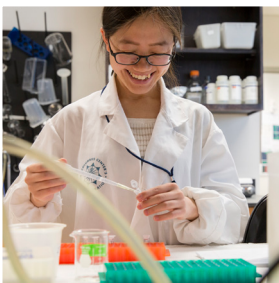
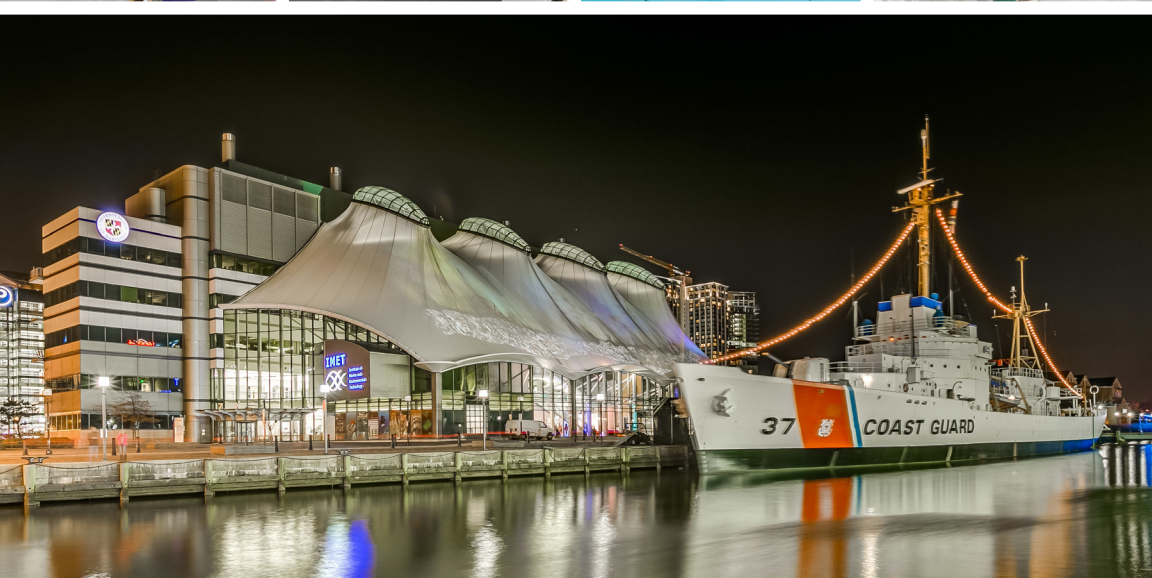
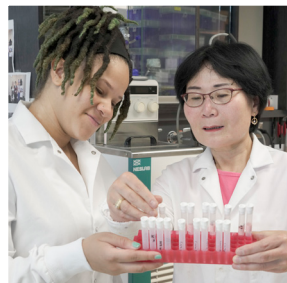
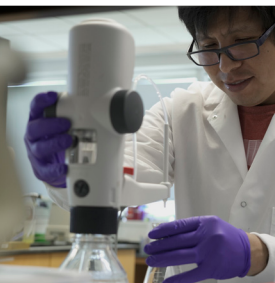


Institute of Marine & Environmental Technology

2019 Annual Report



Thank You from IMET!

As we reflect on 2019, we are very grateful for all those who were part of our community. We would especially like to thank Dr. Jim Albrecht for establishing the "James Albrecht Graduate Student Fellowship," which will support one student in their first year of graduate studies for each of the next five years. This fellowship will enable us to welcome more students and increase our impact in education and research.

There were 51 interns trained at IMET in the summer of 2019! I thank all the IMET faculty, staff, and students who mentored these high school and undergraduate students. Our interns included a group of eleven undergraduate students in our IMET Summer Internship Program led by Professor Rose Jagus. We are thankful to Ms. Mary Catherine Bunting for making this possible. We gave tours of our aquaculture research center to K-12 classes, local business leaders, and scientific researchers. We are proud to be meeting our goal to reach the broader Baltimore community and include even more examples of this work in the following pages.

IMET was awarded a Top Workplaces 2019 honor by The Baltimore Sun, one of only 135 organizations in the region to make this year's list. I am thankful for our passionate and engaged community.

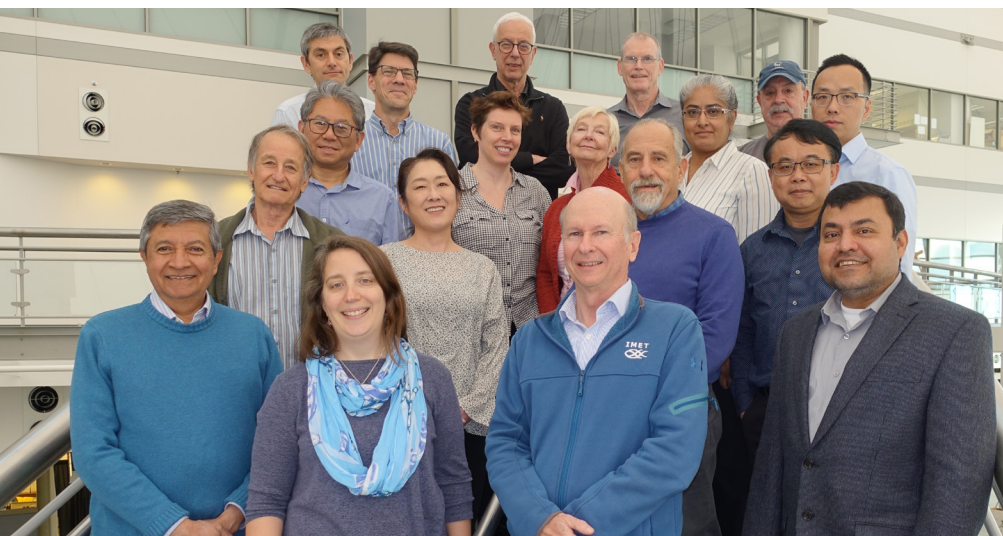


Executive Director Russell Hill

We are excited to continue to share our love of science. We welcome you to our community and hope that you'll join us for the Open House, a lecture, or a tour in 2020.

A handwritten signature in blue ink that reads "R. T. Hill".

Russell T. Hill, Ph.D.
Executive Director, IMET



**TOP
WORK
PLACES
2019**

**BALTIMORE SUN
MEDIA**

**IMET
Faculty**

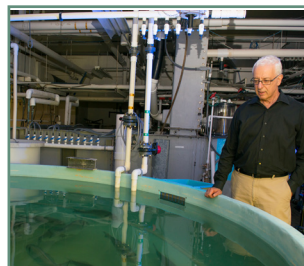
Our Mission

The mission of IMET is to develop innovative approaches to protect and restore coastal marine systems and their watersheds, sustainably use resources in ways to benefit human well-being, and to integrate research excellence with education, training, and economic development.

2019 Program Highlights

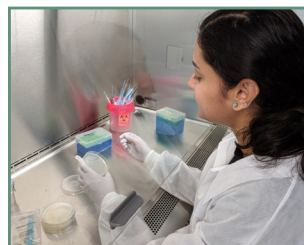
Sustainable Aquaculture Production

Ninety-five percent of the salmon consumed in the US is imported, contributing \$3.4 billion annually to the trade deficit. In an intensive drive to produce Atlantic salmon domestically, over \$1 billion is being invested in environmentally responsible salmon aquaculture, using Recirculating Aquaculture Systems, such as the ones developed by IMET scientists. A major federal-public-private consortium, funded by NOAA National Sea Grant and led by Professor Yonathan Zohar, Chair of UMBC's Department of Marine Biotechnology and Director of IMET's Aquaculture Research Center, aims to build capacity for land-based salmon aquaculture in the US. The consortium consists of Maryland, Wisconsin, and Maine Sea Grant, several universities, and leading salmon producers in five states. The goal of this "Recirculating Aquaculture Salmon Network" is to establish a collaborative hub of knowledge and integrate research, outreach, education, and extension to promote the successful growth, environmental compatibility, and economic feasibility of land-based Atlantic salmon aquaculture in the US.



Environmental, Animal, and Human Health

Som Chatterjee's lab is focused on understanding how bacteria become resistant to antibiotics. Antibiotic resistance is a serious human health concern. It is predicted to be the single most important cause of mortality by the year 2050. Antibiotic resistance in animal pathogens, especially those of livestock and pets are similarly problematic. Overuse and unjudicial use of antibiotics is polluting the environment, which in turn can produce resistant bacteria.



Dr. Chatterjee's lab uses *Staphylococcus aureus*, a bacterial pathogen of high medical importance as a model organism to study antibiotic resistance. The goal of his work is to define newer and better ways of treating bacterial infections by understanding the basic biology that underlies antibiotic resistance. Current research in Dr. Chatterjee's lab is supported by the National Institutes of Health through R01 and R21 grants.

Energy, Climate Change, and Global Health

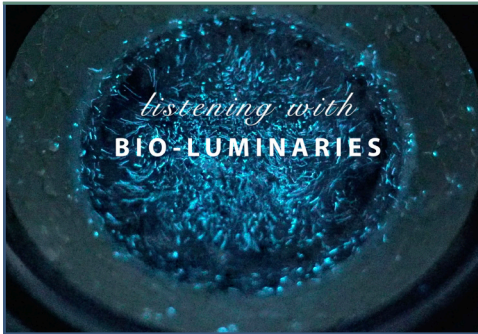
Harmful algal blooms (HABs) have increased in Maryland and globally in recent years. In the wake of the 1997 fish kills and public concern surrounding *Pfiesteria*, IMET scientist Dr. Al Place set out to study the algae species blamed for killing fish and sickening humans in the Chesapeake Bay and its rivers. It turned out that another alga, *Karlodinium veneticum*, was the real culprit in the so-called "*Pfiesteria* hysteria" of 1997. The fish kills can be traced to production of a unique toxin by *Karlodinium veneticum* that makes pores in the gills of fish. Since then, the Place lab has been investigating strategies for suppressing algal blooms. Shown in the photo is Senior Faculty Research Assistant/Graduate Student Ernest Williams applying peroxide to a cyanobacteria bloom on Kent Island. Recently, UMCES Presidential Fellowship awardee, Taylor Armstrong, has been investigating the use of barley spent grain for inhibiting HABs.



Communicating Our Research

IMET Open House

The third year of the IMET Open House was a great day of science exploration and community engagement. New this year, the research vessel *Rachel Carson* docked alongside IMET. Visitors toured the ship, learning about how scientific samples are taken at sea. We also had new activities from our partners at BUGSS and the National Aquarium. The IMET Open House is held every year on the first Saturday in May, and we hope to see you there! In 2020, we'll open our doors on May 2.



Artist-in-Residence

Through a new partnership with the Center for Innovation, Research, and Creativity in the Arts at UMBC, IMET hosted an artist-in-residence in 2019. UMBC's Professor Lisa Moren spent her spring semester learning about our research and developing several pieces that highlighted bioluminescent dinoflagellates. In close collaboration with IMET's Dr. Tsvetan Bachvaroff, she developed an interactive exhibit where vibrations from audio caused the algae to glow. Moren and Bachvaroff exhibited at the Open House and Light City and have ongoing collaborations. In 2020, we'll host a second CIRCA-IMET artist-in-residence and we can't wait to see more art inspired by our research!

Public Lectures

This fall, we hosted three public science events. In October, Dr. Yonathan Zohar took us on a whirlwind tour of 30 years of aquaculture research. In November, Dr. Eric Schott and the National Aquarium's Charmaine Dahlenburg explained how scientists and community members are helping us understand Baltimore's Inner Harbor. In December, we screened "Paris to Pittsburgh" and held a panel discussion on climate change with UMCES' Dr. Matthew Fitzpatrick and youth climate activist Nadia Nazar. These lectures can be found on IMET's YouTube page and details on next year's series will be released on IMET's website.



Education and Training

2019 Graduates

Ammar Hanif, Ph.D.

Advisor: Dr. Rosemary Jagus

Thesis: Diet and Stomach Microbiota of Juvenile Menhaden, a Key Forage Filter Feeding Fish Species

Future Plans: Molecular ecologist and environmental justice advocate

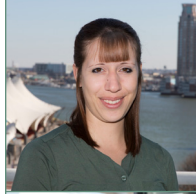


Ryan McDonald, Ph.D.

Advisor: Dr. Harold Schreier

Thesis: The enteric microbiome of a novel wood-digesting organism: diversity of lignocellulolytic and nitrogen fixing communities of the Amazonian catfish, *P. nigrolineatus*

Future Plans: Postdoc for the Blue Crab Genome Initiative



Matt Spitznagel, M.S.

Advisor: Dr. Eric Schott

Dissertation: Mortality and reovirus infection in soft-shell blue crab (*Callinectes sapidus*) aquaculture

Future Plans: Lab Manager with the Maryland Department of Natural Resources Fish Health Lab



Miranda Marvel, Ph.D.

Advisor: Dr. Yonathan Zohar

Dissertation: The roles of Gonadotropin-releasing hormone 2 (Gnrh2) in feeding and reproduction in zebrafish: a potential mediator between the two processes

Future Plans: Postdoc at NIH

Kyarii Ramarui, M.S.

Advisor: Dr. Yantao Li

Dissertation: Improving *Haematococcus pluvialis* growth and astaxanthin production through chemical mutagenesis

Future Plans: Ph.D. student in the lab of Dr. Yantao Li

Summer 2019 Internships



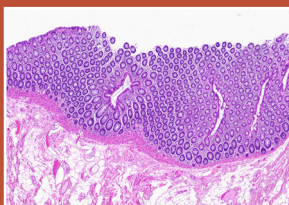
In the summer of 2019, we had a total of **51 interns** in our labs and administrative offices. We had eleven interns in the IMET Summer Internship Program, led by Dr. Rosemary Jagus and supported by the generosity of Mary Catherine Bunting. This program trains undergraduates from backgrounds that are underrepresented in the sciences. This year, we were honored to host **Mr. Calvin Butler**, CEO of BGE, and **Dr. Freeman Hrabowski**, President of UMBC, as guest speakers. They both inspired our summer interns by sharing their own paths to success.

Economic Development

Harbor Launch

Harbor Launch, IMET's business incubator, saw a lot of activity in 2019. We welcomed several new companies to the community, including Accelevir Diagnostics, AlgenAir, Haplet, iAdeptive, Ko Discovery, NewG Lab Pharma, and Vij Biotech. Long-term tenant Intralytix moved to its own facility in Columbia, MD. We also welcomed Dr. Nina Lamba as the IMET Assistant Director and Betsy O'Neill Collie as the Harbor Launch Business Development Manager. Together, Nina and Betsy are ensuring that Harbor Launch at IMET continues to raise its profile with health science and environmental entrepreneurs in and around Baltimore.

A year of growth for NDB Bio



NDB Bio provides specialized histopathology services and consultancy to life scientists in academia, government, and the biotech industry. The company helps researchers in various fields, such as immuno-oncology and neurology, by developing protocols to detect biomarkers in tissue samples. NDB Bio also provides standardized sample prep and advanced assays. **In 2019**, NDB Bio grew its client base, expanded its services, and was acknowledged by clients in several peer-reviewed journals.

Dr. Tanu Sharma, NDB Bio CEO said, "Harbor Launch has helped our business by providing a supportive environment that includes access to knowledgeable mentors who are generous with their time and skilled at guiding young companies."

ndbbio.com

Ratcliffe Environmental Entrepreneur Fellowship

The Ratcliffe Environmental Entrepreneur Fellowship (REEF) completed its fifth year in 2019, with six fellows and seven students. The REEF curriculum is designed to teach students about the business side of science, including developing an idea and pitch, running a business, and tech transfer. It includes weekend courses for students, fully supported fellowship positions with an internship component, and seed funding for student-created businesses.

Minnowtech: From PhD to CEO

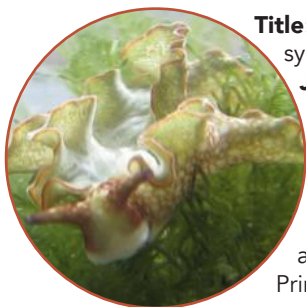


Minnowtech was founded by Dr. Suzan Shahrestani, who defended her Ph.D. at the UMCES Chesapeake Biological Laboratory in 2018. She was a REEF student and fellow and had already formed a company by the time she graduated. Minnowtech is developing an automated low-cost sonar-based system to improve the accuracy and convenience of estimating shrimp abundance and growth in shrimp farms across the globe.

In 2019, Dr. Shahrestani and her team were very successful in securing funding, receiving grants from the NSF Small Business Innovation Research Program, the USM Momentum Fund, UMCES, and the HATCH Aquaculture Accelerator. These resources made it possible for Minnowtech to test their technology at shrimp farms in Hawaii and continue to make improvements.

minnowtech.com

High-Impact Publications



Title: A microbial factory for defensive kahalalides in a tripartite marine symbiosis

Journal: Science

Authors: Jindong Zan⁺, Zhiyuan Li, Ma. Diarey Tianero, Jeanette Davis⁺, Russell T. Hill⁺, and Mohamed S. Donia

The sea slug *Elysia rufescens*, found in Hawai'i, feeds on a green alga containing bioactive compounds with potential as anti-cancer drugs and concentrates these compounds. In this collaboration between Princeton and IMET, the true source of the compounds was found to be a symbiotic bacterium that lives in the algal food of the sea slug.

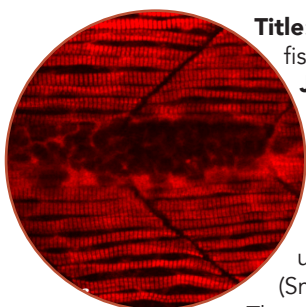


Title: A pilot-scale field study: In situ treatment of PCB-impacted sediments with bioamended activated carbon.

Journal: Environmental Science and Technology

Authors: Rayford B. Payne⁺⁺, Upal Ghosh, Harold D. May, Christopher W. Marshall, and Kevin R. Sowers^{*}

Microbial degradation combined with enhanced adsorption by activated carbon was demonstrated to be effective for treating aquatic environments contaminated with polychlorinated biphenyls (PCBs). This pilot study shows the promise of bioremediation as a cost-effective and sustainable approach to reduce the contamination of the aquatic food web from exposure to PCBs with minimal disruption to the environment.



Title: Defective sarcomere organization and reduced larval locomotion and fish survival in slow muscle heavy chain 1 (*smyh1*) mutants

Journal: FASEB Journal

Authors: Siping P. Li⁺, Haishen S. Wen, and Shaojun J. Du^{*}

Myosins are a superfamily of motor proteins best known for their roles in muscle contraction. Genetic mutations in myosin genes are associated with muscle disease in the heart and skeletal muscles. To uncover the gene function of slow fiber-specific myosin heavy chain 1 (*Smyhc1*), we generated three mutant alleles using CRISPR in zebrafish. The *Smyhc1* mutant larvae showed reduced locomotion and food intake, and increased lethality. Data from this study will help us better understand muscle diseases and could lead to new diagnostic or therapeutic strategies.

⁺IMET faculty, ⁺IMET student/alum, ⁺⁺IMET postdoc/technician

For the full citations of these papers and more publications from IMET in 2019, please scan the QR code or go to:
imet.usmd.edu/2019Pubs



James Albrecht Graduate Student Fellowship

Thanks to the generous support of our dear friend Dr. James Albrecht, IMET established the "James Albrecht Graduate Student Fellowship at IMET" in 2019. This fellowship will fund one student in their first year of graduate studies for the next five years. This will help us reach both our scientific and educational impact goals. Dr. Zohar, whose student Sakura Tanaka was the first fellow, said, "Funding graduate students has increasingly become a challenge and the IMET fellowship allows us to jumpstart a graduate student in their first year." We look forward to welcoming future Albrecht Fellows.



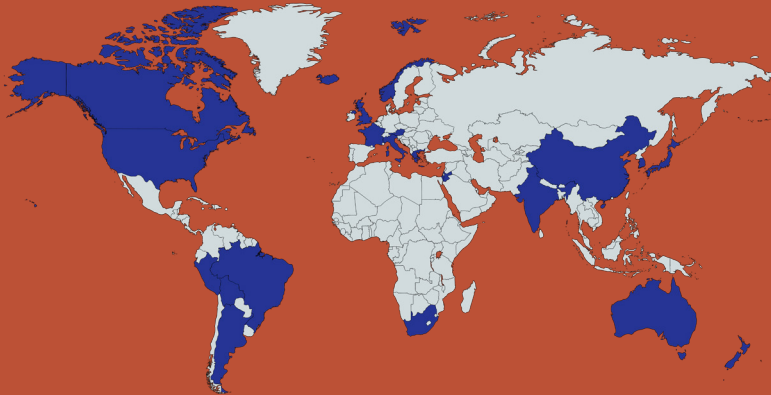
Global Impact: Improving Aquaculture in Iceland

Dr. Ten-Tsao Wong has collaborations in Iceland, New Zealand, and South Korea to help aquaculture industries improve the sustainability of their operations. In Iceland, he works with researchers at the Marine and Freshwater Research Institute. They are developing sterile Atlantic salmon and Arctic char for use in aquaculture. Atlantic salmon are cultured in open-pen sea-cages and environmentalists are concerned about the impact that fertile farmed fish escaping from cages could have on the genetics and ecosystems of wild fish populations. Fish farmers want sterile fish because salmonids have higher quality before they are sexually mature. The group in Iceland is starting small, but plans to expand as they develop their research and as the aquaculture industry grows in Iceland and worldwide.



IMET Around the World

IMET had ongoing collaborations in 21 countries in 2019 (highlighted below), ranging from visiting scientists and scholars to joint research efforts.



Thank you to our donors!

American Honda Motor Co.
 Mohammad R. Alavi
 James J. Albrecht
 Tsvetan R. Bachvaroff
 David A. Balcom
 Michael J. Beegan
 Mary Catherine Bunting
 Feng Chen
 Jum Sook Chung
 Mike & Trish Davis

Arthur W. Edwards
Monica Gellene
Peter and Michal Goodwin
Russell T. Hill
William and Christine Hufnelt
Ronald M. Kreitner
Yantao Li
Thomas M. Lingan
Tammy Lloyd
Donald & Catherine MacMurray

McCormick & Co.
Robert & Carolyn Mroz
Allen & Charlotte Place
Tom & Nancy Reynolds
Richard & Maureen Roden
Tommy Rouse
Eric Schott
United Way of Central MD
Gerardo R. Vasta
Bertram & Deborah Winchester

Foundation support:

Bunting Family Foundation
Stephenson Pope Babcock
Foundation
France-Merrick Foundation
Jim & Patty Rouse Foundation
Philip E. & Carole R. Ratcliffe
Foundation
G. Unger Vetlesen Foundation