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Uncharted Waters: How Tampa Bay's Nutrient Management Experience Adds Clarity to Coastal Zone Management

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Introduction

Seagrasses are an important marine resource, functioning as keystone species in healthy estuaries. Stationary submerged vegetation are effective integrators of water quality and function as sentinel species in estuarine and marine environments.[1] The strong link between water quality and seagrass distribution makes seagrass a good indicator of ecosystem health.[2] Healthy seagrass populations are critical resources that provide a multitude of benefits to estuarine ecosystems including: providing structural habitat for megafauna, recreationally and commercially important fish and invertebrate species, stabilization of submerged shoreline sediments, and functioning as an important component of nutrient cycles.[3]

Due to their roles in providing habitat and food for invertebrates, small vertebrate marine organisms, and large grazing herbivores such as sea turtles and manatees, seagrass communities constitute highly productive and diverse ecosystems.[4] A vast array of estuarine and marine organisms relies upon seagrass habitats for a portion or all of their life cycles.[5] The canopy structure of a seagrass bed provides protection and cover for fish in their fry and juvenile stages, essentially serving as a nursery ground.[6] Such nurseries have an integral function due to their regenerative capacity for many commercially and recreationally important species of fish. Primary production within seagrass beds also provides food for these fish species and serves as a trophic foundation for the ecosystem. The stability for these valuable habitats is provided by the hearty root systems of seagrasses.[7] These root systems provide stability not only for the seagrass communities, but also for sediments and the benthic production that is found at the sea floor.[8]

Nutrient cycling and assimilation are another of the many functions that seagrass communities provide. Seagrasses filter nutrients and contaminants, which helps improve water quality and support adjacent habitats and fisheries.[9] They are hotspots for organic-matter accumulation and nutrient

[1]R.J. Orth, T.J.B. Carruthers, W.C. Dennison, C.M. Duarte, J.W. Fourqurean, K.L. Heck, Jr., A.R. Hughes, G.A. Kendrick, W.J. Kenworthy, S. Olyarnik, F.T. Short, M. Waycott, and S.L. Williams, *A Global Crisis for Seagrass Ecosystems*, 56:12 Bioscience, 987 (2006).

[2]See, e.g. D.A. Tomasko, C.J. Dawes, and M.O. Hall, The effects of anthropogenic nutrient enrichment on turtle grass (*Thalassia testudinum*) in Sarasota Bay, Florida, 22 Estuaries 592 (1996); C.J. Dawes, R.C. Phillips, and G. Morrison, Seagrass Communities of the Gulf Coast of Florida: Status and Ecology (report to the Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute and the Tampa Bay Estuary Program, 2004); K.A. Moore, D.J. Wilcox, B. Anderson, T.A. Parham, and M.D. Naylor, Historical Analysis of Submerged Aquatic Vegetation (SAV) in the Potomac River and Analysis of Bay-wide SAV Data to Establish a New Acreage Goal (report to The Chesapeake Bay Program, Report Number CB983627-01, 2004); and H. Greening and A. Janicki, Toward reversal of eutrophic conditions in a subtropical estuary: water quality and seagrass response to nitrogen loading reductions in Tampa Bay, Florida, USA, 38 Environmental Management 163 (2004).

[3]Dawes et al., *supra* n. 2.

[4]C.A. Moncreiff and M.J. Sullivan, Trophic importance of epiphytic algae in subtropical seagrass beds: evidence from multiple stable isotope analyses, 215 Marine Ecology Progress Series 93 (2001).

[5]Dawes et al., *supra* n. 2.

[6]Dawes et al., *supra* n. 2.; Orth et al., *supra* n. 1.

[7]A.J. Janicki, D.L. Wade, and D.E. Robison, *Habitat Protection and Restoration Targets for Tampa Bay* (report to the Tampa Bay Estuary Program, 1995).

[8]Dawes et al., *supra* n. 2.

[9]Id.

regeneration and recycling, which support primary production and sustain food webs.[10] They can also serve as sinks for nitrogenous loads from watershed sources, which can aid attenuation of nutrient loads when seagrasses are found sufficiently abundant.[11]

While seagrasses are generally resilient, they are threatened by human activities. Anthropogenic nitrogen loads can lead to excessive algae growth in nitrogen-limited systems such as estuaries, which adversely affects light penetration to submerged seagrasses, thus stunting photosynthesis.[12] Sediment deposition related to development of shorelines and the watershed also negatively impact seagrass growth.[13] As seagrasses live in the shallow, protected coastal waters that are generally directly proximal to the shore and watershed, these systems are highly susceptible to nutrient and sediment inputs.[14]

A common pattern in seagrass coverage has emerged in highly-perturbed, urban estuaries, in a process known as eutrophication. As the shorelines and watersheds proximal to seagrass beds have become more developed, anthropogenic loadings of nitrogen and sediments have increased. These increases in loadings have had detrimental effects on water quality; of particular importance to seagrass health are the resultant algal blooms from excessive nitrogenous loads and increased turbidity from sedimentation. Algal blooms and increased turbidity each negatively impact light attenuation in the water column above seagrass communities, which is devastating to green leafy plants. Seagrass populations have declined in response.

As researchers and managers within these systems began to identify this pattern, the notion of seagrass as an ecological bellwether developed. As sentinel species, due to the effectiveness of seagrasses to integrate water quality parameters, these communities were soon realized to be *in-situ* indicators of estuarine health and thus employed as components of watershed-based management and planning tools. Harbor-wide water quality was inherently linked to seagrass health, which was then used as an indicator of the success of efforts to reduce watershed pollutant loads in estuaries throughout the United States, including Chesapeake Bay, and the focus of this study, Tampa Bay.

The Chesapeake Bay program was the first major estuarine program in the United States to make seagrass restoration and protection a vital component of their water pollution control framework.[15] The 1987 Chesapeake Bay Agreement identified the "need to determine the essential elements of habitat quality and environmental quality necessary to support living resources and to see that these conditions are attained and maintained" as instrumental to overall bay health.[16] In 2004, researchers in Chesapeake Bay estimated that only 15% of the bay's historical seagrass distribution remained.[17] Having reviewed aerial photography dating back to 1937, the researchers suggested that these declines in seagrass were linked to deteriorating water quality conditions in Chesapeake Bay.[18] The Chesapeake Bay Program established seagrass restoration targets and defined water quality and habitat-based requirements for seagrasses in Chesapeake Bay.[19]

After decades of losses, seagrass meadows were identified by the Tampa Bay Estuary Program (TBEP) as critical estuarine habitats for fish and wildlife targeted for protection and restoration.[20] This approach is based on the premise that the healthiest seagrass populations are located in open waters fed by rivers, streams, and runoff with the lowest levels of anthropogenic nutrient pollution, which is a

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[10] Id.

[11] Id.

[12] See, e.g., W.C. Dennison, R.J. Orth, K.A. Moore, J.C. Stevenson, V. Carter, S. Kollar, P.W. Bergstrom and R.A. Batiuk, *Assessing Water Quality with Submersed Aquatic Vegetation*, 43 Bioscience 86 (1993); Sarasota Bay National Estuary Program, *The Comprehensive Conservation and Management Plan for Sarasota Bay* (unpublished report, 1995); Chesapeake Bay Program, *Chesapeake Bay Submerged Aquatic Vegetation Water Quality* and Habitat-Based Requirements and Restoration Targets (unpublished report, 2000); L.J. Morris and R.W. Virnstein, The demise and recovery of seagrass in the northern Indian River Lagoon, Florida, 27 Estuaries and Coasts 915 (2004); and Greening & Janicki, supra n. 2.

[13] Moore et al., *supra* n. 2.

[14] Orth et al., *supra* n. 1.

[15] Chesapeake Bay Program, *supra* n. 12.

[16] Id.

[17] Moore et al., *supra* n. 2.

[18] *Id*.

[19] Chesapeake Bay Program, *supra* n. 12.

[20] Janicki et al., *supra* n. 7.

function of upstream land uses. As this premise has been embraced throughout the Tampa Bay watershed, seagrass numbers are on the rebound from the nadir observed in the 1980s. The use of seagrass health as an indicator of water quality is not, however, relegated to the realm of scientific inquiry. As will be explored in this report, seagrass has been chosen as a "biological barometer" to gauge the efficacy of pollution strategies by regulators and managers as well.[21]

Nutrient pollution management in the Tampa Bay watershed is an amalgamation of laws, jurisdictions, and stakeholder groups, with a predictable level of "regulatory cacophony" resulting from this complex regime.[22] Federal and state laws interact, sometimes on-point, sometimes not. The mandates of these laws are left for the various jurisdictions, which include the State of Florida, counties and municipalities, and the Southwest Florida Water Management District (SWFWMD), to apply. Needless to say, the complexity of competing interests and oftentimes contradictory mandates has led to confusion with respect to nutrient pollution abatement in the Tampa Bay watershed. Despite the so-called regulatory cacophony resulting from jurisdictional and legal complexities, stakeholders throughout the Tampa Bay watershed have developed an innovative cooperative management strategy to achieve measurable results with respect to the most-damaging of nutrients entering the estuary: nitrogen loads. The establishment of the Tampa Bay Nitrogen Management Consortium (NMC), which will be discussed at length, *infra*, in Section III., is a unique example of a region coming together to address a serious environmental threat to an iconic natural feature.

The goal of this research is to distill the aforementioned regulatory cacophony into a manageable legal context for nutrient management in Tampa Bay, culminating with a profile of the stakeholder coalition developed to address this mess, the NMC. The author believes that the emerging picture of seagrass health in Tampa Bay is an environmental success, and that discursive and data-driven resource management is a model that could serve international coastal communities, at any level of commitment to conservation.

Legal Background

With the scientific rationale for the use of seagrass as a proxy indicator of the health of Tampa Bay and its watershed firmly in tow, an overview of the complicated regulatory web that exists to protect these resources ensues. This section sets out to describe the jurisdictional boundaries within the Tampa Bay watershed and the federal and state legal regimes designed to protect water quality in the estuary. After a discussion of this convoluted legal milieu, the NMC will be introduced, with specific attention given to the failures of the pre-existing regime which necessitated the formation of the NMC in the first place.

Jurisdictions of the Tampa Bay Watershed

Tampa Bay is a large open-water estuary in Florida, USA, with a watershed encompassing approximately 6,051 km2. Within its confines, the watershed contains all or part of five different counties, 65 municipalities, and even a large military installation, MacDill Air Force Base in Tampa. Applying watershed-based management approaches to a region with so many governmental stakeholders is extremely difficult, due to the inconsistencies between hydrological and geopolitical boundaries, but this only begins to paint the Tampa Bay jurisdictional picture. The State of Florida is further divided into five water management districts (WMD), including the SWFWMD, within which the entire Tampa Bay watershed is located. WMDs are charged with implementing many of the State of Florida's water supply and quality initiatives, with authority to do so granted by the Florida Department of Environmental Protection (FDEP).[23] In turn, going up the vertical federalism ladder, the

[21] Walt Avery and Roger Johanson, *Data Summary from the Tampa Bay Interagency Seagrass Monitoring Program Through Year 2008* 1 (unpublished report to the Tampa Bay Estuary Program, March 16, 2010) (available at http://www.tbeptech.org/TBEP_TECH_PUBS/2010/TBEP_01_10_Data_Summary_from%20TBISP_thru2008Final.pdf).

[22] "Regulatory cacophony" is a euphemism coined by the author in an attempt to characterize the "noise" associated with so many legal instruments and players not always "playing in tune."

[23] See generally, Joy R. Brockman, *Coastal Ecosystem Protection in Florida*, 20 Nova L. Rev. 859 (Winter, 2002).

State of Florida and FDEP implement key federal provisions for environmental protection.[24] Therefore, the federal government, the State of Florida, regional agencies, and local and county municipalities are all conceivable governmental stakeholders in the management of pollution to Tampa Bay. Jurisdictional crowding is inevitable, with the implications even more readily apparent when assessed in the context of the regulatory schemes governing nutrient pollution in the region.

Key Federal and State Laws Governing Nutrient Pollution in Tampa Bay

The United States environmental statutory regime is a complex series of overlapping laws and regulations that are constantly evolving. While many statutes play a role in the protection of aquatic and marine resources, the Clean Water Act (CWA) is particularly pertinent to the discussion of nutrient pollution in Tampa Bay and its watershed.[25] The CWA is the principal federal statute governing pollution discharged to water bodies in the United States. It is primarily implemented at the state level, including Florida. Using both technology-based limits and water quality standards-based effluent limitations (WQBELs), the CWA attempts to regulate pollution at both sources and sinks.[26] Technology-based limits are imposed on dischargers via permits, and are based on the "best" type of pollution control technology required of an industry under the CWA.[27] Of particular importance to the Tampa Bay nutrient pollution issue, due to its nonpoint source nature, are WQBELs.

WQBELs are standards for acceptable levels of pollutants in water bodies. The standards, or criteria, are set based on a "designated use" for a water body.[28] Ranging from drinking water and recreational ("fishable/swimmable") uses to industrial and agricultural uses, a water body's classification dictates the standard against which it will be held. States are required to assess their waters for impairments against the adopted criteria for a particular water body's designated use. When a water body is found to be impaired, the CWA requires that a Total Maximum Daily Load (TMDL) be calculated.[29] The TMDL estimates the total amount of a pollutant that can enter a water body without exceeding existing water quality criteria. It is up to the state to negotiate a load allocation agreement among the responsible parties. Making reliable estimates as to who discharged how much of what pollutant, and how much each party must reduce their loads, is the unenviable role of managers in charge of the TMDL process.

Water quality criteria are generally numeric, meaning that quantitative thresholds on the concentration of a given pollutant represent the WQBELs. Numeric criteria leave little room for argument, for better or for worse. Until 2013, however, there were no numeric criteria for nutrient pollutants in Florida's waters. The former standard was narrative: "In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.".[30] It was plainly evident that objectivity in determining whether a water body is impaired for nutrients was a difficult goal to achieve. Adding to the regulatory cacophony, Florida's vague nutrient criteria posed difficulties to scientists assessing them and create the potential for litigation for those trying to interpret them. EPA has recently promulgated a rule imposing numeric nutrient criteria on Florida waters in an attempt to provide more measurable standards for addressing nitrogen and phosphorus pollution.[31]

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[24] Id.

[25] See generally, Robin Kundis Craig, Valuing Coastal and Ocean Ecosystem Services: The Paradox of Scarcity for Marine Resources Commodities and the Potential Role of Lifestyle Value Competition, 22 J. Land Use & Envtl. L. 355 (Spring, 2007). Other significant federal statutes include the Coastal Zone Management Act, the National Marine Sanctuaries Act, the Marine Mammal Protection Act, and the Magnuson-Stevens Fisheries Conservation Act.

[26] The CWA also regulates the permitting of wetland dredge and fill activities, 33 U.S.C. § 1344. Permitting is generally carried out by the U.S. Army Corps of Engineers, but it is further complicated in Florida by state-level permitting, and even county-level (e.g., Hillsborough County) of some projects. Due to the narrow scope of this paper, a more robust description of Florida's wetlands program is excluded.

[27] Jeffrey M. Gaba, *Environmental Law* 105-8 (4th ed., Thomson West 2009).

[28] Id.

[29] Id.

[30] 62 Fla. Admin. Code 302.530(47) (2010).

[31] 75 Fed. Reg. 4173 (Jan. 26, 2010).

Coalition-Building and the Tampa Bay Nitrogen Management Consortium

The assessment of water bodies for impairments under the CWA, and the ensuing TMDL process for those waters identified as impaired, can be a trying process. TMDLs are inherently rife with conflict. The sink assessment approach of a TMDL can easily result in finger-pointing, especially towards point sources of pollution where an actual load can be calculated. The role of hard-to-measure (therefore, hard-to-regulate) nonpoint sources in nutrient loading is not easily elucidated. Coupled with the multi-jurisdictional, multi-faceted regulatory context within which they must operate, the Tampa Bay watershed's nutrient stakeholders decided to use this framework in their favor. Under the leadership of the TBEP, itself a product of the CWA,[32] the Tampa Bay Nitrogen Management Consortium (NMC) was born.[33] Originating in 1996, the NMC is "an ad-hoc public-private partnership that includes federal and state regulators, local governments, and key-industry stakeholders focused on managing nutrient inputs to Tampa Bay."[34] The success of the NMC is undeniable. Nutrient limits have been developed for all major sources discharging within the Tampa Bay watershed, with nitrogen and phosphorus levels currently half of what they were in the 1970s.[35] Rather than buckle under regulatory cacophony, the NMC has achieved measurable results through the collective voluntary actions of its constituents and state regulatory actions such as the SWIM program. The inclusion of local governments, the typical arbiters of land use planning, allows nonpoint source nutrient pollution originating from urban, residential, and agricultural land uses to be addressed, without focusing blame on industrial point sources. Employing a watershed-based approach, the NMC has brought all the major players to the table to minimize the conflict of the TMDL process.

Note that the efforts of TBEP and the NMC are directed at both phosphorus and nitrogen load reductions. However, acknowledging that the Tampa Bay estuary's primary productivity (i.e., algal growth) is nitrogen-limited, the focus of their efforts is on nitrogen pollution management. Thus, central to the NMC's mission is the protection and restoration of seagrass as an indicator of its progress in achieving specific goals of nitrogen load reductions. In 1995, the TBEP set a proxy goal for nitrogen load reductions: a return to the year 1950 levels of seagrass coverage in Tampa Bay to indicate a "healthy" estuary.

In an environmental law context, the use of a particular species as a proxy for ecosystem health is not without precedent. The National Forest Management Act (NFMA), for example, contains provisions necessitating the creation of land and resource management plans.[36] Regulations promulgated to shed light on the requirements of these plans include provisions demonstrating the need to acknowledge "ecological sustainability" and preserve "focal species."[37] Specifically, managers are to include in plans "[i] information about focal species that provide insights to the integrity of the larger ecological system to which they belong."[38] The logic behind this approach is that a thoughtfully-selected focal species (i.e., keystone species) can serve as a useful proxy for gauging ecosystem health as a whole. While somewhat limited in its scope, the use of focal species such as seagrasses can provide a biological management goal in addition to the WQBELs and total pollutant loadings assessments required by the CWA. The NMC's embrace of this technique demonstrates an embrace of sound science.

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[32]See 33 U.S.C. § 1330 (2000).

[33]Credit should be given also to Florida's Surface Water Improvement and Management (SWIM) Act of 1987, Fla Stat. § 373.451 et seq. (2009), which seemingly recognized the growing concerns of stakeholders deafened by regulatory cacophony. Recognizing the need for better scientific understanding of certain priority water bodies, including Tampa Bay, SWIM conferred authority on the WMDs to develop watershed-based plans for dealing with nutrient pollution and seagrass loss. Acknowledging the intricate relationship these two resource issues share, SWIM was the driver for our current focus on seagrass recovery as a management goal and the regulatory milieu needed for TBEP to form the NMC.

[34] Ltr. from Tampa Bay Nitrogen Management Consortium to EPA, Tampa Bay Nitrogen Management Consortium Comments and Request Regarding the Development of Protective Loads for the Tampa Bay Estuary as It Relates to Establishing Numeric Nutrient Criteria for Lakes, Flowing Waters and Estuaries in Florida 2 (Mar. 4, 2010). (available at http://www.tbeptech.org/attachments/074_FINAL_NMC_Response_NNC_03082010.pdf).

[35]*Id.* at 3.

[36]See 16 U.S.C. § 1604 (2000).

[37]See 36 C.F.R. § 219.20 (2000).

[38]See 36 C.F.R. § 219.20(a)(2)(i)(A) (2000).

Conclusion

Scientific consensus among those affected by environmental regulations is difficult to achieve due to the tensions arising from incongruent conclusions. The science is rarely ever "settled" when significant incentives exist for many parties to keep a debate alive. What is unique about the Tampa Bay NMC is that it comes remarkably close to consensus regarding the sources of nutrient pollution and its relationship to water quality and seagrass coverage in the estuary.[39] The structure of the NMC ensures a place at the proverbial table for disparate stakeholders who have come together to produce technical documents and load allocation agreements based on cooperative interaction, rather than independent analyses that simply "toe a company line." The cooperative process is thus more than strange bedfellows singing Kumbaya around a campfire. Rather, three valuable by-products come from such a process, beyond the tangible manifestations of reduced nitrogen loads and seagrass protection and restoration.

First, scientific uncertainty, and its resulting tension, is muted when the parties come together to produce results. Scientific uncertainty arises when independent research comes to different conclusions. Casting idealism aside, scientific researchers are subject to the same biases as any journalist, lawyer, or politician. Coalitions such as the NMC internalize much of the peer-review process that is paramount to all scientific inquiries. Second, consensus-based dispute resolution leads to regulatory predictability. A significant transaction cost for industry relates to the forecasting of potential changes in the regulatory environment in which it operates. New water quality standards can have significant impacts on bottom lines. Adaptive measures taken by industry in a setting that has been created to foster open lines of communication between business and regulators can help mitigate potential impacts from new regulations by lessening the "surprise" factor. Third, collaborative decision-making leads to solutions that are fairer and more equitable in the long-run. To the extent that a given party participates, nobody can claim that they were shut out of the process or that a particular result did not consider their viewpoint when it is all-inclusive. Because of its unique, non-regulatory, coalition-based approach, and embrace of sound science as a driver of policy, the NMC should be lauded as a triumph over regulatory cacophony.

Epilogue

On May 13, 2015, the TBEP announced that 16,306 ha of seagrass is now observed in Tampa Bay, exceeding the restoration goal of approximately 15,400 ha set in 1995.[40] "This is a remarkable achievement . . . [t]his kind of environmental recovery is a living testament to the collective efforts of all of us working together - the cities and counties, the private sector and the citizens who treasure the bay," said TBEP Director Holly Greening.[41]

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[39] Ltr. from Tampa Bay Nitrogen Management Consortium to EPA, *supra* n. 45, at 3.

[40] TBEP, *Tampa Bay Seagrasses Meet – and Exceed – Recovery Goal*, http://www.tbep.org/news_and_events-whats_new.html (posted May 13, 2015).

[41] Id.