Coastal Science Assistantship Program Application

Name: Megan La Peyre

PROJECT NARRATIVE: Water filtration capacity of oyster reefs in coastal Louisiana

PRINCIPAL INVESTIGATOR AND COLLABORATORS

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PROJECT DESCRIPTION

Restoration of three-dimensional shell habitats in coastal Louisiana presents a valuable and potentially self-sustaining approach to providing shoreline protection, enhancing fish and invertebrate habitat, and improving water quality (Coen et al. 2007, Grabowski et al. 2012). There has been a plethora of reef restoration projects in recent decades (Kennedy et al. 2011, Furlong 2012), and the 2012 Master Plan for coastal Louisiana identifies the use of reef creation as a key strategy in its plan (Louisiana Master Plan 2012). As with most restoration techniques, the calculation of ecosystem service benefits for oyster reefs restoration ranges from estimations based on modeled rates, often derived from other estuaries and regions, to more intensive, site-specific empirical estimates. In Louisiana, the shoreline protection and nekton habitat benefits of restored reefs have been empirically measured for projects in Terrebonne, Barataria, and Breton Sound estuaries (Piazza et al. 2005, La Peyre et al. 2013a, 2013b). However, the water quality contributions of restored oyster reefs in Louisiana, particularly for nutrient and carbon sequestration, have yet to be quantified.

Filtration capacity and potential nutrient load reduction for filter feeders have been estimated, quantified or modeled for a number of species, worldwide (e.g., Newell 2004, Higgins et al. 2011). Forthe eastern oyster (*Crassostrea virginica)* specifically, estimates of nutrient removal or reef filtration capacity for both Atlantic- and Gulf-coast estuaries have been derived using estimates of historical and present oyster biomass, bioenergetics modeling, or experimental data collection (e.g. Fulford et al. 2010, Piehler and Smyth 2011, Higgins et al. 2013). These predictions have been used to calculate potential oyster restoration targets and economic value for nutrient reduction goals (i.e., Fulford et al. 2010, Piehler and Smyth 2011, Higgins et al. 2011). While these modeled estimates, and others like them, provide a good place to start, in no studies have Louisiana estuaries been included, and no empirical estimates have been made of the ability of restored reefs to sequester nutrients and carbon in coastal Louisiana. *This project proposes to estimate filtration capacity, and carbon (c) and nitrogen (N) bioassimilation capacity of Louisiana oyster reefs, using oyster density and size class data collected on natural reefs, harvested reefs, and restored reefs across three estuaries in coastal Louisiana, along with local temperature, salinity and food availability data which are known to critically affect filtration rates.*

Understanding how oyster reefs factor into the delivery of key ecosystem services, particularly filtration capacity, and nutrient assimilation, is imperative as Louisiana implements the 2012 Master Plan which specifically calls for extensive oyster reef restoration as a natural process that is sustainable into the future and advances the plan's restoration goals. Another focus of the Master Plan is its synergistic effects on nutrient management and reduction in accordance with the 2008 Gulf Hypoxia Action Plan, which recommended at least a 45% reduction in riverine total nitrogen and phosphorous loads. Current, multi-state and multi-agency efforts (i.e., Hypoxia Task Force, Louisiana Nutrient Management Strategy) to reduce and manage nutrients are underway and use a variety of techniques, including wetland restoration that reconnects the river to wetlands and bays and a nutrient credit trading program. Currently, however, the majority of focus is on the ability of vegetated wetlands to filter nutrients and

aquatic carbon. While accurate numbers of reef area in coastal Louisiana do not exist, there are over 1.7 million acres of publicly managed oyster grounds, with much more extensive oyster areas known in private leases, areas not used for harvest, and restored areas (LDWF 2011). Because oysters are filterfeeding organisms, restoring oyster reefs may be another critical component in reducing nutrients that would otherwise be discharged into the Gulf of Mexico. Understanding the ability of oyster reefs to filter and remove nutrients is the first step toward evaluating this ecosystem service and potentially providing an incremental value that can be monetized and used in a nutrient credit trading program as an incentive for public-private partnerships and innovative oyster management and leasing strategies.

Expected Project significance and applicability to CPRA

Understanding how oyster reefs contribute to the delivery of key ecosystem services, particularly water filtration, and nutrient and carbon sequestration, is imperative as Louisiana implements the 2012 Master Plan. The Master Plan specifically calls for extensive oyster reef restoration as a natural process that is sustainable into the future and advances the plan's restoration goals; these data will be highly valuable in setting goals during the decision-making process by managers during the implementation of restoring oyster reefs as part of the 2012 LA Master Plan. Another focus of the Master Plan is its synergistic effects on nutrient management and reduction in accordance with the 2008 Gulf Hypoxia Action Plan, which recommended at least a 45% reduction in riverine total nitrogen and phosphorous loads. The utility of these data cannot be overstated. We currently have no estimates of nutrient and carbon sequestration rates for a habitat type that has been severely restricted Gulfwide, is the focus of multi-million dollar restoration investment, and whose contribution is unknown regarding nutrient reduction and mitigation of hypoxia.

Collaborative roles, current funding to be applied, and managerial arrangements of partners

Dr. Megan La Peyre has been working extensively on oyster reefs in coastal Louisiana, and has been working and collecting data at all of the sites proposed for this work. Recent work has quantified the contribution of restored reefs to augmentation of fish production within coastal areas, and examined development trajectories of reef provision of ecosystem services including shoreline stabilization, fish production, and water filtration capacity (La Peyre et al. 2012, 2013a, 2013b, Humphries and La Peyre, in review, La Peyre et al., in review). Dr. La Peyre will be the lead in collecting the field data, and generating the data for analysis. This collection will be partnered with current research grants which cover monitoring of 4 created oyster reefs. The research grants are funded by The Nature Conservancy of Louisiana, and Louisiana Sea Grant. There is no potential conflict of interest with existing or anticipated contractual and/or funding agreements, no work completed in the La Peyre lab has been funded or associated with oil spill research. TNC will be a partner on this project.

Dr. Bryan Piazza (TNC) has been working on oyster reefs for over 10 years, and in his role at TNC, is heavily involved in development of oyster reef restoration projects in Louisiana's coastal wetlands. He is also one of the developers of the Gulf of Mexico Restoration Decision Support Tool (gulfmex.coastalresilience.org) and the Louisiana Freshwater Assessment system. Both systems are designed to support decision making in restoration and integrated water management. As such he has provided technical information to the state's water policy task force regarding integrated water management in Louisiana. His role will be to ensure the data from this project are analyzed and presented in a way that addresses state needs. Additionally, he will work with CPRA directly to ensure the work is integrated into their decision making process.