

INTRODUCTION

By 2030, the global population is expected to exceed eight (8) billion and will require 30% more water, 40% more energy, and 50% more food to survive ([Wharton report¹](#)). Recent advances in science and technology have spurred renewed interest in marine bio-resources as a sustainable, environmentally friendly means to address these global challenges ([Ritchie et al²](#)).

Marine biotechnology, sometimes referred to as **BLUE BIOTECHNOLOGY**, is a relatively new but rapidly growing cluster that can be described as the translation of basic marine science into products and services that impact living organisms for the benefit of society, the environment, and economic development. Still in its early stages of development, North Carolina’s (NC) marine biotechnology cluster requires coordination to fully realize its potential to capitalize on this global market valued at \$168 billion³ with enormous potential for rapid growth.

MISSION

While some limit marine biotechnology to marine-based biochemicals, the Marine Bio-Technologies Center of Innovation (MBCOI) has a much broader vision to ‘fathom the opportunities’ that includes diverse applications of marine-based discoveries in sectors such as food, energy, and health. To be successful, NC’s cluster needs access to subject matter expertise and stakeholders not only in core marine science research, but also into the industries it might touch. By combining a regional focus with a global perspective, MBCOI serves as the **NEXUS** for information, collaboration, and commercialization of marine biotechnologies among our stakeholders, both domestically and internationally.

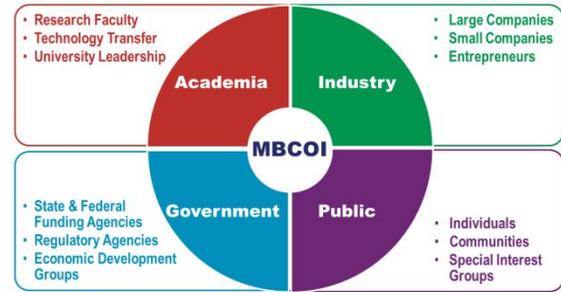
BACKGROUND

As a powerhouse in both marine science and biotechnology research, NC is poised to become a global hub for marine biotechnology in the 21st century as a natural extension and partnership between two strong drivers: 1) the state’s established biotechnology community, recently recognized as second in the nation⁴, and 2), a significant institutional marine science research capacity. Established in 2012 as an independent, non-profit 501(c)(3) corporation, MBCOI facilitates the translation of innovative marine-related discoveries into products and services to benefit NC’s economy.

Strategy	Tactics
Priming the small business pipeline Ensure constant flow of new small businesses and improve efficiency in technology translation and commercialization	<ul style="list-style-type: none"> • Identify “non-obvious opportunities” for new technologies and businesses • Triage technologies to assess market opportunities • Provide mentoring, business counseling, and consulting • Create a marine biotech focused communication network
Nurturing small business community Build and strengthen cluster and community networks and facilitate partnerships to increase peer to peer learning, funding, and access to markets	<ul style="list-style-type: none"> • Convene members of the community to encourage peer learning, increase networking and boost partnering opportunities • Advance growth of small businesses by promoting market specific value to cluster partners • Increase participation of small businesses in funding opportunities • Identify trans-sector opportunities for cluster expansion and synergies

MBCOI’s strong subject-matter expertise and rich extended network enables us to identify opportunities for commercialization of marine biotechnology in other sectors that might otherwise be overlooked. With three regional offices in Wilmington, Morehead City, and Research Triangle Park, NC, MBCOI is able to better serve the state’s marine biotechnology **community**. For **academia**, we facilitate a broad

range of scientific collaboration, identify non-obvious commercial applications of ongoing research in adjacent fields, and establish academic-industry partnerships that can lead to commercial development of inventions and technologies. For **industry**, we connect entrepreneurs and small companies to our network of global stakeholders to maximize value for their promising or cutting-edge technologies or products. For large **companies** we are a trusted partner and source of expertise, new technologies and products needed to maintain healthy pipelines. In the **government** sector, MBCOI drives the promotion of NC's strengths in marine science to maximize its economic wellbeing through management of all marine bio-resources. Finally, MBCOI serves the **public** as the go-to resource for information on marine science in NC and beyond.



PROGRAMS

MBCOI was created to facilitate entrepreneurial growth from marine biotechnologies. By serving as a **NEXUS** for commercialization of NC's marine biotechnologies, MBCOI offers support to its stakeholders, facilitates collaboration with partners, and empowers our stakeholders to gain industry partnerships.

Technology Translation. Turning basic science discoveries into marketable products and services is not trivial. It involves two related but distinct processes: Technology scouting, the systematic identification and feasibility assessment of emerging technologies and mapping their appropriateness for applications and channels; and Commercial landscape analysis, the evaluation of unmet market need and value-proposition for the product or service in relation to those that may already exist or are known to be in development. MBCOI created records for approximately 1,000 life science-related entities in NC in a customized SugarCRM database and developed a controlled vocabulary for keyword searching that allows for rapid pairing of complementary strengths/needs among the marine biotechnology community. Over 250 areas of expertise/technologies have been identified, many of which have been triaged through a formal evaluation process which assesses their technical/scientific merit and development status, as well as their market potential and corresponding level of business readiness. This process permits MBCOI to see opportunities for collaboration or commercialization in non-obvious sectors such as AgBiotech and bring them to the attention of our stakeholders.

Aquaculture and Seafood. Aquaculture is the fastest-growing sector of animal food production across the globe (steady 8-10% CAGR) outpacing combined growth rates of poultry and livestock by three times over the past 40 years.⁵ Many countries see marine aquaculture as a significant source for domestic protein consumption and market export. Wild fisheries are being overharvested, and aquaculture now accounts for over half of the seafood processed world-wide for human consumption. In the United States, aquaculture meets only 5 to 7 percent of US demand for seafood, with only 20 percent of domestic aquaculture coming from marine sources (mostly shellfish, not finfish).⁶ American aquaculture production will grow dramatically in the coming years as biomarine science and technology creates economies of scale for marine production through on-shore recirculating systems and off-shore cages and pens. NOAA estimates that doubling current aquaculture production could result in 50,000 jobs and over \$1 billion in farm gate value.⁷

North Carolina has the potential to take a leadership role in developing new businesses and innovations for the aquaculture industry such as aqua-animal health, broodstock genetics and new production

technology. With a combination of leading research universities, seafood and agriculture history, and biotechnology businesses throughout the state, the fundamentals are in place for NC organizations and individuals to make a lasting impact in this industry. In order to maximize potential in NC, a long-term perspective across the industry and improved coordination is required. MBCOI's **NEXUS** model is perfectly positioned to fill that unmet need.

Genomics. Since genomics is a fundamental research tool used throughout life science research and product development, MBCOI executed a competitive market analysis of this area and identified large unmet needs for genomics in marine and non-marine sectors. Through our exclusive partnership with a leading genomics company in the biodefense arena, MBCOI can now provide our stakeholders with access to OIB's unique and immensely powerful genomic analysis platform. This partnership provides OIB access to valuable new markets; clients gain a strong competitive advantage in research and product development; and, MBCOI shares significantly in revenue generated directly through services rendered, and in the commercialization rights of resulting products.

The genomics platform is fundamentally different and we believe superior to all other known methods such as BLAST, FASTA or k-mer, and enables analyses in minutes or hours for which other platforms require days, weeks or months. Originally designed to address problems of national security such as bioweapons (e.g. Anthrax) emerging pathogens (e.g., Ebola and Zika) and agrodefense (e.g., Swine flu and African Swine Fever Disease), it is optimized for simultaneous and parallel analysis of extremely large datasets such as high-resolution interrogation of whole-genomes, large collections of organisms and dissecting microbiomes and metagenomes that would be impossible or impractical on other systems.

Brand Development and Marketing. MBCOI has established its brand regionally, nationally, and internationally by implementing focused marketing strategies to elevate its visibility and that of NC's marine sciences through speaking engagements, exhibitor showcases, meetings, websites, media campaigns, Twitter, LinkedIn and newsletters. As one of the founding members of the BioMarine International Clusters Association (BICA), MBCOI's serves as a conduit for the global exchange of ideas, perspectives, and collaboration on a range of projects and programs stemming from NC's efforts. In partnership with the North Carolina Biotech Center Southeastern Office, MBCOI hosted the 2105 BioMarine Business Convention in Wilmington, NC, the first time in the US. With CEOs and investors from 19 countries in attendance, the impact of BioMarine 2015 on NC's economy will continue to be realized over many years as the outcomes of the networking opportunities come to fruition. Finally, MBCOI is an integral part of the Wilmington/Carolina Coast Innovation Council which was recently awarded \$250,000 in support and services from Innovate NC for further development of NC's southeastern region's life science and marine biotechnology assets.

TEAM

As a small, lean organization with finite bandwidth, MBCOI has leveraged its strong relationships with other organizations and experts to facilitate technology translation for ourselves and our stakeholders. In this regard, we are fortunate to have established a wide and deep network of local, national and international partners, both formal and informal, who are committed to our success. MBCOI staff members have extensive experience in translation of new technologies into products and services in multiple life science sectors.

Deborah A. Mosca, PhD, CEO, is responsible for driving commercialization of NC’s marine biotechnologies through the cultivation of a collaborative environment among universities, businesses, funding agencies, economic development agencies, marine biotech research advisory groups throughout NC, as well as national and international partners to deliver economic benefits statewide. During her 35 years of experience in various organizations including biotech, non-profit research institutions, and large pharma, she has led multi-disciplinary, interinstitutional project teams in the discovery and development of novel therapeutic agents in particular those effective against multi-drug resistant bacteria. During her career, Dr. Mosca executed critical roles in securing funding totaling more than \$42M in contracts and \$100M in venture capital.

Royston E. Carter, PhD, serves as **Senior Director Development** at MBCOI. With more than 25 years of diverse academic and industry life science R&D and technology commercialization experience, including development of advanced molecular genetics and cell biology technologies, cancer biology, agricultural biotechnology and bio-detection. He has authored 25 scientific publications with over 2,300 citations, and was primary inventor on one issued patent. Dr. Carter oversees technology assessment and partnership opportunities.

Ms. Michelle P. Miller, AAS Bus. Admin., in her role as **Program Coordinator** and **Executive Administrative Assistant**, offers over 20 years in administrative service, finance, program coordination and regulatory affairs in the biotech sector.

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¹ Orts, Eric; Spigonardo, Joanne. “The Nexus of Food, Energy and Water.” IGEL Knowledge@Wharton. June 2013: 1-22. PDF file.

² Ritchie, RJ et al (2013). “Policy to support marine biotechnology-based solutions to global challenges.” Trends in Biotechnology Volume 31.3 (2013): 128-131. PDF file.

³ 4th BioMarine Business Convention Final Report, September 9-12, 2013. www.BioMarine.org

⁴ Recent news reports now cite North Carolina as the second leading biotech state in the nation. See: <http://wraltechwire.com/triangle-jumps-to-no-2-in-life-science-hub-rankings/14790197/#YW7jTr6hoQo1MJl.99>

⁵ http://wwf.panda.org/what_we_do/footprint/agriculture/aquaculture.cfm

⁶ http://www.nmfs.noaa.gov/aquaculture/faqs/faq_aq_101.html

⁷ http://www.nmfs.noaa.gov/aquaculture/docs/aquaculture_docs/world_prod_consumtion_value_aq.pdf