

Linda Kallansrude, NSA Secretariat  
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 Bonito Springs, FL 34135  
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## Upcoming Events

**74<sup>th</sup> Annual Shellfish Conference (NSA-PCS/PCSGA):** Oct. 6-8, 2020. Wenatchee, WA. For more information: <https://pcsga.org/annual-conferences>

**20<sup>th</sup> International Conference on Shellfish Restoration:** Dec. 8-11, 2020. Nelson Bay, NSW Australia. For more information: <https://willorganise.eventsair.com/2020-international-conference-on-shellfish-restoration/>

**Aquaculture America 2021:** Feb. 21-24, 2021. San Antonio, TX. For more information: [www.was.org](http://www.was.org)

**113<sup>th</sup> Annual NSA Meeting:** Mar. 21-26, 2021. Charlotte, North Carolina. For more information: [www.shellfish.org](http://www.shellfish.org)

**Aquaculture Europe 2020:** Apr. 12-15, 2021. Cork, Ireland. For more information: [www.aquaeas.org](http://www.aquaeas.org)

**Physiomar 2021:** Sept. 7-10, 2021. Nelson, New Zealand. For more information: <https://confer.eventsair.com/physiomar-2020/>

**Aquaculture Canada/WAS North America 2021:** Sept 26-29, 2021. St. John's, Newfoundland, Canada. For more information: [www.was.org](http://www.was.org)

**Aquaculture Europe 2021:** Oct. 5-8, 2021. Funchal, Madeira, Portugal. For more information: [www.aquaeas.org](http://www.aquaeas.org)

**Aquaculture 2022:** Feb. 27-Mar 3, 2022. San Diego, CA. For more information: [www.was.org](http://www.was.org)

**Aquaculture America 2023:** Feb. 19-22, 2023. New Orleans, Louisiana. For more information: [www.was.org](http://www.was.org)

If you would like to announce a meeting, conference, workshop, or publication that might be of interest to NSA members, please contact the *QNL* Editor, LeRoy Creswell ([creswell@ufl.edu](mailto:creswell@ufl.edu)).



## President's Message



Deaths worldwide from the COVID-19 pandemic will soon equal the total number of people (~550,000) that live in the Coastal Bend, my home area, of Texas. I am in awe of the enormity and severity of the pandemic. My sympathy goes to those members that have lost loved ones or are now compromised from the SARS-CoV-2 virus. I expect that each member is still adjusting personally and professionally to the pandemic and its effects for the near and distant future.

The stress from this biological confrontation was heightened by the unnecessary death of George Floyd during his arrest by Minneapolis police on 25 May, which sparked social unrest and protest throughout the USA and the world. Since that time, the Executive Committee discussed if we should make a statement on the Black Lives Matter movement and if we did, what would it say. By now, you have seen the statement.

Each of you has seen racial injustice, maybe been a victim of it, and maybe have unknowingly perpetrated it. I thank those NSA members who wrote asking for our Association to make a statement and those that have responded to the statement. During my almost 40 years as an NSA member I do not recall a racially motivated incident in the Association or at our annual meeting, but it does not mean none have occurred. Nor does it mean that current policies and practices are acceptable. Our range of vision and understanding needs to widen and deepen to ensure that the Association remains open, inviting, and respectful to all people.

It is you, our members, that will change society and our Association. I know members that supervise college students of black and indigenous people of color (BIPOC). Members have secured scholarships for minorities, while other members conduct outreach programs to primary and secondary schools whose students are predominantly minority. It is here the academic pipeline begins for realizing diversity and expanding awareness in our field.

I expect that each member's values reflect the best qualities of society. Diversification and understanding will occur through you. Requests for recruiting new members seem to fall short each year. This is your time to recruit or sponsor that new member to ensure our Association is strong for meeting future challenges in shellfisheries.

**John Scarpa, President**

Dear NSA Members,

*Strength lies in differences, not similarities.*  
 (Stephen Covey)

The Executive Committee of the National Shellfisheries Association (NSA) does not condone systemic racism affecting so many people across the country. As one of the oldest scientific societies in the United States, the very roots of the NSA and its actions throughout its history are founded in embracing diversity. The NSA has always been, and will always be, an open, welcoming, and inclusive society to those interested in shellfisheries and science. We stand united in our firm belief that diversity enhances and strengthens science and society. Currently, NSA has several efforts promoting and encouraging minority participation in shellfisheries science, and promises to continue its efforts to increase diversity in our membership, leadership, and our thinking.

**John Scarpa, President**  
**Lewis Deaton, President-Elect**  
**Steve Allen, Past President**  
**Aswani Voley, Vice-President**  
**Jay Parsons, Treasurer**  
**Paul Rawson, Secretary**  
**Melissa Southworth, Member-at-Large**  
**Michael Doall, Member-at-Large**  
**Louis Plough, Member-at-Large**  
**P. Sean McDonald, Chair - Pacific Coast Section**  
**John Krauter, Financial Officer**  
**Sandra Shumway, JSR Editor**

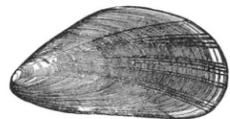
### In this issue:

- **113<sup>th</sup> Annual Meeting Charlotte 2021**
- **Book Review: Biology and Evolution of the Mollusca**
- **BioOne Recognizes NSA student**
- **Student Research Grant Updates**

## NSA is on Instagram



Be sure to follow the latest NSA news, events, and publications on the NSA Instagram account @nationalshellfisheries. We will regularly post updates regarding to the *Quarterly Newsletter*, upcoming conferences and meetings, and general shellfish news from around the world. And in a new initiative to increase visibility of the NSA and its publications, contributing authors to the *Journal of Shellfish Research* will be encouraged to submit materials including images, videos, links, hashtags, and short descriptions to help promote their work and their paper. We will also post 'throwbacks' to past *Journal* articles and conference talks to highlight some topics of general interest. Not only do we hope to keep our existing members more connected with NSA and our publications, but we also hope to bring more awareness of the great science published in the *JSR* to shellfish professionals and enthusiasts outside our society, including those in industry, government, NGO, education, and the general scientific community. So please help support this effort by encouraging colleagues, students, friends, and family to follow NSA on Instagram. Please send any suggestions or ideas for posts, as well as any questions, to [Michael.Doall@stonybrook.edu](mailto:Michael.Doall@stonybrook.edu).

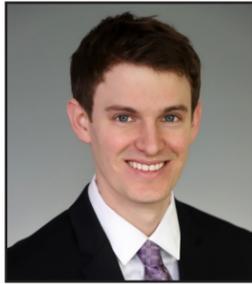


## A huge THANK YOU to our Sustaining Members

**Chad Ballard**  
**Megan Davis**  
**William N. Elsaesser**  
**Steve Geiger**  
**Brian Norton**  
**Eric Schott**  
**Scott Siddall**  
**Elizabeth Tobin**

**your continued extra support is greatly appreciated!**

## BioOne Recognizes NSA Student



Dr. Matthew George received the 2020 BioOne Ambassador Award in April which recognizes early-career researchers who excel at communicating the importance and impact of their specialized research to the public. Established in 2018, the goal of the Ambassador Award is to increase interest in recent research from rising researchers who are effective at communicating their work with the public. Effective communication is fundamental to ensuring the use of scientific information to make informed, evidence-based decisions. Nominees were asked to provide a 250-word plain-language summary of their research which responded to the question: "What are the broader implications of your work, and how does your work impact the public at large?". Winners receive a \$1,000 award and wide dissemination of their research.

Winners were chosen through a competitive process. Active BioOne publishers were invited to nominate an early career researcher who published in their journal in 2019. In order to qualify, the author needed to be either a graduate student or a scientist who had completed their PhD within the last five years.

Matt's doctoral work focused on the biological glue that marine mussels use to attach to the seafloor, an interdisciplinary project with implications for local ecosystems, the shellfish industry, and the development of novel medical adhesives that can adhere to tissues within the body. More detail on the project can be found in his recent publication: Matthew N. George, Jessie Andino, Jonathan Huie, Emily Carrington. 2019. Microscale pH and dissolved oxygen fluctuations within mussel aggregations and their implications for mussel attachment and raft aquaculture. *Journal of Shellfish Research*, 38(3): 795-809.

Dr. George's research interests reside at the intersection of biology, engineering, and medicine. Matt received a BS in biology from Gonzaga University before serving as a research technician in the Ocean Acidification Environmental Laboratory at the Friday Harbor Laboratories (FHL) marine station. While at FHL, Matt developed a passion for biomaterials, eventually motivating the completion of a PhD in biology from the University of Washington under the guidance of Dr. Emily Carrington.

To read Dr. George's summary and to learn more about the BioOne Ambassador Award visit: <http://www.bioonepublishing.org/BioOneAmbassadorAward/2020/MG.html>

**Congratulations, Matt!**



Current members of NSA have access to BioOne through the membership portal ([www.shellfish.org](http://www.shellfish.org)). Please check with your libraries and encourage them to subscribe to BioOne.2 or BioOne Complete for full access via the library portals. "Hits" count when it comes to royalties and these funds are very important to the NSA and support of publication of the JSR. Check out Matt's manuscript and **USE BIOONE OFTEN!**

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## 2019 Melbourne R. Carriker Student Research Grant Update

Awardee: Erin Roberts  
University of Rhode Island

“The Role of Apoptosis Phenotype and Gene Expression in Eastern Oyster Disease Response”

Dermo disease, caused by the parasite *Perkinsus marinus*, has caused significant losses throughout the east coast of the United States and threatens wild and cultured oyster populations. Traditional selective breeding for disease resistance has developed lines of eastern oysters with heritable resistance to Dermo diseases and the use of these lines in aquaculture reduces losses from disease. The progression and outcomes of Dermo disease depend on the interactions between eastern oyster innate immunity and *P. marinus* virulence mechanisms. Lacking the traditional adaptive immunity found in vertebrates, oysters rely on a complex innate immune system to combat the milieu of pathogens in their environment.

Oyster immunity is driven in large part by a major cellular component, hemocytes. During disease response, hemocytes kill invaders via phagocytosis, the respiratory burst reaction, and apoptosis. Apoptotic responses are critical to oyster immunity and specialization of the apoptotic response to diverse pathogens may be vital to successfully combating different diseases. An extremely successful intracellular parasite, *P. marinus* invades and replicates inside hemocytes. Apoptosis could be a critical mechanism used by hemocytes to clear *P. marinus* because cell death of an infected hemocyte kills intracellular *P. marinus* cells, preventing their proliferation; however, *P. marinus* produces serine proteases and superoxide dismutases that inhibit apoptosis and aid in its survival.

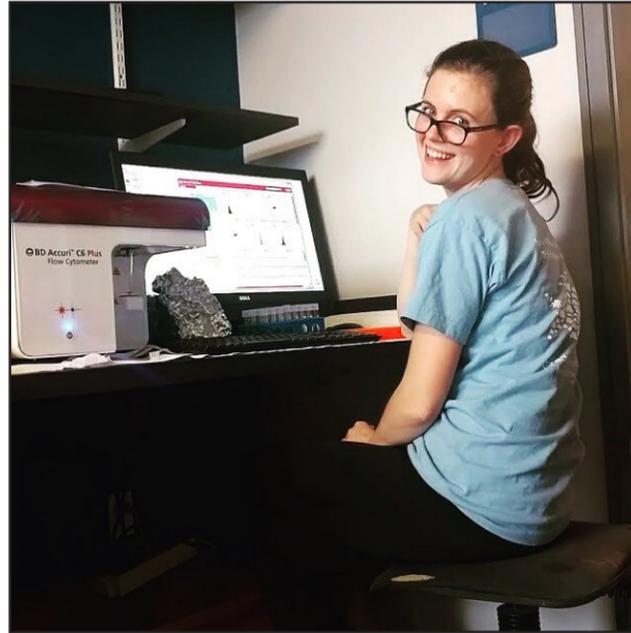
Previous research comparing apoptotic responses in susceptible *Crassostrea virginica* and resistant *C. gigas* oysters revealed that while both oysters experience suppression of hemocyte apoptosis at early time points due to parasite inhibition, at later time points the naturally resistant *C. gigas* oysters overcome apoptosis suppression faster than susceptible *C. virginica*, suggesting that hemocyte apoptosis may be an effective defense response. Despite previous research, mechanisms underlying Dermo response and resistance are not fully understood.

This project aims to gain insights into general mechanisms of apoptosis in the eastern oyster, better understand the role of apoptosis in disease resistance to Dermo disease, and find what specific apoptotic mechanisms may be involved in Dermo response. To better understand the specific role of apoptosis in Dermo susceptibility and the apoptotic mechanisms involved, a collaboration with Dr. Dina Proestou (USDA ARS) and Dr. Gary Wikfors (NOAA NEFSC) to investigate hemocyte apoptosis following Dermo challenge in oysters with known Dermo-susceptibility took place last summer.

Oysters bred in the Chesapeake Bay with known Dermo susceptibility, provided from VIMS ABC (Stan Allen, Jessica Small), were challenged via injection into the adductor muscle with freshly prepared *P. marinus* ( $5 \times 10^7$  cells  $g^{-1}$  wet wt. *P. marinus*). Survival was monitored daily and moribund oysters were assessed for parasite load using qPCR. Hemolymph was

extracted from treatment and control oysters at 7d post-challenge. Using flow cytometry, the following parameters were measured: hemocyte viability, overall apoptosis phenotype, caspase 3/7 enzyme activity (key enzyme often involved in apoptosis execution), and lysosomal membrane permeabilization (cellular organelle potentially involved in apoptotic mechanism). Mantle and gill tissue were preserved and used to measure parasite tissue load using qPCR.

The results of this study showed a significant ( $P < 0.05$ ) decrease in the levels of hemocyte apoptosis in granular cells (the cell type which actively engulfs and becomes infected with Dermo). This response could indicate several hypotheses.



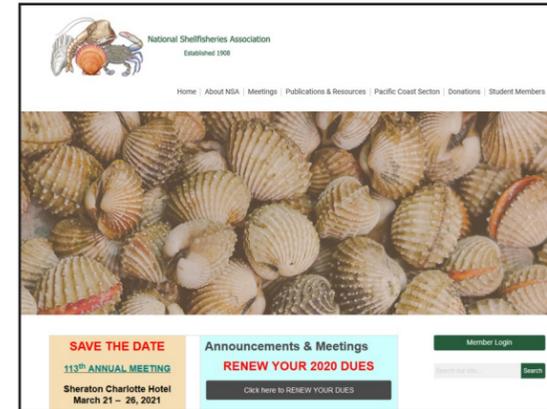
It could indicate that *Perkinsus marinus* is actively inhibiting the apoptotic response of hemocytes, or that there is an overall lack of host response. To investigate these hypotheses, the next critical step in our study is to measure the levels of apoptosis gene expression in the tissues and assess how they change between control and challenged oysters.

This study also revealed that granular hemocytes had no significant change in Caspase3/7 activation following Dermo injection. This could indicate lack of involvement of this enzyme in the apoptotic response to Dermo; however, this enzyme is critical for the apoptotic process during the course of normal development which could be masking our ability to detect a change due to hemocytes infected with Dermo. Future studies are needed to assess the activation of Caspase3/7 in hemocytes specifically infected with the parasite. Previous studies have indicated that a Caspase3/7 independent pathway may be involved in the mechanism of apoptosis in response to Dermo disease, but further investigation is needed.

The results of this study provide further support for previous studies identifying a suppression of apoptosis in susceptible oysters following disease challenge and represent a useful step forward to determine future assays to further assess the mechanism of apoptosis during Dermo disease and the role of this important cellular process in Dermo resistance.

## NSA Website Receives an Upgrade

Since 2013, the NSA website has been supported by the MemberClicks Classic platform. This platform is being phased out and replaced with the new and improved Oasis platform. Some benefits of this new platform include the option to auto-renew membership dues, pay dues for multiple years in one transaction, and automatic renewal reminders. Members will receive three notices notifying them that their dues will be expiring. These notices include a convenient hyperlink for ‘one click’ renewing. Take a moment and peruse the site ([www.shellfish.org](http://www.shellfish.org)) - if you come across any issues logging into your profile contact Noreen Favreau, the NSA webmaster ([webmaster@shellfish.org](mailto:webmaster@shellfish.org)).



## CALL FOR ABSTRACTS

74<sup>th</sup> Annual Shellfish Conference & Tradeshow (NSA-PCS/PCSGA) October 6-8<sup>th</sup>, 2020

Session topics include:

- Ocean Conditions: Climate Change, Ocean Chemistry, Acidification
- Marine Pathogens, Shellfish Disease, HAB
- Human Health Issues
- Emerging Species: Beyond Bivalves
- Kelp, Seaweed
- Restoration and Protection Efforts (Species and Habitat)
- Estuarine Habitat, Ecosystem Services, Multitrophic Interactions
- Genetics, Broodstock Development
- Wild Stock Management
- Public Engagement, Education and Outreach
- Markets, Trade
- Economics of Shellfish, Social Science
- Working Waterfront Conflicts
- Marine Debris, Microplastics
- Pest Management
- Down on the Farm: Shellfish Growers Trials, Tribulations and Triumphs
- Permitting and Regulatory Issues

For more information:  
<https://pcsga.org/annual-conferences>

## SAVE THE DATE Charlotte 2021



Photo credit: <https://www.flickr.com/photos/digidreamgraftx/>

113<sup>th</sup> Annual NSA Meeting  
Charlotte, North Carolina  
Sheraton Charlotte Hotel  
March 21-26, 2021

Many individuals who had sessions organized for Baltimore have already agreed to oversee those sessions in Charlotte. There is room for new sessions and workshops, send your titles or suggestions to:

[sandra.shumway@uconn.edu](mailto:sandra.shumway@uconn.edu)

**ABSTRACT DEADLINE  
DECEMBER 15<sup>TH</sup>, 2020**

Conference Cancellation Follow-up

If you have not received your refund, please contact the Secretariat ([secretariat@shellfish.org](mailto:secretariat@shellfish.org)).



## A Report and a Plea from the Membership Committee

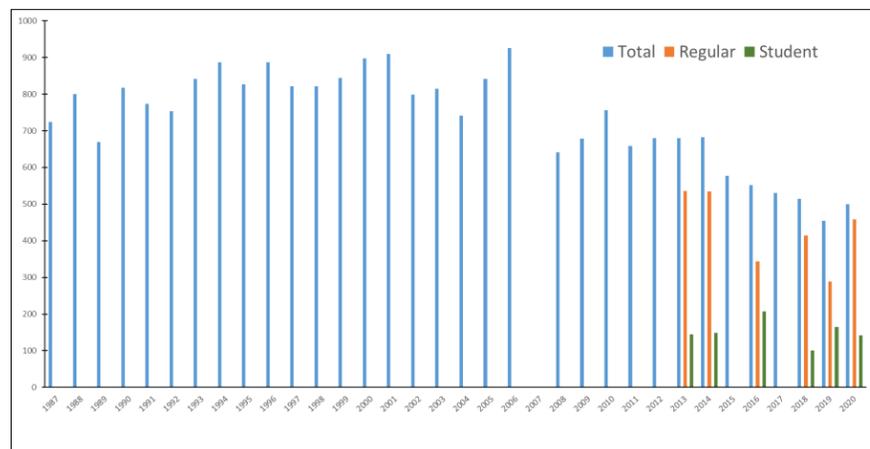
Membership is the backbone of the Association and keeping track of those members has been an arduous task, made easier in recent years by computer programs, but it remains a moving target if members forget to pay their dues or notify the Webmaster if they are dropping out.

The Membership Committee has been busy updating the current listings and making an attempt to clean up the membership lists as the NSA has migrated to a new web platform. This may sound like a simple task, but it is something that has plagued us for years, partly due to the workings of the membership portal, but mostly a result of members not renewing on time and members who have left the Association for various reasons, but remained in the system.

In an effort to remind as many people as possible that their memberships had lapsed, several attempts were made to contact prior members and recent members who had not renewed their memberships. A mass mailing was sent to all former members (438) active from 2013 to 2018. This included a self-addressed envelope asking individuals to tell us why they were not renewing. This resulted in 24 renewals. Only a few provided their reasons for not renewing which included retirements, new jobs or fields of interest, and three were returned marked deceased. Many were students or individuals who joined for one conference, and many were no longer valid addresses. Delinquent members who were paid for 2019 (171 including 55 students) received a post card reminder which resulted in 29 renewals (including 3 students), and a final email reminder was sent to this entire list which resulted in a further eight responses. The chasing and purging is complete and all information for individuals that did not reply will be moved to the archives and they will not be contacted again. Please note that the *JSR* and *Newsletters* will no longer be sent to individuals who are not current with their dues.

The graph below shows the membership numbers from 1987 to the present as best as they could be retrieved from old records. Note that there were always issues regarding both paid and unpaid members being listed together under the general heading of members, i.e. most of the numbers prior to 2007 are overstatements of actual paid members. It is hoped that going forward it will be easier to keep track of members more accurately by utilizing new features on the web portal. Members will receive automatic reminders, dues payment can be set up for automatic payment, and members can opt to pay for multiple years.

Students are important to the Association and have continued to constitute a significant portion of the membership. Only for recent years are numbers available to separate regular and student members. Many students become members for a few years during their degree programs or only join for one conference and then go on to other things, this is to be expected. So while the individuals change, the number of students remains fairly constant.



Currently there are 364 regular members and 142 student members for a total of 506. The Pacific Coast Section has 50 current members (including 40 regular members, 4 HLM, 4 students, and 2 sustaining). Remember that students receive all of the benefits of membership and conference participation, but at drastically reduced rates, i.e. the society subsidizes their participation at every level. Not only does the NSA need your support, it needs new regular members to provide the backbone and stability that will allow continued support for all of our activities and students. We point it out regularly, but if every member recruited just one new member, we would double in size. Over the years there have been contests, pleas, mass emails, and individual letters and requests to renew. They

have all brought but a handful of new members. Maria Rosa was successful in recruiting five new members and received a free year of membership. Most recently Acacia Alcivar-Warren and her team at FUCOBI (see article on p. 5) have been very successful in their goal to engage minority students and students from developing countries. Five students will receive a year of free membership for recruiting five new members each. There are 30 student applications pending, and it is the goal of FUCOBI to continue their recruiting efforts. These are great examples of what can be done if one steps up and makes an effort.

Paying your dues or enrolling new members is easy at [www.shellfish.org](http://www.shellfish.org). If the National Shellfisheries Association is to remain a vibrant and successful society, the members need to do their part in keeping it so. Members receive email reminders, *Newsletter* reminders, and reminders on the *JSR* mailing sheets to pay their dues. The new MemberClicks portal will send automatic reminders (3). This all takes time and effort – please remember to pay your dues on time and encourage your colleagues and students to become members. A membership is also a great gift.

Welcome to all of our new members, thank you to our sustaining members (especially Past-President Scott Siddall who took advantage of the new multi-year option to renew as a sustaining member for 5 years), and remember, the NSA is, and always been, an open and welcoming society.

**The Membership Committee**  
**Sandy Shumway**      **Michael Doall**  
**Steve Allen**         **Louis Plough**



## Aquaculture and the Press: A Way Forward

I'm not surprised that oyster farmers are frustrated with the press. Reporters often come around when there is news, and a lot of that is not positive: a *Vibrio* outbreak after a seafood feast in a resort town; a wealthy property owner claiming unsightly cages will distort their view and therefore filing a lawsuit to block an oyster farm; a fisherman who has worked a certain oyster bottom for centuries, claiming a new aquaculture operation – often started by entrepreneurs who are “not from here” – is going to kill their livelihoods.

Reporters cover both sides of an issue, so they may give equal weight to the property owners who wish for a pristine view and the shellfish farmer who invests his or her own money into cleaning up the Chesapeake. Often, after the first both-sides story that gives maybe a quote from each side and little context, the oyster farmers will tell me they're fed up. Why bother talking to the press anymore if that's what they're going to get?

As a reporter who has covered the Chesapeake Bay since 2004 and the Maryland and Virginia shellfish industry for almost as long, I am also frustrated with the shallowness of coverage on many marine issues, particularly shellfish farming. When I was a reporter for *The Baltimore Sun* and *The Chesapeake Bay Journal*, I invested many hours in visiting oyster farms, getting to know the legal issues with both neighbors and government agencies, and determining how to tell nuanced stories of an industry that helps our nation's waterways at no cost to taxpayers. At one point, I knew just about every oyster farmer in Maryland by name; I'd been to most of their farms, I'd met their dogs, and I was familiar with their issues.

Oyster farming captured my attention because I covered it in Maryland at a time when public investment in the fishery was dwindling, and the oyster population needed a way to recover. Tired of writing about the doom and gloom that so often hangs over environmental stories, I discovered a topic that gave me hope. It didn't hurt that oyster farmers, unlike, say, the air pollution regulators, were always willing to talk. But reporters today do not have that kind of time. When I left *The Baltimore Sun* in 2008, the staff had 525 journalists. They would be lucky to have 100 today. It's a similar story at *The Hartford Courant*, *The Richmond Times-Dispatch*, and many other regions. And those are the lucky places – they still HAVE a newspaper. Chances are the “environmental” reporter is also covering medicine, the legislature, and filling in on the crime beat. Nuanced reporting on a subject they don't really understand is not going to be easy.

All is not lost, though. Here are a few solutions to improving the situation:

- Get to know your reporters. Determine the major news sources where you live – TV, radio, newspapers, and blogs if there are any large ones. Call them and ask who covers the environment. Get their contact information, and reach out. Introduce yourself, and tell them you are here to be a resource for them on any shellfish story.
- Schedule a media day. Invite your news reporter to your farm – or, better yet, get a group together and make it a yearly event where you visit different farms and hatcheries. Explain how oysters grow, and have a chef on hand to prepare them. Ask your partners from the State Natural Resources Agencies, Extension, and Sea Grant to join. The reporters will likely prepare stories on the “day,” but a lot of them will also file away the information and come back to you when there's shellfish news.
- Establish contact with your state legislators, and keep the channels open. Legislators have aides who are in frequent contact with the press, and their action or inaction on different bills is the basis of many stories. Throughout my years of reporting, I've often covered a repeat of this tale: a well-heeled waterfront homeowner asks for a legislator to introduce a bill that would prohibit an oyster farm. He (it's always been a man) then realizes the homeowner didn't provide all the facts, and the bill either dies on its own or the legislator kills it. The most recent example in Maryland occurred in August 2016. Tal Petty of Hollywood Oyster Co. wanted a lease in front of the historic Sotterley Plantation. His neighbors fought him, but the state approved it. Unhappy with the result, they found a delegate three hours away, in Baltimore, to introduce a bill that would have prohibited oyster farms from being near National Historic Landmarks. The only active oyster farm that it would have impacted was, you guessed it, Petty's lease at Sotterley. The Sotterley advocates showed photos of cages on top of the water to make the case that the farm would obstruct their view. In reality, Petty used cages on the bottom; only three buoys were visible on the surface. When confronted with a photo I took of Petty's situation – no cages visible – the delegate told me he'd made a mistake. He let the bill die, but only after it had passed the Maryland House of Delegates 139-1. If the delegate had understood how oyster farming worked, he likely wouldn't have introduced the bill in the first place, saving everyone lots of time.
- You have a positive message – keep repeating it. Oyster and clam farms employ people in coastal areas where few waterfront jobs remain. The bivalves help to clean the water. The farmers fund that environmental benefit on their own, though the whole state shares in the bounty of cleaner water and greater biodiversity. It is a sustainable way to grow seafood at a time when most fish and shellfish populations in the oceans and Bays are under immense stress. It's a good story, and a true one, and the more you tell it, the more likely it will be to stick.

Following these steps is no guarantee of better coverage. But there's a good chance that when reporters call you following an outbreak of food poisoning after a tourist ate shellfish at a seaside restaurant that you will have laid the groundwork for a conversation about more than just the negative. If you have developed a relationship, chances are whatever story they run will at least acknowledge the benefits of aquaculture. You should also remind them, though, that food poisoning from oysters is rare. Until there's confirmation from the health department, we can't be sure it wasn't the macaroni salad.

**Rona Kobell**

Science writer and Editor for Maryland Sea Grant, where she edits the magazine *Chesapeake Quarterly*

## Recruits' Corner

### Welcome to the new Recruits Co-Chairs

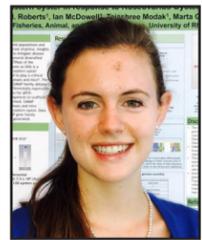


Hannah Collins  
hannah.i.collins@uconn.edu



Alexandra Marquardt  
armarquardt@vims.edu

Hannah is pursuing her M.S. at UConn researching the effects of microplastics on blue mussels, and Alex is beginning her Ph.D. at VIMS after completing her M.S. at California Polytechnic State University.



### A great thanks to the out-going Co-Chairs, Erin Roberts and Laura Spencer!



## Membership Contest Winners

Each FUCOBI member is going to receive free 2021 NSA membership for recruiting 5 members each!

Marcelo Victorio-De los Santos, México  
Mayra Galindo Larrea, Ecuador  
Gober Asunción Peláez, Ecuador  
Lisett Herrera González, Ecuador  
Pedro Alcivar Marcillo, Ecuador  
Miriam Alcivar-Arteaga, Ecuador

**Congratulations!**

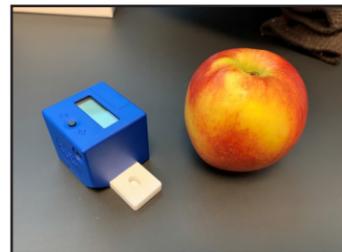


## Safe & Sustainable Shellfish: Introducing Local Testing and Management Solutions

Shellfish are an essential commodity for the USA, employing a huge number of people and producing a revenue in excess of \$300 million per annum; however, as filter feeders they are susceptible to the accumulation of the biotoxins produced by some algae, presenting a hazard to human health. Public health is protected by implementation of the National Shellfish Sanitation Programme. The presence of biotoxins above regulatory levels in shellfish tissues, represents a business critical issue for the producer and a risk to public health. Furthermore, the opportunity for business expansion is limited by the impact of sporadic unpredictable suspension of shellfish harvesting. Hence, there is an urgent need for a rapid, simple, quantitative multi-toxin analysis that can be applied at the shellfish harvesting site to facilitate management remediation strategies.

Safe & Sustainable Shellfish: Introducing local testing and management solutions is a consortium project funded in the UK by BBSRC/NERC Joint Call in Aquaculture: Collaborative Research & Innovation. The consortium led by Robert Gordon University (RGU) includes; Centre for Environment, Fisheries & Aquaculture Science (Cefas), Queen's University Belfast, Plymouth Marine Laboratory, Association of Scottish Shellfish Growers, Agri-Food and Biosciences Institute, Food Standards Scotland, Cromarty Mussels Ltd., West Country Mussels, Scottish Aquaculture Innovation Centre (SAIC), Food Standards Agency & Cornwall Port Health Authority.

The aim of this Consortium Project is to develop effective rapid biotoxin testing of shellfish supported by early warning through remote sensing and phytoplankton analysis. This, combined with the deployment of a photocatalytic curtain to protect harvesting sites, will ensure that the impact of biotoxins on shellfish production areas will be mitigated, supporting expansion of this important industry as reported in the UK industry newsletter "The Grower" in April 2020 ([www.assg.org.uk](http://www.assg.org.uk)). A simple lateral flow paper-based test for quantification of multiple toxins using a simple, portable reader has been developed by the team (Figure 1).



Portable biotoxin reader.  
Photo credit: Michael Dillon

Another aspect of the project led by Plymouth Marine Laboratory explores the link to routine monitoring and remote sensing data (ShellEye). Finally, we are developing a photocatalytic curtain for destruction of HABs and their toxins in the vicinity of the mussel ropes. Okadaic acid, one of the main DSP toxins, dissolved in artificial seawater was completely destroyed in 20 minutes with no residual toxicity <https://www.sciencedirect.com/science/article/pii/S0048969720328631>. Over the next few months we will challenge live dinoflagellates by this technique.

If you are keen to attend a workshop on toxin detection with our rapid test kit please contact Prof. Christine Edwards ([c.edwards@rgu.ac.uk](mailto:c.edwards@rgu.ac.uk)) for further information.

**Christine Edwards**  
**Robert Gordon University**

## The FUCOBI Foundation of Ecuador – A growing presence at NSA



The FUCOBI Foundation is a non-profit organization that promotes, manages, and conducts scientific research of aquatic and terrestrial species in order to conserve the biodiversity of the species and the natural and original environment of the resources where they live. To further their mission, FUCOBI developed the ONE HEALTH project, which incorporates a holistic concept of maintaining healthy ecosystems, obtaining healthy animals, and protecting public health. The ONE HEALTH is directed by Dr. Acacia Alcivar-Warren, D.M.V.Z, M.Sc., Ph.D., and former President of FUCOBI. Dr. Alcivar-Warren's fields of expertise span molecular biology, genomics, zoonotic diseases, reproductive physiology and endocrinology, biotechnology, and epigenomics. She examines shrimp genomes (*Litopenaeus vannamei*, *Penaeus monodon*, *Pandalus borealis*) to help the shrimp industry breed healthy,

environmentally-friendly, pesticide-free and high-growth shrimp, while tracking environmental and animal fingerprints. She has worked since 1998 on projects based on the holistic concept of ONE HEALTH in the Philippines, Thailand, and other countries.

In 2017, FUCOBI partnered with Environmental Genomics, Inc. (EGI), a family-run small business that helps develop the aquaculture of local, glyphosate-free shrimp (*Pandalus borealis*) in the northeastern US, and promotes aquaculture of *Penaeus* species from US coasts, raised with organic feeds free of hormone disruptors or ingredients from genetically engineered-based crops. Environmental Genomics Inc. funds research opportunities and educational activities for national and international students of the FUCOBI Foundation for presentation at international meetings. Environmental Genomics Inc. also supports travel and NSA memberships for students, postdocs/research associates, and NGO and senior volunteers to attend the annual NSA meetings.

Considering the challenges of providing opportunities to promote the research projects of minority students and students in developing countries, Dr. Alcivar-Warren found the NSA meetings the best venue for presenting educational, basic science, environmental, health, and related issues. Over the past 14 years, FUCOBI and EGI have worked closely with Dr. Sandy Shumway and found a welcoming and comfortable venue for their students and researchers. Over the years, they have worked to increase their participation in the annual conferences. The ONE HEALTH and ShrimpENCODE projects now have full sessions at the annual meetings, and FUCOBI has generously offered cash awards for student presentations, and sponsored travel for minority NSA students. Most recently, efforts by FUCOBI to encourage their colleagues to become NSA members was hugely successful - 30 colleagues, representing nine countries, joined NSA last year and all of whom hope to attend the meeting in Charlotte (see p. 12).



Acacia Alcivar-Warren, Diego Alejandro Tigrero MD, and Karina Alejandro Rosales MD at the 110<sup>th</sup> Annual Meeting in Seattle, Washington.

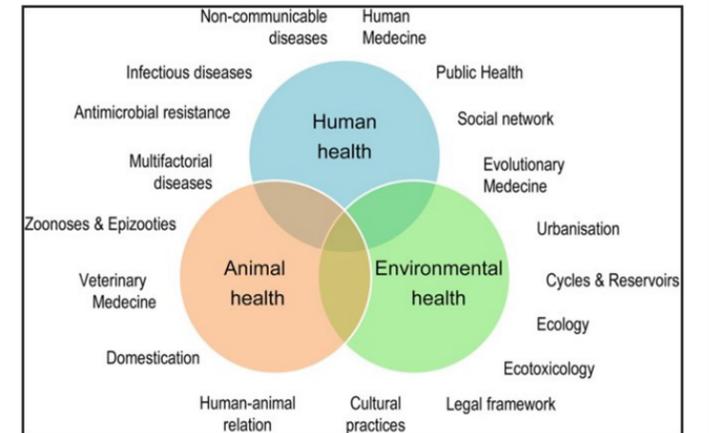


The FUCOBI Foundation and Environmental Genomics look forward to continuing their association with the National Shellfisheries Association to provide a venue for their research findings, the opportunity to form new research collaborations, and to provide rewarding experiences to their members.

### Dr. Acacia Alcivar-Warren



FUCOBI students at the 2019 Triennial meeting in New Orleans. From left to right: Lissette Roman Serrano (Ecuador), Andrea Alejandro Rosales (Ecuador), Marcus Vinicius Canário Viana (Brazil), Yiping Chen (China) and Marcelo Victorio-De Los Santos (Mexico). Photo credit: Ms. Miriam Alcivar Arteaga, FUCOBI President.



The ONE HEALTH concept: a holistic, transdisciplinary, and multisectoral approach of Health. Taken from Destoumieux-Garzón et al., 2018.

# 2019 Michael Castagna Student Research Grant Update

Awardee: Daniel J. Bowling  
North Carolina State University

“Research in Support of a Stock Assessment Survey for Oysters in North Carolina”

For many Atlantic coast states, the eastern oyster, *Crassostrea virginica*, bares significant ecologic, economic, and social importance. Despite a trending population decline in most regions over the last century, the natural fishery stock continues to provide needed jobs and natural resource revenue, while fulfilling numerous well-documented ecosystem services, such as water filtration, shoreline stabilization, and the provision of nursery habitat. The eastern oyster is a unique species as it not only provides these critical services, but it is also a valuable fishery to stakeholders in its own right. Such an important species commands the need for ecological monitoring in both habitat and fishery capacities, which can be extremely challenging as they sometimes embody opposing objectives. North Carolina has programs in place to guide management of the eastern oyster, but a traditional stock assessment has never been conducted. It is currently listed as a species of concern due to historic decline and data deficiency. This collaborative, multidisciplinary research is partnering with The North Carolina Division of Marine Fisheries, The Nature Conservancy, local oystermen, and other university colleagues to address critical data gaps such as oyster habitat size and distribution, oyster densities and abundance, and oyster mortality by enhancing current survey methods and providing recommendations to management and support a future stock assessment.



D. Bowling and local oystermen using dredge gear to assess 2019-2020 post-season condition of oysters on the natural reefs around Crab Hole, Pamlico Sound.

To assess the subtidal reefs, a fishery-independent methodology was developed and piloting of the study across natural reefs in the Pamlico Sound was initiated in the fall of 2018. This methodology used side-scan sonar and mapping, diver excavation surveys, and power dredge gear (a method that is utilized and supported by the commercial fishermen) to establish oyster densities, new mortality, size-frequency demographics, and reef substrate quality. While the typical oyster dredge is not efficient, this research demonstrated how it can be effectively applied to sample large areas and generate a more robust average density, abundance estimates, and size-frequency data. This can result in an ideal overall representation of oyster density and reef health for an area due to the careful calibration of dredge efficiency through diver surveys, standardized sampling methods, and the incorporation of gear experts from the commercial fishery.

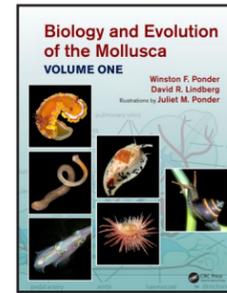
A similar, but unique, approach was applied to evaluate and monitor the intertidal oyster population. Despite near full exposure twice a day, the extensive intertidal reef complex remains difficult to access and navigate thanks to a short tidal window. To address such challenges, a new survey methodology paired traditional quarter square meter quadrat ground-truthing techniques with cutting edge drone technologies and unmanned aerial vehicles (UAV) to improve survey sample size and efficiency, generating high-resolution aerial maps. In the last year, hundreds of acres of intertidal reef were mapped and ground-truthed to test new survey methods and evaluate the ability to detect a change in oyster density, size-frequency demographics, and reef footprint over time. Working with North Carolina Division of Marine Fisheries, long-term monitoring sites, referred to as sentinel sites, were established along with research into developing best practices for drone monitoring. Nearly thirty years have gone into generating a complete illustration of NC intertidal reefs with previous mapping programs, and the hope is that with advancing technologies and sound methodologies future reassessments can be completed in a fraction of the time.

While both sections of the project demonstrate their ability to evaluate reef distribution, and oyster density and demographics of the stock due to fishery influence, notable impacts from Hurricane Florence and Dorian were also observed. These observations include heavy sedimentation on reefs, strong water column stratification, hypoxic and anoxic conditions, and reduction in reef material, all correlating with an overall decrease in oyster density during the same time period. In some cases, a 90% decrease in oyster density per square meter occurred across study reefs, with an average overall decrease in density of 64% for the entire study area. With a forecasted increase in tropical storm frequency in the decades ahead, fishery-independent surveys are just as vital for monitoring water quality and storm-induced mortality as fishery mortality. While further study is needed, preliminary results suggest that reef size, profile, and location will significantly influence the severity of storm disturbance and resulting oyster mortality. In short, shallower oyster reefs, with elevated profiles and larger footprints may fare much better offering buffering from forcing events, hypoxic water, and sediment burial.

Taking these findings into consideration, I plan to investigate fishery induced and natural mortalities, and dredge discard fate in the upcoming year. These are critical data gaps that require an extension and further investigation to build toward a future stock assessment. Future fieldwork will also continue to refine dredge efficiency estimates through additional surveys and pre- and postseason data collection. Time will also be allocated to discern drone survey mapping accuracies, considering factors such as water and light level, wind speed, and ground control points (GCP), to improve estimates for potential habitat area and oyster abundance.

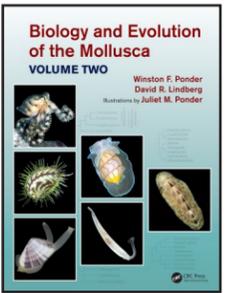
As the project moves forward, I aim to highlight the most notable achievement and embed it as a central focus: the effective collaboration and inclusion of fishermen, researchers, and resource managers in all project facets. Integration across disciplines and professions has resulted in a diverse and well-rounded approach, a fostering of trust, and improved standardized practices. The hope is that such methods could serve as an exemplary model for all state fisheries as they strive to improve stock management, integrate stakeholders, and adapt to future environmental challenges.

## Book Review: Biology and Evolution of the Mollusca Two Volume Set



Volume 1 (900 p.; 303 color and 18 b/w illustrations) and Volume 2 (870 p.; 250 color and 993 b/w illustrations) 2020. Ponder, W.F., D.R. Lindberg and illustrated by J.M. Ponder. Taylor and Francis Publishers, CRC Press. Baton Rouge, LA. Hardback (\$250/\$240) and eTextbook available.

A little over a decade ago, Ponder and Lindberg published *Phylogeny and Evolution of the Mollusca* which was applauded at the time as a ‘tour d’force’, but they have outdone themselves here. Want to know how Edgar Allen Poe influenced conchology? Why it is so difficult to ascribe an ancestral mollusc? Fact check your favorite group of molluscs? This new publication has it all.



The current work is divided into two volumes, the first providing an overview of physiology and genomics, anatomy, function, movement, reproduction, feeding, digestion, excretion, respiration, nervous system, sense organs, natural history, and interactions with humans. The second volume covers relationships of molluscs with other animal groups and of the class level taxa within the Mollusca, early fossil history, phylogeny, classification, and evolutionary relationships. It is gratifying to see that all groups are given equal coverage within the limits of available information.

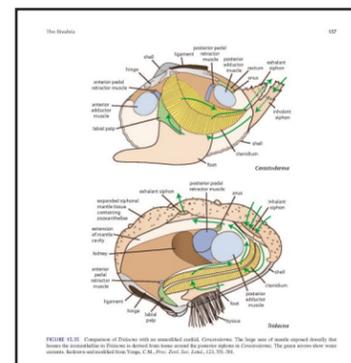
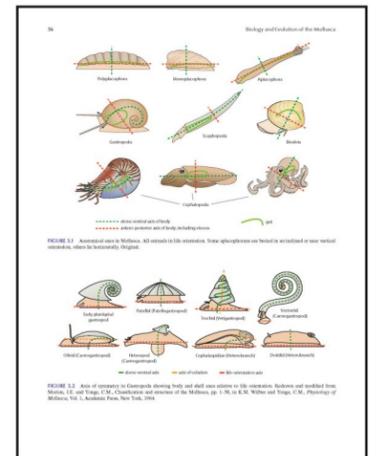
Before you panic over the price tag, please take the time to consider the product. Yes, I read it all and my first comment is that it is very readable, even the taxonomic sections. A lot was a refresher course, but much was new to me, especially information regarding the gastropods and minor groups. Reading about scaphopods, monoplacophorans, scutopods, and other groups that rarely make it to the forefront was most enjoyable.

The ability of the authors and illustrator to present integrated material succinctly and clearly is a testament not only to their decades of scientific study (almost a century between them), but to their ability to synthesize that material and discuss it within and across groups. Their many years of field work also come to the forefront - in much the same way as demonstrated by Vera Fretter and Alistair Graham over a half century ago. Figure 1.1 is the first example of this effort where all of the organs are presented as a color-keyed diagram across classes to demonstrate anatomical relationships among them. This color system is used throughout the volumes and adds immeasurably to the ease of use of the text. Notes on natural history are a common thread in the current work.

Beautifully illustrated throughout by Juliet Ponder, the color plates were carefully chosen to demonstrate the beauty and diversity of molluscs. The diagram of *Mytilus* anatomy is missing the exhalant siphon, a minor omission and the only one I noted!

The final chapter on present and future directions for molluscan research touches upon museum collections, research workshops, DNA barcoding, and genetics are all brief and the authors offer an interesting suggestion in the section on text mining to turn the almost half million entries in the Web of Science into data that could help with the usefulness of digital resources. There is a 180-page illustrated Appendix on the classification of all extinct and living members of the extant classes of molluscs, and the Index is detailed and useable. The volumes are heavily cross-referenced throughout, and there are numerous text boxes. As the authors note, their EndNote database contained over 30,000 references.

The authors suggest that the future for rare and endangered molluscs is generally bleak because public concern and conservation efforts are focused so heavily on vertebrates. Sadly, we all know it is easier to garner sympathy and support for a flailing whale than for a struggling snail. The set ends with a section entitled ‘The Future (21.8)’ in which the importance of relationships between living taxa and extinct ancestors is stressed. Short discussions on the value of text mining, new technologies, phylogenetic and evolutionary research, biodiversity, and citizen science are presented. If you have an opportunity to take part in a Molluscan BioBlitz event, take it.



The two volumes in hardback are expensive, so is the eTextbook, which has limited accessibility. The book has already started to appear on Amazon in various categories. At this writing a new hard copy of Volume 1 was available for \$157 and Volume 2 for \$209. The eTextbook is \$159 and \$210, respectively (available on iOS, Android, PC & Mac, Kindle E-readers and on Fire Tablet devices) - I strongly recommend purchasing the actual book, if not for your personal library, recommend it to your librarian!

This two-volume set is a treasure trove for anyone lucky enough to be teaching malacology, a reference work for investigators in a multitude of fields, and a true companion for students and advanced researchers. It will stand for decades, joining immediately the list of classic volumes covering the Mollusca. A tour d’force that speaks to the knowledge, dedication, and talent of the authors, illustrator, and also to the publisher that had the vision to make such an epic possible in today’s publishing world. The authors note that they hope their effort will provide the tools necessary to train and inspire others to investigate and document this amazing group of animals - I believe they have done that and so much more.

Sandra E. Shumway

### References

Ponder, W. F. and D.R. Lindberg (eds.) 2008. *Phylogeny and Evolution of the Mollusca*. Berkeley, CA University of California Press.  
Fretter, V. and Alistair Graham 1962. *British Prosobranch Molluscs Their functional anatomy and ecology*. Ray Society, London. 755 p.

## Restoring Oysters to Urban Waters: Twenty Years of Research and Restoration Efforts

Oysters are making a comeback in New York City. No, we're not talking about raw bars and cocktail parties. The eastern oyster (*Crassostrea virginica*) is returning to the Hudson River, the East River, Jamaica Bay, and the rest of the waters surrounding the five boroughs. Just a few decades ago, restoring oysters to New York Harbor would have seemed an effort destined to fail. The waters were too polluted and the Harbor was a forgotten place. What began as grassroots efforts in the late 1990s to see if oysters could merely survive in these waters has evolved into professional restoration endeavors with promising results and momentum.

Now is the perfect time to look back on the past two decades of oyster restoration and research in the waters surrounding New York City. *Restoring Oysters to Urban Waters* tells the story of *Crassostrea virginica* in one of the most heavily urbanized estuaries in the world. These waters have been the subject of over 20 years of research and restoration, and a significant scaling-up of efforts is planned for the near future. Now is the time to shape the future of oyster restoration practice in New York City and other urbanized estuaries through a look back at how we got here.

*Restoring Oysters to Urban Waters* assesses past efforts and synthesizes the lessons learned and challenges ahead. Before New York was the *Big Apple*, it was the *Big Oyster*, so the report begins by summarizing the history of oysters in New York Harbor. It reviews past and present efforts to bring oysters back to these waters and involve communities in the process. And it argues that restoring oysters can have large ecological benefits even in urbanized estuaries.

Over the past 20 years of restoration activities there have been many lessons learned. Restoring oysters to New York Harbor is especially difficult because of several factors. Like the saying about New York goes, "If you can make it here, you can make it anywhere." Oysters are functionally extinct in New York Harbor today, with less than 0.01% of the historical population surviving. They face challenging environmental conditions (e.g., frequent low oxygen events, strong currents and wakes) and challenging economic realities. Unlike other estuaries where oysters are restored to enhance commercial stocks, oysters restored to New York Harbor cannot be harvested for consumption. This means the case for restoration is made solely on the ecosystem services they can provide.

Despite these challenges, oyster restoration is moving forward. Restored oysters grow and survive, but oyster growth and survival alone cannot ensure that the population will be self-sustaining. Future restoration efforts must focus on understanding and achieving successful reproduction and recruitment. If restoration is successful even small amounts of restoration can lead to big ecological impacts. Even a restoration project as small as 10 or 20 acres may provide substantial water filtration and biodiversity enhancement. More than 20 species of fish that are known to be enhanced by oyster restoration in other estuaries occur in New York Harbor, including striped killifish (*Fundulus majalis*), skillettfish (*Gobiosox strumosus*), oyster toadfish (*Opsanus tau*), and blue crab (*Callinectes sapidus*). These species will benefit from restored reefs. Furthermore, in an urbanized estuary like New York Harbor, the social benefits of engaging community members, educating them about the Harbor, and providing opportunities to interact with the water may be one of the greatest successes of oyster restoration.



Photo credit: The Nature Conservancy

There are also key challenges and recommendations for moving oyster restoration forward in these waters, which *Restoring Oysters to Urban Waters* identifies. Restoration activities must scale up, and innovative financing is needed. Investment in education and engagement should be continued. Restoration practitioners and permitting agencies must work together to develop mutually agreeable conditions allowing restoration activities to proceed and to minimize potential public health risks. Practitioners should continue to monitor, learn, adaptively manage, and refine best practices. The restoration community should develop a shared plan that specifies the locations, timing, and methodologies, that is based on stakeholder engagement and the desired level of services provided by a given investment in restoration.

This report celebrates the hard work and dedication of nonprofits, community members, researchers, and government agencies to bring this powerful bivalve back to New York Harbor. It has been jointly published by The Nature Conservancy and the Billion Oyster Project. Since 2016, The Nature Conservancy has partnered with the Billion Oyster Project whose objective is to restore oyster reefs to New York Harbor through public education initiatives. To date, the Billion Oyster Project has planted over 30 million oysters, and collected and recycled 1.5 million pounds of shell. The Nature Conservancy provided scientific and technical expertise to characterize impacts, understand challenges, and improve outcomes. Together, the organizations have worked to improve the health of New York Harbor. The web version of the report is available for download here: <https://www.nature.org/content/dam/tnc/nature/en/documents/new-york-city-restoring-oysters-lessons-learned-2019.pdf>

**Mike McCann, Ph.D., Urban Marine Ecologist, The Nature Conservancy**  
**Katharine McGlynn, Marketing Manager, The Nature Conservancy**

## 2019 George R. Abbe Student Research Grant Update

Awardee: Jordanna Barley  
University of Massachusetts Amherst

### "Exploring Mechanisms Underlying the Range Limit of a Marine Crab in a Warming Hotspot"

Anthropogenic climate change is reorganizing the distribution of biota in marine ecosystems. Species in all ecosystems are faced with either rearranging biogeography, evolving to maintain ability to live in their current habitat, or becoming extirpated or extinct. It is clear that many species are able to move to new habitats; however, it is not well understood why some species seem to have stable range edges despite drastic warming in recent years. It is important to understand the response of species to warming temperatures, especially when species undergoing range shifts occupy a novel role within the ecosystem. These species, in particular, have the potential to radically disrupt the communities with deleterious effects on biodiversity. Therefore, understanding the implications and mechanisms of range shifts in habitat-altering species is critical in forecasting changes in marine coastal ecosystems.

The herbivorous purple marsh crab (*Sesarma reticulatum*) is of increasing concern to managers because of its contribution to the collapse of New England salt marshes. Salt marshes, an ecologically important coastal ecosystem, provide nursery habitat for many shellfish and fisheries species and ecosystem services such as shoreline protection. More recently, connectivity within coastal habitats has been shown to preserve the ecosystem services that these habitats provide. Coastal ecosystems have undergone significant declines and connectivity interruption over the last century, putting the important ecological services they provide at risk. Increases in populations of *Sesarma* have been strongly linked to salt marsh vegetation declines. As the ocean warms, there is increasing concern that habitat-altering species such as *Sesarma* will expand their range to new ecosystems.

Sea surface temperatures (SST) along the east coast of the US are increasing at an unprecedented rate. The Gulf of Maine (GOM) is warming faster than 99% of the global ocean in large part due to a poleward shift in the Gulf Stream current. Within the GOM, Cape Cod is a major biogeographic break serving as a range boundary for hundreds of species. Evidence suggests that at least two marine species in the GOM are undergoing active range expansions, and temperature may be a driving factor in this phenomenon. Thermal tolerance is a common inhibitor of development for marine species and therefore could be constraining the leading range edge at which *Sesarma* exists. The GOM therefore is the ideal system in which to test the constraints of species range limit expansion.

The mechanisms underlying range limits are poorly understood, despite the well-documented effect of climate inducing distributional shifts. There is significant heterogeneity in the direction and rate of documented distribution shifts, and further studies are needed to determine mechanisms driving species distribution changes. This research project examined the potential for *Sesarma* to expand to new salt marshes in New

England and clarify the causal mechanisms that set the range limit of this species.

Because the exact current range edge was unknown, sites were chosen on Cape Cod during the summer of 2019 to determine the current range limit of *Sesarma*, and populations were reevaluated in known salt marshes as well as in marshes where they had not been previously found. Presence/absence surveys were conducted at night-time low tides because of the nocturnal nature of this species. Because *Sesarma* mainly inhabits the low tidal elevations of salt marshes, the search started at a random point in the lower tidal elevation of each marsh, pulling back vegetation to look for burrows as well as crabs. Once one male and one female *Sesarma* were found, the search was abandoned. If no crabs were found within the 30 minutes, the search was abandoned. It was successfully determined that Provincetown, MA was the northern-most location that *Sesarma* inhabits indicating this species has a relatively stable range edge that is not expanding at the same rate as other, similar species (*Minuca pugnax*).

Ovigerous female *Sesarma* were also collected from two sites (Provincetown, MA, the range edge; and West Dennis, MA, a range interior population) for larval temperature experiments. Larvae released from the adult females of both populations were collected and subjected to six temperature treatments to determine the temperature threshold for larval development, a critical point in understanding the role temperature plays in this species' range limit. Differences in the length of larval development periods were also investigated which could provide understanding of whether this species is locally-adapted and therefore more likely to be able to expand its range north. It was found that the temperature threshold for



Picture of a *S. reticulatum* megalopa (bar is 996 µm).

larval development is 18°C, which indicates that temperature is not the driving factor of the range limit of this species since much of the GOM is already well above this threshold for most of the summer. Preliminary results also suggest that the interior population (West Dennis) develops significantly faster than the range edge population (Provincetown) which means that this species does not show evidence for local adaptation in the larval development time. This might be hindering the range expansion north for *Sesarma*. Future efforts will investigate how larval behavior can affect dispersal ability to further elucidate the mechanisms of setting the range limit of this species.



## COVID-19 and the Shellfish Industry - What's Next?

As Executive Director of the East Coast Shellfish Growers Association, I get to help hard-working, proud farmers produce a great-tasting, sustainable product while helping the environment. In times like these, my job takes on a new sense of urgency. Our community is taking a huge hit. Sales are a small fraction of those needed to cover expenses, and the uncertainty about the future is eroding everyone's confidence. We were riding high on a renaissance of oyster consumption and then it suddenly ground to a halt.



It has become painfully obvious that the fate of our industry is inextricably tied to the survival of restaurants (perhaps more so than any other food). When restaurants closed, oyster sales plummeted 90% in just a few days. While some restaurants are trying to hang on with takeout and delivery, the National Restaurant Association estimates that 20-40% may not survive. With some eateries cautiously reopening, sales are somewhat recovering, but as of mid-June oyster demand is still down by about 75%. Clam consumption has not been hit quite as hard, but clam growers in Florida are suffering from unprecedented weak demand.

Government relief efforts have been rushed without fully defining rules and expectations. Announcements about various programs are coming out at a furious pace, often changing on the fly. If you are not a member of the ECSGA Listserv you are missing out on the main tool I have for keeping members informed about what is available and how to apply. We also post updates on our website blog ([ecsga.org/blog](https://ecsga.org/blog)) on a regular basis. Many ECSGA members have been able to take advantage of the Payroll Protection Plan funds and the Economic Injury Disaster Loans offered through the Small Business Administration.

States are beginning discussions on how to disburse the \$300 million in Fisheries Disaster Funding allocated through the CARES Act, but these funds seem to be woefully inadequate for the many fishermen, processors, and shellfish farmers. In my state (RI), shellfish farmers that qualify (by documenting a 35% decline in revenues compared to the previous 5-year average) might receive about 17% of the revenues lost to date, while those losses continue to pile up week after week. I am most concerned about the potential for a price collapse. As the animals become too big for the raw bar market and growers get desperate for revenue, pressure to drop prices will continue to mount. If prices drop too far we would expect many growers to throw in the towel. It could take years to recover.

Hatcheries are taking a big hit as well because many growers are reducing or cancelling orders, and until they can make sales there is no place to put this year's crop. Gear suppliers and shellfish dealers are all feeling the pain. Some are optimistic that demand will recover as restaurants reopen, but data from the online restaurant reservation service OpenTable.com shows the number of sit-down meals is still off by 75% from the same dates last year. This number improves by ~5% a week, but all bets are off if we get a new wave of illnesses, and few predict a return to normal any time soon. Some growers have been able to pivot to on-line sales, home deliveries, and farmers markets, but it requires extra marketing efforts and rarely accounts for more than 30% of what they were selling last year.

We are actively exploring ways to take some product off the market to avert a price collapse.

- The ECSGA submitted a petition to the USDA Agricultural Marketing Service requesting the purchase of oyster meats for distribution to food banks under their Section 32 program, designed to purchase excess agricultural products to keep prices stable.
- Included in the CARES Act was \$16 billion for the Coronavirus Food Assistance Program (CFAP). Unfortunately, shellfish farmers were directed to seek relief from the NOAA Fisheries Disaster Funds instead of the USDA CFAP. We are trying to convince Senate offices that this was a big mistake and the shellfish growers are farmers, not fishermen, but this is a heavy lift.
- In May, a bipartisan group of 25 Senators requested \$2 billion to purchase domestically-harvested seafood products. They also requested an additional \$1 billion in direct relief for payments to all fishery participants and seafood businesses. A bipartisan group of 49 House members sent a similar letter to leadership. Whether the effort gets traction remains unclear.
- Sea Grant is making \$4 million available for rapid-response proposals, some of which may be used to fund reef restoration projects. We were hoping to get some funds for restoration reefs through the USDA Environmental Quality Incentives Program (EQIP) into the HEROES Act, but couldn't move quickly enough. We will continue to see if we can get some funds for these activities as the Senate starts to consider a response.
- Collaboration with The Nature Conservancy and the Pew Charitable Trusts to develop a bigger plan to conduct restoration plantings using large farmed oysters in each state is being discussed. We are working together on legislative affairs and the daunting logistics of planning dozens of restoration projects in each of 18 East Coast and Gulf states.
- We are working with the Seafood Nutrition Partnership and Sea Grant through social media to encourage home consumption of all fishery products (but especially shellfish) by posting recipes and cooking videos with the hashtag #EatSeafoodAmerica. With supply-chain issues surrounding pork and beef, we are hopeful that consumers will pivot to seafood, and especially healthy, nutritious, high-zinc shellfish products!
- I talk to the press almost daily and I have been hammering the concept that it is the civic duty of every American to buy a box of shellfish, and learn how to shuck to save a job.
- A philanthropist bought 16,000 oysters from Martha's Vineyard farmers and handed out 36-count bags to eager Island residents. Organizers estimated around 450 cars showed up for the "Great Oyster Giveaway" on May 16<sup>th</sup>. Similar efforts in towns across America funded by well-promoted Go Fund Me campaigns could go a long way toward getting Americans to get comfortable with preparing oysters at home.
- Talented musician Matt Hobbs has recorded a song "50 Ways to Shuck an Oyster" and we have a videographer turning it into a film that we hope will help convince folks to try shucking at home (as soon as they stop laughing).

Bob Rheault



## Follow the science, not the headlines: Are shorebirds and horseshoe crabs impacted by aquaculture?

'Impacts' can be a loaded term. Often portrayed negatively even when the 'impact' may be positive. Is the impact of aquaculture on endangered species negative? Maybe, but it could be positive, or even inconsequential. When migratory bird conservationists in Delaware Bay learned that intertidal aquaculture was being revived, they reacted by trying to limit it citing putative, yet unconfirmed, impacts of the farming activities on wildlife. Thus began a contention among many, to who, under other circumstances, might be allies in efforts to improve the health and use of our coastal ecosystems.

Many shellfish farmers are proud of the fact that farming shellfish provides many documented ecosystem benefits. Although shellfish farming is one of the greenest food production systems, farms operating in coastal areas are important to migratory shorebirds, and provide critical spawning and nursery habitat for commercial, recreational or ecologically significant species. The potential for both good and bad interactions (impacts) between farms and wildlife cannot be avoided.

Home to an oyster farming tradition more than a century old, the Delaware Bay today hosts rack-and-bag culture producing oysters regionally known for their creamy, sweet flavor. The Bay also hosts the world's largest spawning migration of horseshoe crabs, a species of great ecological, medical, and economic importance. In the spring, crabs come ashore in droves, laying energy-rich eggs along the sandy shores. These eggs attract migratory shorebirds as they migrate northwards towards summer breeding grounds. Among those visiting shorebirds are rufa red knots, whose decline in abundance have led to the Federal listing of this species as 'threatened'.



Horseshoe crabs spawning on beach adjacent to oyster farm on June 20, 2020. Photo credit: David Bushek.

The common use of the tidal flats of the lower Delaware Bay by oyster farms, spawning horseshoe crabs, and migratory shorebirds warrants investigation into interactions among farms and wildlife. If the nature of the interactions is positive, chalk up another ecosystem services win for oyster farming. If negative, it is important to carefully understand the interaction so that farm practices can be modified to minimize them.

The Federal listing of the red knot (the full status listing is available at <https://www.fws.gov>) stimulated a review of the pertinent science concerning negative impacts of oyster farms on the birds and their important food source, horseshoe crab eggs. A number of potential impacts, with little data to address them, were identified resulting in a level of uncertainty that limited the ability of State and Federal agencies to develop regulations that could balance trade-offs between the needs of farm operators and concerns for biological conservation. In 2016, two research programs began at Rutgers University to investigate whether horseshoe crabs can move through farms to access spawning beaches, and whether red knots (and other shorebirds) avoid farms and adjacent spawning beaches.

The crab research program focused on the ability of horseshoe crabs to access spawning beaches, employing complimentary studies testing if farms alter crab distribution, or if farms change crab behavior. Low and high tide surveys mapped crab distribution at farm and control locations. Behavior experiments in large tanks observed crabs moving among farm gear. Experiments on the flats during low tide observed crabs moving under and around the gear. And finally, behavior experiments performed during high tide under completely natural conditions observed crabs moving through farms. The high turbidity in the Delaware Bay presents a challenge for direct observation underwater, so a novel high frequency sonar (DIDSON) was used for these natural experiments. All surveys and experiments show conclusively that neither crab access to spawning habitat, nor their use of mudflats is altered by rack-and-bag gear (Munroe *et al.*, 2017; 2020).



Red knot. Photo credit: Brian Schumm

The other research program (Maslo *et al.*, 2020) focused on impacts of farms on abundance and distribution of shorebirds of concern, including the rufa red knot. Over three years, it was shown that oyster farm gear had no influence on distribution of red knots, indicating that the birds do not specifically avoid farms while in Delaware Bay. Red knot numbers, however, were reduced slightly (1-7%) when farmers were working at farms. Red knot abundance was far more strongly correlated with that of other foraging shorebirds, suggesting that the distribution of their preferred food, crab eggs, is the primary driver of shorebird distribution during the migratory stopover.

Meanwhile, headlines dramatized the situation pitting farmers, fisherman and the pharmaceutical industry against conservationists, whilst all should be aligned in balancing resource use with conservation, a.k.a., sustainability. The two research programs highlighted here contributed crucial information identifying trade-offs, and lack of apparent tradeoffs, between economic growth and

biological conservation. Although there has not been a wholesale reversal of restrictions implemented early, when uncertainty about specific interactions among farms and wildlife ruled the day, small but important changes have been made providing farmers some relief without compromising wildlife recovery.

More information about the research programs and their results can be found in the following papers.

Maslo, B., J.C. Burkhalter, D. Bushek, T. Yuhas, B. Schumm, J. Burger, and J.L. Lockwood. (2020). Assessing conservation conflict: Does intertidal oyster aquaculture inhibit foraging behavior of migratory shorebirds? *Ecosphere*, 11(5): e03097.

Munroe, D.M., T.M. Grothues, N.E. Cleary, J. Daw, and S. Estrada. (2020). Oyster aquaculture does not impede spawning beach access for Atlantic horseshoe crabs *Limulus polyphemus*. *Aquaculture Environment Interactions*, 12: 81-90.

Munroe, D., D. Bushek, P. Woodruff, and L. Calvo. (2017). Intertidal rack-and-bag oyster farms have limited interaction with horseshoe crab activity in New Jersey, USA. *Aquaculture Environment Interactions*, 9: 205-211.

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