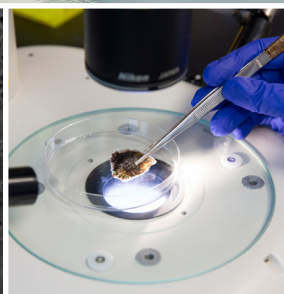
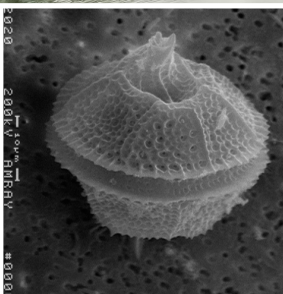


# *Institute of Marine & Environmental Technology*

# **2017 Annual Report**



# A note from the director...

We are thrilled to share with you our progress during 2017 in this IMET Annual Report. We accomplished a great deal, making major contributions to the fields of sustainable aquaculture, animal and human health, energy and climate change, and innovation and entrepreneurship. These contributions come directly through the important research done by our faculty members and through their efforts in training the next generation of scientists. These are the cornerstone areas for us in realizing our goal of being the world leader in marine and environmental technology, and we are on our way.



Director Russell Hill

In 2017, we took our expertise to 21 countries, partnering with many national and international organizations. These partnerships advance our scientific research and extend IMET's impact while helping Maryland's economic development and raising our profile.

While our vision may be global, we know that our strength comes from our local community in Baltimore. We engage high-school and undergraduate students in research through internship opportunities. Our outstanding graduate students have the option to receive additional

training in entrepreneurship and research communication to general public. Working with local groups, we raised fish to feed some of Baltimore's economically disadvantaged population. We hosted hundreds of scientists in Baltimore to share discoveries on harmful algal blooms, which directly affect the Baltimore Harbor and the Chesapeake Bay. Here at IMET, we believe that even the smallest local change can have great impact.

In 2018, we plan to hold an expanded array of public events, showcase another year of innovative research, train our talented graduate students to connect research with entrepreneurship, contribute to the economic development of Baltimore and Maryland and, thanks to the generosity of private donors, welcome our first IMET Student Fellow.

We are proud of our accomplishments and are excited for the year to come. Please take a moment to read through our report, and we hope to see you at IMET soon.

Best regards,

A handwritten signature in blue ink that reads "RT Hill".

**Russell T. Hill, Ph.D.**

Director, IMET

## 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.*

# 2017 Program Highlights

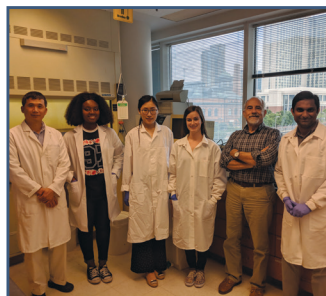
## ***Sustainable Aquaculture Production***

The Norwegian aquaculture industry generated \$8.4 billion in revenue in 2016. As the industry continues to expand there is an active effort to find sustainable solutions for dealing the environmental impact of fish waste in both land based and off-shore net pens. In collaboration with Cermaq AS and Sterner AS, Kevin Sowers, Keiko Saito, and Yoni Zohar developed a consortium of microorganisms that efficiently converts fish waste to biogas fuel. This consortium is being tested in a 100 m<sup>3</sup> anaerobic bioreactor designed to treat waste from a land based salmon smolt farm that is expected to produce 12.2 million smolts annually. The facility will require 1530 tons of feed, which will generate an estimated 520 tons of sludge annually with a density of 25% dry matter. In addition to cleaning the effluent waste stream before it is discharged, biogas from the digester is used to supplement the energy requirements of the aquaculture facility. The waste treatment facility will serve as an environmentally sustainable treatment option for the aquaculture industry.



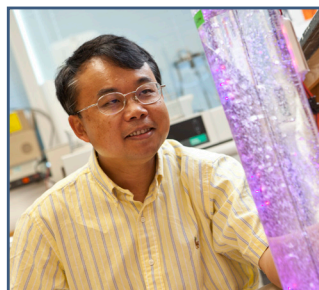
## ***Environmental, Animal, and Human Health***

Gerardo Vasta's research focuses on interactions between proteins and carbohydrates and contributes to understanding of disease in many systems, including diseases of oysters in the Chesapeake Bay. His recent findings may one day help people with the flu. In the test tube and in mice, his laboratory has found that a protein that binds to sugars, called galectin 3 (Gal3), causes an over-reaction of airway cells in pneumococcal pneumonia that often follows the flu. Working with Dr. Lai-Xi Wang (UMCP), they have developed inhibitors that are effective in preventing this binding, a key achievement that may lead to less of the immune over-reaction that is responsible for the high mortality in flu epidemics. A patent application was filed in July 2017, and the project is supported by an MII award, TEDCO, MD, USA, and a grant from the Mizutani Foundation, Japan.



## ***Energy, Climate Change, and Global Health***

Dr. Feng Chen and Dr. Michael Gonsior (UMCES) conducted a collaborative research project to investigate the chemical composition and the fate of virus-mediated dissolved organic matter (VDOM) and the effect of VDOM on the composition of bacterial communities. Using the advanced analytical instruments, including ultrahigh resolution MS (FTICR-MS) and NMR, they demonstrate that picocyanobacteria and deep-ocean fluorescent dissolved organic matter share similar optical and chemical properties. This helps us better understand carbon cycling in the oceans.



# Engaging with the public

## IMET Open House

IMET held its first annual open house event on May 6, 2017. Over 150 members of the public showed up to meet our researchers and take part in special activities showcasing our work, including a unique opportunity to tour the Aquaculture Research Facility. The IMET Open House will be held every year on the first Saturday in May.



## General Outreach

Members of IMET continue to conduct outreach to local schools. Students Shadaesha Green and Amanda Lawrence helped Professor Sook Chung host 8th graders from the Lexington Franklin Middle School. Dan Fucich, Eric Schott, and Tsvetan Bachvaroff gave 40 Towson High School students a tour of the Aquaculture Research Center. Students then observed dinoflagellates and invertebrates from Baltimore Harbor under the microscope. This tour was in partnership with the National Aquarium, and is an outgrowth of the harbor biodiversity project.

## Fall Seminar Series

The IMET Fall Lectures: Science on the Waterfront kicked off this year. In September, IMET hosted members of the public for a screening of the film 'A Plastic Ocean'. The screening was preceded by a presentation on microplastics by the Baltimore Underground Science Space (BUGSS) International Genetically Engineered Machine (iGEM) team, and followed up with a Q&A by Dr. Michael Gonsior (UMCES) who is a featured researcher in the film. In October, IMET's newest faculty member, Dr. Helen Dooley, gave a public seminar on her work examining the comparative immunology in sharks to better understand human health.



# Economic Development

## Entrepreneurship at IMET

Led by Assistant Director Dr. Nick Hammond, IMET has proven to be an innovator in entrepreneurship both within the University System of Maryland and in the greater Baltimore area.

**9 companies launched to date**

**7 patents granted in 2017**

**2 licensing agreements issued**

**13 harbor launch incubator companies**



## Harbor Launch

Harbor Launch is IMET's startup business incubator, founded in 2016. Via Harbor Launch, IMET offers startup-friendly office and wet lab space, in addition to business services and other benefits to early-stage companies. To date, 16 companies have joined Harbor Launch. In 2017, the first Harbor Launch company, Manta Biofuel, graduated and established a larger facility nearby.

## Ratcliffe Environmental Entrepreneur Fellowship (REEF)

The Ratcliffe Environmental Entrepreneur Fellowship (REEF) completed its 3rd year in 2017. 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. To date, the program has mentored 11 fellows and 21 students, while providing seed funding for four student businesses.

## Entrepreneur Office Hours (EOH)

IMET gathers representatives from the Baltimore entrepreneurship community every month to provide *pro bono*, one-on-one advising session to aspiring life science and technology entrepreneurs. To date, IMET has helped more than 250 entrepreneurs through Entrepreneur Office Hours.

# Education at IMET

## Student Highlights

- **Ammar Hanif** was awarded the Sea Grant Knauss Fellowship.
- **Stephen Grabowski**, a high school intern in the Sowers Lab, won the Grand Prize in the Baltimore Science Fair for his work on biogas production from fish waste. This qualified him to participate in the International Science and Engineering Fair competition.
- **Jerren Liu** was selected for the Leaders in Future Trends (LIFT) program. Scientists training in other countries receive funding to return to Taiwan to receive specialized coaching to aid their career development.
- **Kelsey Abernathy**, as part of IMET faculty member, Dr. Vik Vakharia's, spin-off company VakSea, pitched her way into the final round of the international Fish 2.0 competition in Stanford, CA.

## Recent IMET Graduates



### David Marsan

**Degree:** Ph.D.

**Advisor:** Dr. Feng Chen

**Dissertation Title:** "Adaptive mechanisms of an estuarine *Synechococcus* based on genomics, transcriptomics, and proteomics"

**Where are they now:** David is currently part of the Future Leaders Program at GlaxoSmithKline working on Vaccine R&D.



### Olivia Smith Spicer

**Degree:** Ph.D.

**Advisor:** Dr. Yonathan Zohar

**Dissertation Title:** "Molecular mechanisms involved in *Lpxrfa* and *Gnrh3* regulation of the brain-pituitary-gonad axis of the zebrafish (*Danio rerio*)"

**Where are they now:** Olivia is currently a Program Analyst for the National Institute of Mental Health, NIH.



### Jan Vicente

**Degree:** Ph.D.

**Advisor:** Dr. Russell Hill

**Dissertation Title:** "Sponge mutualism in the face of climate change"

**Where are they now:** Jan is currently completing an NSF-funded postdoctoral fellowship at the Hawai'i Institute of Marine Biology.



### Leah Maurer

**Degree:** M.S.

**Advisor:** Dr. J. Sook Chung

**Dissertation Title:** "Influence of prey density and dietary supplementation on the early development of the blue crab, *Callinectes sapidus*"

**Where are they now:** Leah is currently a Research Associate at Walt Disney World Resorts.



### Yuanchao Zhan

**Degree:** Ph.D.

**Advisor:** Dr. Feng Chen

**Dissertation Title:** "Isolation, genomics, and ecology of bacteriophages infecting marine roseobacters"

**Where are they now:** Yuanchao is currently completing a postdoctoral fellowship at the Hong Kong University of Science and Technology.

# Selected Publications

- Bachvaroff, Tsvetan** — Janouskovec, J., G.S. Gavelis, F. Burki, D. Dinh, T.R. Bachvaroff, S.G. Gornik, K.J. Bright, B. Imanian, S.L. Strom, C.F. Delwiche, R.F. Waller, R.A. Fensome, B.S. Leander, F.L. Rohwer, and J.F. Saldarriaga. Major transitions in dinoflagellate evolution unveiled by phylotranscriptomics. *Proc Natl Acad Sci USA*, 2017. 114: p. E171-E180.
- Burge, Colleen** — Schudt J.P., K.A. McComas and C.A. Burge . 2017. Intersecting frames in communicating environmental risk and uncertainty. *J. Risk Res.* 1-12.
- Chen, Feng** — Zhao, Z., M. Gonsior, J. Luek, S. Timko, H. Ianiri, N. Hertkorn, P. Schmitt-Kopplin, X. Fang, Q. Zeng, N. Jiao, and F. Chen. 2017. Picocyanobacteria and deep-ocean fluorescent dissolved organic matter share the same optical properties. *Nature Communications* 8:15284.
- Chung, Sook** — Maurer, L., D. Liang, and J.S. Chung. 2017. Effects of prey densities and dietary supplementation on the larval development of the blue crab, *Callinectes sapidus* Rathbun, 1896 (Brachyura: Portunidae). *J. Crusta Biol.* 37:674-682.
- DasSarma, Shiladitya** — Laye, V.J., R. Karan, J-M. Kim, W.T. Pecher, P. DasSarma, and S. DasSarma. Key amino acid residues conferring enhanced enzyme activity at cold temperatures in an Antarctic polyextremophilic  $\beta$ -galactosidase. *Proc Natl Acad Sci USA*, 2017. 114: 12530-12535.
- Dooley, Helen** — Redmond, A.K., R. Pettinello, R. and H. Dooley. 2017. Outgroup, alignment, and modelling improvements indicate that two TNFSF13-like genes existed in the vertebrate ancestor. *Immunogenetics.* 69; 187-192.
- Du, Shaojun "Jim"** — Anderson J.L., T.S. Mulligan, M.C. Shen, H. Wang, C.M. Scahill, F.J. Tan, S.J. Du, E.M. BuschNentwich, S.A. Farber SA. 2017. mRNA processing in mutant zebrafish lines generated by chemical and CRISPR-mediated mutagenesis produces unexpected transcripts that escape nonsense-mediated decay. *PLoS Genet.* 13:e1007105.
- Hill, Russell** — MJ Marty, J Vicente, BL Oyler, A Place, Hill R. Sponge symbioses between *Xestospongia deweerdtae* and *Plakortis* spp. are not motivated by shared chemical defense against predators. *PLoS ONE.* 12:e0174816.
- Jagus, Rosemary** — Liu. C-L, A.R. Place and R. Jagus. 2017. Use of antibiotics for maintenance of axenic cultures of *Amphidinium carterae* for the analysis of translation. *Mar. Drugs* 15:242.
- Li, Yantao** — Xin Y., Y. Lu, Y-Y. Lee, L. Wei, J. Jia, Q. Wang, D. Wang, F. Bai, H. Hu, Q. Hu, J. Liu, Y. Li and J. Xu. 2017. Producing designer oils in industrial microalgae by rational modulation of co-evolving Type-2 diacylglycerol acyltransferases. *Mol. Plant* 10:1523–1539.
- Place, Allen** — Rodriguez, J. D., S. Haq,, T.R. Bachvaroff, K.F. Nowak, D. Morgan, V.V. Cherny, M. Sapp, S. Bernstein, A. Bolt, T.E. DeCoursey, A.R. Place and S.M.E. Smith. 2017. A vacuolar proton channel triggers the bioluminescent flash in dinoflagellates. *PLoS ONE* 12:e0171594.
- Robb, Frank** — An Y.J., S.E. Rowland, J.H. Na, D. Spigolon, S.K. Hong, Y.L. Yoon, J.H. Lee, F.T. Robb, S.S. Cha. Structural and mechanistic characterization of an archaeal-like chaperonin from a thermophilic bacterium. *Nat Commun.* 8:827.
- Saito, Keiko** — Vasta,G.R., Amzel, L.M., Bianchet, M.A., Cammarata, M., Feng, C., Saito, K., F-type lectins: A highly diversified family of fucose-binding proteins with a unique sequence motif and structural fold, involved in self/non-self recognition, *Front. Immunol.* 8:1648.
- Schott, Eric** — Flowers, E.F., T.R. Bachvaroff, J.V. Warg,, J.D. Neill, M.L Killian, A.S Vinagre, A. Almeida, Y. Zhan, E.J. Schott. 2016. Genome sequence analysis of CsRV1, a pathogenic reovirus that infects the blue crab *Callinectes sapidus* across its trans-hemispheric range. *Front. Microbiol.* 7:126.
- Schreier, Harold** — Marden, C., R. McDonald, H. J. Schreier and J.E.M. Watts. 2017. Investigation into the fungal diversity within different regions of the gastrointestinal tract of *Panaque nigrolineatus*, a woodeating fish. *AIMS Microbiology* 3:749-762.
- Sowers, Kevin** — Payne, R.P., U. Ghosh, H.D. May and K.R. Sowers. 2017. Mesocosm studies on the efficacy of bioamended activated carbon for treating PCB-impacted sediment. *Environ. Sci. Technol.* 51: 10691-10699.
- Vakharia, Vikram** — Zhang W., W. Zheng, Y. Toh, M.A. Betancourt-Solis, J. Tu, Y. Fan, V.N. Vakharia , J. Liu, J.A. McNew, M. Jin and Y.J. Tao. 2017. Crystal structure of an orthomyxovirus matrix protein reveals mechanisms for self-polymerization and membrane association. *Proc Natl Acad Sci USA.* 114:8550-8555.
- Vasta, Gerardo** — Vasta G.R., C. Feng, N. González-Montalbán, J. Mancini, L. Yang, K. Abernathy, G. Frost and C. Palm. 2017. Functions of galectins as 'self/non-self'-recognition and effector factors. *Pathog .Dis.* 31:75.
- Wong, Ten-Tsao** — Reyes-Tomassini, J.J., T-T. Wong and Y. Zohar. (2017). Seasonal expression of arginine vasotocin mRNA and its correlations to gonadal steroidogenic enzymes and sexually dimorphic coloration during sex reversal in the gilthead seabream (*Sparus aurata*). *Fish Physiol. Biochem.* 43, 823-832.
- Zohar, Yonathan** — Zmora N., J.D. Stubblefield, T-T. Wong, B. Levavi-Sivan and Zohar Y. (2017). Neurokinin-B regulates reproduction via inhibition of kisspeptin in a teleost, the striped bass. *J. Endocrinol.* 233:159-174.

# Personnel & Awards

## Award Highlight – Wilson H. Elkins Professorship

Dr. Rosemary Jagus was awarded the Wilson H. Elkins Professorship to Support Diversity in Marine Sciences, Vision Research, Education, and Open Educational Resources for her contributions to increasing the diversity of scientists working in the marine sciences. Jagus is the Project Director of the Living Marine Resources Cooperative Science Center (LMRCSC) summer undergraduate internship program at IMET. The LMRCSC is a minority training program operating in collaboration with the University of Maryland Eastern Shore (UMES). The Elkins Professorship will allow Jagus to continue and enhance minority undergraduate training within the LMRCSC.



## IMET Around the World

IMET had ongoing collaborations in 21 countries in 2017 (highlighted below), ranging from visiting scientists and students to joint research efforts.

