ABSTRACTS
2021 SEA Fellows Summer Science Symposium

Poster	Title	Authors	Abstract
1	Maine Aquaculture Innovation Center's role in Maine aquaculture, 2006-2021	Abby Gray, Anne Langston Noll & Chris Davis, Maine Aquaculture Innovation Center	To inform how to best focus funding in the future, this project documents how past funding by the Maine Aquaculture Innovation Center (MAIC) has supported aquaculture in Maine by informing the industry, inspiring research, creating educational opportunities, and contributing to growth in the value and extent of aquaculture in Maine. Through a synthesis of data from Maine Department of Marine Resources, MAIC funding data, as well as a survey and interviews of MAIC grantees, this project will assess the impacts of MAIC funding to date. Conclusions will guide future MAIC support and also guide the aquaculture research and development community more broadly.
2	How different environments facilitate scallop growth and influence profitability	Beatrice Johnson, Tom Kiffney, Struan Coleman & Damian Brady, all of University of Maine	Atlantic sea scallop (*Placopecten magellanicus*) aquaculture is a growing industry in the state of Maine. With the rise in aquaculture, farmers need better information on how to best site their farms and on the time it will take to bring scallops to market. The Sea Scallop Aquaculture Budget Tool can be used to economically analyze scallop farms based on farm size, costs and expenses, business and loan characteristics and key biological factors. A key factor in analyzing economic success for farms is the "months to market size" variable. We used an earlier study of scallop growth rates at four Maine scallop farms to improve estimates of the 'months to market size' variable, considering how it varied with location. We also linked these estimates to site-based environmental data at each location. Together, these analyses enabled us to assess the estimated time to profitability for different farm location across Maine.

3	Comparing oyster feeding rates on live versus frozen algae cells	Jack Rigazio, Robert Cuddy, & Damian Brady, all of University of Maine	Shellfish aquaculture is used to produce food, enhance habitat quality and diversify coastal livelihoods in Maine and beyond. This study investigates a way in which shellfish production efficiency may be increased, to better meet demand. Currently, many shellfish hatcheries feed young shellfish nutrient rich non-motile algae in the form of a frozen paste. Non-motile cells can be frozen and reconstituted, offering a considerable advantage to hatcheries. However, the rate at which American oysters feed on live, motile cells versus non-motile algal cells is not well known. We aim to determine whether there is a significant difference between the feeding rates of American oysters (Crassostrea virginica) on live, motile algal cells and non-motile cells by feeding them chlorophyll concentrations of 1, 2.5, 5, 25, and 50 µg chla/l.

4	Improving methods to survey eelgrass with Remotely Operated Underwater Vehicles (ROVs)	James Greenwood (1), Elisabeth Maxwell (1), JoAnna Shaw (1,2) & Damian Brady (1), where 1. University of Maine and 2. Hobart and William Smith Colleges	Eelgrass (*Zostera marina* L) is a flowering seagrass that serves as a foundation species in subtidal marine ecosystems by providing habitat for larval species of commercial fish. Eelgrass also contributes to shoreline protection. In Maine, eelgrass has been surveyed by the Department of Marine Resources (DMR) twice [in what years] through aerial photography and visual observation above water. In this project, we tested the feasibility of using a Remotely Operated Underwater Vehicle (ROV) to conduct an eelgrass survey. An experimental site near Fort Island in Boothbay, Maine was chosen based on published DMR survey data where eelgrass was last said to be present. Several methods were tested to document the precise location of eelgrass beds and to determine the efficacy of using the ROV to document the presence of eelgrass. Based on our work, best practices are offered to field researchers who wish to use this technology in the future.

5	Observing Microplastics in the Damariscotta River	JoAnna Shaw (1,2), Kathleen Thornton (1), James Greenwood (1) & Damian Brady (1), where 1. University of Maine and 2. Hobart and William Smith Colleges	Plastics are a driving source of marine pollution, as high use in global markets has led to increased levels in our waterways. Fisheries, aquaculture, agriculture, and other industrial sectors, as well as consumer use, contribute to this pollution. This study focuses on the smallest plastics in the environment: microplastics. Microplastics are defined as pieces of plastics less than 5 mm in diameter. Plastics are weathered by ultraviolet radiation and ocean waves, causing them to break into even smaller pieces, creating concerns for humans and ecosystems. Our goal is to assess the presence of microplastics in two known areas of the Damariscotta River. One location is a source with little direct human influence whereas the other experiences more human activity. We use standard procedures for water sampling, density separation, and filter staining to increase visualization under a fluorescent microscope. Our results help inform understanding of if and to what degree microplastics exist in these two locations in midcoast Maine, USA.

6	Comparative Analysis of *Primnoa pacifica* , Red Tree Coral, spermatocyst size before versus after thermal variability events	Jocelyn Cooper, Julia Johnstone, & Rhian Waller, all of University of Maine	Cold-water corals in the deep ocean can be a keystone species, a habitat forming organism supporting other species that are vital to the health of the ecosystem. Recent research data collected from the coral *Primnoa pacifica* communities indicates thermal variability has adversely impacted reproduction and growth in shallow fjords. However, this species primarily lives in the deep sea, where impacts are unknown. We propose to investigate if there is a difference in deep population spermatocyst production before versus after a thermal variability event passed through the Gulf of Alaska (GOA) from 2013-2015. We are reviewing previously collected samples from two deep-water sites in the GOA collected in 2013 and 2015. This comparative analysis hopefully will help predict the impact of global climate change on this species.

7	Integrating local knowledge and ecological surveys to monitor intertidal shellfish	Caroline Rolfe (1,2), Amelia Papi (1), Sarah Risley (1) & Heather Leslie (1); where 1. University of Maine, 2. University of Denver	A major concern for Maine's shellfish industry is the decreasing trend of shellfish landings over the past several decades. There is limited data on how or why shellfish landings have declined due to the challenges of conducting intertidal surveys to study shellfish populations. Our research seeks to evaluate the abundance and distribution of shellfish species and their predators in the Damariscotta River Estuary (DRE) by using a community science approach that integrates ecological field surveys and local knowledge data collection with educational opportunities for local high school students. Using local knowledge and community engagement, the information collected will support better understanding of changes in shellfish populations and help guide future conservation and management. Once these protocols are completed and tested in the DRE, they have the potential to be used in other places along the coast of Maine and beyond.

8	A guide to recreational shellfishing in Brunswick	Madison Bailey (1), Dan Sylvain (2), & Dan Devereaux (2), where 1. University of Maine, 2. Town of Brunswick	Shellfish harvesting is an important part of Maine culture. However entry into this fishery can be complex. Recreational fishing guides can help, by providing individuals with the entry level knowledge needed to become a part of the fishery. Currently in Maine, there is no guide to recreational shellfishing. Having such a shellfish guide is important because it provides prospective harvesters with the knowledge necessary to be successful in shellfish harvesting and also to know relevant laws and regulations. Each particular municipality manages their local shellfish resources differently. For example in Brunswick, harvesting is illegal when water is over the mud flats and it can be illegal to dig when there is excessive rainfall. We created this guide by using resources such as the Maine Shellfish Handbook and interviewing the Brunswick Marine Warden. A Guide to Shellfishing in Brunswick will help sustain the area's shellfishery and improve communtiy knowledge on the local shellfish resource. This guide can be accessed via the Town of Brunswick website.

9	Understanding eDNA Data through environmental measurements and nutrient analyses	Megan Alberding (1, 2), Sean O'Neill (1), Rachel Presley (1), & Jeremy Rich (1), where 1. University of Maine, 2. Wesleyan University	Environmental data provide context for interpreting eDNA samples, and ecological change, through time. Measurements taken monthly from October 2020 through July 2021 using a Sonde instrument on eDNA cruises in both the Damariscotta River estuary and Damariscotta Lake indicate seasonal and overall climatic changes through time. As factors such as temperature, turbidity, dissolved oxygen, salinity, and PAR seasonally change and are overall impacted by climate change, nitrogen availability and chlorophyll abundance (a proxy for primary productivity) in the water vary. Examining associations among these environmental data and eDNA information are important in order to understand ecosystem dynamics. This information, once analyzed, will help advance ecological understanding and support ecosystem-based management.
10	Exploring strategies to reduce post-harvest mortality in the Maine and Canadian lobster fisheries	Adelaide Mullin (1,2), Cassandra Leeman (1), & Damian Brady (1) where 1. University of Maine, 2. Bard College at Simon's Rock	Maine's lobster industry contributes to local economies and communities. As a lobster travels from trap to dealer in Maine, post-harvest mortality leads to 2-8.6% loss of marketable stock. Comparatively, the Canadian fishery suffers from a lower post-harvest/transport mortality rate. With this study, we seek to understand what factors cause the mortality rate differences between the Canadian and Maine fisheries and to identify possible strategies to reduce post-harvest mortality further.

11	Prey preference of American lobster larvae (*Homarus americanus*) in the Gulf of Maine's pelagic food web	Patrick, E.(1), M. Spencer (2), M. Niemisto (3) R. Lasley-Rasher (2), D. Fields (3), R. Wahle (1), A. Ascher (1) where 1. University of Maine, 2. University of Southern Maine, 3. Bigelow Laboratory for Ocean Sciences	Research suggests that recent declines in recruitment of the American lobster (*Homarus americanus*) may be driven by climate-related changes in the pelagic food web. Understanding preferences of larval lobster for zooplankton prey is therefore important to help provide insight into the trophic linkages among these species. We are conducting controlled grazing experiments to determine the preferences of four larval stages of lobster for specific copepods commonly found in the Gulf of Maine. In six-hour prey choice experiments, larvae will be offered equal numbers of three different prey species at high densities. We predict that larvae will preferentially consume the most energy-rich species, *Calanus finmarchicus* , as they have a greater nutritional value compared to *Acartia* and *Temora* .

12	Density dependent growth factors and their effect on American glass eel growth rates	Sophie Swain (1), Kathleen Marciano (2), Sara Rademaker (2), where 1. University of Maine, 2. American Unagi	In fish farming,and specifically in recirculating aquaculture systems (RAS), the densities in which fish are stocked can have a direct effect on growth rates and the ability of fish to reach target weights. Standard growth rates (SGRs) can be assessed through regular sampling. Feed conversion ratios (FCR), together with SGR data, allow fish farmers to predict with a higher degree of accuracy the target amount of feed required to maximize growth. When the correct species-specific ratio is achieved, biomass increase is predicted to follow. While this theory is straightforward, in practice, both biotic and abiotic factors influence the success of RAS. This project focuses on how stocking density of juvenile American Glass Eels influence performance. We predict that eels stocked at lower densities will perform better than those stocked at higher densities.

13	Developing eDNA tools to count harmful algae in Maine waters	Claire Volk (1), Robin Sleith (2), Sydney Greenlee (3,2), & Pete Countway (2), where 1. University of Southern Maine, 2. Bigelow Laboratory for Ocean Sciences, 3. University of Maine	The increased prevalence of harmful algal blooms in the northeastern United States necessitates inquiry into the population, community, and toxicity dynamics of potentially toxic organisms like *Dinophysis* spp. Several species of this genus of dinoflagellate are known to produce the toxins responsible for diarrhetic shellfish poisoning (DSP). A qPCR assay accurate to the species level would allow for the cost-effective quantification of *Dinophysis* in environmental water samples. The ITS region of single-cell Dinophysis spp. picks from the Gulf of Maine were amplified and sequenced for species identification and primer design. An alignment of these and GenBank sequences was used for the development of qPCR primers and probes to quantify *D. norvegica* and the *D. acuminata* complex. Given inter and intraspecific variability in toxicity, these assays will complement toxicity and environmental DNA work in elucidating how populations of these species respond to predator and prey dynamics during algal bloom events.

14	Surmounting methodology hurdles in the use of eDNA to study food web interactions of American lobster larvae (Homarus americanus)	C. Morris (1), A. Ascher (1), P. Countway (2), D. Fields (2), R. Wahle (1), where 1. University of Maine, 2. Bigelow Laboratory for Ocean Sciences	High-throughput DNA sequencing is gaining wide application as a powerful molecular tool to reveal the species composition of marine communities and food webs. As part of a larger study to evaluate trophic interactions of larval American lobster (*Homarus americanus*) in the pelagic food web, we are developing methodology to characterize the components of the lobster larval diet. Here we optimize the application of a lobster-specific blocker to reduce host DNA interference and allow for the identification of larval stomach contents. First, we determine optimum concentrations of the lobster-blocker to balance host DNA suppression against the need to detect prey taxa. Next, cross-reactivity of the blocker is determined by analyzing DNA expression of lab-reared larvae fed on a known diet to determine whether the blocker selectively suppresses DNA from prey taxa more closely related to lobster (e.g., other crustaceans). These experiments will help establish protocols for the application of future DNA sequencing in trophic ecology studies.

15	Two methods to evaluate sea scallop spawning in Maine	Samuel Burgess (1), Phoebe Jekielek (1,2), Madison Maier (2), Samantha Poratti (2), Lucy Williams (2), Heather Leslie (1), & Nichole Price (3), where 1. University of Maine, 2. Hurricane Island for Science & Leadership, 3. Bigelow Laboratory for Ocean Sciences	For many commercially important shellfish species such as scallops, there is a lack of temporal and spatial resolution of spawning patterns and larval supply. On Hurricane Island, Maine, we are investigating the question: Are there differences in spawn timing and magnitude between cultured and wild populations of scallops? To do this we are documenting the timing of spawning and the distribution of gametes and larvae from farmed and wild scallop populations using two methods: gonadosomatic indices (GSI) and environmental DNA (eDNA) analysis. GSI are the ratio of gonad mass to total viscera mass. eDNA water samples, taken at different depths from areas adjacent and far from farmed scallops, have been used to quantify scallop sperm density in the past. Together, these methods will help advance understanding of population dynamics of commercially important species and, specifically, the potential for farmed scallops to contribute to the sustainability of wild populations.

16	Do seed oysters grow better in OysterGro or Zapco Cages and how does oyster density effect growth?	Emily Rand (1), Scarlett Tudor (1), Annie Fagan (2), & Meredith White (1,2), where 1. University of Maine, 2. Mook Sea Farm	Factors influencing the growth of young oysters, or seed, include type of aquaculture gear used and the environmental conditions at a site (e.g., temperature, salinity, food availability, and water flow). We tested seed growth in Eastern oysters (Crassostrea virginica) in two gear types: OysterGro and Zapco cages (n=3 cages per type). OysterGro cages are suspended in surface waters by air-filled floats. Zapcos are intertidal cages that tumble seed as they rise and fall with tides. We simultaneously examined how stocking density influenced growth (n=3 density levels). At six and nine weeks post-deployment, oyster seed were graded by size to assess growth. Week Six results indicated that low stocking density in Zapco produces the fastest seed growth. Our results will help inform decisions about which gear type and stocking density are most likely to produce fastest seed growth at a site.

17	Comparing growth and survivorship of three commercial shellfish species in vacant lobster pounds in downeast Maine	Hunter Carson (1,2), Kyle Pepperman (2), & Brian Beal (1-3), where 1. University of Maine, 2. Downeast Institute, 3. University of Maine at Machias	We are investigating how water temperature and salinity influence growth in three different commercial shellfish species: Eastern Oysters (*Crassostrea virginica*), Atlantic surf clams (*Spisula solidissima*), and European Oysters (*Ostrea edulis*). The three species were deployed in 4 mm floating oyster bags at each of two sites in Beals, Maine: Flying Place Pound and Elmer's Pound. Four replicate bags were deployed for each species at each location (n=4 bags per species per site). The water temperature in Elmer's Pound is colder than the Flying Place Pound, which often has surface temperatures greater than 20 degrees C. We predict that the highest growth rates will be found in the pound with the greatest average teamperature, while the cooler pound will show adequate but lesser growth of these species. We will compare the growth and suvrivorship for each species at each loaction, as well as the physical parameters of temperature and salinity. These results will help indicate the viability of a commercial shellfish aquaculture oppertunity using vacant lobster pounds in downeast Maine.

18	The effects of different gear types on farming Atlantic sea scallops	Sydney Avena, Christopher Davis, & Anne Langston Noll, all of the Maine Aquaculture Innovation Center	As Maine's aquaculture industry continues to grow, there is interest in developing innovative and cost effective techniques for Atlantic sea scallop (Placopecten magellanicus) aquaculture. This study is assessing four different aquaculture gear types for grow-out of farm-raised sea scallops (lantern nets, floating bags, bottom cages, and dark sea trays) to investigate the influence of these gear on scallop growth rates and survival. We also will test the influence of depth, as well as the capital cost and labor involved in deployment and maintenance of each gear type. The information gained from this study will help inform farmers' decisions about gear choice and location.

19	Are marine ecosystem changes affecting lobster sheltering behavior in coastal Maine?	Katey Gould, Robert Jarrett, & Robert Steneck, all of University of Maine	In recent decades Maine's coastal ecosystem has become dominated by benthic algae and lobster habitat use has changed. Lobsters naturally seek shelters, yet studies conducted at identical sites from the 1990s to present day show a shift in population density from shelter-providing boulder fields, where lobster abundances were historically highest, to less topographically complex ledge and sediment habitats. Our field and laboratory studies aim to determine which environmental factors correspond with these observed changes in habitat use, and if sheltering behavior is also changing along with the shift in population density. Specifically, we are analyzing data collected in the field by SCUBA divers to determine if there has been a shift in shelter preference and if this correlates with a change in algal cover and population distribution. Results from this study will inform future research on the population distribution and behavior of lobsters.

20	Does the invasive alga *Dasysiphonia japonica* impact American lobster shelter selection and postlarval settlement: experimental methods	Katherine Burnham, Robert Jarrett, & Robert Steneck, University of Maine	In Maine's coastal ecosystems, declines in American lobster (*Homarus americanus*) abundance, recruitment, landings, and evidence of more randomly distributed populations across habitat types have recently been observed. Increases in algal cover may be responsible for these changes, particularly of the invasive alga Dasysiphonia japonica, a chemically defended, filamentous red alga native to Japan but increasingly prevalent in the Gulf of Maine following the rise in sea surface temperatures. It is possible that increased abundances of filamentous algae like D. japonica are making critical shelter habitat unsuitable to adult lobsters and even postlarval lobsters attempting to settle. We investigated the impacts of D. japonica on lobster shelter selection and postlarval lobster settlement using laboratory and field experiments. The aim of this poster is to present our experimental methods in detail. Understanding possible changes in lobster habitat-use is critical for predicting impacts to one of the most valuable fisheries in the U.S.

21	Counting lobsters with an underwater robot	Lydia Harris, Robert Jarrett, & Robert Steneck, University of Maine	The aim of this research is to determine population density and habitat use of the American lobster, Homarus americanus. This research builds off of previous lobster population studies using sampling done by divers. Over two decades ago, these studies found a preference for boulder habitat over relatively featureless sediment and ledge. In 2019 there were similar lobster densities across all bottom types. The current data were collected through video surveys taken by an underwater robot, or remotely operated vehicle (ROV), at Damariscove Island. The ROV allows for much greater coverage area compared to diver sampling. From the videos, we determined lobster population density, body size, algae cover, and depth. Preliminary results indicate the lobster population density found using the ROV survey (0.02 m-2) was lower than diver surveys at similar depths (0.39 m-2), and the population density increases with depth.

22	What type of material do young dulse prefer to settle on?	Jillian Galloway, Anne Langston Noll & Chris Davis, all of Maine Aquaculture Innovation Center	Seaweed farming is a new and growing industry in Maine. Research is required to develop key nursery and grow-out techniques for dulse, a species that is currently only wild harvested. This study will assess the success of dulse tetrasporophyte settlement and adhesion on a variety of substrates. The substrates used in these experiments are currently in use or are being considered for farming another seaweed, sugar kelp. The study will test spore settlement success on at least four substrate types that vary in rugosity (rough and smooth) and material type (textile and plastic). By experimenting with a variety of potential substrates to elucidate optimal spore adhesion, the results of this study will provide valuable information for local current and prospective dulse farmers. Increasing available information on successful dulse growth practices will expand seaweed aquaculture and add to the diversity of Maine's working waterfront.

23	Virtual experiental learning activity gives recognition to algal aquaculture in Maine	Lauren Maeve Trainor, Scarlett Tudor, Carla Scocchi, Melissa Malmstedt, all of University of Maine	The global pandemic has resulted in a demand for innovative virtual learning tools and resources to engage youth from home. The 4-H Summer Learning Series is an interdisciplinary range of workshops and clubs, designed to teach and engage virtually with youth in a range of science topics. We created a workshop that engages youth with the gelling abilities of alginate, a chemical found in the cell walls of kelp. During this activity youth create a lava lamp with multicolored alginate beads in a simple, at-home experiment. Through this activity students gain first hand experience with the properties of algae and learn the ways in which algae is used for a diversity of products. It is beneficial for Maine youth specifically to learn about the kelp that grows off their coastlines and to recognize the growing seaweed aquaculture industry surrounding them.

24	Better marketing for Maine sea vegetables	Nelson Wu, Anne Langston Noll & Chris Davis, Maine Aquaculture Innovation Center	Many sea farms, especially those in niche sectors like seaweed or those run by new farmers, are challenged by marketing.This project focuses on providing searchable, clearly understandable data on which good business planning can be based, particularly for seaweed farms in Maine. Seaweed farms can realize a significant competitive advantage by practicing market-driven as opposed to supply-driven business decision making and planning. Ultimately, the result of this project will inform seaweed farmers about consumer attitudes and preferences, allowing them to produce the products and volumes that consumers want and to communicate that information to wholesalers and retailers.