Signaling Dissolved Oxygen Response to Eutrophication Using High Frequency Data

Matthew R. Hall and Catherine E. Wazniak
MD Department of Natural Resources

Eva M. Bailey and Walter R. Boynton
Chesapeake Biological Laboratory,
Unv. of MD Center for Environmental Science

Peter J. Tango
USGS at the Chesapeake Bay Program

Aim of Presentation

is to describe the use of **high frequency dissolved oxygen data** as a signal for coastal eutrophication in the Maryland Coastal Bays, USA.

Maryland Coastal Bays

- Lagoon system
  - Shallow
  - Does not stratify
  - Low flushing, except near inlets
- Annual brown tide blooms

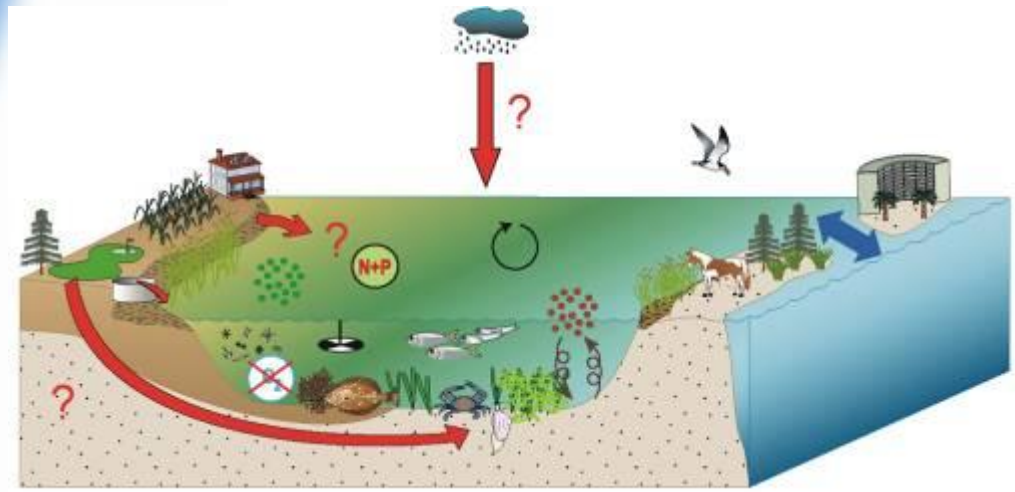
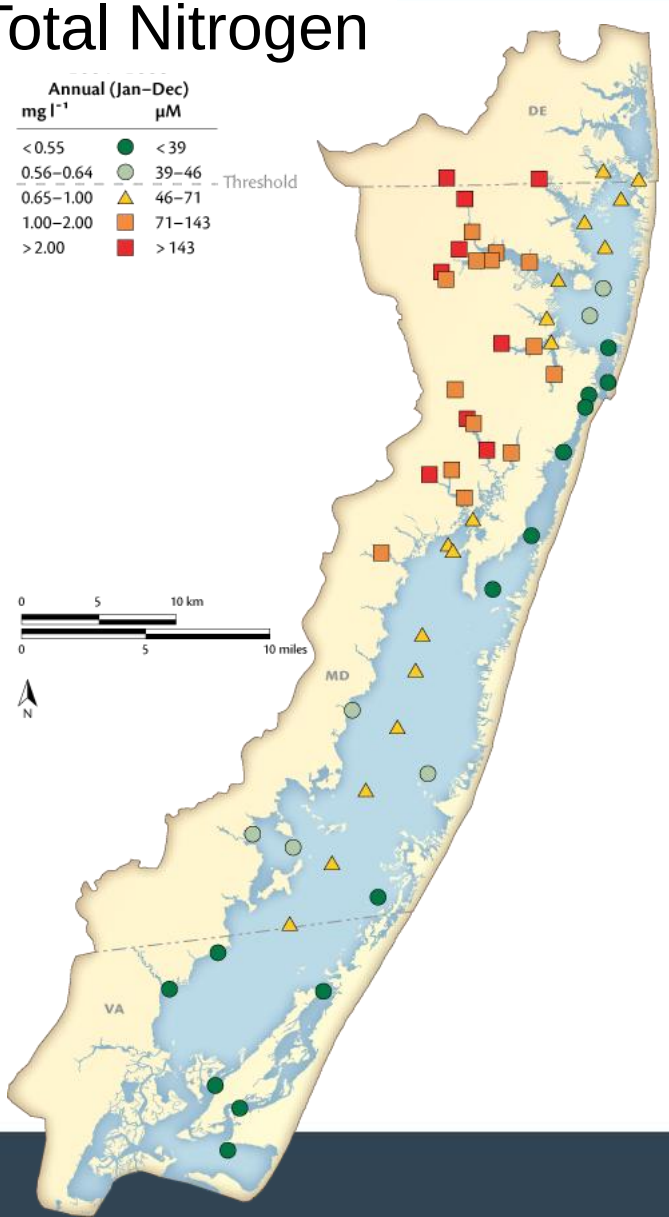


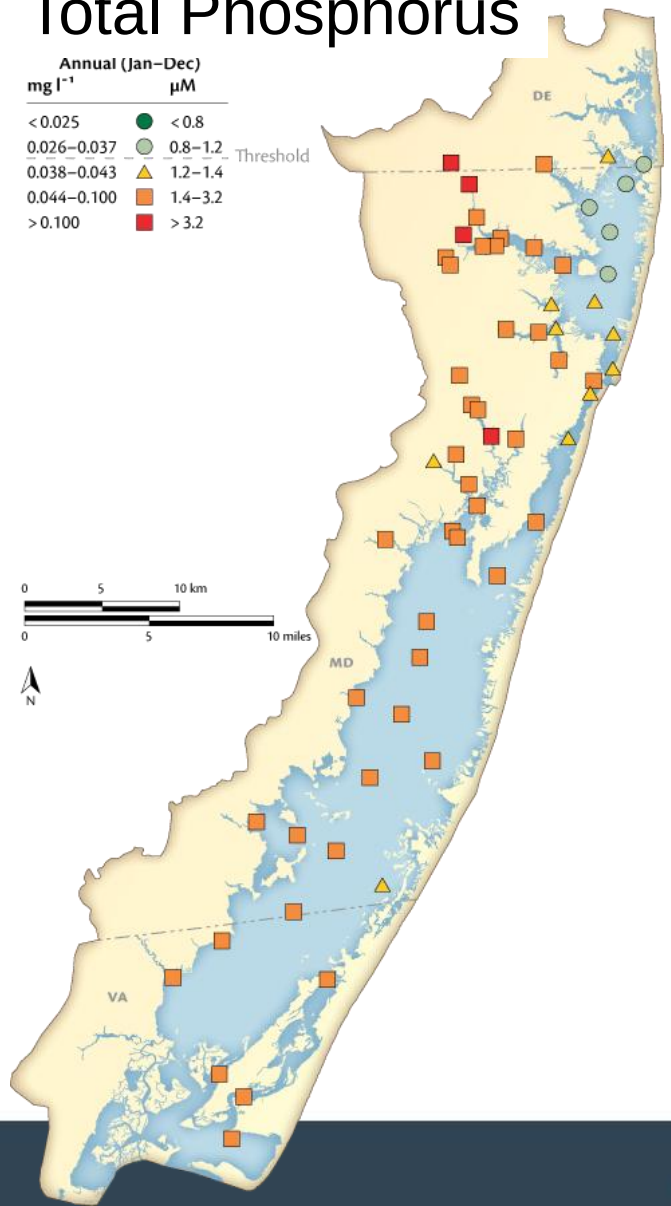
Diagram and map courtesy of Jane Thomas, IAN-UMCES

Eutrophication in Coastal Bays

Total Nitrogen

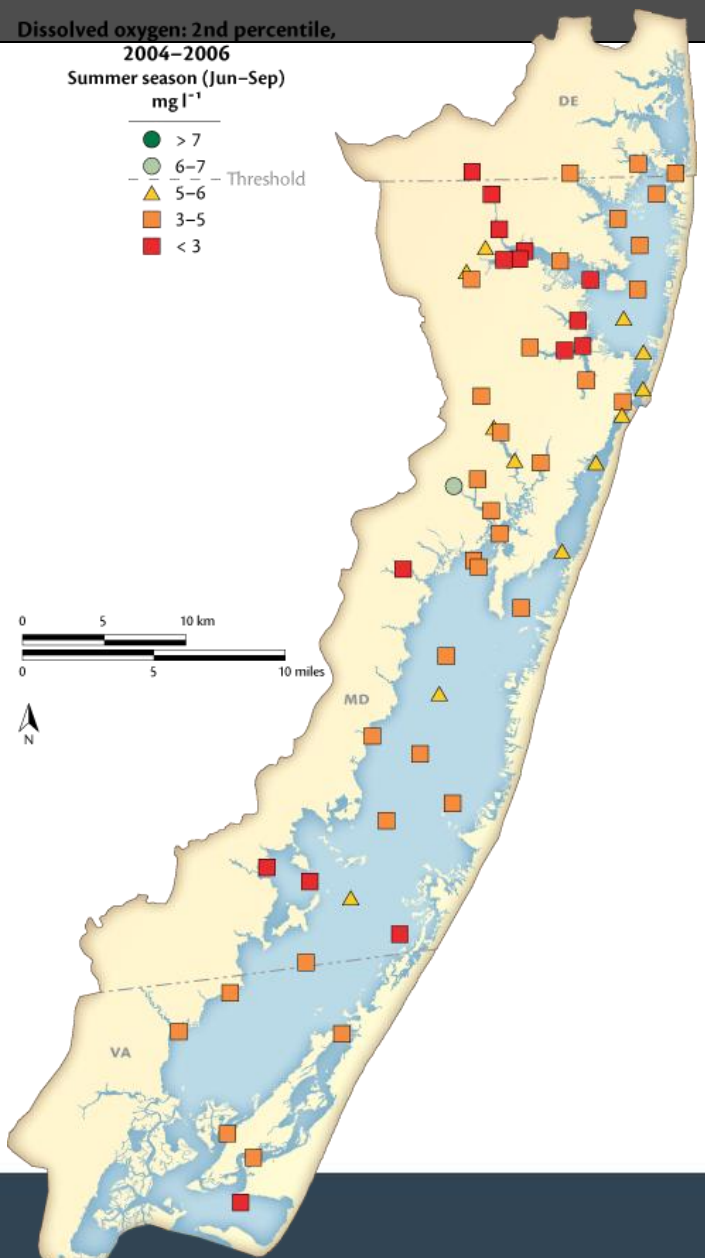


Total Phosphorus



MARYLAND DEPARTMENT OF NATURAL RESOURCES

Eutrophication effects dissolved oxygen

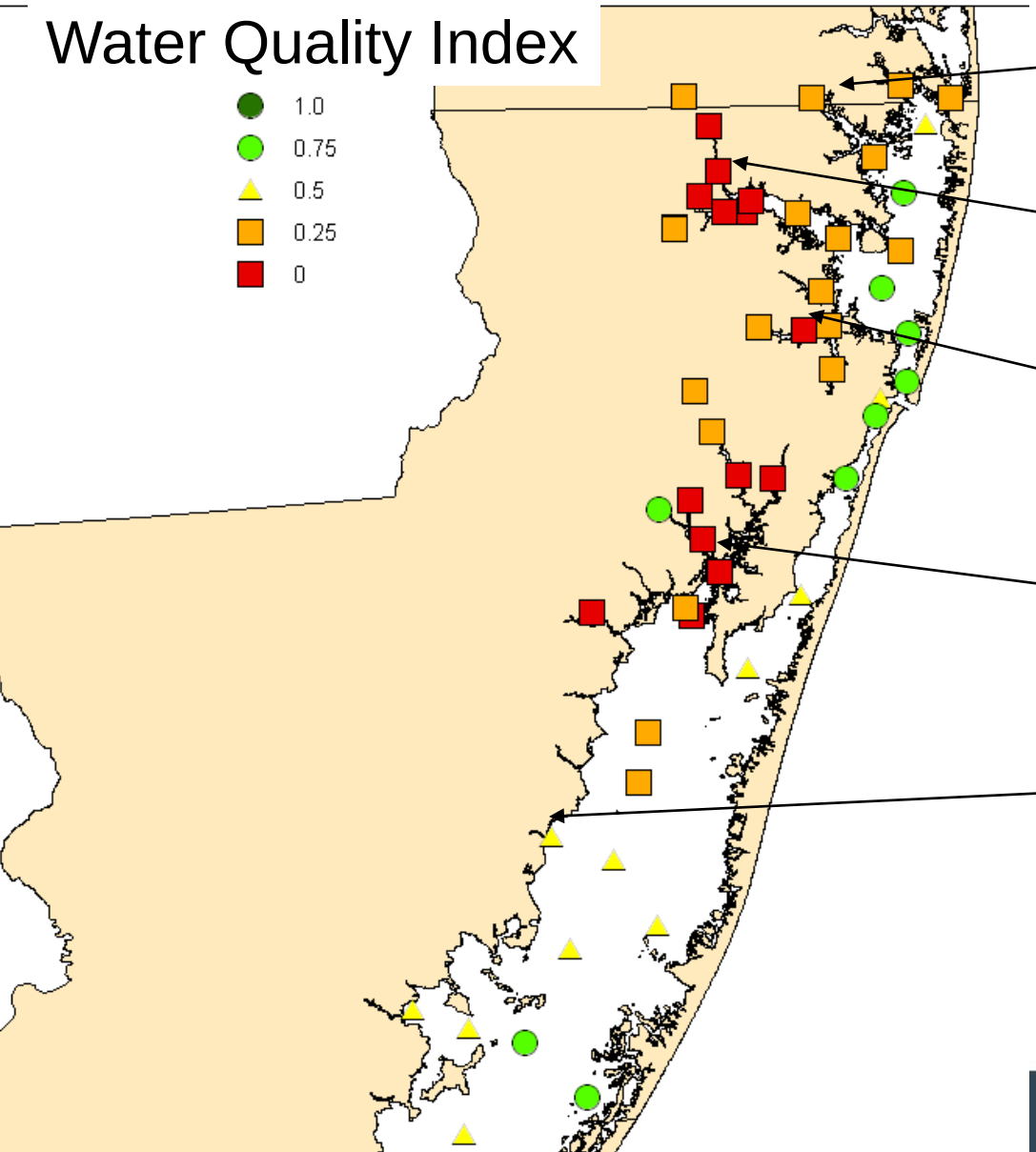


KEY DO THRESHOLDS

- Minimum of 5 mg/L during day
- Minimum of 3 mg/L at any time

<u>Management Objective:</u>
To maintain suitable fisheries and benthic community habitat.

In Situ Continuous Monitors



Grey's Creek
2008-present

Bishopville Prong
2002-present

Turville Creek
2002-2007

Newport Creek
2006-present

Public Landing
2005-present

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Temporally intensive monitors provides data during extreme events

4 automated *in situ* continuous monit
October)

.5m off bottom; reading every 15 min.

•Telemetered to web (http://mddnr.chesapeakebay.net/eyesonthebay/)

http://mddnr.chesapeakebay.net/eyesonthebay/index.cfm

Edit View Favorites Tools Help

Eyes on the Bay Index Page - Maryland Department o...

MARYLAND
...art, Green & Growing

EYES ON THE BAY

Email Friend print page

EOTB HOME | CURRENT CONDITIONS | STATUS & TRENDS | HARMFUL ALGAE | SATELLITE MAPS | MORE

How to Use This Site

Monitoring Stories and Publications

What Does It Mean?

Lesson Plans

Links and Social Media

Partners

Ask an Expert

BayStat

Maryland StreamHealth

DNR Home Page

Eyes on the Bay - Home

Welcome to the new site! Please email us with comments or kudos and view our Twitter feed below.

Maryland DNR said: NOAA showing 20-40% chance of 1-min avg 39mph winds for MD portion of the Ches. Bay. 5-10% for 58mph for So.MD Bay. http://t.co

Maryland DNR said: Had a report of small wave activity created by the earthquake in the Choptank. Anyone else on the water observe this? #baynami about

Maryland DNR said: @ko_im_16 On E.Shore Coastal Bays, Big Annem., Corsica, Sassafras telemetry will be taken out. Data still collected just not in real-time

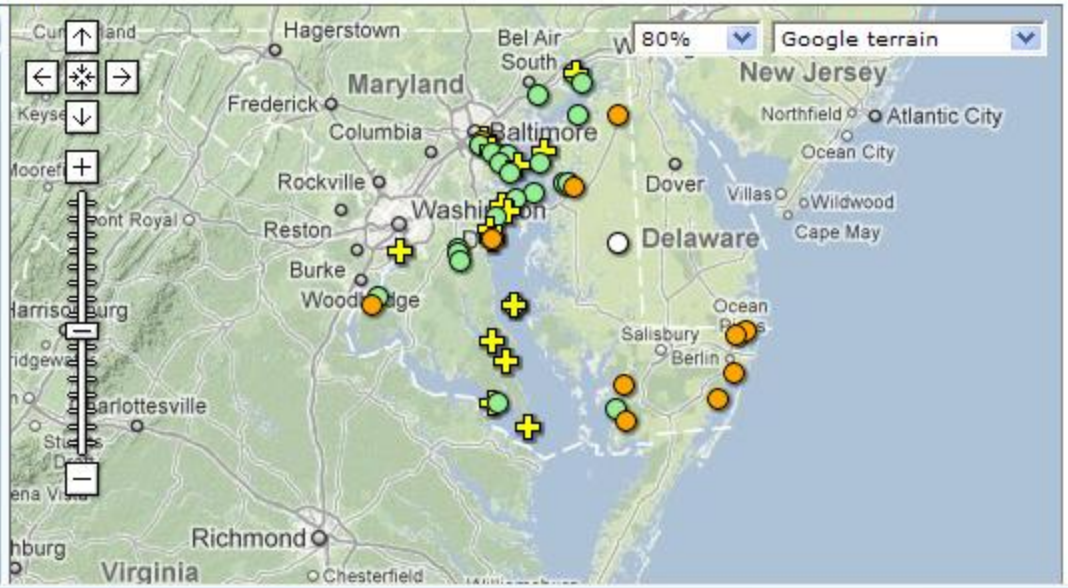
Click a station for more info and data

Monitoring Types & Stations

- Water Quality Mapping
- Continuous Monitoring
- Long-Term Monitoring
- Partners/Other Data Providers

-Click Arrow to Expand Legend
-Checkbox Removes/Adds Layer
-Link Returns Program Info

Select Another Year for Map Display:
2011

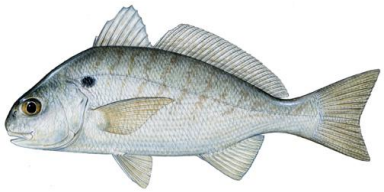


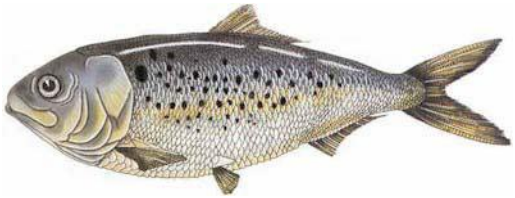
Three Methods of Relating High Frequency Data to Eutrophication

Method 1: Rate of failure for each threshold.

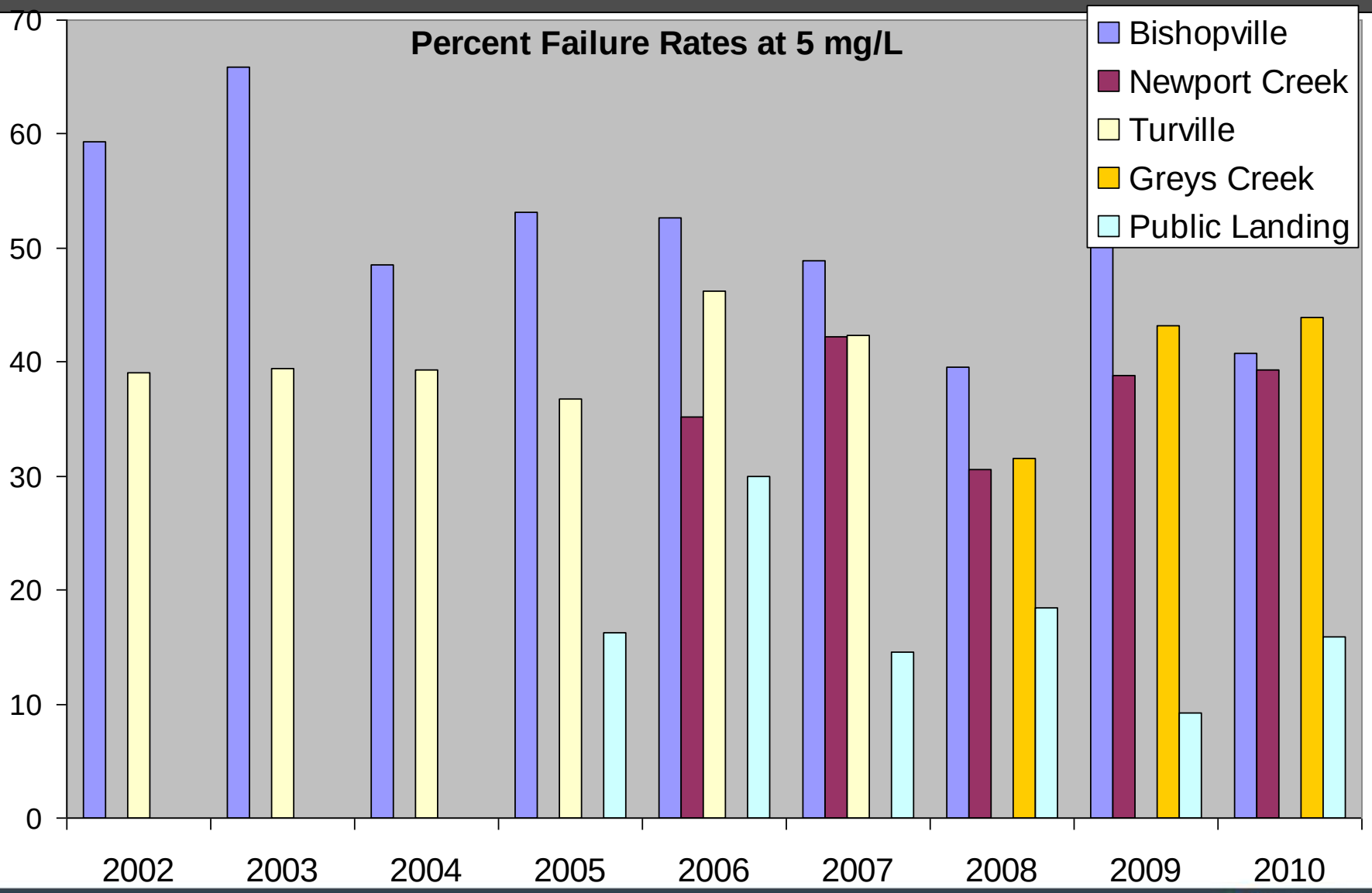
Method 2: Duration of failure for each threshold.

Method 3: Assessment of DO habitat conditions for common species.

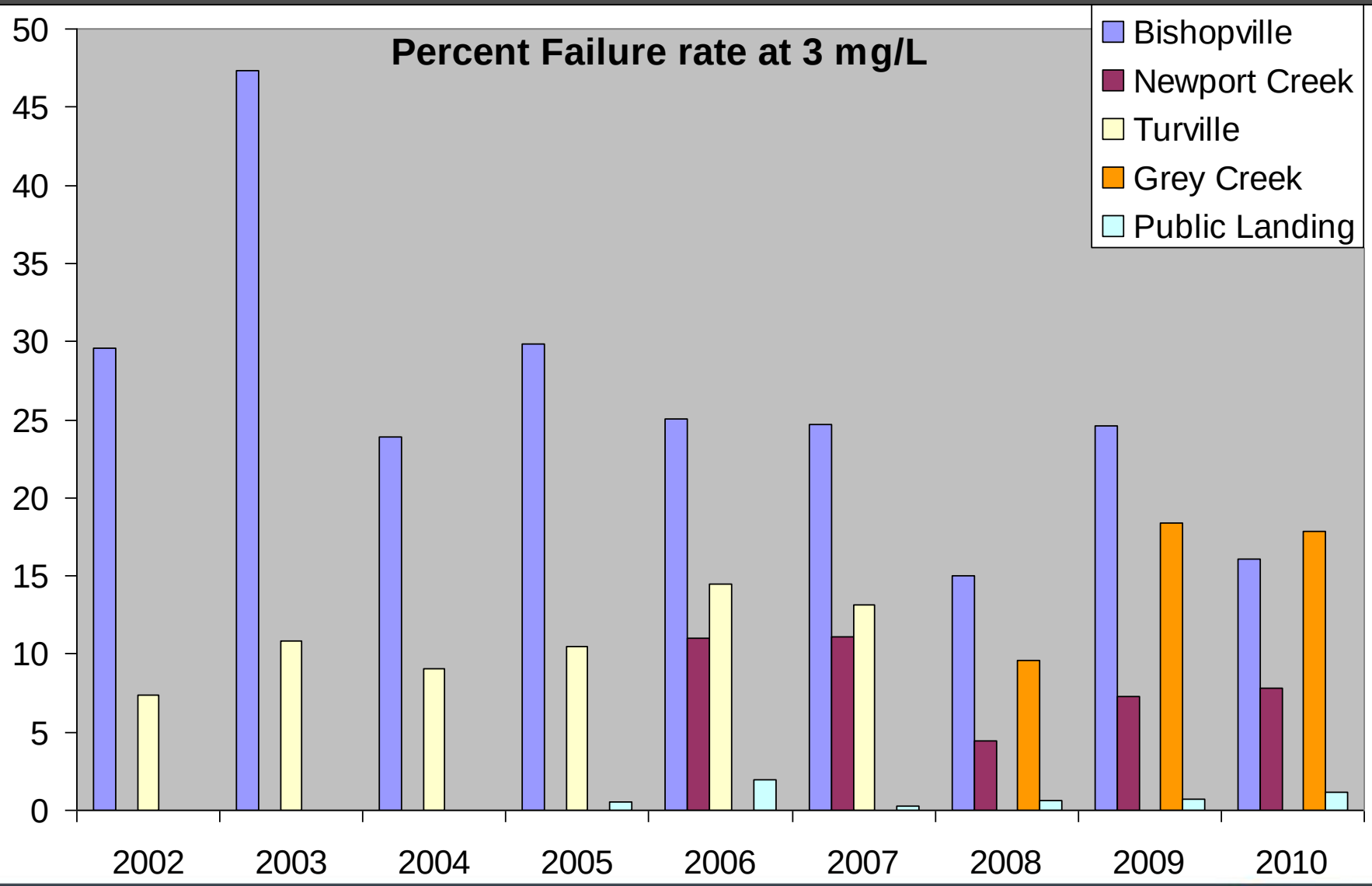




1. Rate of Failure of DO Thresholds

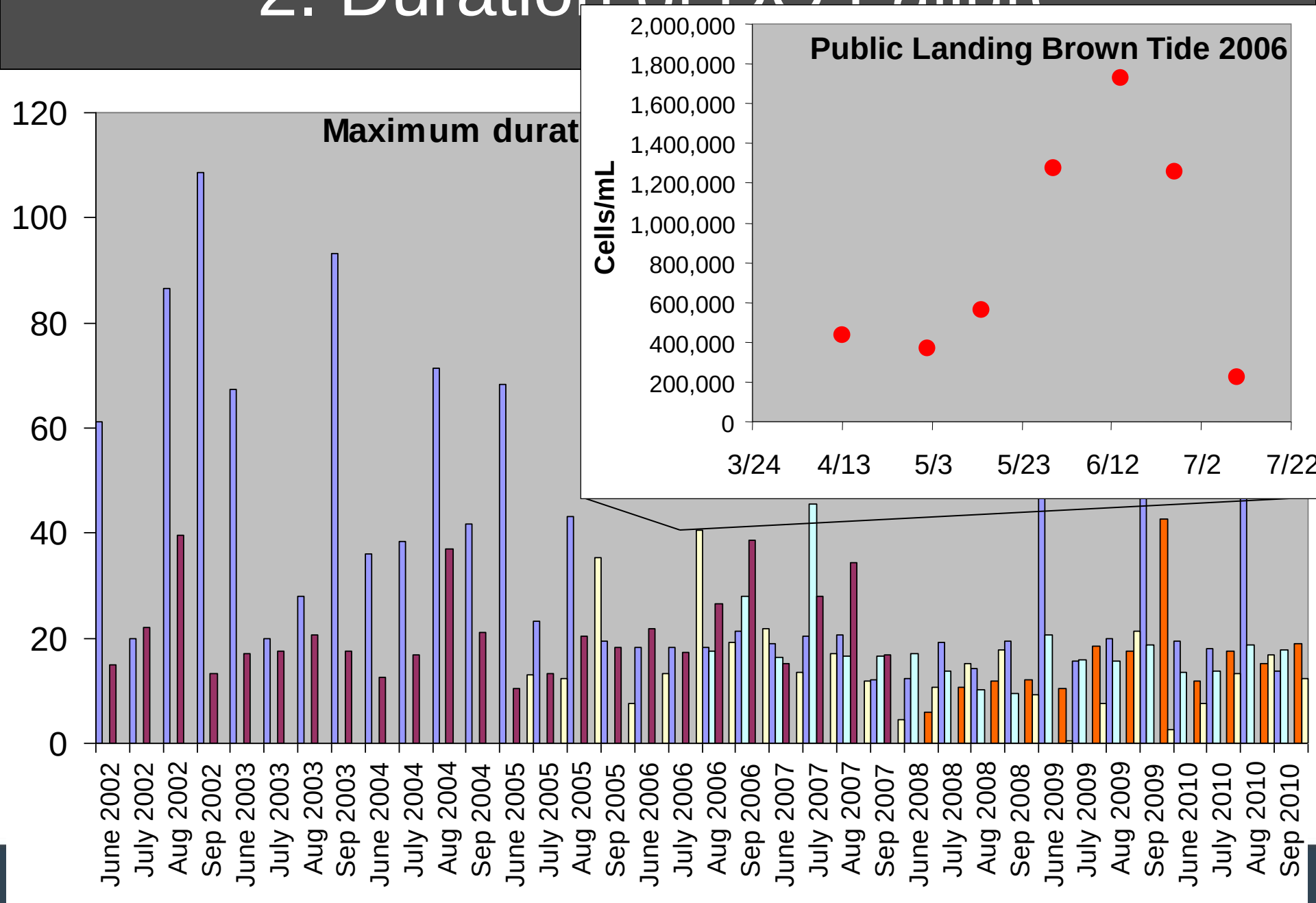


1. Rate of Failure of DO Thresholds

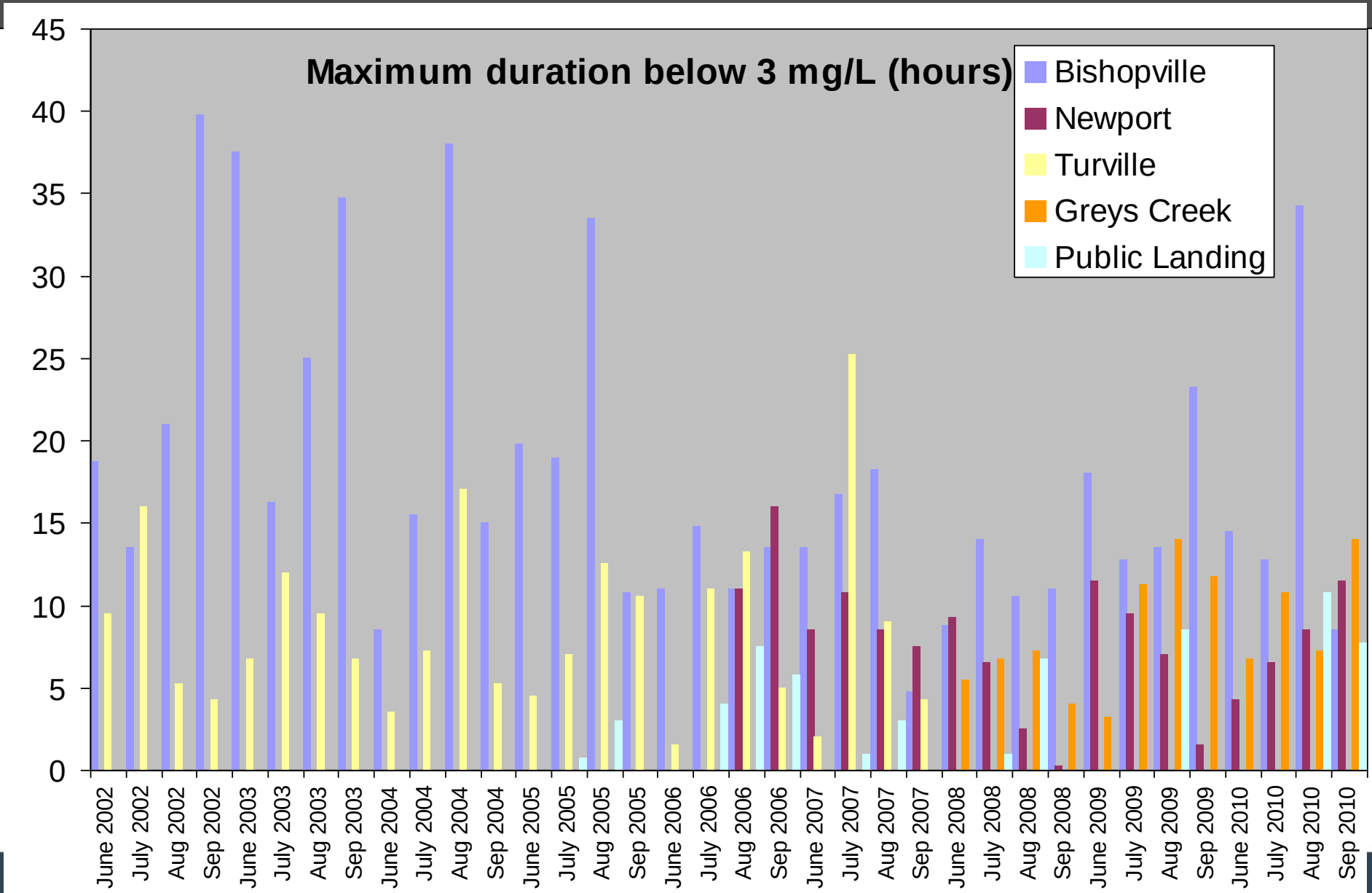


Duration of oxygen failure

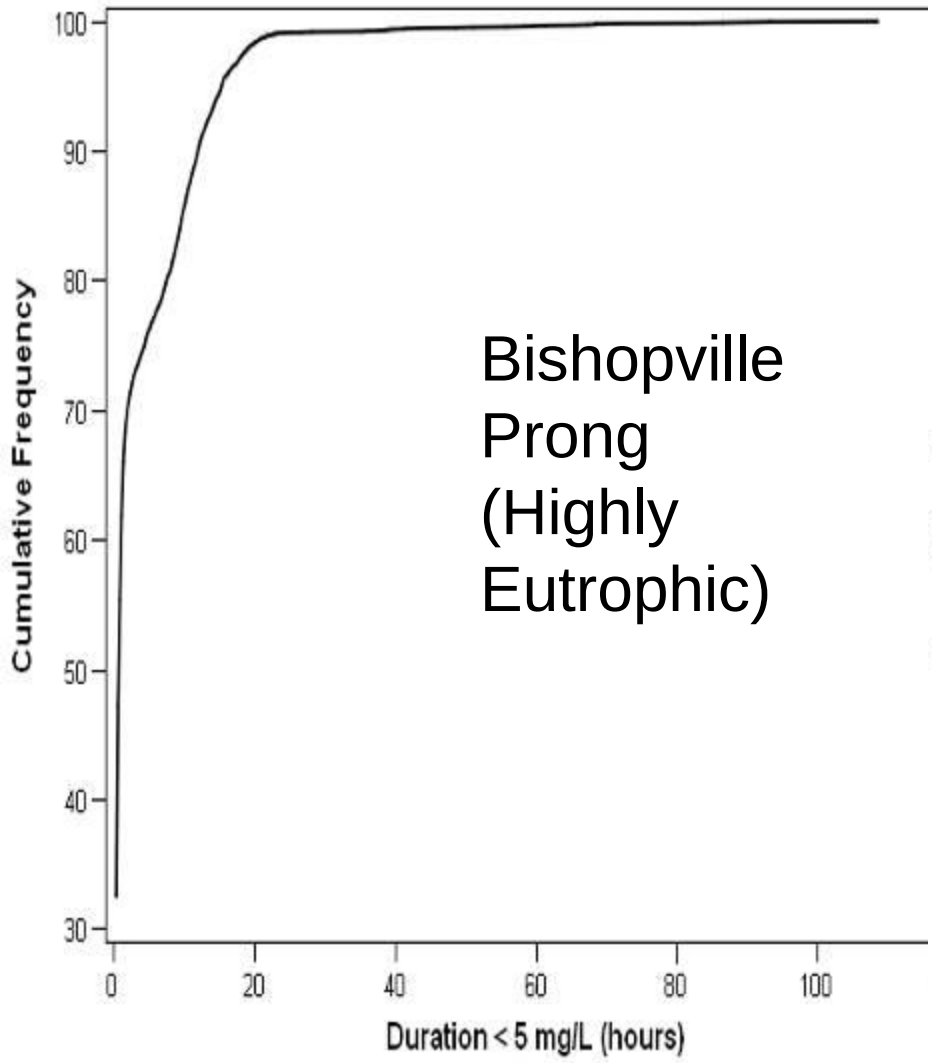
2. Duration of DO Failure



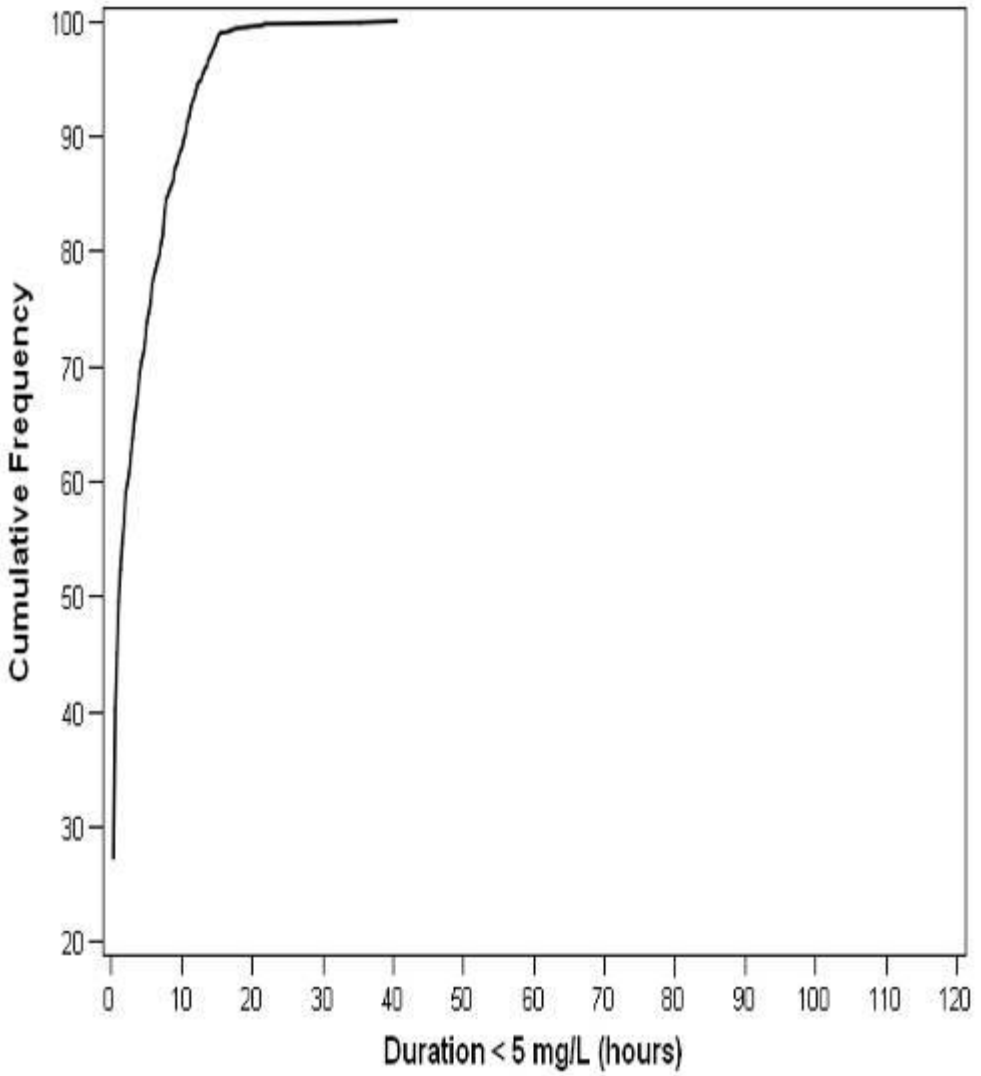
2. Duration of DO Failure



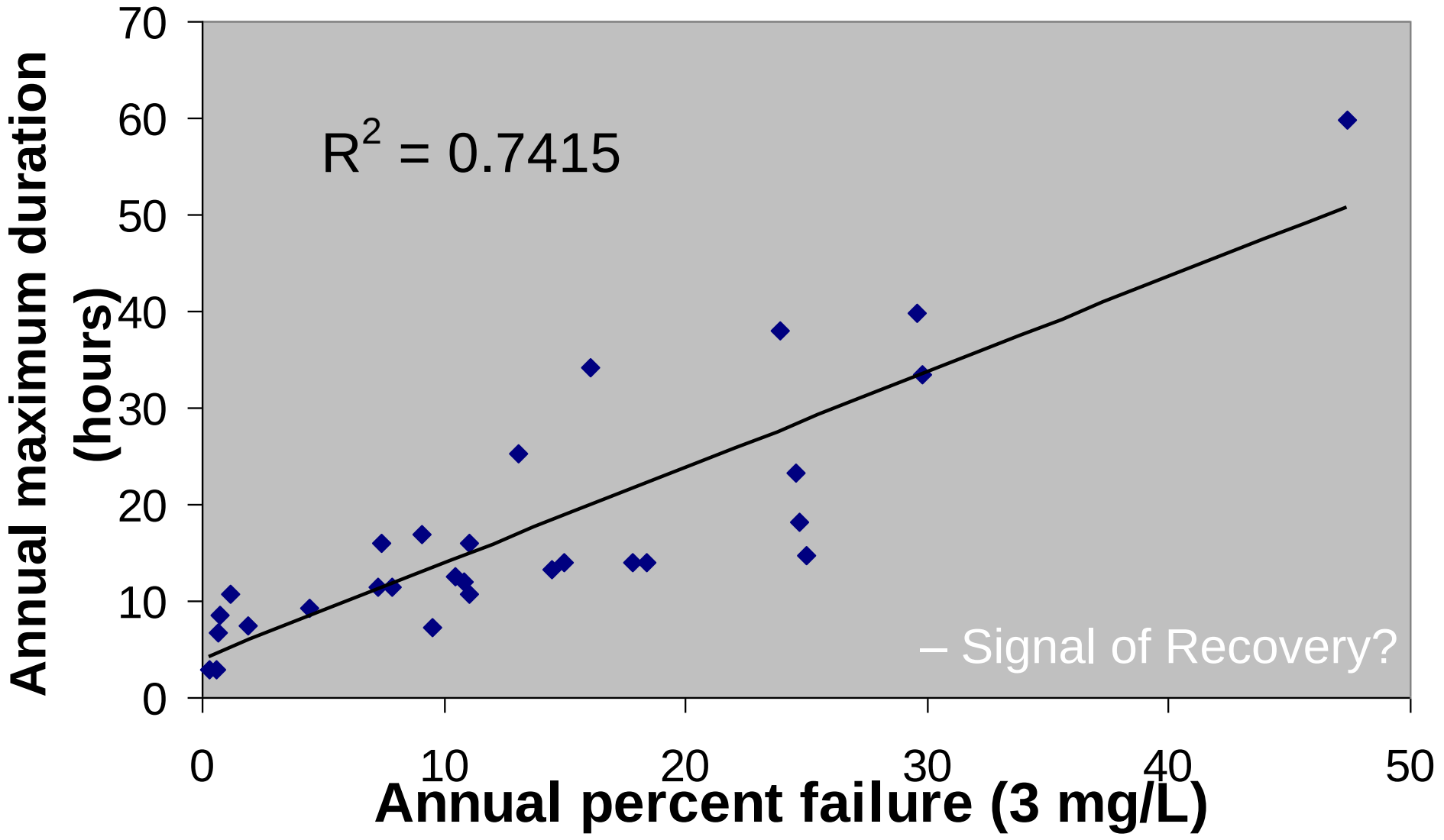
2. Cumulative Frequency of Durations



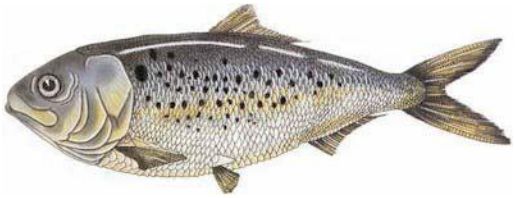
Bishopville Prong (Highly Eutrophic)



2. Failure Rate vs. Duration

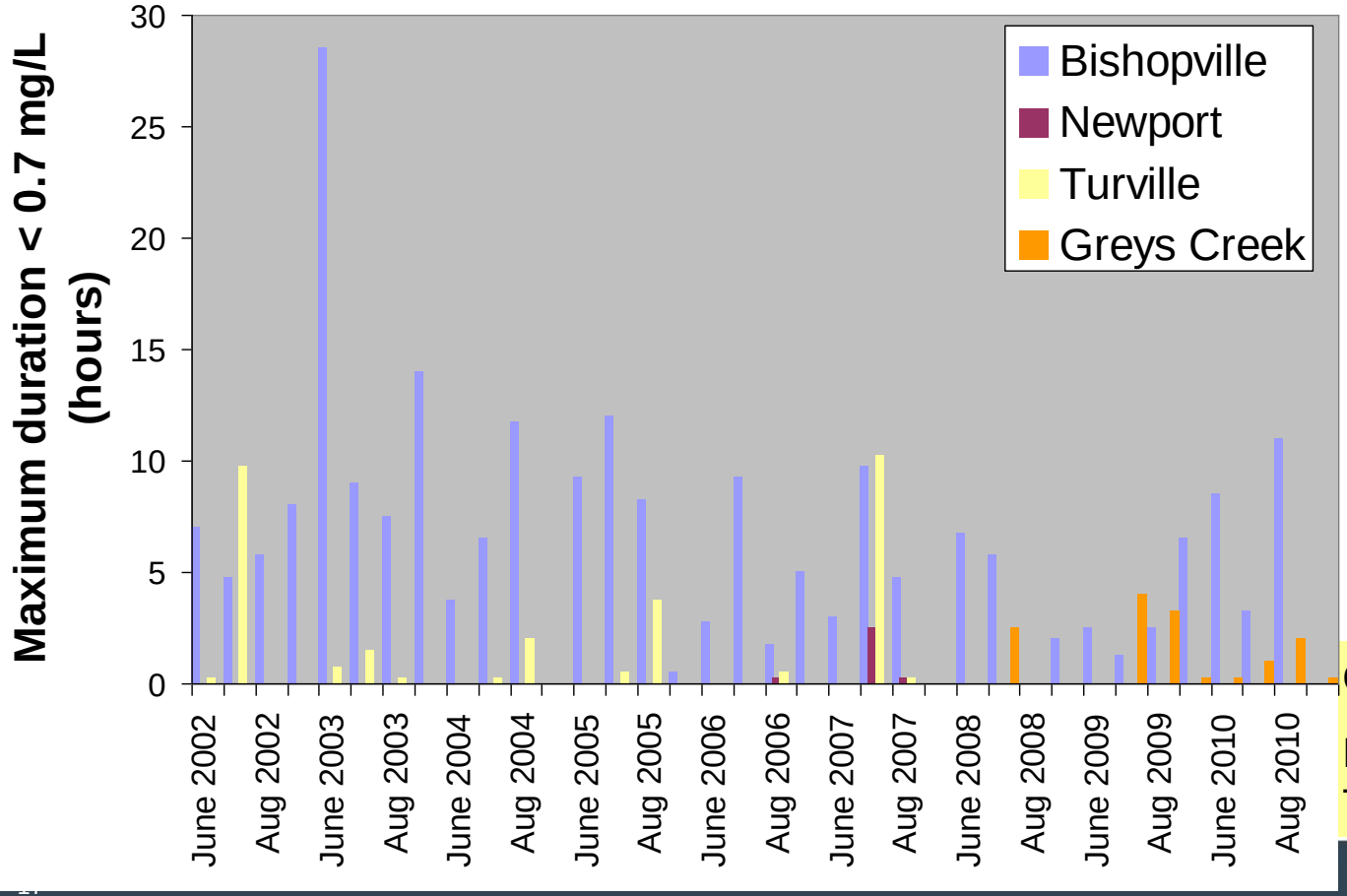


3. Habitat Suitability for Menhaden



2 hour **LC50** = 0.7 mg/L DO (juvenile)
@ 28ºC and 6.9 salinity

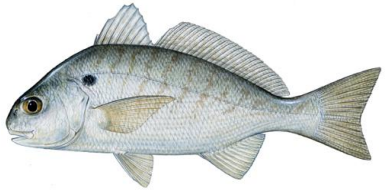
Station	Sal	ºC
NPC	21	26
TUV	25	27
BSH	22	28
GYC	21	28
PUB	27	27



Overall failures:

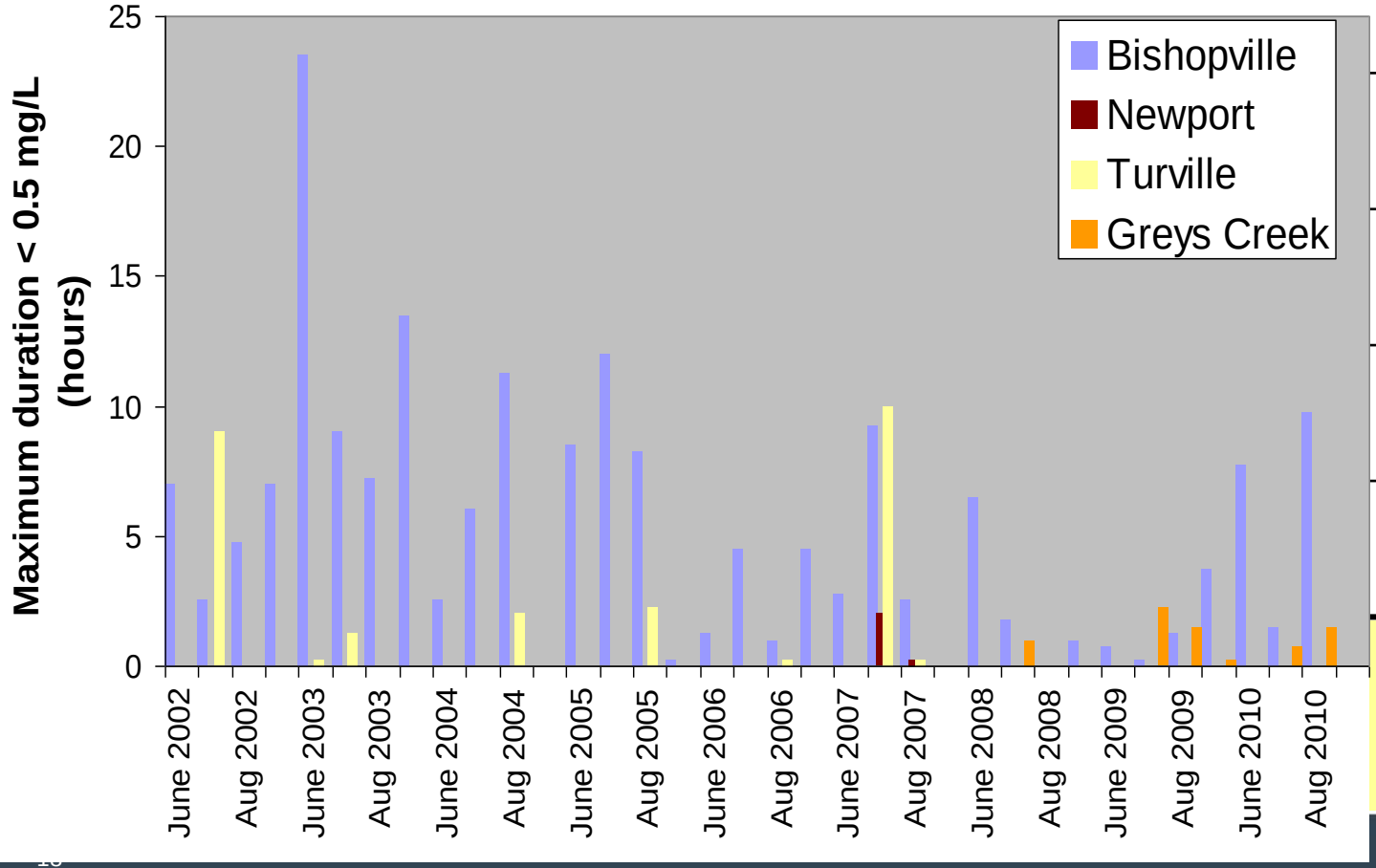
BSH=6.15%, NPC=0.07%,
TUV=0.61%, GYC=0.78%

Habitat Suitability for Spot



1 hour **LC50** = 0.5 mg/L DO (juvenile)
@ 28ºC and 6.9 salinity

Station	Sal	ºC
NPC	21	26
TUV	25	27
BSH	22	28
GYC	21	28
PUB	27	27



Overall failures:

BSH=4.96%, NPC=0.04%
TUV=0.44%, GYC=0.45%

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Conclusions and Future Research

- Percent failure of established DO thresholds follows a decreasing pattern from highly eutrophic areas to less eutrophic areas.
- Maximum duration below thresholds are also longer at highly eutrophic stations; however, **less eutrophic stations experience some long durations** below thresholds.
- Maximum duration is related to percent failure of thresholds. This could serve as a signal of recovery or degradation over time.
- DO tolerant finfish species experience hypoxia in exceedence of established LC50's in highly eutrophic areas.

Many thanks

DNR Field Office (deploying and maintaining continuous monitors):

Bill Hamilton

Stephanie Thompson

Maureen Anderson

Lauren Cunningham

John Zimmerelli

Jamie Strong

DNR Data Management (collecting, QAQC and storing data):

Mark Trice

Ben Cole

Lenora Dennis

Diana Domotor

Brian Smith

Special Thanks to Elgin Perry for analytical guidance.