

# The Interrelationships Between Dissolved Oxygen and Recreational *Morone saxatilis* (striped bass) Catch in the Chesapeake Bay



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# Background

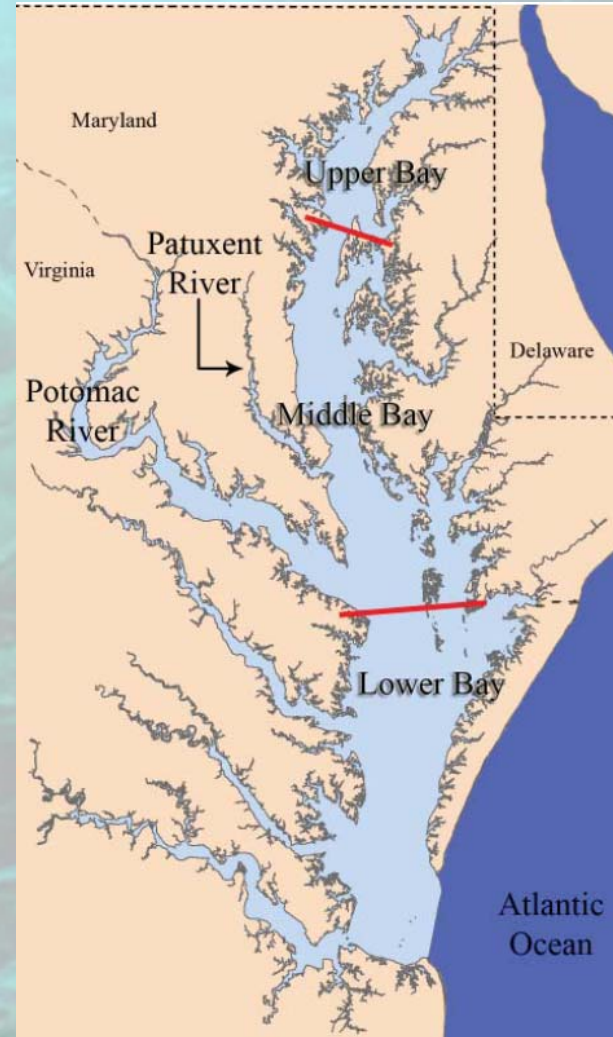
- Effects of Human-related activities and uses on coastal environment
- 60% of estuaries in the US affected by eutrophication
- Indicators of economic/human-use describe specific gains and/or losses

# Background

- Impacts of DO on fish catch
  - Behavioral changes
- Point water quality vs. interpolated water quality
- Statistical significance of DO

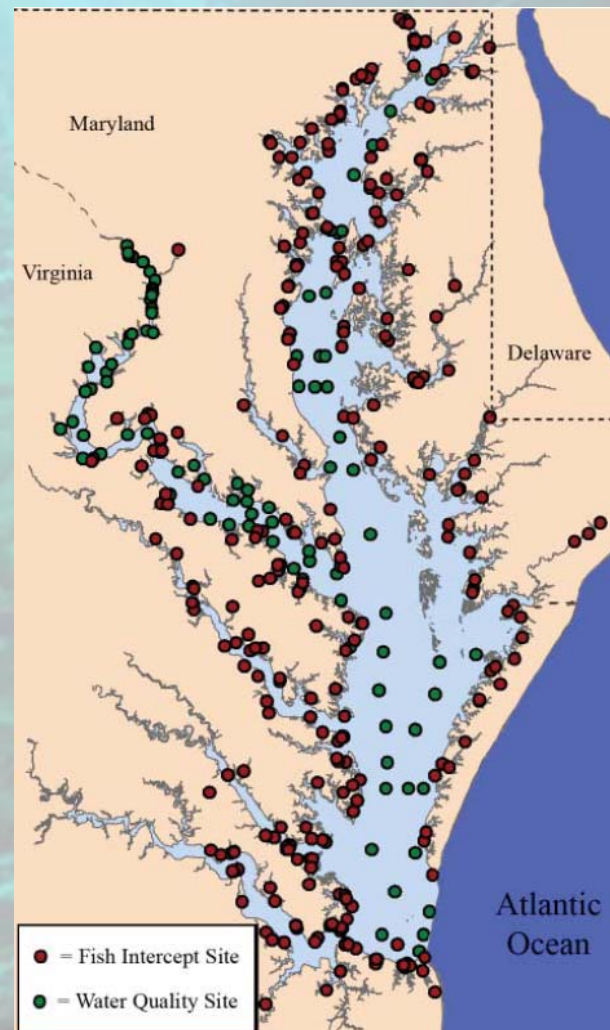
# Study Site

- Chesapeake Bay Physical Characteristics
  - 300 km long
  - 11,000 km<sup>2</sup> area
  - 167,000 km<sup>2</sup> watershed
  - 15 million people



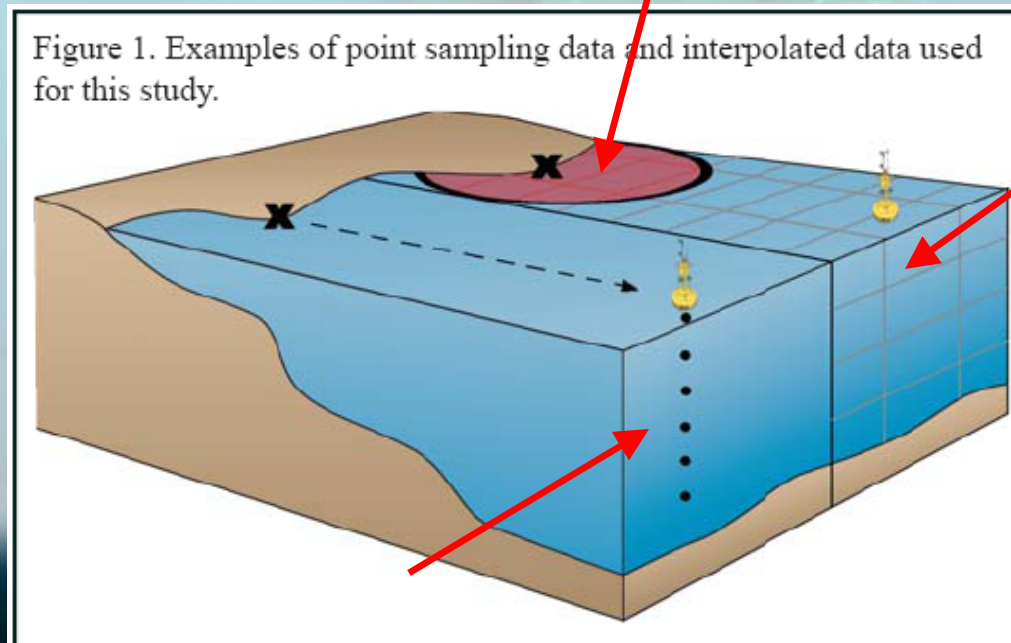
# Methods

- Fish Catch data
  - Fish landing site interviews
- Water Quality data
  - Point & Interpolated
- 2000-2006 data used for analysis



# Methods (cont.)

- Point Water Quality Data
- Interpolated Water Quality
  - Buffer (16km)



# Methods (cont.)

- DO Thresholds
  - NOAA
    - Anoxic = 0 mg/L
    - Hypoxic = >0 – 2 mg/L
    - Biological Stress = >2 – 5 mg/L
  - EPA
    - Anoxic = 0 – 0.5 mg/L
  - Modified
    - OK = >5 – 12 mg/L
    - High = >12 mg/L
- Data Subsets

# Methods (cont.)

- Expected striped bass catch model

$$\text{Equation 1: } C_{f,r} = \alpha + \beta_1 MC_r + \beta_2 HRSF_{f,r} + \beta_3 FDAY_f + \beta_4 BSALIN_r + \beta_5 BTEMP_r + \beta_6 BDO_r + \beta_7 (BDO_r)^2 + \beta_8 (BDO_r * BTEMP_r)$$



# Results

- Poisson Regression Model DO Results

	Model R-Square	Mean Catch ( $\beta_1$ )	Hours Fished ( $\beta_2$ )	Days Fished in Previous 12 Months ( $\beta_3$ )	Bottom Salinity ( $\beta_4$ )	Bottom Temperature ( $\beta_5$ )	Bottom Dissolved Oxygen (DO) ( $\beta_6$ )	Bottom DO <sup>2</sup> ( $\beta_7$ )	Bottom DO x Bottom Temperature ( $\beta_8$ )
Abbreviations		MC	HRSF	FDAY	BSALIN	BTEMP	BDO	BDO <sup>2</sup>	BDO*BTEMP
Chesapeake Bay	0.0459	0.3674	0.1379	-0.0001	-0.0042	0.0743	0.8995	-0.0355	-0.0073
Upper Bay	0.1444	0.3747	0.1167	0.0008	-0.0688	0.1736	1.7676	-0.0776	-0.0135
Middle Bay	0.0856	0.3603	0.1201	-0.0004	-0.1038	-0.1482	0.6797	-0.0679	0.0209
Lower Bay	0.0443	0.4564	0.1607	0.0001	-0.0192	-0.0181	-0.0027	-0.0005	0.0011
Patuxent River	0.1825	0.6589	0.2084	0.0005	-0.0509	0.025	-0.9799	0.0800	0.0050
Potomac River	0.1716	0.2527	0.3442	0.0138	-0.4222	-0.8600	-4.3616	0.1680	0.1360



 = significant at the 95th percentile  
 = not significant at the 95th percentile

Table 3. Modeled parameter estimates and their significance at the 95<sup>th</sup> percentile for each region of study in the Chesapeake Bay.

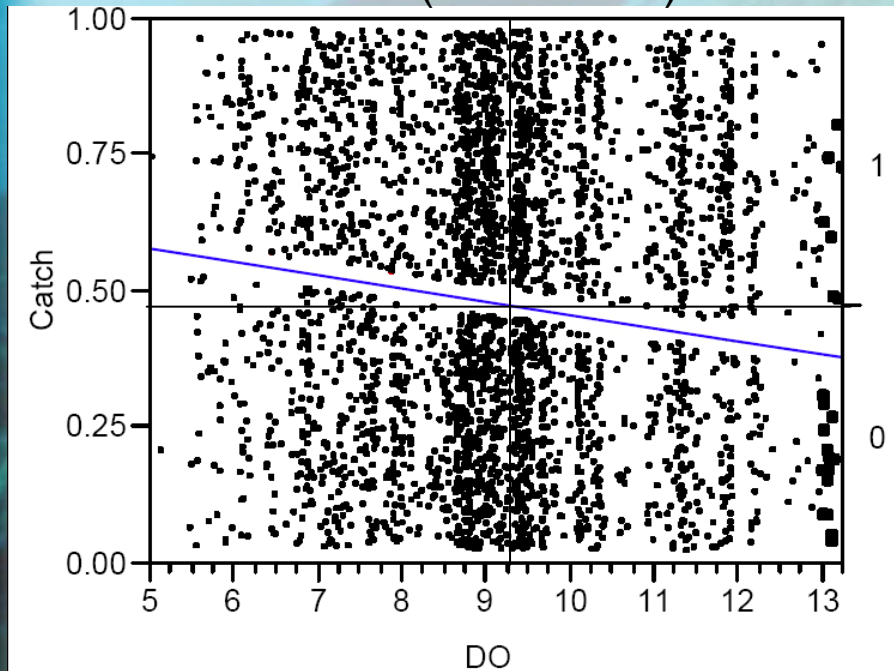
System/Region	Expected Fish Catch at Mean DO Conditions	Expected Fish Catch at 5 mg/L	Expected Fish Catch at 2 mg/L DO	Percent Increase from 2 to 5 mg/L
Chesapeake Bay*	(mean = 9.28 mg/L) <b>5.85</b>	2.03	0.67	<b>202</b>
Upper Bay*	(mean = 8.35 mg/L) <b>9.90</b>	3.98	0	<b>Undefined</b>
Middle Bay*	(mean = 7.49 mg/L) <b>0.25</b>	0	0	0
Long Island Sound**	(mean = 7.18 mg/L) <b>2.75</b>	2.77	2.71	2.1
Patuxent River**	(mean = 5.99 mg/L) <b>7.63</b>	6.27	2.16	65.5
Potomac River**	(mean = 4.53 mg/L) <b>4.07</b>	4.55	1.45	68.1

\* = Results from this study (2000-2006). \*\* = Results from Bricker et. al. 2006 (August 2002).

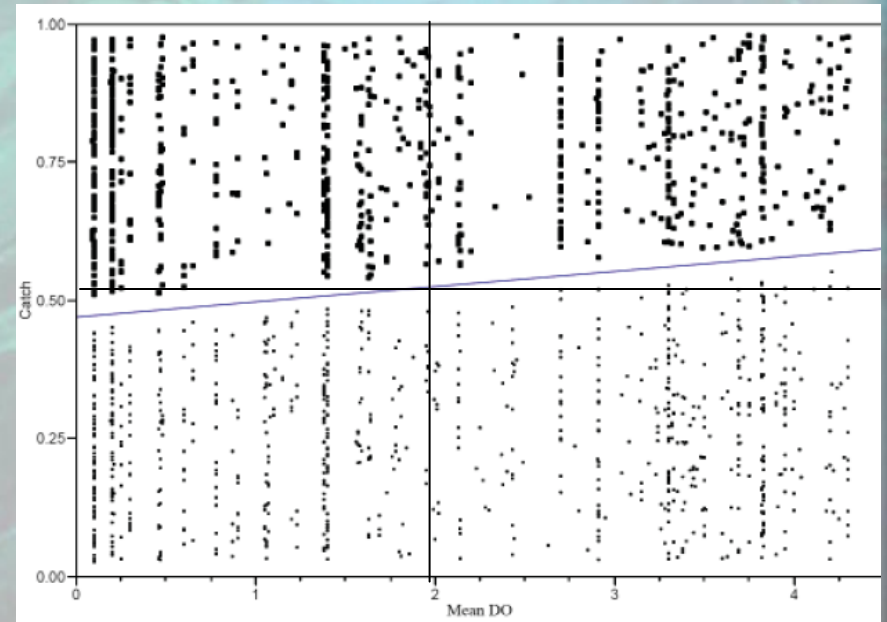
# Results (cont.)

- Chesapeake Bay

All DO (2000-2006)



Lower 10<sup>th</sup>% DO (2000-2006)

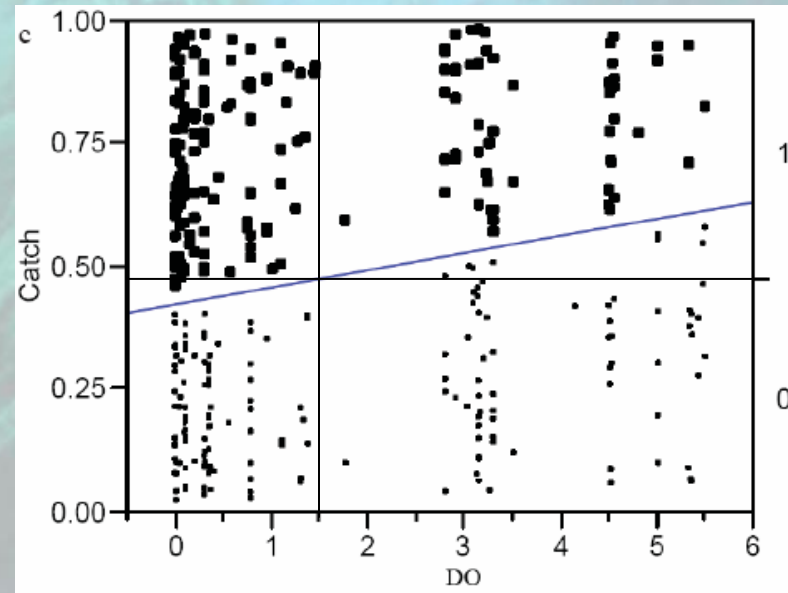
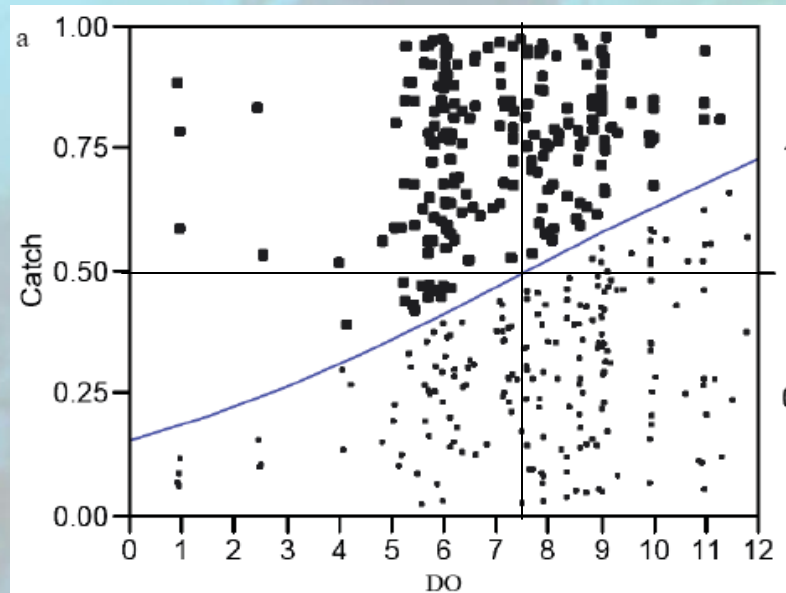


# Results (cont.)

- Middle Bay

All DO

Lower 25<sup>th</sup>%



		No Catch Included		No Catch Excluded	
		Cluster Analysis	Frequency Analysis	Cluster Analysis	Frequency Analysis
Chesapeake Bay	All	EX		EX	
	25th	UC	UC	UC	IR
	10th	EX	IR	UC	
Upper Bay	All	UC		UC	
	25th				
	10th				
Middle Bay	All	EX*			
	25th	UC	EX	EX	
	10th	EX	EX	EX	EX
Lower Bay	All	EX*			
	25th				
	10th				

EX = Generally expected outcome. Represents approximately 55% of significant results.

UC = Unclear results. Represents approximately 35% of significant results.

IR = Inverse expected relationship shown in both extreme categories. Represents approximately 10%.

\*Denotes where expected results deviated only in that the high DO (>12 mg/L) corresponded to no catch (NC).

# Conclusions

- Point vs. Interpolated data – No significant difference
- DO affects fish catch in bell curve
- Optimal DO in Chesapeake for catching Striped bass is 8-9 mg/L
- DO affects Striped bass catch more than other environmental variables included

# Acknowledgements

- Committee Members
- John Christensen, CCMA
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An underwater photograph showing a diver on the left and a large, dense patch of green seaweed on the right. The water is clear and blue. The word "Questions?" is centered in the image.

Questions?