The Big and Small of Long Island Sound

61st Annual
Northeast Algal Symposium
Mystic, Connecticut
April 14-16, 2023

We are Honored to Dedicate the Conference to Arthur Curtis Mathieson 1937-2022

Phycologists from around New England and beyond lost a dear friend and colleague on August 19th, 2022, when Arthur C. Mathieson passed away after several months of hospice care. Art was born in Santa Monica, CA, and received both a BS (1960) and MS (1961) in Botany at UCLA. Originally interested in plant morphology and anatomy, Art's interests quickly changed to seaweeds when he met PhD students Clinton Dawes and Mike Neushul. Mike at the time was one of the first to conduct underwater surveys of *Macrocystis* beds using SCUBA. No doubt this fruitful collaboration had an influence on Art's decision to pursue a PhD with Robert F. Scagel at the University of British Columbia, as well as his proclivity to study ecological aspects of seaweeds. Art was offered a job in the Botany Department of the University of New Hampshire in 1965, where he stayed until retiring in 2018. In addition to being a Professor in the Botany Department, Art was Director of the UNH Jackson Estuarine Laboratory from 1972 to 1982.

Over his fifty years of collecting and studying seaweeds from Newfoundland to Florida, Art worked with a very large number of collaborators that included both faculty and graduate students. He was the major or co-advisor for 39 graduate students, including 19 doctoral candidates. He has published over 290 publications, most of which he is the first author on. The breadth of subjects in his publications is without comparison and includes, for example, the molecular ecology, reproductive ecology, ecophysiology and phytogeography of seaweeds, as well as studies of economically important seaweeds, eelgrass decline, carbon flow, and habitat changes to the Great Bay Estuary. Amongst his most recognized publications, Art edited and wrote a chapter in Volume 24, of Elseviers's Ecosystems of the World: Intertidal and Littoral Ecosystems (1991). He also co-authored two important and large floras: The Seaweeds of Florida (Dawes and Mathieson 2008), and Seaweeds of the Northwest Atlantic, (Mathieson and Dawes 2017). The latter is the first, and likely last, comprehensive revision of William Randolph Taylors' Marine Algae of the Northeastern Coast of North America (1957).

One of the key components to Art's unique ability to revise Taylor's book was his enormous collection of algal herbarium specimens, said to be over 75,000, the 5th largest macroalgal collection in the US. His vast collection of seaweed specimens, dating back to 1965, is what also made Art the perfect phycologist to serve as seaweed specialist for the Rapid Assessment Surveys for Marine Invasive Species in New England and New York. Art's last publication, in fact published after his passing in March, 2023, was entitled "A Synopsis of Introduced and Native

Seaweeds from 14 Open Coastal and Estuarine Sites within Southern Maine and New Hampshire, USA" (Rhodora, 2023: 123, 367-423). His seaweed collection, archived at UNH, will certainly be a most valuable resource for future studies for years to come.

Art was a natural born teacher and students loved his courses in Aquatic Botany, Marine Phycology, and Marine Ecology. The highlight of his classes was usually the collecting trips. But students quickly learned that they had better know their species, because Art loved to ask students to identify not only seaweed, but also land plant specimens, in the field. Art had a great sense of humor and loved to kid students and colleagues alike. He was a great friend and would do anything for you. We never heard him say a mean thing about anyone, and this is echoed by all of his students and colleagues. He was one of a kind. And he will be sorely missed by all who knew and worked with him. RIP.

Respectfully submitted, Don Cheney and Peter Siver

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Welcome Message

Welcome to the ***61st*** Northeast Algal Symposium! Our 61st NEAS is being held in Mystic, CT, on the Shore of the Long Island Sound, which is the motivation of our meeting theme, The Big and Small of Long Island Sound.

Prominent in our minds is that we meet together on the territory of the Mashantucket Pequot and the Mohegan Tribal Nations. We recognize their stewardship of this land throughout the generations, and thank them for strength and resilience in protecting this land. We aspire to uphold our responsibilities according to their example.

Long Island Sound (LIS) is an important national estuarian ecosystem, with algae at its center. Flowing fresh waters from the East, Housatonic, Connecticut and Thames Rivers mix with the Atlantic Ocean. The LIS is the subject of major scientific research, including work by Dr. Senjie Lin (Univ. of Connecticut, Avery Point) who will be speaking on Saturday afternoon about phytoplankton growth regulation. On Sunday, we will turn our attention to kelp farming with a focus on LIS. The session will begin with a keynote by Dr. Charles Yarish, followed with presentations by Toby Sheppard Bloch (GreenWave), Suzie Flores (Stonington Kelp Company) and David Standridge (Shipwright's Daughter), and ending with a what should be a lively panel discussion. The kelp farming session will be moderated by Anoushka Concepcion from Connecticut Sea Grant.

Special thanks to our judges for the Wilce Graduate Oral Presentation Award (Dominique Derminio, Lindsay Green-Gavrielidis, & Jackson Achankunju), the President's Undergraduate Oral Presentation and Undergraduate Poster Award (Carla A Narvaez, Sarah Whorley & John D. Hall), and the Trainor Graduate Poster Award (Diba Khan-Bureau, Sarah Hamsher, & Yaoguang Li). Many thanks to all who volunteered to judge award presentations - we had a very strong showing and did not need everyone who signed up but thank you all! We appreciate our session moderators: Karolina Fucikova, Catherine Crowley, Sarah Redmond, and Gabrielle Kuba, and of course, our irreplaceable auctioneer, the one and only Craig Schneider. We are grateful to Vermont's own Nick Bezio for designing our meeting logo and NEAS merch. We are grateful to our distinguished guests Charles Yarish, Senjie Lin, Anoushka Concepcion, Toby Sheppard Bloch, Suzie Flores, and David Standridge. Finally, we are honored to have Myla Mathieson and members of her family join us as we honor Arthur Mathieson.

We hope you will enjoy this impressive line-up of scientists and practitioners focusing on the algae of Long Island Sound, in addition to the many fantastic presentations on our roster by students young and old- it should be an exciting meeting!

Peter Siver, Anne Lizarralde, Dale Holen, Louise Lewis, NEAS 2023 Co-conveners

P.S. Don't forget: You can get various conference-themed merchandise in our online store: https://www.redbubble.com/shop/ap/139573577

Virtual Directions

Available times, all EST:
Saturday, 8:40 am-noon, 1:15-3:30 pm
Sunday, 8:45 am-11:45 am

Zoom link for talks: ("Louise Lewis's Personal Meeting Room")
https://us02web.zoom.us/j/4579718228?pwd=OURsaXpWMFRjZHB3V2hjUkNaZGRJQT09
Passcode: NEAS2023

Meeting Code of Conduct

NEAS is committed to creating a safe and welcoming environment for all attendees. To do so, all attendees are expected to abide by the following Code of Conduct:

- All attendees will treat each other with respect.
- Considerate, respectful and collaborative communication is expected.
- Personal attacks directed toward individuals, or disruptions of the virtual portions of the meeting (e.g., "zoom-bombing"), will not be tolerated.
    - Examples of unacceptable behavior include, but are not limited to, written and verbal comments related to physical appearance, body size, race, religion, national origin, gender, gender identity and expression, sexual orientation, as is use of nudity and/or sexual images in presentations or chats.
- Downloading and capturing information presented is strictly prohibited without the written permission of the authors. This applies to oral and poster presentations.

Individuals engaging in behaviors that violate this code of conduct will be removed from the meeting by the moderator/host.

Sponsors

This year's meeting is co-sponsored, in part, by Dominion Energy and the Dominion Energy Charitable Foundation, Connecticut Sea Grant and the Connecticut Institute of Water Resources.

Dominion Energy
Actions Speak Louder

Sea Grant Connecticut

CTIWR Institute of Water Resources

Keynote Speaker and Panelist Biographies

Dr. Senjie Lin (University of Connecticut), a molecular ecologist of phytoplankton and algae. His research interest is broad but is currently focused on phytoplankton growth regulation from the perspective of energy and nutrient acquisition, defense, and sexual reproduction (ENDS).

Charles Yarish (Prof. Emeritus, University of Connecticut) has worked in advancing the global seaweed farming industry and spearheaded the developing kelp industry in Long Island Sound, funded in large part the CT and the National Sea Grant Programs. He has an extensive publication record that spans decades, actively serves as a speaker and consultant, and has been on the cutting edge of research and development initiatives. He is credited for developing the global and North American regenerative seaweed aquaculture industries including Integrated Multi-Trophic Aquaculture & nutrient bioextraction. He has been a national lecturer, secretary, a member of the Phycological of America's Executive Committee and President (2001). In 2019 he received the Phycological Society of America's Award of Excellence for his sustained scholarly contributions in, and impact, on the field of phycology over his career. He is a visiting scientist at The Woods Hole Oceanographic Institution and chief scientist for the GreenWave Organization.

Toby Sheppard Bloch (GreenWave) is an entrepreneur and social impact leader with significant experience conceiving and growing enterprises that provide access to wealth-building employment opportunities for historically excluded community members. As a GreenWave's Infrastructure Director, Toby oversees all facilities operations and infrastructure-related special projects. He works with producers, researchers, policymakers, and buyers to build equitable and sustainable businesses. Before joining GreenWave, Toby led a social enterprise that mitigated the urban heat island effect through green infrastructure improvements to support safer, healthier, and more equitable communities while creating jobs for people most directly impacted by climate change. He thrives on deconstructing complex systems and finding ways to make them more responsive to the people they serve.

Suzie Flores is a former market development executive turned kelp farmer. She and her husband Jay run the largest commercial seaweed farm in the state of CT selling food grade sugar kelp to local restaurants and shops as well as operating a small processing cooperative for sugar kelp. When not farming, Suzie engages in outreach education around the sustainability of seaweed farming and works to support the development of an emerging blue economy in the north east. Suzie was awarded CT's Outstanding Young Farmer Award for her efforts farming kelp by the Department of Agriculture in 2021. She also currently serves on the board of directors for Eating with the Ecosystem in RI.

David Standridge is the Executive Chef of the Shipwright's Daughter in Mystic, CT, a restaurant featuring innovative selections that incorporate native sea resources. He actively supports the local kelp industry through the Kelp Consortium, papaticipates in the New England Kelp Harvest Week, and promotes of sugar kelp through the Shipwright's Daughter website. Of course, he has created many delicious entrees featuring sugar kelp!

Anoushka Concepcion is an Associate Extension Educator focusing on marine aquaculture with the Connecticut Sea Grant Program based at the Avery Point Campus in Groton, CT. She is also a faculty member in UConn's Department of Cooperative Extension. Her programming focuses on supporting marine aquaculture stakeholders in Connecticut, including the nascent seaweed aquaculture industry and associated stakeholders. Anoushka collaborates with industry and regulators to address emerging challenges associated with seaweed aquaculture. Specifically, she assists with the development of guidance on potential human health hazards associated with seaweed grow-out and processing, market development and permitting. She conducts one-on-one consultations with prospective aquaculture producers regularly, conducts research to address emerging stakeholder needs, organizes workshops for industry and general audiences, and presents at various research conferences. Anoushka leads the National Seaweed Hub, a collaborative effort of 11 Sea Grant programs and their stakeholders, which addresses the emerging needs of the national seaweed aquaculture industry. She also serves on the Steering Committee for the Safe Seaweed Coalition, a global partnership supported by the United Nation's Global Compact and Lloyd's Register Foundation, and on the Board of Directors for the non-profit organization Minorities in Aquaculture. Anoushka is passionate about providing the world's population with responsibly produced food through aquaculture.

Program Overview – Mystic Hilton Facilities

Friday, April 14

Time	Event	Location
4:00pm - 7:00pm:	Registration	Schooner Ballroom Entryway
	Auction Donation	Admiral Board Room
	Poster Hang Up	Clipper Room
7:00pm - 9:00pm:	Gathering (optional)	Jealous Monk, Old Mystic Village https://www.jealous-monk.com/

Saturday, April 15

Time	Event	Location
7:00am - 9:00am:	Breakfast	Water Wall near Reception Desk
	Continental breakfast and coffee will be available	
8:00am - 9:00am:	Registration	Schooner Ballroom Entryway
	Auction Donation	Admiral Board Room
	Presentation Upload	Schooner Ballroom
	Poster Hang Up	Clipper Room
8:45am - 9:00am:	Welcoming Remarks	Schooner Ballroom
9:00am - 10:15am:	Oral Session 1	Schooner Ballroom
10:15am - 10:30am:	Break	
10:30am - 12:00pm:	Oral Session 2	Schooner Ballroom
12:00pm - 1:15pm:	Lunch, EC meeting	Ironside Restaurant, Soundings Rm.
	A buffet will be available	
1:15pm - 2:15pm	Oral Session 3	
2:15pm - 2:30pm	Break	
2:30pm - 3:30pm:	**Senjie Lin, Keynote**	Schooner Ballroom
3:30pm - 4:00pm:	Break	
4:00pm - 5:30pm:	Posters	Clipper Room (Cash Bar)
5:30pm - 6:30pm:	Break	Mystic proper
6:30pm - ???	Gather for Banquet, Art Mathieson dedication *A buffet meal will begin being served at 7:00pm. There will be a cash bar available.*	
	Auction	Schooner Ballroom

Sunday, April 16

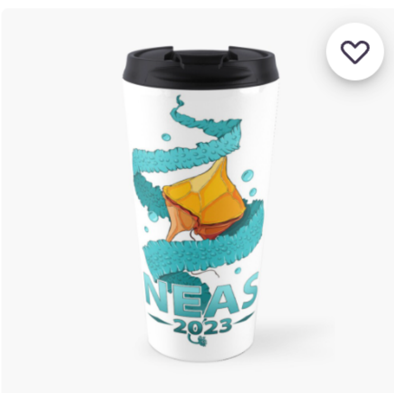
Time	Event	Location
7:00am - 9:00am:	Breakfast	Water Wall near Reception Desk
	Continental breakfast and coffee will be available	
8:00am - 8:45am:	Registration, Auction Donations, Presentation Upload Poster Clean-up	

8:45am - 9:15am:	Oral Session 4	Schooner Ballroom
9:15am - 9:30am:	Coffee Break	

9:30am - 11:40am:	**Kelp Farming Symposium**
9:30am - 9:35am:	Introduction to the Kelp Farming Session Peter Siver
9:35am - 9:45am:	Anoushka Concepcion, Connecticut Sea Grant
9:45am - 10:25am:	Charles Yarish, University of Connecticut
10:25am -10:40am:	Toby Sheppard Bloch, GreenWave
10:40am - 10:55am:	Suzie Flores, Stonington Kelp Company
10:55am - 11:10am:	David Standridge, Executive Chef of the Shipwright's Daughter
11:10am -11:40am:	Panel Discussion
11:45am - 12:45pm:	Lunch, Business Meeting - Cutter Ballroom, Schooner Ballroom *Boxed lunches will be available*

~Depart~

We will see you next year in Rhode Island!



Travel Coffee Mug

Visit our online store to order conference-themed merch: https://www.redbubble.com/shop/ap/139573577

Executive Committee

President: Hilary McManus
Treasurer: Lindsay A. Green-Gavrielidis
Secretary: Sarah Princiotta
Membership: Brian Wysor
Nominations: Chris Lane
Members at Large: Karolina Fučíková, Sarah Whorley, Anne Lizarralde
Development: Amanda Savoie, Greg Boyer, Craig Schneider, John Wehr
Publications: *vacant*
Website: Chris Neefus
2022 Convenors: Sarah Whorley, Karolina Fučíková
2023 Convenors: Dale Holen, Louise Lewis, Anne Lizarralde, Peter Siver
2024 Convenors: Brian Wysor, Lindsay A. Green-Gavrielidis, Craig Schneider

Candidates for NEAS Executive Committee

We will hold an election during the meeting for the following positions. You can read more about each position in the NEAS Officers Manual.
https://northeastalgae.org/organization_docs/NEASofficersmanual.Feb2011.pdf

Nominations Chair, Chris Lane (clane@uri.edu).

Vice-President/President Elect: A) Brian Wysor
B) Sarah Whorley

Treasurer: A) Lindsay Green-Gavrielidis

Member at Large : A) Ken Karol
B) Jessie Muhlin

Nominations Committee Chair Elect: A) Dominique Derminio
B) Michael Kausch

Candidate Biographies

Vice-President/President Elect:

Brian Wysor is a marine phycologist who specializes in the biodiversity, distribution and classification of seaweeds. His research has ranged from the characterization of the marine flora of Atlantic and Pacific Panama, to studies of green tide biodiversity in RI, to the molecular systematics of green algae. Wysor earned his PhD in evolutionary and environmental biology from the University of Louisiana at Lafayette with Suzanne Fredericq, and he pursued post doctoral studies on ulvophycean green algae with Charley O'Kelly at the Bigelow laboratory for Ocean Sciences. He has led several field phycology courses in Caribbean and Pacific Panama, and serves as Professor of Biology – Phycology at Roger Williams University in Bristol, RI, where he serves as Department Chair. Wysor attended his first NEAS meeting in 1994 with his undergraduate advisor and former NEAS president (1993-94), Larry Liddle, and credits his experience at the 1994-1996 meetings with the inspiration to pursue graduate studies in phycology. Wysor has served on the NEAS Executive Committee as Membership director since 2008, and co-convened the 2010, 2014 and 2018 annual meetings. He contributed to the vision of the NEAS laboratory manual and authored a chapter on species concepts and identification. In 2018 he was honored with the Frank Shipley Collins Award for 'service to the society and to Phycology.' If elected to serve as President, Wysor commits to facilitating the tradition of student-centered, professionally-valued annual meetings and to prioritizing efforts that maximize inclusivity and belongingness throughout the membership and at the annual symposium.

Sarah Whorley is an Associate Professor of Biology at Daemen University. She has been a member of NEAS since 2010 when she began as a graduate student at Fordham University. She has been a Member at Large since 2016 and was the Co-Convenor of the 2022 Symposium meeting in Burlington, VT. Sarah's algal focus is freshwater periphyton in streams and studying how anthropogenic activities alter community composition and biochemical properties. As president, her goals and priorities would include revitalizing our operating bylaws, improving and increasing our online presence, and working to secure more external funding for meetings and student activities within the society.

Treasurer:

Lindsay A. Green-Gavrielidis is a marine ecologist and an assistant professor in the Department of Biology and Biomedical Sciences at Salve Regina University. She's been a member of NEAS since 2010 and served as the treasurer since 2018. Her research is focused on human impacts on seaweed communities, macroalgal blooms, non-native species, and seaweed aquaculture. Lindsay is passionate about teaching in the classroom, laboratory, and field and hopes to continue to inspire people to appreciate, study, and conserve the natural world.

Member-at-Large:

Ken Karol is a Cullman Associate Curator at the New York Botanical Garden. His primary research interest focuses on utilizing several molecular and morphological approaches toward understanding the evolution of green algae in a broad sense, and, more restrictively, the biology, evolution, systematics, and classification of the Characeae. He is also part of a NSF funded Tree of Life project, The Green Algae Tree of Life (GrAToL). This project involves the collaboration of five institutions to understand the evolutionary relationships of all of the major groups of green algae, a diverse group of more than 14,000 photosynthetic species worldwide.

Jessie Muhlin is a Professor of Marine Biology and Chair of the Corning School of Ocean Studies at Maine Maritime Academy. Her research interests focus on the reproductive ecology, population genetics, food web ecology, and resource management of fucoid seaweeds in the northwestern Atlantic. Jessie is actively involved in art-science collaborations using marine algae as inspiration. She has a deep commitment to public outreach and routinely participates in outreach programs with the National Park Service, Schoodic Institute, Maine Sea Grant, and other local partners. You can find her feeding her students an assortment of edible sea vegetables and encouraging everyone to understand and appreciate the algae.

Nominations Chair Elect:

Dominique Derminio is currently an Assistant Professor of Biology at Keuka College in Keuka Park, NY. She earned her Bachelor of Arts in Biochemistry at Keuka College in 2011, her Masters by Research at the University of New South Wales in Psychiatry in 2014, and her Ph.D. from SUNY ESF in Biochemistry in 2020. Her dissertation work examined the photosystem of Microcystis aeruginosa and the toxin microcystin. After completing her Ph.D., she was a visiting instructor and adjunct instructor at Keuka College, Onondaga Community College, and SUNY ESF for two years. During this time, Dominique also received a PALM fellowship which was established to increase the use of active learning in undergraduate classrooms. She also works as the senior research scientist at Eget Liber studying the effects of various non-chemical methods of remediating harmful algal blooms.

Michael Kausch is finishing his dissertation on harmful algal blooms in New York lakes with John D. Wehr at Fordham University. His broader scientific interests include ecological stoichiometry, chemically driven microbial community succession, and antibiotic resistance expansion in microbial communities. He has attended NEAS meetings since 2016 and is very excited to become more involved through the role of Nominations Chair elect.

PRESENTATION SCHEDULE

SATURDAY, APRIL 15

7:00am – 9:00am: Breakfast,
8:00am – 9:00am: Auction Donations, Presentation Upload**,** Poster Hang-up, Exhibitors
8:45am – 9:00am: Welcoming Remarks

ORAL SESSION 1, MODERATOR: KAROLINA FUCIKOVA

9:00am - 9:15am: Wilce Award Candidate
Margaret M. Cassidy & Gary W. Saunders. Systematics and diversity of the family Galaxauraceae (Nemaliales, Rhodophyta) in remote regions of Australia.

9:15am - 9:30am: Wilce Award Candidate
Davis Fray, Callahan McGovern, Dale A. Casamatta, Bopaiah Biddanda, & Sarah E. Hamsher Life in the Extreme: Algal Biodiversity and Biogeography of Microbial Mat Communities in Low-oxygen, High-sulfur Springs Using a Multi-marker Metabarcoding Approach.

9:30am - 9:45am: Wilce Award Candidate
Brandon O'Brien, Christopher Neefus, Jennifer A. Dijkstra. Seasonal recruitment and succession patterns of macroalgae in the subtidal.

9:45am - 10:00am: Wilce Award Candidate
Dominique Lockwood & Tatiana Rynearson. Seasonal Dynamics of the Phytoplankton Communities in Narragansett Bay: Insights from High-Resolution Sampling and Analysis.

10:00am - 10:15am: Wilce Award Candidate
Madelaine Wrey, John Wehr & Larry Stevens. Production and nutrient content of benthic algae in the Glen Canyon section of the Colorado River in 2021.

10:15am - 10:30am: *Coffee Break*

ORAL SESSION 2, MODERATOR: SARAH REDMOND

10:30am - 10:45am: Wilce Award Candidate
Sophia M. Musiak, Kenneth G. Karol & Roy E. Weitzell Jr. Distribution and Diversity of Stoneworts (Characeae) across an Urban Gradient in Western Pennsylvania.

10:45am - 11:00am: Wilce Award Candidate
Michael E. Kausch & John D. Wehr. Non-heterocystous *Limnoraphis birgei* Does Not Require Dissolved Nitrogen for Growth.

11:00am - 11:15am: President's Award Candidate
Thomas Irvine, Ben Carolan, Brian Wysor. Molecular characterization of the cosmopolitan family Rhodomelaceae in Rhode Island.

11:15am - 11:30am: President's Award Candidate
Hannah Mitchell, Shawna Chamberlin, Allex Gourlay, & Skylar Bayer. Determining the optimal media and light intensity conditions to culture *Margalefidinium polykrikoides*, rust tide.

11:30am - 11:45am: **Sarah Princiotta**, Ted Harris, Dale Holen, & Josh Kellogg. Evaluation of biological interactions between heterotrophic and mixotrophic nanoflagellates with toxic cyanobacteria.

11:45am - 12:00pm: **Andrea Angera**, Sarah Redmond. The Maine seaweed exchange.

12:00pm - 1:15pm: *Lunch - Ironside Restaurant*
Executive committee meeting – Soundings Room

ORAL SESSION 3, MODERATOR: CATHERINE CROWLEY

1:15pm - 1:30pm: **Roseanna M. Crowell** & Morgan L. Vis· Resolving relationships among seven genera in the Batrachospermales (Rhodophyta) using a multi gene approach.

1:30pm - 1:45pm: **Victor Rodriguez.** Effects of Indole-3-Acetic Acid decomposition byproducts on the Population Density of *Arthrospira platensis*.

1:45pm - 2:00pm: **Danielle Moloney**, Emma Garcia, Brynn Mendes, Sam Parsons, Jackelin Ramos, & Lindsay Green-Gavrielidis. Assessing the impact of *Ulva compressa*, *Ulva lacinulata*, and tubular *Ulva* on marine invertebrates.

2:00pm - 2:15pm: **Yaoguang Li**, Crystal Ng, Michael Marty-Rivera, David Bailey, Margaret Aydlett, Scott Lindell, Charles Yarish. Effects of directly spraying gametophytes or juvenile sporophytes on growing lines for *Saccharina latissima* farming.

2:15pm – 2:30 pm: *Break*

2:30pm - 3:30pm: **KEYNOTE ADDRESS 1:** Introduction: Louise Lewis
Senjie Lin, Diverse N, P nutrient strategies in phytoplankton and trends of Long Island Sound phytoplankton and nutrients in the last decade.

3:30pm – 4:00pm: *Break, or preview posters*

4:00pm - 5:30pm: **POSTER SESSION Trainor and President's Awards, Professionals (Cash Bar)**

5:30pm - 6:30pm: *Break:* Catch up with your colleagues, network, explore Mystic, or take a nap!

6:30pm – ? Banquet (buffet meal served at 7:00 pm), Art Mathieson dedication, Auction. Spooner Ballroom

SUNDAY, APRIL 16TH

7:00am – 9:00am: Breakfast,
8:00am – 8:45am: Registration, Auction Donations, Presentation Upload
Poster Clean-up

ORAL SESSION 4, MODERATOR: GABRIELLE KUBA

8:45am - 9:00am: **Hannah G Reich**, Marley Gonsalves, Rachel Lewis, Cassidy Stadtfeld, Corinne Richard, Elizabeth L. Harvey. Nutrient deficiency mediates the susceptibility of marine microalgae to 'zombification' by a bacterially produced quinolone.

9:00am - 9:15am: **Kayla Kurtz**, Lindsay Green-Gavrielidis, Lucie Maranda, Carol Thornber, & Vinka Craver. A Comparison of Biofouling Adhesion by Field Sampled and Laboratory Cultured *Ulva* spp**.**

9:15am - 9:30am: *Coffee Break*

KELP KEYNOTE SESSION:

9:30am - 9:35am: **Peter Siver**, Introduction

9:35am - 9:45am: **Moderator: Anoushka Concepcion**, Connecticut Sea Grant

9:45am - 10:25am: **KEYNOTE ADDRESS**: **Charles Yarish**, University of Connecticut, Opportunities, challenges and future directions of seaweed aquaculture in the USA

10:25am - 10:40am: **Toby Sheppard Bloch**, GreenWave

10:40am - 10:55am: **Suzie Flores**, Stonington Kelp Company

10:55am - 11:10am: **David Standridge**, Executive Chef of the Shipwright's Daughter

11:10am - 11:40am: Panel Discussion

11:45am – 12:45pm: Closing remarks and General Business Meeting

Lunch - *boxed lunches*

Oral Abstracts (In order of presentation)

SATURDAY, APRIL 15

ORAL SESSION 1, WILCE AWARD

Systematics and diversity of the family Galaxauraceae (Nemaliales, Rhodophyta) in remote regions of Australia. Margaret M. Cassidy & Gary W. Saunders. Centre For Environmental & Molecular Algal Research, Department of Biology, University of New Brunswick, Fredericton, NB, E3B 5A3, Canada. **(Wilce Award)**

We provide an update on an ongoing survey of Galaxauraceae emphasizing remote regions of Australia. All four galaxauraceaen genera are currently represented in the Australian flora by 19 recognized species. However, DNA sequences have been essential for verifying the widespread tropical to warm temperate distributions reported for species in this family as many morphological characteristics overlap. Consequently, we have initiated a DNA barcode survey using COI-5P and *rbc*L-3P for recent collections from the Cocos (Keeling) Islands, Western Australia, New South Wales including Lord Howe Island, and Norfolk Island. Our data have revealed additional species assignable to this family throughout these waters. A combination of molecular and morphological comparisons have demonstrated that many of these collections represent novel species, whereas others expand the distribution of existing Indo-Pacific species. Our molecular data have also revealed numerous species complexes, uncovering novel Australian species residing under the names *Actinotrichia fragilis, Dichotomaria obtusata*, *Galaxaura rugosa* and *Tricleocarpa cylindrica*. In addition, our research provides the first records for members of this family at the Cocos (Keeling) Islands. This re-examination of species diversity in the Australian flora using molecular and morphological/anatomical data could be instrumental for conservation efforts given the importance of galaxauraceaen species in warm-water ecosystems and the remoteness of some of the floras studied.

Life in the Extreme: Algal Biodiversity and Biogeography of Microbial Mat Communities in Low-oxygen, High-sulfur Springs Using a Multi-marker Metabarcoding Approach. Davis Fray[1], Callahan McGovern[2], Dale A. Casamatta[2], Bopaiah Biddanda[1], and Sarah E. Hamsher[1,3]
[1]Annis Water Resources Institute, Grand Valley State University, Muskegon, MI 49441, USA [2]Department of Biology, University of North Florida, Jacksonville, FL 32224, USA [3]Department of Biology, Grand Valley State University, Allendale, MI 49401, USA **(Wilce Award)**

Algal communities found in isolated areas with extreme conditions present an opportunity for studying microbial biogeography and biodiversity. High-sulfur, low-oxygen environments formed by underwater sinkholes and springs create such habitats, and are populated by unique microbial mat communities. Although cyanobacteria dominate these mats, other bacteria and diatoms are also present. To explore the diversity and better describe the taxonomic composition of these communities, mat samples, water parameters, and nutrients were collected from sites in Alpena and Monroe, Michigan and Palm Coast, Florida over the growing season of 2022. Cyanobacteria and diatoms were cultured from mat subsamples to create a culture-based DNA reference library. Remaining mat samples were used for high-throughput sequencing using a multi-marker metabarcoding approach focused on exploring bacterial and diatom diversity using 16S and *rbc*L markers, respectively. Metabarcoding analyses revealed higher alpha diversity than reported previously in these communities. Beta diversity and taxonomic composition differed between sites across a regional and continental geographic range. Redundancy analyses suggest *Craticula* are associated with low dissolved oxygen concentrations and *Staurosira* was indicative of low water temperature. Our study provides novel information on microbial mat communities in extreme environments and advances the field of microbial biogeography by describing distinct communities in similar habitats across geographic scales.

Seasonal recruitment and succession patterns of macroalgae in the subtidal. Brandon O'Brien[1], Christopher Neefus[1], Jennifer A. Dijkstra[2] 1. University of New Hampshire, Department of Biological Sciences. Durham, NH 03824. USA. 2. University of New Hampshire, Center for Coastal and Ocean Mapping. Durham, NH 03824. USA. **(Wilce Award)**

Many seaweeds in the subtidal follow seasonal patterns of growth and reproduction, though the availability of space is often a limiting factor. We collected data on short-term seasonal recruitment and long-term succession patterns using settlement plates deployed in the southern Gulf of Maine over two years. Recruitment was random and opportunistic, with recruit richness showing a peak in the summer and a low in the fall. Succession appears to follow a traditional succession pattern with rapid initial recruitment of opportunistic species, and gradual decline of species richness over time. The final community after two years was dominated by red turf algae – filamentous or foliose species which are hardy perennials or which recruit every season. Only one non-native species was commonly found in recruited communities, *Dasysiphonia japonica*, and though it is common in the surrounding community it did not dominate the recruitment plates. Our results show that this macroalgae community is diverse and dynamic. Diversity is maintained by the regular opening of new bare space. This allows kelps and rare species to persist in a system that would otherwise become turf-dominated over time. With warming waters in the Gulf of Maine causing stress to kelps, it is likely that this community will become more turf-dominated in the future.

Seasonal Dynamics of the Phytoplankton Communities in Narragansett Bay: Insights from High-Resolution Sampling and Analysis. Dominique Lockwood[1] & Tatiana Rynearson[1].
[1]The University of Rhode Island Graduate School of Oceanography, Narragansett, RI, 02882, U.S.A. **(Wilce Award)**

Narragansett Bay (NBay) is a complex estuarine system along the northeastern coast of the United States that contributes billions of dollars annually to Rhode Island's economy and has been the site of a long-term plankton time series for over 60 years. Weekly sampling at the site of this time series has revealed seasonal patterns in the biomass and growth rates of phytoplankton. However, contributions of different phytoplankton size fractions to biomass and ultimately the functioning of the estuary are less understood. Water was collected from NBay each week from June 2022-March 2023. Taxonomic identity of phytoplankton was determined using light microscopy (cells > 10 µm in size) and flow cytometry (cells < 10 µm in size). The contribution of different size fractions to total biomass was determined using size-fractionated chlorophyll *a* (> and < 10 µm). Chlorophyll *a* concentrations revealed two phytoplankton blooms; one in the late summer, dominated by Chl *a* from the < 10 µm size class, and one in winter, dominated by the > 10 µm size class. Flow cytometry revealed that cells < 10 µm in size reached the highest concentrations observed during the late summer bloom and were at their lowest during the winter bloom, when cells > 10 µm dominated Chl *a* biomass. Phytoplankton in the < 10 µm size class were identified via flow cytometry as *Synechococcus*, nanoeukaryotes, and picoeukaryotes and we found that they did follow a seasonal succession pattern. Instead, they exhibited similar temporal patterns of abundance, peaking during the summer bloom and dropping to low abundances in late fall and winter. This study highlights the dynamic nature of some of the smallest organisms in NBay and in the future, will better allow us to understand how they contribute to net primary production rates.

Production and nutrient content of benthic algae in the Glen Canyon section of the Colorado River in 2021. Madelaine Wrey[1], John Wehr[1] & Larry Stevens[2]. [1]Biological Sciences, Fordham University, Armonk, NY, 10504, U.S.A.; [2]Springs Stewardship Institute, Flagstaff, AZ, 86001. **(Wilce Award)**

Glen Canyon Dam, one of the nation's largest hydroelectric power dams, is situated on the Colorado River. Until recently, Glen Canyon Dam has been run as a hydropeaking facility, generating turbulent flows. In response to drought conditions and sediment retention management goals, dam operations shifted to a stabilized flow pattern. Reduced daily flow fluctuations have coincided with a decrease in the historically dominant macrophyte *Cladophora glomerata,* the major host for epiphytic algae, and a proportionate increase in other macrophytes. To assess the factors currently driving the base of this food web, we deployed brick substrata, which we sampled monthly at 3 north-south paired sites along a 21-km transect from Glen Canyon Dam to Lees Ferry, to assess effects of season, distance from the dam, and light availability on algal production and nutrient content, from April 2021 through January 2022. Benthic algal production was greatest in May (3.4 $mg/m^2/day$) and declined by 93% and remained low (0.255 – 0.384 $mg/m^2/day$) throughout the summer. We observed a concurrent shift in algal stoichiometry from a phosphorus-enriched (May: CP ratio 32.38) to strongly phosphorus-limited (June-Aug C:P 681.32 – 999.77). While there were no annual trends, there were significant differences in algal production month to month e.g., from May to June (two-way t-test, $P = 0.006$). During late summer months, August and September, algal production differed with respect to bank orientation, within the canyon (two-way t-test, $P = 0.001$, 0.003). Similarly, August C:P also varied significantly with light exposure (by river bank; $P = 0.0005$), as did algal N:P ($P = 0.03$). Dissolved P concentrations in the river showed similar but non-significant trends, while algal nutrient data suggest that algal production is P-limited most of the year.

Distribution and Diversity of Stoneworts (Characeae) across an Urban Gradient in Western Pennsylvania. Sophia M. Musiak[1], Kenneth G. Karol[2] & Roy E. Weitzell Jr.[1]. [1]Falk School of Sustainability and Environment, Chatham University, Gibsonia, PA, 15044, U.S.A.; [2]The Lewis B. and Dorothy Cullman Program for Molecular Systematics, New York Botanical Garden, Bronx, NY, 10458, U.S.A. **(Wilce Award)**

Stoneworts (Characeae) are a diverse group of macroalgae that provide numerous ecosystem benefits, acting as indicators of good water quality while serving as habitat and food for numerous organisms, both aquatic and terrestrial. Found mainly in freshwater lentic habitats, the Characeae are global in distribution, yet little is known about their diversity and distribution in western Pennsylvania. To address this gap, 9 lakes spanning an urban gradient in western Pennsylvania were sampled bi-weekly, from May through September 2022. A total of 14 sites were sampled; 1 lake had 3 sites, 3 lakes had 2 sites, and 5 lakes had 1 site, yielding a dataset including Characeae diversity, data for a suite of water quality parameters, and notes on habitat and associated aquatic plant species. Five species were identified from 7 of the 9 lakes, and the timing of seasonal emergence and senescence was noted. Analysis of water quality data, and land use statistics within a 100-meter buffer as well as in the watershed of each lake will be discussed in relation to Characeae presence and diversity over time. The results of this research will serve as a baseline for understanding the distribution, diversity, and ecology of Characeae in western Pennsylvania lakes and the impacts of human development on water quality and aquatic plant communities from local to regional scales.

Non-heterocystous *Limnoraphis birgei* Does Not Require Dissolved Nitrogen for Growth.
Michael E. Kausch & John D. Wehr. Louis Calder Center - Biological Station and Department of Biological Sciences, Fordham University, Armonk, NY, USA. **(Wilce Award)**

Cyanobacteria harmful algal blooms produce surface scums that diminish light availability and outcompete other algae. *Limnoraphis birgei* is a bloom-forming cyanobacterium lacking heterocytes for which little ecological data exist, despite documented blooms in many US states. In previous laboratory experiments, we highlighted the ability of this species to sustain growth under near-zero nitrogen conditions. To further test the influence of dissolved nitrogen on growth, phosphorus uptake, and nutrient stoichiometry, we conducted experiments using unialgal cultures of *L. birgei* isolated from North Lake (NY), a lake which produces annual blooms. Experiments were run in replicated 125-mL Erlenmeyer flasks inoculated with nitrogen-depleted filaments in 50 mL modified BG-11 medium amended with 0 mM N, 0.1 mM nitrate (NO_3^-), 0.1 mM ammonium (NH_4^+), or 0.05 mM ammonium nitrate (NH_4NO_3). In 0 mM N treatments, dry mass increased 18-fold, further supporting previous results highlighting the ability of *L. birgei* to sustain growth in the absence of dissolved nitrogen. Dry mass also increased in all +N treatments, but to a lesser extent than in zero-N added treatments: 15-fold in 0.1 mM NO_3^- and 0.05 mM NH_4NO_3, and least (11-fold increase) where 0.1 mM NH_4^+ was the sole N source. Phosphorus uptake by *Limnoraphis* was significantly correlated with growth rate. P was depleted by 99% in all zero-N or NO_3^- added treatments, but only by 76% in the 0.1 mM NH_4^+ treatment. NO_3^- was depleted by 95% at day 14 in the 0.1 mM NO_3^- treatments and by 99% at day 7 in the 0.05 mM NH_4NO_3. C:N ratios in *Limnoraphis* increased in all treatment conditions over time. Together, these results suggest that growth of *L. birgei* and nitrogen availability are uncoupled, and that blooms of this species can occur even under very low dissolved nitrogen conditions.

Molecular characterization of the cosmopolitan family Rhodomelaceae in Rhode Island.

Thomas Irvine[1], Ben Carolan[1], Brian Wysor[1] [1]Department of Biology, Marine Biology and Environmental Science, Roger Williams University, Bristol, RI **(President's Award)**

The compounding of disturbances to natural communities through global climate change, pollution and coastal development, and the ease with which seaweeds can be transported in association with human activities means that the arrival and establishment of foreign species in RI waters is likely. However, monitoring for changes in species richness in RI seaweeds is difficult because many species closely resemble each other. This project establishes a DNA-informed inventory of the Rhodomelaceae, a family of filamentous red algae with high species richness and high affinity for dispersal beyond its native range. Two chloroplast encoded DNA markers were used to identify RI Rhodomelaceae, these were the *rbc*L and UPA markers (genes). 93 sequences of the 3' end of the *rbc*L marker as well as 74 sequences of the UPA marker were generated. From these data, eleven distinct species were identified and all but one group were supported by both markers. Contemporary patterns of species richness and distribution will be compared to historical reports and discussed in the light of global climate change and biological invasions.

Determining the optimal media and light intensity conditions to culture *Margalefidinium polykrikoides*, rust tide. Hannah Mitchell[1], Shawna Chamberlin[1], Allex Gourlay[1], & Skylar Bayer[2]. [1] Center for Economic and Environmental Development, Roger Williams University, Bristol, RI, 02809, U.S.A.; [2]NOAA Fisheries Alaska Regional Office, Juneau, AK, 99801, U.S.A.
(President's Award)

Harmful algal blooms (HABs) are a global phenomenon caused by microscopic algae that can cause devastating impacts on both the economy and coastal ecosystems. *Margalefidinium polykrikoides* is a toxic dinoflagellate responsible for HAB events worldwide. Known as rust tides, these blooms have caused expansive finfish and shellfish die-offs, resulting in economic losses of up to millions of dollars per event. Despite the scale of this impact, the mechanism underlying the toxicity of *M. polykrikoides'* and aspects of its lifecycle remain unclear. Developing a method to culture *M. polykrikoides* that results in high densities is essential to understand what makes this HAB species toxic. This project explored how light intensity and two different types of enriched seawater media impact growth and chain formation of *M. polykrikoides*. Our cultures achieved significantly higher cell densities over the course of a 40-day growth experiment in L1 vs. f/2 medium, which we attribute to the presence of additional trace metals in L1 medium. Furthermore, the culture conditions tested in this experiment resulted in significantly more chains in L1 medium than f/2. Additionally, we learned that cell densities and number of chains were no different among cultures grown across a range of light intensities from 27-133 µmol $m^{-2}\cdot s$ over a 54-day growth experiment. This suggests that light intensity might not be a crucial variable in culturing this algal species, or that the difference in light intensities was not great enough to produce significantly different results. Exploring the impact medium formulation and light intensity has on *M. polykrikoides* growth provides insight into the culturing conditions that help produce high cell densities for future studies.

Evaluation of biological interactions between heterotrophic and mixotrophic nanoflagellates with toxic cyanobacteria. Sarah Princiotta[1], Ted Harris[2], Dale Holen[3], & Josh Kellogg[4]. [1]Pennsylvania State University Schuylkill, Schuylkill Haven, PA, 17972, USA. [2]Kansas Biological Survey, Lawrence, KS, 66047, USA. [3]Pennsylvania State University Scranton, Dunmore, PA, 18512, USA. [4]Pennsylvania State University, University Park, State College, PA, 16801, USA.

Proliferations of cyanobacteria are a major threat to water quality world-wide. Although several genera can produce a suite of toxic secondary metabolites, triggers for production and fate of these metabolites are not fully understood. To date, much attention has been directed towards abiotic drivers of cyanotoxin production. However, there is compelling evidence that biotic interactions within the aquatic microbial community may contribute to cyanobacteria population dynamics and production of cyanotoxins. Here, we describe a series of experiments in culture that demonstrate the role of nanoflagellates in top-down control of cyanobacteria. Two species of nanoflagellate in the Chrysophyceae (*Spumella*, *Ochromonas*) were grown alone or in co-culture with a toxic or non-toxic strain of *Microcystis*. The experimental protocol was repeated in three modifications of media that represent P-limitation, co-limitation of N and P, and N-limitation. Measurements for growth rate, grazing rate, and intracellular microcystin-LR were taken over an 8-day period. We hypothesized that P-limitation would enhance grazing by nanoflagellates on *Microcystis* and given previous reports of these species to withstand exposure to microcystin, that the toxic strain of *Microcystis* would represent a viable food source. Growth rate of toxic *Microcystis* was significantly reduced in co-culture with both nanoflagellate species, but results were dependent upon nutrient conditions. Generally, both species of nanoflagellate were capable of ingesting toxic *Microcystis*, but grazing rates also varied with nutrient conditions. There was a notable reduction in MC-LR that occurred when toxic *Microcystis* was grown in co-culture with *Ochromonas*, but only under P-limitation. Work such as this will provide insight into the complex mechanisms that underly formation and subsequent decay of cyanobacteria blooms from a novel biological perspective.

The Maine seaweed exchange. Andrea Angera[1]*, Sarah Redmond[2]. [1]The Maine Seaweed Exchange, Gouldsboro, Maine. [2]Springtide Seaweed, LLC, Gouldsboro ME.
The Maine Seaweed Exchange is a 501(c)(3) non-profit corporation with a mission to support the development of an organic, sustainable, and restorative seaweed aquaculture industry. The organization works to support the seaweed aquaculture industry through seaweed farming education, training, research, diversification, product and market development, organic certification, and by facilitating key networks for the industry. The MSE hosts events and workshops, which have included the Maine Seaweed Fair, the Practical Seaweed Farmer's Conference, and a number of in-person and remote training, educational, and consulting events. We offer a wide range of seaweed farming courses and training opportunities that cover all aspects of seaweed farming in order to promote responsible, informed farmers for a more professional industry. Recently, we have launched the Organic Kelp Collaborative, where we work to train, support, and connect new organically certified seaweed farmers and processors in order to develop a network of organic producers. Springtide Seaweed's commercial seaweed farm works with the Maine Seaweed Exchange to offer hands on internships, volunteer and visitor opportunities, as well as research and development projects. Recent projects include new red seaweed crop development, new sea urchin and oyster integrated aquaculture crop development, new aquaculture technology, and full safety and nutritional analysis on Maine farmed seaweeds. The Maine Seaweed Exchange works to create opportunities within the new industry with an emphasis on organic values and community collaboration.

ORAL SESSION 3

Resolving relationships among seven genera in the Batrachospermales (Rhodophyta) using a multi gene approach. Roseanna M. Crowell[1] & Morgan L. Vis[1]. [1]Environmental and Plant Biology, Ohio University, Athens, Ohio, 45701, U.S.A.

Freshwater red algae are important photosynthetic members of stream communities worldwide and unique as most red algae inhabit marine environments. Although there are freshwater representatives scattered throughout the red algal evolutionary tree, two-thirds of the species are in the strictly freshwater order Batrachospermales. Recent systematics research has revealed high statistical support for each genus but little support for how these genera are related to each other. Previous research has utilized a few genes, notably the *rbc*L gene, to understand the evolutionary relationships, but a new approach is needed to clarify the relationships among the 21 genera. Within the order, there is a well-supported clade of seven genera (*Batrachospermum*, *Lemanea*, *Lympha*, *Paralemanea*, *Sirodotia*, *Tuomeya* and *Volatus*) that have a variety of morphology and reproductive characters representative of the Batrachospermales as a whole. Using a subset of 10 chloroplast genes, I built single gene trees for the seven genera in the clade and a concatenated tree. The gene trees showed varying topology, however, there were two groups of genes that share the same topology. The first group included *pet*A, *psa*A and *tuf*A, while the second group included *rbc*L and *rbc*S. The other gene trees (23S, *psa*B, *psb*A, *psb*C and *pet*B) still resolved two subclades among the seven genera, but topology within each subclade varied. I compared the *rbc*L gene tree to the concatenated tree and found that support at most nodes within the clade improved such as the node supporting the subclade containing the genera *Batrachospermum*, *Lympha*, *Sirodotia*, *Tuomeya*, and *Volatus.* However, the support at other nodes within this subclade decreased such as the node supporting the genera *Batrachospermum*, *Lympha*, *Tuomeya*, and *Volatus* and will need to be explored further. My next step will be phylogenomic analyses of all genes from the chloroplast genome.

Effects of Indole-3-Acetic Acid decomposition byproducts on the Population Density of Arthrospira platensis. Victor Rodriguez[1], [1]Victor's Laboratory, Albany, NY 12203 U.S.A.

Arthrospira platensis (spirulina) is a photosynthetic cyanobacterium used in the food, energy, and pharmaceutical industries. Several studies have shown the potential of using indole-3-acetic acid (IAA), a plant hormone, as a growth-promoting additive for spirulina culture production. However, the exact concentration required for optimal biomass production has not been determined. Studies have shown that IAA can promote the growth of spirulina at moderate concentrations. However, studies suggest that higher concentrations of IAA can inhibit spirulina growth. In this study, we compared the effects of Indole-3-Acetic Acid (IAA) and photo-decomposed IAA on the population density of spirulina. Three Culture groups, each consisting of five 10ml cultures with an initial population density of 1.5X10^4 trichomes per ml, were subjected to different treatments for four days. First, the control group received 1ml of control media. Then, the second group was inoculated with a 1.0X10^-3 M concentration of IAA. The final group was inoculated with a photodecomposed 1.0X10^-3 M concentration of IAA. The photodecomposition was achieved by subjecting the IAA to five days of intense light with a mix of wavelengths of 630 nm, 460 nm, and 660 nm. The group treated with IAA showed an increase of 10% in population density compared to the control group over the four days($P<.001$). However, the photo-decomposed IAA Treated group showed a 3% decrease in population density growth compared to the control group, although the decline was not statistically significant ($P=.09$). These findings confirm that IAA has a positive effect on the population density of spirulina. However, as IAA decomposes, accumulating photodecomposed byproducts over time may cause slower growth rates. However, more research is needed to confirm this phenomenon.

Assessing the impact of *Ulva compressa*, *Ulva lacinulata*, and tubular *Ulva* on marine invertebrates. Danielle Moloney[1], Emma Garcia[1,2], Brynn Mendes[1], Sam Parsons[1], Jackelin Ramos [1], & Lindsay Green-Gavrielidis[1]. [1]Department of Biology & Biomedical Sciences, Salve Regina University, Newport, RI 02840, U.S.A.; [2]Department of Kinesiology, University of Rhode Island, 45 Upper College Road, Kingstown, RI 02881, U.S.A.

Macroalgae provide important benefits to coastal ecosystems including nutrient sequestration, habitat structure, and the base for many food webs. Certain species of bloom-forming macroalgae such as those in the genus *Ulva* compete via chemical competition by producing and releasing allelopathic compounds. Exposure to these compounds can result in lethal and sublethal effects on marine species. However, these compounds and their effects on southern New England organisms are poorly understood. This study assessed how exposure to *Ulva* (*Ulva compressa*, *Ulva lacinulata*, and tubular *Ulva*) at bloom-level concentrations (3.5 and 5.0 g/L) impacted the growth rate and mortality of *Idotea balthica* (isopods), *Palaemontes pugio* (shrimp), and juvenile *Mytilus edulis* (mussels). Pleopod beating behavior was analyzed in *Palaemontes pugio* as a proxy for stress. Exposure to *Ulva* did not significantly affect growth of shrimp or isopods. However, mussels grew significantly less when exposed to 5.0 g/L of *U. compressa* than they did in mesocosms where no algae were present. Mussel mortality was higher than shrimp or isopod mortality across all experiments, and slightly higher in mesocosms that contained *Ulva*. High mortality of mussels in the experiment may be partially attributed to fluctuating pH which was observed in mesocosms. Future directions may assess the conditions that lead to allelopathy in *Ulva*, which currently remains uncertain. The sub-lethal effects observed here impact ecosystem health via altered predation, dispersal, and survival rates of important marine species. These effects may also lead to the disruption of coastal food chains that many humans rely on for nourishment.

Effects of directly spraying gametophytes or juvenile sporophytes on growing lines for *Saccharina latissima* farming Yaoguang Li[1], Crystal Ng[1,2], Michael Marty-Rivera[1], David Bailey[3], Margaret Aydlett[3], Scott Lindell[3], Charles Yarish[1] [1]University of Connecticut, Stamford, CT, USA; [2] Los Angeles Pierce College, Los Angeles, CA, USA; [3]Woods Hole Oceanographic Institution, Woods Hole, MA, USA.

In North America, sugar kelp *(Saccharina latissima)*, a brown marine macroalgae, is being farmed to meet the increasing demands of the human food and animal feed industries. It also has great potential as a clean and efficient source of biomass for many applications: fertilizers, bioplastics, biofuels, and carbon sequestration. To sustainably meet biomass requirements offshore kelp farming requires superior strains and improved hatchery protocols. Directly attaching gametophytes or juvenile sporophytes to grow lines versus using meiospores from donor populations is an improved hatchery method that allows for the use of superior strains and reduces hatchery operating expenses. To develop this method, we conducted two independent experiments in Connecticut and Alaska to test the effects of two main factors on direct seeding success: 1) development stage: gametophytes or juvenile sporophytes; and 2) applying binder or not. From these experiments, results showed that directly spraying either gametophytes or juvenile sporophytes on ropes will lead to adult sugar kelp growth within the growing year. The plots with no binder had more total blades and higher wet weight than those with a binder. We expect the implementation of these findings to contribute significant improvements in the kelp hatcheries and reduce the cost of seeding processes.

KEYNOTE ADDRESS 1

Diverse N, P nutrient strategies in phytoplankton and trends of Long Island Sound phytoplankton and nutrients in the last decade. Senjie Lin, Department of Marine Sciences, University of Connecticut, Groton, CT 06340, USA

Climate change and eutrophication are causing alteration of phytoplankton community structure and ecosystem service globally and locally such as in Long Island Sound (LIS). Consequences of these include harmful algal blooms and hypoxia, among others. As one of the major factors influencing phytoplankton dynamics, it is increasingly recognized that the nutrient factor is complex and its mechanistic is poorly understood. Highly diversified strategies phytoplankton have evolved to acquire nutrients in the dynamical and often imbalanced nutrient field and gain competitive advantages. Results from laboratory research and field studies in Long Island Sound will be presented to demonstrate some of the complexities of phytoplankton nutrition and trophic mode and explore the effects of nutrient conditions on phytoplankton and hypoxia in LIS.

SUNDAY, APRIL, 16

ORAL SESSION 4

Nutrient deficiency mediates the susceptibility of marine microalgae to 'zombification' by a bacterially produced quinolone. Hannah G Reich[1], Marley Gonsalves[1], Rachel Lewis[1], Cassidy Stadtfeld[1], Corinne Richard[1], Elizabeth L. Harvey[1], [1] Department of Biological Sciences, University of New Hampshire, Durham NH 03824

Symbioses between microalgae and bacteria contribute a considerable fraction of global CO_2 sequestration, and the ocean carbon pump. The interactions between the two are ubiquitous in the photic ocean, with environmental and biological forces regulating the outcomes of these symbiotic interactions. For example, global interactions between the cosmopolitan coccolithophore (*Emiliania huxleyi*) and bacteria (*Pseudoalteromonas piscicida*) are disrupted following bacterial production of algicidal compounds. The bacterially produced quinolone, HHQ (2-heptyl-4-quinolone), induces microalgal cell stasis and confers viral resistance with negligible impacts on photophysiology but at toxic levels, triggers cell lysis and ultimately cell death. It is possible that bacterial HHQ production and induction of coccolithophore cell lysis is incentivized during spells of nutrient limitation to acquire and consume nutrient-rich (algal) organelles. To evaluate how biogeochemistry alters coccolithophore resistance to HHQ production, axenic *E. huxleyi* (CCMP 2090) were exposed to media deplete of Iron, Zinc, Cobalt, Phosphorus, or Nitrogen and exposed to the pure HHQ chemical compound. Briefly, coccolithophore susceptibility to HHQ remained unchanged when grown in metal poor culture media. Surprisingly, coccolithophore resistance to HHQ improved for a short duration in Phosphorus deplete conditions (~1 day) and for longer spells in Nitrogen deplete conditions (4+ days). The capacity for nutrient deficiency to rewire cellular communication (or lack thereof) will be evaluated by paired metabolomics and proteomics of coccolithophore-bacteria co-cultures. Broadly, these results will provide information on the biogeochemical drivers of symbiosis success, algal blooms, and the ocean carbon pump.

A Comparison of Biofouling Adhesion by Field Sampled and Laboratory Cultured *Ulva* spp.

Kayla Kurtz[1], Lindsay Green-Gavrielidis[2], Lucie Maranda[3], Carol Thornber[4], & Vinka Craver[1]. [1]Department of Civil and Environmental Engineering, University of Rhode Island, Kingston, RI 02881, U.S.A; [2]Department of Biology, Salve Regina University, Newport, RI, U.S.A; [3]Graduate School of Oceanography, University of Rhode Island, Narragansett, RI 02881, U.S.A.; [4]Department of Natural Resources Science, University of Rhode Island, Kingston, RI, 02881, U.S.A.

Biofouling is a significant problem for long-term deployment of water quality sensors in marine environments. The marine algae *Ulva* spp. is commonly used as a model organism in biofouling experiments. This session presents a study using tubular *Ulva* spp. to compare the biofouling potential of several surface-enhanced Raman scattering (SERS)-based seawater sensors. In addition, prevention and removal of the zoospores from the SERS-based sensors using electric potential will be discussed. The findings from these biofouling studies provided quantitative insight into the biofouling capacity, attachment processes, and anti-fouling strategies for *Ulva* spp. zoospores on SERS-based sensors. However, limitations from relying on field samples were identified including uncertainty of species, seasonal variation, the inability to run experiments year-round, and a requirement to conduct studies in coastal regions with access to *Ulva* spp. for harvesting. To address these limitations, a follow-on study compared the biofouling potential of field sampled Ulva *spp*. with two species of laboratory cultured Ulva *spp.* The outcomes of this investigation have the potential to improve biofouling testing methods, enabling year-round experimentation independent of location.

KEYNOTE ADDRESS 2

OPPORTUNITIES, CHALLENGES AND FUTURE DIRECTIONS OF SEAWEED AQUACULTURE IN THE USA. Charles Yarish. University of Connecticut, Dept. of Ecol. & Evol. Biology, 1 University Place, Stanford, CT, 06901-2315. Woods Hole Oceanographic Institution, Applied Ocean Physics & Engineering Dept., 266 Woods Hole Rd. MS #34, Woods Hole, MA 02543, USA.

Global seaweed aquaculture production is approximately 30 million metric tons with an annual value of > $13.7 billion in 2020. In the past four hundred years, seaweeds have been very important part in Asian cuisine more so than in western cultures. Global seaweed aquaculture production occupies approximately 25% of total world marine aquaculture production by weight, with upwards of 97% being produced in Asia. Seaweed aquaculture production is dominated (> 81 % of total production) by several species: the brown kelp, *Saccharina japonica* and *Undaria pinnatifida*; and the red seaweeds including *Neopyropia/Pyropia/Porphyra* spp. ('nori' in Japanese and 'gim' in Korean), *Kappaphycus alvarezii* and *Eucheuma striatum* (carrageenophytes) and *Gracilaria/Gracilariopsis* spp. (agarophytes). Currently, more than 50,000 tons of seaweed have been cultivated in the Americas and Europe with an annual value of US $74 million. Although seaweed aquaculture is a relatively new industry in North America and Europe, the demand by western markets is expected to increase rapidly due to growing consumer demand for new protein sources, healthy food supplements, food industry's interest in sustainable textural additives and food security. With the nursery technologies developed at the University of Connecticut, the cold-water brown seaweeds, *Saccharina latissima* and *S. angustissima* have been successfully cultivated in open water farms in the Northeast. Our selectively bred kelp grew as much as 7.0 m in length and yielded up to 28 kg FW per meter after 6 months with a density of >400 plants per meter. Typical commercial yields are 4 to 8 kg FW per meter. Seaweed aquaculture provides ecosystem services by removing excess nutrients (carbon and nitrogen) from ecosystems and thereby improves water quality, potentially reducing ocean acidification and creating opportunities for carbon sequestration. Kelp aquaculture in Northeast America can remove up to 180 kg N and 1800 kg C per hectare per year, depending on the spacing of the longlines and cultivation arrays. After more than $60 million invested by the ARPA-E (US DOE) MARINER Program, seaweed aquaculture is developing new business opportunities in the US. With improvements in productivity, kelp and other farmed seaweeds continue to build significant value as foods for human consumption and could potentially be viable feedstocks for animal feeds, phycocolloids (including bioplastics) and biofuels. There are unique opportunities for phycologists to work with ocean engineers, plant breeders and others to develop and apply advanced breeding technologies that will increase growth and production for open water and land-based farm systems in the temperate and tropical waters of the US.

POSTER ABSTRACTS (Alphabetical by presenting author)

(1) Diversity of Aquarium-Fouling Coralline Crustose Algae. Benjamin Carolan[1], Abigail St. Jean[1] & Brian Wysor[1]. [1]Biology, Roger Williams University, Bristol, RI. **(President's Award)**

Crustose Coralline Algae (CCA) are common and beneficial constituents of reef tanks, where they reinforce reef structures, signify high water quality, and appeal to hobbyists for their vivid colors. In the wild, CCA are incredibly diverse, with an estimated 1600 species known, but little is known about those species that populate reef tanks. In this study, we used DNA barcoding to elucidate the species richness of aquarium-associated CCA. Specimens were sampled from professional and hobby aquarium systems to provide insight into the species richness of aquarium CCA. In this study we attempt to determine whether aquarium CCA are constituted by a small group of "aquarium-selected" species or whether CCA diversity is consistent with the source water that is local to the aquarium, or the source region of aquarium constituents. Preliminary *rbc*L findings reveal that RI field specimens of *Phymatolithon* are distinct from specimens taken from a flow-through aquarium system at Roger Williams University, but identical to a hobby aquarium in New Hampshire. The RWU specimen is closely related to, but genetically distinct from, a species described from Korea. Anticipated data from three additional aquarium systems should elucidate trends within the distribution of CCA species found within aquariums.

(2) UC-V, Sonication, Aeration, and Ozone Treatments to Maximize Remediation of *Microcystis aeruginosa* PCC7806 and its Toxin Microcystins. Dominique S. Derminio[1,2] & Jason Dean[2], [1]Keuka College, Keuka Park, NY 14478, [2]Eget Liber, Canastota, NY 13032

Cyanobacterial harmful algal blooms (cHABs) are common in many lakes across New York State and the world, *Microcystis aeruginosa* being one of the most prevalent toxin-producing species. Many cHAB remediations use biological organisms or chemicals that can also impact other non-cHAB species. However, Eget Liber has come up with novel treatments using a combination of UV-C, sonication, aeration, and ozone that only interacts with up to the first 10 centimeters of water to limit unwanted exposure to other species in the water column. In order to identify the most effective order of treatments to limit cyanobacterial concentration, UV-C, sonication, and ozone were each run alone, then in various order combinations to observe if treatment order matters. Samples were exposed to 80-seconds of each treatment method, then left under 50 µmol photons m^2 s^{-1} light for 13 days with 12 h dark: 12 hr light cycles. On each sampling day, *in vivo* chlorophyll samples and cell counts were completed. Most treatments showed a significant decrease in chlorophyll concentration levels and cells per mL for the first 6 days, the most significant decrease was by approximately 45% in the UV-C-ozone-sonication-ordered treatment. Toxicity was examined for total, intracellular, and extracellular microcystins after using sonication, aeration, and UV-C alone and in combination. Total microcystin concentration decreased when samples were exposed to 8-seconds of treatment by 40%. However, after each treatment method alone, intracellular microcystin concentrations decreased by 50% (all *p*-values were <0.001) and a combination of all three treatments decreased the concentration of intracellular microcystins by 90% ($p < 0.0001$). This study will improve the fundamental understanding of how *Microcystis aeruginosa* responds to potential remediation methods in the field in the future without adding lasting chemicals into the water column.

(3) New or old: Can paleolimnological methods be used to trace the arrival of nuisance stalk-forming diatoms in rivers. Katherine L. Doiron[1, 6]; Reilly Stiefel[2]; Diba Khan-Bureau[1, 2]; Peter Siver[3]; Paul Hamilton[4]; William Ouimet[5]; Louise A. Lewis[2]. [1]Three Rivers Community College, Norwich, Connecticut, 06360, USA; [2] Department of Ecology & Evolutionary Biology, University of Connecticut, Storrs, Connecticut, 06269, USA; [3]Botany and Environmental Studies, Connecticut College, New London, Connecticut, 06320, USA; [4]Canadian Museum of Nature, Ottawa, Ontario, Canada; [5]Department of Geosciences, University of Connecticut, Storrs, Connecticut, 06269, USA; [6]Department of Natural Resources and the Environment, University of Connecticut, Storrs, Connecticut, 06269, USA

In recent years nuisance stalk-forming diatoms are believed to have been widely recognized for their prolific blooms with thick mats of long filamentous stalk material causing adverse conditions to rivers ecosystems worldwide. These conditions include the deterioration of habitats, loss of biodiversity, and significant negative impacts on the sport fishing industry. Since 2012, three especially problematic and nuisance stalk-forming species are now regularly seen growing in the West Branch Farmington River in Connecticut, U.S.A.: *Cymbella janischii*, *Didymosphenia hullii*, and *Didymosphenia geminata. Didymosphenia* taxa are known to grow in stable flowing, oligotrophic waters. These conditions are enhanced with the regulated release of cold bottom, hypolimnetic water from lacustrine waterbodies into the river, which is the case for the West Branch of the Farmington River. Our project used coring, and morphological analysis of sedimented cells, to determine whether these taxa historically have been present in the river, but rare, or represent new arrivals. Coring has been widely used to examine paleo-records of diatom frustules from lakes, though this approach has not been frequently employed in rivers due to challenges of flow and sedimentation. In 2020-2022, gravity coring and vibracoring was used to successfully retrieve sediment samples from the river, which are now the subject of microscopic examination. This work may provide enough information to determine the historical extant of these stalk-forming diatoms in Connecticut.

(4) First Insights into Green Algae from New Mexico Soils. Karolina Fučíková[1], Victoria Williamson[1], Cameron Choquette[1], David Bustos[2] & Nicole Pietrasiak[3,4]. [1] Biological and Physical Sciences, Assumption University, Worcester, MA, 01609, U.S.A.; [2] U.S. Department of the Interior, White Sands National Park, Holloman AFB, NM, 88330, U.S.A.; [3] School of Life Sciences, University of Nevada - Las Vegas, Las Vegas, NV, 89154, U.S.A.; [4] Plant and Environmental Sciences, New Mexico State University, Las Cruces, NM, 88003, U.S.A.

Microscopic green algae are severely understudied, compared to their plant relatives. Terrestrial algae inhabiting gypsum substrates are especially poorly understood. Our study was the first to

investigate the diversity of green algae in the gypsum soil crusts of White Sands National Park (WSNP). In addition, we characterized new algal isolates from another desert area, the Organ Mountains-Desert Peak National Monument (OMDP). We used a combination of light microscopy and DNA barcoding to classify the newly obtained algal strains. We also conducted an experiment to determine whether strain isolation could be aided by the addition of anhydrite to the growth media. We isolated 24 green algal strains, spanning twelve genera in two classes. There was no overlap in taxa between localities or samples. The most common taxon was *Bracteacoccus minor*, a species with a near-worldwide distribution. The WSNP samples also harbored two genetically unique algae from the family Oocystaceae, which may represent species new to science. The OMDP samples were overall more diverse than the WSNP material and contained species belonging to common soil-dwelling genera. Our growth experiment did not support our hypothesis – the growth of colonies was significantly inhibited by the addition of anhydrite to culture media. Overall, our study shows high potential of novel biodiversity in the soil crusts of New Mexico. Additional sampling and isolation will likely reveal more algal diversity in both localities and will further enrich our knowledge of the New Mexico microflora, which to date remains largely unknown.

(5) Patterns in Cyanobacteria Abundance and Microcystin in Lakes of the Pocono Region.
Aloura Gavalis[1], Sarah Princiotta[1], & Beth Norman[2]. [1]Department of Biology, Pennsylvania State University Schuylkill, Schuylkill Haven, PA, 17972, USA. [2]Lacawac Sanctuary, Lake Ariel, PA, 18436, USA. **(President's Award)**

Proliferations of cyanobacteria pose serious risks to water quality worldwide, especially in Northeastern Pennsylvania where inland waters act as a highly valuable natural resource. This is of critical concern given that tourism associated with recreational lakes provide the economic backbone for the region. Production of toxins associated with cyanobacteria blooms (cyanotoxins) have gathered attention in the public health realm as wildlife mortality and human illnesses have been linked to contact with impaired waterways. In 2021, we used a monthly "snapshot survey" approach to monitor fourteen recreational lakes in the Pocono Plateau with the purpose of elucidating both biological and abiotic drivers of bloom events. ELISA immunoassays were used to quantify the concentration of microcystin-LR and phytoplankton community structure, including cyanobacteria, were assessed by microscopy on Lugols-fixed samples. Concentration of microcystin-LR during the study period in all lakes ranged from undetectable to 0.28 µg L^{-1}. MC-LR was above the detection limit on at least one sampling date in nine of the fourteen lakes studied. In lakes with detectable MC-LR, cyanobacteria represented a significantly greater proportion of the phytoplankton population in September and October as compared to July. Cyanobacteria taxa were observed in all lakes and within all sampling points. However, relative abundance of cyanobacteria was not strongly related to the concentration of MC-LR, and lakes with a higher concentration of cyanotoxin did not always have a greater relative abundance of cyanobacteria.

(6) Using Barcoding loci to evaluate species relationships in two populations of *Eisenia arborea.* Katherine Haines & Naomi Phillips. Biology, Arcadia University, Glenside, PA, 19038, U.S.A.

In benthic coastal marine environments, brown algae form one of the largest and most ecologically important groups of primary producers, but evolutionary relationships among the various lineages remain elusive. Previous research on populations of *Eisenia arborea* that had significant phenotypic plasticity theoretically tied them to hydrodynamically different environments. This suggested that incipient speciation had occurred between these distinct populations. As genetic analysis techniques improved, more precise methods for measuring incipient speciation were developed (e.g., through Next Generation Sequencing [NGS]). The focus of this study was twofold: to determine whether the results demonstrated that Next Generation Sequencing was a cost and time-effective method of genetic analysis enabling future expanded studies and to address if the two morphologically distinct populations were in fact two species. Using a combination of Sanger sequencing and NGS of four barcoding loci, gene alignments were built for phylogenetic analysis. Phylogenetic analyses of gene alignments clearly confirmed that NGS (alone or in combination with Sanger) can be used to barcode populations and examine speciation events. Results also showed more diversity than expected, strongly suggesting three diverging clades. The results underscore that algal communities remain poorly studied and contain significant variation. Using metabarcoding techniques, as demonstrated here, may help unravel this cryptic diversity.

(7) A Preliminary Report on the Characeae of Maryland. John D. Hall[1], Victoria D. Davis[2] & Kenneth G. Karol[2]. [1]Plant Science and Landscape Architecture, University of Maryland, College Park, MD, 20742, U.S.A.; [2]The Lewis B. and Dorothy Cullman Program for Molecular Systematics, New York Botanical Garden, Bronx, New York, 10458, U.S.A.

The state of Maryland, United States of America, is a geographically small but geologically diverse state. It spans the physiographic provinces of the Atlantic Coastal Plain, Piedmont, Ridge and Valley and the Appalachian Plateau. Characeae (Charophyceae, Charophyta) are macroscopic green algae that have been found in freshwater and brackish habitats in each physiographic province of Maryland. Approximately 30 species of Characeae have been reported from Maryland. In this study, we reviewed herbarium specimens and recent collections of Characeae from across Maryland and the District of Columbia. Specimens were identified by microscopy and – where possible – DNA sequence analysis. To date, we have confirmed the presence of 22 species with 18 confirmed by DNA sequences. The diversity and distribution of Characeae in Maryland is summarized. In addition to the many freshwater habitats in Maryland, our findings suggest that the brackish waters of the Chesapeake Bay may be an important but poorly understood habitat for Characeae on the East Coast.

(8) Analysis of LightDeck Biosensor for Cyanotoxins in Freshwater Samples. Sydney Hall[1] & Gregory L. Boyer[1]. Department of Chemistry, State University of New York, College of Environmental Science and Forestry, Syracuse, NY, 13210, U.S.A.

Harmful algal blooms are a severe expanding problem due to anthropogenic eutrophication and climate change stressors. Freshwater cyanobacterial blooms can produce cyanotoxins such as microcystins, anatoxins, cylindrospermopsins, and saxitoxins. These cyanotoxins have negative impacts on human health. The conventional methods for determining the concentration of these cyanotoxins in a water sample require a sample to be collected and returned to the laboratory for analysis. There is a need for a mobile detection system that can provide results in near-real-time. An innovative planar waveguide biosensor was developed by LightDeck to meet this need for easy, mobile, and quick cyanotoxin detection. Here we report on a side-by-side comparison of this new technology with traditional LC-MS/MS monitoring techniques. Samples were collected at biweekly intervals by citizen volunteers from two lakes in Central New York (Lake Canandaigua and Lake Chautauqua) and submitted to the laboratory for analysis. Both lakes experienced harmful algal blooms in 2022 that contained measurable amounts of microcystins. The LightDeck system is capable of detecting microcystin (0.5-4.0 ug/L), cylindrospermopsin (0.7-3.0 ug/L), and saxitoxin (0.6-2.0 ug/L). However, no neurotoxins were found in either lake during 2022. A comparison of the microcystin results will be presented. Further studies will include field deployment of these sensors and a rapid monitoring system for cyanotoxins.

(9) Cellular takeover: how do neoplastic red algal parasites manipulate their host?
Gabrielle M. Kuba[1] & Christopher E. Lane[1]. [1]Department of Biological Sciences, University of Rhode Island, Kingston, RI, 02881, U.S.A. **(Trainor Award)**

Eukaryotic pathogens have evolved from photosynthetic ancestors in several major lineages across the tree of life. Understanding these processes has been difficult because of the barriers in finding closely related free-living lineages to compare directly with parasite lineages. Florideophyceaen red algae have offered a unique model to investigate the genetic relationships between host and parasite lifestyles. Parasitism has independently evolved over 100 times in red algae and in a variety of relationships; infecting closely related sister species (neoplastic) and more distantly related species (archaeplastic). Common traits of red algal parasites include the lack of or lessened pigmentation, reduced morphologies, and secondary pit connections that connect host and parasite cells. Preliminary data on archaeoplastic parasites has suggested gene loss in plastid genomes, however, whether this is a cause or a consequence of parasite evolution is unclear. Further investigation of this lifestyle transition is needed, especially in neoplastic parasites. Long read, high throughput sequences, generated using Oxford Nanopore Technologies, offer an opportunity to better understand the genomic differentiation that occurs between host and parasite sister species. Parasite DNA will be isolated via nuclei isolation from mature infections and separated from host contamination using nuclei separation gradients. This study will build on our preliminary genomic data from a single red algal parasite by producing high quality genomes from novel host

/ parasite pairings. Red algal parasites, regardless of their infection pathway, have identified mechanisms to alter the host and allow for propagation. By producing multiple parasite genomes, we will create a map of gene and pathway losses in parasites, as well as identify gene family expansions or possible gene transfers.

(10) Inducing Reproductive Development and Spore Release in Tubular *Ulva*. Sara Labbe[1], Cailin Martin[1], Danielle Moloney[1], Vinka Craver[2], Kayla Kurtz[2], Lucie Maranda[4], Carol Thornber[3] & Lindsay Green-Gavrielidis[1]. [1]Department of Biology, Salve Regina University, Newport, RI, U.S.A; [2]College of Engineering, University of Rhode Island, Kingston, RI 02881, U.S.A; [3]Department of Natural Resources Science, University of Rhode Island, Kingston, RI, 02881, U.S.A; [4]Graduate School of Oceanography, University of Rhode Island, Narragansett, RI 02881, U.S.A. **(President's Award)**

Ulva are a ubiquitous, major contributor to biofouling communities. Biofouling, or growth of organisms on surfaces, impacts the functionality of marine sensors and technologies. *Ulva* has an isomorphic alternation of generations from a diploid sporophyte that produces quadriflagellate zoospores to haploid gametophytes that produce biflagellate gametes. Quadriflagellate zoospores of *Ulva* are used as a model organism in biofouling studies and can be used to screen anti-biofouling materials. The goal of this study was to develop a protocol for on demand development and release of *Ulva* zoospores to offset issues with relying on field collection. We quantified the effects of temperature shock, photoperiod, and nutrients on spore release in tubular *Ulva*. Thalli were exposed to a 4°C temperature shock (1 hour) while submerged in ambient seawater or seawater with additional nutrients. Specimens were subsequently placed under a 12:12 (neutral) or 16:8 light: dark (long day) photoperiod at 20°C. *Ulva* placed under long day conditions with nutrients had the highest rate of reproductive development (30%), with 17% of specimens releasing spores 48 hours following the temperature shock. These methods were used to induce mass spore release in tubular *Ulva* for use in biofouling trials on two separate dates with a 68.5% and 50% success rate; more than 50 million spores were produced from laboratory cultured material during these trials. Here, we present a simple, easily replicated protocol for on demand production of *Ulva* spores from wild collected or laboratory cultured specimens that can be used in experimental or aquaculture settings.

(11) Freshwater red algal diversity in Michigan. Gabriella Lindsey[1], Roseanna Crowell[1], Sarah Shainker-Connelly[2], Alexis Oetterer[2], Brinkley Thornton[2], Stacy Krueger-Hadfield[2], Morgan Vis[1]. [1]Environmental and Plant Biology, Ohio University, Athens, OH, 45701, U.S.A.; [2]Biology, University of Alabama at Birmingham, Birmingham, AL, 35294, U.S.A. **(President's Award)**

Michigan has abundant freshwater habitats, including lakes, streams, ponds, and rivers. These habitats are ideal for freshwater red algae and there are numerous herbarium records, though literature reports are few. Approximately 60% of herbarium records are >20 years old. Recent collections are from a small geographic area and only five specimens have associated DNA sequences often needed for accurate species identification. Therefore, we surveyed broadly in the

Upper and Lower Peninsula, revisiting previously sampled sites and exploring new localities. In total, freshwater red algae were collected from 19 sites in May 2022. These sites varied from small streams, rivers, and lake inlet/outlets with a corresponding range in water temperature (7.5-24°C), pH (5.5-8.6) and conductivity (19 to 740 $\mu S.cm^{-1}$). Four genera were collected, *Batrachospermum*, *Paludicola*, *Sheathia* and *Virescentia*, with species identifications verified with *rbc*L gene sequence. *Sheathia* was the most abundant (15 sites) with *Sheathia grandis* in 10 sites and *Sheathia involuta* in five. *Batrachospermum gelatinosum* was present in seven sites. *Paludicola communis* and *Virescentia viride-americana* were collected in one site each. From the literature and herbarium records, the four genera are previously known from the state. This study provides the first *rbc*L sequence for *Batrachospermum gelatinosum* and *Paludicola communis* in Michigan. In 1992, *Virescentia viride-americana* was first collected at Fleming Creek and we confirm its presence 30 years later. Previously, *Sheathia involuta* was reported from one location in Michigan but we have added to its known distribution. *Sheathia grandis* was described in 2014 from two locations in Wisconsin and Ohio. This study is not only the first report in Michigan, but has added considerably to the known locations. This survey has yielded new records, species identification with DNA sequence, and expanded habitat information.

(12) Siderophore utilization by *Amphidinium carterae* as an adaptive strategy to iron limitation. Sydney McDonald, Felipe Porto, Senjie Lin, & Julie Granger. Oceanography, University of Connecticut, Groton, CT, 06340, U.S.A. **(Trainor Award)**

Iron is a limiting nutrient for primary production in 30% of the global ocean. Dinoflagellates thrive in a wide variety of coastal and oceanic environments, including iron-limited regions. As iron is a biologically essential element for the growth and proliferation of marine algae, dinoflagellates may have evolved adaptive mechanisms to combat iron limitation. Presently, these mechanisms have been scantly investigated. Here, we compare the growth response of the well-studied diatom *Thalasiossira weissflogii* to that of the model dinoflagellate *Amphidinium carterea* to different iron conditions: (a) iron-replete, (b) iron-limited, and (c) iron-limited medium supplemented with the siderophore Deferoxamine B (DFB). Preliminary observations suggest that *A. carterae* is able to assimilate iron bound to DFB. Transcriptome analysis will reveal whether *A. carterae* possess genes transcribing TON B dependent receptors associated with iron-siderophore transport in prokaryotes. A more comprehensive understanding of dinoflagellate adaptation to low iron conditions is key to understanding the biogeochemical dynamics of these regions.

(13) The Effect of Photoperiod, Light Level, and Temperature on the Growth of Wildemania amplissima (Kjellman) Foslie. Riplee Mercer & Chris Neefus. Department of Biological Sciences, University of New Hampshire, Durham, NH, 03824, USA.

Over the past decade, the macroalgae industry along New England's coastline has greatly expanded. With production being predominantly dominated by kelp, the goal of this research is to diversify New England's aquaculture industry by introducing new methods of grow-out for the red alga Wildemania amplissima, a local nori species. Initial objectives were to establish optimal

laboratory culture conditions for growth of the conchocelis phase and to determine conditions that would trigger production and release of conchospores. Laboratory cultures were established through the collection of fertile blades at the end of spring near intended grow-out trial sites. Two methods were used for collecting zygotospores. One method involved collecting released zygotospores under a dissecting microscope using a drawn-out glass pipette. The second method macerated fertile portions of blades in a blender, which were then sieved through several mesh sizes and poured over sterilized oyster shells. To determine optimal culture condition for conchocelis, 12-well plates were placed in culture chambers under 12 combinations of photoperiod (12L:12D and 16L:8D), temperature (10, 14, and 18 ^{o}C), and light (30 and 60 umol/m2/s). The experiment ran for 7 weeks. Growth rate was calculated through area change by way of image analysis in each well, using images captured each week and the software ImageJ. It was found that only light level had a significant effect on conchocelis growth with a 50% increase in growth rate at 60 umol/m2/s compared to 30 umol/m2/s ($p<0.0042$).

(14) The Next Era of Lichen Photobiont Systematics: Validating *Trebouxia* Target Capture Baits. Zachary Muscavitch, Bernard Goffinet, & Louise Lewis, University of Connecticut, Ecology and Evolutionary Biology, Storrs, CT, 06269 USA. **(President's Award)**

Despite the inherent duality of lichens, research into lichen symbionts has been largely asymmetric with little attention paid to lichen photobionts. The most common lichen photobionts are the green algae in Trebouxiales, which associate with approximately 90% of known lichen forming fungi. These algae can be tricky to culture and have a small number of morphological traits by which to delimit taxa, thus molecular tools have been increasingly employed for photobiont systematics. In the past decade, several novel genera in Trebouxiaceae have been identified and evidence of >100 estimated new species of *Trebouxia* s. str. is mounting from recent molecular systematic work. Advances in genomic sequencing technologies and phylogenomic methods offer promise for reconstructing evolutionary relationships among symbionts, but conventional phylogenomic studies can be problematic because of the low biomass (and DNA) of algae compared to fungi in a lichen. Therefore, many studies have primarily employed Sanger sequencing of barcoding loci for systematic analyses, even though phylogenetic analyses focusing on one or two loci may fail to adequately resolve cryptic species. To overcome these methodological hurdles and assess the hypothesis of cryptic diversity in lichen photobionts not resolved by ITS, we designed custom target capture baits for 260 green algal loci. The baits were designed for *Trebouxia* Clade A from a combination of genomes and transcriptomes, and they work by hybridizing regions of genomic interest to custom RNA probes. The baits have been recently validated for *Trebouxia* Clade A, with reads from those taxa mapping to an average 98% of the target loci. Reads obtained from other *Trebouxia* species as well as other Trebouxiaceae genera appear to be compatible with these target capture baits. This is the first successful application of target capture on Chlorophyta adding a valuable tool to our arsenal to study lichen photobionts.

(15) Screening Water from Seaweed Blooms for Allelopathy. Samantha Parsons, Danielle Moloney, Isabella Ares & Lindsay Green-Gavrielidis. Department of Biology & Biomedical Sciences, Salve Regina University, Newport, RI 02840, U.S.A. **(President's Award)**

As climate change alters our ecosystems, we are seeing an increase in macroalgal blooms across Narragansett Bay and surrounding waters. Blooms occur when there is intense growth in free floating species of macroalgae which can be attributed to excess nutrients and/or decreased herbivory. Blooms have the potential to alter seawater chemistry and soil biogeochemistry, as well as harm the communities of organisms that reside in affected waters. *Ulva* is a group of prominent bloom-forming green macroalgae that release allelopathic compounds that have been linked to the inhibition of other macroalgal growth and mortality in larval oysters. To determine if a bloom is actively releasing allelopathic compounds, we developed a laboratory assay using phytoplankton species. Two phytoplankton species were cultured: *Dunaliella tertiolecta,* a biflagellate green microalga, and *Skeletonema costatum*, a diatom. Bloom-water was collected from an active bloom event (n=10) and brought to the lab where it was processed. Water was left in its "raw" condition or pasteurized to eliminate viruses and diluted before adding nutrients and phytoplankton cultures. Growth of phytoplankton was tracked daily for 14 days using optical density and verified via cell counts. We found that field collected bloom water had a slightly inhibitory effect on *D. tertiolecta* growth; pasteurization did not alter the observed trends indicating that viruses were not responsible for depressed growth. In contrast, pasteurization tended to have a positive impact in *S. costatum* trials, where we also observed a slight inhibitory effect of green tide toxins. These results suggest that the elimination of marine viruses appears to support the growth of *S. costatum*. Future research will repeat these experiments in a second field season and include an assessment of whether time of day plays a role in the allelopathic effects of *Ulva* blooms on phytoplankton growth.

(16) Culturing freshwater Chlorophyta to Restore *Daphnia magna* Populations at Lake Waramaug, CT. Maria Rodriguez-Hernandez[1], Edwin Wong[1], Theodora Pinou[1]& Laurence Marsicano[2]. [1]Biology, Western Connecticut State University, Danbury, CT, 06810; [2]Aquatic Ecosystems Research, LLC & Adjunct Faculty in Biology Department, Western Connecticut State University, Danbury, CT, 06810. **(Trainor Award)**

The *Daphnia magna* diet varies over a wide range of different Chlorophyta. *Chlorella vulgaris* and *Scenedesmus spp.* were cultured for *Daphnia magna* to graze on in upcoming experiments. *Scenedesmus spp.* commonly grows in linear two- to four-cell colonies and grew exponentially in the following conditions: 12/12 light/dark cycle, 22°C, filtered Lake Waramaug water, Algal-Gro® Concentrated Medium, and in either 125mL or 500mL Erlenmeyer flasks. *Chlorella vulgaris* grows as a unicell or form clusters of cells; *Chlorella vulgaris* was able to grow in the same conditions as the *Scenedesmus spp.*, but not rapidly. Differences in growth may be due to the size difference between the two algal species; *Chlorella vulgaris* was on average 9.3µm in diameter while *Scenedesmus spp.* was on average 20.8µm in diameter. The larger *Scenendesmus spp.,* which had a larger surface area, flourished in the 500mL Erlenmeyer flasks reaching concentrations of tens of thousands of cells/mL. *Chlorella vulgaris* grew better in the 125mL Erlenmeyer flasks. It took approximately 2 months for the *Chlorella vulgaris* to reach thousands of cells/mL, while it took approximately 2 weeks for the *Scenedesmus* to reach the same populations. We surmise that cell surface area relative to flask size may play a role in growth rates of the two species. Furthermore, *Chlorella vulgaris* showed a yellowing discoloration over time, we surmised that a high light intensity had a negative effect on the cells. A change from 12/12 light/dark cycle to an 8/16 light/dark cycle was made to resolve this issue. We intend to modify culturing methods for *Chlorella vulgaris* to increase growth, for example using a different growth medium and increasing aeration within the flasks to provide a more ideal environment.

(17) Remediation of *Karenia brevis* in Culture Using UV-C, Sonication, Aeration, and Ozone

Devyn, Scheidt[1], Dominique S. Derminio[1,2], & Jason Dean[2] [1]Keuka College, Keuka Park, NY 14478, U.S.A [2]Eget Liber, Canastota, NY 13032, U.S.A. **(President's Award)**

Red tides are a common occurrence in the Gulf of Mexico where there is a high concentration of the harmful marine alga *Karenia brevis.* This dinoflagellate can produce brevetoxins that can cause severe impacts on natural resources, marine life, and public health. Methods for red tide mitigation have been studied, but few resources have been put towards remediation. However, Eget Liber has come up with a novel treatment using UV-C, sonication, aeration, and ozone that only interacts with contained water to limit unwanted exposure to other species in the water column. After the cultures were exposed to 8 seconds of each treatment method alone and in various combinations, samples were kept in an incubator under 50 µmol photons m^2s^{-1} for 14 days with 12 h dark: 12 hr light cycles. Samples were analyzed for chlorophyll concentration and cell counts over the course of the *K. brevis* growth cycle. The various combinations of UV-C, sonication, and aeration decreased cell counts between 65% and 85% after 5 days. After 14 days, the UV-C/sonication/aeration treatment still showed a significant decrease in chlorophyll concentration by 60%. Cell count data correlated with chlorophyll concentrations until *K. brevis* entered the stationary phase and clumping began to occur in cell counts making the chlorophyll data more ideal for later lifecycle analysis. This study will improve the fundamental understanding of how *Karenia brevis* responds to potential remediation methods in the field in the future.

(18) The impact of thiamin (B1) and its precursors on microzooplankton-phytoplankton interactions Sara Smith**,** M.S. Student in Marine, Estuary, and Freshwater Biology, University of New Hampshire **(Trainor Award)**

Phytoplankton are marine microalgae that compose the basis of the oceanic food web, and significantly influence the flow of essential nutrients throughout marine ecosystems. In particular, phytoplankton have been implicated in the cycling of thiamin (B1) and its components 4-methyl-5-thiazoleethanol (HET) and 4-amino-5-hydroxymethyl-2-methylpyrimidine (HMP). These compounds are essential to many marine microbes but are found in relatively small concentrations (<500 pM) throughout the earth's oceans. Despite the importance of these vitamins in fueling marine microbial growth, very little is understood regarding their sources and sinks. To better understand the impacts of vitamins on phytoplankton growth and interactions with microzooplankton grazers, 20 dilution experiments spiked with additions of B1, HET, or HMP were conducted. These were performed across seasons between February - September 2022 at the Judd Gregg Marine Research Complex Pier located in New Castle, New Hampshire. Changes in bulk chlorophyll concentration and size-specific growth, as well as growth and grazing rates, were calculated. Results were ultimately variable while remaining within a typical range for coastal Atlantic waters, indicating interactions driving vitamin cycling are much more nuanced and highly dependent on community composition.

(19) Uncovering new depths of hidden algal diversity and geographic distribution within fog desert lichens. Reilly Stiefel[1], Zachary Muscavitch[1] & Louise A. Lewis[1], [1] University of Connecticut, Ecology and Evolutionary Biology, Storrs, CT, 06269 USA.

Lichens play a key role in the energy transfer in ecosystems around the world, but the algal partner (photobiont) in this fungi-algae mutualism is poorly known despite its role as primary producer within lichen thalli. Despite the one alga one fungus paradigm, multiple unique species of algae may coexist within a lichen thallus enhancing the "fitness" of the association, however these 'hidden' symbionts largely escape scientific scrutiny. Little is known about the geographic distribution of lichen photobionts, but the identity of these photobionts likely changes along ecological and geographic gradients within or among lichen species. Further, extreme environments gradients such as those in deserts may exhibit high species turnover. We will test the hypothesis of species turnover and identify the 'hidden' algae using lichens growing in fog deserts on the west coast of North America. We will characterize the lichen photobionts and the associated symbionts within fog lichens using amplicon sequences of ITS1 in the ribosomal array, a common barcoding locus. Sequence data will be derived from pooled metagenomic extracts of lichens present in sympatric lichen communities. These data will be used to compare the associated algal diversity within and across lichen communities and test our previous understanding of photobiont diversity and geographic distributions.

(20) Species diversity and phylogenetic context of rhodolith-forming coralline red algae in recently discovered Haida Gwaii rhodolith beds. Keelie Taylor & Gary Saunders. Biology, University of New Brunswick, Fredericton, New Brunswick E3B 2T5, Canada. **(Trainor Award)**

Rhodoliths are a specific morphological type of crustose coralline red algae that live unattached to the sea floor. As ecosystem engineers, they form extensive beds that support highly diverse benthic ecosystems, which further serve as important nursery habitats and factories for carbonate production. Despite their scientific and economic importance, there is little accessible knowledge on rhodolith beds in the NE Pacific, particularly in British Columbia. However, rhodolith beds are under threat by both climate-related changes, such as sea temperature rise and ocean acidification, and human-induced disturbances like dredging and fouling, all of which threaten bed health and stability. Consequently, it is critical to have species diversity data that can be used to monitor bed decline and to act as the baseline for conservation and restoration projects. Recently, several rhodolith beds have been identified in Haida Gwaii, which is a known biodiversity hotspot. This

project uses both molecular and morphological data to assess the diversity of rhodolith species in three Haida Gwaii beds (Murchison/Faraday Island bed, Hotspring Island bed and Tanu, Tanu Island bed). Unique genetic groups identified as part of these diversity surveys are being placed into a phylogenetic context with other coralline algae using multigene analyses to understand their evolutionary relationships. In addition to providing foundational data on rhodoliths in BC, this study provides insight into the relationship between rhodoliths and their likely source species among the crust-forming coralline algae both in phylogenetic and ecological contexts.

(21) What are you holding onto? Holdfast morphological variation in *Saccharina latissima*.
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Hapteral holdfast are responsible for anchoring kelp to their substrate. This important function has been affected traditionally by biotic and abiotic factors (*Modiolus modiolus, Mytilus edulis*, turf macroalgae and wave exposure) increasing the likelihood of dislodgement. One recent artificial area of attachment and of interest for aquaculture is twine/rope. Here we examine morphological characteristics of kelp holdfasts collected *in situ* at Fort Wetherill, Jamestown, RI, and provided to us from New England Sea Farms (Guilford, CT). Specifically, the number of bifurcations, stipe diameter and weight of holdfasts from three natural attachment substrates (rock, turf algae, and grouped), and one artificial substrate (twine/rope for aquaculture). All kelp holdfasts characteristics examined were statistically similar when attached to rock or twine/rope substrates but both differed significantly from those attached to turf habitats or attached in a group of holdfasts. We conclude that kelp grown in aquaculture on twine/rope maintains the most natural aspect of the kelp hapteral holdfast as they were most similar to those collected from their natural rock substrate.

(22) Let's get to the bottom of it: An evaluation of methods used to estimate benthic cyanobacteria biomass in lakes and their relationship to toxicity.
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Blooms of benthic cyanobacteria are understudied despite their increased proliferation in lakes and their potential to produce harmful cyanotoxins. Most methods for estimating cyanobacteria biomass are developed for planktonic cyanobacteria (i.e. measuring chlorophyll-*a*), and it is not known if these methods are appropriate for benthic cyanobacteria. Here we compare traditional methods of estimating cyanobacteria biomass (in vitro fluorescence of the pigments chlorophyll-*a*, phycocyanin, and phycoerythrin) with an in situ fluorometric tool (the bbe BenthoTorch) and explore these relationships across nearshore sites in two temperate lakes differing in nutrient availability, light attenuation, and cyanotoxin detection in periphyton. This study involved the deployment of artificial substrates to assess attached cyanobacteria communities and gain insights into their development, composition, and toxicity. Through the summer, we observed an increase in the proportion of cyanobacteria and a decrease in that of green algae in periphyton from both lakes. Attached cyanobacteria were always detected at each site by the bbe BenthoTorch. Toxin analyses showed detectable microcystin in periphyton of the mesotrophic lake only, though its source is not confirmed. Updated pigment and cyanotoxin analyses will be discussed here as well as future natural substrate sampling methodology. We expect that phycocyanin and phycoerythrin (at sites with limited light) will be better predictors of benthic cyanobacteria biomass and toxicity than chlorophyll-*a*, as these periphyton communities are diverse in algal groups. This research contributes information necessary to determine a pragmatic monitoring method for benthic cyanobacteria and improve our understanding of their presence and potential to produce harmful toxins in the Finger Lakes.

(23) Expanding the light-nutrient hypothesis to natural stream communities and conditions.
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The light-nutrient hypothesis has attempted to tease apart the relative importance of either photosynthetically relevant light or nutrient ion availability to determining algal growth within aquatic systems. This study represents a novel investigation using naturally occurring gradients of both light and nutrients on periphytic algae over a large geographic (Ozark Mountains), namely through the measurement of fatty acid production. This study further investigates the effect of both light and nutrients on macroinvertebrate functional feeding groups' fatty acid content. Periphytic algae and macroinvertebrates were collected from streams through the Ozarks in August and September of 2019. Fatty acid content was measured using gas chromatography and calculated based on the mass of the individual organisms, or by volume for algal samples. Initial findings suggest that periphytic algal fatty acid production is negatively affected by light and phosphorous availability. This was true for total fatty acid content (light: $r = -0.304$, $P = 0.050$; phosphorus: $r = -0.369$, $P = 0.016$). Nitrate availability positively influence fatty acid content ($r = 0.322$, $P = 0.038$). Collecting macroinvertebrates also showed a number of significant relationship to light and nutrient availability but in different ways. Positive relationships were observed compared to phosphorus availability ($r = 0.400$, $P = 0.019$) while negative relationships were observed compared to light ($r = -0.341$, $P = 0.048$) and nitrate ($r = -0.322$, $P = 0.063$). Other functional feeding groups did not have their fatty acids affected by light or nutrient availability, which suggests that these organisms have more stable physiological parameters of various fatty acids. Overall this study demonstrates the complexity of organism biochemistry as a response to both light and nutrient availability and indicates that these reactions can be far more nuanced than previously simplified studies suggest.

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