

# Margaret A. Davidson Fellowship: Reserve Management Needs

NOAA Office for Coastal Management

*Read about each reserve's specific management needs.*

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## Caribbean Region

### Jobs Bay Reserve, Puerto Rico

- Mangrove forests, marshes, and associated ecosystems in Jobs Bay Research Reserve are under constant threat of degradation by sea level change and associated hydrological changes. In addition, migration is limited by coastal development. But we do not know how to assess short-term relative sea-level changes and how we can take action and implement effective management action plans. Therefore we seek additional information on short-term changes in relative sea level rise by implementing innovative (biological, chemical, physical) proxies. *Reserve point of contact for additional information: Angel Dieppa, Research Coordinator, adieppa.jbnerr@gmail.com, (787) 853-4617.*
- Benthic marine ecosystems in Jobs Bay Reserve are being anthropogenically altered, and pollutants in sediments have been translocated to terrestrial/coastal areas via trophic transfer. But we do not know what is the extent and magnitude of the impacts. Therefore we need to implement high-impact and low-cost bioindicators to provide rapid environmental assessment that will provide essential information to design best mitigation or restoration practices. *Reserve point of contact for additional information: Angel Dieppa, Research Coordinator, adieppa.jbnerr@gmail.com, (787) 853-4617.*

## Great Lakes Region

### Lake Superior Reserve, Wisconsin

- Despite wild rice restoration and seeding within several bays of the St. Louis River estuary, resource managers have not yet established a naturally reproducing wild rice population. Many factors including sediment geochemistry, water quality, seiche dynamics, waterfowl herbivory, seed germination, and genetics could be contributing. But the main determinants of restoration success are unknown. Therefore we need information on factors influencing wild rice restoration success to inform best practices. *Reserve point of contact for additional information: Hannah Ramage, Monitoring Coordinator, hannah.ramage@ces.uwex.edu, (715) 399-4088.*
- Several exotic plants (for example, purple loosestrife, phragmites, and yellow iris) ecologically impact estuaries along the Lake Superior coast and appear to decrease wetland biodiversity. But several parameters affecting successful biocontrol and restoration efforts are unknown. Therefore we need to identify the primary drivers of exotic species success to derive successful control methods. *Reserve point of contact for additional information: Hannah Ramage, Monitoring Coordinator, hannah.ramage@ces.uwex.edu, (715) 399-4088.*
- Western Lake Superior is experiencing more precipitation, warmer winters, and increasing storm events. These environmental changes impact human health and well-being in complex ways. But community leaders need to understand climate impacts to human health at the local level in order to prepare their communities for future conditions. Therefore, a comprehensive local assessment of the risks and severity of climate change health impacts is needed. *Reserve point of contact for additional information: Karina Heim, CTPC, karina.heim@ces.uwex.edu, (715) 399-4089.*
- High water levels have persisted in Lake Superior over the past four years and have created extreme conditions for wetland and plant communities as well as waterfront infrastructure. But planners, resource managers, and property owners need to make decisions and investments that consider periodic oscillations in water levels. Therefore additional information about management practices that consider fluctuating extremes in water levels is needed. *Reserve point of contact for additional information: Karina Heim, CTPC, karina.heim@ces.uwex.edu; (715) 399-4089.*
- Flood events of the past seven years have severely impacted regional communities. Understanding flooding costs can motivate decision makers to prioritize resilience. But the economic and social costs of extreme flooding have only been partially captured. Therefore an analysis of the socioeconomic impacts of flood events in the region would help the reserve and communities understand how to plan in the context of increasing flood events. *Reserve point of contact for additional information: Karina Heim, CTPC, karina.heim@ces.uwex.edu; (715) 399-4089.*

### Old Woman Creek Reserve, Ohio

- **Community readiness and capacity to adopt and implement nature-based shorelines.** Increased water levels and more frequent storm events in the Great Lakes are causing increased erosion along the lakeshore. Most coastal landowners are choosing to protect their shorelines by hardening them. But hardened shorelines displace natural habitats, alter shoreline characteristics, and adversely impact the availability of sand resources. Therefore we need to understand available nature-based shoreline best practices as well as the needs of coastal landowners in order to develop effective outreach and communication materials to promote the adoption of nature-based shorelines. *Reserve*

*point of contact for additional information: Jennifer Bucheit, Education Coordinator, Jennifer.Bucheit@dnr.state.oh.us, (419) 433-4601.*

- **Monitoring nutrient retention capacity of an agricultural wetland.** Agricultural activities are a major contributor of nutrients and sediment into western Lake Erie. The adoption of in-field conservation practices are an important reduction strategy, but often do not fully address the needed reductions during large rain events. Therefore monitoring edge of field practices such as agricultural or flow-through wetlands for nutrient and sediment retention will determine the relative efficacy of this approach to capture, process, and retain field-derived pollutants. *Reserve point of contact for additional information: Dr. Kristi Arend, Research Coordinator, Kristin.Arend@dnr.state.oh.us, (419) 433-4601.*
- **Monitoring and modeling OWC lower estuary hydrodynamics.** Coastal wetlands (i.e. the Old Woman Creek estuary) are important filters that reduce nutrient inputs into Lake Erie. Nutrient concentration and loading into coastal wetlands are easily measured. But measuring nutrient loads into Lake Erie is complicated by the bidirectional flows of lake and estuary waters at their confluence. Therefore enhanced monitoring and the development of hydrodynamic modeling tools will allow us to more accurately measure and predict nutrient loading into Lake Erie from the Old Woman Creek estuary. *Reserve point of contact for additional information: Dr. Kristi Arend, Research Coordinator, Kristin.Arend@dnr.state.oh.us, (419) 433-4601.*
- **Economic feasibility study of plastics reduction techniques for coastal businesses.** Single-use plastic items associated with the food, fishing, and pharmaceutical industries are the most frequent items found in the Great Lakes environment. Their abundance presents a threat to human health and the local economy, as over 11 million people derive their drinking water from Lake Erie, and utilize its fisheries and natural resources. But the financial implications in reducing the dependency on these single-use plastic items have not been fully analyzed. Therefore an economic feasibility study comparing alternative business products and strategies is needed to identify reasonable alternatives that are sustainable for businesses (e.g. biodegradable options, decreased availability of non-essential items) in order to promote the long-term health and economic well-being of Lake Erie. *Reserve point of contact for additional information: Emily Kuzmick, Coastal Training Program Coordinator, Emily.Kuzmick@dnr.state.oh.us, (419) 433-4601.*

## Gulf Coast Region

### Apalachicola Reserve, Florida

- Our lower river marshes may be vulnerable to sea level rise and changes in riverine input. Our Sentinel Site Program aims to get a better understanding of the long-term impacts of climate change in this system. But the current methods of investigation only address changes in marsh surface and associated plant communities. Therefore, we need additional information about how changes in sea level may impact herpetological, fish, and macroinvertebrate communities in the Apalachicola system. Reserve point of contact for additional information: *Jason Garwood, Research Coordinator, jason.garwood@dep.state.fl.us, (850) 670-7705.*
- We have been able to link riverine input and our SWMP data to some of our biological monitoring programs, showing significant patterns in spatial and temporal distributions in communities. This suggests that there are definable linkages in food webs within the Apalachicola estuary. But we have limited information on the trophic interactions of species within the system. Therefore, we need an in-depth analysis of our system-wide environmental and biological data to identify and define key linkages. Reserve point of contact for additional information: *Jason Garwood, Research Coordinator, jason.garwood@dep.state.fl.us, (850) 670-7705.*
- We have seen changes in fisheries and their essential habitats in the Apalachicola Bay system, and much of those changes can be attributed to riverine input and anthropogenic impacts. But we don't have a good understanding of the how the resources can be managed more effectively from a biological and socio-economic standpoint. Therefore, we need a management and recovery plan based upon a new ecosystem services evaluation to help our community become more resilient to future impacts. Reserve point of contact for additional information: *Jason Garwood, Research Coordinator, jason.garwood@dep.state.fl.us, (850) 670-7705.*

### Grand Bay Reserve, Mississippi

- Coastal habitats are being restored throughout the northern Gulf of Mexico, and many of these efforts have well-defined end points that can be used to determine restoration success. But effectiveness monitoring is rarely conducted and monitoring data is not often available for synthesis; Therefore we need more information on the effectiveness of restoration approaches in both upland and estuarine systems to guide future management efforts in the region. *Reserve point of contact for additional information: Dr. Ayesha Gray, Reserve Manager, Ayesha.Gray@dmr.ms.gov, (228) 475-7047.*
- Grand Bay has historically had low nutrient concentrations and high fecal coliform counts, and though the watershed is generally undeveloped, the waters are closed to shellfishing. But we don't know the source of fecal contamination or the potential impacts of contaminants from other nearby sources. Therefore we need better information about the sources and impacts of contaminants across the reserve so we can develop effective mitigation strategies. *Reserve point of contact for additional information: Dr. Ayesha Gray, Reserve Manager, Ayesha.Gray@dmr.ms.gov, (228) 475-7047.*
- Due to the impacts of the Deepwater Horizon oil spill, restoration of coastal habitats is occurring throughout the northern Gulf of Mexico. Many of these efforts are expected to improve the socio-economic condition of the Gulf Coast communities as well as the environmental condition. But few research efforts focus on ecosystem valuation in terms of the socio-economic impacts of restoration. Therefore we need more information on how and if restoration to the local environment impact local

communities and economies. *Reserve point of contact for additional information: Dr. Ayesha Gray, Reserve Manager, Ayesha.Gray@dmr.ms.gov, (228) 475-7047.*

- The Grand Bay Estuary serves as a reference site for many on-going restoration projects across the Mississippi Coast, and reserve data are critical to evaluating restoration effectiveness. But we have little population or ecological data for many vertebrate species. Therefore we need population and ecological studies for both terrestrial and aquatic vertebrates to continue to serve the critical role of a reference estuary. *Reserve point of contact for additional information: Dr. Ayesha Gray, Reserve Manager, Ayesha.Gray@dmr.ms.gov, (228) 475-7047.*
- The Grand Bay Reserve marshes are affected by several ecological and physical processes, and are slowly being converted to open water. But we do not understand the physical processes affecting critical ecological functions. Therefore we need studies to better understand overland flow, water circulation patterns, and sediment dynamics (e.g., erosion, transport, deposition) in the reserve to better conserve our estuarine ecosystem. *Reserve point of contact for additional information: Dr. Ayesha Gray, Reserve Manager, Ayesha.Gray@dmr.ms.gov, (228) 475-7047.*

## **Mission-Aransas Reserve, Texas**

- Resilience is the capacity of a linked anthropogenic-social and natural-ecological system to absorb extreme events and other drivers of change, yet maintain their essential structures and functions. Many coastal estuaries and their wetlands are impacted by major events such as hurricanes and by long-term drivers of ecological degradation. But often the links between these drivers of ecological change and their impacts on communities, economies, and livelihoods are poorly understood. Therefore we need information on how long and short term environmental drivers impact social, economic, and ecological systems, and how management actions can enhance resilience across the socio-ecological system. *Reserve point of contact for additional information: Dr. Edward Buskey, Research Coordinator, ed.buskey@utexas.edu, (361) 749-3102.*
- The Mission-Aransas Reserve is vulnerable to numerous impacts from climate change, including sea level rise, ocean acidification, increasing water temperatures and decreasing frequency of hard freezes in winter. Our subtropical location makes us vulnerable to invasive species and range extensions of tropical species. Therefore we need to understand how a changing climate will impact the structure and function of our estuarine ecosystem as tropical species—such as mangroves—re-structure our wetlands and climate change drivers favor new species and displace others. *Reserve point of contact for additional information: Dr. Edward Buskey, Research Coordinator, ed.buskey@utexas.edu, (361) 749-3102.*
- The Mission-Aransas Reserve is located in South Texas which is known for extended periods of drought, and increasing demands for freshwater by agriculture, industry and municipalities can leave little freshwater to flow into estuaries, reducing delivery of nutrients and sediments to the estuaries and increasing salinities for estuarine dependent species. Therefore we need to assess the ecological consequences of natural and anthropogenic factors affecting freshwater inflows that could alter the diversity, structure, and function of our reserve's ecosystem. *Reserve point of contact for additional information: Dr. Edward Buskey, Research Coordinator, ed.buskey@utexas.edu, (361) 749-3102.*
- The Mission-Aransas Reserve is located next to the sixth largest port in the US in terms of tonnage, with deep channels dredged through otherwise shallow coastal bays and estuaries. We know that most of the commercially and recreationally important species of finfish and shellfish are estuarine dependent species (shrimp, blue crabs, red drum, southern flounder). But little is known about the factors that are needed for the tiny larvae of these species to locate and enter widely dispersed

channels connecting the estuaries to the open ocean. Therefore we need more information about how plans to deepen these channels and alter the hydrography and salinity of the coastal bays and estuaries will impact recruitment of estuarine dependent species. *Reserve point of contact for additional information: Dr. Edward Buskey, Research Coordinator, ed.buskey@utexas.edu, (361) 749-3102.*

- In mid-2018, the Mission-Aransas Reserve completed a marine debris accumulation rate study along the Gulf of Mexico facing beaches. The beaches in South Texas have the highest marine debris accumulation rates of any other beaches in the United States. But not much is known about the long term impacts of marine debris on the ecological system, fisheries, or human health risks. Therefore we need to study in more detail the impact marine debris is having on habitats, food webs, reproductive cycles of wildlife, and human effects so that solutions and alternatives can be developed. *Reserve point of contact for additional information: Dr. Edward Buskey, Research Coordinator, ed.buskey@utexas.edu, (361) 749-3102.*

## **Rookery Bay Reserve, Florida**

- The Picayune Strand Restoration Project is currently underway to restore natural freshwater sheetflow to coastal wetlands and embayments within the Ten Thousand Islands. We are monitoring downstream indicators of change to water quality and resident fisheries. But there are still many questions about the impact of freshwater alteration and restoration on coastal vegetation, oyster reefs, and other macro- and micro-fauna. Therefore additional information is needed to understand the long-term impacts of freshwater management and natural flow restoration on estuarine production and connectivity. *Reserve point of contact for additional information: Brita Jessen; Research Coordinator; brita.jessen@dep.state.fl.us, (239) 530-5964.*
- The distribution and phenology of native flora and fauna in our system which depend on seasonal perturbations such as fire regimes, and regional-scale changes in climate and sea level are affecting seasonal cues. But we don't understand the interactions between climate, fire, and invasive species. Therefore we need an integrative assessment to describe the best management practices for fire management and invasive species control under the context of regional environmental change. *Reserve point of contact for additional information: Jeffrey Carter; Stewardship Coordinator; jeffrey.a.carter@dep.state.fl.us, (239) 530-5960.*
- Natural resources within the Rookery Bay and Ten Thousand Island ecosystems contribute significant economic support for the local economy, and our system has experienced recent episodic events (e.g., hurricanes, harmful algal blooms). But these environmental stressors have the potential to negatively impact ecosystem integrity and production. Therefore we need information socio-economic effects from major natural and human-enhanced episodic events. *Reserve point of contact for additional information: Jeffrey Carter; Stewardship Coordinator; jeffrey.a.carter@dep.state.fl.us, (239) 530-5960.*
- Coastal wetlands and uplands (e.g., mangroves, salt and brackish marsh, scrub forest) perform ecosystem services that include storm buffering and flood reduction. These systems are undergoing spatial, biological, and physical changes from sea level rise and storm impacts. But we need a greater understanding on the resilience and recovery regimes of these systems after major storm events. Therefore additional information is needed to understand the combined effects of regional climate changes and episodic storms on coastal vegetation resilience and recovery. *Reserve point of contact for additional information: Brita Jessen; Research Coordinator; brita.jessen@dep.state.fl.us, (239) 530-5964.*

- Coastal and upland habitats (e.g., salt and brackish marsh and scrub forests) are vulnerable to a spatial squeeze from landward-migrating mangroves and developed areas. The Picayune Strand Restoration Project is currently underway to restore natural freshwater sheetflow to the region. But we don't have enough information to determine the interactive effects of freshwater restoration and sea level rise. Therefore we need information to understand habitat squeeze under the context of freshwater restoration and management and sea level change.
- *Reserve point of contact for additional information: Brita Jessen; Research Coordinator; brita.jessen@dep.state.fl.us, (239) 530-5964.*

## **Weeks Bay Reserve, Alabama**

- High levels of pathogens in the Fish River have the potential to harm human health. The Total Maximum Daily Load completed in 2013 identified stormwater pathogens entering the Fish River from urbanizing landscapes. But microbial source tracking didn't quantify proportional pathogen inputs from known or common sources (i.e. pets or wildlife). Therefore we need information on proportion of pathogens contributed by identified sources to implement effective management to reduce human health threat & meet TMDL-mandated pathogen reduction target. *Reserve point of contact for additional information: Mike Shelton, CTPC, Mike.Shelton@dcnr.alabama.gov, (251) 928-9792.*
- We have research from the Southeast that use of fire in management of freshwater, brackish and salt-marshes increases diversity and reduces encroachment of woody plant species. We have managed Weeks Bay Reserve marshes with fire for many years, but we do not have empirical data on how use of fire in marsh management affects the carbon cycle. Therefore we need information about effects of fire on marshes as concerns carbon cycle and how that interacts with marsh ecotone migration, diversity, productivity and prevalence of invasive species with ultimate outcome of planning an overall best fire management regime. *Reserve point of contact for additional information: Dr. Scott Phipps, RC, Scott.Phipps@dcnr.alabama.gov, (251) 928-9792.*
- Weeks Bay is considered an eutrophic estuary and we have gathered data that gives us nitrogen loading and productivity estimates (primary and secondary). We have data on changes in land use and land cover illustrating loss of wetlands in the Weeks Bay watershed. But we do not have empirical data to predict how these will interact along with climate change effects on rainfall. Therefore we need information how changes in hydrology, climate & nitrogen loading will affect productivity of the Weeks Bay estuary and the possibility of future Harmful Algal Blooms. *Reserve point of contact for additional information: Dr. Scott Phipps, RC, Scott.Phipps@dcnr.alabama.gov, (251) 928-9792.*
- Stakeholders are concerned with protecting the coastal community within the Weeks Bay watershed and reserve boundary. Proper management actions may help protect and preserve the marsh community. But it is not clear how marsh biota will respond to environmental change over time. Therefore additional information is needed to predict response and implement appropriate management actions to conserve natural community function. *Reserve point of contact for additional information: Eric Brunden, SC, Eric.Brunden@dcnr.alabama.gov, (251) 928-9792.*
- We know socio-economic data can be used to inform revisions of reserve programs and we know there is information to be obtained in the community from resource users. Gathered information is lacking to understand these data and their impacts. Therefore investigation is needed to perform ecosystem services valuation of the reserve's habitats, better understand linkages between

ecosystems services and local community well-being and values, and to conduct ongoing monitoring of pertinent socio-economic indicators to determine change over time. *Reserve point of contact for additional information: L. G. Adams, Manager, LG.Adams@dcnr.alabama.gov, (251) 928-9792.*

## Mid-Atlantic Region

### Chesapeake Bay Reserve, Maryland

- The State of Maryland, through the use of existing tools, is prioritizing tidal wetland restoration and conservation to enhance coastal resilience. But we do not have a clear understanding of overall tidal wetland health and management methods. Therefore we need to know how to best assess existing marsh conditions and management actions. *Reserve point of contact for additional information: Kyle Derby, Research Coordinator, kyle.derby@maryland.gov, (410) 260-8724.*
- Benthic habitats are critical to the health of the Chesapeake Bay and its fisheries. In recent years, several drastic shifts in these vulnerable habitats, including an increase in submerged aquatic vegetation (SAV) coverage, have been observed. But their vulnerabilities to environmental stressors are not well understood. Therefore more data collection and analysis of the benthic habitats in the Reserve are needed to inform appropriate management and restoration strategies. *Reserve point of contact for additional information: Becky Swerida, Reserve Biologist, rebecca.swerida@maryland.gov, (410) 260-8722.*
- Marsh birds can be indicators of the ecosystem health of our Atlantic coastal wetlands. Tidal wetlands in the Chesapeake Bay and are good candidates for citizen scientist monitoring, but we have long struggled with ideal methodologies to accurately assess their numbers and trends. Therefore we need data that evaluates the strength in the current approaches and looks at new techniques to monitor these important species. *Reserve point of contact for additional information: Chris Snow, Stewardship Coordinator, chris.snow@maryland.gov, (410) 260-8731.*
- Currently, we have a good understanding of nutrient and sediment water quality issues in the Chesapeake Bay. This data has informed management actions through the Chesapeake Bay Total Maximum Daily Load. But other water quality issues are continually identified in our estuary such as PCBs, road salt usage, and marine debris. Therefore additional information is needed to assess potential threats and investigate mitigation and outreach strategies for emerging water quality concerns. *Reserve point of contact for additional information: Becky Swerida, Reserve Biologist, rebecca.swerida@maryland.gov, (410) 260-8722.*
- Saltwater intrusion is a threat to both human and natural communities and is of increasing concern within the state. But current research in Maryland is limited, therefore we need additional information to evaluate risk and adaptation options. *Reserve point of contact for additional information: Kyle Derby, Research Coordinator, kyle.derby@maryland.gov, (410) 260-8724.*

### Chesapeake Bay Reserve, Virginia

- **Water Quality – Variability in Pollutant Load and Response.** The York River estuary and adjacent waters continue to suffer from chronic water quality issues driven by excessive loads of nutrients, organic matter, and sediment. Responses to loads include intense algal blooms, low oxygen, and reduced water clarity that impact living resources. But the precise connections between watershed loads and estuarine response remain poorly understood. Therefore further quantification of linked temporal variability in loads and response is needed to establish effective mitigation goals. *Reserve points of contact for additional information: Carl Friedrichs, Ph.D., Loretta and Lewis Glucksman Professor of Marine Science, Carl.Friedrichs@vims.edu, (804) 684-7303 or William Reay, Ph.D., Manager, wreay@vims.edu, (804) 684-7119.*

- **Water Quality – Harmful Algal Blooms.** Harmful algal blooms (HABs) have become more common within the York River estuary, and produced toxins can have harmful effects on shell and finfish, shallow water ecosystems, and humans. Although a topic of active study, understanding of bloom initiation, dynamics and impacts on water quality and natural resources is limited. Therefore synthesis of York River observing network data, and focused field and modeling studies are needed to provide guidance on reducing HAB occurrence and their detrimental effects. *Reserve points of contact for additional information: Carl Friedrichs, Ph.D., Loretta and Lewis Glucksman Professor of Marine Science, Carl.Friedrichs@vims.edu, (804) 684-7303 or William Reay, Ph.D., Manager, wrey@vims.edu, (804) 684-7119.*
- **SAV Habitat Vulnerability.** Highly valued seagrass beds within the York River estuary have undergone significant declines. Research and monitoring are shedding light on the impacts of eutrophication, reduced water clarity, and elevated water temperature. But many questions still remain about plant physiology, mixed species interactions, seed and bed dynamics and resiliency. Therefore additional information is needed to evaluate seagrass bed structure and function in response to changes under future climate and water quality scenarios. *Reserve points of contact for additional information: Erin Shields, Marine Scientist, eshields@vims.edu, (804) 684-7702.*
- **Wetland Habitat Vulnerability.** The York River exhibits diverse wetland communities distributed along gradients of salinity. Vulnerability to climate change is expected to vary between community types. But there is limited information on how site variability (e.g., sea level rise, salt intrusion, sediment load) influences measures of vulnerability. Therefore increased understanding and forecasting of marsh structure and function in response to climate stressors, across salinity regimes, is needed to inform adaptation and mitigation planning. *Reserve points of contact for additional information: Scott Lerberg, Stewardship Coordinator, Lerbergs@vims.edu, (804) 684-7129 or William Reay, Ph.D., Manager, Wrey@vims.edu, (804) 684-7119.*

## Delaware Reserve, Delaware

- Climate change is an ongoing global issue. Tidal marshes in Delaware have the potential to store and sequester carbon dioxide. But we lack a thorough understanding of the geospatial timescales of greenhouse gas fluxes and carbon storage in different tidal wetland and hydrological systems. Therefore we need information on the carbon storage and/or fluxes in Delaware’s estuarine habitats. *Reserve point of contact for additional information: Kari St.Laurent, Ph.D., Research Coordinator, Kari.stlaurent@delaware.gov, (302) 735-3413.*
- Pollution from pesticides, pharmaceutical chemicals, and other industrial products are a growing concern. Delaware is at an intersect of many agricultural, industrial, and commercial activities which have the potential to release contaminants. But we have a limited understanding of which emerging contaminants are a concern to Delaware’s estuarine ecosystems. Therefore we need information on which emerging contaminants we should be focused on and whether they are affecting estuarine ecosystems. *Reserve point of contact for additional information: Kari St.Laurent, Ph.D., Research Coordinator, Kari.stlaurent@deleware.gov, (302) 735-3413.*
- Coastal and ocean acidification has become an interest for the Mid-Atlantic. Nutrient pollution and increasing atmospheric carbon dioxide make Delaware’s coastal region vulnerable to carbonate system changes. But we do not have many measurements or an understanding of how Delaware’s estuaries are responding to coastal and ocean acidification. Therefore we need information on which sensors are most appropriate for Delaware’s coastal region and how the carbonate system fluctuates on a daily basis. *Reserve point of contact for additional information: Kari St.Laurent, Ph.D., Research Coordinator, Kari.stlaurent@deleware.gov, (302) 735-3413.*

- Delaware is the lowest lying state and thus is vulnerable to sea level rise and coastal storm-related inundation. But we still lack an understanding of how different land types will react to changing sea levels and salinities in the near-future. Therefore we need information on how future sea level rise will manifest in Delaware's different estuarine habitats and how it could affect coastal communities. *Reserve point of contact for additional information: Kari St.Laurent, Ph.D., Research Coordinator, Kari.stlaurent@deleware.gov, (302) 735-3413.*
- Many small municipalities and rural communities in Delaware (and in the Mid-Atlantic region) are extremely low-lying and subject to increasing impacts from climate change and sea level rise. But they have small budgets and often lack of staff support to accomplish many of their goals when it comes increasing their resiliency to these hazards. Therefore decision makers such as municipal leaders, state level planners, managers, and community supporting organizations need cost-benefit analysis of adaptation options such as infrastructure upgrades and green infrastructure or nature-based solutions in order to determine potential priority actions that will uphold a community's quality of life, societal function, cultural heritage, as well as the quality and function of their natural resources. It is also important to study the costs/benefits of taking action now before impacts occur versus potentially retroactively dealing with damages in the future so they can choose when and how to wisely spend their limited time and efforts. *Reserve point of contact for additional information: Kelly Valencik, Coastal Training Program Coordinator, kelly.valencik@delaware.gov, (302) 378-5734.*

## Hudson River Reserve, New York

- **Submerged Aquatic Vegetation:** There was a 90% loss of submerged aquatic vegetation (SAV) in the Hudson during an extreme storm event in 2011. We know from GIS data that while *Vallisneria americana* is recovering, it does not include all prior areas and there may be some loss of genetic diversity. But we do not know the factors influencing recovery, the consequences of genetic differences, and the viability of transplanting. Therefore, to prepare for large-scale restoration, we want to know if transplantation of native Hudson River SAV is feasible and if so, what conditions maximize restoration success. *Reserve point of contact for additional information: Dan Miller, Habitat Restoration Coordinator, Daniel.Miller@dec.ny.gov, (845) 889-4745 x110.*
- **Tidal Wetlands:** The Hudson River estuary is sediment rich, and we know that most tidal wetlands seem to be accreting sediment to keep pace with sea level rise. We do not know if accretion rates differ with different configurations of tidal wetlands span a salinity gradient, have different sediment supplies, and can be protected behind structures or exposed. Therefore we want to know what geographic, vegetation or other factors affect past accretion to better manage their resilience in the future. *Reserve point of contact for additional information: Sarah Fernald, Research Coordinator, Sarah.Fernald@dec.ny.gov, (845) 889-4745 x111.*
- **Eels:** The American eel is an important species in the Hudson. We know that barriers to their upstream migration are one contributing factor to population declines, but we do not know how far they are moving up different tributaries. Therefore we want to know if monitoring techniques such as eDNA can help us to better understand eel population dynamics and distribution. *Reserve point of contact for additional information: Sarah Mount, Educator, Sarah.Mount@dec.ny.gov, (845) 889-4745 x106.*
- **Ecosystem Services:** Natural resource management decisions often do not consider nature's services because of the challenge to attribute an absolute or relative value to them, and we need to understand the range of ecosystem services, such as carbon sequestration and flood attenuation which are important to society and to improve the general state of knowledge around how to assess, value, and possibly monetize ecosystem services. Therefore we would like to conduct a pilot study in

either Tivoli Bays or Stockport Flats watershed that will help us understand and communicate the societal value of each ecosystem service. *Reserve point of contact for additional information: Emilie Hauser, Estuary Training Coordinator, Emilie.Hauser@dec.ny.gov, 845-(889) 4745 x112.*

## **Jacques Cousteau Reserve, New Jersey**

- Water and habitat quality of the Mullica River-Great Bay Estuary has been excellent due to limited development and low nutrient loading and the nutrients that enter upriver typically are not effectively utilized. But, periodic upwelling, ocean acidification and saltwater intrusion along with increasing precipitation projected by climate change models are therefore likely to lead to changes to the estuarine system and result in range shifts in habitats and organisms that need to be determined to inform future management strategies. *Reserve point of contact for additional information: Mike De Luca, Manager, deluca@marine.rutgers.edu, (732) 932-6555 x512.*
- Since tropical storm Sandy, increasing resilience of built and natural communities has become a priority and the reserve has been viewed as a leader in providing resilience data, tools and technical assistance. But there has been no assessment of the effectiveness and impact that this work has had on overall coastal community resilience. Therefore, we need to assess the Jacques Cousteau Reserve resilience portfolio to determine what has been effective and what barriers exist to utilizing these resources to increase resilience. *Reserve point of contact for additional information: Lisa Auermuller, Coastal Training Program Coordinator, auermull@marine.rutgers.edu, (609) 812-0649 x204.*
- The Oyster Creek Nuclear Generating Station drew cooling water from the Barnegat Bay estuary and discharged warm effluent back into it with potential impacts to fish ecology in the Jacques Cousteau Reserve. But the nuclear station began a shutdown in fall 2018 with unknown impacts to larval and juvenile fishes. Therefore, we need to study the distribution, abundance, growth, and assemblage structure of fishes as a response prior to decommissioning of similar plants in the USA and as a potential model for predicting the effect of climate change. *Reserve point of contact for additional information: Tom Grothues, Research Coordinator, grothues@rutgers.edu, (609) 296-5260 x262.*
- The Jacques Cousteau Reserve includes parts of a drowned river valley and a barrier island lagoon with a common inlet, but one is naturally acidic and the other alkaline which potentially stimulates different responses in phytoplankton assemblage and growth, particularly those of concern for production of toxins. Therefore, the reserve presents an ideal location for the study of pH and nutrients on the environmental forcing of the evolution of algal blooms, and especially toxic species. *Reserve point of contact for additional information: Tom Grothues, grothues@rutgers.edu, (609) 296-5260 x262.*
- Shellfish farms are low impact forms of coastal food production and they provide ecosystem services such as nutrient reduction and habitat provisioning. But we lack a thorough understanding of the types of fish and wildlife interactions that occur at these farms. Farm production is expanding in the Barnegat Bay estuary; therefore, it is important to collect data about fish habitat on farms and how these influence fish and wildlife communities in the bay. *Reserve point of contact for additional information: Daphne Munroe, dmunroe@hsrl.rutgers.edu, (856) 785-0074 x4325.*

## Northeast Region

### Great Bay Reserve, New Hampshire

- Protecting estuarine and riparian buffers maintains valued ecosystem services associated with water quality, wildlife habitat, and flood risk reduction. We understand the challenges associated with buffer management stem from the complex interplay of natural systems, community perspectives and values, economics, and the regulatory environment. But there is no state and limited municipal implementation of buffer conservation or restoration in the coastal watershed. Therefore we need to have a deeper understanding of what prevents effective buffer management and propose practical solutions for landowners and municipal decision makers. *Reserve point of contact for additional information: Steve J. Miller, Coastal Training Program Coordinator GBNERR, Steve.Miller@wildlife.nh.gov, (603) 294-0146.*
- Saltmarshes along the New Hampshire coast are threatened by sea level rise. The Great Bay Reserve is actively conducting several research and monitoring efforts to understand this threat and how to plan protection, restoration, and land use decisions that will allow salt marsh habitat to persist. But we do not know what types of restoration activities are best suited for different types of marshes in our system therefore we need to explore the potential of innovative ways to facilitate marsh resilience and how to site those activities appropriately. *Reserve point of contact for additional information: Rachel Stevens, Stewardship Coordinator, Rachel.Stevens@wildlife.nh.gov, (603) 778-0015.*
- Oysters populations in Great Bay, which provide multiple benefits to the ecosystem and the people around it (filter excess nutrients and sediment, habitat for fish and crabs, shoreline protection, recreational and commercial harvest), have severely declined over the past decades. Managers and conservation agencies have tried to reverse this dramatic downturn by limiting harvest and creating and seeding new reef structures. But oyster populations remain historically low. Therefore we need to enhance our understanding of how local factors (e.g., water quality, disease, predation, etc.) affect native populations and restoration efforts. *Reserve point of contact for additional information: Chris Peter, Research Coordinator, Christopher.Peter@wildlife.nh.gov, (603) 294-0146.*
- Land use changes and climate change are increasingly altering Great Bay. These stressors have cascading impacts affecting physical and chemical conditions, estuarine habitats (oyster reefs, saltmarshes, seagrasses) and inhabiting keystone species (fish populations, horseshoe crabs, lobsters, etc.). But we do not clearly understand the effects of these anthropogenic stressors on our estuary. Therefore we need research to help inform us on how these stressors are linked to changes in our bay. *Reserve point of contact for additional information: Chris Peter, Research Coordinator, Christopher.Peter@wildlife.nh.gov, (603) 294-0146.*

### Narragansett Bay Reserve, Rhode Island

- **Tidal marsh adaptation.** Thin-layer sediment addition (TLP) projects are an increasingly common way to build tidal marsh resilience to sea-level rise and numerous large-scale projects are underway in Rhode Island. But very little is known about how these projects affect key ecological services and functions that marshes provide. Therefore we critically need research into the effects of TLP projects on marsh services and functions including habitat utilization by fish and wildlife, carbon sequestration, and nutrient cycling, among many others. *Reserve point of contact for additional information: Kenny Raposa, Research Coordinator, kenneth.raposa@dem.ri.gov, (401) 683-7849.*

- **Tidal marsh adaptation.** Tidal marshes need to be able to migrate into adjacent uplands to keep pace with sea-level rise, and some studies show this to be happening in some regions. But we still do not know the rate at which Rhode Island marshes have migrated historically, nor do we have good data on current migration rates in our state, which generally has steep-profile shorelines that may not be conducive for migration. Therefore we need research to quantify both historic and current rates of marsh migration in Rhode Island. *Reserve point of contact for additional information: Kenny Raposa, Research Coordinator, kenneth.raposa@dem.ri.gov, (401) 683-7849.*
- **Tidal marsh adaptation.** A variety of natural and anthropogenic barriers exist along the heavily-developed Rhode Island shoreline that inhibit or stop landward marsh migration. Fledgling efforts are now underway to evaluate different ways to remove or modify these barriers to facilitate migration. But this is an emerging field with a limited amount of fruitful results and data. Therefore more research is needed to identify and evaluate cost-effective ways in which upland marsh buffers can be manipulated to facilitate migration. *Reserve point of contact for additional information: Kenny Raposa, Research Coordinator, kenneth.raposa@dem.ri.gov, (401) 683-7849.*
- **Social science.** Researchers understand the value of altering uplands adjacent to marshes to facilitate migration. Some degree of outreach to coastal landowners is generally associated with migration projects, but a thorough assessment of how the public and other non-scientific stakeholders values the potential trade-offs between different types of coastal uplands and marshes has not been undertaken. Therefore such a quantitative assessment is needed to help guide best practices for future migration facilitation studies and implementation. *Reserve point of contact for additional information: Kenny Raposa, Research Coordinator, kenneth.raposa@dem.ri.gov, (401) 683-7849.*
- **Submerged Aquatic Vegetation.** In recent decades, significant investments in the reduction of nutrients entering Narragansett Bay have improved water quality conditions and moderately increased the health and spatial extent of submerged aquatic vegetation (SAV). But we don't have a thorough understanding of how future climate change drivers will affect the distribution, resilience and ecosystem functions of SAV in the bay. Therefore, additional studies are needed on the response to potential future conditions to inform coastal management of this valuable resource. *Reserve point of contact for additional information: Kenny Raposa, Research Coordinator, kenneth.raposa@dem.ri.gov, (401) 683-7849.*

## Wells Reserve, Maine

- **Invasive species biology.** Anthropogenic and climate-mediated processes are driving shifts in the distribution of invasive species (e.g., green crab), and estuarine systems are especially vulnerable to high rates of invasions. However, interactions between native and non-native species in our estuaries and coastal waters remain poorly understood. Therefore we seek a better understanding of these connections as it pertains to coastal and marsh dynamics and ecosystem services. *Reserve point of contact for additional information: Jason Goldstein, Research Director, jgoldstein@wellsnerr.org; (207) 646-1555 x136.*
- **Healthy and sustainable fisheries in the Gulf of Maine.** Climate change is already having adverse impacts on economically- and ecologically-relevant marine species in the Gulf of Maine, and we expect challenging environmental conditions (e.g., thermal stress, coastal acidification, disease) to persist. Therefore, we would like to expand empirical studies and predictive modeling to inform coastal resource stakeholders of how these stressors affect finfish and shellfish species, especially for

those species that are considered data-poor. *Reserve point of contact for additional information: Jason Goldstein, Research Director, jgoldstein@wellsnerr.org; (207) 646-1555 x136.*

- **Novel tools/methodologies to assess species of conservation concern.** Environmental monitoring programs are essential for effective estuarine management, and they provide a strong basis for understanding ecosystem structure and function. But environmental DNA presents an opportunity to harness new technology and fundamentally improve our capacity to monitor biological communities. Therefore, we seek to expand this type of monitoring and develop best practices/analyses to provide end-users with a novel management tool. *Reserve point of contact for additional information: Jason Goldstein, Research Director, jgoldstein@wellsnerr.org; (207) 646-1555 x136.*
- **Coastal resiliency.** Shorelines are increasingly vulnerable to storms, sea level rise, and erosion. In response, vulnerable coastal communities are making complex management and policy decisions about how to adapt to change. One issue related to adaptation remains difficult. ‘Relocation’ raises hard questions about property rights and emotional attachments to place. Therefore, research is needed to better understand the challenges of developing adaptation strategies and relocation policies and the methods for engaging communities in dialogues that build resilience. *Reserve point of contact for additional information: Christine Feurt, Coastal Training Program Director, cfeurt@wellsnerr.org; (207) 646-1555 x111.*
- **SWMP data science & synthesis.** The System-wide Monitoring Program (SWMP) measures changes to water quality and sea-level rise to inform coastal zone management. We seek to better synthesize these data to compare changes within our ecological communities, but we lack the analytical tools to comprehensively analyze such large datasets. Therefore, the development of new tools and analyses are needed to amplify these data with better precision to facilitate monitoring of other parameters (e.g., carbonate chemistry) in the future. *Reserve point of contact for additional information: Jason Goldstein, Research Director, jgoldstein@wellsnerr.org; (207) 646-1555 x136.*

## Waquoit Bay Reserve, Massachusetts

- Eutrophication is a chronic problem for many Cape Cod estuaries and much effort has been devoted to assess alternative nutrient reduction methods but some methods (e.g., floating constructed wetlands, shellfish) merit site-specific investigations. Public perceptions of alternative treatment methods likewise have not been thoroughly addressed. Therefore we seek researchers to conduct field experiments in Waquoit Bay and social science investigations assessing public understanding of nutrient reduction strategies. *Reserve point of contact for additional information: Tonna-Marie Rogers, Coastal Training Program Coordinator/Interim Manager, Tonna-Marie.Surgeon-Rogers@mass.gov, (508) 457-0495 x110.*
- Tidal marshes in the Waquoit Bay Estuary are threatened by sea level rise, excessive nutrients, increased storm severity and crab activity. But there may be manipulations we can institute that would alter the trajectory of declining marsh integrity. Therefore, we need information on effective management strategies that can enhance marsh sustainability for current and future conditions. *Reserve point of contact for additional information: Megan Tyrrell, Research Coordinator, Megan.Tyrrell@mass.gov, (508) 457-0495 x105.*
- Diel occurrences of low pH water currently occur at some reserve water quality monitoring sites, and climate change will exacerbate acidification conditions. But we haven’t fully explored the implications of this change. Therefore we need to utilize the reserve water quality data and infrastructure to strengthen causal inference and predictive power for larger or longer lasting conditions of low pH

water and its implications for estuarine organisms. *Reserve point of contact for additional information: Megan Tyrrell, Research Coordinator, Megan.Tyrrell@mass.gov, (508) 457-0495 ext 105.*

- Salt marshes provide many significant ecosystem services including blue carbon storage. GIS-based analyses suggest that the vegetated area in Waquoit Bay salt marshes was decreasing at a rate of roughly three percent each year from 2004 to 2012. However, the reserve lacks more recent aerial photography as well as research targeting the drivers of this change and possible migration outcomes. Therefore, we need an updated habitat map and a more in-depth change analysis to assess the future of our salt marshes and the services they provide. *Reserve point of contact for additional information: Megan Tyrrell, Research Coordinator, Megan.Tyrrell@mass.gov, (508) 457-0495 x105.*
- The abundance of threatened and declining species (e.g. American eel, tidal marsh specialist birds) is unknown for the Waquoit Bay Reserve. We have strong research, management and educational motivations to learn their status, but we lack the information necessary to effectively manage for these species. Therefore, we need targeted surveys and management recommendations to address and potentially enhance habitat value for rare and declining species in the Reserve. *Reserve point of contact for additional information: James Rassman, Stewardship Coordinator, James.Rassman@mass.gov; (508) 457-0495 x101.*

## Southeast Region

### ACE Basin Reserve, South Carolina

- Long-term meteorological and estuarine data exists for the ACE Basin Reserve, and analyses indicate increases in short-term variability and long-term trends occur. But integrated assessments of biological data with meteorological and water quality data has not been conducted. Therefore integration and syntheses of the long-term meteorological, water quality, and biological datasets to understand the ecological implications of these changes is a high priority. *Reserve point of contact for additional information: Denise Sanger, Research Coordinator, SangerD@dnr.sc.gov, (843) 953-9074.*
- ACE Basin marshes are vulnerable to sea level rise, and managers are only beginning to understand the consequences of the potential changes. But little research has been done to assess these impacts. Therefore, we need to conduct research to better understand how our dominant ecosystems will change and develop potential adaptation or mitigation strategies. *Reserve point of contact for additional information: Denise Sanger, Research Coordinator, SangerD@dnr.sc.gov, (843) 953-9074.*
- The ACE Basin Reserve creates unique recreational opportunities found in few other public lands and waterways. Use of those lands and waterways is increasing over time, but increased visitor use may lead to impacts to the visitor experience and to natural resources. Therefore we need to characterize visitor use and understand its potential to impact key natural resources. *Reserve point of contact for additional information: Blaik Keppler, Manager, KepplerB@dnr.sc.gov, (843) 953-9024.*
- The ACE Basin Reserve and other partners have developed resources—such as the Low Impact Development (LID) Manual for Coastal South Carolina and associated tools—to aid decision-makers with low impact development and the use of LID practices is increasing in coastal South Carolina. But the reserve has not evaluated the success of the previously developed resources or identified persisting LID-related informational needs. Therefore, we need qualitative and quantitative information about resource use and information needs to better address coastal decision-maker needs moving forward. *Reserve point of contact for additional information: Blaik Keppler, Manager, KepplerB@dnr.sc.gov, (843) 953-9024.*

### Guana Tolomato Matanzas Reserve, Florida

- Many waterbodies within the Guana Tolomato Matanzas Reserve are listed as “impaired” for water quality by the state of Florida. Long-term monitoring is carried out by multiple agencies at fixed stations. But local causes and consequences of water quality impairments have yet to be elucidated. Therefore studies are needed to synthesize available water quality and biological data, characterize spatial patterns, investigate indicators of ecological condition and associated ecosystem services, and determine how to restore water quality. *Reserve point of contact for additional information: Nikki Dix, Research Coordinator, Nikki.dix@dep.state.fl.us, (904) 823-4519.*
- Guana Tolomato Matanzas Reserve marshes (salt water, brackish and freshwater) are vulnerable to sea level rise due to a lack of riverine sediment delivery, barriers to upland migration and saltwater intrusion. But land acquisition and restoration projects are effective at mitigating loss. Therefore we need locally-specific information about marsh sustainability and associated ecosystem services to best site and conduct mitigation strategies. *Reserve point of contact for additional information: Nikki Dix, Research Coordinator, Nikki.dix@dep.state.fl.us, (904) 823-4519.*

- Guana Tolomato Matanzas Reserve is a bar-built estuary with a dynamic coastline. An increasing population coupled with more frequent storm events has increased dredging, shoreline armoring, and sand placement activities. But local impacts of those activities on nearshore and estuarine structure and function are unknown therefore our region is in need of habitat mapping, sediment transport, hydrodynamic, and ecosystem service studies to investigate the benefits and tradeoffs of different management options, including living shorelines. *Reserve point of contact for additional information: Nikki Dix, Research Coordinator, Nikki.dix@dep.state.fl.us, (904) 823-4519.*

## North Carolina Reserve, North Carolina

- **Water Quality and Weather.** As part of the reserve's System-wide Monitoring Program, the North Carolina Reserve collects long-term water quality and meteorological data. These data can be used to examine impacts of human activities (e.g., land-use/land cover), climate, and storms on water quality. But these data have not been analyzed for these impacts, nor do we understand end user and decision-maker needs for this information. Therefore data syntheses are needed to provide meaningful and accessible data products for end users. *Reserve point of contact for additional information: Brandon Puckett, Research Coordinator, Brandon.puckett@ncdenr.gov, (252) 838-0851.*
- **Ecosystem Services.** The North Carolina Reserve sites provide ecosystem services and the habitats that provide these services are impacted by climate change, invasive species, and coastal development. But we have limited information on how these factors influence the provision of ecosystem services. Therefore research is needed to quantify and better understand the services our habitats provide and how they may change in association with the factors above to inform future management strategies. *Reserve point of contact for additional information: Brandon Puckett, Research Coordinator, Brandon.puckett@ncdenr.gov, (252) 838-0851.*
- **Vulnerability.** Habitats at the North Carolina reserve are vulnerable to climate change impacts (e.g., sea-level rise, increases in storminess and temperature). The vulnerability of habitats to climate change is influenced by human manipulation (e.g., sand placement, dredging). But it is not clear how vulnerable the habitats are to climate and human impacts and how to best mitigate vulnerability. Therefore more information is needed to understand habitat vulnerability and possible management actions to enhance habitat resilience. *Reserve point of contact for additional information: Brandon Puckett, Research Coordinator, Brandon.puckett@ncdenr.gov, (252) 838-0851.*
- **Habitat Change.** As part of the reserve's System-wide Monitoring Program, the North Carolina Reserve mapped its habitats using standardized protocols. We have since observed habitat change and are interested in better understanding habitat change over time. But we do not know the trade-offs of different mapping technologies, mapping frequencies, and approaches to measure change in different habitats, therefore we need to develop best practices for habitat mapping and assessing change to inform reserve system protocols and habitat management actions for the North Carolina Reserve. *Reserve point of contact for additional information: Brandon Puckett, Research Coordinator, Brandon.puckett@ncdenr.gov, (252) 838-0851.*
- **Species and habitat restoration/enhancement.** Many habitat restoration projects have occurred within the North Carolina Reserve and nearby estuarine ecosystems, and we are interested in a more holistic, ecosystem-services based approach to restoration. But analyses and syntheses of the restoration success of these projects are limited. Therefore we need to know the biophysical factors underpinning restoration success or failure; the ecological functions restored habitats provide and how these functions change over time; and the benefits and impacts of restoration on natural habitats. *Reserve point of contact for additional information: Brandon Puckett, Research Coordinator, Brandon.puckett@ncdenr.gov, (252) 838-0851.*

## North Inlet–Winyah Bay Reserve, South Carolina

- South Carolina has some of the fastest rates of coastal development in the nation. Effective stormwater management is essential for sustainable coastal development. But the effectiveness and cumulative impacts of both conventional stormwater control measures and alternative low impact development practices remains a critical knowledge gap with regard to downstream water quality protection. Therefore additional information on how existing and emerging stormwater management practices impact the transport, transformation, and fate of stormwater pollutants is needed to better inform effective management of non-point source pollution. *Reserve point of contact for additional information: Erik Smith, Reserve Manager, erik@belle.baruch.sc.edu, (843) 904-9035.*
- Much of the coastal area surrounding the North Inlet-Winyah Bay Reserve has been altered by shoreline development, including various shoreline armoring and stabilization efforts. Shoreline development practices are known to impact marsh ecosystem processes. But the effects of shoreline development on the future sustainability of marshes as essential habitat are not well understood. Therefore an assessment of the effects of various shoreline development practices on ecosystem and living resource conditions in adjacent marshes and tidal creeks is needed to improve marsh management and mitigation planning. *Reserve point of contact for additional information: Jennifer Plunket, Stewardship Coordinator, jen@belle.baruch.sc.edu, (843) 904-9033.*
- Human communities in the Winyah Bay watershed have experienced four extreme weather events in the past four years, some with unprecedented impacts and these communities are composed of demographically diverse populations. But it is unclear how different groups have experienced and perceived these events, especially in relation to climate science, planning, and policy. Therefore information is needed on how extreme events have shaped attitudes within a heterogeneous community in order to better inform decision makers representing the community. *Reserve point of contact for additional information: Maeve Snyder, Coastal Training Program Coordinator, msnyder@belle.baruch.sc.edu, (843) 904-9034.*
- Saltmarshes are highly productive ecosystems that sequester significant amounts of atmospheric carbon. This productivity varies as a function of the marsh's position in the tidal frame. But how climate change affects ecosystem productivity, carbon and sediment dynamics along a marsh's elevation gradient is not fully resolved. Therefore, further information is needed to improve predictions of climate change impacts on marsh productivity at the ecosystem scale. *Reserve point of contact for additional information: Erik Smith, Reserve Manager, erik@belle.baruch.sc.edu, (843) 904-9035.*
- Climate changes, such as sea level rise and warming temperatures, are impacting South Carolina's coastal zone. Coastal development has been shown to alter the physical-chemical conditions within estuarine tidal creeks. But how these changes may interact and affect the planktonic component of the ecosystem (organisms that represent the base of the estuarine food chain as well as the critical life-stage of many commercially and recreationally important species) is not well documented. Therefore we need to better understand how interacting stressors within tidal creeks affect the dynamics of the plankton community. *Reserve point of contact for additional information: Jennifer Plunket, Stewardship Coordinator, jen@belle.baruch.sc.edu, (843) 904-9033.*

## Sapelo Island Reserve, Georgia

- Sapelo Island and other area barrier islands have upland freshwater wetlands that support a variety of coastal flora and fauna species. These wetlands are potentially threatened with saltwater intrusion

by sea level rise and decreased aquifers from increased groundwater withdrawal. But we don't know what characteristics make these habitats important or vulnerable compared to their mainland counterparts. Therefore we need research that characterizes the ecological importance and resilience of these freshwater habitats. *Reserve point of contact for additional information: Rachel Guy, Research Coordinator, Rachel.guy@dnr.ga.gov, (912) 485-2251.*

- Many of the large freshwater swamps and other wetlands found on Sapelo Island historically have been drained by extensive ditching carried out in the past. With sea level rise some of these ditches may be facilitating the flow of salt and brackish tidal waters into upland natural habitats and the residential community. But we don't know which ditches are having or may have the most significant impact on upland areas. Therefore we need research on the patterns of altered hydrology on the island and how impacts might best be mitigated. *Reserve point of contact for additional information: Rachel Guy, Research Coordinator, Rachel.guy@dnr.ga.gov, or Suzanne VanParreren, Stewardship Coordinator, Suzanne.vanparreren@dnr.ga.gov (912) 485-2251.*
- Sapelo Island Reserve has two living shorelines that were constructed in 2007. Living shorelines are increasingly being used as an ecologically friendly solution to shoreline erosion. But we don't know the effects of these structures on surrounding habitats, compared to traditional hard-armoring techniques (e.g., bulkheads). Therefore we need research that will investigate the effects of living shorelines on adjacent and nearby habitats, compared to traditional hardened-shoreline techniques. *Reserve point of contact for additional information: Rachel Guy, Research Coordinator, Rachel.guy@dnr.ga.gov, (912) 485-2251.*
- Sapelo Island Reserve has been collecting continuous water quality data since 2004 through the System Wide Monitoring Program. We know that climate change will play a role in shifting water quality values. But we don't know how such changes might affect plankton populations and other estuarine organisms. Therefore we need research that expands our knowledge of relationships between local water quality and patterns in the composition, abundance and persistence of estuarine aquatic biota. *Reserve point of contact for additional information: Rachel Guy, Research Coordinator, Rachel.guy@dnr.ga.gov, (912) 485-2251.*
- The private community on Sapelo Island affects water quality, habitat integrity, and ecosystem functions within the Reserve. The community has been affected by major land use changes in the past and continues to be affected by ongoing socio-economic and demographic changes. But the community is increasingly vulnerable to sea level rise and nuisance flooding. Therefore we need research to better understand these complex, interacting factors to help enhance the resilience of the community and the multiple state agencies and institutions on the island. *Reserve point of contact for additional information: Doug Samson, Reserve Manager, doug.samson@dnr.ga.gov, (912) 485-2251.*

## West Coast Region

### Elkhorn Slough Reserve, California

- We have conducted a major salt marsh restoration project, raising the marsh plain of a subsided area through sediment addition, and we will be conducting some monitoring of elevation and vegetation changes. But we do not have the staff resources to closely examine the trajectory and consequences of restoration for many ecosystem indicators. Therefore, we welcome student projects investigating restoration success of physical or biological indicators of restoration, anywhere from the tidal creeks to marsh plain to adjacent coastal grassland that is also being restored. *Reserve point of contact for additional information: Kerstin Wasson, Research Coordinator, Kerstin.Wasson@gmail.com, (831) 728-2822.*
- Elkhorn Slough salt marshes have been drowning over past decades, and we know that multiple factors, including groundwater overdraft, eutrophication, sediment starvation and crab bioturbation are likely contributing. But we lack a clear understanding of the relative importance of different factors, and how this varies spatially. Therefore we need information, from correlative studies and experiments that shed light on drivers of marsh loss and strategies for reversing them. *Reserve point of contact for additional information: Kerstin Wasson, Research Coordinator, Kerstin.Wasson@gmail.com, (831) 728-2822.*
- Wetlands around Elkhorn Slough exhibit symptoms of eutrophication. We have determined that both high nutrient concentrations and stagnant conditions resulting from artificial tidal restriction contribute to eutrophication. But we do not know what drives spatial and temporal variation in eutrophication at a local scale, leading to peaks in nutrients or eutrophication at some places in time, and declines in others. Therefore we need information on land use activities in the adjacent subwatershed or water control structure management that drive these patterns, so that we can recommend best management practices for improving water quality *Reserve point of contact for additional information: Kerstin Wasson, Research Coordinator, Kerstin.Wasson@gmail.com, (831) 728-2822.*
- Elkhorn Slough and nearby watersheds are largely surrounded by agricultural fields. We infer from our water quality monitoring that excess nutrients from the fertilizing of these fields finds its way to the estuary via runoff and possibly through groundwater infiltration. Therefore, a better understanding of farmer decision-making about the application of fertilizers, including their knowledge about fertilizer environmental impacts and existing techniques to mitigate these, as well as possible economic incentives or penalties that might further affect their fertilizer use, would be useful for working with stakeholders and policymakers for the reduction of fertilizer impacts to estuarine ecosystems. *Reserve point of contact for additional information: Kerstin Wasson, Research Coordinator, Kerstin.Wasson@gmail.com, (831) 728-2822.*
- Native oyster numbers are very low in Elkhorn Slough, and we know that natural recruitment fails to occur in most years. But we don't know the cause of recruitment failure, nor the potential role aquaculture could play in overcoming it. Therefore we need investigations of correlates of recruitment failure, identification of the life history stage that causes it (lack of reproduction by adults vs. larval death, etc.), as well as tests of the effectiveness of aquaculture at increasing recruitment in the estuary. *Reserve point of contact for additional information: Kerstin Wasson, Research Coordinator, Kerstin.Wasson@gmail.com, (831) 728-2822.*

## He'eia Reserve, Hawaii

- The water flowing out of the wetland and into the estuary in the He'eia NERR are eutrophic, anoxic, and carry excessive amounts of sediment. We know this is a drastic change from the past. The wetland portion was formerly a highly productive agro-ecological system managed by native Hawaiians for about 1,000 years. This agro-ecological system trapped sediments, and the water flowing out of it had an ideal amount of nutrients and oxygen to fuel primary productivity (phytoplankton and macro-algae) in the estuary, which in turn facilitated the development of an 88-acre aquaculture system (i.e., a fishpond) that increased the abundance and availability of herbivorous fish. After being abandoned for several generations, one of our site partners is endeavoring to restore the agro-ecological system. But we don't know the biochemical mechanisms that created these ideal conditions in the water. Therefore we need to understand how a return to traditional resource management strategies of the agro-ecosystem affects water quality and sedimentation in wetlands and estuaries. *Reserve point of contact for additional information: Shimi Rii, Research Coordinator, shimi@hawaii.edu, (808) 783-9621.*
- Mangroves are noted as important nursery habitat for fish in areas where they are native. But in Hawai'i they are invasive facilitate the persistence of non-native fauna including a macrobenthic community which serve as prey for fish and birds, and promote detrital decomposition. As mangroves are removed, we anticipate a change in the macrobenthic and fish communities, but we do not know what sort of communities will proliferate after restoration. Therefore, we need to know how the removal of invasive mangroves affect the macrofaunal community and the recruitment and migration of both native and invasive fish species. *Reserve point of contact for additional information: Shimi Rii, Research Coordinator, shimi@hawaii.edu, (808) 783-9621.*
- Hawaiian aquaculture systems (i.e., fishponds) are noted for their ability to increase primary productivity (phytoplankton and macro-algae) in estuaries. We know that this in turn facilitates an increased abundance and availability of herbivorous fish. But, we do not have a good understanding of the trophic relationships that exist in these productive aquaculture systems. Therefore we need to understand the functional food-web dynamics in traditional Hawaiian fishponds, including phytoplankton and zooplankton assemblages that promote productivity of native fish species. *Reserve point of contact for additional information: Shimi Rii, Research Coordinator, shimi@hawaii.edu, (808) 783-9621.*
- Mangroves are important components of estuaries in areas where they are native, but in Hawai'i they are invasive and mangroves drive out native species and promote sedimentation and anoxia. We are currently in the process of restoring the wetland and coastal ecosystems within our reserve to increase ecosystem services. But we do not know which ecosystem services are impacted with a return to traditional resource management. Therefore, it would be beneficial to determine the types of ecosystem services increased by several restoration efforts in our wetlands and in our coastal habitats. *Reserve point of contact for additional information: Kawika Winter, Manager, kawikaw@hawaii.edu, (808)346-5708.*
- Organizations within the He'eia Reserve and in adjacent areas have run environmental education programs for the past two decades. We know through the visitor data collected that their programs have engaged thousands of children and adults. But program evaluation and rigorous measurement of the educational and social impacts has lagged behind program development. Therefore, it would be beneficial to analyze the existing data to tell the story of the collective evolution of education programs within the reserve, and collect new social and educational data to determine the effectiveness of 'aina-based and cultural education in meeting organizational goals. *Reserve point of*

*contact for additional information: Fred Reppun, Education Coordinator, freppun@hawaii.edu, (808) 779-9411.*

## **Kachemak Bay Reserve, Alaska**

- **Translating long-term monitoring programs to stakeholders.** Kachemak Bay Reserve is home to a variety of long-term monitoring data and is viewed by a variety of stakeholders as a source of information. But stakeholders often don't understand how the data produced via the long-term monitoring programs can help them respond to impacts and hazards associated with environmental change. Therefore, we are seeking to develop relevant communications around long-term monitoring with all communities in the region, and to identify overlap between Kachemak Bay reserve and Traditional Ecological Knowledge that could guide future monitoring efforts. *Reserve point of contact for additional information: Coowe Walker, Manger, Cmwalker9@alaska.edu, 907-399-3418.*
- **Environmental Drivers of Coastal Ecosystems.** There are large data gaps around nearshore biotic communities in the Kachemak Bay region, as well as in southcentral Alaska in general. There are increasing requests for aquaculture permits, shoreline development, disaster response plans, and other activities. But decision-making is difficult without information on the biological communities that could be affected. Therefore, models for the abiotic factors that influence coastal ecosystem biotic communities need to be developed. *Reserve point of contact for additional information: Coowe Walker, Manger, Cmwalker9@alaska.edu, 907-399-3418.*
- **Effects of Climate Change on Watershed Productivity and Salmon Habitats.** Kachemak Bay Reserve has led research efforts to evaluate the role of groundwater in supporting the regions salmon streams. Our research has shown that groundwater inputs sustain stream flows, moderate stream temperatures, and deliver nutrients to salmon streams. But, we need ways to interpret groundwater models for use in land use planning, permitting, policy decisions, and habitat protection. Therefore, we are seeking to understand how changes in groundwater due to climate change and human impacts could affect groundwater resilience. *Reserve point of contact for additional information: Coowe Walker, Manger, Cmwalker9@alaska.edu, 907-399-3418.*
- **Promoting Resilient Groundwater Resources.** Extensive peatlands in the watersheds of the Kenai Peninsula have been shown by Kachemak Bay Reserve led research to be important to salmon stream productivity, and represent potentially large stores of carbon. But, these peatlands are threatened to be released by the regions rapidly increasing population and growing development pressures. Therefore, we need to build understanding of carbon content differentiation across different types of peatlands, and understand the local and regional policy structure and entry points. *Reserve point of contact for additional information: Coowe Walker, Manger, Cmwalker9@alaska.edu, 907-399-3418.*
- **Blue Carbon associated with peatlands in the Kachemak Bay region.** Kachemak Bay Reserve led research has elucidated landscape connections to headwater streams in salmon bearing watersheds of the Kachemak Bay region. We have conducted extensive stakeholder engagement, education, and outreach of the science to improve decision-making for habitat protection. But there has been no long-term evaluation effort to identify effectiveness of our efforts and direct links to habitat conservation. Therefore, research is needed to evaluate the influence of this research and engagement to improve Kachemak Bay Reserve program performance and ascertain whether program activities have resulted in the desired outcomes. *Reserve point of contact for additional information: Coowe Walker, Manger, Cmwalker9@alaska.edu, 907-399-3418.*

## Padilla Bay Reserve, Washington

- **Ecology of eelgrass in waters of the Salish Sea.** Padilla Bay is home to one of the largest contiguous eelgrass meadows in North America and as such is a valuable ecological, economic, and cultural resource. However, we lack quantitative evidence for many of the important and emergent ecosystem services traditionally associated with eelgrass ecosystems. Therefore, we are seeking projects that can address the following questions:
  - To what extent do eelgrass meadows of Padilla Bay provide habitat for commercially and ecologically important marine macrofauna such as forage fish, salmonids, and/or crustaceans? What role do eelgrass play in supporting the commercial industries associated with these organisms?
  - What are the ecosystem services and ecological implications of the presence and expansion of the non-native *Zostera japonica* when compared to *Zostera marina* or bare mud flats? How does the ecological role of *Z. japonica* compare to *Z. marina* and what are the implications with respect to the management of this non-native?
  - What is the carbon storage and sequestration capacity of PNW eelgrass and how does this vary among eelgrass species, tidal elevation, and across different temporal scales (e.g. short vs long-term sequestration)?

*Reserve point of contact for additional information: Dr. Jude Apple, Research Coordinator, japple@padillabay.gov, (360) 428-1098.*

- **Interactions between eelgrass and shellfish aquaculture.** Expansion and restoration of eelgrass habitat in Puget Sound is a high priority for Washington state. At the same time, NOAA Marine Fisheries has identified expansion of shellfish aquaculture as a regional priority. However, shellfish aquaculture and eelgrass generally utilize similar areas of the intertidal. Therefore we are interested in projects that provide evidence regarding the mutual benefits – or compromises – of the co-location of eelgrass and shellfish aquaculture in intertidal waters of the Salish Sea. Examples of questions that address this topic include:
  - What are the ecological benefits and impacts of shellfish aquaculture as it relates to eelgrass habitat? Are there mutual benefits of the co-location of eelgrass and aquaculture that can enhance local ecological and commercial productivity?
  - What are the ecosystem services or ecological benefits provided by shellfish aquaculture (e.g. structural aspects) as it relates to commercially and ecologically valuable organisms such as Dungeness crab, forage fish, and salmonids.

*Reserve point of contact for additional information: Dr. Jude Apple, Research Coordinator, japple@padillabay.gov, (360) 428-1098.*

- **Human benefit and value associated with the socioecological system of Padilla Bay.** Coastal and estuarine ecosystems provide a wide range of ecological benefits and ecosystem services. However, we lack quantitative evidence of the connection between measurable aspects of coastal ecosystem services and indicators of human well-being. Therefore, we are interested in projects that can help more fully evaluate the value of coastal ecosystems to local and regional communities. Specific questions related to this topic include:
  - What are the sociocultural and economic benefits of eelgrass and how do these manifest on both regional and place-based (e.g., Padilla Bay Reserve) scales? Can we generate ecosystem service frameworks linking eelgrass to metrics of human well-being and thus quantify the social, cultural and economic benefits for local and regional communities?

- What are the positive social and cultural benefits associated with eelgrass meadows and salt-marsh habitats and how can these be used to evaluate and promote restoration and conservation efforts across the region?
- Based on socioecological frameworks and ecosystems services models, what are the potential sociocultural and economic impacts of the loss of eelgrass and salt-marsh ecosystems associated with large scale perturbations (e.g. climate change, sea-level rise) or other local catastrophic events (e.g., oil spills)?

*Reserve point of contact for additional information: Dr. Jude Apple, Research Coordinator, japple@padillabay.gov, (360) 428-1098.*

- **Groundwater dynamics and their effects on tidal wetlands and coastal farmland.** The delivery of freshwater to the nearshore environment affects species composition, productivity, and ecological functions of coastal habitats. Further, sediment composition (e.g. grain size, organic content) can also affect rates of intrusion, residence time of both fresh and saline groundwater, and sediment biogeochemical processes. However, our understanding of the dynamics of groundwater interactions in the nearshore is poorly described and the effect of climate change on groundwater dynamics is not well understood. Therefore, we are seeking projects that advance our understanding of how biota will respond to changes in groundwater supply and quality and inform management practices and restoration strategies that increase habitat resilience. We are particularly interested in projects that address the following:
  - Can locations of fresh groundwater delivery to intertidal zones be identified based on plant, algae, invertebrate, or biofilm characteristics? How do the communities of plants, algae, invertebrates, or biofilm differ across the spectrum of porewater salinity? Can we map the locations and quantify the delivery of fresh groundwater to Padilla Bay? Can we quantify the delivery of terrestrially-derived nutrients via groundwater to the bay?
  - How will sea level rise affect groundwater levels and saltwater intrusion in nearshore environments? Can changes in groundwater dynamics be used as a predictor of habitat change or migration?
  - How does groundwater chemistry (salinity and nutrients) change seasonally, and how does it differ between wet and dry years? After major rain events, how fast does terrestrially-derived groundwater manifest in intertidal environments? Do benthic algae or biofilm communities change in response to rain-driven changes in groundwater chemistry, and can we use them as indicators?
  - On low-lying coastal farmland, how does saltwater intrusion in the groundwater vary spatially and temporally? How far from the location of mean higher high water (MHHW) can tidal pumping be detected in groundwater wells? How will sea level rise affect groundwater levels and saltwater intrusion on farmland? Can we model the effects of sea level rise on groundwater elevation and chemistry in low-lying coastal agricultural areas?
  - How does groundwater chemistry and soil grain size interact to affect tidal wetland plant composition and productivity? How do our dominant tidal marsh species differ in terms of productivity across the spectra of soil porewater salinity and grain size? How does soil grain size interact with sea level rise to affect tidal wetland plants? If porewater salinity changes with climate change, how might this affect the species composition and productivity of tidal wetlands?

*Reserve point of contact for additional information: Roger Fuller, Stewardship Coordinator, rfuller@padillabay.gov, (360) 428-1098.*

- **Land-use in the Padilla Bay watershed and connections to the health and function of eelgrass.** Padilla Bay Reserve is located in Skagit County, where population has more than doubled over the

past 50 years. Runoff from the developments required to support this population growth will impact the eelgrass meadows of Padilla Bay. However, the effect of changes in the quantity and quality of freshwater inputs to Padilla Bay—combined with increased and intensified storm events, sea-level rise, and rising temperatures—is unknown. Therefore, we are interested in projects that identify linkages between land use and water quality, as well as provide recommendations for land management practices that accommodate growth while optimizing eelgrass ecosystem health and function. We are particularly interested in projects that:

- Develop and test scenarios defining linkages between water quality, submerged aquatic vegetation, freshwater inputs from upland sources, and changes in land cover and land use in the watershed.
- Document and recommend improvements to local and state policy and coastal planning as it relates to development of the Padilla Bay watershed.
- Utilize and leverage existing resources available at Padilla Bay, including SWMP water quality and weather data, high resolution lidar, aerial imagery, and water course/subbasin delineations, change maps, stream water quality data, and watershed characterization studies.

*Reserve point of contact for additional information: Suzanne Shull, GIS Specialist, sshull@padillabay.gov, (360) 428-1092.*

## **San Francisco Bay Reserve, California**

- Native oysters are ecologically important and a component of living shoreline initiatives in San Francisco Bay. We know their distribution throughout the estuary is variable in time and space but we don't understand all of that variability or the drivers behind it. Therefore we need more comprehensive studies of the distribution of oysters, their predators, and key environmental parameters affecting oysters. *Reserve point of contact for additional information: Matt Ferner, Research Coordinator, mferner@sfsu.edu, (415) 338-3724.*
- The San Francisco Bay Reserve China Camp State Park component has a low lying road that bisects its marshes and floods at "king" high tides. We have started an effort to engage stakeholders in identifying possible adaptation solutions but we want to pursue gaining more knowledge about the system as well as furthering the project. Therefore we need more studies of the ecology, hydrology, and geomorphology of the muted marshes as well as pursuing opportunities that will lead to a full adaptation feasibility study. *Reserve point of contact for additional information: Stuart Siegel, Coastal Resilience Specialist, siegel@sfsu.edu, (415) 823-3746 and Matt Ferner, Research Coordinator, mferner@sfsu.edu, (415) 338-3724.*
- The San Francisco Bay Reserve is taking a lead role in developing a regional tidal wetland monitoring program for the San Francisco estuary. There is great interest in how to integrate a representative network of existing and new sentinel sites into this program. But how these should be integrated into a base map of the estuary, where additional sentinel sites should be situated, and what kinds of fine-scale data are needed, needs careful study. Therefore we need focused research on these questions to help in the design of this regional tidal wetland monitoring program. *Reserve point of contact for additional information: Michael Vasey, Director, mvasey@sfsu.edu, (650) 255-5763.*
- The two components of the San Francisco Bay Reserve each have a long history of human occupancy and use. The San Francisco Bay Reserve and our partners are interested in how past use of the sites can inform and improve current land management, restoration, understanding, and education. But so far we do not have tribal or cultural contacts or any expertise in this area. Therefore we would like a focused project to be conducted on this topic and educational trainings to be developed to increase

knowledge at either or both of the two reserve components. *Reserve point of contact for additional information: Sarah Ferner, Education Coordinator, daviess@sfsu.edu, (415) 338-3707.*

- Tidal marshes in the two components of the San Francisco Bay Reserve are used, studied, and loved by visitors, students, and scientists. We are interested in continuing to support these uses but we lack data on how human activities impact broad or specific aspects of tidal marsh ecology. Therefore we need comprehensive studies of human use of these sites and the associated impacts to local habitats, species, and ecological structure, process, and function. *Reserve point of contact for additional information: Matt Ferner, Research Coordinator, mferner@sfsu.edu, (415) 338-3724.*

## South Slough Reserve, Oregon

- South Slough is home to several endangered and ecologically important native species including western lily (*Lilium occidentale*), eelgrass (*Zostera marina*), lamprey (*Entosphenus tridentatus* and *Lampetra spp.*), Olympia oyster (*Ostrea lurida*), and salt marsh bird's beak (*Chloropyron maritimum palustre*). The South Slough Reserve wants to protect and restore populations of these species, but we suspect that climate change and land-use are negatively affecting environmental conditions for these species. Therefore, we need more information on the ecology of these species and assessment of management actions to improve habitat conditions in order to create effective restoration strategies. *Reserve point of contact for additional information: Shon Schooler, Research Coordinator, shon.schooler@state.or.us, (541) 888-8270, x315.*
- Sea-level rise is projected to greatly alter South Slough Reserve tidal wetlands, and we are beginning to monitor these effects using surface elevation tables, marker horizons, groundwater wells, vegetation transects, weather stations, and water column data sondes. However, we do not yet understand the effect of climate change on wetland accretion rates, carbon sequestration capacity, changes in groundwater salinity, and water column pH. Therefore, we need additional research capacity to use both previously collected and new data to understand the effect of climate change on tidal wetland environmental functions and conditions. *Reserve point of contact for additional information: Shon Schooler, Research Coordinator, shon.schooler@state.or.us, (541) 888-8270, x315.*
- Invasive species including the green crab (*Carcinus maenas*), reed canary grass (*Phalaris arundinacea*) and Port Orford cedar root pathogen (*Phytophthora lateralis*), are affecting South Slough habitats. Effects of these species are impeding restoration projects, but we don't fully understand the ecology and impacts of these species (e.g. green crab) or know what management strategies will be effective (e.g., reed canary grass). Therefore we need more information on the ecology, impacts, and management of these species in order to restore marsh, eelgrass, and forest habitats. *Reserve point of contact for additional information: Shon Schooler, Research Coordinator, shon.schooler@state.or.us, (541) 888-8270, x315.*
- The South Slough Reserve is in the process of restoring tidal wetlands and thinning early successional forests to promote healthier forested uplands. There are several previously restored marshes that haven't been evaluated for long-term effects and we lack information about thinning for late-successional old-growth forest conditions. Therefore, there are opportunities to research wetland restoration trajectories and forest management methods at the South Slough Reserve. *Reserve point of contact for additional information: Shon Schooler, Research Coordinator, shon.schooler@state.or.us, (541) 888-8270, x315.*
- We have harmful algal blooms (HABs) in the Coos Estuary, and we know they cause shellfish to become toxic to humans. But we don't have a good method to predict levels of toxicity nor do we know the effect of climate change on HABs. Therefore we need research to develop better predictive

models and better understand how the effect of HABs might change in the future under a changing climate. *Reserve point of contact for additional information: Shon Schooler, Research Coordinator, shon.schooler@state.or.us, (541) 888-8270, x315.*

## **Tijuana River Reserve, California**

- The Tijuana Estuary is the largest, most intact coastal wetland left in Southern California. A variety of science-driven restoration and conservation efforts have resulted in a system that supports a diversity of habitats and species. But stressors such as biological invasions, habitat degradation, and pollution remain. Therefore we need research addressing processes that support assemblages of native biota, approaches for tracking changes in both populations and stressors, and strategies for effective management of species and habitats. *Reserve point of contact for additional information: Jeff Crooks, Research Coordinator, jcrooks@trnerr.org, (619) 575-3613 x333.*
- Excessive sedimentation is one of the principal threats to the integrity of the Tijuana River Valley. Efforts are underway to capture and dispose of this material. But we lack a full understanding of local sediment dynamics and how they might respond to various management interventions and changes in surrounding landscapes. Therefore we need studies that address the role of sediment in this coastal ecosystem and develop innovative approaches for management and beneficial reuse. *Reserve point of contact for additional information: Jeff Crooks, Research Coordinator, jcrooks@trnerr.org, (619) 575-3613 x333.*
- Debris is a significant source of impairment in the Tijuana Estuary and presents a variety of risks, but efforts to reduce solid waste at the source have been limited in their success. Therefore we need a deeper socio-ecological assessment of debris, including waste management in the City of Tijuana, Mexico, as well as household-level behaviors and barriers that would inform training and technical assistance strategies. *Reserve point of contact: Kristen Goodrich, Coastal Training Program Coordinator, kgoodrich@trnerr.org, (619) 575-3613 x312.*
- Southern California lagoons, such as the Tijuana Estuary, are characterized by relatively small, very dynamic river mouths. Tidal exchange through these inlets fundamentally shapes the estuarine ecosystem, but anthropogenic changes in tidal prism and nourishment of adjacent beaches can compromise inlet functioning. Therefore we need studies of estuary-ocean connections (physical, chemical, and biological) and how these change under varying conditions. *Reserve point of contact for additional information: Jeff Crooks, Research Coordinator, jcrooks@trnerr.org, (619) 575-3613 x333.*
- Climate change will affect virtually all aspects of the natural and built environment of the Tijuana River Valley and we are beginning to see apparent climate impacts. But these are against a backdrop of many other anthropogenic effects in this urban ecosystem. Therefore, we need studies that consider climate in the context of the unique socio-ecological setting of the Tijuana River Valley and address resilience to inter-related drivers of change. *Reserve point of contact for additional information: Jeff Crooks, Research Coordinator, jcrooks@trnerr.org, (619) 575-3613 x333.*