

Florida Red Tide Mitigation and Technology Development Initiative

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MOTE.ORG

Red Tide Initiative Overview

- Signed into law in June 2019
 - 379.2273 Florida Statutes
 - Mote partnership with FWC FWRI
- \$18M over 6 yrs (\$3M/yr)
- Legislative intent:
 - develop **prevention, control, and mitigation** technologies and approaches to address the impacts of red tide on coastal environments and communities in Florida
- Year one has three parts:
 - Infrastructure at Mote for:
 - Mote led projects
 - Partner led projects



Red Tide Initiative Overview

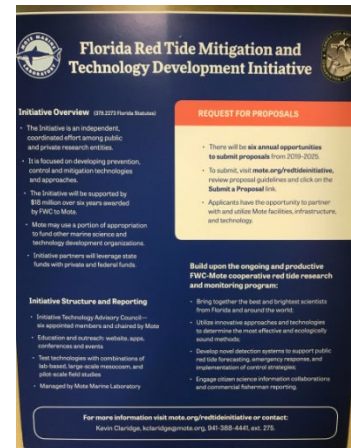
Strategically leverages appropriations with Mote's private and federal funding:

- Bring together the best/brightest scientists;
- Utilize innovative approaches/technologies to determine the most effective and ecologically sound methods for mitigating adverse impacts from red tide;
- Lab-based, large-scale mesocosm and pilot-scale field studies;
- Develop novel detection systems to support public red tide forecasting and implementation of control strategies;
- Enhance public health protection with expansion of reporting, community outreach and engagement;
- Develop new technologies for smartphone apps to engage citizen science and commercial fisherman reporting.



Red Tide Initiative Progress

- Established Initiative Administrative Support
- Executed state contract between FWC and Mote
- Outreach: press releases, speaking events, conferences, meetings, forums, partner newsletters, webinar, DEP Protecting Florida Together website, 2020 Oceans Day, and the **Mote Red Tide Initiative website**:
 - <https://mote.org/research/program/Florida-Red-Tide-Mitigation-and-Technology-Development-Initiative>
- Mote Infrastructure under construction
- Year 1 RFP just closed
- Statutory required Technical Advisory Council
 - first meeting was Jan 17th
 - Minutes on Mote Red Tide Initiative website



Technical Advisory Council

Dr. Michael P. Crosby – Mote President and CEO

Dr. James Powell – House Speaker Appt

Dr. James Sullivan – Senate President Appt

Dr. Katherine Hubbard – FWC Appt

David Whiting – DEP Appt

Governor Appt Pending



Red Tide Initiative Reporting

- Beginning **January 15, 2021**, and each January 15 thereafter until its expiration, **the initiative shall submit a report that contains an overview of its accomplishments** to date and priorities for subsequent years to the Governor, the President of the Senate, the Speaker of the House of Representatives, the Secretary of Environmental Protection, and the executive director of the Fish and Wildlife Conservation Commission.
- Annual Workplans, Reports, and Invoices to FWRI
- Website, Public Records, and Meeting Minutes



Mote Project and Facility Overviews

- Facilities
 - Mesocosm Facility
 - *Karenia brevis* Culture Facility
- Technology Development in Support of Mitigation
 - Programmable Hyperspectral Seawater Scanner (PHySS)
 - UAV (Unmanned Aerial Vehicle, Drone) based Detection System
 - Beach Conditions Reporting Systems (BCRS)
 - Quantitative Polymerase Chain Reaction (qPCR)
- Mitigation Projects
 - Compounds (Natural, Clay, Chemicals)
 - Laboratory and Mesocosm



Experimental Mesocosm Facility

Motivation

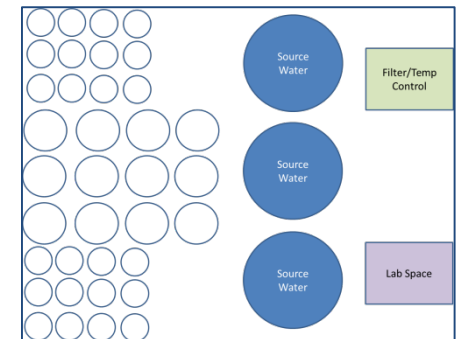
- To provide multi-scale, multi-user red tide research infrastructure for Initiative scientists

Goals

- Used by visiting scientists, graduate students, educational groups, and in-house scientists
- Ability to perform land-based mesocosm studies on red tide

Outcomes

- Enable the development of innovative technologies and approaches that are critically needed to address control and mitigation of red tide impacts
- Dedicated red tide mitigation mesocosm facility will allow more ecosystem-based testing of mitigation compounds in a controlled setting, reduce the need to postpone research or shorten experimental designs due to lack of available space and enable year-round, longer, multiple-use studies



Phytoplankton Culture Facility

Motivation

- To support the Initiative with *Karenia brevis* culture

Goals

- Meet the demands of the mitigation research with **consistent and reliable production of large volumes of *K. brevis***
- Expand collection of *K. brevis* species (growing and maintaining several different strains)

Outcomes

- Leverage Mote's strong foundation of ecology, advanced biology and physiology to collaborate at state, national, and international levels and improve scientific productivity - i.e. support this Initiative with culture and Red Tide expertise



PHySS - Programmable Hyperspectral Seawater Scanner

Motivation:

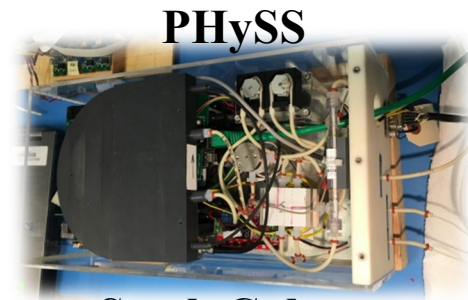
- Develop an instrument to aid in the mitigation of red tide and provide **early detection and warning**
- Developed at Mote; Similarity Index; fully programmable data acquisition with web-based data analysis tool

Goals:

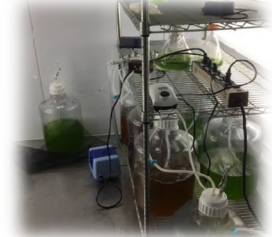
- Develop a spectral library of different phytoplankton groups with variable morphologies and physiological states, optical signatures will be obtained for a range of cell densities
- Improve sensitivity, identify multiple phytoplankton groups
- Achieve concurrence with direct and remote observations of the SI estimates across different biological and physical regimes

Outcome:

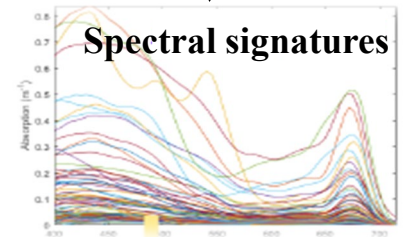
- Form observatory providing continuous high frequency data
- Data will be made publicly available in web based platform



PHySS



Stock Cultures



Spectral signatures



UAV-based Red Tide Detection System

Motivation:

- Patchy nature of red tide makes mitigation technology challenging
- Airborne hyperspectral sensors could allow the mapping of HABs with a high spatio-temporal resolution at local (drone) and regional (satellite) scales.

Goals:

- Conduct shore-based flights in local waters
- Collect hyperspectral data
- Develop data processing scheme, instrument calibration and deliver proof-of-concept
- Quality control check of algorithm performance
- Implementation of new approaches for algorithm development

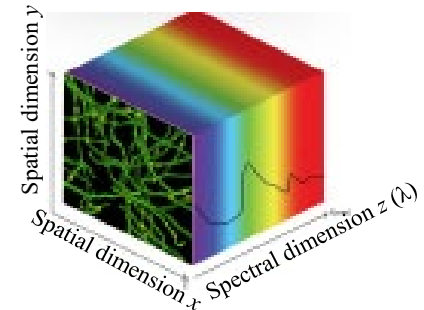
Outcomes:

- Develop an application tool to assist in management of events that may involve significant risk to the public
- Decrease costs of detection, improve mitigation application



Imagery of red tide collected from drone

Hyperspectral data cube



Advance Red Tide Reporting Technology

Motivation:

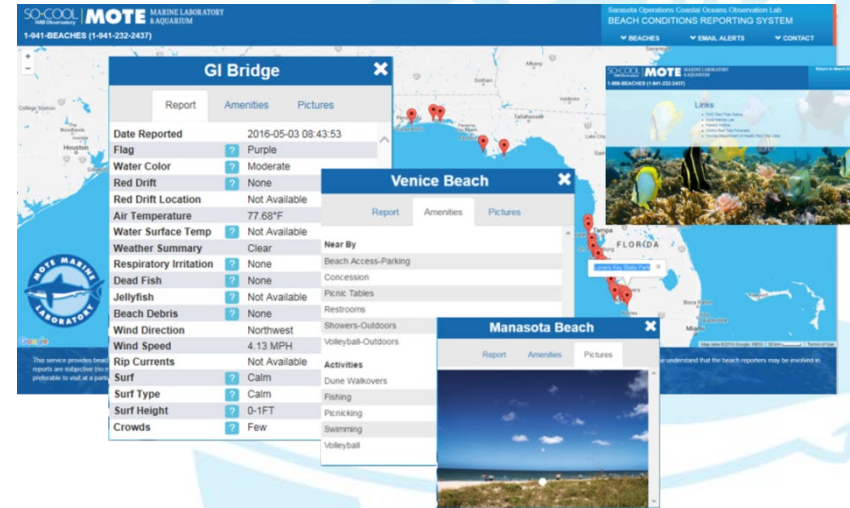
- Alert the Public of Red Tide and its Effects and minimize economic impacts to Florida
- Put red tide reporting technology in the hands of fisherman – coastal and offshore

Goals:

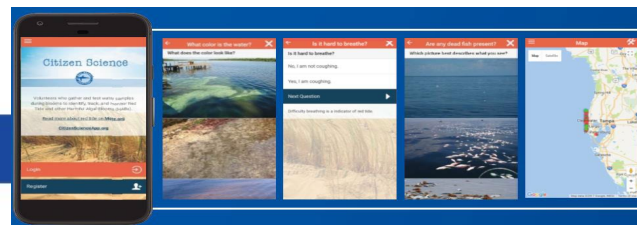
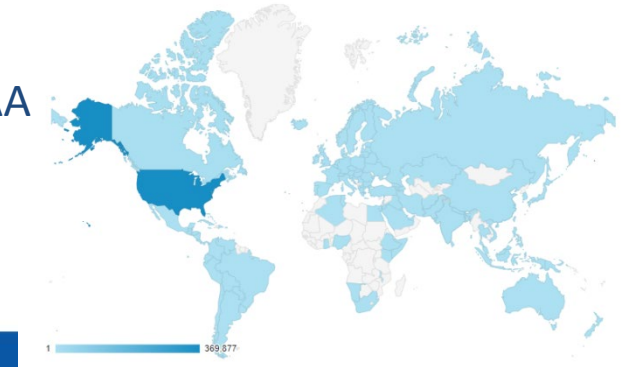
- Update/combine the Beach Condition Reporting System with the Citizen Science is Cool App
- Enhance validation components (thumb up/down), pictures, amenities and alerts for blooms and reporting
- Bloom Zoom for cell detection, App for Chl-a

Outcomes:

- Information disseminated to BCRS/App, SECOORA and NOAA
- Reporting to/by anyone With a Cell Phone, anywhere.



Since October 15, 2017
Unique Users: 1.5Million
Page Views: >4.5Million



Acceleration of user-friendly, smart phone integrated qPCR technology development and Citizen Science integration for *K. brevis* mitigation testing

Motivation:

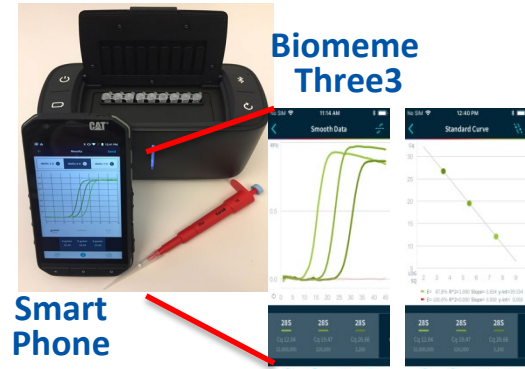
Meet the ongoing, well-defined, need for new public-friendly, automated, web-interfaced detection methodologies that can provide accurate and timely cell monitoring data.

Overall Goal:

Accelerate the development and validation of a hand-held, qPCR based *K. brevis* and *K. mikimotoi* detector (Biomeme Three3) and develop protocols for integration into Citizen Science program.

Outcomes:

- Develop cell-based DNA standards from Gulf *Karenia* cultures,
- Validate efficacy of existing *K. brevis* and *K. mikimotoi* primers for use on the Biomeme Three9 simultaneously in a single reaction,
- Provide training to Mote personnel on use of qPCR technology, and
- Establish pipeline/protocols for linking and cross-calibrating cloud-based qPCR data to existing Citizen Science databases.



- ❖ 9 samples per run
- ❖ 3 qPCR assays at once
- ❖ Stable reagents
- ❖ Smartphone interface
- ❖ Cloud-based data storage



Undergraduate use of Biomeme to monitor *K. mikimotoi* and *Gloeotrichia* in Maine



Red Tide Mitigation Products & Processes

Overall Goal:

To develop, test and implement the most effective and ecologically sound products and technologies for mitigation and/or control of adverse impacts of Florida Red Tides, in collaboration with experts from multiple external research institutions.



Tier-1 Lab studies

Outcome:

Implement a tiered approach:

- Tier 1. Lab-scale tests to determine the effective methodology for eliminating *K. brevis* cells and toxins.
- Tier 2. Mesocosm-scale (larger volume, multiple organisms) to assess impacts of non-targeted marine organisms and water quality
- Tier 3. Open Field applications: Test the most appropriate method(s) under natural field conditions (timing depends on outcome of previous tests, permission for field application and red tide events).



Tier-2 Mesocosm- scale



Tier-3

Clay field application in canal



Red Tide Mitigation Products & Processes

Potential Mitigation Products:

- Natural Products

- Macro Algal Allelopathy; Barley straw extract
- Bacteria, Parasites, Viruses

- Chemical Products

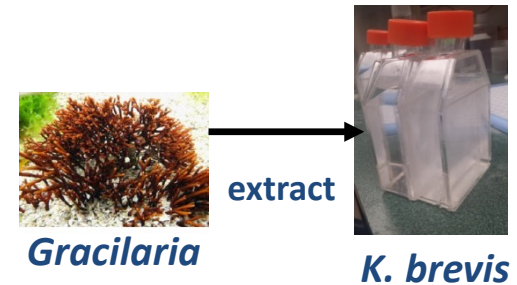
- Commercial algicides; Enzymes; Ozone; Bleach
- Surfactants-emulsifiers; Hydrogen peroxide

- Physical Processes

- Clay; Nano-bubbles; UV-C radiation

Parameters Monitored:

- Water Quality: DO, Temp, pH, PSU, CDOM, Nutrients
- Red Tide cells and Tide Toxins
- Phytoplankton Community Composition
- Impacts/Toxicity to Marine Biota
 - Mortality; Growth; reproduction
 - Cellular function



Chemical products



Water Quality



Nutrients



Toxins



Red Tide Initiative Engagement

- Mote will facilitate funding engagement (as stated in Initiative statute):
 - Leverage state funds with private and federal funds
 - Mote may use a portion of appropriation to fund other marine science and technology development organizations in Florida and around the world to pursue applied research and technology



Request For Partner Proposals

- Open to any/all interested parties
- Anticipated grant funding in year one is \$1M
 - Likely \$150-\$250K for each grant, 4-5 organizations
 - Support not to exceed 1 year –
 - may request longer in second year RFP
- Proposal guidelines and to submit a proposal:
 - Mote.org
 - Announced November 7th at US HAB Symposium
 - Closed January 31st
 - Notification of Awards in March
- Core infrastructure developed at Mote for projects
- Use of Mote facilities/infrastructure is encouraged
- Panel of scientists review
 - NOAA, EPA, FWC, DEP, and University scientists
 - Each scientist will review 3-5 proposals using provided questionnaire
 - Projects will be selected by Mote and presented to TAC in April



Future Red Tide Initiative Information

- **Visit:**
<https://mote.org/research/program/Florida-Red-Tide-Mitigation-and-Technology-Development-Initiative>
- **Send:** Kevin Claridge (kclaridge@mote.org)
your email to be put on the distribution list for future announcements or webinars



Questions?

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