IMET Strategic Plan
2017-2022

The Institute of Marine & Environmental Technology

IMET

Institute of Marine & Environmental Technology

University System of Maryland · UMBC · University of Maryland, The Founding Campus · University of Maryland Center for Environmental Science

The Institute of Marine & Environmental Technology Strategic Plan 2017-2022

The Institute of Marine & Environmental Technology (IMET) is home to one of the largest groups of scientists in the world addressing marine and environmental research through molecular approaches. IMET is a collaborative partnership of University System of Maryland capitalizing on the strengths of the University of Maryland Center for Environmental Science, University of Maryland Baltimore County, and University of Maryland, Baltimore, in a dedicated state-of-the-art research facility located at Baltimore's Inner Harbor. The scientists at IMET take innovative approaches to protect and restore coastal marine systems and their watersheds and to develop approaches for sustainable use of resources that will provide benefits to society and to human health. Our approach is to apply advanced tools of biotechnology and molecular biology to the study of marine organisms and processes, with a strong emphasis on research excellence, education and public outreach, and economic development. IMET is in a unique position to maintain and enhance its role as a world leader in marine and environmental biotechnology, provided that it grows its faculty base, increases its research capabilities through effective collaborations, equipment and facilities investments, and increases its funding base. In this Strategic Plan, IMET's growth and future programs are carefully charted to enhance IMET's scientific contributions and the economic, environmental sustainability, and health goals of the state and nation.

The Strategic Plan is the result of a coordinated effort of all IMET faculty members. With the help of IMET's Program Committee and Governing Council, we will implement this plan to establish IMET as the world leading, state-of-the-art research institute in marine and environmental technology.

Vision

IMET will become the leading research institute in marine and environmental technology by focusing our research efforts on four key programs: Sustainable Aquaculture Production; Environment, Animal & Human Health; Energy, Climate Change & Global Health; and Innovation & Entrepreneurship in Marine & Environmental Technology.

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.

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IMET Programs

Using its state-of-the-art ARC facility, IMET studies aquaculture in environmentally responsible recirculating systems.

Sustainable aquaculture production

- *Land-based fully contained aquaculture*
- *Reproduction, breeding, hatchery and trait enhancement technologies*
- *Disease control*
- *Sustainable feeds and value-added products*
- *Aquaculture microbiology*

Aquaculture is the fastest growing agro-industry in the US and worldwide, and half of all seafood consumed currently comes from aquaculture. Aquaculture must increase production three-fold in the next 20 years to fill the growing gap between the increasing demand and declining supply of fishery products. Research at the Institute of Marine & Environmental Technology (IMET) will help aquaculture become more efficient, cost-effective and environmentally responsible as it increases production to reduce dependence on the declining supply of wild seafood for the growing world population. The IMET Sustainable Aquaculture Production program focuses on key research areas that address the main biological and technological challenges that aquaculture is now facing. Our Aquaculture Research Center (ARC) provides unique capabilities for research on land-based, fully contained aquaculture systems, focusing on improvement of biological waste treatment/conversion technologies and aquaculture system engineering. This research will further enhance water quality and increase waste management efficiency for the complementary goals of environmental sustainability, human health and economic viability.

The first prerequisite to the introduction of any new aquaculture species is closing its life cycle in captivity, i.e. producing fertilized eggs and viable juveniles on a year-round basis. The IMET faculty critical mass and expertise in the molecular and endocrine basis of reproduction, development and growth will enable us to continue our leadership role in understanding the mechanisms responsible for these processes and in developing technologies to enable reliable spawning, larval rearing and year-round seed production. The most promising strategy to ensure genetic containment in aquaculture is to generate reproductively sterile fish, so as to alleviate the threat of farmed fish breeding with wild stocks and prevent the possible propagation in the wild of genetically-engineered and non-native species. We will

Scientists at IMET are discovering ways to restore and preserve natural levels of marine life.

continue our innovative research on understanding the molecular and hormonal basis of sex determination and differentiation, germ-cell and gamete development in both the zebrafish model and commercially important aquaculture species.

IMET's exceptional algal production and live feed capabilities facilitate the integration of the above research goals into a coherent broodstock/breeding/hatchery package to support applied work ready for transfer to the industry. Whether for stock enhancement or commercial farming, fish health is critical to the aquaculture industry. Progress in the development of specialized adjuvants and delivery systems will enable vaccines to become even more targeted, specific and allow for faster responses to emerging diseases. Aquaculture vaccines provide business opportunities and we expect an IMET biotech company to be founded in this area within the next two years.

Using synthetic biology, we can tailor efficient vaccines for specific pathogens whose complete genomes are known and in the future create disease resistant hosts via RNA-guided "gene drives". Feed costs comprise up to 50% of the total budget for raising fish to harvest, and current feeds use ingredients extracted from wild fishery stocks. IMET is developing sustainable plant and algal-based feeds as an alternative to conventional fish-based feeds, thereby reducing reliance on a limited fishery resource. IMET faculty engineer microbial communities to improve water quality in recirculating aquaculture systems, control the development of microbial infections and minimize off-flavor during high-density production. We are also assessing microbiomes of production systems and cultured fish to determine how to control aquaculture microbiota by use of probiotics as alternative biological water quality and disease control agents.

IMET faculty

UMB-IMET: Helen Dooley, Jim Du, Gerardo Vasta
UMBC-IMET: Colleen Burge, Harold Schreier, Keiko Saito, Ten-Tsao Wong, Yonathan Zohar

UMBC-UMB-IMET: Colleen Burge
UMCES-IMET: Sook Chung, Allen Place, Eric Schott, Yantao Li

Collaborating faculty at partner institutions

UMB: Martin Flajnik, Jacques Ravel (Microbiology and Immunology, School of Medicine); Margaret McCarthy (Physiology, School of Medicine)
UMBC: Bill LaCourse (Chemistry and Biochemistry); Rachel Brewster, Tamra Mendelson (Biological Sciences)

UMCES: Louis Plough, Don Merritt (HPL); Dave Secor, Tom Miller (CBL)
UMCP: Reggie Harrell (Department of Environmental Science and Technology, Agricultural and Natural Sciences)

Strengths and challenges

IMET's Aquaculture Research Center (ARC) provides unique, outstanding resources for research in recirculating and sustainable aquaculture. ARC allows us to seamlessly alternate between different species and projects, depending on the research objectives and funding opportunities. Keeping ARC funded is an important challenge for IMET, being addressed by an ARC Financial Sustainability Committee in close consultation with UMBC and our other partners. We will have a new financial plan in place for ARC by the end of 2017. There are cohesive and synergistic interactions among the majority of IMET faculty in interdisciplinary, complimentary research areas specifically addressing key challenges in current aquaculture production and sustainability. These include closing the life cycle of commercially important fish (including exciting recent work on spawning and larval rearing of blue-fin tuna), overcoming disease, formulating environmentally responsible plant and algal-based feeds and developing technologies and production systems to prevent genetic and chemical interactions between aquaculture and the environment. Discussions on commercialization of our recirculating aquaculture technology are far advanced and successful commercialization is expected by the end of 2017. Moreover, IMET researchers have strong links and funded collaborations with the aquaculture industry which is seeking innovative solutions. The projected rapid growth of aquaculture in the US and worldwide provides IMET a unique opportunity to solidify its national and international leadership in this field over the next five years.

Future directions

Changes in the field likely to influence the program: the aquaculture industry will increasingly be driven towards environmental compatibility, with emphasis on sustainability, further increasing the importance of our programs. There is a trend towards growing diversification of species, and the need for closing life cycles of new aquaculture species, genetically containing farmed species and developing alternative feeds, providing opportunities for current and future IMET faculty. Research using the tools of genetic engineering, gene silencing and gene editing will enable new levels of understanding and control of reproduction, development, disease resistance and growth, and will drive our faculty as well as industry to enhance traits in aquaculture species such as developmental success, growth rate, environmental tolerance and disease resistance.

Funding opportunities

NSF provides opportunities for basic research on reproduction and breeding, development, pathogen-host interactions and aquaculture microbiology. NOAA/Sea Grant and USDA have an increasing emphasis on sustainable aquaculture. Industry opportunities are still developing, and successes include contracts with Europharma, Intrexon, Great American Aquaculture, Qualitas and Cermaq. The National Institutes of Health (NIH) may be a good source of funding for our basic research in reproduction and comparative immunology. National Institute of Environmental Health Sciences (NIEHS) and EPA provide opportunities for our research protecting the environment from aquaculture-driven pollution. The National Institute of Standards and Technology (NIST) has an interest in developing standards for the aquaculture industry. IMET has also had success with foundations such as the Gudelsky Foundation, which has been a major supporter of IMET's aquaculture research. IMET should further explore foundation and philanthropic organizations interested in preserving ocean biodiversity and in food security and marine-based proteins to feed the world. Potential funding opportunities in the area of applied research include Small Business Innovation Research (SBIR), Maryland Industrial Partnerships (MIPS), and Maryland's Technology Development Corporation (TEDCO).

IMET is researching ways to restore levels of the Chesapeake Blue Crab.

Environment, animal & human health

- *Host-pathogen interactions and immunology of established and emerging model systems*
- *Regulation of vertebrate and invertebrate development*
- *Extremophiles as disease models and for vaccine delivery*
- *Discovery of bioactive compounds with therapeutic potential*
- *Natural and man-made environmental toxins*

The Institute of Marine & Environmental Technology (IMET) is a leader in research of protozoan, bacterial, and viral diseases of economically and ecologically important marine and estuarine species, including Chesapeake Bay species such as the blue crab and the eastern oyster. Research spans innate immune recognition mediated by protein-carbohydrate interactions and acquired immunity in model and non-model systems, including in shark immunity. An important area for application of this research is in vaccine development, including gene-based vaccine antigens and archaea-derived vaccine delivery technology.

IMET contributes to human health through work in established and emerging model systems for the study of infectious disease, including Influenza A, pneumococcal pneumonia, and sepsis, and the role of *Helicobacter pylori* in gastric inflammation and cancer. Research in aquatic and microbial model systems contributes to understanding of vertebrate musculoskeletal development, eye lens development and retinal regeneration and the glycobiology of neoplastic transformation and progression.

Research on drug discovery at IMET aims to find beneficial products from microbes associated with marine invertebrates and high value lipids and secondary products from algae. Novel lectins are explored as reagents for histochemistry, analytical and preparative glycoprotein studies, cell separation and other applications.

Human health can be impacted by algal toxins in positive and negative ways. The genes, biosynthesis and mechanisms of action of toxins from dinoflagellates and other algae are being studied and these toxins may have beneficial uses as drugs. Development of cost bio-assays and *in situ* methods to reduce cyanobacteria blooms can help reduce the negative health impacts of harmful algal blooms.

Utilizing multiple techniques to examine genes in model organisms, IMET scientists are helping to advance their field.

IMET faculty

UMB-IMET: Shiladitya DasSarma, Helen Dooley, Jim Du, Frank Robb, Gerardo Vasta
UMBC-IMET: Harold Schreier, Vikram Vakharia, Ten-Tsao Wong, Yonathan Zohar

UMBC-UMB-IMET: Colleen Burge
UMCES-IMET: Tsvetan Bachvaroff, Rosemary Jagus, Russell Hill, Allen Place, Eric Schott

Collaborating faculty at partner institutions

UMB: Thomas Blanchard (Pediatrics, School of Medicine); Alan Cross (Medicine, School of Medicine); Shengyun Fang (Physiology, School of Medicine); Martin Flanik, Matthew Frieman (Microbiology and Immunology, School of Medicine); Simeon Goldblum (Medicine, School of Medicine); David Goodlett (Pharmaceutical Sciences, School of Pharmacy); Margaret McCarthy (Pharmacology, School of Medicine); Eric Sundberg (Medicine, School of Medicine)
UMBC: Lee Blaney (Civil and Environmental Engineering); Rachel Brewster (Biological Sciences); Tom Cronin (Biological Sciences); William LaCourse (Chemistry and Biochemistry)
UMCES: Don Merritt, Louis Plough (HPL); Tom Miller, David Secor (CBL)
UMCP: Lai-Xi Wang (Chemistry and Biochemistry);
Additional regional and USM collaborators: National Aquarium, Morgan State University, Coppin State University, University of Maryland Eastern Shore, Smithsonian Environmental Research Center, Johns Hopkins University

Strengths and challenges

IMET has a critical number of faculty working on diverse host-pathogen systems. Our research spans diverse approaches to immunity, including the study of innate and acquired immunity, glycoimmunology, and vaccine development. The high functioning recirculating marine aquaculture system provides unique capabilities. We use diverse model systems and have the ability to create models from novel organisms.

IMET lacks adequate aquatic pathogen challenge facilities. There is a regional and national gap in capacity to undertake experimental aquatic disease research. A high priority is to establish well equipped, appropriately located and sized challenge facilities. Interactions between IMET and partners should be increased from our already strong foundation. There is a need for state-of-the-art instrumentation, including high resolution mass spectrometry. The challenging trends in support of research funding at the federal and state level require extra effort to obtain these funds and are an incentive for further diversification of IMET's funding base, including more funding from industry and philanthropic support.

Future directions

Changes in the field likely to influence the program: the potential for gene editing technology to enable genetic manipulation of non-model systems provides great scientific opportunities. Climate change and increasing anthropogenic inputs into the environment will increase the already high level of harmful algae blooms and infectious diseases.

Funding opportunities

NSF Integrative Organismal Systems (IOS), Biological Oceanography, Molecular and Cellular Biosciences (MCB) are potential funding sources for this research area. NIH is one of the largest sources of funds, and likely to continue to be so. The specific divisions of NIH include National Institute of General Medical Sciences (NIGMS), National Institute of Environmental Health Sciences (NIEHS), National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), and National Institute of Child Health and Human Development (NICHD). Funding for human health has been declining from NOAA and the NOAA strategic plan indicates that the agency is turning more to climate and resilience at a landscape to global scale. It is likely that goals of the IMET environment and human health core strengths will require success with agencies and funding sources other than NOAA over the next 5 years. There is potential for USDA funding for aquaculture and the health of aquaculture species to support some of what IMET's strengths enable us to do. Fish vaccines are an example of current work that coincides with USDA priorities in aquaculture and animal health. Programs with this focus area have not yet explored all the possible foundation or philanthropic possibilities. These may be small to start, but build as relationships become established and funders gain a sense of return for investment. Similar to the relationships with foundations, industry opportunities are still developing. Examples of success are contracts with Europharma and Intrexon.

Algae is being explored as a promising producer of clean biodiesel.

Energy, climate change & global health

- *Urban molecular ecology/urban ecosystems*
- *Ecosystem restoration*
- *Microbial diversity and function*
- *Global climate change and biogeochemistry*
- *Waste management*
- *Water and wetland resources*
- *Sustainable energy resources*

Research at the Institute of Marine & Environmental Technology (IMET) on energy, climate change and global health includes sustainable energy and biofuels, climate change and nutrient cycling, ecosystem restoration and waste management.

Microalgae and cyanobacteria, along with their symbiotic bacteria, are being investigated as producers of lipids and hydrocarbons at molecular and systems level to develop innovative bioenergy processes. The microbiological factors that regulate methane production from biomass and the conversion of organic waste to biogas are studied to improve the efficiency of the process.

Genomic and metagenomic studies of marine and estuarine microbes at IMET contribute to understanding of microbial biodiversity and roles of microbes in biogeochemical cycles. Modeling of microbial metabolic fluxes contributes to understanding of processes driving climate change.

IMET researchers are conducting research in microbial bioremediation to develop novel technologies for sustainable, *in-situ* treatment of organic pollutants such as PCBs and PAHs in sediments and soils. IMET researchers are developing mitigation strategies and approaches to lessen the impact of harmful algae and nutrient pollution. IMET scientists study complex symbioses

Technologies developed at IMET are having a positive impact on the health of local ecosystems.

between bacteria and microalgae or animals, with implications for biofuel production and global health.

Research on extremophiles at IMET seeks to understand the origin, evolution, distribution and future of life in the Universe, specifically the potential for life to adapt to different environments and the implications for life elsewhere. Our understanding of the adaptive mechanisms of extremophiles is opening up a large area for development of high temperature enzymes for manufacturing and bioenergy production.

IMET faculty

UMB-IMET: Shiladitya DasSarma
UMBC-IMET: Harold Schreier, Kevin Sowers
UMCES-IMET: Feng Chen, Russell Hill, Allen Place
UMCES-UMBC-IMET: Yantao Li

Collaborating faculty at partner institutions

UMB: Ilia Baskakov (Anatomy and Neurobiology, School of Medicine); C.S. Raman (Pharmaceutical Sciences, School of Pharmacy); Jacques Ravel (Institute for Genome Sciences)

UMBC: Jeffrey Gardner, Stephen Miller (Biological Sciences); Lee Blaney, Upal Ghosh (Civil and Environmental Engineering)
UMCES: Michael Gonsior (CBL)

Strengths and challenges

IMET has developed a critical core of expertise in the areas of photosynthetic algae and cyanobacteria, lipid chemistry, and biomass conversion that is only beginning to leverage this strength for funding and potential applications in both the private and public sectors. More collaboration is needed to position IMET for competitive funding in larger multi-investigator projects from both federal agencies and the private sector.

IMET's microbiology program is clearly more focused on laboratory based approaches, however fieldwork is emerging as the basis for several research programs. In terms of the application of molecular techniques to address key questions in marine and environmental microbiology, IMET is among the top two or three centers worldwide. The closest competing institutes are the SARS Institute in Bergen, Norway; the Woods Hole Oceanographic Institute; the Scripps Institute of Oceanography; and, the Monterey Bay Aquarium Research Institute. IMET must maintain a commitment to state-of-the-art facilities for molecular biology, omics (including genomics, transcriptomics, proteomics, metabolomics, and fluxomics), bioinformatics and genome engineering tools. In order to join the front rank of omics-driven research, we need to increase our commitment to infrastructure to enable IMET to carry out stand-alone omics projects and establish strong relationships with the Institute for Genome Sciences at UMB and other collaborators.

IMET is a world leader in the development of sustainable bioremediation technologies for soils and sediments. Our primary focus has been on developing the first in-situ microbe-based treatment of polychlorinated biphenyls, which is nearing commercialization. This treatment twill be expanded to other relevant environmental pollutants. We need to maintain state-of-the-art instrumentation for analyses of environmental pollutants and continue to form collaborations with environmental engineers and chemists to develop real-world solutions both in the lab and the field.

Future directions

Changes in the field likely to influence the program: the field is moving beyond the production of ethanol as an alternative fuel source and lipid-based biofuels will continue to be a national priority. DOD and DOE will continue to promote production of biodiesel and aviation fuel and the transportation industry will continue to drive research in production of biofuel precursors and gasoline. Conversion of non-food feedstocks such as agricultural plant waste, grasses and wood will continue to be funded. In addition, the availability of low-cost domestic natural gas will likely lead to funding for bioconversion to liquid fuels. The advent of high throughput analysis and the use of genomic data to examine adaptive responses and biodiversity will lead to greatly increased ability to explore microbial diversity and understand marine processes. A critical mass of expertise exists at IMET, addressing the molecular biology and ecology of extremophiles. IMET has unique facilities for research with extremophiles with capabilities found at few institutions in the world. With the current multi-institutional structure of IMET that has the potential to further broaden our expertise in extremophiles, attempts should be made to identify funding opportunities for a large program grant.

Funding opportunities

The DOE Advanced Research Projects Agency for Energy (ARPA-E) and Office of Energy Efficiency and Renewable Energy (EERE) are potential sources of funding for collaborative projects on lipid and hydrocarbon production, C1 metabolism and thermophilic biomass conversion. DOE-Genomes to Life and the NSF Energy for Sustainability programs are also potential sources of funding. IMET has a strong track record of funding from NASA to conduct research on archaea as models for adaptation to extreme environments and IMET is well placed for continued funding in this area. IMET is in an excellent position to establish large-scale program-projects in marine microbiology for the microbial genome programs at USDA/NSF, the Genomic Science Program, the Joint Genome Institute's Community Sequencing Program and the Energy Biosciences Program at DOE. Initiatives at NIEHS and NOAA related to oceans and human health are potential sources for funding consortia of several research faculty. We anticipate continued funding opportunities for our bioremediation program through the NIEHS Superfund Program and DOD programs such as the Office of Naval Research (ONR), Strategic Environmental Research and Development Program (SERDP) and Environmental Security Technology Certification Program (ESTCP). As we commercialize our bioremedial technologies we also anticipate funding from the Maryland Innovation Initiative, Maryland Industrial Partnerships, Small Business Innovation Research (SBIR) / Small Business Tech Transfer (STTR), and through contracts with industry for environmental clean-up projects.

REEF students interact with local business leaders during their studies.

Innovation & entrepreneurship in marine & environmental technology

- *Graduate student training in entrepreneurship and leadership*
- *Fostering early stage companies*
- *Business incubation in IMET Harbor Launch*
- *Fostering industry partnerships and strategic alliances*

The Institute of Marine & Environmental Technology (IMET) currently leads four programs in entrepreneurship: 1) the Ratcliffe Environmental Entrepreneurs Fellowship (REEF) Program, 2) Baltimore Entrepreneur Offices Hours, 3) the IMET Harbor Launch Incubator and 4) the IMET Entrepreneur in Residence Program. The **REEF Program** helps young scientists cultivate the leadership and business skills necessary to bring their research into commercial markets. REEF provides students with a more informed appreciation of the potential business implications of their research. The program includes fellowships for select students as well as short courses over four weekends each semester that cover basic business principles, marketing, intellectual property, stage gate theory, venture capital development, leadership and other factors that foster entrepreneurship.

Baltimore Entrepreneur Office Hours is a collaboration between the Maryland Technology Enterprise Institute (Mtech) and IMET, and a partnership with representatives from the greater Baltimore entrepreneurship community and funding agencies. Aspiring entrepreneurs with ideas for new companies and established start-ups can receive free, 1-on-1 advice on a variety of pivotal issues, including building and financing a start-up company; developing and protecting intellectual property;

Members of the local scientific and business communities get together once a month for Entrepreneur Office Hours.

navigating the technology transfer process; and, business strategy refinement.

The IMET **Harbor Launch** Incubator serves as a business launch pad for young companies working to promote the development of products and services having a positive impact on the environment and human health. The scientists at IMET create technologies designed to foster the protection and restoration of coastal marine systems, sustainable use of their resources and improvement of human health. Incubation of small businesses focused on this mission furthers IMET's important role in economic development in these areas.

The **IMET Entrepreneur in Residence** Program builds on a well-established practice. Entrepreneur in Residence (EIR) programs originated from venture capital firms needing very experienced entrepreneurs in a particular area of interest. These EIRs gave insights into new market trends, business climate, business landscape, industry networks and the future direction of the market. The IMET EIR provides services to tenant companies at Harbor Launch. These services include helping tenants refine their business plan, giving advice on sources of funding for early stage companies, and making introductions to people and institutions that will aid in propelling the startup companies toward success.

IMET personnel

UMCES-IMET: Nicholas Hammond (Assistant Director),
Lindsay D'Ambrosio (HarborLaunch Manager)

Collaborating faculty at partner institutions

UMB: Jim Hughes (Chief Enterprise and Economic Development Officer; Director, UMVentures)
UMBC: David Fink, Wendy Martin (Office of Technology Development)
UMCES: Bill Dennison (Integration & Application Network)

Strengths and challenges

IMET has developed an essential core of an entrepreneurial ecosystem containing both startup companies and stable, growth-focused companies operating in proximity to university faculty. In addition to proximity, IMET has four programmatic support programs to further company commercialization efforts and interface with the broader entrepreneurial community in the Baltimore area. As with IMET itself, partnership has been a cornerstone of economic development efforts at IMET.

Further opportunities to expand the current successes exist. There is a significant opportunity to establish a small business accelerator program centered on nutrition and human health. With IMET being in close proximity to the National Institutes of Health (NIH), the Food and Drug Administration (FDA) and having local partners, such as DSM Royal, there is a considerable knowledge base located in Maryland that has yet to be accessed. IMET has many research interests centered on nutrition and human health, including sustainable aquaculture, lipids and nutrients sourced from algae, and water quality management.

Additional programs may be developed, including a Seed Grant Program, Corporate Sponsored Business Plan Competition, Environmental Leadership Education Program, and a Monthly Networking Event.

Future directions

Changes in the field likely to influence the program: changes may be coming to the types of programs and funding offered by Maryland's Technology Development Corporation (TEDCO), a major player in early-stage R&D financing in Maryland.

Funding opportunities

IMET has been successful thus far in self-funding economic development programs, resources from private funding and similar grant funding, although challenging, will continue to be sought. The University System of Maryland has renewed its dedication to economic development goals in Baltimore through the establishment of the Center of Maryland Advanced Ventures with an annual budget of $4M per year beginning July 1, 2017. In light of this renewed dedication to Baltimore, additional state funds may be sought to support economic development programs at IMET. In addition to state funds, partnerships with large companies that may wish to have a presence in Baltimore or Maryland may be sought.

Meet our IMET faculty

The faculty at the Institute of Marine & Environmental Technology (IMET) is highly collaborative and the research programs of individual faculty members typically involve more than one focus area. Primary research interests for each faculty member are described below.

Bachvaroff, Tsvetan (Assistant Research Professor, UMCES-IMET): Dinoflagellate evolution with focus on the parasitic dinoflagellates; large scale sequencing and phylogenetic methods to describe evolutionary histories.

Burge, Colleen (Assistant Professor, UMBC-UMB-IMET): Marine host-pathogen-environment interactions; invertebrate immune response and physiology; ocean health: an organism, environment and human perspective.

Chen, Feng (Professor, UMCES-IMET): Marine microbial ecology; microbial oceanography and biogeography; microbial diversity, genomics, and functional genomics; phage-host interactions; clean green biotechnology.

Chung, Sook (Associate Professor, UMCES-IMET): Neuroendocrine regulation on crustacean physiology of molting, growth, reproduction, sex differentiation and stress responses.

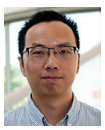
DasSarma, Shiladitya (Professor, UMB-IMET): Post-genomics and biotechnology of salt-loving, radiation tolerant, and cold-adapted extremophiles; production of virus-like vaccine nanoparticles and therapeutic proteins.

Dooley, Helen (Assistant Professor, UMB-IMET): Comparative immunologist focused on cartilaginous fish, with an interest in the development of new technologies/ therapies to understand, diagnose, and treat human and animal disease.

Du, Shaojun "Jim" (Associate Professor, UMB-IMET): Developmental biology, muscle biology and genetics; genetic regulation of muscle and bone development; zebrafish as a model organism for the study of vertebrate development.

Hill, Russell (Professor, UMCES-IMET): Symbiosis between bacteria and marine invertebrates, especially sponges; marine actinomycete ecology and molecular biology: microbiology of marine natural products; microalgae and biofuels; marine biotechnology.

Jagus, Rosemary (Associate Professor, UMCES-IMET): Translational control of gene expression; regulation of gene activity during early development; host defense against virus infection and viral countermeasures; role of protein synthesis in lactation.



Li, Yantao (Assistant Professor, UMCES-UMBC-IMET): Microalgal molecular biology and lipid biochemistry; metabolic engineering for biofuels and bioproducts; microalgal biotechnology and environmental bioremediation.

Place, Allen (Professor, UMCES-IMET): Elucidation of the molecular mechanisms that permit organisms to adapt to unique diets, environments, and interactions (symbiosis); molecular basis of sex determination.

Robb, Frank (Professor, UMB-IMET): Mechanisms of heat tolerance in hyperthermophiles; heat shock proteins, including their use to improve high-temperature industrial or biomedical processes.

Saito, Keiko (Assistant Research Professor, UMBC-IMET): Aquatic microbial ecology and aquacultural microbiology; anaerobic ammonium-oxidizing bacteria (anammox) and ammonia-oxidizing archaea (AOA) for waste treatment in marine recirculating aquaculture systems (RAS).

Schott, Eric (Assistant Research Professor, UMCES-IMET): Discovery, characterization and quantification of estuarine pathogens; aquaculture health; health and biodiversity of urban waters.

Schreier, Harold (Associate Professor, UMBC-IMET): Nitrogen and sulfur cycles of marine recirculating aquaculture systems; nitrogen fixation in the gut of a wood-eating catfish; use of probiotic bacteria in oyster larvae hatcheries and their interaction with bacterial pathogens; biochemistry and physiology of the Planctomycetes.

Sowers, Kevin (Professor, UMBC-IMET): Biology of methanogenic Archaea; anaerobic conversion of organic wastes to biomethane; microbial reductive dehalogenation of organochlorines, *in situ* treatment of persistent organic pollutants in sediment and soil.

Vakharia, Vikram (Professor, UMBC-IMET): Viral pathogenesis of fish rhabdoviruses; development of novel vaccines for economically important fish pathogens.

Vasta, Gerardo (Professor, UMB-IMET): Molecular, biochemical, structural, and functional aspects of protein-carbohydrate interactions relevant to immunity and early development.

Wong, Ten-Tsao (Assistant Professor, UMBC-IMET): Molecular, cellular and applied aspects of fish germ cell biology and reproductive physiology.

Zohar, Yonathan (Professor, UMBC-IMET; Head of ARC): Basic and applied aspects of fish reproductive physiology and molecular endocrinology; broodstock management and hatchery technologies; aquaculture and fisheries biotechnology; environmentally sustainable recirculating marine aquaculture.

IMET personnel

Hammond, Nick (Assistant Director, UMCES-IMET): economic development and technology commercialization; Harbor Launch, Baltimore Entrepreneur Office Hours, Ratcliffe Environmental Entrepreneurs Fellowship Program, Entrepreneur in Residence Program

D'Ambrosio, Lindsay (Harbor Launch Manager, UMCES-IMET): technology commercialization, bioengineering and marine microbiology; Harbor Launch management.

IMET is governed by the IMET Governing Council, pictured here with IMET Director Russell T. Hill, Ph.D. (bottom right). The IMET Governing Council comprises the University System of Maryland Chancellor Robert L. Caret, Ph.D. (top center); Donald F. Boesch, Ph.D. (President UMCES; top right); Freeman A. Hrabowski, III, Ph.D. (President UMBC; top left); and, Jay A. Perman, M.D. (President UMB; bottom left).

IMET

Institute of Marine & Environmental Technology

The Institute of Marine & Environmental Technology (IMET) has a culturally and socioeconomically diverse student body and a very strong track record of training a diverse student body. IMET provides a highly collaborative environment and established interdisciplinary collaborations to address challenging scientific questions. IMET occupies a unique position as the hub for communication and collaboration between three universities.

In its first five years of existence, IMET has succeeded in developing a high functioning multidisciplinary program. To firmly establish our position as an international leader in the field of marine and environmental technology, we need to grow in faculty, research funding and graduate education. The present strategic/program development plan aims to achieve this goal.

To learn more, visit: ***imet.usmd.edu***
or email: ***imetdirectorsoffice@umces.edu***