

# **Anatomy of a Fish Kill**

**Dr. Edie Widder, CEO & Senior Scientist  
Ocean Research & Conservation Association**

**[www.teamorca.org](http://www.teamorca.org)**

**ORCA**



NG STORY • DEVELOPING STORY • DEVELOPING STORY • DEVELOPING STORY • DEVELOPING STORY •

**FOX 35**  
5:05 64°

**MASSIVE FISH KILL IN BREVARD CO.  
INDIAN & BANANA RIVERS**

**DEVELOPING  
STORY**





Photo by Kyle Burton



Photo by Kyle Burton





# THE FLOATING DEAD

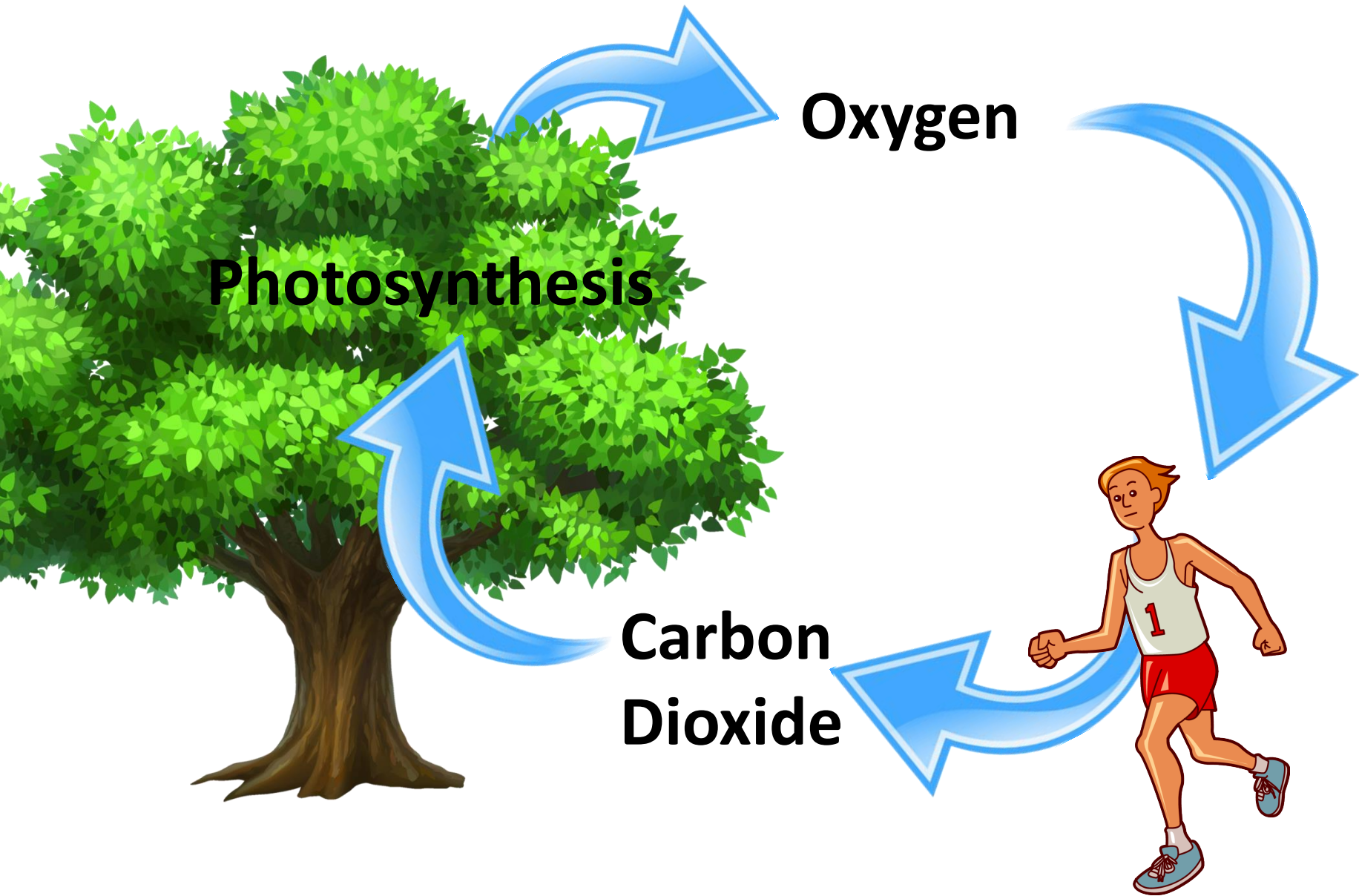
WHEN REALITY IS MORE HORRIFYING THAN FICTION



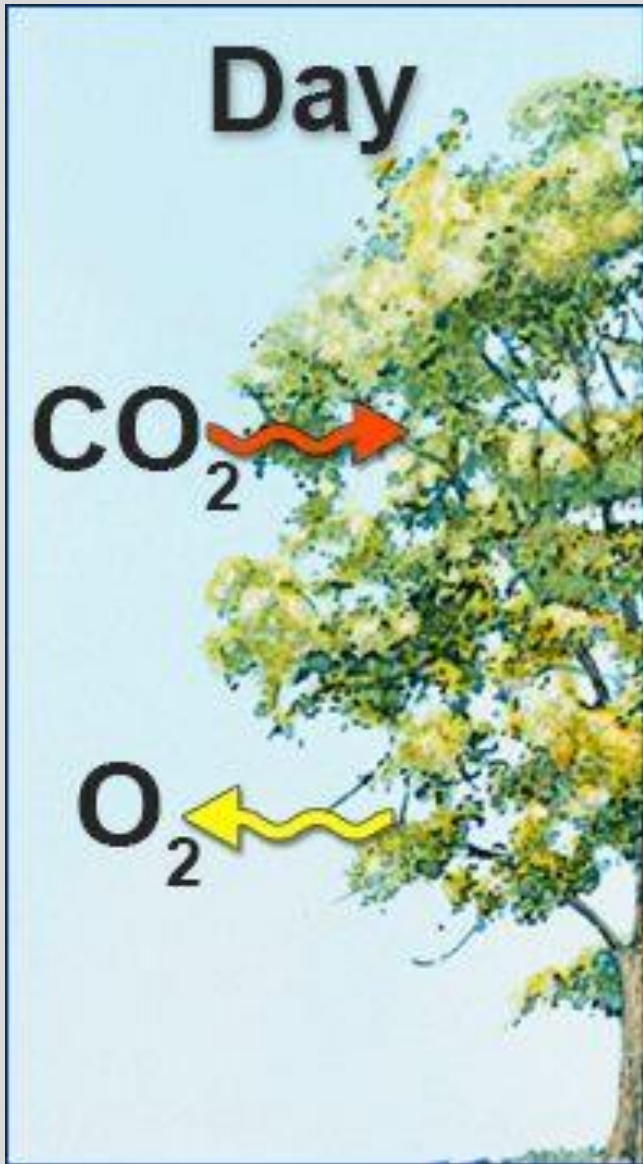
Andy  
Marlette  
News Journal  
Facebook.com/marlettecartoons  
©creators.com 2015

# Causes of Fish Kills

- Low Dissolved Oxygen
- Toxic Algae
- Chemical Pollution

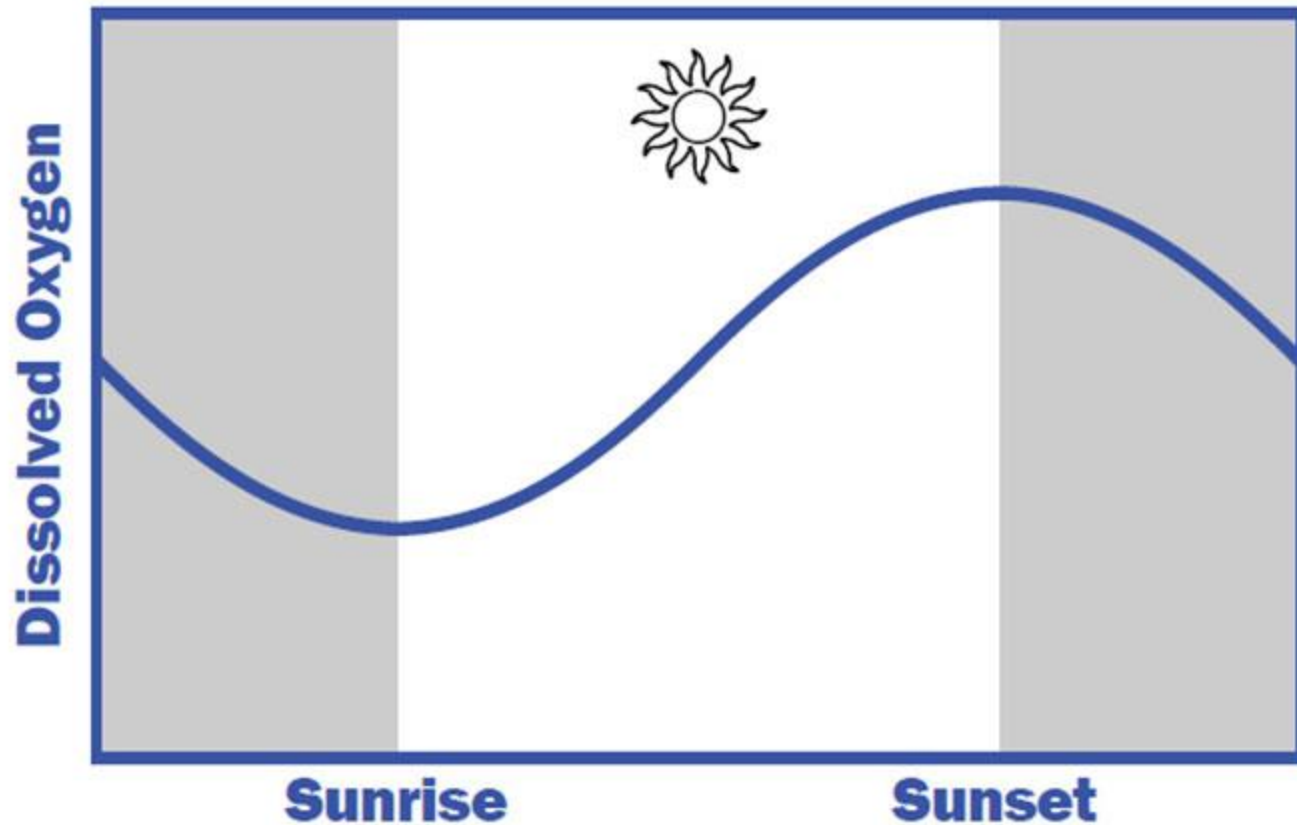


Day

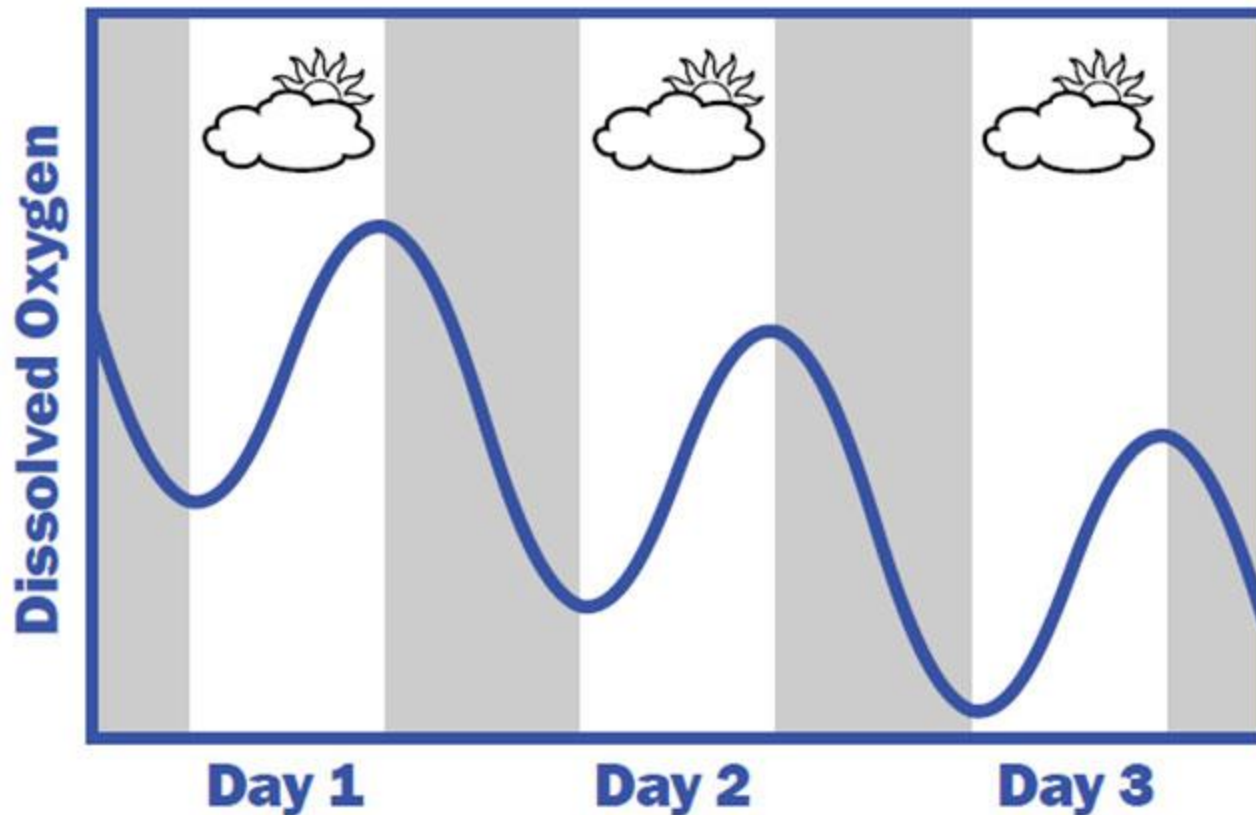








**The normal daily cycle of dissolved oxygen production. Production starts when the sun rises and stops when it sets.**

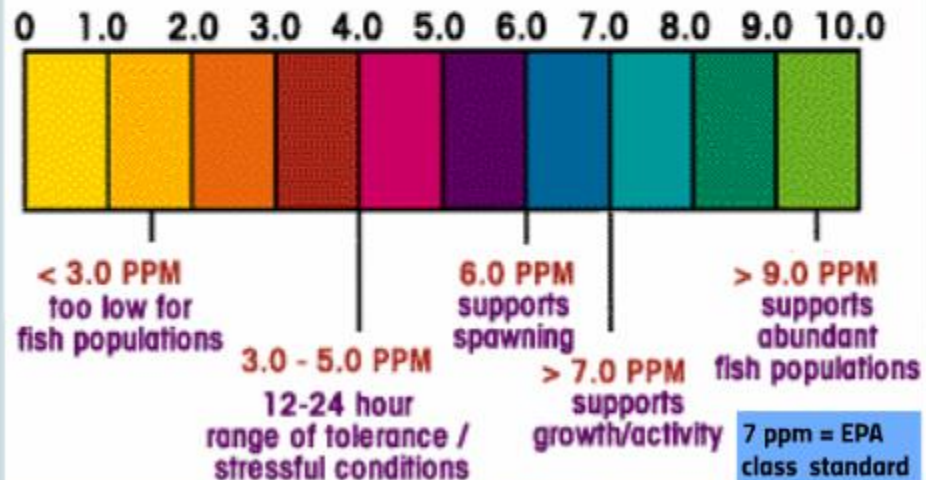


**Several continuous days of cloudy weather can repeatedly drop the oxygen level lower and lower.**

## Dissolved Oxygen

### RANGE OF TOLERANCE FOR DISSOLVED OXYGEN IN FISH

PARTS PER MILLION (PPM)  
DISSOLVED OXYGEN



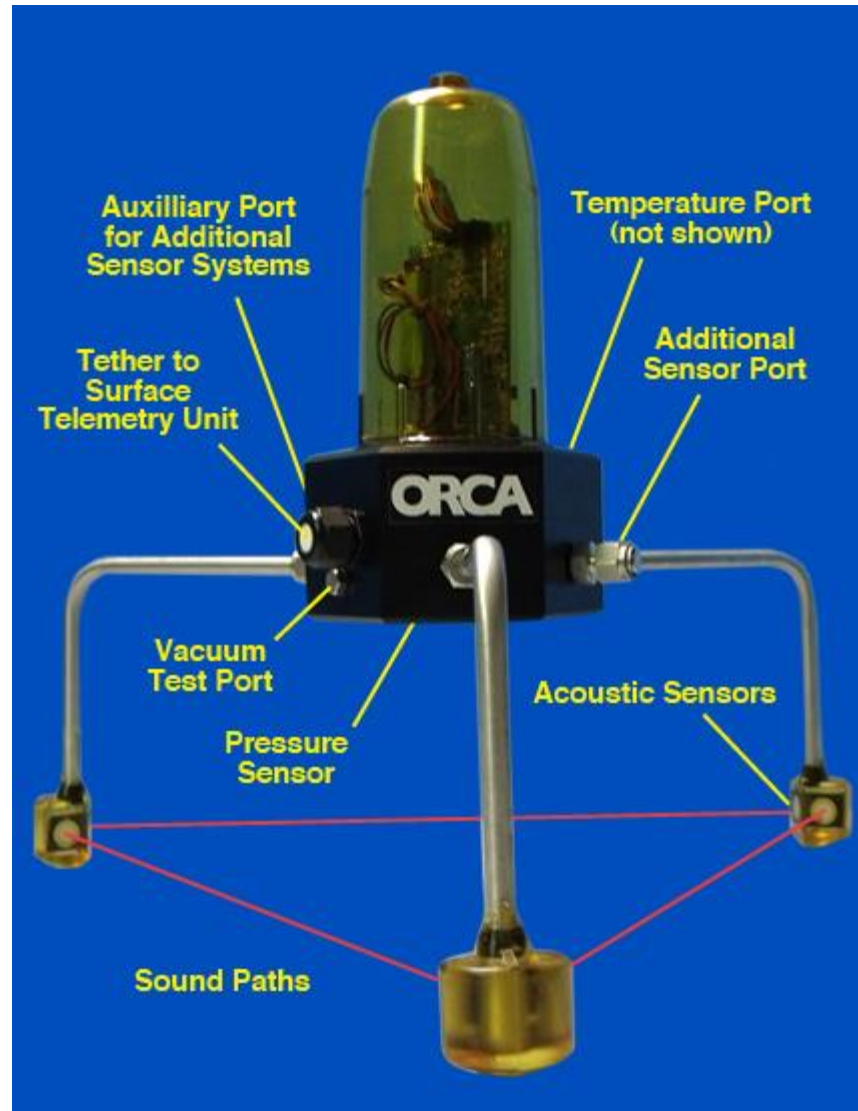
*Image courtesy of PBS.org*





# ORCA

18"





## Kilroy Measurements

Flow speed  
Flow direction  
Depth  
Water Temperature  
Conductivity  
Salinity  
Dissolved oxygen  
pH  
Oxygen Reduction Potential  
Turbidity  
Chlorophyll  
Blue Green algae  
CDOM  
Nitrite + Nitrate  
Ortho – Phosphate

### Met Station:

Rainfall  
Wind speed  
Wind direction  
Solar  
Barometric pressure  
Air temperature

### Kilroy ecosystem monitoring

- Real time
- Wireless
- Low cost
- Easy to install

Kilroy  
Sensor  
Suite



Solar  
Panel

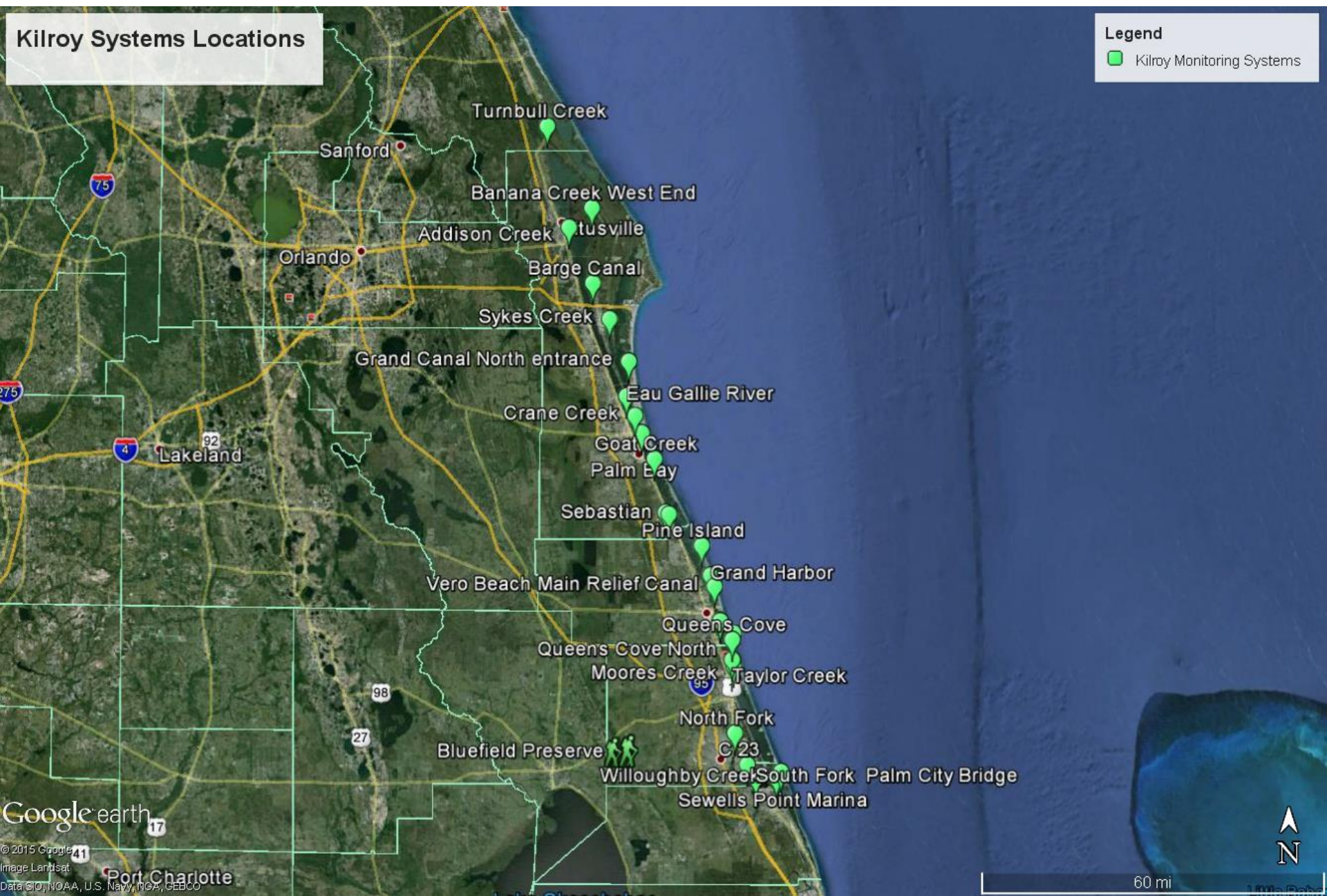
Kilroy's Voice  
(Telemetry Unit)

Kilroy's Hatrack

## Kilroy Systems Locations

**Legend**

- Kilroy Monitoring Systems





Ocean Research & Conservation Association

CHANGING THE NATURE OF AQUATIC PRESERVATION

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## FEATURE STORIES



### What We Are Learning From Kilroys

Dr. Edie Widder talks to WPTV News Channel 5 about the 13 ORCA Kilroys in the Indian River Lagoon and what we are learning. [Learn More Here](#)



### The Campaign for a Clean Indian River Lagoon

ORCA has created a Campaign for a Clean Indian River Lagoon. The plan includes simple steps; first we will create a pollution gradient map of the entire 156 miles of the Indian River Lagoon. Then we will install 50 ORCA Kilroy™ water monitoring devices in the lagoon. With these two steps, sources of pollution can be identified and then be corrected or eliminated and nature can be restored. To learn more about ORCA's Campaign for a Clean Indian River Lagoon. [Click Here](#)



### The Technology Behind Those Amazing Giant Squid Images

The first footage of the Giant Squid (*Architeuthis dux*) in its natural habitat was filmed by ORCA's deep sea camera, Medusa! Dr. Edie Widder was one of the three Scientists involved in the Discovery Channel expedition that captured the Giant Squid on film in its natural habitat for the first time in history. The electronic jellyfish (e-jelly) that she and ORCA engineers developed, attracted the Giant Squid and made it possible to get this special video footage. This e-jelly imitates certain bioluminescent displays, like that of deep-sea jellyfish. More on this story: [CBS Evening News](#) | [CBS This Morning](#) | [CNN](#)

Follow us on:



### Kilroy Monitoring

View map of Kilroy Monitoring Systems for State of Florida project. [View Map](#)



### Live Kilroy Data

View live, realtime Kilroy data and meteorological data from the Ft. Pierce Inlet, FL. [View Feed](#)



### Stay Informed

Stay informed about ORCA's work to protect important aquatic ecosystems by signing up for our monthly eNewsletter. [Sign Up](#)

## Make a donation

ORCA is dedicated to the protection and restoration of aquatic ecosystems and the species they sustain through the development of innovative technologies and science based conservation action. Please help support our mission.

### DID YOU KNOW?

More oil reaches the oceans each year as a result of leaking automobiles and other non-point sources than was spilled in Prince William Sound by the Exxon Valdez.

Map Satellite

**ORCA**

-  Kilroy
-  Weather
-  Kilroy Weather

Addison

Barge

Sykes

Grand

Eau Gallie

Crane

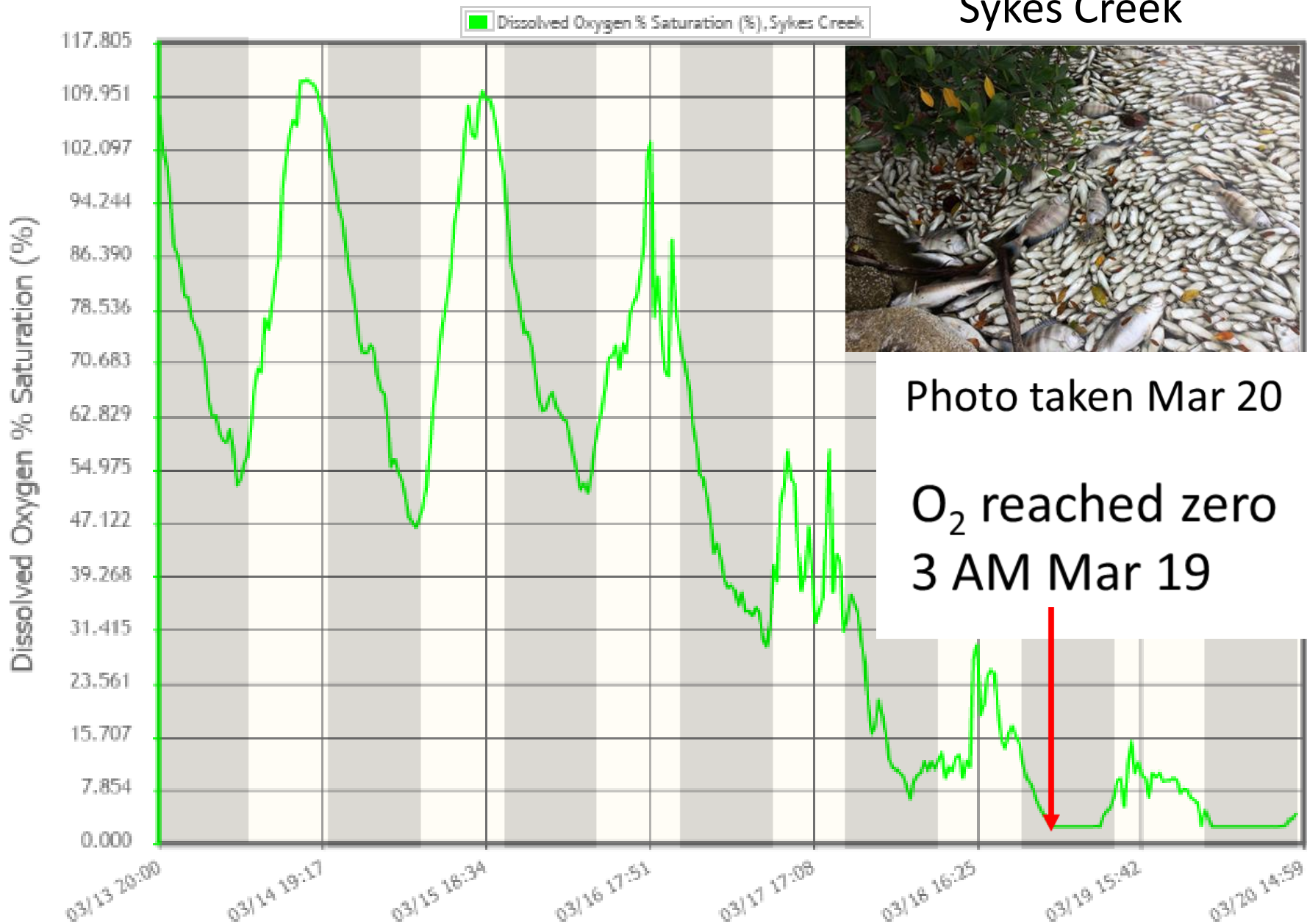
Turkey

Goat

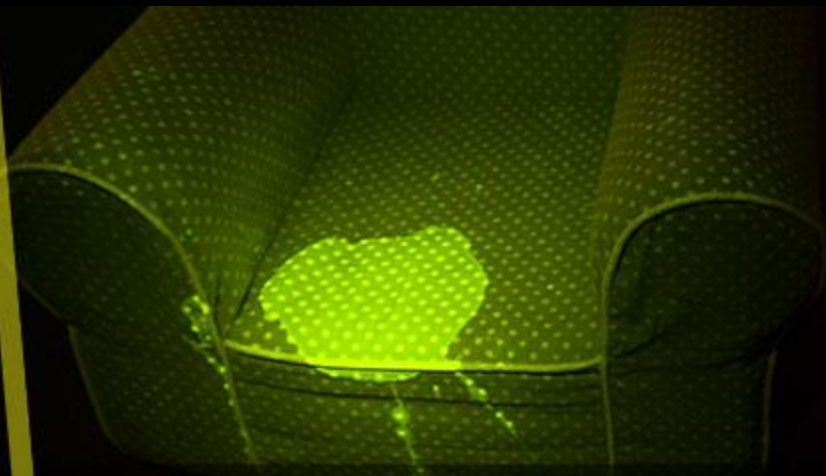
Google

Imagery ©2016 TerraMetrics Terms of Use Report a map error

# Sykes Creek



Why did the dissolved oxygen plummet?



PL PORTABLE FORENSIC 5W BLUE LASER, 445NM  
LED FORENSIC LIGHT SOURCE FOR IDENTIFYING EVIDENCE.

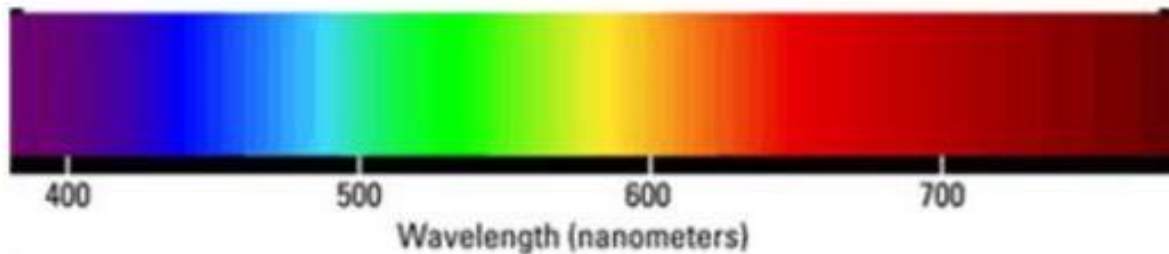




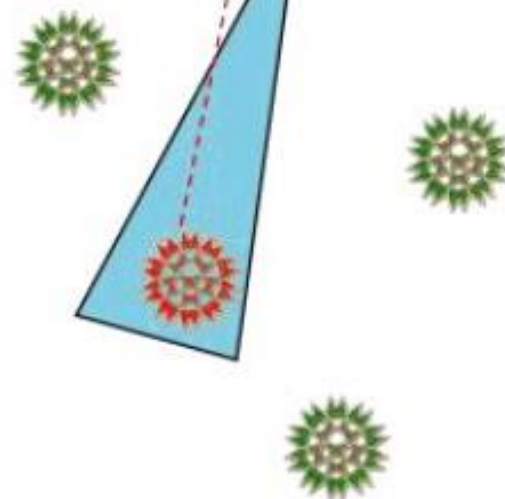
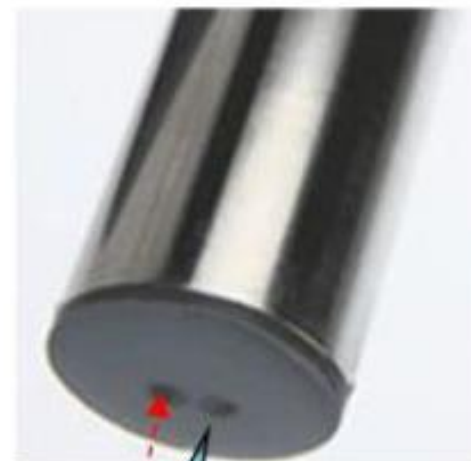
P - lite

P - lite



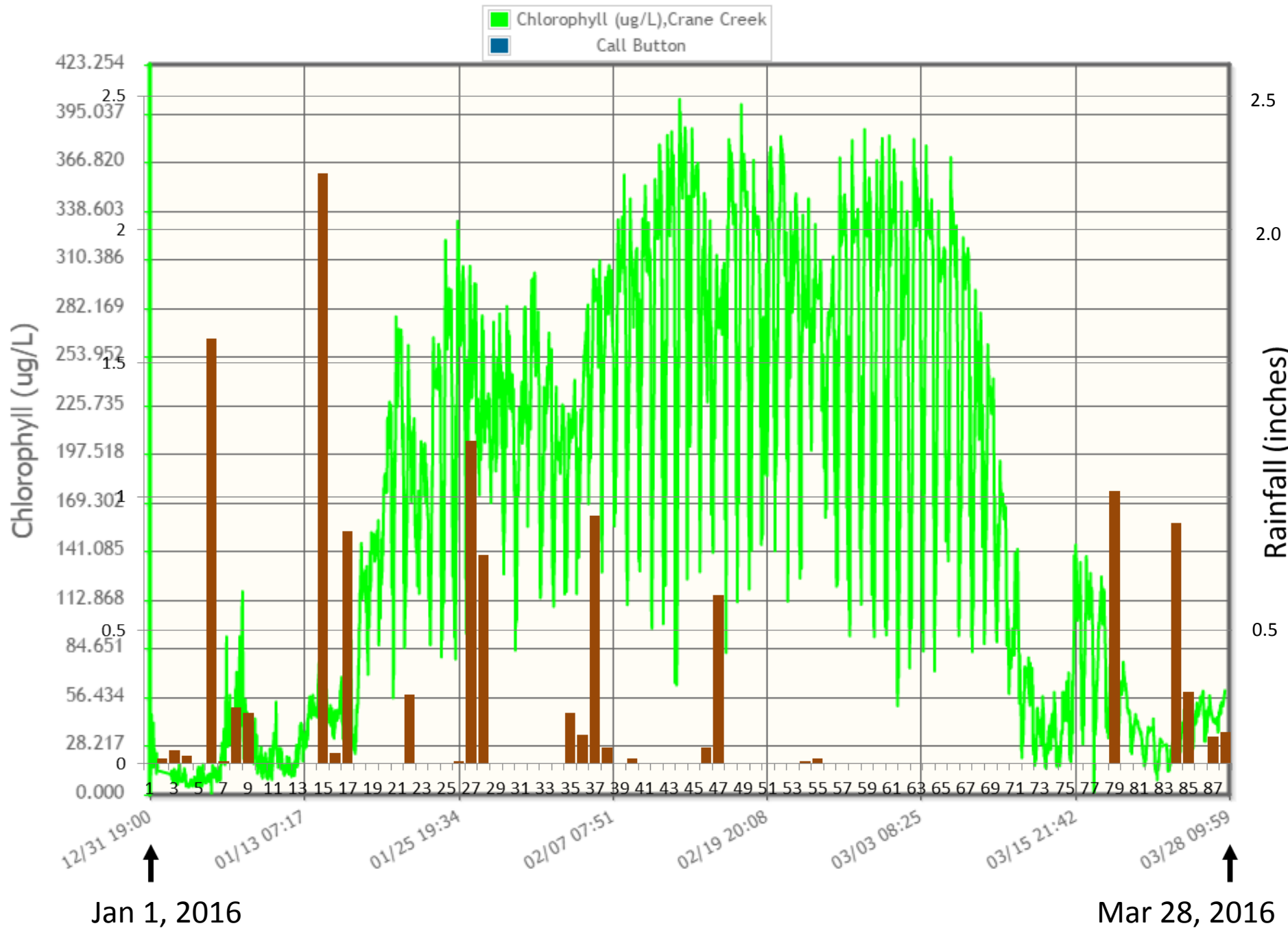


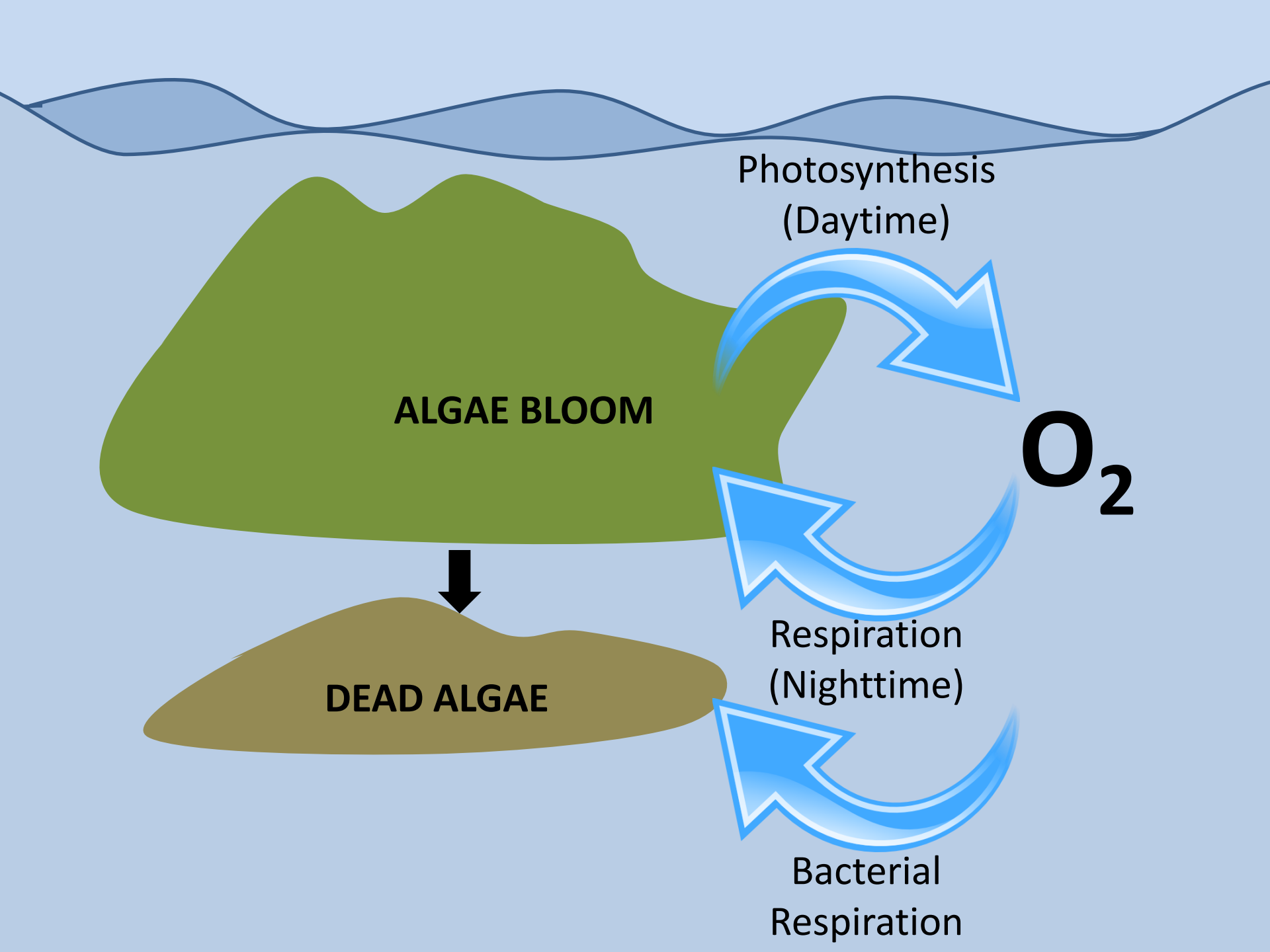
Fluorescent molecule **chlorophyll a**



**ex** Excitation light photon **430nm**

**em** Fluorescence emission **660nm - 710nm filter**





Photosynthesis  
(Daytime)

ALGAE BLOOM

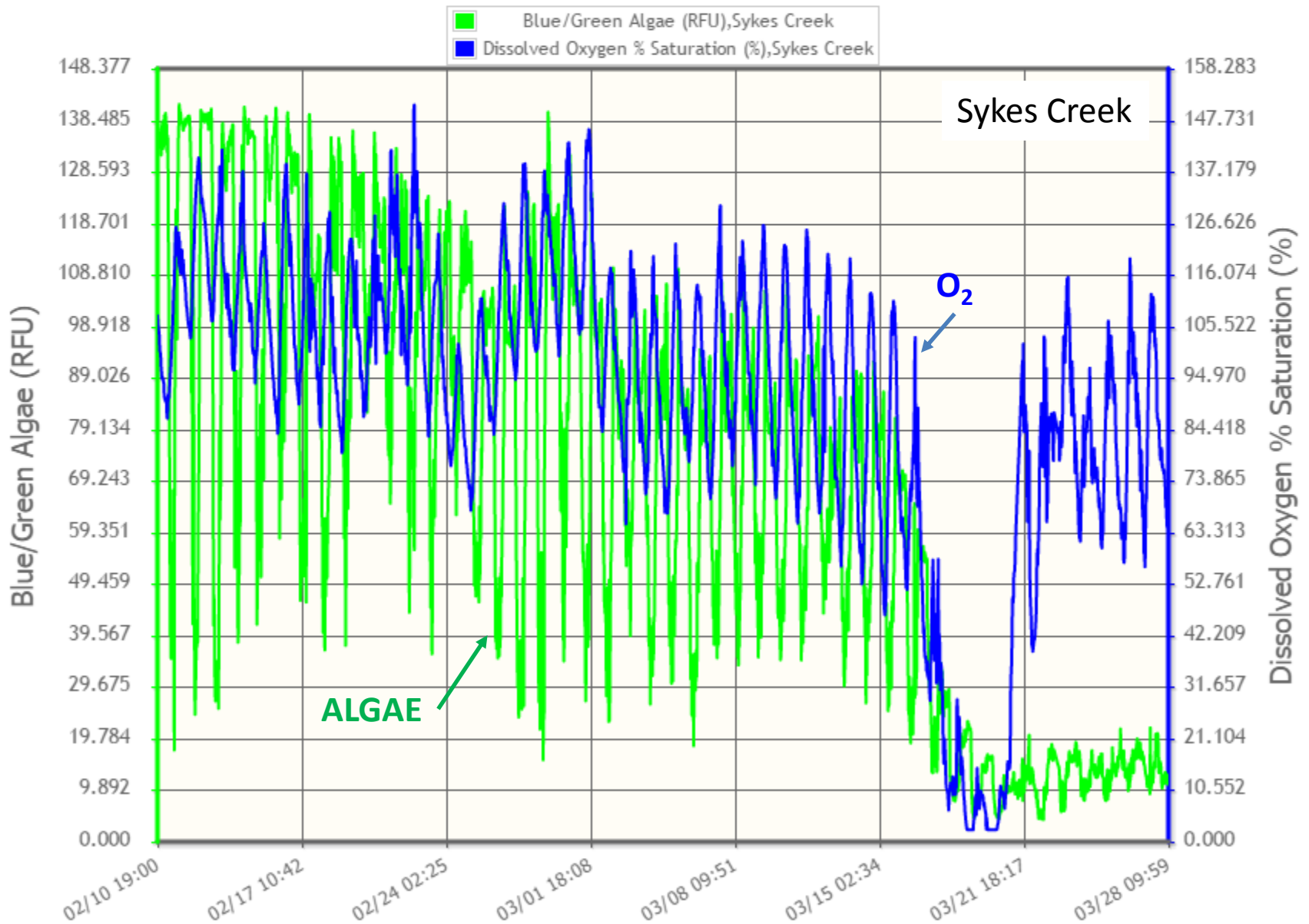
O<sub>2</sub>



DEAD ALGAE

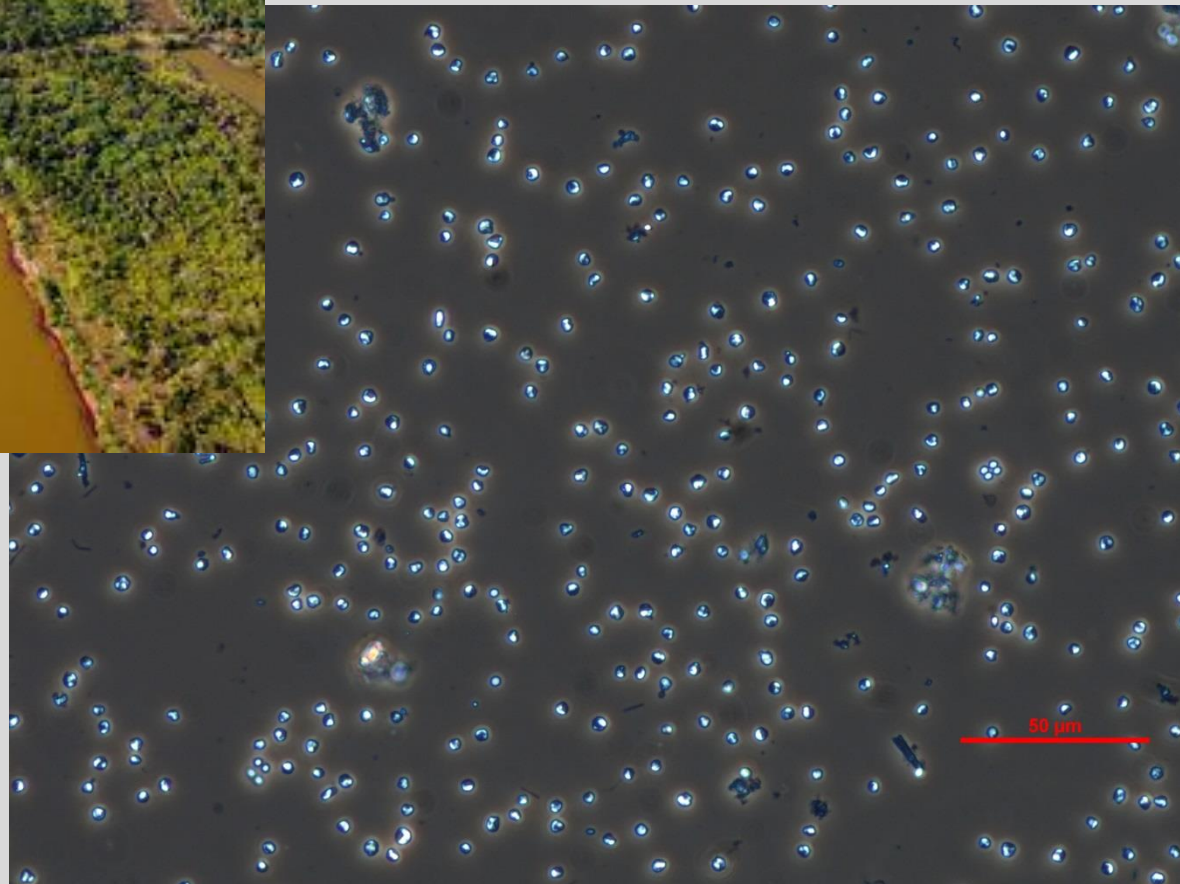
Respiration  
(Nighttime)

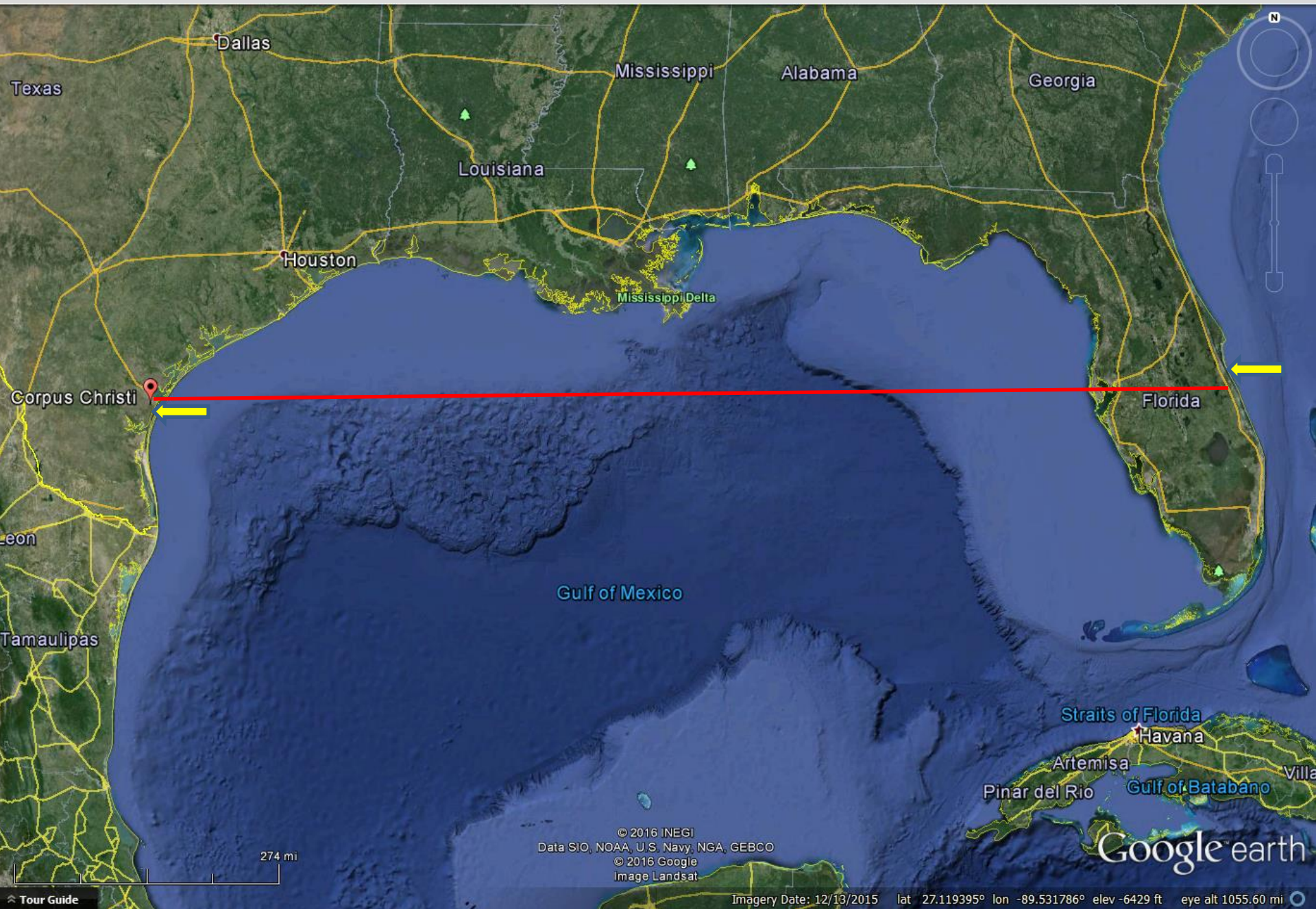
Bacterial  
Respiration





Brown tide  
*Aureoumbra lagunensis*





Dallas

Mississippi

Alabama

Georgia

Louisiana

Houston

Mississippi Delta

Corpus Christi

Florida

Gulf of Mexico

Leon

Tamaulipas

Straits of Florida

Havana

Artemisa

Pinar del Rio

Gulf of Batabano

Villa

274 mi

© 2016 INEGI  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
© 2016 Google  
Image Landsat

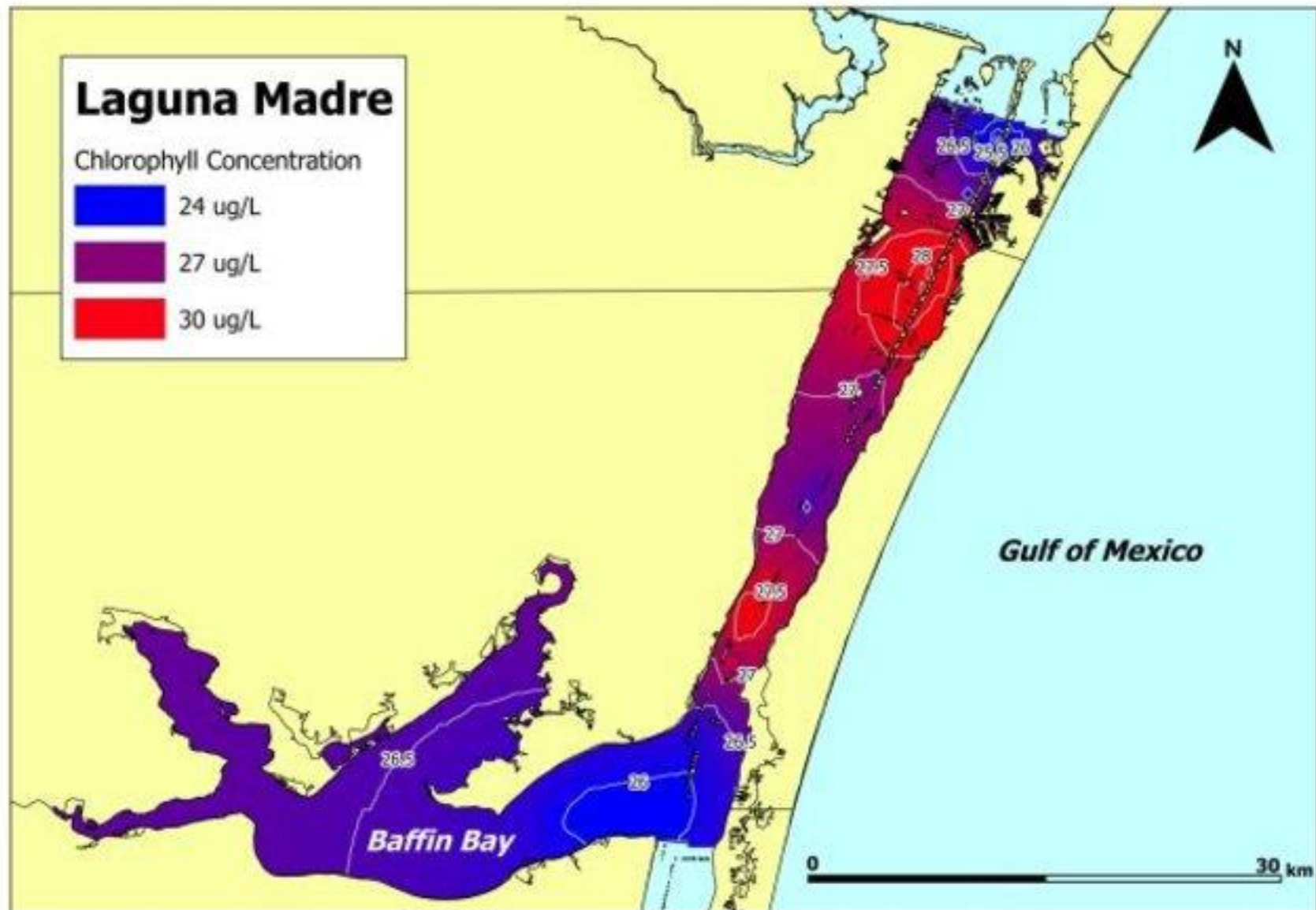
Google earth

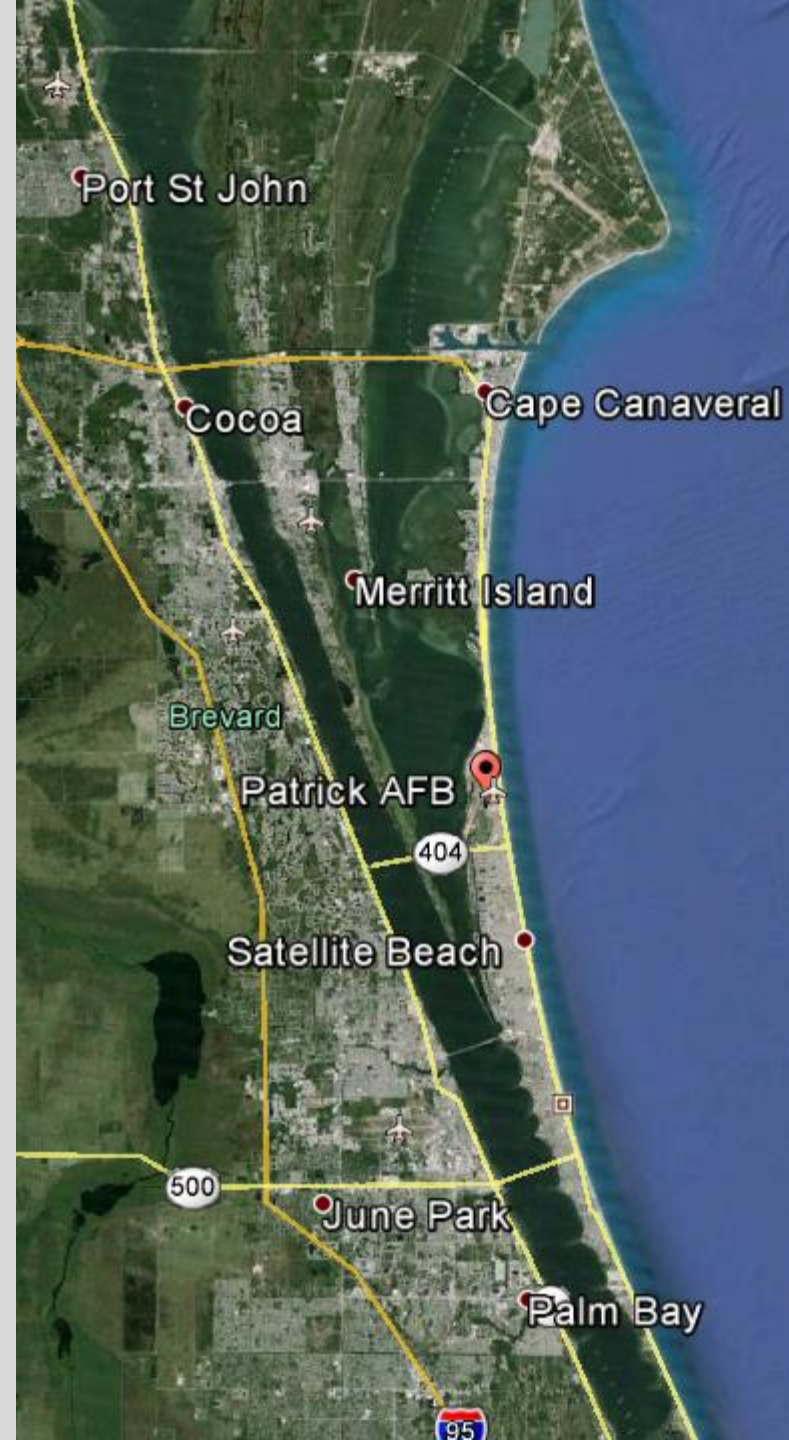
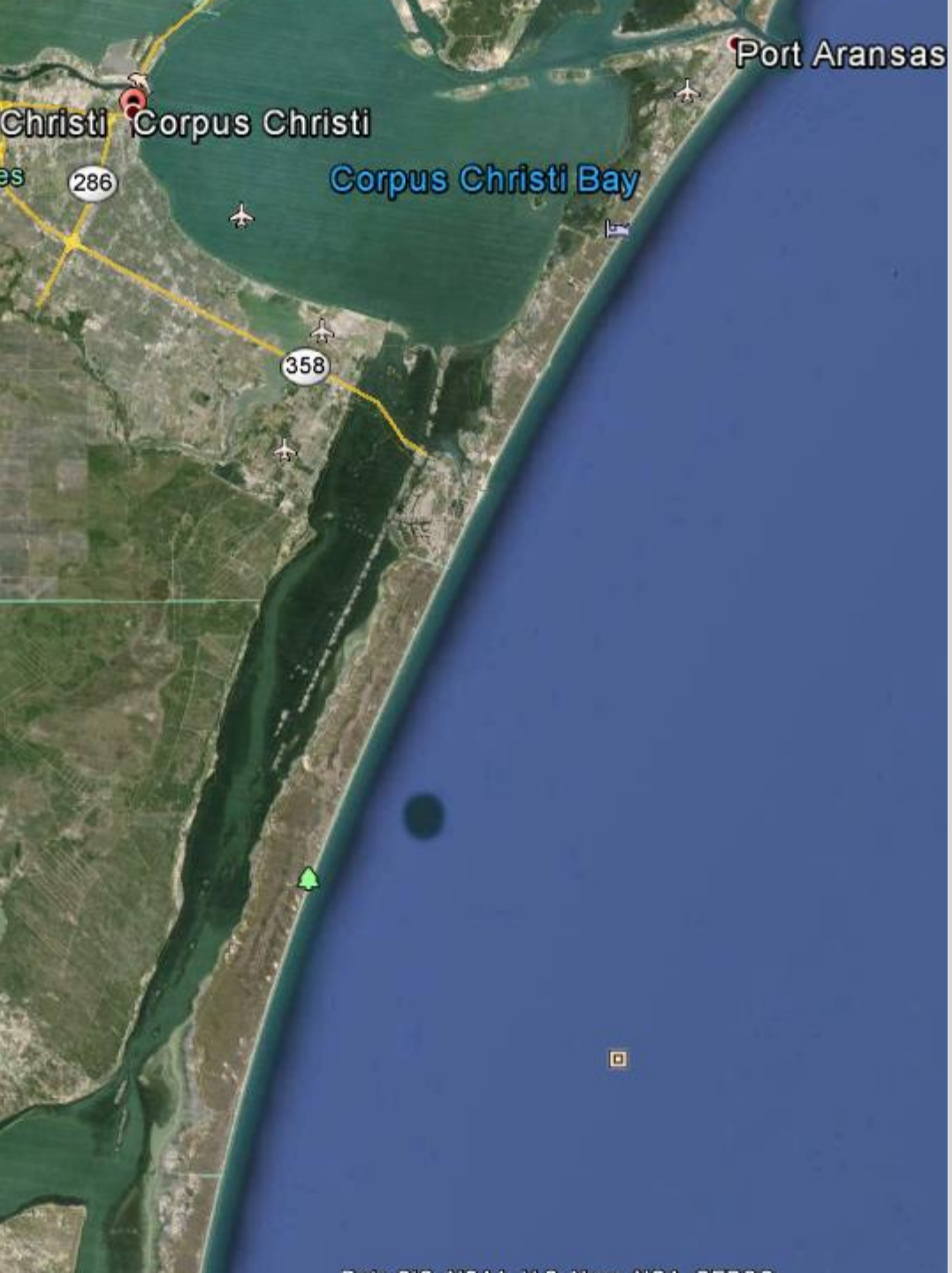
Imagery Date: 12/13/2015 lat: 27.119395 lon: -89.531786 elev: -6429 ft eye alt: 1055.60 mi

Tour Guide

# Laguna Madre

Chlorophyll Concentration





# Chlorophyll a

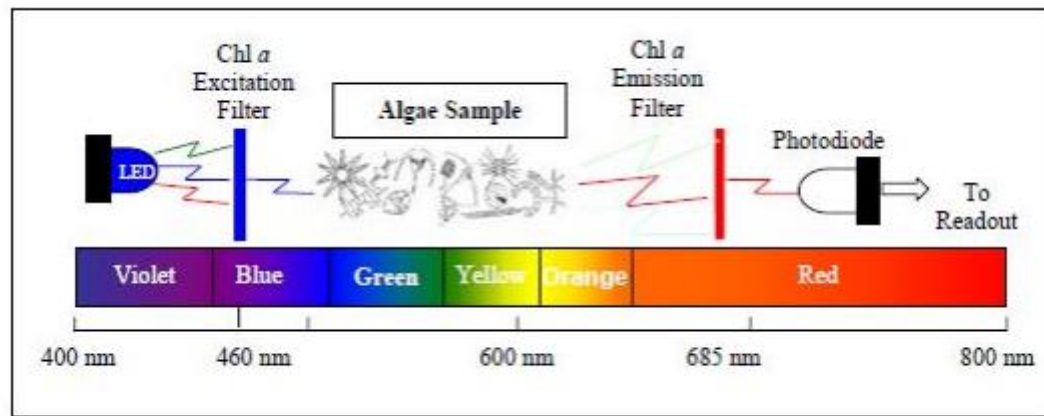


Figure 2.1. Fluorometer configuration for detection of chlorophyll a (Turner Designs 2004)

# Phycocyanin

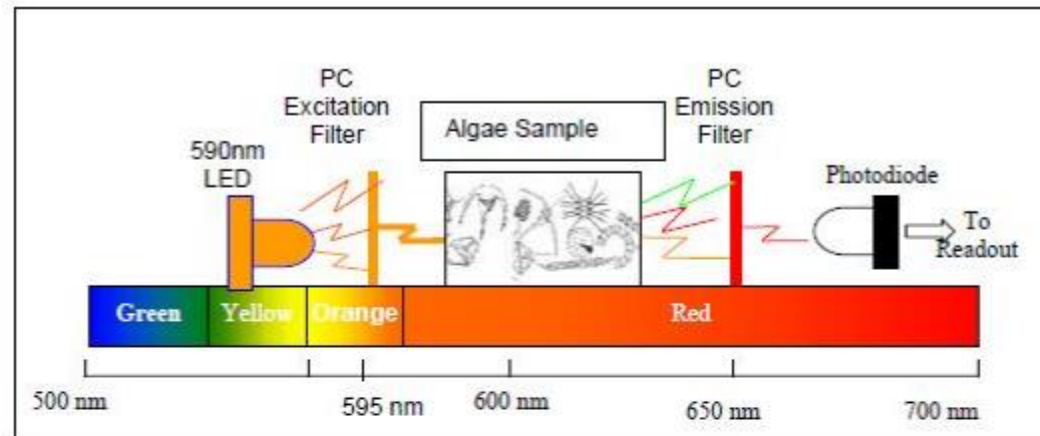


Figure 2.2. Fluorometer configuration for detection of phycocyanin (Turner Designs 2004)

# Phycoerythrin

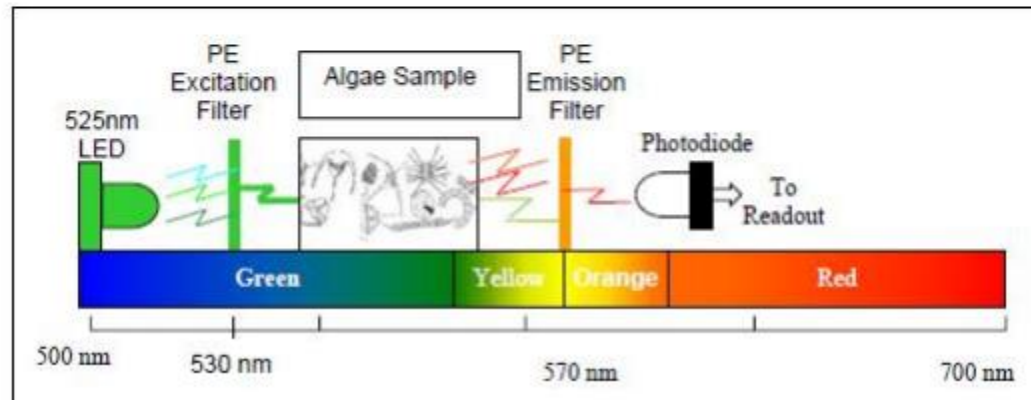
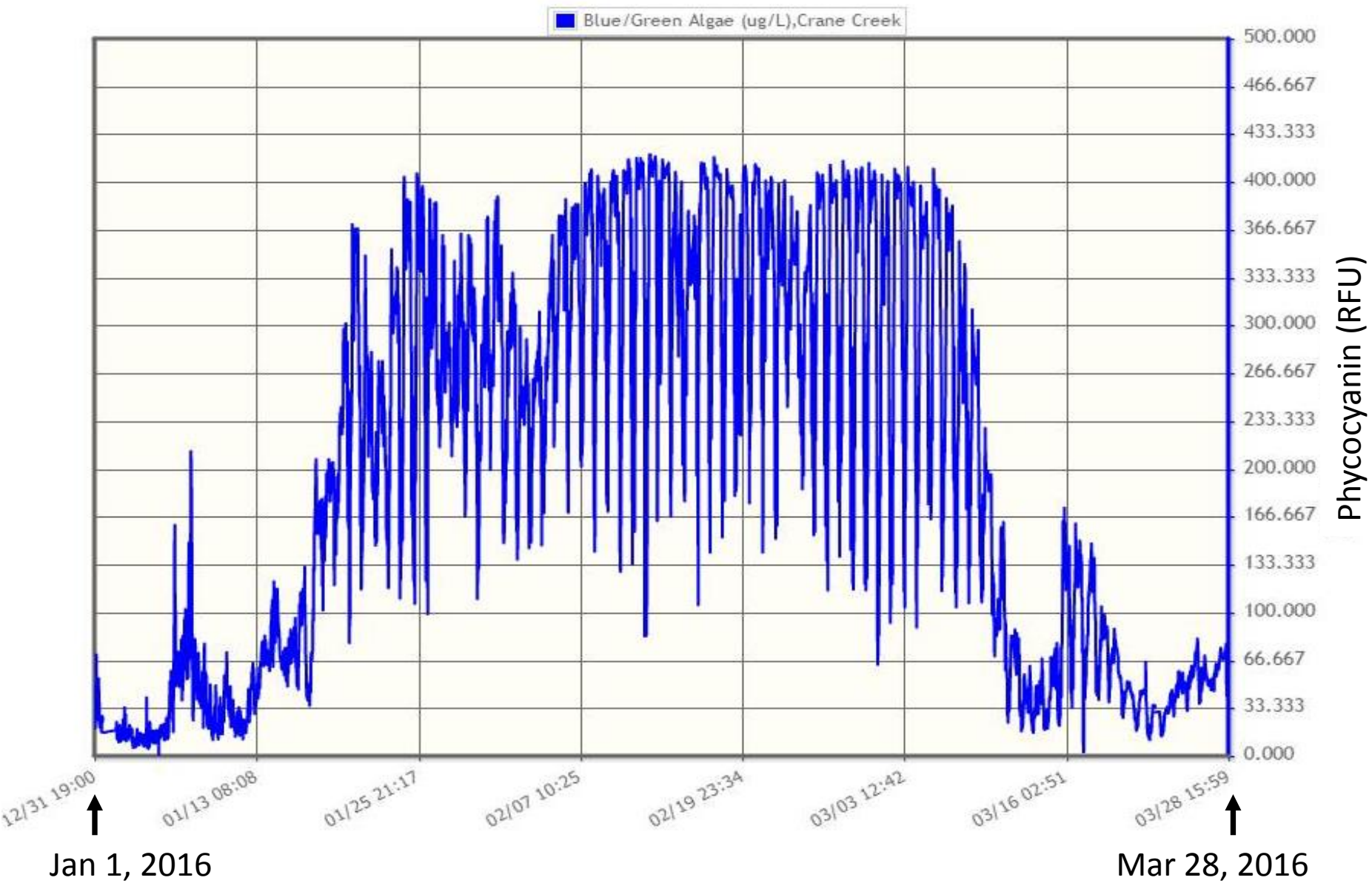
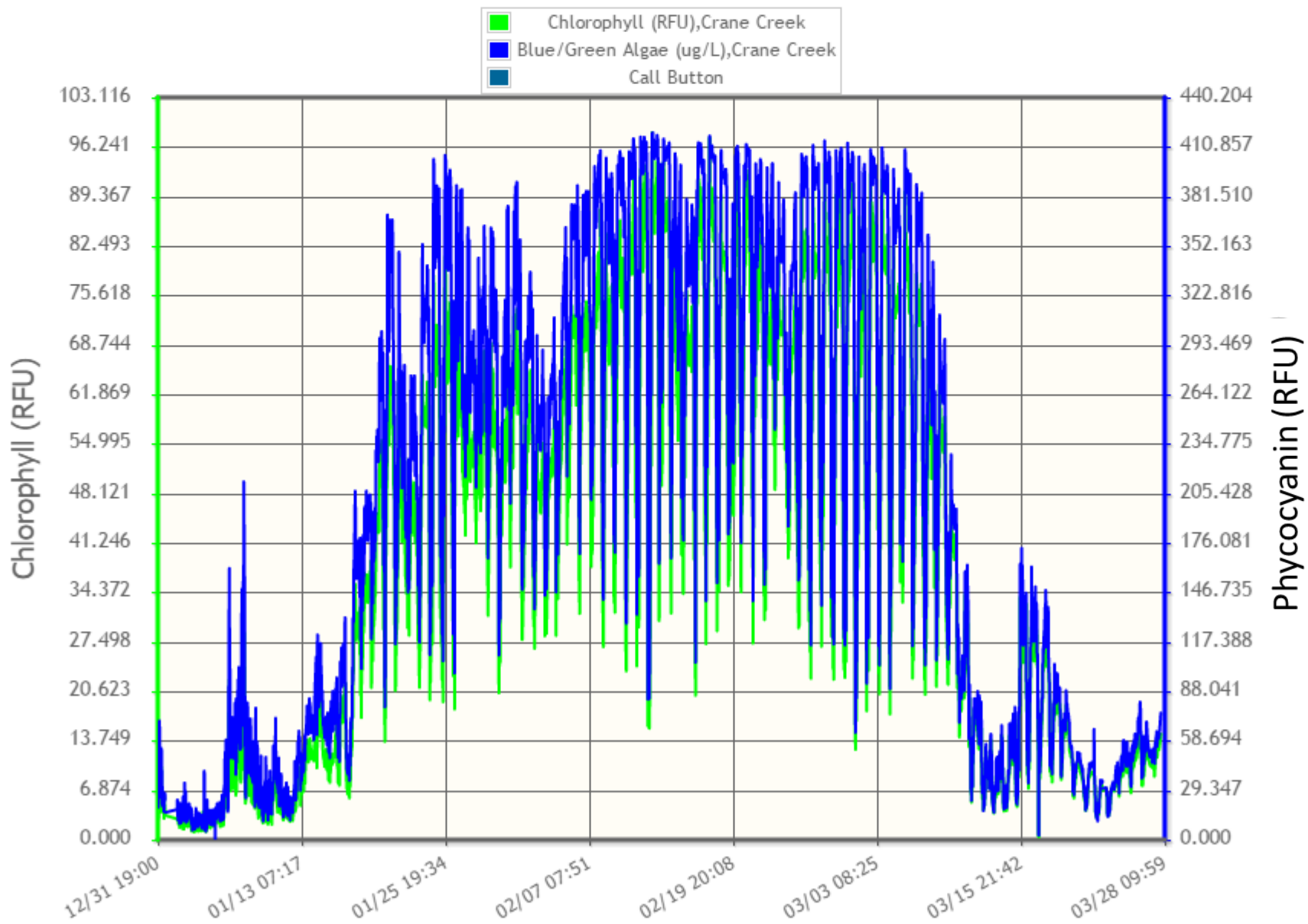
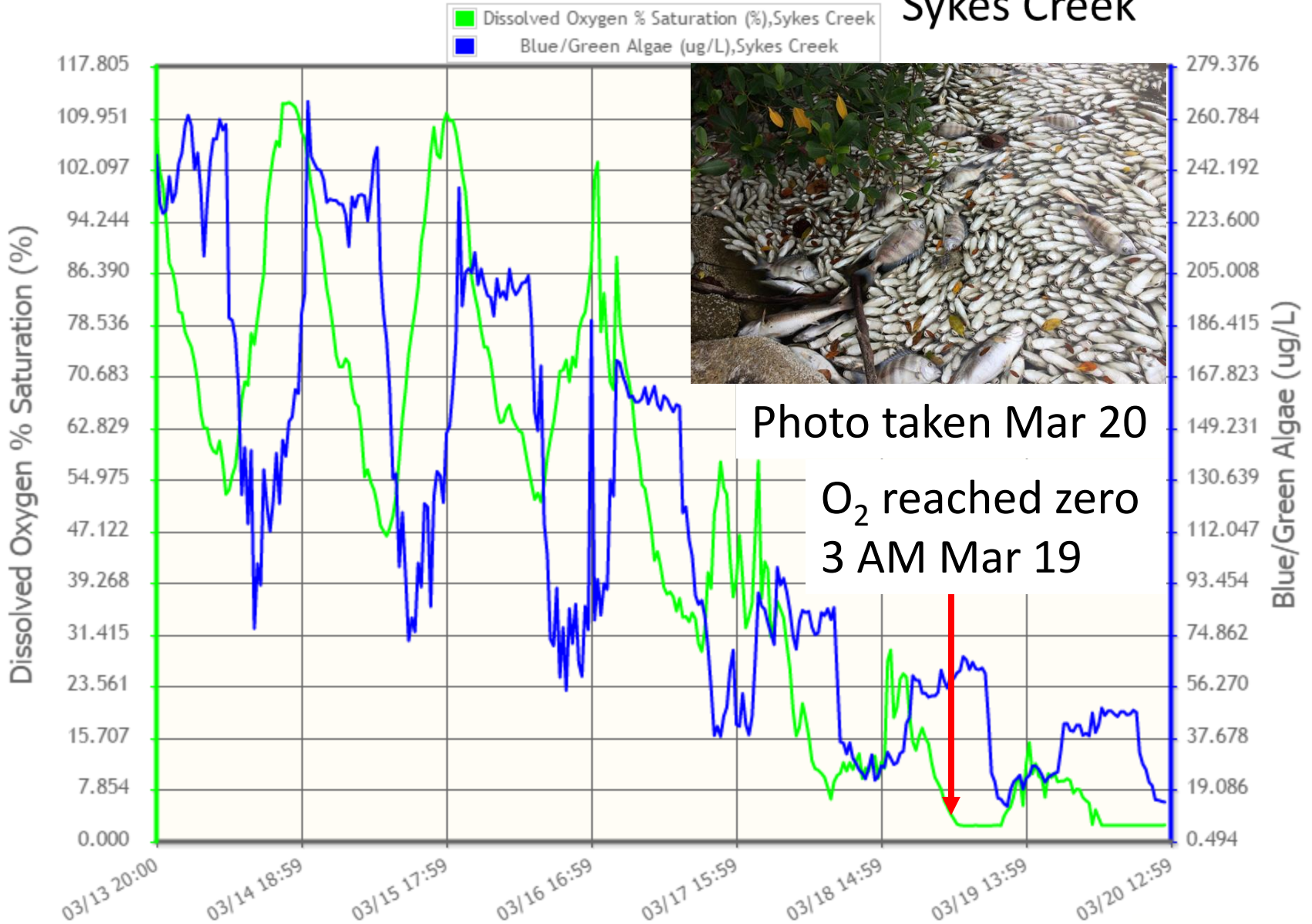


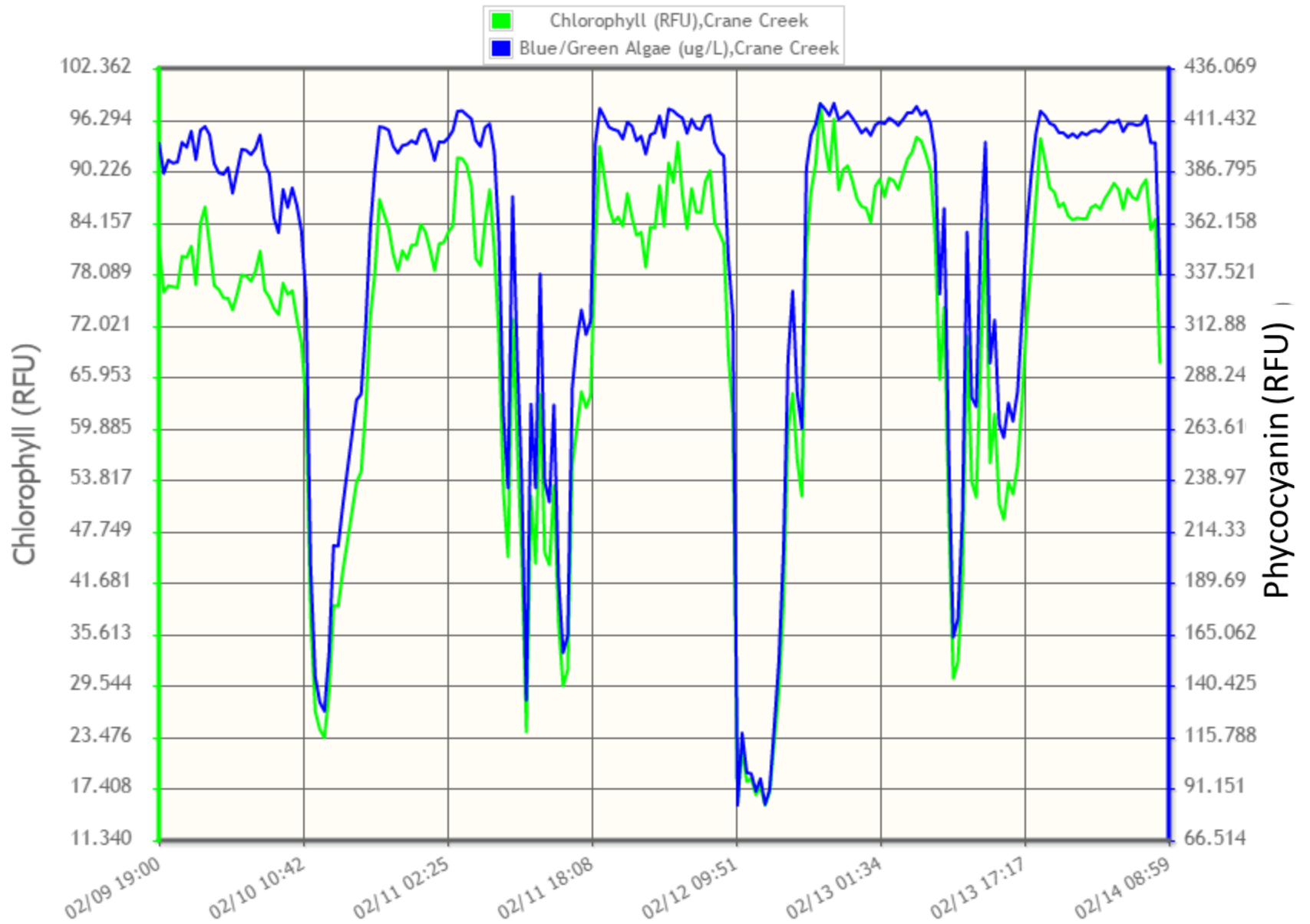
Figure 2.3. Fluorometer configuration for detection of phycoerythrin (Turner Designs 2004)



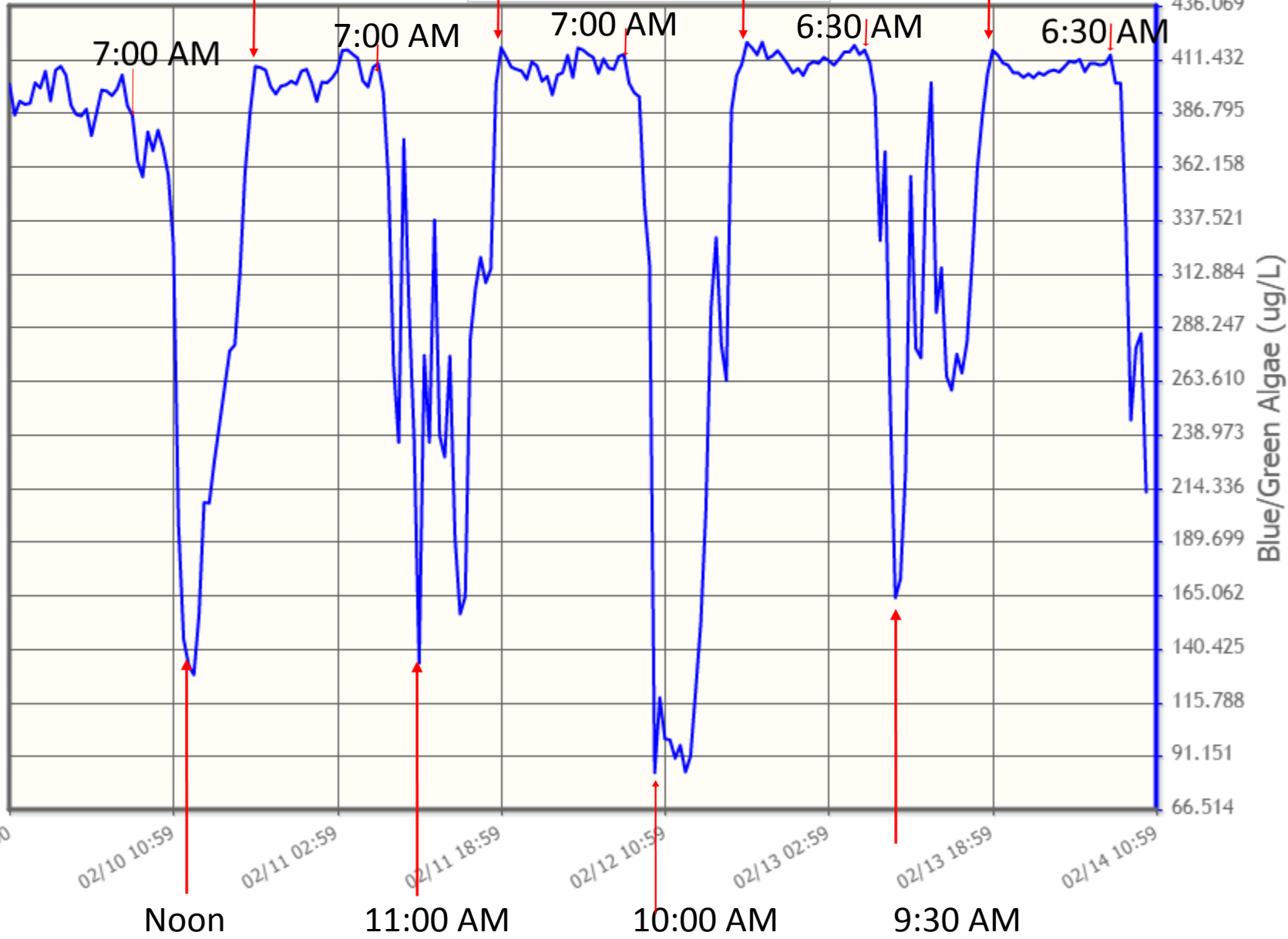


# Sykes Creek

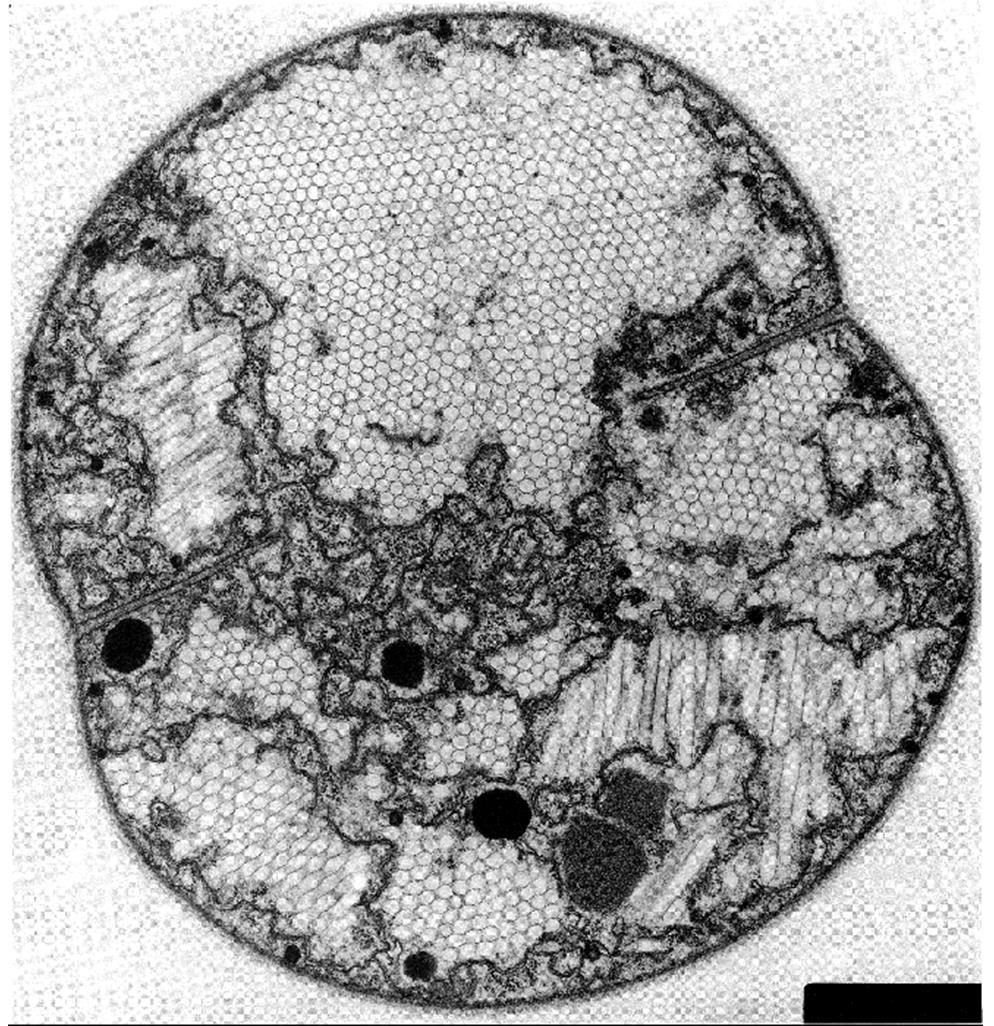
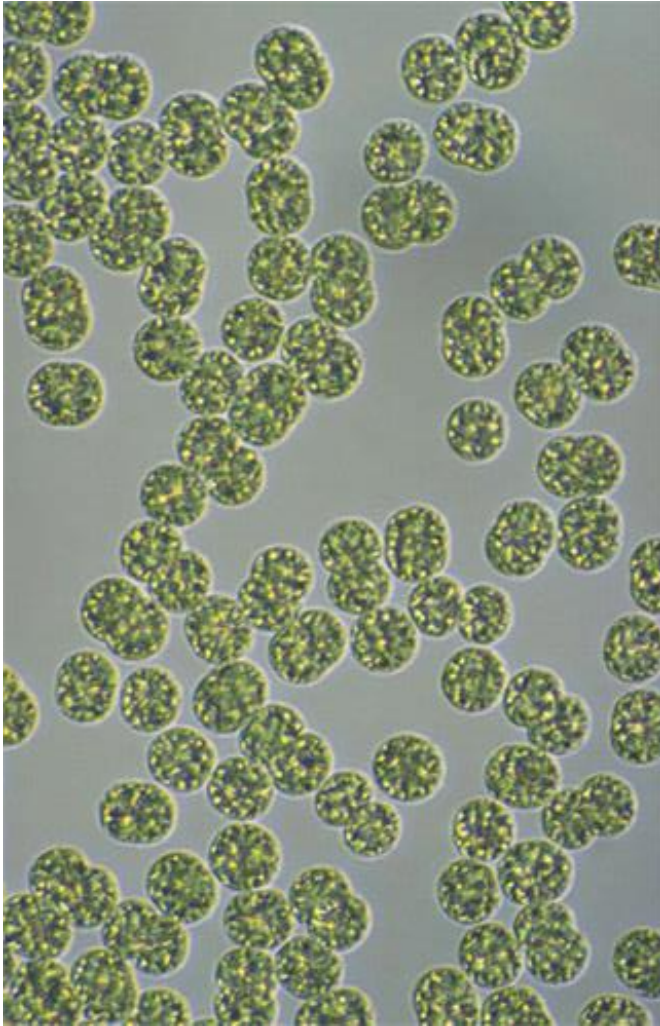


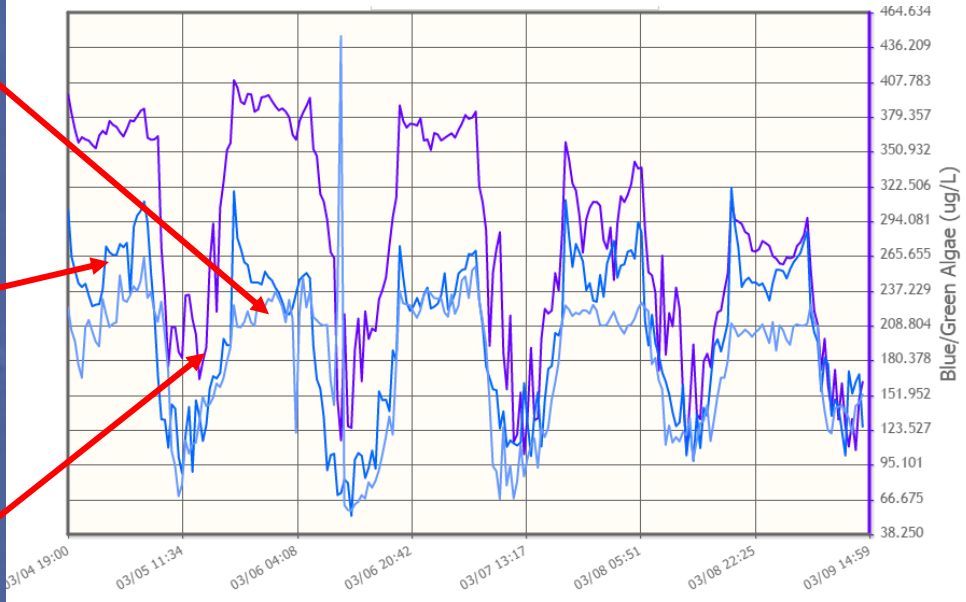
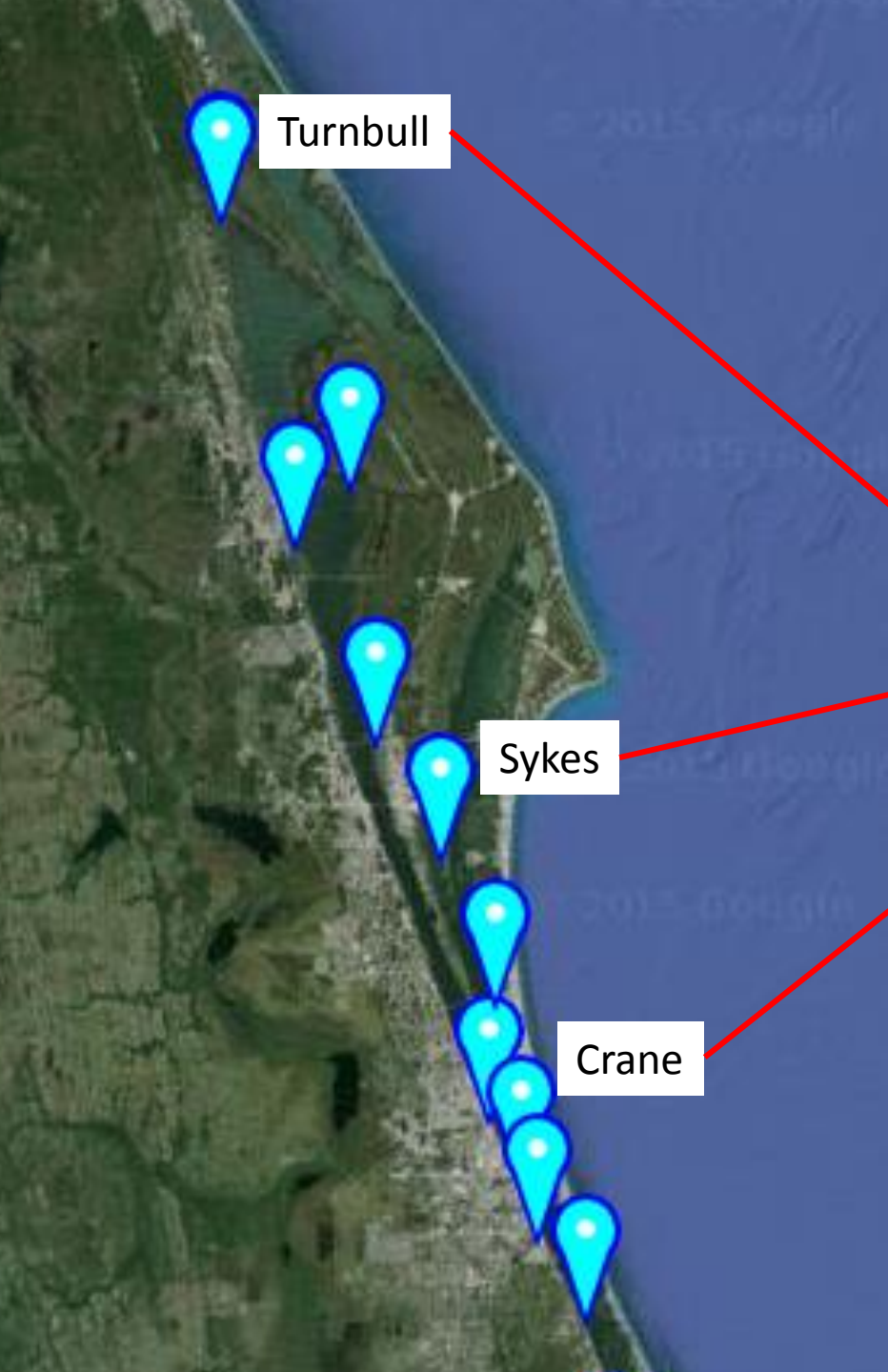


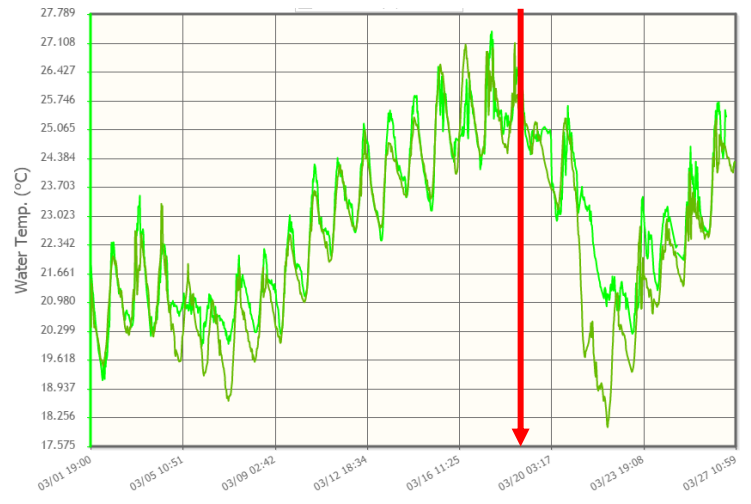
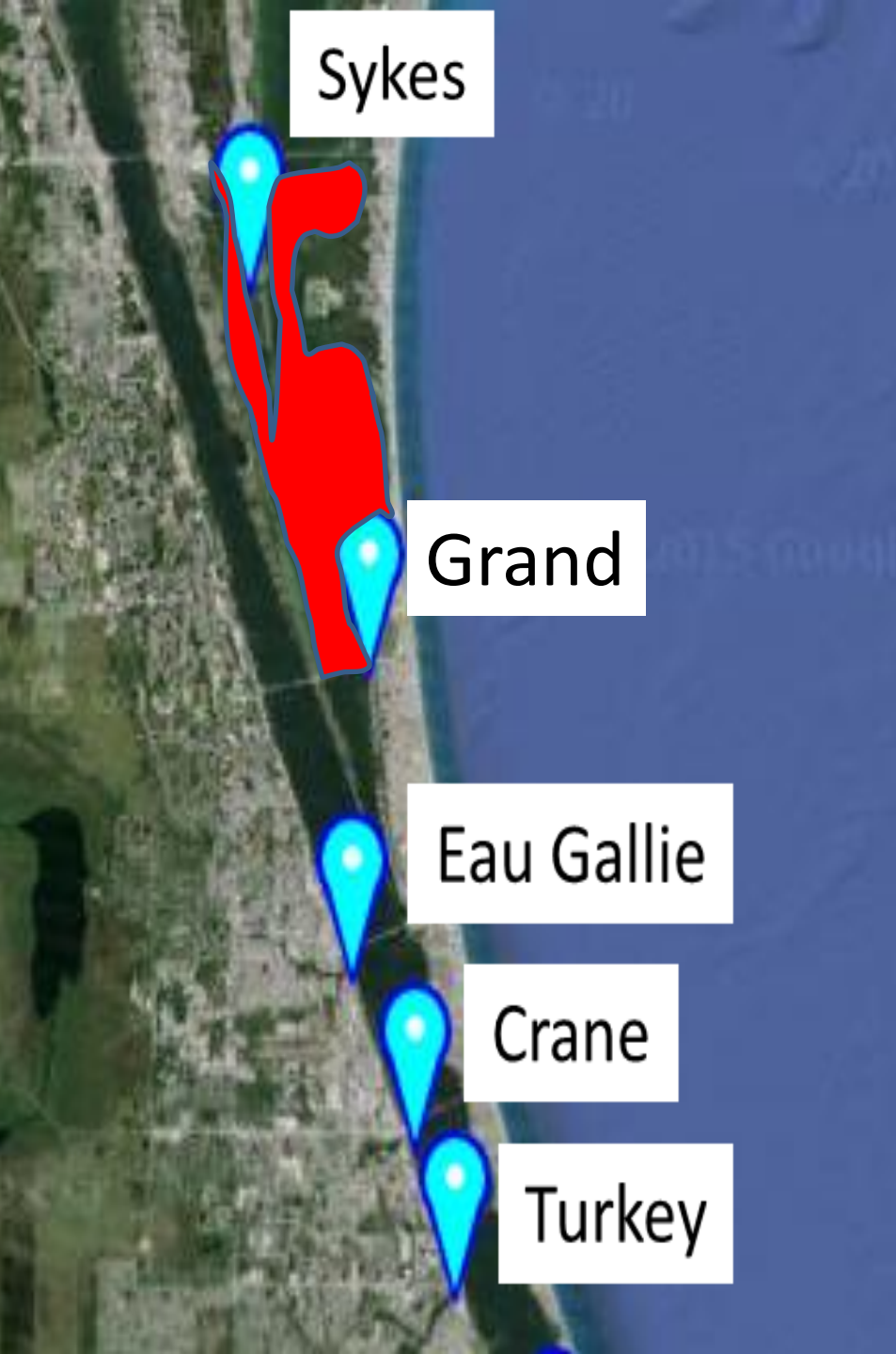
Blue/Green Algae (ug/L),Crane Creek



Blue Green Algae = Cyanobacteria  
True bacteria but with chlorophyll-a, like algae

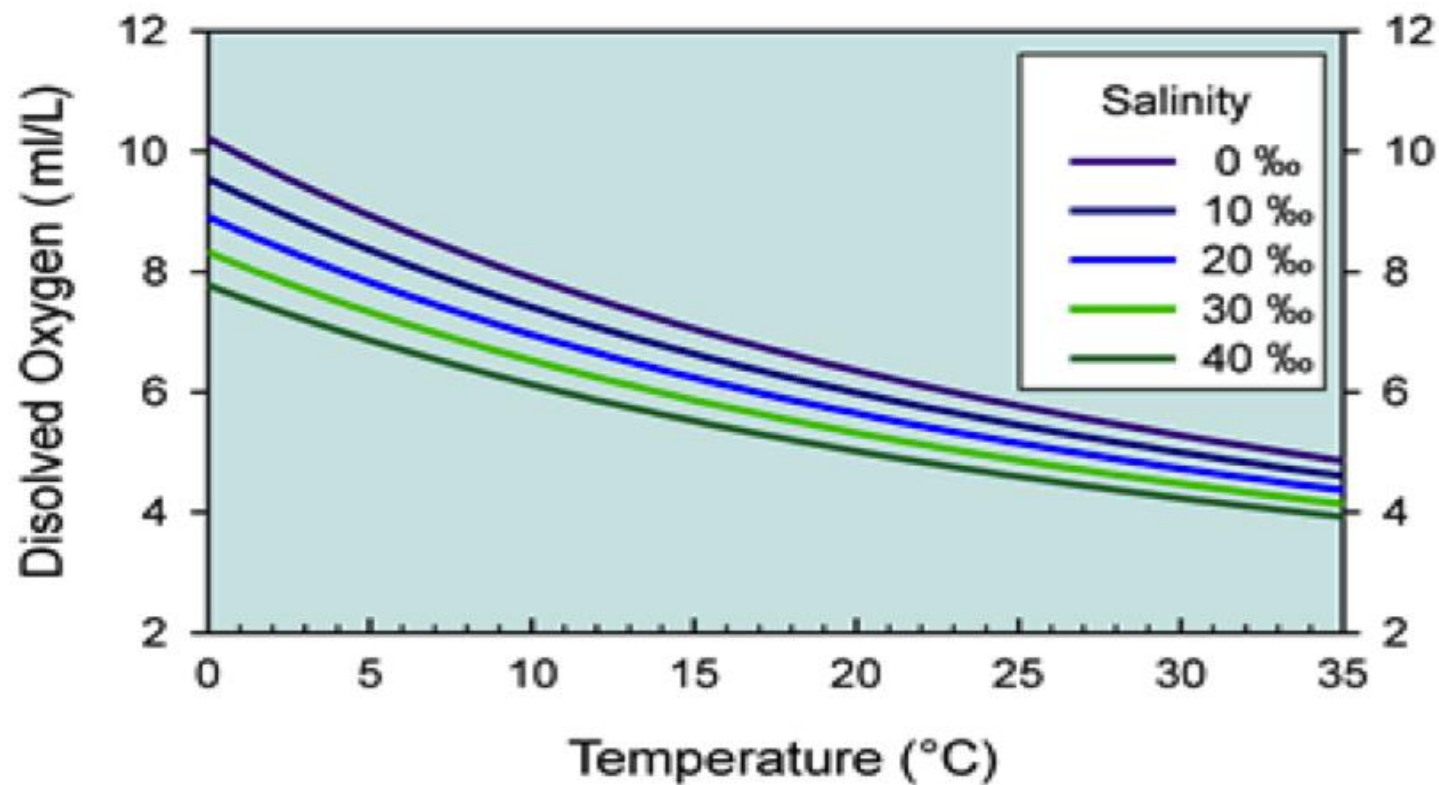


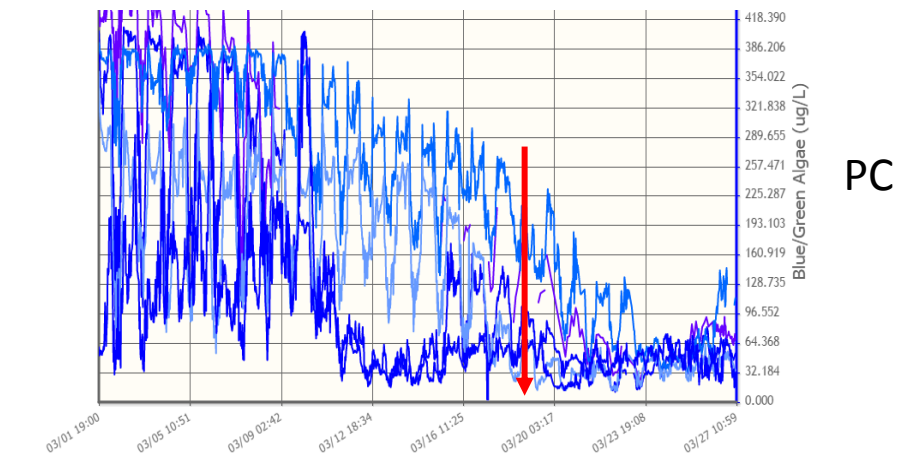
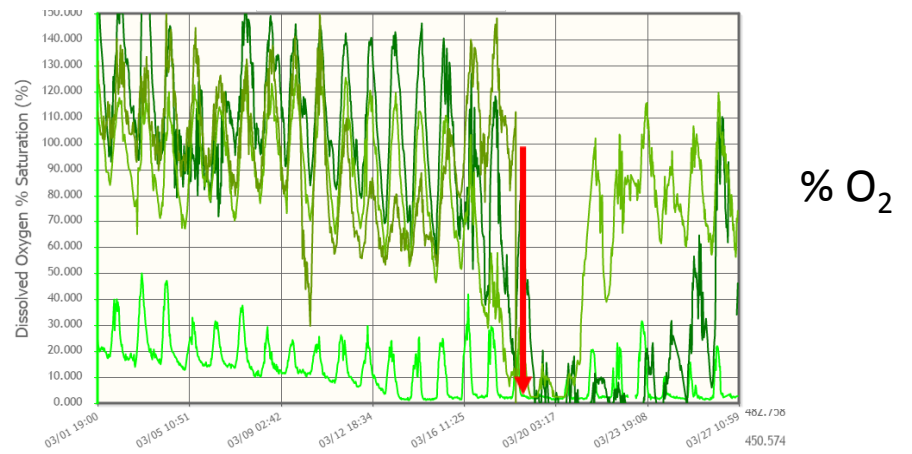
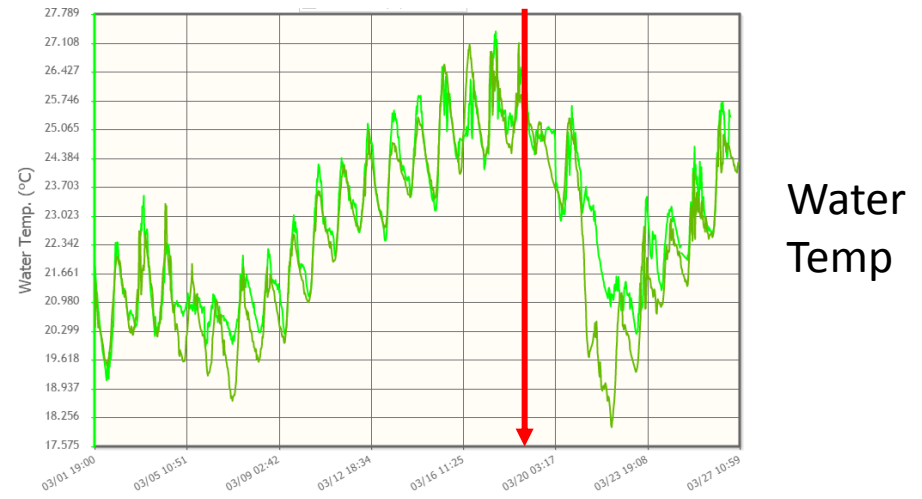
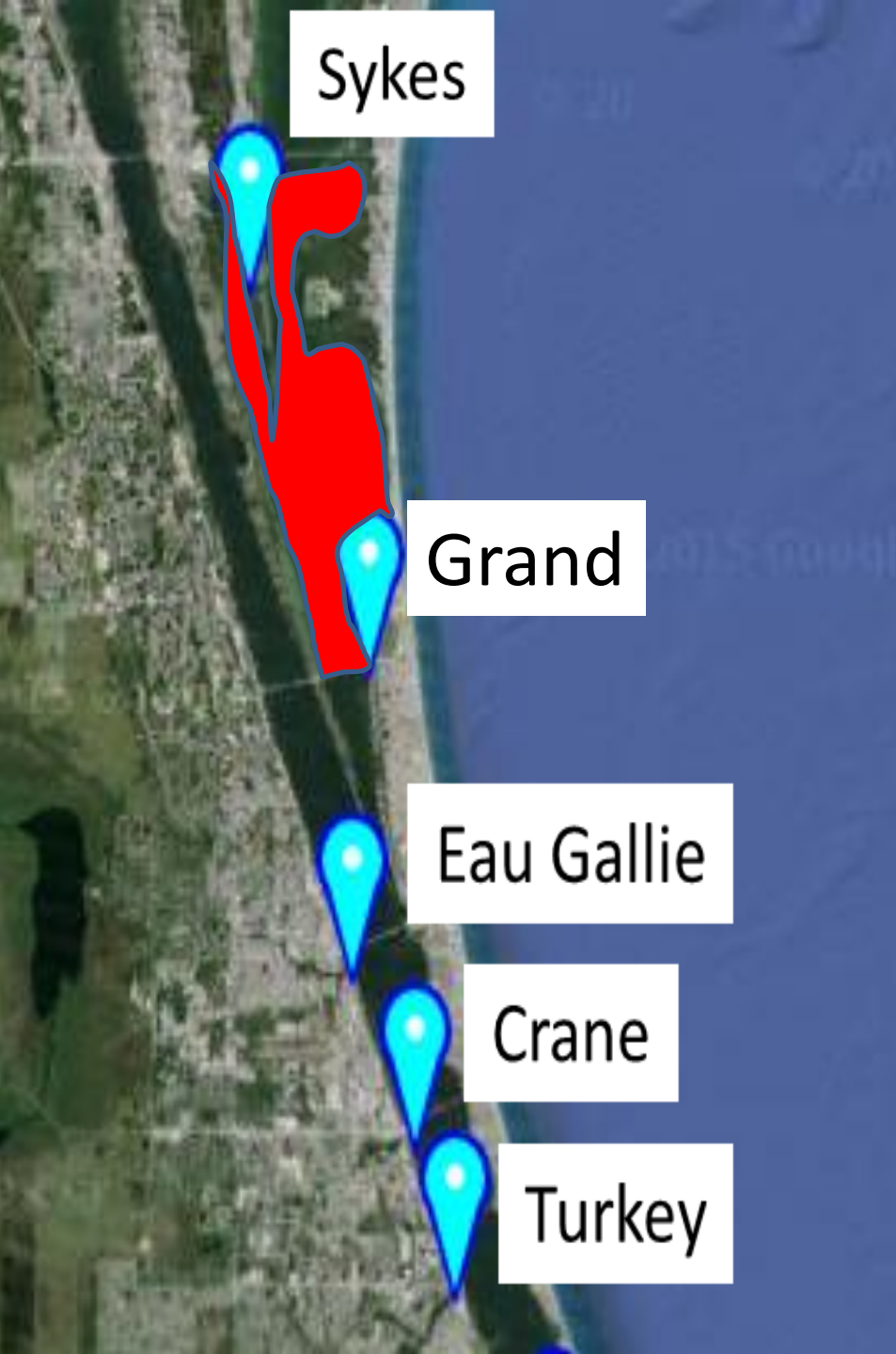


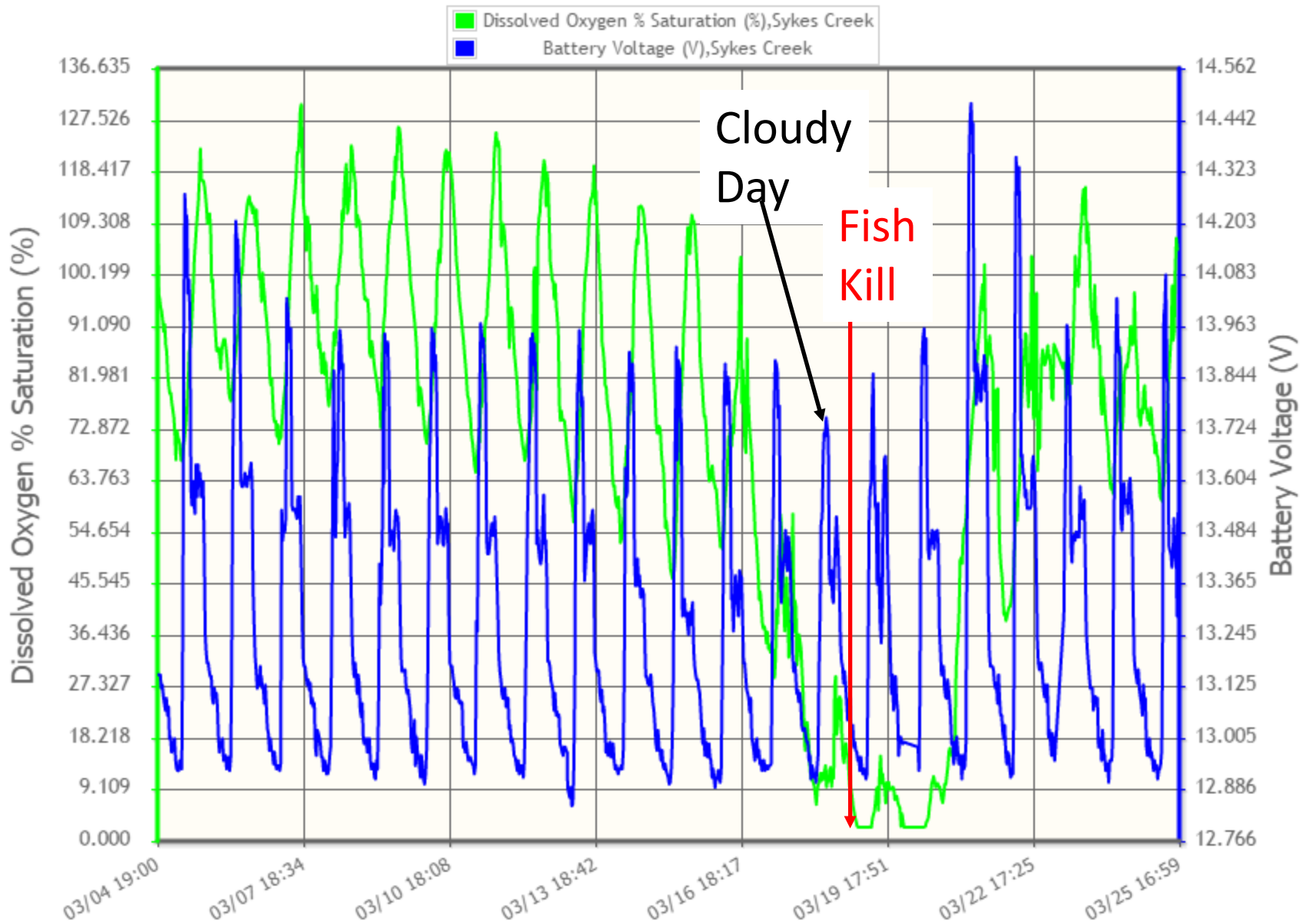


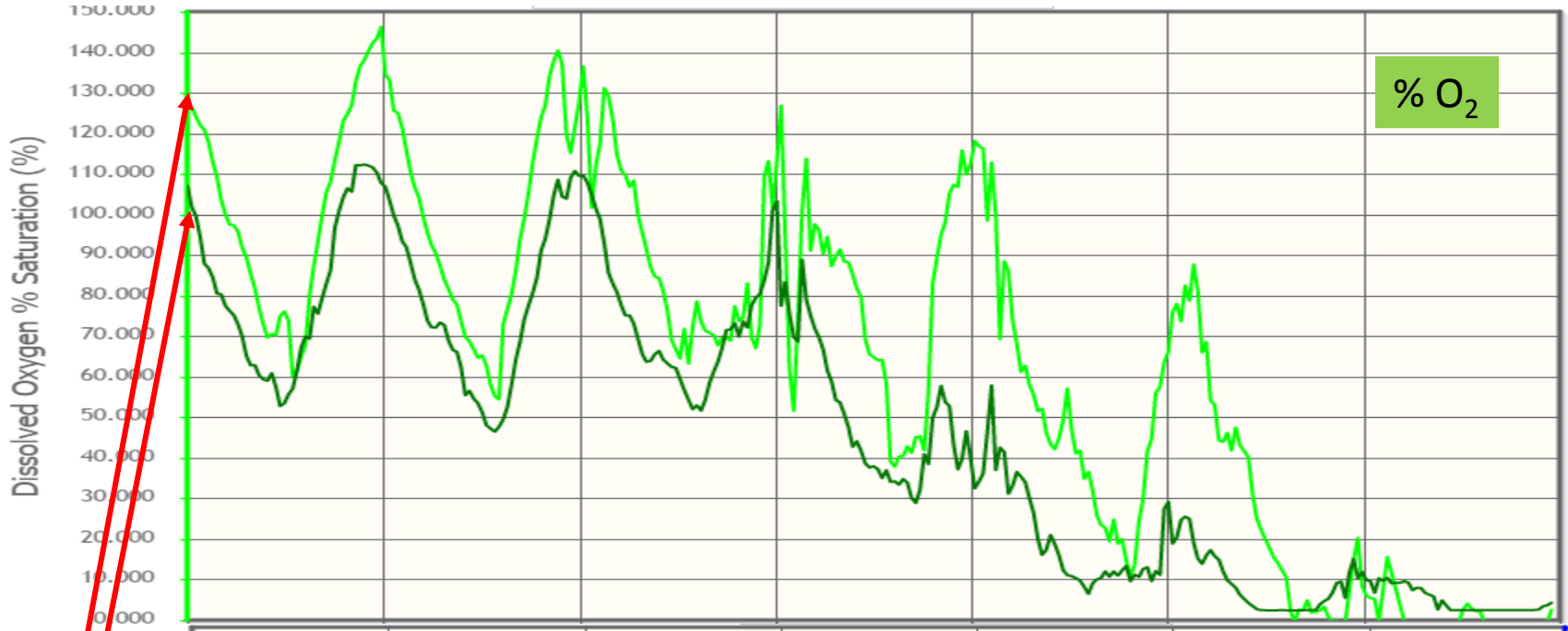
Water Temp

## Oxygen Concentration vs Temperature in (Sea) Water





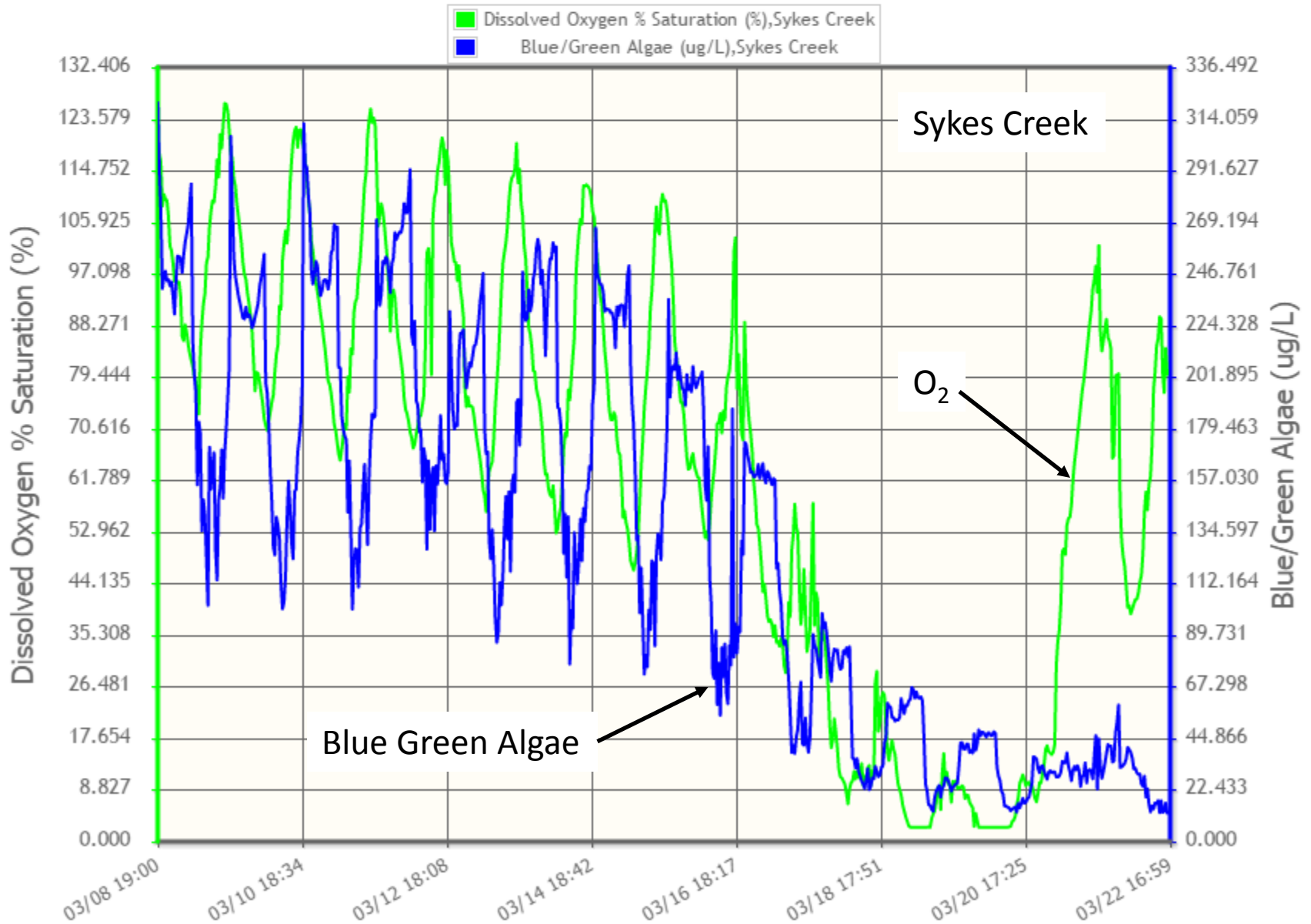




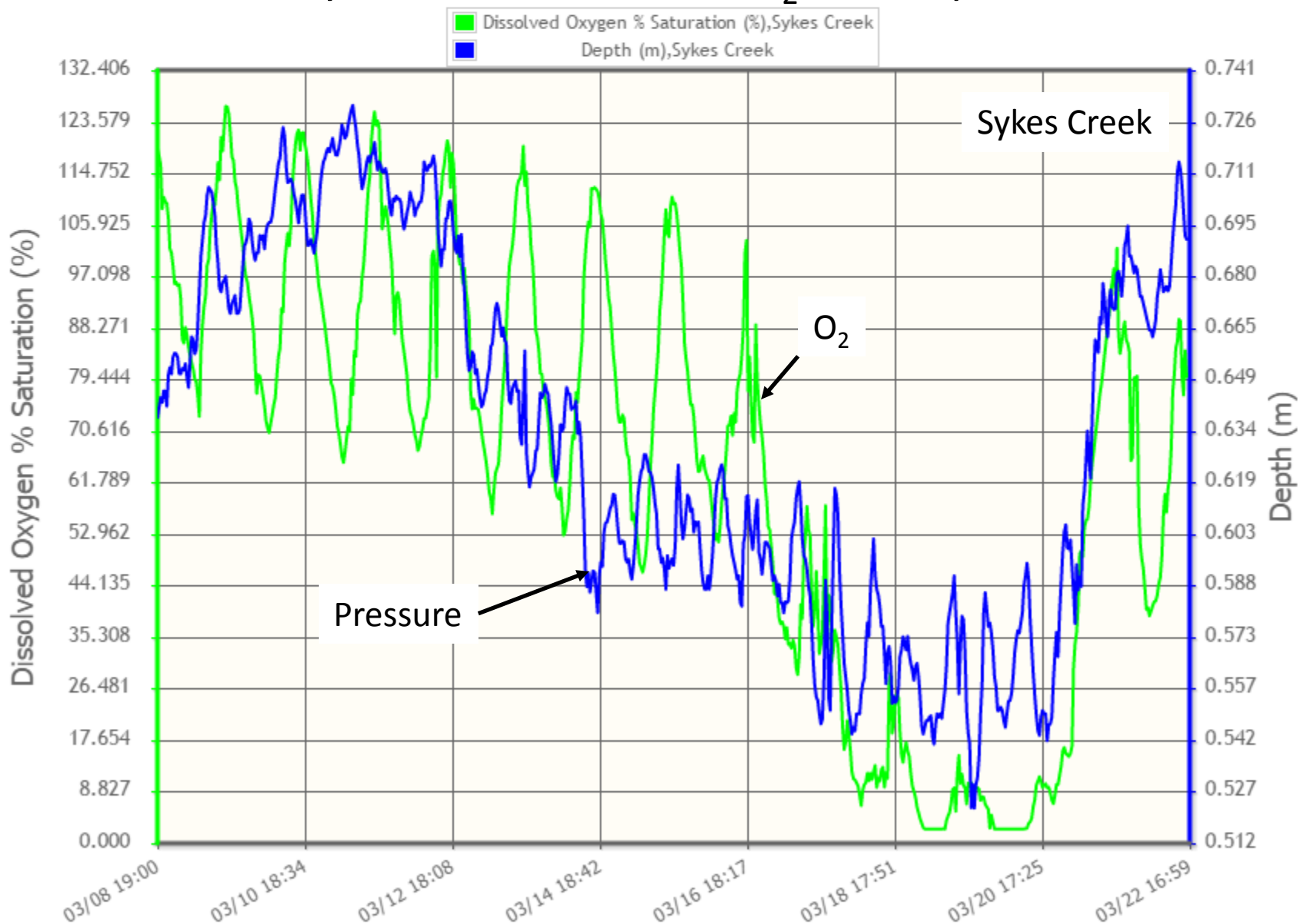
Grand  
Sykes



# Sykes Creek Mar 8-22, 2016 O2 and Phycocyanin

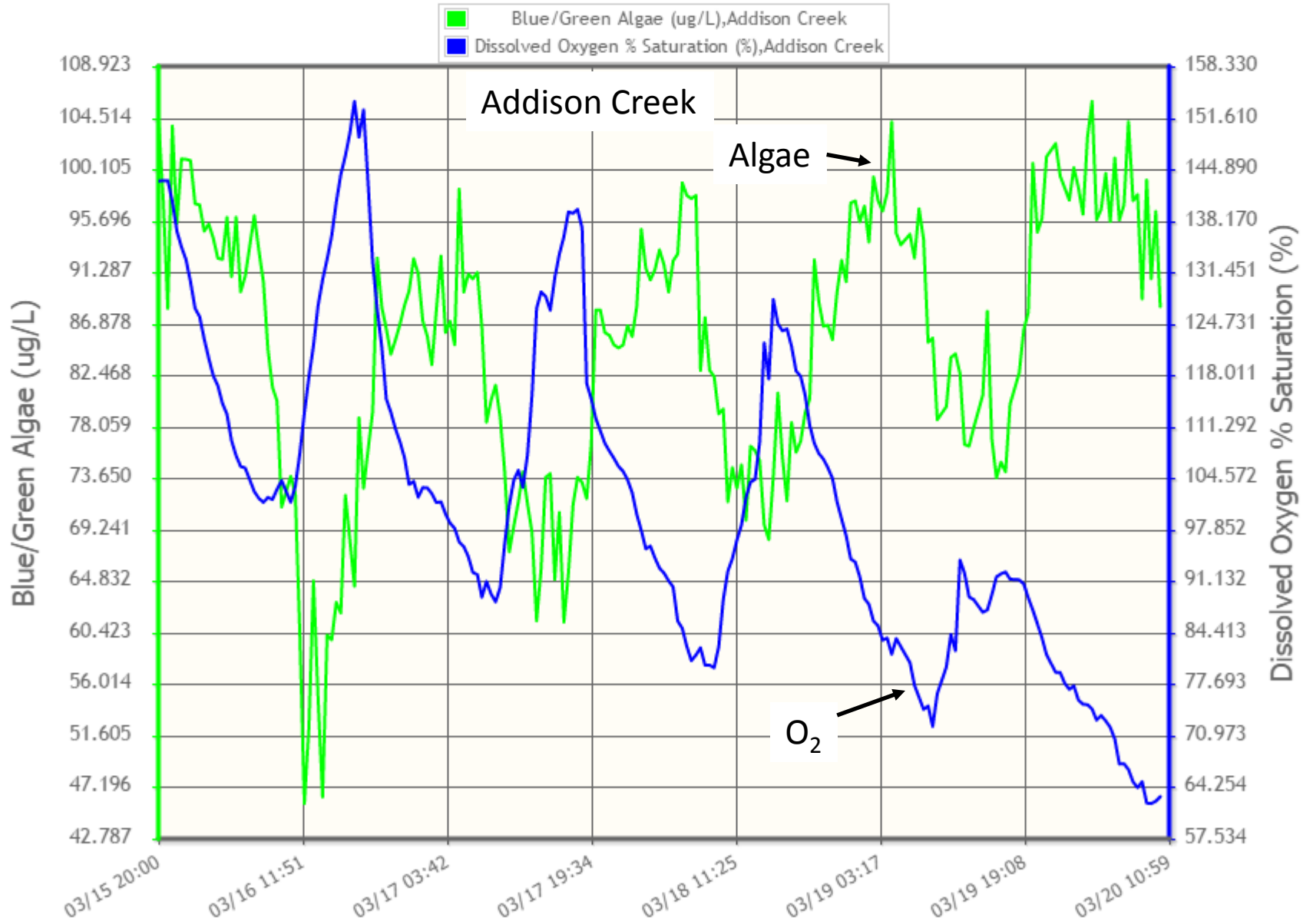


# Sykes Creek Mar 8-22 O<sub>2</sub> and Depth



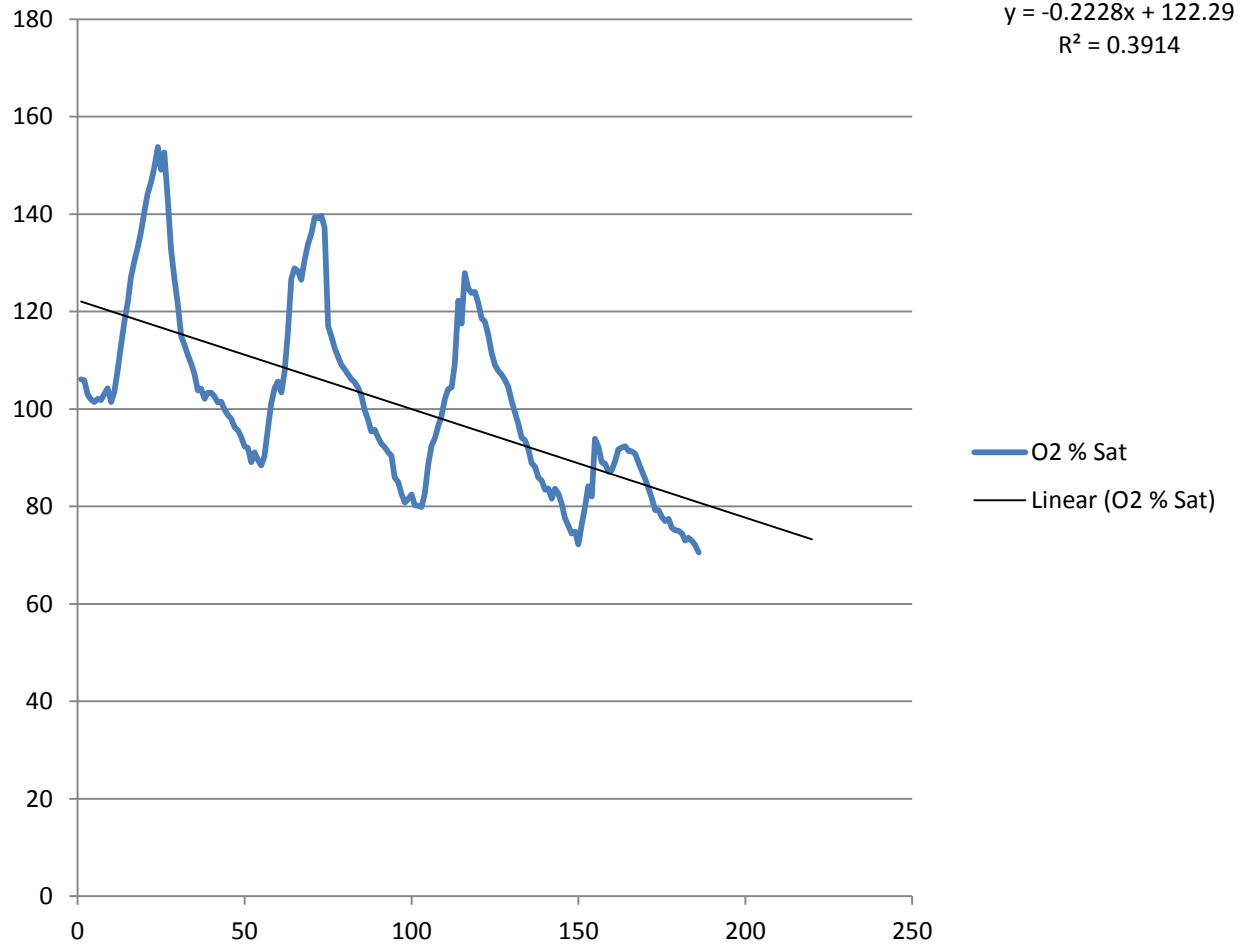
# Addison Creek

Create Plot



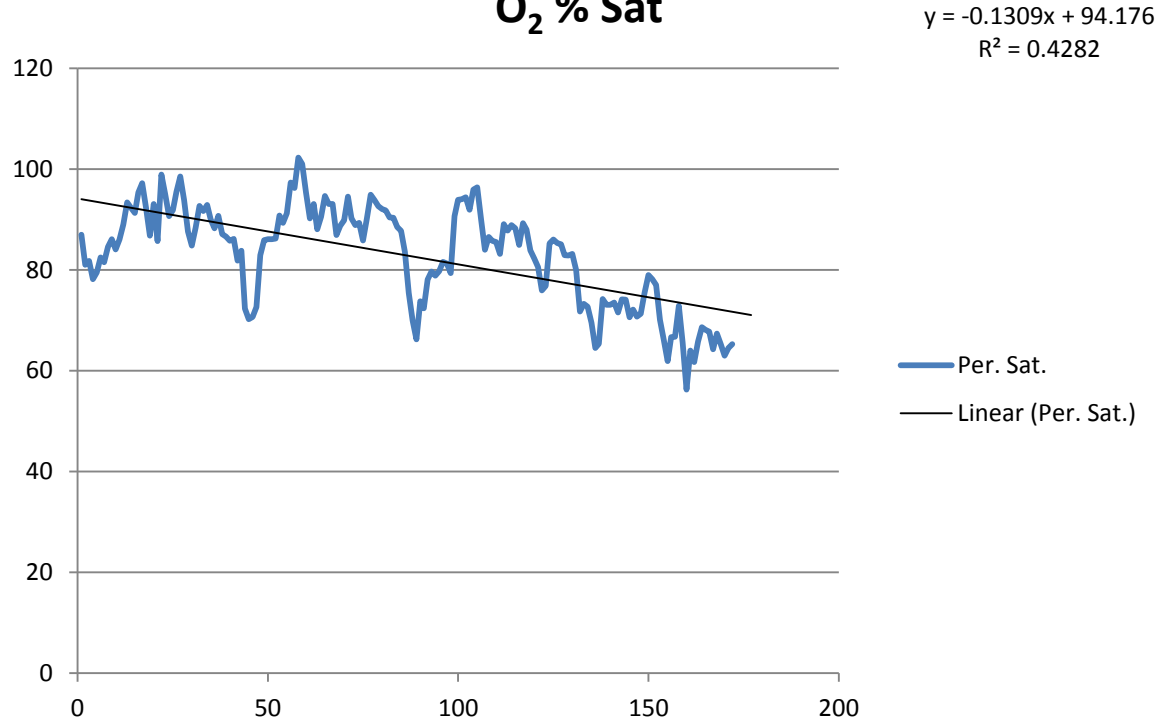
# Addison Creek

## O<sub>2</sub> % Sat



# Bethel Creek Vero Beach

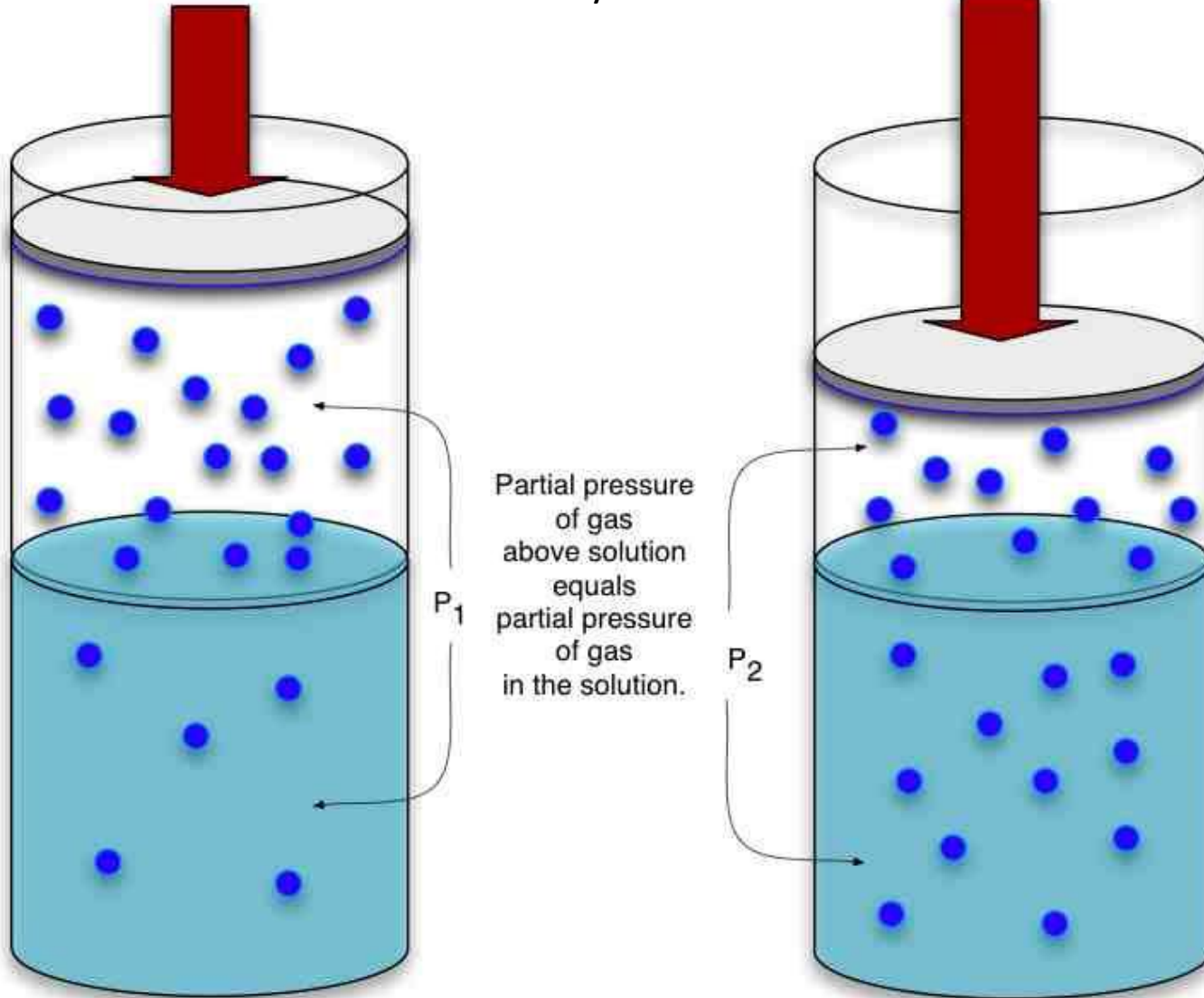
## O<sub>2</sub> % Sat



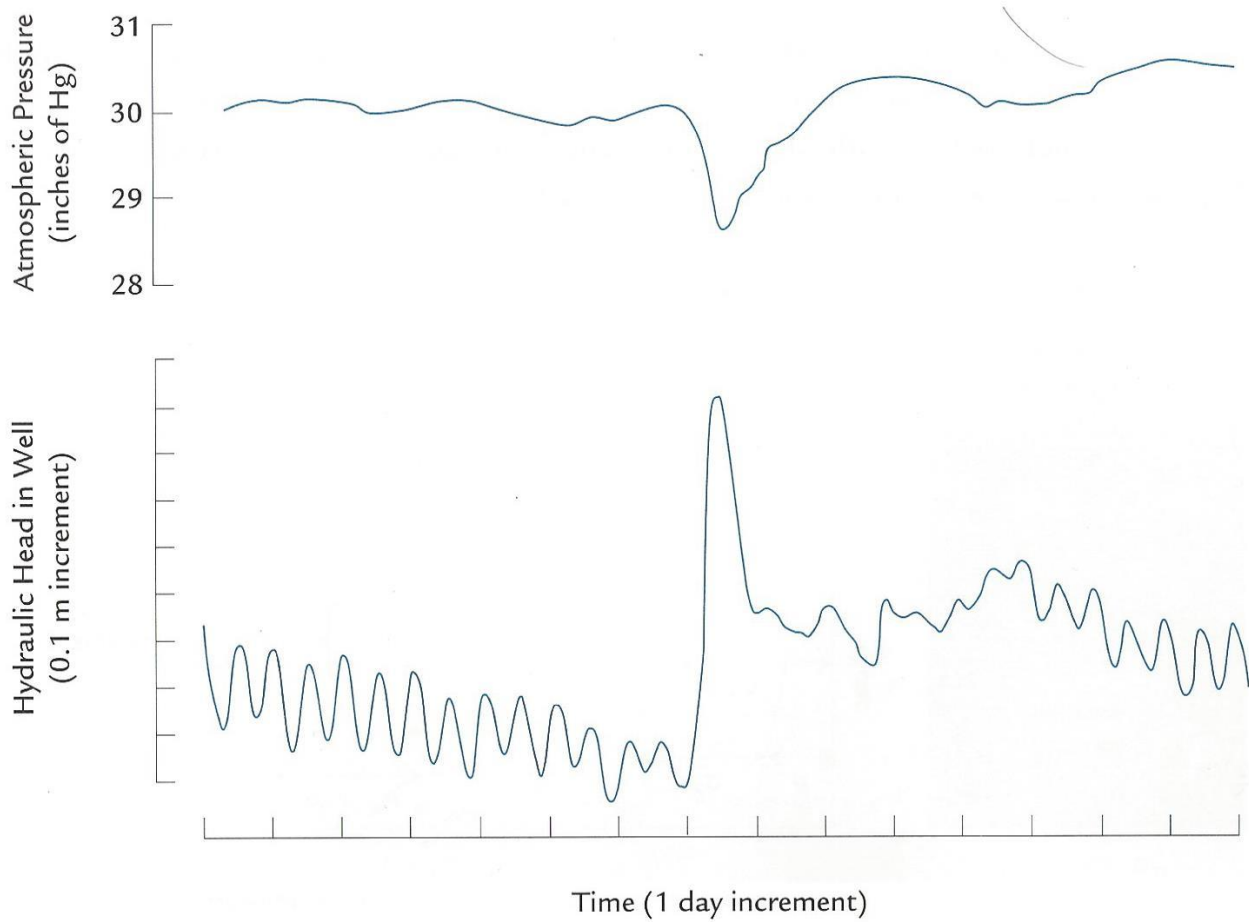
Low Pressure

High Pressure

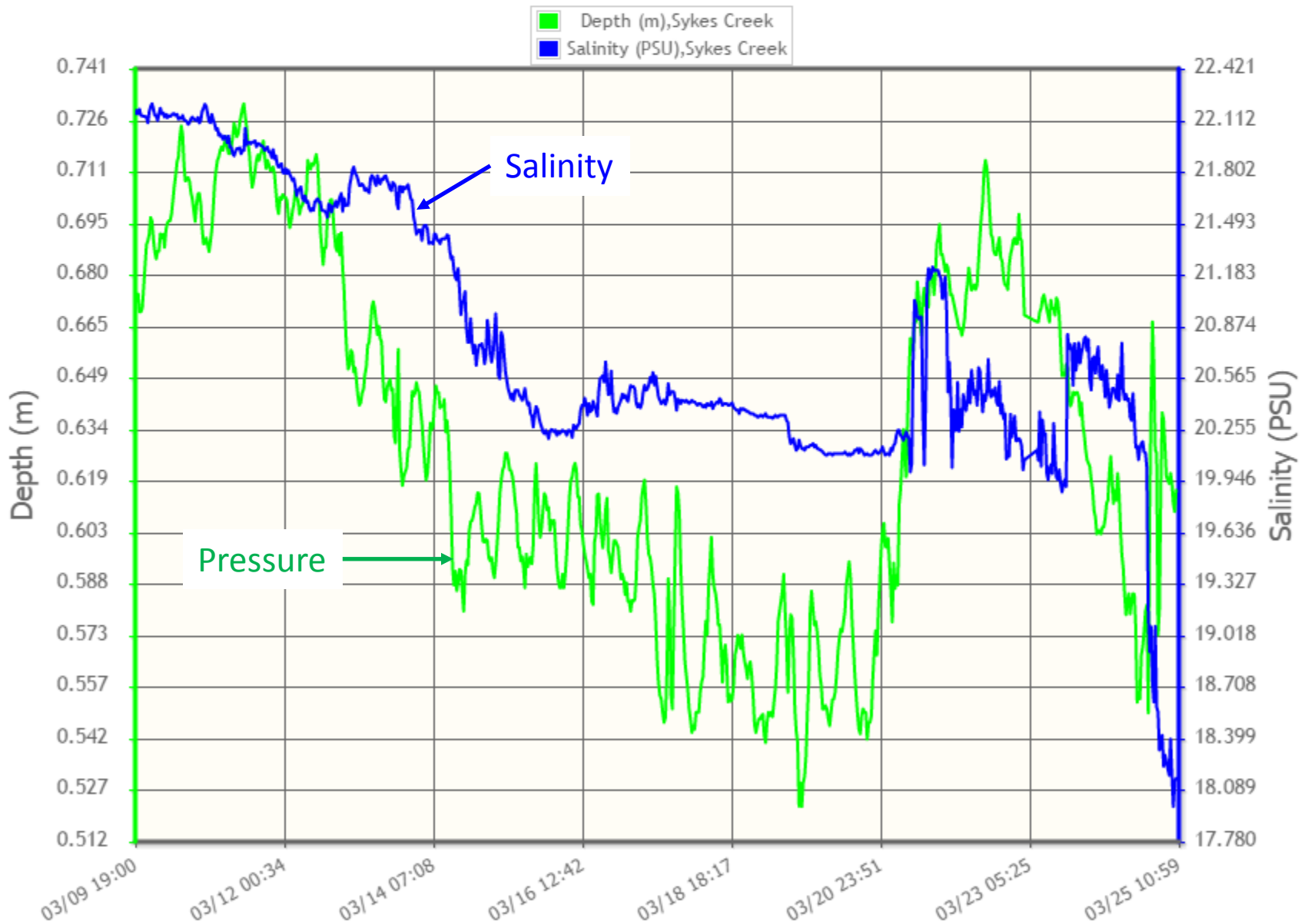
## Henry's Law



The solubility of a gas in solution will decrease as the partial pressure of the gas above the solution decreases.



**Figure 5.3** Records of atmospheric pressure and hydraulic head in a crystalline bedrock well in Georgia in March, 1993. A large low-pressure storm passes in the middle of the record. This well is open in the interval from 37 to 620 ft deep, and its barometric efficiency during this storm was 0.58. From Landmeyer, J. E. 1996, Aquifer response to record low barometric pressures in the southeastern United States, *Ground Water*, 34(5), 917-924. Reprinted from *Ground Water* with permission of the National Ground Water Association. Copyright 1996.



# Factors Contributing to Brevard Fish Kill

- Heavy rains → massive algae bloom
- Presence of blue green algae helped feed the bloom?
- Die off of algae → decrease in dissolved oxygen
- Water temperature increased 6° C in 11 days preceding the bloom
- Decreased sunlight favored respiration over photosynthesis
- Decrease in barometric pressure → decrease in dissolved O<sub>2</sub>



# KILROY ACADEMY



[www.kilroyacademy.org](http://www.kilroyacademy.org)

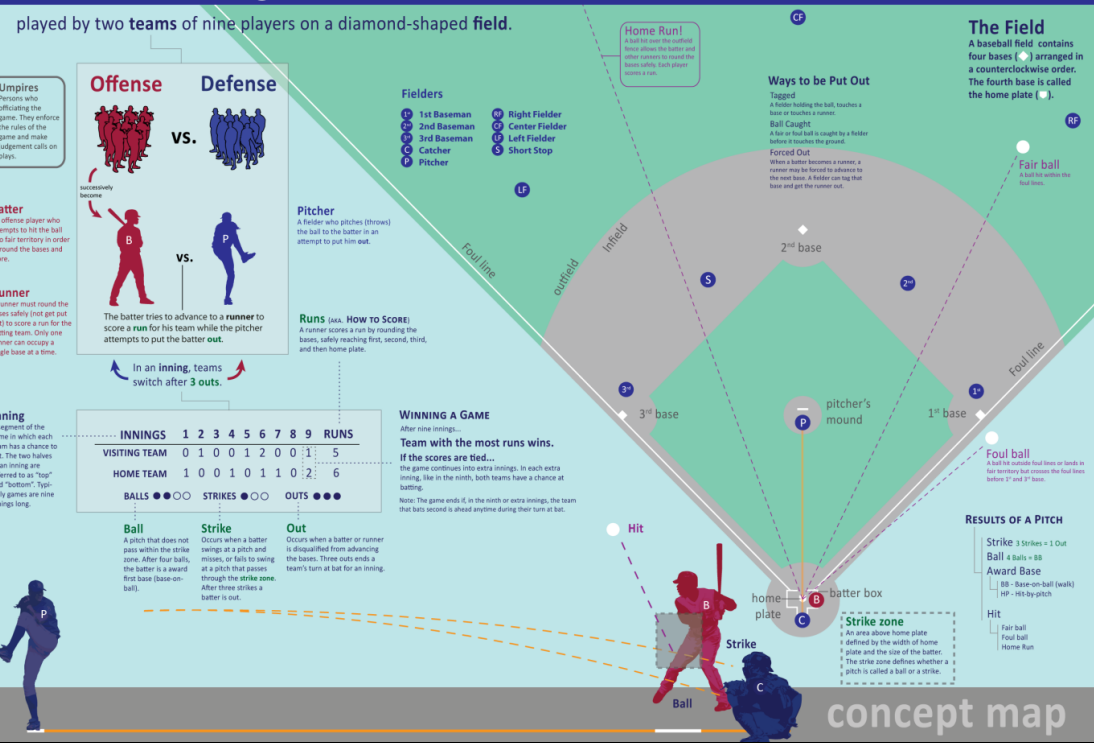
# Imagine if we taught baseball the way we teach science



**Alison Gopnik. 1999. Small Wonders,  
The New York Review of Books**

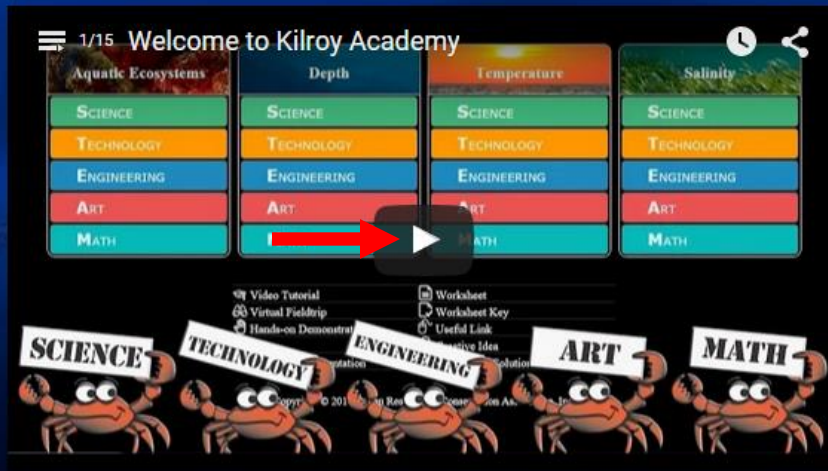
# BASEBALL is a game...

Ame Wongs  
Professor Ann Taylor  
Information Design Studio



- School children would be taught the rules of the game.
- Undergraduates might get to reproduce famous historic baseball plays.
- But only in graduate school would they, at last, actually get to play a game..
- What kind of baseball players will they be?

Welcome to Kilroy Academy, the place that answers the question "Why do we have to learn this stuff?"



1/15 Welcome to Kilroy Academy

Aquatic Ecosystems	Depth	Temperature	Salinity
SCIENCE	SCIENCE	SCIENCE	SCIENCE
TECHNOLOGY	TECHNOLOGY	TECHNOLOGY	TECHNOLOGY
ENGINEERING	ENGINEERING	ENGINEERING	ENGINEERING
ART	ART	ART	ART
MATH	MATH	MATH	MATH

Video Tutorial    Worksheet  
 Virtual Fieldtrip    Worksheet Key  
 Hands-on Demonstration    Useful Link  
 Creative Idea    Problem Solving

SCIENCE    TECHNOLOGY    ENGINEERING    ART    MATH

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**Tweets**

**Kilroy Academy** @KilroyAcademy 6h  
 We invite you to participate in the #LifeSciencesSouthFlorida upcoming webinar on Tuesday, October 20, 2015 from... fb.me/3M5DZ63VE

**Kilroy Academy** @KilroyAcademy 6h  
 Tweet to @KilroyAcademy

**Kilroy Academy**



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Resources cover a range of topics including:



**KILROY ACADEMY**



Aquaculture  
Aquatic Ecosystems  
Environmental Art  
Evolution



Exponential Growth  
Data Visualization  
Deep Sea Biology  
Depth



Dilute Solutions  
Dissolved Oxygen  
Habitat Restoration



Human Health  
Invasive Species  
Logarithms



Marine Conservation  
Natural Disasters  
Ocean Acidification  
Ocean Engineering



Osmosis  
pH  
Real-time Data

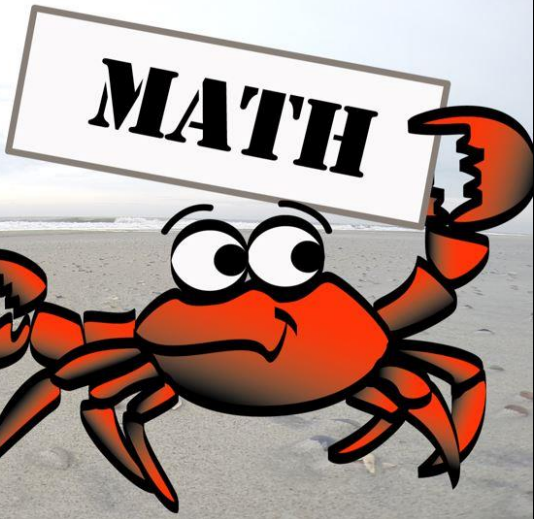
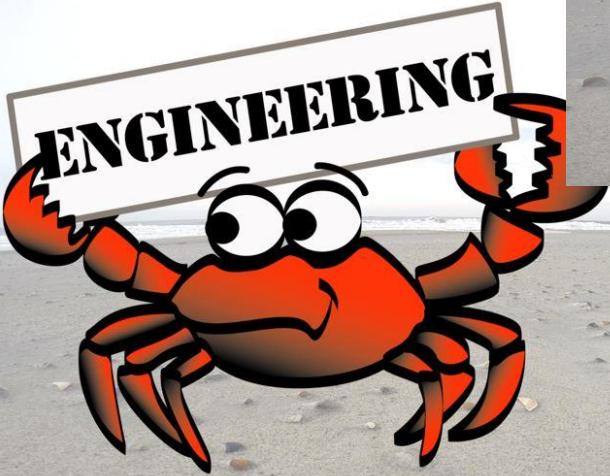
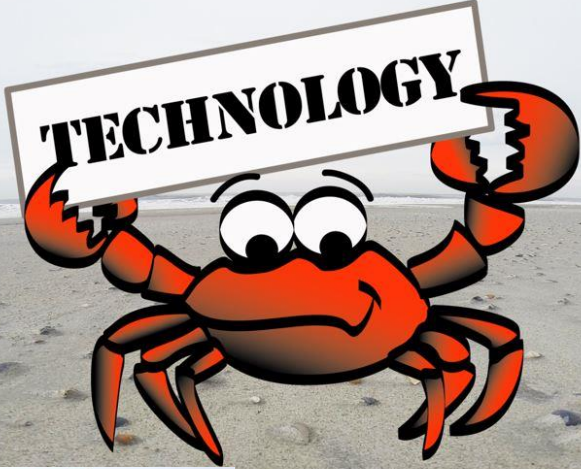
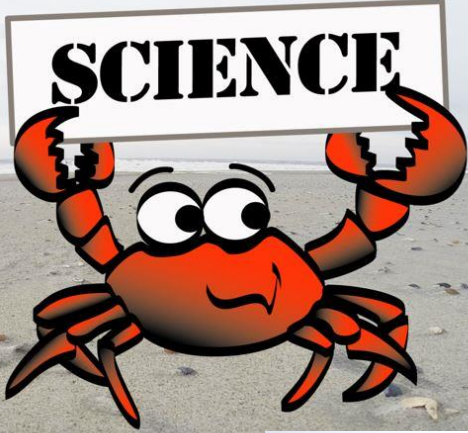


Salinity  
Sea Level Rise  
Temperature




Tides  
Trigonometry  
Water Quality  
Why Art Matters

# STEAM





## Aquatic Ecosystems



SCIENCE

TECHNOLOGY

ENGINEERING

ART

MATH

## Depth

SCIENCE

TECHNOLOGY

ENGINEERING

ART

MATH

## Temperature

SCIENCE

TECHNOLOGY

ENGINEERING

ART

MATH

## Salinity

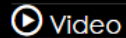
SCIENCE

TECHNOLOGY

ENGINEERING

ART

MATH



Video



Virtual Fieldtrip



Hands-on Demonstration



PowerPoint Presentation



Worksheet



Worksheet Key



Useful Link



Real World Solution



## Aquatic Ecosystems

### SCIENCE

Aquatic Ecosystems

Florida Springs

How Life Came to Land

Plankton

Seahorse Aquaculture & Conservation

What is a Crinoid?

What's Lurking in the Waters?

Mangrove Restoration

Deep Sea STEM

Small Species - Big Impact

### TECHNOLOGY

### ENGINEERING

### ART

### MATH

## Depth

### SCIENCE

### TECHNOLOGY

### ENGINEERING

### ART

### MATH

## Temperature

### SCIENCE

### TECHNOLOGY

### ENGINEERING

### ART

### MATH

## Salinity

### SCIENCE

### TECHNOLOGY

### ENGINEERING

### ART


### MATH











## Aquatic Ecosystems

### SCIENCE

#### Aquatic Ecosystems

Learn about different aquatic ecosystems on earth and the importance of zones of tolerance for the species living in aquatic ecosystems. 4:17 min 

- Exploring Marine Ecosystems PowerPoint 
- Exploring Marine Ecosystems Poster Project for Students 
- Exploring Marine Ecosystems Poster Project for Teachers 
- Exploring Zones of Tolerance with Brine Shrimp 
- How Much Freshwater is there on Earth? 
- Sustainable Seafood Guide 
- Indian River Lagoon Species Inventory 
- ORCA's Land to Sea Initiative: Stopping Water Pollution at its Source 

## Depth

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### ENGINEERING

### ART

### MATH

## Temperature

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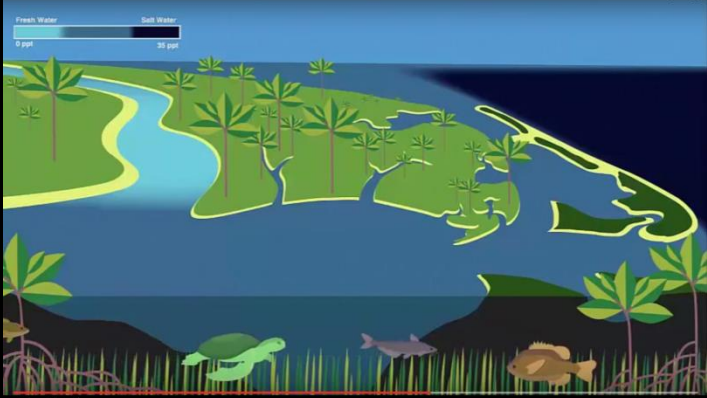
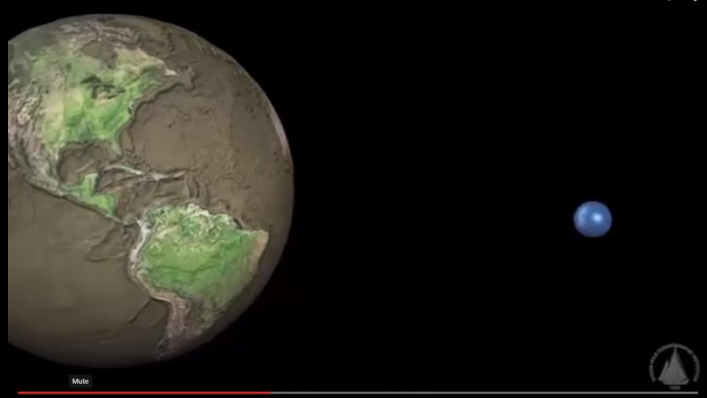
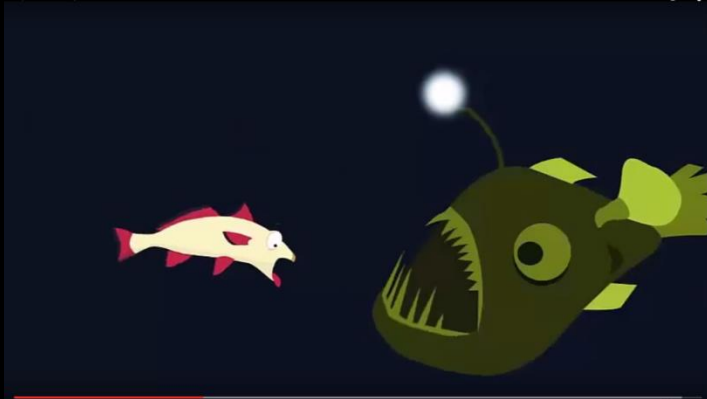
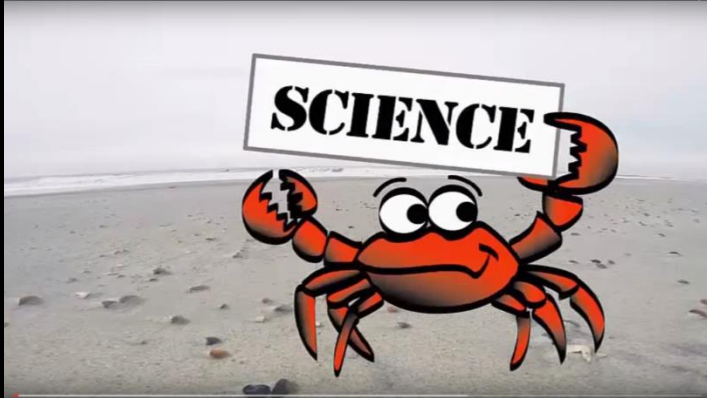
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## Aquatic Ecosystems

### SCIENCE

#### Aquatic Ecosystems

Learn about different aquatic ecosystems on earth and the importance of zones of tolerance for the species living in aquatic ecosystems. 4:17 min



Exploring Marine Ecosystems PowerPoint



Exploring Marine Ecosystems Poster Project for Students



Exploring Marine Ecosystems Poster Project for Teachers



Exploring Zones of Tolerance with Brine Shrimp



How Much Freshwater is there on Earth?



Sustainable Seafood Guide



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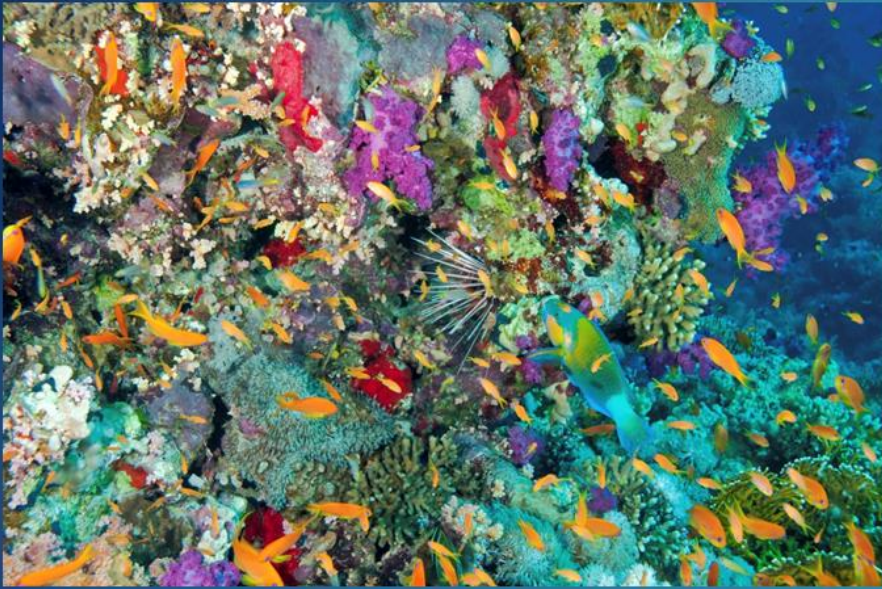
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# EXPLORING MARINE ECOSYSTEMS




- ▶ All ecosystems contain biotic and abiotic factors
- ▶ Biotic = living features
- ▶ Abiotic = non-living physical features
- ▶ Relationship between biotic and abiotic factors is important to ecosystem health





## Aquatic Ecosystems


### SCIENCE


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**KILROY  
ACADEMY**

NAME: \_\_\_\_\_ DATE: \_\_\_\_\_

## **EXPLORING MARINE ECOSYSTEMS POSTER PROJECT**

**PROJECT:** You will be designing an informative poster board that will detail vital facts about a specific marine environment.

- First, you will select one marine ecosystem to explore. Using any reference books and the internet, you will research the details of your chosen ecosystem and record the information in your notebook.
- You should research and record information such as:
  - Ecosystem description and locations
  - Various plants and animals living there
  - Biotic and abiotic factors
  - Describe what it is like to live there
  - Anthropogenic impacts (positive and negative)
- Once your research is complete, you will organize the facts to be creatively displayed on a poster board.
- Then, present your poster and research to the class for a discussion.


**\*\*\*Be sure to reference the rubric when designing your poster board.\*\*\***





## Aquatic Ecosystems


### SCIENCE



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
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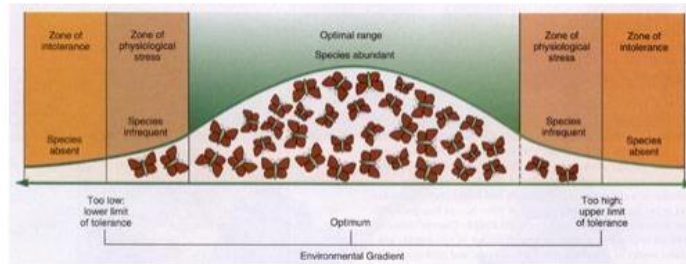


## EXPLORING ZONES OF TOLERANCE WITH BRINE SHRIMP

### PRELAB DISCUSSION

What are zones of tolerance?

<http://dtc.pima.edu/blc/105/503/tutor/tutor31.html>



Each species of animal, plant, or any living thing needs a certain set of environmental conditions if that species is going to survive. For example, the population of butterflies in the graph above needs to have the temperature of the environment within a certain **zone of tolerance** in order to survive. If the temperature gets too hot or too cold, all of the butterflies die. This area outside the range of tolerance is called the **zone of intolerance**. But, just like people, not every butterfly in the population likes to be at exactly the same temperature. And just like people, not every butterfly can survive extreme temperatures at the edge of the zone of tolerance. That is why this zone of tolerance describes the conditions needed for the **population**, not the individual.







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