Florida Red Tide Mitigation and Technology Development Initiative

3rd Technical Advisory Council Meeting

October 2, 2020, 9:00am-12:00pm EST

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This meeting is open to the public.

1. Welcome
2. Technical Checks and Council Role Call
3. Agenda Overview
4. Review of previous Technical Advisory Council meetings
5. Project Status and Plans
6. Initiative Report
7. Looking Ahead
8. Public Comments

Florida Red Tide Mitigation and Technology Development Initiative
Technical Advisory Council Public Webinar – October 2nd, 2020, 9:00 am-12:00 pm EST

In Attendance: Dr. Michael P. Crosby, Dr. James Powell, Dr. James Sullivan, Dr. Katherine Hubbard, David Whiting, Kevin Claridge, Dr. Michael Barbour, Kayla Bernier, & *see additional Attendee List included at the end of these meeting minutes*.

Presenters: Dr. Sumit Chakraborty, Dr. Vince Lovko, Kevin Claridge, Dr. Cindy Heil, Dr. Emily Hall, Dr. Dana Wetzel, Dr. Rich Pierce, Dr. Andrea Tarnecki, Dr. Kathryn J. Coyne, Dr. Allen Place, Igor Tsengam, Dr. Don Anderson, Dr. Michael Parsons, Neil Williams, Dr. Alexis Carpenter, Ralph Elliott, Dr. Regina Rodriguez, Annarie Lyles, Dr. Jamie Lead, Dr. George Philippidis

Meeting Minutes:

Welcome, Webinar Meeting Logistics, & Agenda Overview

- Welcome remarks by Dr. Crosby
- Kevin Claridge reviewed the Agenda for this meeting.

Review of January 17th and April 3rd TAC Meetings

- Overview of the Red Tide Initiative and Statute
- Role of the TAC
- Sunshine and Public Record Laws
- Meeting Minutes
- Red Tide Initiative Website on Mote.org
- Florida Red Tide Background
- Statutory Reporting Requirements
- FWC Contract and Reporting Requirements
- Initiative Outreach
- Year 1 Project Presentations and Updates
- Looking Ahead to Year 2

Mote Marine Laboratory Aquaculture Research Park Mesocosm and Culture Lab

Red Tide Initiative Facility

- Provide multi-scale, multi-user, research infrastructure, culture, and support at no cost for Initiative projects

  See Red Tide Initiative 3rd TAC Meeting – October 2, 2020 PPT presentation for Mesocosm Facility Diagram & Photos of Construction progress.

Questions from the Technical Advisory Council:

- Dr. Hubbard asked about air filtration due to brevetoxins and if we considered their previous advice from previous TAC meetings.
    - Kevin Claridge said he can provide additional details after discussing with Mote's facilities Director, but that these concerns were highly considered during HVAC planning.

Mote Led Projects

Overview:

- Technology Development in Support of Mitigation
    - Programmable Hyperspectral Seawater Scanner (PHySS)
    - UAV (Unmanned Aerial Vehicle, Drone) - based Detection System
    - BloomZoom – *K. brevis* Phone Based Microscope
    - Beach Conditions Reporting Systems (BCRS)
    - Quantitative Polymerase Chain Reaction (qPCR)
    - Red Tide Toxin Biosensor for Shellfish and Seawater
- Mitigation Projects
    - Compounds (Natural, Clay, Chemicals, Bacteria)
- *Mote scientist collaboration with Partner Led Projects*
- *Leveraging funding sources*

PHySS (2.0) – Programmable Hyperspectral Seawater Scanner – Dr. Sumit Chakraborty

- Motivation:
    - Develop an instrument to aid in the mitigation of red tide and provide early detection and warning
- 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, uncertainty analysis, improve power consumptions
    - Calibration and validation of the Similarity Index estimates across different optical sensors
- Update:
    - Task1: Our new PHySS 2.0 is ready and operating.
    - Task2: Soon to start the process of creating the hyperspectral library. Phytoplankton cultures are being grown in the lab under different light levels.
    - Task3: New power saving mode (sleep mode) has been incorporated; wakes up the PHySS to collect a sample.

Mote Airborne Red-tide Remote Sensing System (MARRSS) – Drs. Vincent Lovko & Sumit Chakraborty

- Motivation:
    - Airborne hyperspectral sensors can provide high spatio-temporal resolution mapping of HABs at local (drone) scales to compliment regional (satellite) scale observations
- Major Project Goals and Anticipated Outcomes:
    - Establish routine UAS surveys to develop hyperspectral database for analysis and algorithm testing/modification
    - Develop an application tool to assist in management of events that may involve significant risk to the public
    - Decrease detection costs, improve mitigation application
- Updates:
    - Acquired Resonon Airborne Spectral Imaging System – currently set up in bench-top configuration for testing
    - Drone (DJI Matrice 600 Pro) sent to CA for repair (2 malfunctioning GPS units and battery replacement)
    - Drone flights will resume in October
    - Training of additional pilot underway

BloomZoom: A portable phone-based microscope for quantitative detection of *K. brevis* through citizen science – Drs. Vincent Lovko & Tracy Fanara

- Motivation:
    - Enhance citizen science capability for detection of Florida red tide for early warning and bloom forecasting
- Overall Goal:
    - Develop a durable, portable, user-friendly imaging scope for accurate, semi-automated detection of *K. brevis*, applicable to citizen science efforts
- Updates:
    - Initial design based on an open-source 3-D printable model (https://www.thingiverse.com/thing:3032770)
    - Printing is underway, followed by assembly and testing
    - Modified design effort is underway using an external USB camera to create a linear light path (eliminating mirrors), allowing use with any phone, tablet, or laptop and eliminating the need for model-specific device holder
    - Cell concentrator can allow a minimum detection limit of ~5,000 cells L^{-1}

Red Tide Reporting Technology Upgrades – Kevin Claridge

- Motivation:
    - Alert the public of red tide and its effects
    - Reporting in hands of beachgoers and fisherman
- Goals:

    - Update the Beach Conditions Reporting System
- Outcomes:
    - Disseminated to SECOORA, GCOOS, NOAA and FWC
    - Reporting of conditions to/by anyone with a cell phone
- Update:
    - Finalizing redevelopment; new app/website will be published by end of October
    - Contractor began education portal and community science validation (FAQ's, videos, and thumbs up/down)

Citizen Science Detection and Quantification of Florida Red Tides via Personal and Smartphone-enabled PCR Technology – Drs. Cynthia Heil & Tracy Fanara and Drs. Peter Countway & Nick Record (Bigelow Laboratory for Ocean Sciences)

- Objectives:
    - Develop and validate multiplex qPCR technology to simultaneously ID & quantify *K. brevis* and *K. mikimotoi*
    - Compare two 'personal' qPCR units (Biomeme vs. Chai Bio) for efficacy and user-friendliness
- Current Progress:
    - Purchased Biomeme & Chai units (a challenge during a pandemic!)
    - Developed novel TaqMan qPCR assays for *K. brevis* and *K. mikimotoi*
    - Established & documented protocols for both Biomeme and Chai Bio
    - Utilized protocols for method validation using *K. brevis* and *K. mikimotoi* primers and probes, ran repeated trials for creation of a standard curve
    - Tested protocols on BCRS & Institute staff
- Next Steps (Florida Sea Grant funded):
    - Validate standard curves for *K. brevis* and *K. mikimotoi* (CQ value vs. Cell Concentration) & analyze bloom samples to determine detection sensitivity
    - Determine unit best suited for Citizen Science
    - Test and train 'citizen scientist' volunteers involved in HAB monitoring on this user friendly DNA technology
    - Establish & test data transfer methodologies (GCOOS, FWRI)

Questions from the Technical Advisory Council:

- Dave Whiting asked what the cost of the Biomeme was vs Chai.
    - Dr. Heil stated that it was approximately $8k for Biomeme & $4k for Chai.

Evaluation of QUAT Efficacy for Florida Red Tide Mitigation – Drs. Cynthia Heil & Emily Hall and Amanda Muni-Morgan & Erin Cuyler

- What are quaternary ammonium (QUAT) compounds?

    - FDA approved cationic surfactants shown to bond to negatively charged bacterial and algal cell walls, resulting in enzyme inactivation and disruption of membranes and cell processes.
    - Easily absorbed onto substrates (e.g. concrete, fiberglass) so they can be placed in a water body and then removed.
- Experiment 1: QUAT treated concrete (QCA) was tested in triplicate against untreated concrete (UCA) and *K. brevis* controls.
    - QUAT adhered to quick setting concrete.
    - Both UCA and QCA were effective at reducing cells and toxins.
    - Ammonia concentrations were high in all treatments, but not inhibitory to *K. brevis*.
- Next Steps: Test effectiveness of QUAT treated fiberglass substrate

Questions from the Technical Advisory Council:

- Dr. Hubbard asked question regarding impacts of high concentrations of ammonium.
    - Dr. Heil said it didn't seem to have an effect, which shows broad ecological implications of *K. brevis*.

A Rapid Field Red Tide Toxin Biosensor for Commercially Important Shellfish and Seawater – Drs. Dana Wetzel & Tracy Sherwood

- This project has been selected for funding by both NOAA and the USDA-Food Safety and Defense Program.
- Motivation:
    - A once thriving $37 million Florida shellfish farming industry with over 50 active growers, now being farmed by few, has been crippled due to red tide. Current complex seafood safety procedures force farmers to quarantine for extended periods until it can be cleared using time-consuming laboratory analyses.
- Goals: In consultation with shellfish farmers, the Florida Shellfish Association and the Florida Department of Agriculture and Consumer Services, this project is designed to address two critical industry needs:
    - develop a rapid, red tide toxin field biosensor for commercially important shellfish + seawater
    - develop commercial application methods for depuration of red tide toxins from shellfish using a land-based recirculation system
- Status: project start date August 2020
    - a large-scale red tide exposure system has been designed and construction almost complete for the pilot red tide shellfish tissue contamination and toxin depuration recirculation system evaluations beginning early October 2020.
    - antibody generation against both type A and type B brevetoxins has begun with toxin antigen coupling as the first step in this process.

Mitigation Products & Processes (Introductions & Applications) – Dr. Rich Pierce

- Motivation:
    - A consortium of five Mote Research Programs focusing interdisciplinary expertise on developing science–based response strategies to reduce the intensity of red tides and mitigate impacts on coastal ecosystems, Florida's economy, and public health. Including Expertise: Phytoplankton Ecology; HAB dynamics; Benthic Ecology; Ecotoxicology; Nutrients and Water Quality (+ collaboration with other projects).
- Overall Goal:
    - To complement the on-going FWC-Mote Cooperative Red Tide Monitoring and Research Program to test and implement the most effective and ecologically sound products and technologies for Mitigation and Control of Red Tides.
- Outcome:
    - Development and implementation of ecologically sound products and technologies, through a science-based, tiered protocol, for mitigation and/or control of Red Tide impacts.
        - Tier 1. Lab-scale tests to determine effective methodologies for reducing/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. Field applications: Test the most appropriate Methods under field conditions (with permission and a red tide event).
- Potential Mitigation Products:
    - Marine organisms
        - Macro Algal Allelopathy;
        - Bacteria, Parasites, Viruses
    - Chemical Products
        - Commercial Algicides; Natural chemical extracts
        - Surfactants-emulsifiers; Oxidizing agents
    - 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

Natural Compound Control and Mitigation for Red Tide – Drs. Dana Wetzel, Tracy Sherwood, Andrea Tarnecki, & Vincent Lovko

- Motivation:
    - Naturally occurring, bacterial algicidal products can play a role in prevention, termination, and regulation of HABs with lower risk of harmful side effects than other control measures.
- Goals:
    - Identify algicidal bacteria collected from the Gulf of Mexico
    - Characterize and identify algicidal compounds
    - Determine mode of algicidal action
    - Evaluation of efficacy and feasibility of algicides in mesocosm studies
- Outcomes:
    - Algicidal compounds showing promise for mitigation
- Updates (as of 9/29/20):
    - 276 isolates screened – 18 identified for algicidal testing
        - 11 fall into group commonly containing algicidal bacteria
        - 7 of a potentially new species within a genus containing known algicidal bacteria
    - Screening is ongoing, and algicidal testing will soon begin

<u>Partner Led Year 1 Projects</u>

Red Tide Initiative – Partner Led Proposals

- 379.2273(2)(c)(1) Florida Statutes: Mote may use a portion of awarded funds to facilitate additional engagement with other pertinent marine science and technology development organizations…
- Open to any/all interested parties
- Proposal guidelines and proposal submission:
    - Mote.org
    - Webinars on RFPs and to answer any questions
    - Support not to exceed 1 year – may request longer in next RFP
- Use of Mote facilities/infrastructure was encouraged
- 20 proposals Year 1; 26 proposals Year 2
- Partner Led Proposal Review Process:
    - Diverse set of red tide PhD level expertise from NOAA, EPA, FWC, Universities, Estuary Programs, and Mote
    - Each scientist reviewed ~5 proposals using provided questionnaire
    - Additional Non-Conflicted Mote Scientist Review
        - Organized and provided all reviews together for Dr. Crosby
        - Presenting to TAC today for comment

Dr. Kathryn J. Coyne, University of Delaware: *Optimizing production of a dinoflagellate-specific algicide for control of Karenia brevis*

- Work completed:
    - June 15 – July 15: Analyzed exometabolomics data (ongoing)
    - July 15 – Returned to research in limited capacity
    - Aug. 15 – Completed training
    - Sept. 15 – Completed evaluation of light/dark effects on algicide production (no effect)
    - Sept. 23 – Received *K. brevis* cultures and medium (ongoing challenge!)
    - Optimize medium to reduce batch-to-batch variability (Sept. 25)
- Upcoming deadlines:
    - Purchase potential N and C sources based on metabolomics analysis (Oct. 2)
    - Prepare algicide with range of N and C sources (Oct. 14)
    - Bioassays completed for N and C sources (Oct. 23)
    - Prepare algicide at different temperatures with optimized C/N source (Nov. 4)
    - Bioassays completed to identify optimum temp, C/N sources (Nov. 15)

Dr. Allen Place, University of Maryland: *Pushing Karenia Over the Edge with Beer Derived Flavonoids*

- Dr. Place discussed evaluating different filtration methods for recovery of brevetoxins from Brewers Spent Grain Solution.
- Results:
    - No significant difference among filters and Disk SepPak exhibited significantly higher recovery of all toxins, PbTx-2 most abundant indicating viable *K. brevis* cultures

Dr. Vijay John & Dr. Tim McLean (Igor Tsengam presenting), Tulane University: *A Thin Shroud with Integrated Algaecide to Flocculate and Sink Karenia brevis*

- Objectives:
    - To develop technology to sink KB efficiently
    - The technology must prevent escape of KB from flocs.
    - By integrating algaecide into the flocs, can we again mitigate escape?
- The concept of the shroud:
    - A key aspect of their work is the use of metal phenolic networks (MPNs). MPNs are made up of polyphenolics (tannic acid) coordinated with Fe(III) to form thin sheets that are effective flocculants for KB.
- Why MPNs?
    - Polyphenolics have biomimetic properties of adhesion to surfaces. They are environmentally benign algeistats/algeicides. Would integrating such compounds in the flocculant system lead to targeted delivery?

- Continuing Work:
    - Collaboration with Mote
        - Translation to mesocosms (80L tanks).
        - Understanding toxin release and removal.
        - Implications to off-target organism toxicity.
    - Important considerations
        - Logistics
        - Cost

Dr. Don Anderson, Woods Hole Oceanographic Institute: *Fate and Effects of Karenia brevis Cells, Toxins, and Nutrients Following Clay Application for Bloom Control*

- Objectives:
    - Determine long-term fate of *Karenia* cells, toxins, metals, and nutrients removed from surface waters after clay application
    - Assess benthic impacts resulting from clay flocculation of *Karenia*
    - Communicate results of the study to managers and stakeholders
- Progress to Date (2020):
    - Mesocosm studies:
        - The Mote mesocosm and culturing facilities are not yet operational.
    - Lab experiments:
        - Dynamics of cell and toxin removal, 80-L tanks
            - Tests conducted in 80L vertical tanks to evaluate cell removal with 0.5 and 0.3g/L clay. Both had >90% removal within 6 hr.
            - Effect of DOM (humics) on cell removal (tank and flask studies): DOM had no significant effect on removal efficiency in tanks. Some recovery was observed after 48 hours in small flasks with the DOM additions, however.
        - Impact of clay treatment non-target benthic species
            - Experiments with blue crabs compared mortality and reflexes in 4 treatments: seawater, clay only, *Karenia* only, and *Karenia* plus clay
            - Preliminary results show: 1) clear impacts on crabs in *Karenia*-only treatments and 2) clay alleviates toxic stress by sequestering cells and toxins, even under conditions with constant resuspension
            - Tank experiments are providing insights on potential challenges in mesocosms (ammonia, aeration, resupply of *Karenia* cells)
        - Opportunistic field experiments:

          Clay treatment of cyanobacterial bloom, Cape Coral

            - Two clay formulations tested

        - Highly effective cell removal with ~20g/m2 clay treatment applied with hydroseeder
        - Many environmental parameters analyzed, results pending, but results are very encouraging. The city has ordered a pallet of clay for further testing and treatment
        - An example of the Rapid Response capability that this project envisions
    - Next steps
        - Continue lab-based tank and aquarium experiments
        - Set up mesocosms to learn how best to create and sustain *Karenia* populations and a representative benthic community. (Oct – Nov)
        - Begin clay treatments (Dec - Jan)
        - Respond to blooms opportunistically. Question to the TAC: Can we shift project resources to treat a *Karenia* bloom in the field?)
        - Support other Mote Initiative teams with our facilities and knowledge (e.g., Almagro-Moreno et al. Ecological and public health implications of clay mitigation).

Questions from the Technical Advisory Council:

- Dr. Powell asked if they considered the implications for endangered species such as Manatees or other bottom feeders.
    - Dr. Anderson stated that it is difficult to address because of concerns over exposure studies; they would compare the impacts against the impact of red tide alone though.
    - Dr. Crosby suggested using modeling/forecasting since we can't test on animals in mesocosms.

Dr. Michael Parsons, Florida Gulf Coast University: *Examining the Feasibility of Removing and Composting Fish Carcasses to Mitigate Red Tide*

- Objectives and Progress
    - Better quantify the nutrient inputs to red tide from fish kills in southwest Florida
        - Completed first fish decay experiment
        - Awaiting cooler weather for second experiment
        - Awaiting nutrient data analysis results
    - Conduct a cost/benefit analysis of fish removal as a mitigation tool
        - Collecting and reviewing available data (past fish removal efforts; toll collections on Sanibel Causeway; alcohol sales taxes, etc.)
    - Evaluate composting and use of a compost accelerator compound to repurpose the dead fish as fertilizer for local stakeholder use
        - Parsons and Heil have composting accelerant in hand

- Awaiting a fish kill
- Refining brevetoxin measurement methodology in fish tissue

Questions from the Technical Advisory Council:

- Dr. Crosby asked about the wait for a natural Red Tide event to obtain dead fish. He suggested looking into alternative resources due to the urgency and short timeframe.

Partner Led Year 2 Projects

Neil Williams, nTec solutions LLC: A Chemical-Free Red Tide Mitigation Technology Utilizing UV-C LEDs

- Large scale environmental applications have not been feasible due to power requirements and environmental concerns. The advent of UVC LEDs has changed this.
- Phase I: Laboratory Scale Experiments (FIU)
    - Starting cell densities
    - Pulsing
    - UV absorbing materials (caffeine)
    - Selectivity (cyanobacteria/diatoms)
    - UV aging
    - UV transparent materials (PTFE, FEP)
- Phase II: Fabrication (nTEC)
    - Power Requirements
    - Contact time
    - Exposure protocol
    - Materials
- Phase III: Mesocosm (and Field?) Scale Experiments (MML)
    - Scale up
    - Power
    - Toxins

Dr. Alexis Wells Carpenter, AxNano LLC: *Evaluation of Controlled Release Oxidants for Red Tide Treatment and Mitigation*

- AxNano LLC is a small business entity that develops innovative technologies for the environmental space, with a focus on water. They partner with universities, gov't labs, and industry to commercialize high-impact technologies.
- Hypothesis:
    - Hydrogren peroxide (H_2O_2) is proven to prevent algae growth and inactivate toxins, but the practical use is restricted due to short lifetime and hazards of liquid-based amendments. They hypothesize that their controlled release technology can provide sustained hydrogen peroxide levels to maintain algaestatic conditions and prevent red tide blooms.

- Aim 1: Determine the toxicity of RemRx™ CRP Percarbonate to *K. brevis*
    - Task 1.1: Test lethality of current RemRx™ Percarbonate formulation to *K. brevis*. Cell enumeration and brevetoxin testing. (AxNano 25%, Mote 75%)
    - Task 1.2: Evaluate alternative biocompatible slow release matrices (AxNano 90%, Mote 10%)
- Aim 2: Develop deployment strategies for emplacement of RemRx™ CRP Percarbonate in canal ways (AxNano 90%, Mote 10%)

Questions from the Technical Advisory Council:

- Dr. Crosby asked if they had considered the buoyancy of their compound since *K. brevis* is predominantly found in the upper portion of the water column.
    - Dr. Carpenter stated yes and that their controlled release would be via a porous structure that can be placed in specific spaces within the water column.

Ralph Elliott, Ecological Laboratories: *Microbe-Lift Mitigation 96 Hour Testing with Karenia brevis*

- The unique difference between Microbe-Lift technology and all other microbial products is MICROBE-LIFT technology has processes and pathways to mitigate *K. brevis*. This involves the capability to conduct denitrification, control cell lysis during declining phase (death phase) by utilizing light photons and CO_2, thereby eliminating the release of stored nutrients during death phase.
- Using chemical algaecides like copper sulfate result in the decline and death of *K. brevis*, with the definite return of nutrients through cell lysis, fostering the return of *K. brevis*. Therefore, these methods provide only a temporary, cosmetic solution.
- MICROBE-LIFT technology controls nutrient release through photosynthesis.
- Process:
    - MICROBE-LIFT cultures attach to suspended *K. brevis* formations through charge relationships in the mitigation process.
    - MICROBE-LIFT vegetative consortium is active upon application, oxidizes a wider range of organic carbons that effectively competes with *K. brevis* for nutrient uptake.
- Functions:
    - MICROBE-LIFT active vegetative facultative microorganisms exhibit a wide range of oxidation reduction processes, aerobic, anaerobic, and anoxic respiration to achieve denitrification.
        - The process of Nitrogen cycle involves aerobic and anaerobic processes. While most biological product focus on the aerobic process only, MICROBE-LIFT utilizes both processes to complete the cycle with total removal of nitrogen in the form of nitrogen gas.
    - MICROBE-LIFT technology contains photosynthetic culture that control cell lysis.

- MICROBE-LIFT consortium has the potential to inhibit *K. brevis*.
- MICROBE-LIFT biologically reduces organic matter from the bulk water, increases cellular nutrient uptake, activates denitrification, and controls cell lysis.

Dr. Regina Rodriguez, Carbonxt: ***In-situ Mitigation of Florida Red Tide via Activated Carbon***

- Company Background
  - Established in 2001 to help power industry meet emissions standards
  - Headquartered in Gainesville, Florida
- Technological Developments
  - Supplies activated carbon to coal-fired power plants, cement plants and waste to energy facilities
  - SO_2 – NO_X – Hg removal with activated carbon pellets
  - >10 patents and patent applications on innovative technologies for environmental controls
- Regional Production Model
  - Use of renewable resources
  - Engineered sorbent redundancy
  - Production facilities in Georgia, Ohio and Minnesota
  - Only activated carbon pellet manufacturer in North America
- Activated Carbon Mitigation Technology
  - Vision:
    - Apply pellets or a sprayed slurry of powdered activated carbon formulated to simultaneously kill *K. brevis* and remove its toxins without causing long-term harm to the ecosystem. This is intended to prevent spread of the algae before it has broad impacts.
  - Strategy:
    - Formulations will be initially tested in small-scale vessels for their impact on *K. brevis*. Promising candidates will be tested in larger vessels for toxin removal.
  - Future Work:
    - The next phase will determine which delivery mechanism (slurry or pellets) works best in larger scale aquariums. The last phase will be a full-scale test in an estuary to demonstrate effectiveness.

Annarie Lyles, Solaris Cybernetics, LLC: ***Efficacy of EVIE Robot against K. brevis***

- EVIE Robot, akin to a Roomba on pontoons, seeks out & takes-up incipient blooms, converting biomass to biofuels.

- Solaris Cybernetics to bring an EVIE Robot to Mote labs for three tests runs in tanks with *K. brevis* cells.
- Intent is to evaluate the safety, ease of use, efficacy and potential of the EVIE technology as a scalable tool for red tide mitigation.
- On FL-DEP list of approved technologies. AI has been safety tested by USCG.
- EVIE robots were tested and run in green house tanks, sea and freshwater over multiple years with no safety issues.
- AECOM ran Florida red-tide material through the EVIE tech. Reported elimination of toxins.
- Potential outcome:
    - Assuming the EVIE technology destroys *K. brevis* cells and toxins, relative to the viability of a red tide culture control, we hope to advance to field testing, possibly in canals, as a next step.

Dr. Jamie Lead, University of South Carolina: *A preliminary study to assess the feasibility of a nanotechnology approach to the removal of Karenia brevis cells and brevetoxin from estuarine and marine waters*

- A nanotechnology platform has been successfully developed for oil and metal removal;
- The technology is based on sorption and magnetic removal;
- It is cost-effective, synthesis has a low environmental footprint and is scalable, the nanomaterials are low toxicity and exposure can be controlled, nanomaterials can be recycled;
- Will be tested for dosage optimization and efficacy in removal of *K. brevis* cells and brevetoxins in laboratory experiments;
- Future aims to scale-up, field deploy, test for in-situ and/or ex-situ remediation

Dr. George Philippidis, University of South Florida: *Bioprospecting of natural algicidal bacteria associated with Harmful Algal Blooms to develop a sustainable mitigation strategy for red tides*

- Objective: Investigate the bacterial community of the HAB ecosystem to identify algicidal bacteria and develop a sustainable mitigation strategy for red tides
- Task 1: Profile the bacterial community of algal blooms using genetic sequencing and bioinformatics
- Task 2: Isolate and characterize natural algicidal bacteria in *K. brevis* algal blooms

<u>Statutory Report</u>

379.2273(2)(d) Florida Statutes:

> 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.

FWC Initiative Contract:

Due to FWC-FWRI on January 7, 2021 and each January 7 thereafter

Presentation of Draft Report:

Email Red Tide Initiative Technical Advisory Council for input

Governor Office

Legislative Committees

FWC Commission (December 16-17 Meeting?)

Report Outline

1. Initiative Background and Goals
2. Operational Overview
3. Project Reviews
4. Present Outcomes
5. Looking ahead
6. Appendix of Executive Summaries

(Largely this presentation is what will be in the Report)

Looking Ahead

- FWC Report due October 31st
- 2020 Nov/Dec Mesocosm and Culture Facilities Event
- Report to Governor, Legislature, Agencies by Jan 15
- Year 3 RFP March 1st
    - Funding subcontracted early July 2021
- 2021 TAC Meetings
    - May to review status and Year 3 Proposals
    - Nov to review overall status and prepare for 2nd Report

Public Comments: None

Final Council Member Remarks:

- Dr. Hubbard asked if we were using any metrics/scale to assess readiness for operations of projects? She stated that NOAA has an approach.
    - Dr. Crosby stated that we do have an approach: lab bench test, mesocosm, field.

Adjourned - 11:30 am

A copy of the PowerPoint Presentation can be provided by contacting Kevin Claridge at kclaridge@mote.org.

Attendee List

Florida Red Tide Mitigation and Technology Development Initiative
Technical Advisory Council Public Webinar – October 2nd, 2020, 9:00 am-12:00 pm EST

Name:	Organization:
Sarah Caywood	Mote Marine Laboratory
Aspen Cook	Mote Marine Laboratory
Bryan Davis	Mote Marine Laboratory
Dr. Sumit Chakraborty	Mote Marine Laboratory
Dr. Emily Hall	Mote Marine Laboratory
Dr. Michael P. Crosby	Mote Marine Laboratory
Dr. Rich Pierce	Mote Marine Laboratory
Dr. Vince Lovko	Mote Marine Laboratory
Dr. Dana Wetzel	Mote Marine Laboratory
Dr. Cindy Heil	Mote Marine Laboratory
Dr. Michael Barbour	Mote Adjunct Scientist
Kevin Claridge	Mote Marine Laboratory
Kayla Bernier	Mote Marine Laboratory

Conference Code	Participants	End Time	Mins
535051	48	10/02/2020 11:31:27 AM	4338

Call Number	Name	Called To	Join Time	Leave Time	Caller Duration	Role
941-388-4441 (SARASOTA, FL)	Unspecified	TOLLFREE	10/02/2020 08:44:02 AM	11:31:27 AM	168	Host
000-000-9277	Unspecified	LOCAL	10/02/2020 08:50:16 AM	11:31:27 AM	162	Attendee
000-000-9284	Unspecified	LOCAL	10/02/2020 08:57:53 AM	11:31:27 AM	154	Attendee
000-000-1540	Unspecified	LOCAL	10/02/2020 08:58:17 AM	11:31:27 AM	154	Attendee
000-000-4822	Unspecified	LOCAL	10/02/2020 08:58:34 AM	11:31:27 AM	153	Attendee
000-000-7085	Unspecified	LOCAL	10/02/2020 08:58:40 AM	11:31:27 AM	153	Attendee
000-000-8715	Unspecified	LOCAL	10/02/2020 08:59:20 AM	11:31:27 AM	153	Attendee
000-000-2624	Unspecified	LOCAL	10/02/2020 08:59:50 AM	11:31:27 AM	152	Attendee
000-000-5870	Unspecified	LOCAL	10/02/2020 09:01:58 AM	11:31:27 AM	150	Attendee
000-000-4100	Unspecified	LOCAL	10/02/2020 09:02:50 AM	11:31:27 AM	149	Attendee
000-000-4756	Unspecified	LOCAL	10/02/2020 09:02:56 AM	11:31:27 AM	149	Attendee
000-000-7249	Unspecified	LOCAL	10/02/2020 09:04:10 AM	11:31:27 AM	148	Attendee
000-000-7704	Unspecified	LOCAL	10/02/2020 09:05:45 AM	11:31:27 AM	146	Attendee
000-000-8984	Unspecified	LOCAL	10/02/2020 09:24:52 AM	11:31:27 AM	127	Attendee
000-000-7740	Unspecified	LOCAL	10/02/2020 10:06:52 AM	11:31:27 AM	85	Attendee
000-000-5421	Unspecified	LOCAL	10/02/2020 11:09:37 AM	11:31:27 AM	22	Attendee
000-000-7561	Unspecified	LOCAL	10/02/2020 08:59:41 AM	09:00:27 AM	1	Attendee
000-000-6729	Unspecified	LOCAL	10/02/2020 09:01:40 AM	09:01:47 AM	1	Attendee
000-000-6729	Unspecified	LOCAL	10/02/2020 09:02:11 AM	09:02:18 AM	1	Attendee
000-000-6729	Unspecified	LOCAL	10/02/2020 09:03:14 AM	09:03:21 AM	1	Attendee
850-245-8191 (TALLAHASSEE, FL)	Unspecified	TOLLFREE	10/02/2020 08:52:45 AM	09:04:15 AM	12	Attendee
000-000-1832	Unspecified	LOCAL	10/02/2020 09:04:37 AM	09:04:58 AM	1	Attendee
000-000-3858	Unspecified	LOCAL	10/02/2020 08:59:15 AM	09:05:49 AM	7	Attendee
000-000-3858	Unspecified	LOCAL	10/02/2020 09:06:15 AM	09:07:59 AM	2	Attendee
000-000-1722	Unspecified	LOCAL	10/02/2020 08:56:57 AM	09:08:17 AM	12	Attendee
000-000-1735	Unspecified	LOCAL	10/02/2020 09:07:47 AM	09:23:38 AM	16	Attendee
000-000-8124	Unspecified	LOCAL	10/02/2020 09:01:18 AM	09:35:03 AM	34	Attendee
000-000-2239	Unspecified	LOCAL	10/02/2020 09:23:57 AM	09:38:53 AM	15	Attendee
000-000-1526	Unspecified	LOCAL	10/02/2020 09:03:17 AM	10:04:03 AM	61	Attendee
000-000-5105	Unspecified	LOCAL	10/02/2020 09:10:06 AM	10:13:23 AM	64	Attendee
239-405-0908 (BONITA SPRINGS, FL)	Unspecified	LOCAL	10/02/2020 09:08:03 AM	10:26:16 AM	79	Attendee
401-290-7156 (PROVIDENCE, RI)	Unspecified	TOLLFREE	10/02/2020 09:00:00 AM	10:29:15 AM	90	Attendee
206-349-5613 (SEATTLE, WA)	Unspecified	LOCAL	10/02/2020 09:01:24 AM	10:49:30 AM	109	Attendee
000-000-2236	Unspecified	LOCAL	10/02/2020 08:47:59 AM	10:52:45 AM	125	Attendee
000-000-3974	Unspecified	LOCAL	10/02/2020 09:01:04 AM	10:56:29 AM	116	Attendee
000-000-5911	Unspecified	LOCAL	10/02/2020 09:36:24 AM	10:58:03 AM	82	Attendee
000-000-2337	Unspecified	LOCAL	10/02/2020 08:57:58 AM	11:01:03 AM	124	Attendee
000-000-2861	Unspecified	LOCAL	10/02/2020 09:05:31 AM	11:03:34 AM	119	Attendee
000-000-1537	Unspecified	LOCAL	10/02/2020 10:57:19 AM	11:19:44 AM	23	Attendee
000-000-9222	Unspecified	LOCAL	10/02/2020 09:16:14 AM	11:23:02 AM	127	Attendee
941-388-4541 (SARASOTA, FL)	Unspecified	TOLLFREE	10/02/2020 09:04:15 AM	11:28:47 AM	145	Attendee
000-000-6401	Unspecified	LOCAL	10/02/2020 09:05:37 AM	11:31:09 AM	146	Attendee
000-000-4174	Unspecified	LOCAL	10/02/2020 11:02:07 AM	11:31:24 AM	30	Attendee
000-000-1628	Unspecified	LOCAL	10/02/2020 09:01:39 AM	11:31:25 AM	150	Attendee
000-000-1722	Unspecified	LOCAL	10/02/2020 09:08:33 AM	11:31:25 AM	143	Attendee
000-000-8069	Unspecified	LOCAL	10/02/2020 09:04:40 AM	11:31:26 AM	147	Attendee
000-000-9672	Unspecified	LOCAL	10/02/2020 10:27:03 AM	11:31:26 AM	65	Attendee
239-405-0908 (BONITA SPRINGS, FL)	Unspecified	TOLLFREE	10/02/2020 10:26:50 AM	11:31:26 AM	65	Attendee