Comments from: Joel S. Steward, Technical Program Manager, Division of Environmental Sciences, Coastal Basins, St. Johns River Water Management District

I serve on Florida's Marine Technical Advisory Committee assisting the Florida Dept. of Environmental Protection with its development of numeric nutrient criteria for estuaries. I was listening in on the SAB teleconference meeting, Feb. 7, and I noted with interest your comments regarding seagrasses as endpoints and the application of loading - seagrass relationships as one way to develop criteria. I certainly support that application as one method; perhaps as the primary method for some estuaries. I would like to direct your attention to a few papers that, aside from the Tampa Bay paradigm, have demonstrated the application of the loading - seagrass relationship toward determination of nutrient loading limits: Vaudrey et al. (2010); Steward and Green (2007); Hauxwell et al. (2003); Valiela and Cole (2002); Short and Burdick (1996). Upon a cursory review of these papers, it is interesting to note that an intermediary response variable, such as chlorophyll a, is not always necessary to construct a simple model relating nutrient loading to seagrass depth-limit coverage and/or areal coverage.

Another more general empirical approach is the relationship between nutrient loading limits (e.g., TMDLs) and residence time across many Florida estuaries (Steward and Lowe 2010). This simple model addresses the nutrient-impaired estuaries in Florida by predicting upper mesotrophic N and P loading limits. This can be applied as one method of a multiple lines of evidence approach for establishing site-specific criteria for mesotrophic (not oligotrophic) estuaries. Residence time is also addressed in this model as advocated by Dr. Hans Paerl.

Because estuaries are complex, there is a strong tendency to apply complex methods (e.g. complex mechanistic models). If prediction can be explained by a rudimentary relationship, then simple models may be better for the development of nutrient criteria. R. H. Peters in his Critique for Ecology noted that "... just as the failure of complex models shows that complexity does not ensure success, so the success of very simple models shows that complexity is not always necessary."

Hauxwell, J. J., J. Cebrian, and I. Valiela. 2003. Eelgrass Zostera marina loss in temperate estuaries: Relationship to land-derived nitrogen loads and effect of light limitation imposed by algae. Mar Ecol. Prog. Ser. 247:59-73.

Peters, R. H. 1991. A Critique for Ecology. Cambridge University Press, New York, USA.
Short, F. T. and D. M. Burdick. 1996. Quantifying eelgrass habitat loss in relation to housing development and nitrogen loading in Waquoit Bay, Massachusetts. Estuaries 19:730-739.

Steward, J. S. and W. G. Green. 2007. Setting load limits for nutrients and suspended solids based upon seagrass depth-limit targets. Estuaries and Coasts 30:657-670.

Steward, J. S. and E. F. Lowe. 2010. General empirical models for estimating nutrient load limits for Florida's estuaries and inland waters. Limnol. Oceanogr. 55:433-445.

Valiela, I. and M. L. Cole. 2002. Comparative evidence that salt marshes and mangroves may protect seagrass meadows from land-derived nitrogen loads. Ecosystems 5:92-102.

Vaudrey, J. M. P., J. N. Kremer, B. R. Branco, and F. T. Short. 2010. Eelgrass recovery after nutrient enrichment reversal. Aquatic Botany 93:237-243.