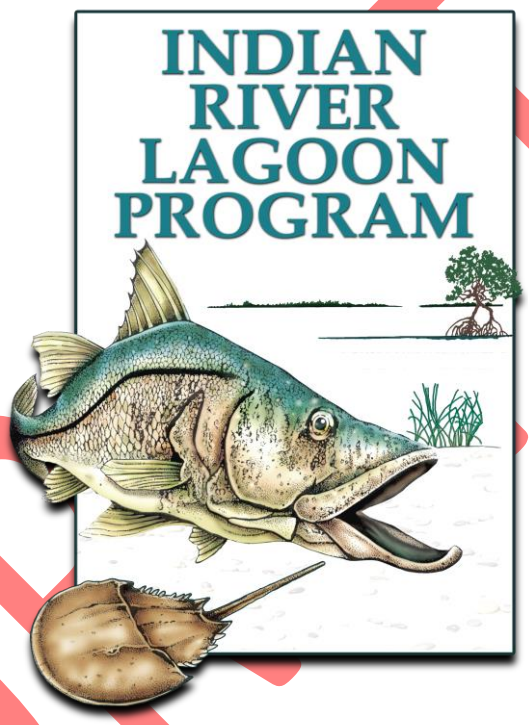
Indian River Lagoon National Estuary Program Vision 2030



Science & Technology Priorities for the Next Decade

ANTICIPATED REPORT OUTCOMES

(De Freese, 2017)

Preliminary outcomes for this report are:

1. To identify a 10-year scientific research strategy that builds on past knowledge and identifies scientific research that fills gaps in knowledge important to developing a holistic understanding of the Indian River Lagoon (includes the social sciences).

2. To clearly define the intellectual and technical capacity of the IRL regional coastal science, engineering and technology workforce as the foundation for an ocean and coastal industry cluster that supports an Indian River Lagoon valued at $7.6 billion annually.

3. To identify potential partnerships and trans-disciplinary research needed to address IRL research priorities, strengthen our understanding of coupled human-natural estuarine systems, engage and inform public policy, guide management decision making, and increase coastal literacy.

4. To harness the entrepreneurial spirit across the Lagoon to apply the best available scientific knowledge to build infrastructure support and capacity for habitat restoration (i.e. filter feeders, seagrasses, mangroves and salt marshes); comprehensive and coordinated monitoring, mapping and modeling; and citizen education and outreach.

5. To position the IRL scientific, technology, engineering and monitoring/mapping/modeling community ($STEM^3$) as a national leader in estuarine research, education, management and stewardship.

PRELIMINARY ISSUES LIST

The following issues and recommendations have been collected from scientists and public comments. Most have been shared as part of formal IRLNEP Management Conference discussions or meetings.

This is a PRELIMINARY DRAFT list of science issues of interest and concern. As this list undergoes review and analysis through the IRLNEP Management Conference, science issues and opportunities will be detailed, categorized and grouped to serve as a basis for development of this report and 2008 CCMP action plan revisions.

Science Recommendations from the Indian River Lagoon 2011 Consortium (2015):

- Garner an improved understanding of the biology and physiology of picocyanobacteria and Pedinophyceae, including their ability to use organic forms of nutrients, their nutrient uptake rates, their reproductive rates and their defenses against grazers.
- Maintain or expand water quality sampling to ensure spatiotemporal variations are captured adequately, which could include continuous monitoring of various parameters to fill gaps between monthly samples.
- Develop an improved understanding of the physiological tolerances of drift algae and seagrasses.
- Maintain or expand surveys of drift algae and seagrasses to improve our capacity to evaluate their role in nutrient cycles.
- Improve our ability to model bottom-up influences from external and internal nutrient loads, including atmospheric deposition, surface water runoff, groundwater inputs, diffusive flux from muck, and decomposition of drift algae.
- Enhance surveys of bacterioplankton to improve our understanding of nutrient cycling.
- Improve surveys of potential zooplanktonic, infaunal, epifaunal and fish grazers to enhance our understanding of spatiotemporal variation in top-down control of phytoplankton blooms.
- Evaluate grazing pressure exerted by common IRL species to enhance our understanding of top-down control of phytoplankton blooms.

Recommendations from the IRLNEP Management Conference (preliminary list of suggestions)

- In order to better understand and manage the significant challenges of HABs in IRL, we need to both understand past and present blooms, while also leveraging new scientific techniques and analytical approaches.
- New technology development (i.e. water quality remediation, sensor technology, restoration techniques, muck dredging, muck dewatering, muck conversion to beneficial by-products).
- Identification of biosolid land spreading and quantification of biosolid nutrient contributions to surface and ground waters.
- Enhanced understanding of seagrass productivity, health and response to stressors, thresholds and tipping points.
- Predictive models for harmful algal bloom initiation.
- Impacts of climate change and sea level rise on IRL.
- Scientific evaluation of efficacy and risk of water and muck mitigation strategies approaches (i.e. aeration, ultrasound, etc.).
- Research to understand shoreline acidification from coastal acid sulfate soils (CASS).
- Studies to better understand impact of global ocean acidification in coastal systems.
- Lagoon-wide carbonate studies.
- Expansion of atmospheric nutrient deposition studies throughout the lagoon.
- Comprehensive long-term studies of drift macroalgae in IRL and role in nutrient cycling.
- IRL thermal pollution studies.
- Better understanding of hydrodynamics of IRL as it relates to ocean flushing, engineering solutions and water quality improvements.
- Pilot study of *in situ* muck capping.
- Infrastructure capacity study to assess the need for east coast stocking capacity for seagrasses, oysters, clams and living shorelines (capital infrastructure improvements, O&M costs).
- Comprehensive evaluation of a 21st century monitoring, mapping and modelling network along the IRL supported by discrete and continuous monitoring, remote sensor systems, volunteer water quality network (citizen science) and data crowd sourcing.
- Improved groundwater model for nutrient loads to incorporate ammonium.
- IRL "One Health" epidemiology studies.
- Full spectrum analysis of toxicants, pollutants and emerging pollutants of IRL concern.
- Improve understanding of nutrient availability and harmful algal bloom initiations.
- Studies to better understand cyanoHABs and human health threats.
- Human behavior analysis. How do science messages influence behavior change?
- Economic valuation IRL ecosystem services.

- Scientific research to support better understanding of IRL water budget, estuarine shoreline stabilization, monitoring, enforcement of environmental laws, sanitary sewer overflows, septic contribution, biosolids and recharge water nutrient/pollutant contribution.
- Impact of pharmaceuticals on IRL water quality, wildlife and human health.
- Basic research to understand taxonomy and eco-physiology of emerging IRL pico- and nano-plankton. And *Aureoumbra*.
- Ecological drivers for initiation of IRL algal blooms.
- Ecological drivers for termination of IRL algal blooms
- Need for a science-based habitat restoration for IRL with a focus on seagrasses, filter feeders, mangroves, salt marshes and living shorelines.
- Science solutions to build IRL resiliency.
- Science solutions to address nutrient overload and eutrophication.
- Science to understand and mitigate for body burdens of diverse chemicals, toxicants and pollutants.
- Identification of root cause stressors of IRL.
- Evaluation of risk and unintended consequences of interventions in IRL domains not normally considered (i.e. new inlets, water quality remediation, muck handling, etc.).
- Understanding how various ecosystem drivers affect multiple IRL trophic levels using a systems approach.
- Science to optimize economic, social, and environmental benefits to IRL.
- Identify opportunities for R&D for disruptive technologies and innovative tools.
- Science to inform IRL risk exposure, disaster preparation and response.