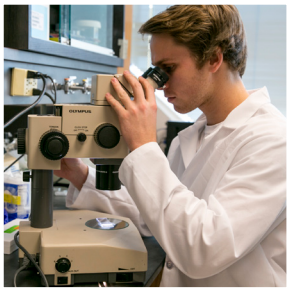
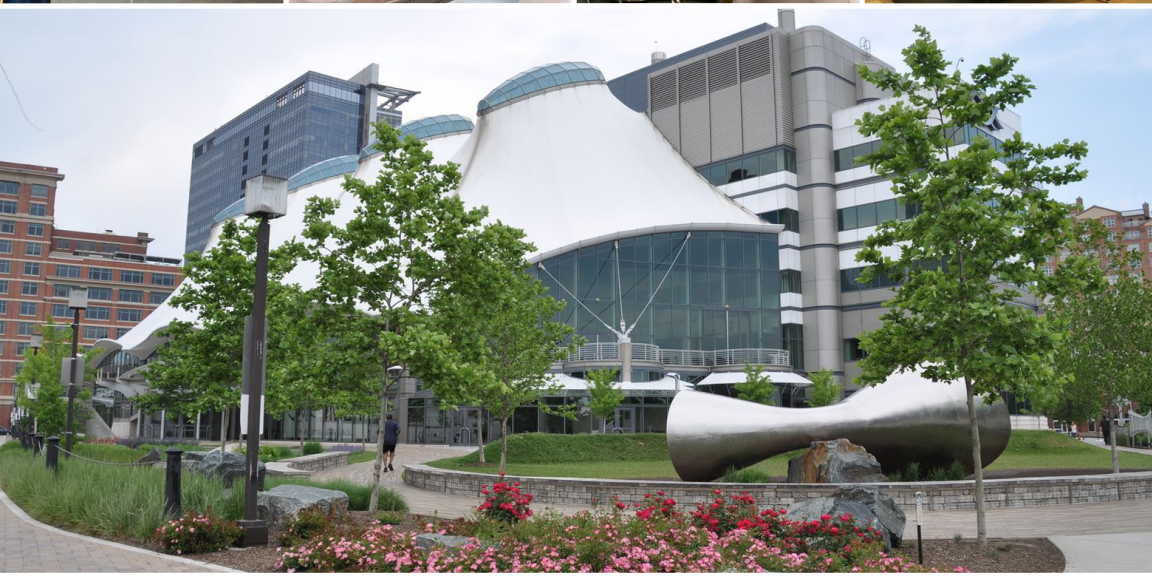
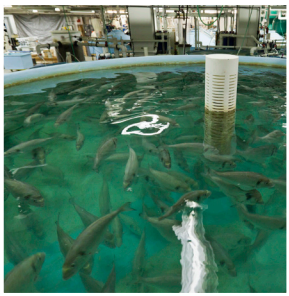
Institute of Marine & Environmental Technology

2018 Annual Report



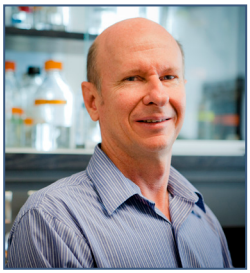



Thank You from IMET

IMET had another great year during 2018! Many of our successes stem from our supportive community of collaborators, donors, and members of the public. A partnership with United Way of Central Maryland and McCormick made it possible to grow 3,600 pounds of fish to serve to food-insecure residents of Baltimore. The generosity of Jim Albrecht helped to fund our first IMET student fellow. A gift from Mike and Trish Davis and friends helped us make excellent progress in sequencing the blue crab's genome. Continued support from the G. Unger Vetlesen Foundation fueled innovative work in our laboratories, and the Ratcliffe Foundation funded another year of entrepreneurship training for our graduate students. We are fortunate as well to have faculty, staff, and alumni who have made donations to IMET.

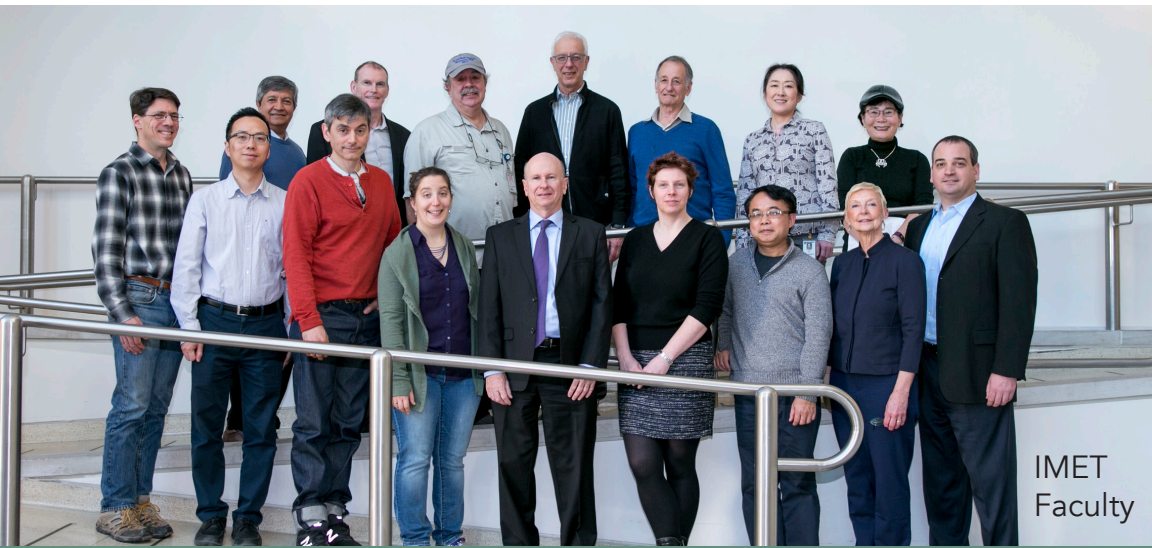


Executive Director Russell Hill

We also thank all those who visited IMET for tours of the Aquaculture Research Center, our public lectures, and our Open House, bringing invaluable enthusiasm and perspective to our research.

We are grateful to everyone who helped advance our mission in 2018 and look forward to strengthening and expanding our community in the coming year.

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



IMET Faculty

Our Mission

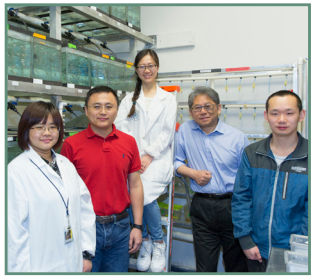
The mission of IMET is to develop innovative approaches to protect and restore coastal marine systems and their watersheds, sustainably use resources in ways to benefit human well-being, and to integrate research excellence with education, training, and economic development.

2018 Program Highlights

Sustainable Aquaculture Production

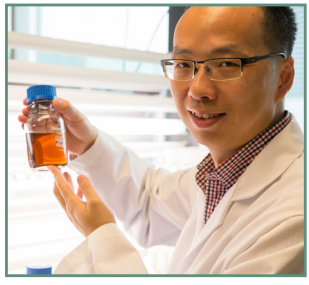
The Feeding Individuals to Support Health (FISH) project is a public-private partnership led by United Way of Central Maryland, McCormick's Flavor for Life program, IMET, the Franciscan Center, seafood distributer JJ McDonnell, and the Maryland Food Bank. The project provides healthy, high-quality seafood such as bronzini, or Mediterranean sea bass, to underserved residents of Baltimore. Researchers at IMET are developing the next generation of environmentally friendly methods of seafood farming using land-based, closed-containment systems and microbial waste treatment technologies. In 2018, about 3,600 pounds of bronzini were grown using these methods in IMET's Aquaculture Research Center. They were harvested and served at Baltimore soup kitchens. Keiko Saito and Sook Chung are proud to be the lead scientists in this collaboration.

Environmental, Animal, and Human Health



Numerous muscle diseases, or myopathies, affect the function of skeletal muscle and can cause weakness, pain or even paralysis. Some myopathies, such as muscular dystrophies, are inherited. Dr. Shaojun (Jim) Du's lab is using zebrafish as an animal model to study genetic mutations that disrupt normal muscle structure and function during the development of an embryo. They demonstrated that Smyd1, an enzyme specifically expressed in skeletal and cardiac muscles, plays a vital role in skeletal muscle cell formation and contraction. Their studies have provided insights into genetic muscle diseases from Smyd1 mutation. Recently, Dr. Du was awarded a major grant from the National Institutes of Health to study the molecular regulation of muscle development by Smyd1. Results from this project will further define the genetic causes of skeletal muscle disease and could empower clinicians to develop new diagnosis and prognosis tools to improve the overall health and well-being of humans.

Energy, Climate Change, and Global Health



Yantao Li's research investigates lipid and pigment metabolism in microalgae and engineers algae for production of biofuels and high-value products such as the carotenoid pigment astaxanthin. Astaxanthin is used in the dietary supplement and aquaculture industries as a strong antioxidant and a coloring agent. AlgaBT LLC, a Maryland biotech startup spun out of Li's lab, is applying that understanding to the astaxanthin production industry. They are developing high-yield, well controlled fermentation technology, and have made significant progress towards commercialization with funding support from the Maryland Industrial Partnerships (MIPS) program and the biotech industry. They aim to sustainably produce high-value bioproducts from renewable natural resources in a cost-effective and eco-friendly way.

Communicating Our Research

IMET Open House

For the second year, we opened our doors to the public and offered a wide range of activities to inspire a love of science in our Baltimore community. Visitors learned about coral reefs while making their own construction paper ecosystems and tried their hands at lab techniques like using a microscope and pipetting. The IMET Open House is held every year on the first Saturday in May and we hope to see you there! In 2019, IMET's Open House is on Saturday May 4th, also known as Star Wars Day (May the 4th Be With You!).

Internships

During their time at IMET, our interns experienced all aspects of working in a lab — attending lab meetings, feeding animals in the Aquaculture Research Center, running DNA barcoding in the BioAnalytic Services Laboratory, and communicating science to non-scientists. The interns will take with them an experience unlike any other. Our 2018 IMET Internship Program was made possible by the support of the University System of Maryland's Elkin's Professorship, awarded to Dr. Rosemary Jagus, the generous support of the Bunting Family Foundation, and all of the faculty mentors at IMET.

Fall Into Science

In 2018, IMET hosted two lightning talk events, including Fall Into Science. Students, faculty, and Harbor Launch companies summed up their work in two-minute talks. This gave everyone an opportunity to consider how best to communicate the importance of their research or business to an audience with diverse interests. This event is part of a wider effort to increase interactions and collaborations between IMET researchers and the 25 life science companies that are in the Columbus Center, including those in IMET's Harbor Launch business incubator.

Congratulations to our graduates!

Saddef Haq, Ph.D.

Advisor: Dr. Allen Place

Dissertation: Beyond the Dinoflagellate Transcriptome: Validation of Protein Production via Biochemical Analysis and Mass Spectrometry

Future Plans: ORISE Postdoctoral Fellow at the Biomedical Advanced Research and Development Authority

Mary Larkin, Ph.D.

Advisor: Dr. Allen Place

Dissertation: A Role for Taurine in Food Sensitivities in Fish

Future Plans: Entrepreneurial Postdoctoral Fellowship with Blueblood, LLC

Victoria Laye, M.S.

Advisor: Dr. Shiladitya DasSarma

Thesis: Survival of a Polyextremophilic Archaeon and Function of its Enzyme in Potentially Astrobiological Conditions

Future Plans: Ph.D. Candidate in DasSarma Lab

Samuel Major, M.S.

Advisor: Dr. Russell Hill

Thesis: The Probiotics of Biofuel: A Metagenomic Study of Microalgae Grown for Fuel Production

Future Plans: Research Associate at Scanogen Inc.

Benjamin Oyler, Ph.D.

Advisor: Dr. Allen Place

Dissertation: Advances in Mass Spectrometric Structural Biology Techniques for Pattern Recognition Receptor Ligands of Microbial Origin

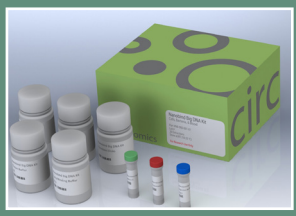
Future Plans: ORISE Postdoctoral Fellow at the FDA Center for Food Safety and Applied Nutrition

Economic Development

Harbor Launch

Harbor Launch is IMET's startup business incubator, founded in 2016. IMET's Harbor Launch offers startup-friendly office and wet lab space, in addition to business services and other benefits to early-stage companies. To date, 19 companies have joined Harbor Launch.

A year of growth for Circulomics



Circulomics develops sample preparation technologies for genomics applications such as long-read sequencing and optical mapping. Their Nanobind technology enables rapid processing of long DNA strands that can be more easily assembled into high quality genomes than by traditional approaches using short-read sequencing.

In 2018, Circulomics began selling its first kits which have seen rapid adoption for processing of cell, bacteria, blood, and plant samples. In 2019, they will launch new kits for tissues and other organisms as well as new technologies for downstream sequencing library preparation.

circulomics.com

Ratcliffe Environmental Entrepreneur Fellowship

The Ratcliffe Environmental Entrepreneur Fellowship (REEF) completed its fourth year in 2018, with five fellows and seven students. The REEF curriculum is designed to teach students about the business side of science, including developing an idea, a pitch, running a business, and tech transfer. It includes weekend courses for students, fully supported fellowship positions involving an internship component, and seed funding for student-created businesses.

Announcing: AlgenAir LLC

AlgenAir was founded by Kelsey Abernathy and Dan Fucich, two graduates of the REEF Program. They developed the first natural air purifier that uses algae to improve air quality in homes and offices.

In 2018, AlgenAir incorporated and raised funds for their startup by placing in or winning four business competitions: F3 Tech Accelerator, Shore Hatchery, the Hardware Cup Regional Pitch DC, and IMET's own REEF pitch competition. They developed a prototype, which they will begin to sell in 2019. Abernathy and Fucich are grateful to REEF for helping them to develop as entrepreneurs and for providing guidance as they formed AlgenAir.

algenair.com

High-Impact Publications

Bachvaroff, Tsvetan — Bachvaroff T. 2019. A precedented nuclear genetic code with all three termination codons reassigned as sense codons in the syndinean Amoebophrya sp. ex Karlodinium veneficum. **PLOS ONE** 14(2): e0212912.

Burge, Colleen — Groner ML, Burge CA, Cox R, Rivlin ND, Turner M, Van Alstyne KL, Wyllie-Escheverria S, Bucci J, Staudigel P, Friedman CS. 2018. Oysters and eelgrass: potential partners in a high pCO2 ocean. **Ecology** 99(8): 1802-1814.

Chen, Feng — Zhan Y*, Chen F. 2018. Minireview: Bacteriophages infecting marine Roseobacters: genomics and ecology. **Environmental Microbiology**. https://onlinelibrary.wiley.com/doi/epdf/10.1111/1462-2920.14504.

Chung, Sook — Bembe, S, Williams E, Place A, Liang D, Chung JS. 2018. Effects of temperature and photoperiod on hemolymph vitellogenin levels during spawning events of the blue crab, *Callinectes sapidus*, in captivity. **Aquaculture Research** 49(6):2201–2209.

DasSarma, Shiladitya — DasSarma S and Schwieterman EW. 2018. Early evolution of purple retinal pigments on Earth and implications for exoplanet biosignatures. **International Journal of Astrobiology**. https://doi.org/10.1017/S1473550418000423.

Dooley, Helen — Redmond AK, Macqueen DJ, Dooley H. 2018. Phylotranscriptomics suggests the jawed vertebrate ancestor could generate diverse helper and regulatory T cell subsets. **BMC Evolutionary Biology** 18: 169.

Du, Shaojun "Jim" — Shi J, Cai M, Si Y, Zhang J, Du S. 2018 Knockout of myomaker results in defective myoblast fusion, reduced muscle growth and increased adipocyte infiltration in zebrafish skeletal muscle. **Human Molecular Genetics** 27(20): 3542–3554.

Hill, Russell — Dangi AK, Sharma B, Hill RT, Shukla P. 2018. Bioremediation through microbes: Systems biology and metabolic engineering approach. **Critical Reviews in Biotechnology** 39: 79-98.

Jagus, Rosemary — Roy S, Jagus R, Morse D. 2018. Translation and Translational Control in Dinoflagellates. **Microorganisms** 6(2): E30.

Li, Yantao — Singh SK, Major SR*, Cai H, Chen F, Hill RT, Li Y. 2018. Draft genome sequences of Cloacibacterium normanense IMET F, a microalgal growth-promoting bacterium, and Aeromonas jandaei IMET J, a microalgal growth-inhibiting bacterium. **Genome Announcements** 6:e00503-18.

Place, Allen — López-Rosales L, Sánchez-Mirón A, García-Camacho F, Place AR, Chisti Y, Molina-Grima E. 2017. Pilot-scale outdoor photobioreactor culture of the marine dinoflagellate *Karlodinium veneficum*: production of a karlotoxins-rich extract. **BioResource Technology** 253: 94-104.

Robb, Frank — Robb FT, Techtmann SM. 2018. Life on the fringe: microbial adaptation to growth on carbon monoxide. **F1000Research**.

Saito, Keiko — Saito K, Quinn B, Zohar Y, Sowers K. 2018. Solid waste treatment for saltwater RAS: Anaerobic sludge digestion and bio methane production. In J. Dalsgaard (Ed.) 4th NordicRAS Workshop on Recirculating Aquaculture Systems, Aalborg, Denmark, 12-13 October, 2017, DTU Aqua Report, No. 321-17, **National Institute of Aquatic Resources**, Technical University of Denmark, 56 pp.

Schott, Eric — Spitznagel MI*, Small HJ, Lively JA, Shields JD, Schott EJ. 2019. Investigating risk factors for mortality and reovirus infection in aquaculture production of soft-shell blue crabs (*Callinectes sapidus*). **Aquaculture** 502: 289-295.

Schreier, Harold — Schreier HJ. 2018. Draft genome sequence of marine *Bacillus sp.* ISO11, a candidate finfish and shellfish probiotic. **Microbiology Resource Announcement** 7:e01227-18.

Sowers, Kevin — Payne RP, Ghosh U, May HD, Marshall CW, Sowers KR. 2019. A Pilot-Scale Field Study: In Situ Treatment of PCB-Impacted Sediments with Bioamended Activated Carbon. **Environmental Science and Technology** 53(5): 2626-2634.

Vakharia, Vikram — Citarasu T, Lelin C, Babu MM, Anand SB, Nathan AA, Vakharia VN. 2019. Oral vaccination of *Macrobrachium rosenbergii* with baculovirus-expressed M. rosenbergii nodavirus (MrNV) capsid protein induces protective immunity against MrNV challenge. **Fish Shellfish Immunology** In Press.

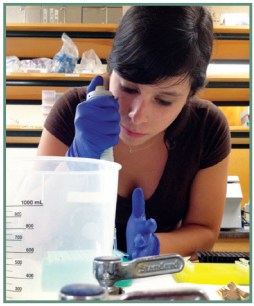
Vasta, Gerardo — Gerdol M, Gomez-Chiarri M, Castillo MG, Figueras A, Fiorito G, Moreira R, Novoa B, Pallavicini A, Ponte G, Roumbedakis K, Venier P, Vasta GR. 2018. Immunity in Molluscs: Recognition and Effector Mechanisms, with a Focus on Bivalvia. In: **Advances in Comparative Immunology**. Springer International Publishing AG.

Wong, Ten-Tsao — Wong TT, Zohar Y. 2018. Reproductive Technology (Non-human/Non-primate): Sex Control and Sterilization in Fish. In: **Encyclopedia of Reproduction** (Second Edition), ed Skinner MK (Academic Press, Oxford), pp 796-801.

Zohar, Yonathan — Marvel M*, Spicer OS*, Wong TT, Zmora N, Zohar Y. 2018. Knockout of the Gnrh genes in zebrafish: effects on reproduction and potential compensation by reproductive and feeding-related neuropeptides. **Biology of Reproduction** 99(3): 565-577.

* IMET Student

Maryland SeaGrant Fellowship Awarded to Ana Sosa



A Maryland Sea Grant Competitive Graduate Research Fellowship has been awarded to Ana Sosa. Sosa is a third-year Ph.D. student in the Marine Estuarine and Environmental Science program and is receiving her graduate training in Dr. Feng Chen's marine microbial ecology lab. The two-year funding was awarded to her proposal "Functional and Taxonomic Diversity of Microbial Communities in Microplastic Particles from the Chesapeake Bay."

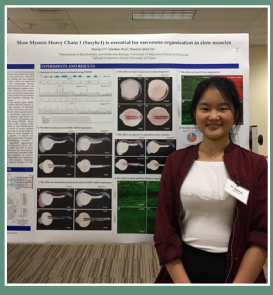
Sosa will do community outreach and develop her science communication skills. She will reach various groups across Maryland, including high school science teachers and students. Sosa understands the importance of representation in STEM and aims to inspire anybody who might be interested in these fields. "I have the chance to give back for the opportunities I have been fortunate enough to receive. I envision myself helping and teaching future scientists and hopefully inspiring young people of all backgrounds, ethnicities, and genders to learn more about the importance of all scientific development and consider incorporating it into their careers and lives."

IMET Around the World

25 *In 2018, IMET had collaborations in 25 countries.*

9 *In 2018, IMET hosted students/postdocs from 9 countries.*

Visiting Ph.D. Student from Ocean University of China



Siping Li is a visiting student from the Ocean University of China, receiving training in the lab of Dr. Jim Du. Through an agreement between the two institutions, there is funding and support for several students from OUC to conduct research at IMET.

Siping is researching the function of the myosin gene in skeletal muscle development. She first learned about IMET after seeing Dr. Du give a talk at OUC. She was excited to learn new techniques, such as CRISPR/Cas9, which have helped her grow as a scientist.

University System of Maryland

UMBC

University of Maryland Baltimore

University of Maryland Center for Environmental Science