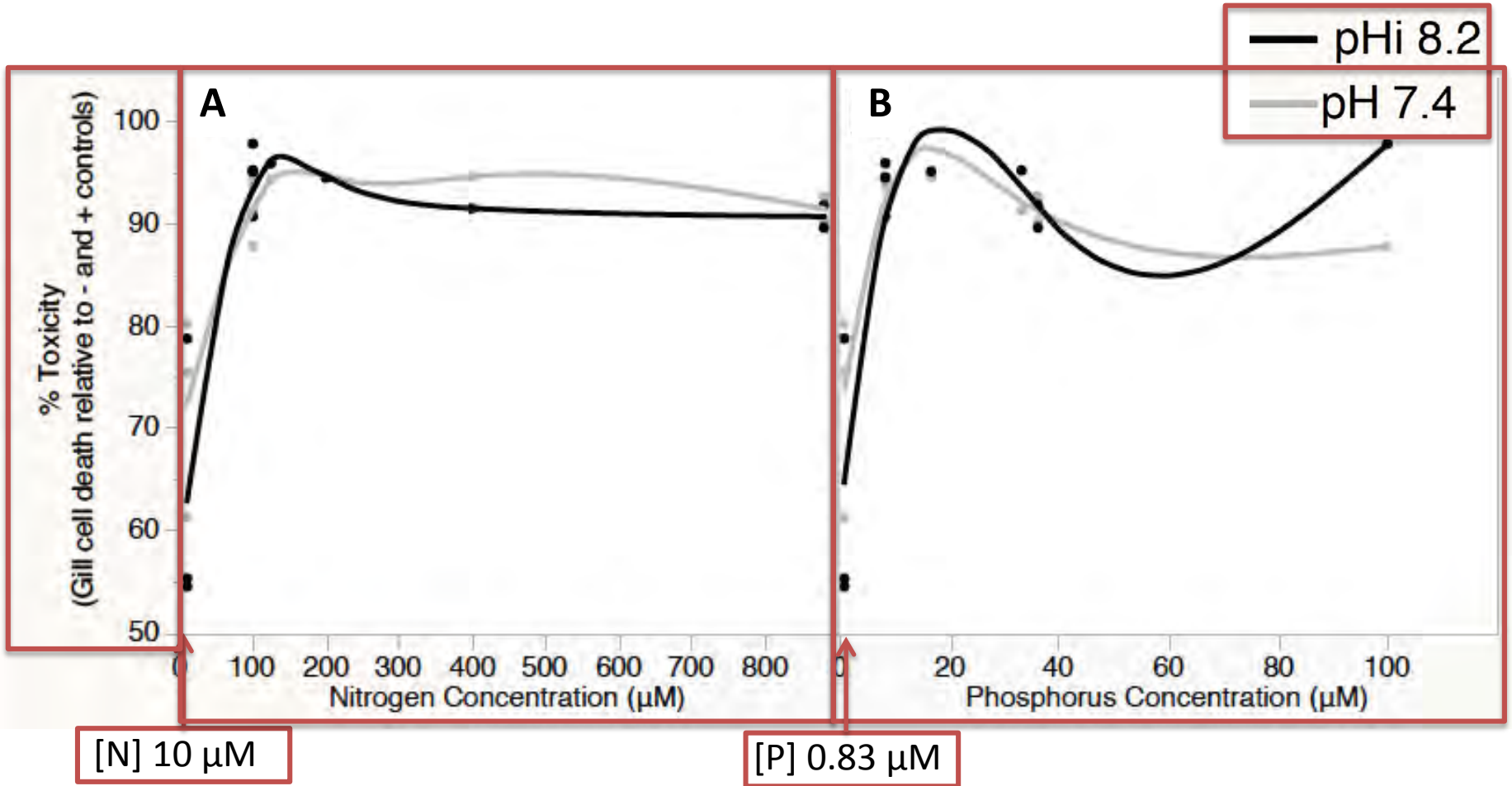
# ICHTHYOTOXICITY

Will *H. akashiwo* be toxic to fish?



# Toxicity

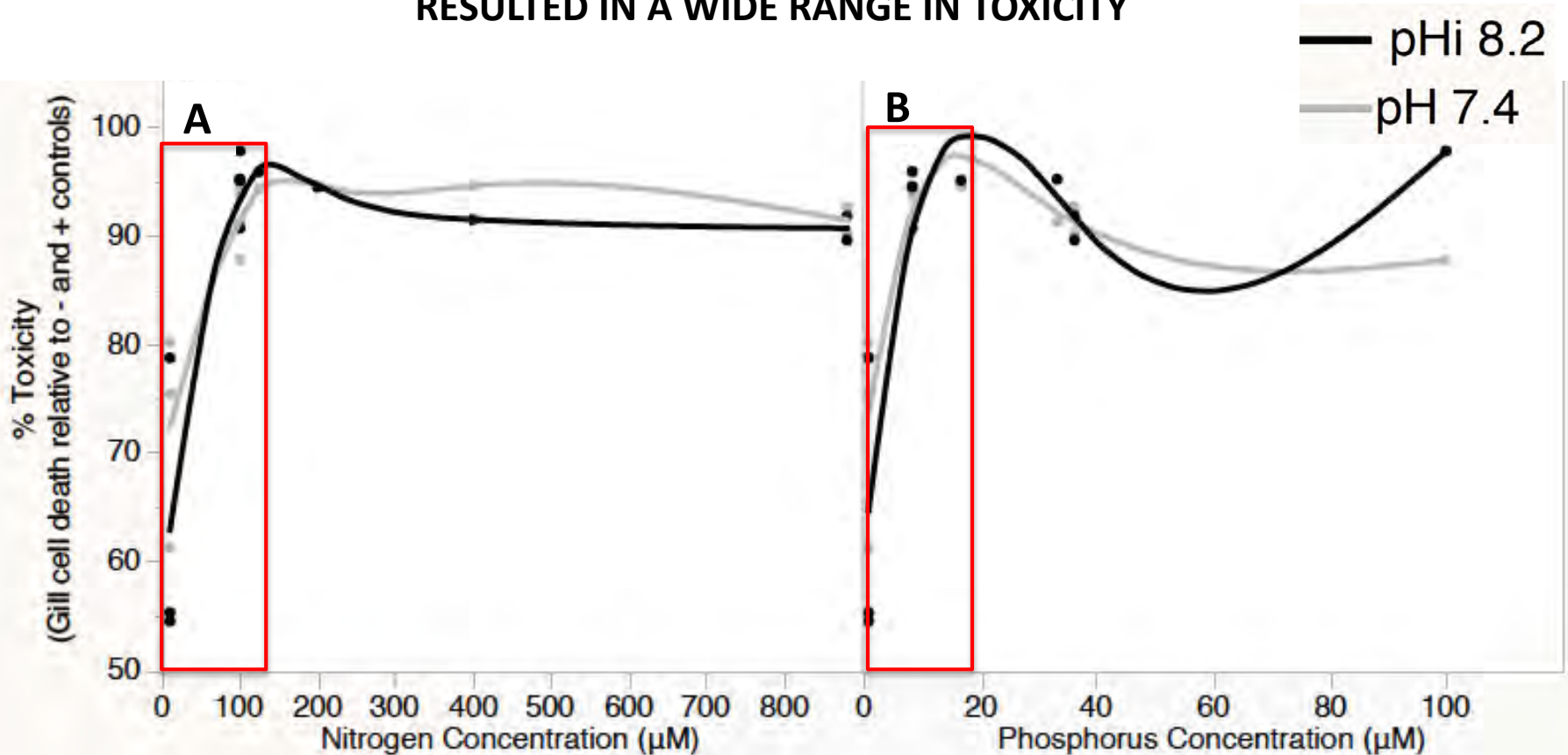
Toxicity is not enhanced at lower pH



$\lambda$  of cubic spline = 0.05

# Toxicity

A NARROW RANGE OF NUTRIENT CONCENTRATIONS  
RESULTED IN A WIDE RANGE IN TOXICITY



$\lambda$  of cubic spline = 0.05



# ICHTHYOTOXICITY

Will *H. akashiwo* be toxic to fish?



- Toxicity was not affected by pH
- **Showed increased toxicity across a narrow range of N and P concentrations**
- No change in growth rates despite enhanced toxicity

# Conclusions

**Nutrient concentration impacts toxicity;  
nutrients led to toxic cells.**

- **A small shift in nutrient concentrations led to a wide range in toxicity**
  - A range of 0-100  $\mu\text{M}$  N and 0 -20  $\mu\text{M}$  P caused toxicity to increase by 50%.

***H. akashiwo* cells were resilient to changes in pH.**

- **Growth and toxicity were not impacted by lower pH**
  - For pH values tested in my study (7.4, 7.8, 8.1, 8.2)

**Future conditions with high nutrients and low pH could result  
in continued blooms of *H. akashiwo* that are more toxic.**

- Implications to the aquaculture industry (in upwelling-zones)

# Acknowledgements



**NOAA Northwest Fisheries  
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**Romberg Tiburon Center for  
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**Western University  
Biology Department**

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Dr. Vera Trainer

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