University of New England
College of Arts and Sciences

SUMMER UNDERGRADUATE RESEARCH EXPERIENCE SYMPOSIUM

UNIVERSITY OF NEW ENGLAND
INNOVATION FOR A HEALTHIER PLANET

Saturday • October 2, 2021

RESEARCH AT UNE

On behalf of the UNE College of Arts and Sciences, welcome to the 2021 Summer Undergraduate Research Experience (SURE) Symposium! This annual event features the work of over 30 students that have performed research during the summer at our home campus in Biddeford and regions throughout the northeastern United States. Over the summer, our students worked closely with dedicated faculty to build on the knowledge they have acquired through their coursework, to explore advanced realms of understanding, and to prepare for continued study in their fields.

Students from disciplines ranging from chemistry and marine science to applied social and cultural studies and environmental science have spent their summer investigating a diverse array of research questions, including:

- *Are microplastics vectors for pathogen contamination of edible seaweed?*
- *How are poverty rates, race, and population density related to prevalence and mortality rates of COVID-19 within Maine's counties?*
- *What factors contribute to the increased warming of the Gulf of Maine?*
- *What is the neurological basis for the relationship between neonatal care and anxiety later in life?*

These projects are the basis for future scholarly work in the field of research through articles, presentations, manuscripts, and more.

Please join us in celebrating the hard work, dedication, and creativity of our students and learning more about their fascinating projects. We hope you enjoy your day!

Amy Keirstead, Ph.D.
Associate Dean and Associate Professor of Chemistry
College of Arts and Sciences

SCHEDULE

Saturday, October 2, 2021 | 9 – 11 a.m.
Alfond Center for Health Sciences Lobby

9 – 11 a.m. | Poster Presentations

10:20 a.m. | Remarks

Jonathan Millen, Ph.D.
Dean, College of Arts and Sciences

Aubrey Sahouria (Neuroscience, '21)
President, Research Experience Club

Karen Houseknecht, Ph.D.
Associate Provost for Research and Scholarship

PRESENTATIONS

LEGEND

2. Ecosystem Services of Seaweed Aquaculture off the Gulf of Maine

Student Author(s)

Emilly Schutt, M.S. '22, Hannah Korper '22, Elena Shippey '22, Salma Bezzat '23 | *Carrie Byron, Ph.D.*

Faculty Advisor(s)

Abstract

While natural kelp forests are declining in the Gulf of Maine due to climate change, there is also a decline in the ecosystem services they provide. Ecosystem services include material and non-material benefits people obtain from the environment. A possible way to assist in providing these services is through seaweed aquaculture. The supporting service habitat creation will be quantified to assess what large mobile commercially important fish and crustaceans are interacting with the kelp farms.

Funded by

The Nature Conservancy, Maine EPSCoR

PRESENTATIONS

1. How does microplastic concentration impact eDNA detection?

Kai Alger '22 | *Markus Frederich, Ph.D., Emily Pierce, M.S.*

Environmental DNA (eDNA), released by animals into the environment, can be used to detect the presence of marine species. Previous research has found that the level of eDNA in seawater can be impacted by temperature, salinity, pH, and species biomass, but no research has been published yet on eDNA and microplastic particles. This project aims to investigate whether the presence and concentration of different types of microplastics impacts eDNA detection in seawater.

Marine Science Center Summer Undergraduate Research Experience

2. The effects of blocking amygdalar CRF in rats experiencing hypersensitivity due to neonatal pain.

Skyler McComas '22 | *Michael Burman, Ph.D.*

Infants in the neonatal intensive care unit (NICU) are likely to develop anxiety and stress-related disorders later in life. The amygdala contains CRF cells, activated by trauma and pain. Chemogenetic methods were used to inhibit CRF cells in rats that experienced neonatal pain. The hypothesis that inhibition of CRF cells will reverse hypersensitivity to pain later in life was supported by the data. This confirmed that CRF cell changes are vital in neonatal pain.

Khan Family Fellowship

3. De-stress or Distress? Thermotolerance and physiological impact among *Hemigrapsus sanguineus* within the Gulf of Maine

Benjamin Rico '23 | *Markus Frederich, Ph.D., Emily Smith, M.S.*

Looking at different physiological impacts of thermal stress within the Asian Shore Crab found in the Gulf of Maine. Effects could include altered locomotion, heart rates, respiration, etc.

4. Comparing Atmospheric and Hydrological Factors of the Gulf of Maine: An Investigation of the Warming Gulf

Lydia Pinard '22 | *Charles Tilburg, Ph.D.*

The Gulf of Maine is warming faster than 99% of the global ocean. We calculated the change in heat content of the Gulf of Maine throughout the water column to test the recent assumption that the surface layers of the water column are warming faster than the depths. The application of our data analysis will allow us to examine the influence of currents on heat absorption as a result of global climate change.

Maine Space Grant Consortium and the CAS Summer Undergraduate Research Experience Program

5. Synthesis and Structural Characterization of Pyrogallol Derivatives to Determine Minimum Chain Length for Antimicrobial Activity

Sarah Padellaro '23 | *Amy Deveau, Ph.D.*

In recent research striving to develop novel antibiotic therapies, synthetic molecules with a pyrogallol core and ortho-hydrocarbon chain were shown to impede the growth of the *S. aureus Newman* strain seven times more effectively than pyrogallol itself. In this work, pyrogallol-based ketones with shorter chain lengths of 6, 7, and 8 were synthesized, purified, and characterized. Analysis of these synthetic compounds in broad-spectrum antibacterial and antifungal assays is underway.

Summer Undergraduate Research Experience

6. Production of antimicrobial properties from local marine algae

Marie Hoehner '23 | *Ursula Roese, Ph.D.*

The summer research explored the inhibitory effects of the algae *Chondrus crisups* against the gram-positive human pathogens *Staphylococcus aureus Newman* and USA300 (MRSA) and *Staphylococcus epidermidis* KMB141. Using disk assays to compare results, first the solvent that was best at extracting the algal material was found to be a 50/50 mixture of dichloromethane and methanol. The *C. crispus* was then exposed to four different treatment groups with the control group displaying the most inhibition.

Maine Space Grant Consortium and the CAS Summer Undergraduate Research Experience

7. Advancing American Chestnut *(Castanea dentata)* Restoration through Science, GIS, and Partnerships

Tyler Riendeau '22 | *Tom Klak, Ph.D*

UNE continues to be a major contributor in chestnut restoration science. Our goals were to better understand pollen viability over time, create the first New England transgenic American chestnut field site, and continue to maintain the Saco GCO. We found time isn't a deterrent for pollen viability and transgenic seedlings grow differently than their wild siblings. This work contributes to the wider effort in restoring the American chestnut back to the eastern US forests.

Summer Undergraduate Research Experience

8. Using laboratory and field trials to test the effectiveness of electronic bycatch reduction devices (BRDs) on sharks in longline fisheries.

Bethany Brodbeck '22 | *John Mohan, Ph.D.*

Bycatch reduction devices (BRDs) are designed to impair elasmobranchs' electrosensory systems using micro-voltages, which consequently deters individuals from biting baited longline hooks and results in a reduction of bycatch. Using Spiny Dogfish *(Squalus acanthias)* as a representative species, the effectiveness of these devices was tested. Results indicate a 50% reduction in total predation, as well as predation consistently taking 100% longer when the stimulus was active, validating the possibility of deterrence in the field.

Marine Science Center Summer Undergraduate Research Experience

9. Utilizing dose addition analysis in rodent models of Dopamine D1/mu opioid receptor interactions in the central nervous system to facilitate design of more effective and/or safer drugs to treat pain

Francesca Asmus '22, Ravin Davis '21, Hannah LaCourse '23, Meghan Smith '23, Madison Henderson '24, Emmerson Cahill '24 | *Glenn Stevenson, Ph.D.*

An FR10 operant schedule was utilized in the presence and in the absence of lactic acid inflammatory pain-like manipulation (therapeutic and side effect endpoints). SKF82958 (D1 dopamine agonist) and methadone (mu opioid agonist) alone produced dose-dependent response rate suppression and restoration of pain-depressed responding. These data extend earlier delta/mu opioid combination experiments, and current studies are testing fixed-ratio mixtures of SKF82958/methadone to determine the nature of D1 dopamine – mu opioid receptor interactions.

This research was supported by a National Institutes of Health (NIAMS) R15 AREA grant (AR054975-02A1) and UNE faculty mini-grant to Glenn Stevenson. A portion of this work was supported by the National Institute on Drug Abuse Drug Supply Program and Dr. Jack Bergman at McLean Hospital/ Harvard Medical School.

10. Investigating Translational Regulation with Open-Source Software and Bioinformatics Tools

Peter Neufeld '23 | *Benjamin Harrison, Ph.D.*

The Celf4 protein is a ribosomal binding protein that has been implicated in the sensitization of the A-delta nociceptive fiber. In this project, several types of open-source software and publicly available data are used to investigate the translational effects of this protein and identify possible downstream effectors to inform further research.

Kahn Family Foundation.

11. Using *Tenebrio molitor* Larvae as an Alternative Protein Source for the Production of Aquaculture Feeds

Jessica Kemp '22 | *Jeri Fox, Ph.D., Aurora Burgess, M.S.*

Fishmeal is an ideal but unsustainable source of protein in the aquaculture industry. Mealworms *(Tenebrio molitor)* (TM) are a promising alternative, as they are highly nutritious and are easily produced. Eight Nile tilapia juveniles were split into a control (fish meal only) and experimental (20% by weight TM meal substitution) diet. Their growth will be measured over a period of 6-8 weeks to evaluate TM meal's effect on growth, protein digestibility, and general fish health.

Maine Sea Grant and the CAS Summer Undergraduate Research Experience Program

12. Evaluation of drug exposure and inflammatory biomarkers in zebrafish embryos treated with atypical antipsychotic medications

William Sampson | *Karen L. Houseknecht, Ph.D.*

Patients treated with the antipsychotic medication risperidone (RIS) show changes in inflammatory cytokines. Prostaglandins (PGs) play important roles during inflammation. Effects of antipsychotic drug exposure on inflammation are not well understood. The aims of this project were to: 1) Conduct a dose-ranging study with antipsychotic medications in zebrafish *(Danio rerio)* embryos, 2) evaluate liquid chromatography-mass spectrometry (LCMS/MS) methodology for quantifying prostaglandins, and 3) evaluate effects of RIS or OLAN treatment on PG production.

This work was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences (NIH) grant P20GM103423 and NIH grant DK095413-01 (Houseknecht).

13. Post-harvest Time and Temperature Exposure of Edible Seaweed for Promotion of Food Safety

Hannah Korper '22 | *Carrie Byron, Ph.D.*

There is a lack of information on how to safely handle edible seaweed as it is considered neither a seafood nor a vegetable by the FDA. Storage temperature and duration can impact the microbial load and food safety of edible seaweed. This project recorded the temperature of seaweed from harvest to the time it is processed. It was found that seaweed exhibits a consistently warmer temperature than the ambient air temperature post-harvest.

Aquaculture Research Institute at the University of Maine and the Summer Undergraduate Research Experience program

14. Identifying Differences in the Structural Morphology of Denticles for Skate Species Native to the Gulf of Maine

Ryan Zimmermann '22 | *Kathryn Ono, Ph.D.*

This research aimed to develop a method to quickly identify skate at the species level from just a denticle sample to further research into the diet of seals in the Gulf of Maine and Massachusetts and allow for the differentiation of future skate denticle samples. Noticeable morphological differences exist between species which will allow for the future identification of unknown samples to the species studied. An identification guide was developed to display morphological characteristics.

Summer Undergraduate Research Experience

15. Estimating origins of recreationally caught Striped Bass *(Morone saxatilis)* using the chemical composition of scales as a non-lethal natural tag

Brian Alper '22 | *John Mohan, Ph.D.*

Our objective was to determine if the microchemistry of Striped Bass *(Morone saxatilis)* scales accurately reflects that of their otoliths to see if scales can be used as a valid method of determining a fish's natal origin. This would provide a non-lethal sampling alternative to otoliths. This life history information can then be put towards implementing more effective fisheries management strategies, in order to preserve the local populations of Striped Bass in Maine.

Summer Undergraduate Research Experience

16. Unraveling the life history of White Hake *(Urophycis tenuis)* within the Gulf of Maine using otolith geochemistry

Benjamin LaFreniere '22 | *John Mohan, Ph.D.*

White Hake are one of the most understudied groundfish species within the Gulf of Maine. This project utilized the Maine Department of Marine Resources' otolith inventory collected over a 20-year trawl survey. Analyzing otoliths using Laser Ablation ICP-MS allows us to further describe the variations in elemental concentrations of these structures due to both environmental and physiological processes. This data allows us to better inform fishery managers on the lifestyle characteristics of this mysterious species.

Mohan Lab Startup Funds along with collaboration with the Maine Department of Marine Resources

17. Effect of post-harvest drying method on viability of pathogens associated with edible seaweed

Colleen Moody '22, Jessica Vorse '22, Lyle Massoia '22 | *Kristin Burkholder, Ph.D., Carrie Bryon, Ph.D.*

The purpose of this study was to investigate post-harvest drying methods impact on pathogen load associated with *Ascophyllum nodosum* (rockweed). Freeze drying and air drying techniques are used to compare which drying method reduces pathogen load. The FDA does not have regulations for seaweed as a food product, so it is important to provide seaweed farmers with data to enable safe post harvest handling of edible seaweed to ensure risk of foodborne illness remains low.

Maine Sea Grant award to C. Byron and K. Burkholder and the CAS Summer Undergraduate Research Experience Program

18. The saphenous nerve is the primary source for sensory innervation of the tibia

Jacob Hickey '21 | *Tamara King, Ph.D., Kathleen A. Becker, Ph.D.*

The tibia is one of the most common sites of fracture, but the source of tibial innervation is unknown. Retrograde signaling from the tibia was analyzed by fast blue injection and highest in the L2 and L3 dorsal root ganglia (DRG). DRG labeling decreased with saphenous nerve transection, indicating that the saphenous nerve is the primary source of tibial innervation. Further studies are needed to evaluate the impact of saphenous nerve injury on tibial fracture.

Khan Family Research Foundation

19. Microplastics as vectors for pathogen contamination of seaweed

Lyle Massoia '22, Justin Dixson '22 | *Kristin Burkholder, Ph.D.*

Microplastics are abundant ocean pollutants and are ingested by marine organisms, including those used for human consumption. There is concern that pathogenic microbes can bind to microplastics. The project goal was to demonstrate that bacterial pathogens bind to microplastics. Successful binding of *E. coli* was facilitated through pre-treatment of MP fibers with a conditioning solution. Future work will test whether bacteria-associated MP can lead to bacterial accumulation in marine organisms such as bivalves and fish.

Maine Space Grant Consortium and the CAS Summer Undergraduate Research Experience Program

20. Analyzing the genetic structure of *Quercus rubra* and *Pinus strobus* in order to determine the applications of a community genetics approach in the UNE 363-acre woods

Katrina Kelley '22 | *Steve Travis, Ph.D.*

Over 12 weeks this summer, I solidified and employed a procedure for the genetic analysis of Eastern white pine samples collected from the UNE 363-acre forest. Although I was not able to determine any results from working on the pine samples, most of the sequencing has been finished. This research has great importance because it provides a framework for future ecological research within the same plots at UNE, as well as similar sites worldwide.

Maine Space Grant Consortium and the CAS Summer Undergraduate Research Experience Program

21. Dietary mercury exposure and subsequent accumulation in *C. maenas*

Katie Dimm '22 | *Stephan Zeeman, Ph.D.*

Methylmercury is the organic highly toxic form of the element mercury that accumulates naturally in aquatic organisms. High trophic level organisms have been well documented having high concentrations of the heavy metal; in comparison much less is known about accumulation patterns in those residing at the bottom of the food chain. This study looks to investigate these patterns using dietary mercury exposure in green crabs, a low trophic level and invasive species in Maine.

My project was funded by multiple donors through Experiment. com. https://experiment.com/projects/dietary-methylmercury-accumulation-in-green-crabs

22. Red Oak Defense Against Herbivory

McKayla Arsenault '22 | *Greg Zogg, Ph.D.*

Higher leaf mass per area (LMA, g/cm2) is a leaf trait that aids in physical defense against insect herbivores. I conducted an experiment in which leaves from understory oak seedlings were fed to gypsy moth caterpillars. Measures of leaf area consumed and LMA were analyzed to determine whether a difference in LMA between sites exists and if there is a relationship between LMA and leaf area consumed.

Maine Space Grant Consortium and the CAS Summer Undergraduate Research Experience Program

23. The synthesis and structural characterization of antimicrobial pyrogallol-based ketones with varying hydrocarbon chain lengths

Carolyn Curley '23 | *Amy M. Deveau, Ph.D.*

Molecules with hydrocarbon chains of 10, 11, and 12 carbons were successfully synthesized, purified, and characterized by proton (1H) & carbon (13C) NMR spectroscopy and mass spectrometry. The synthetic compounds are currently being analyzed by the Community for Open Antimicrobial Drug Discovery (COADD) for selective antimicrobial and antifungal activity. This research expands our knowledge of structural patterns found in organic molecules that may effectively impede drug-resistant pathogens that threaten human health.

Maine Space Grant Consortium and the CAS Summer Undergraduate Research Experience Program

24. Pyrogallol impairs *Staphylococcal* biofilm formation and may increase microbial susceptibility to antibiotics

Katharina Roese '22 | *Kristin Burkholder, Ph.D.*

The risk of hospital-acquired bacterial infection is exacerbated by pathogens that can form biofilms on indwelling medical devices and host tissues. One strategy for developing novel antimicrobials is to use drugs that target biofilm formation. Here, we show that the polyphenolic compound pyrogallol impairs biofilm formation in the major hospital-associated pathogens *Staphylococcus aureus* and *Staphylococcus epidermidis*. Our findings suggest that pyrogallol-mediated biofilm reduction is caused by its pro-oxidant stress effects on the bacteria that were tested.

UNE Office of Research and Sponsored Programs Faculty Minigrant award to K. Burkholder

25. Health Disparities of COVID-19 within Maine as Related to Race and Ethnicity

Amanda Barrese '22 | *Samuel McReynolds, Ph.D.*

Racial and ethnic inequalities in health systems are causing higher Covid-19 incidence among marginalized groups. Historically, racial minorities have been affected by disease incidence at higher rates than their white counterparts, but why? In Maine, Black and African American, American Indian/Alaska Native, and Hispanic and Latino people have suffered Covid-19 incidence at a significantly higher rate than any other racial group due to the social determinants of health (SDOH) that influence our lives every day.

St. Francis College Class of 1969 Summer Undergraduate Research Experience

DIRECTORY

POSTERS BY AUTHOR

THANK YOU

THANK YOU!

The annual SURE Symposium would not be possible without the support of many individuals and organizations who each contribute in their own way.

First a hearty **THANK YOU** to the faculty mentors and professional staff who have supported the students in carrying out the research presented here today. Your generosity of time and effort has allowed the students to complete truly remarkable work. Likewise, the College of Arts and Sciences Undergraduate Research Committee was instrumental in the success of our 2021 SURE program.

Several agencies have sponsored the students' summer research through fellowships and grants including the Khan Family Foundation, the National Institutes of Health (NIH), the Aquaculture Research Institute at the University of Maine, the Maine Department of Marine Resources, Maine Sea Grant, the Maine Space Grant Consortium, the St. Francis College Class of 1969, the UNE Office of Research and Scholarship, and the UNE Marine Science Center. Thank you for your investment in our students. Appreciation is also extended to UNE Institutional Advancement and the Office of Communications for their help in executing our event.

Thank you to all of the family and friends who have traveled to UNE to support their students during this event and for your support during their busy summer research period.

Finally, I'd like to extend a special thank you to Erinn Stetson who has provided invaluable logistical and tactical support during all aspects and stages of the SURE 2021 program, including this symposium.

—Dr. Amy Keirstead

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