Advanced dissolved oxygen criteria: temperature accounting?

Peter Tango with input again from Modeling WG (Gary Shenk, Lew Linker) and others

CAP WG

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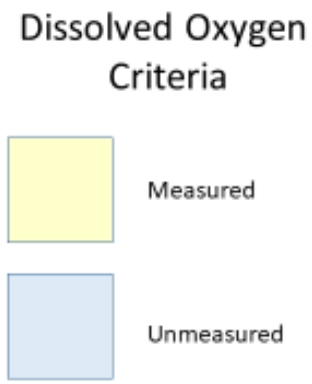
Designated Use	Dissolved oxygen Criteria Concentration/Duration		Temporal Application
Migratory fish spawning and nursery use	7-day mean ≥ 6 mg/L tidal habitats with 0-0.5ppt salinity		February 1 – May 31
	Instantaneous min ≥ 5 mg/L		
	Open water fish & shellfish designated use criteria apply		June 1 – January 31
Shallow water Bay grass use	Open water fish & shellfish designated use criteria apply		Year-round
Open water fish and shellfish use	30-day mean	≥ 5.5 mg/L Salinity: (0-0.5ppt)	Year-round
		≥ 5 mg/L Salinity: >0.5ppt	
	7-day mean	≥ 4 mg/L	
	Instantaneous min ≥ 3.2 mg/L		
Deep-water seasonal fish and shellfish use	30 day mean > 3mg/L		June 1 – September 30
	1-day mean >2.3 mg/L		
	Instantaneous min ≥1.7 mg/L		
	Open water Fish and shellfish designated use criteria apply		October 1-May 31
Deep channel seasonal refuge use	Instantaneous min > 1 mg/L		June 1 – September 30
	Open water F & S applies		October 1 – May 31

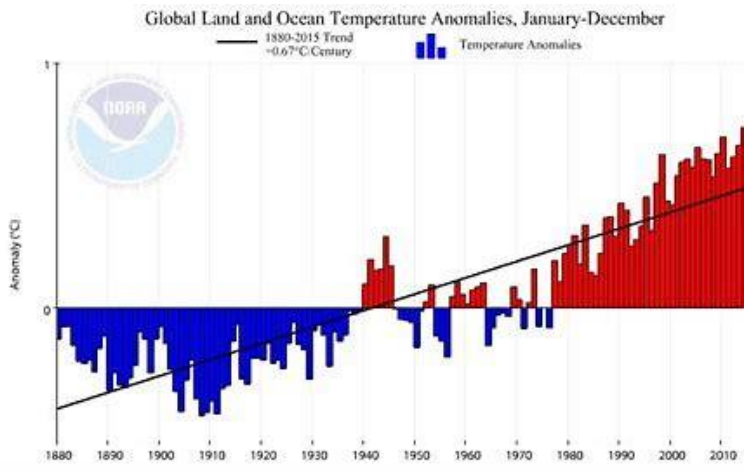


Present criteria are static for a static world

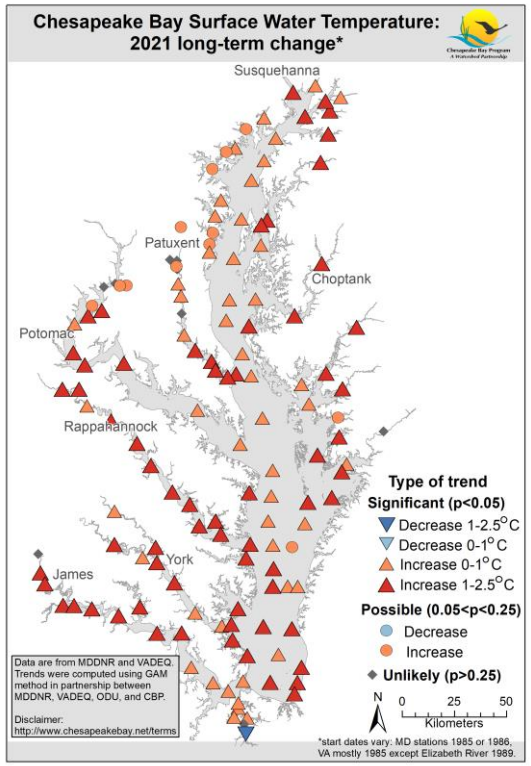
Foundation of Table USEPA (2003)

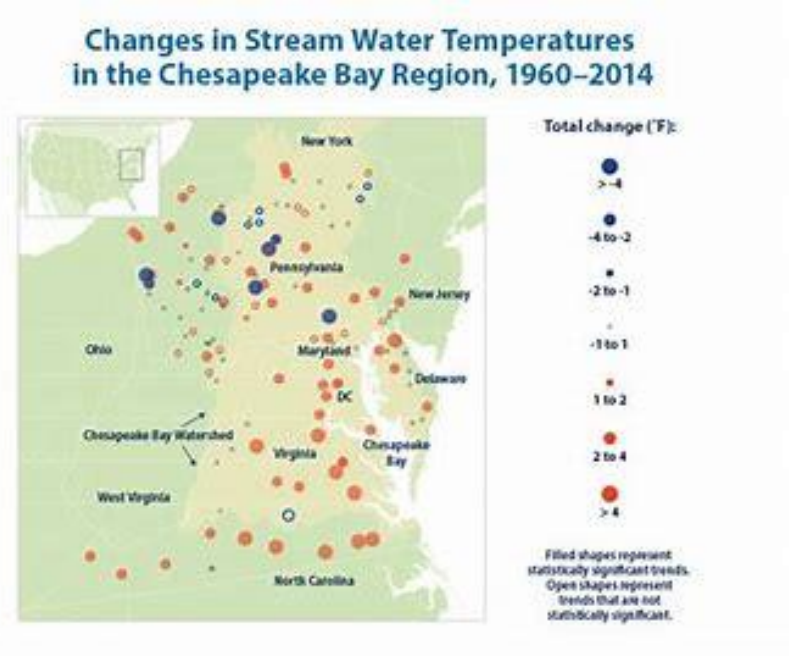
However, we have acknowledged and have good data indicating our world and our system is evolving. We are a non-stationary system affected by climate change

Global land and ocean temperature trends



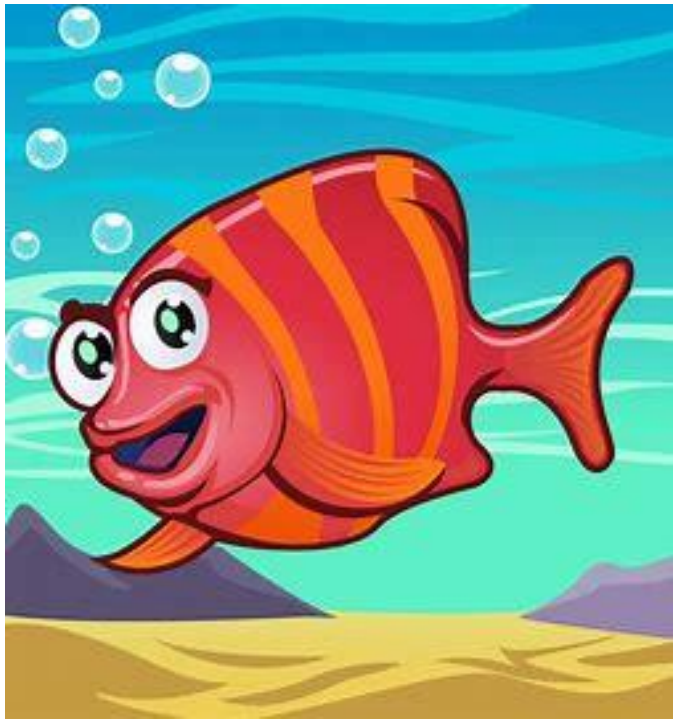
Bay and watershed water temperature trends



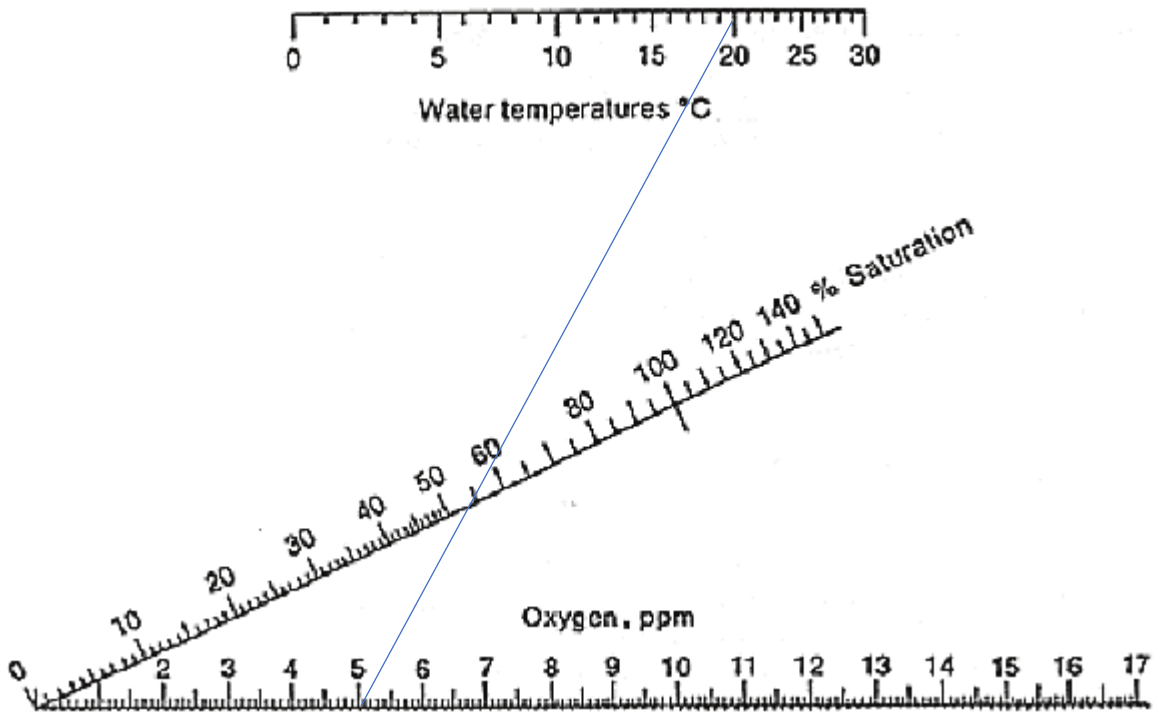


Can we/Should we update our criteria to account for rising temperatures?

- Oxygen saturation equivalence

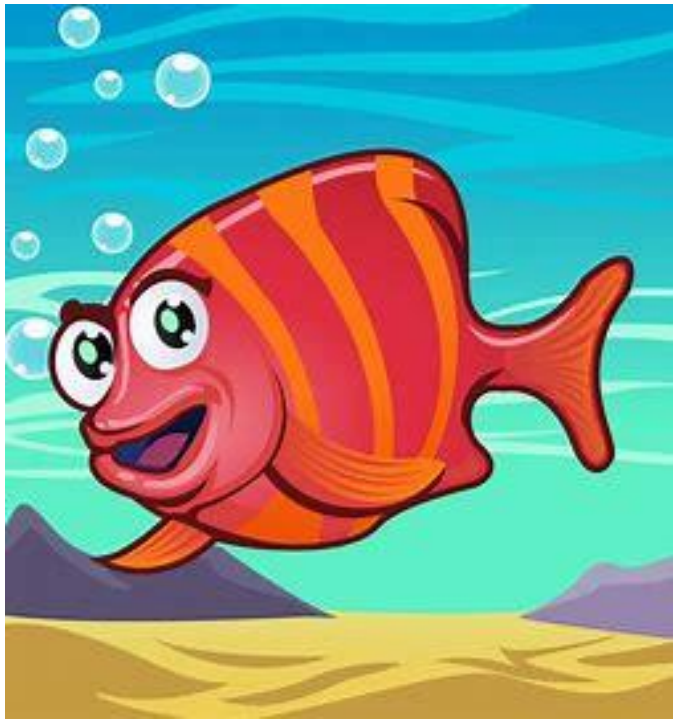


Nomograph



Question: Can we/Should we update our criteria to account for rising temperatures?

- Oxygen saturation equivalence



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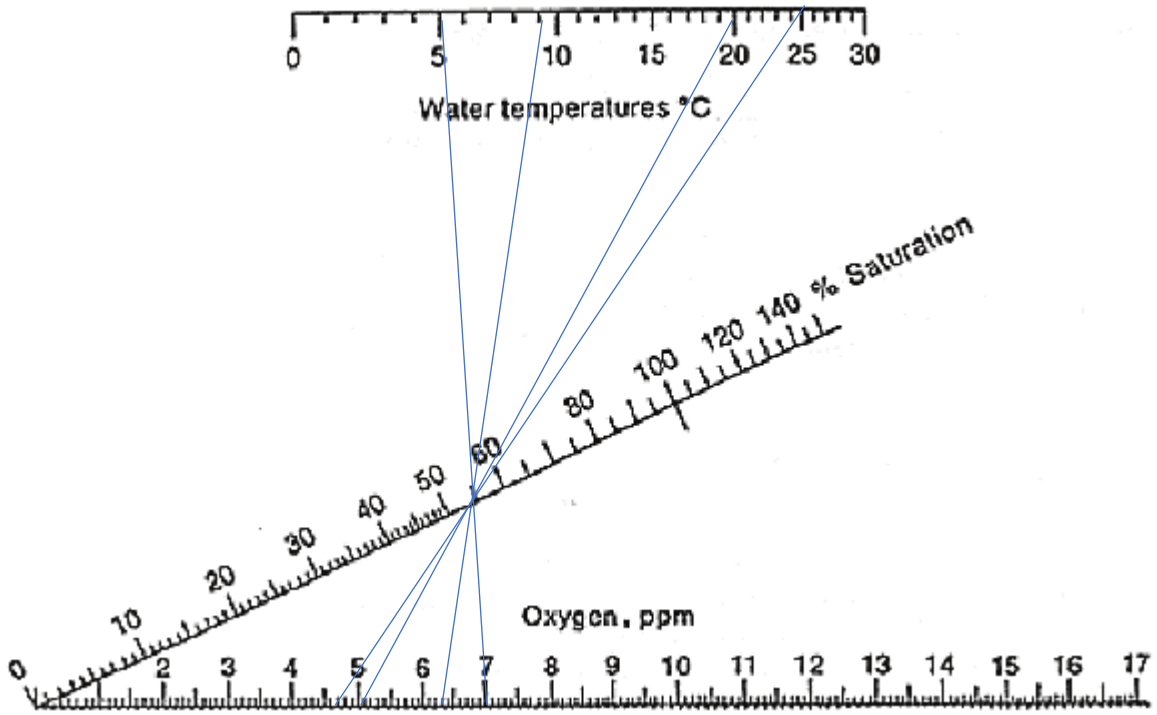

But wait! There’s more!

How does salinity affect the oxygen measurement?

- The solubility of oxygen in water is dependent on salinity, while the partial pressure and the % saturation of oxygen is not affected by changes in salinity. This means that in absolute concentration a seawater sample will contain less oxygen than a freshwater sample at the same temperature although the partial pressure is the same.
- The table below lists values of the concentration of dissolved oxygen at several temperatures in solutions with various chloride concentrations.
- Increasing the salt concentration leads to a decrease in oxygen solubility.

Table Solubility of oxygen in water as a function of temperature and salt concentration (Total pressure = 760 torr)

T [°C]	*Oxygen solubility [mg/L]*					
[Cl^-] (g/1000g)	**0**	**4**	**8**	**12**	**16**	**20**
0	14.5	13.9	13.3	12.6	12.0	11.3
10	11.3	10.8	10.4	9.9	9.5	9.0
20	9.1	8.8	8.5	8.1	7.8	7.4
30	7.5	7.3	7.0	6.7	6.4	6.1

Considerations

• Since DO saturation is more important than concentration to our fish and shellfish, do we move toward…

- Expressing criteria in DO SAT in the first place?

- Adjust criteria for average bay summer temperature based on the DO SAT difference between 1993-1995 and the current 3-year period.
  - Do we need to further incorporate salinity?