Attachment 18 – Consultation with experts on transition time to attribute improvements

Question from EPA to fish experts regarding transition time for striped bass, blue crab and oysters.

Sent: Tue 4/30/2013 9:18 AM

Dear fish panelists,

Thanks again for your earlier input on our Chesapeake Bay TMDL benefits study. As we are preparing to implement the stated preference survey component of our study, another question has arisen that would benefit from your input.

Specifically, our survey includes a statement of the time lag between implementation of watershed management practices and the realization of improvements in the stocks of three species: blue crab, eastern oysters, and striped bass. Insofar as possible, we want the descriptions of these time lags to be realistic. So our question is this:

For each of these species--and keeping in mind any other restoration activities that may be occurring at the same time--how long would you expect it to take for their population sizes in the Bay to fully respond to the water quality improvements and associated habitat changes once the nutrient and sediment loads reach the TMDL goals? Less than 5 years? Between 5 and 15 years? More than 15 years?

Thanks in advance for any insights you can provide!

Best regards,

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Steve Newbold
U.S. EPA
National Center for Environmental Economics (NCEE)
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Responses from Expert Consultants

Michael Kemp, Professor, Horn Point Laboratory, University of Maryland Center for Environmental Science

On Tue, Apr 30, 2013 at 12:07 PM, Michael Kemp <kemp@umces.edu> wrote:
Steve
My response is embedded in the text below.
Best of luck,
Michael

blue crab, ~5 yrs
eastern oysters, <5 yrs
striped bass, 5-10 yrs

Walter Boynton, Professor, Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science

On Tue, Apr 30, 2013 at 1:22 PM, Walter Boynton <boynton@umces.edu> wrote:
Steve,

My estimates is that the lag would be less than 5 years for crabs and striped bass and a long time (>20 years) for oysters. The oysters need a great deal of time to build reefs that support vibrant communities. That's my 2 cents

Walt Boynton

Elizabeth North, Associate Professor, Horn Point Laboratory, University of Maryland Center for Environmental Science

From: enorth@umces.edu
To: "Steve Newbold" <newbold.steve@epa.gov>
Subject: Expert fish panel compilation and summary for your review
Date: Fri, May 3, 2013 5:15 pm

Hi Steve,
I think you would see a big increase in these three species within 5 years, but it would take 5 to 15 years for blue crab and oysters to fully respond because their generation times are 1-3 years. Striped bass may take longer, more than 15 years, because they take ~ 5 years to reach sexual maturity and it will take several generations to see the full effects of water quality improvements.

Kind regards,
Elizabeth North

Edward Houde, Professor, Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science

On Tue, May 7, 2013 at 7:51 AM, Edward Houde <ehoude@umces.edu> wrote:

Steve: You pose yet another difficult question that requires speculation. And, you ask the question in the context of a "full response" to TMDL goal achievement and associated habitat changes.

Blue Crab: If there is any detectable response, I would speculate that it would be modest, registered as a small increase in aveage productivity over the long term, rather than a sudden bump-up in abundance or production. So, how about a small response in the 15-yr timeframe?

Oyster: Here, there potentially could be a notable response within a few years of achieving the TMDL goal and associated water-quality and habitat accompaniments. This possibly could occur on a decadal timeframe.

Striped Bass: There is no problem now with striped bass abundance or productivity in Chesapeake Bay. Their abundance has been at a historical high level for more than a decade, held to levels lower than they would be by quite high directed fishing mortality. I don't think it is reasonable to expect any clear effects of TMDL goal achievement and associated habitat changes. One could speculate about effects of climate change (increased temperature) combined with achievement of TMDL goals in which the TMDL success might mitigate the effects of climate change--i.e., propensity to reduce habitat volume suitable for striped bass production.

As you know, I worry about how speculation might affect policy decisions. Appropriate modeling research may be the only way to explore potential responses that are certain to be complex, probably non-linear, and at least partly dependent on species interactions.

Regards--EdH

Edward D. Houde, Professor and Vice President for Education
University of Maryland Center for Environmental Science
Chesapeake Biological Laboratory

Source for transition time of lake condition attribute

Erik Jeppesen, et al. (2005). "Lake responses to reduced nutrient loading - an analysis of contemporary long-term data from 35 case studies." Freshwater Biology **50**(10): 1747-1771.
http://dx.doi.org/10.1111/j.1365-2427.2005.01415.x

SUMMARY
1. This synthesis examines 35 long-term (5–35 years, mean: 16 years) lake re-oligotrophication studies. It covers lakes ranging from shallow (mean depth <5 m and/or polymictic) to deep (mean depth up to 177 m), oligotrophic to hypertrophic (summer mean total phosphorus concentration from 7.5 to 3500 lg L)1 before loading reduction), subtropical to temperate (latitude: 28–65_), and lowland to upland (altitude: 0–481 m). Shallow northtemperate lakes were most abundant.
2. Reduction of external total phosphorus (TP) loading resulted in lower in-lake TP concentration, lower chlorophyll a (chl a) concentration and higher Secchi depth in most lakes. Internal loading delayed the recovery, but in most lakes a new equilibrium for TP was reached after **10–15 years**, which was only marginally influenced by the hydraulic retention time of the lakes. With decreasing TP concentration, the concentration of soluble reactive phosphorus (SRP) also declined substantially.
3. Decreases (if any) in total nitrogen (TN) loading were lower than for TP in most lakes. As a result, the TN : TP ratio in lake water increased in 80% of the lakes. In lakes where the TN loading was reduced, the annual mean in-lake TN concentration **responded rapidly**.
Concentrations largely followed predictions derived from an empirical model developed earlier for Danish lakes, which includes external TN loading, hydraulic retention time and mean depth as explanatory variables.
4. Phytoplankton clearly responded to reduced nutrient loading, mainly reflecting declining TP concentrations. Declines in phytoplankton biomass were accompanied by shifts in community structure. In deep lakes, chrysophytes and dinophytes assumed greater importance at the expense of cyanobacteria. Diatoms, cryptophytes and chrysophytes became more dominant in shallow lakes, while no significant change was seen for cyanobacteria.
5. The observed declines in phytoplankton biomass and chl a may have been further augmented by enhanced zooplankton grazing, as indicated by increases in the zooplankton : phytoplankton biomass ratio and declines in the chl a : TP ratio at a summer mean TP concentration of <100–150 lg L)1. This effect was strongest in shallow lakes. This implies potentially higher rates of zooplankton grazing and may be ascribed to the observed large changes in fish community structure and biomass with decreasing TP contribution. In 82% of the lakes for which data on fish are available, fish biomass declined with TP. The percentage of piscivores increased in 80%of those lakes and often a shift occurred towards dominance by fish species characteristic of less eutrophic waters.

6. Data on macrophytes were available only for a small subsample of lakes. In several of those lakes, abundance, coverage, plant volume inhabited or depth distribution of submerged macrophytes increased during oligotrophication, but in others no changes were observed despite greater water clarity.
7. Recovery of lakes after nutrient loading reduction may be confounded by concomitant environmental changes such as global warming. However, effects of global change are likely to run counter to reductions in nutrient loading rather than reinforcing re-oligotrophication.