National Oceanographic Partnership Program

OCEAN ENTERPRISE INITIATIVE

MBON
Marine Biodiversity Observation Network

TECHSURGE

>>>WORKSHOPS THAT MOVE KNOWLEDGE FORWARD

Ocean Biodiversity TechSurge Synthesis Report

October 1-2, 2024 | Baltimore, MD

MTS marine technology society

GOOS Global Ocean Observing System

NOAA

IOOS Integrated Ocean Observing System

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Executive Summary

The U.S. ocean economy supports 2.4 million jobs across multiple sectors that benefit from marine life, its biodiversity, and interactions between organisms. This includes fishing, tourism, shipping, energy development, and materials and pharmaceutical discovery and production, all which contributed around $400 billion to the U.S. gross domestic product in 2019. The biological diversity in our Exclusive Economic Zone is part of our nation's heritage. Coordination of emerging science, technology, and policy innovation to monitor this biodiversity is a key to sustained economic development of ocean spaces. Getting there requires bringing together diverse users, and public and private investment, including entrepreneurs, start-ups, and philanthropy.

On October 1–2, 2024, the Marine Technology Society's (MTS) Ocean Enterprise Initiative, in partnership with the National Oceanographic Partnership Program (NOPP), along with organizing partners including the U.S. Integrated Ocean Observing System (IOOS) and the Marine Biodiversity Observation Network (MBON), hosted the Ocean Biodiversity TechSurge and Tech Café in Baltimore, Maryland. This event focused on the role of the technology sector in advancing ocean biodiversity 'knowledge to action'. This report on the TechSurge summarizes conversations and opportunities surrounding scaling ocean biodiversity technologies.

Priority outcomes from this conversation include providing opportunities to spur technology innovation to monitor ocean biodiversity; coordinating financing solutions that lead to evidence-based decision-making about ocean uses and that can monitor for success; advancing interoperability of biodiversity information; and supporting growth of the workforce that manages ocean uses for the sustained benefit of human communities, economies, and ecosystems.

Context and Key Takeaways

This event included conversations with representatives from multiple sectors about the economic and social value of biodiversity in ocean, coastal, and Great Lakes waters. Emerging technologies and data solutions that support uses of ocean spaces need to be centered on providing information on biodiversity to ensure good policy. The private, research, technology, and government sectors have an opportunity to converge to accomplish this. Together they can leverage public and private investment to develop and produce high-impact solutions.

The 2024 Ocean Biodiversity TechSurge revealed that there is significant interest and enthusiasm for continued cross-sector dialogue to advance several initiatives to develop marine biodiversity monitoring technology and applications. Four panels convened during the TechSurge, with these conclusions:

Panel on The Value of Biodiversity

The first panel of experts and practitioners emphasized the importance of biodiversity information and the technology to collect this information in our daily lives. They stated the implicit understanding in society that biodiversity supports our culture and a sustainable Blue Economy, and yet marine biodiversity and its value are often taken for granted. The panel discussed innovation in monitoring biodiversity. Suggestions included developing technologies that measure marine life, to disrupt traditional approaches to understanding abundance and distribution of living resources simply based on incomplete information about the environment

such as measurements of physical and chemical variables to infer biological status and trends. The panel also discussed innovation in financing instruments such as blue bonds and the rapidly developing biodiversity credit markets. These can be effective to align conservation efforts with economic prosperity. Caution was raised by participants about engaging in biodiversity offsetting (trading biodiversity in one area for biodiversity in another, far away area), or following some of the incentives for mismanagement (unreliable baselines and weak verification processes) that have emerged in the carbon credit market as these end up with undesired, negative local impacts.

Panel on Aggregating Demand for Sustaining Development and Conservation

This panel showcased real-world examples driving the demand for ocean biodiversity monitoring technologies. The case studies highlighted different end users, including government agencies, industries, conservation and resource managers, and scientists. Panelists emphasized the importance of establishing measurable actions and biodiversity outcome requirements to ensure accountability and impact (metrics to measure success of investments). They discussed the importance of new, low-cost technologies to fill knowledge gaps, and of linking user needs with technology development and innovation. Opportunities exist to satisfy a very large national and international market by addressing cost, complexity, time constraints, scalability, and data interoperability and management.

Panel on Technology and Data Innovations for Biodiversity Monitoring, Reporting, Verification, Forecasting and Integration

Innovation is a key outcome of public-private partnerships and the co-design of solutions. Panelists explored strategies to de-risk startups, emphasizing approaches such as phased investment models, regulatory sandboxes, and the integration of early-stage startups into government-led pilot programs. Opportunities will emerge by fostering stronger relationships between the public (government) and industry, including implementing creative local community engagement and financing for startup development. The panel highlighted how advanced sensors, data analysis, and information services will unlock Blue Economy opportunities that balance conservation with economic prosperity.

Panel on Financial Tools to Scale Biodiversity Conservation

Experts from the finance sector addressed mechanisms and tools for investment in particular biodiversity outcomes, including private capital, blended finance structures, and insetting as financial tools and incentives. Panelists outlined recommendations for scaling biodiversity conservation efforts, focusing on innovative strategies such as Blue Bonds, biodiversity credits, parametric insurance, and incentivizing solutions like aquaculture. They explored current supply chain models that often result in biodiversity loss. An opportunity for economic development exists in simply quantifying biodiversity and in organizing large, interoperable databases of biodiversity to create and enhance markets.

In summary, the key takeaways from the TechSurge are:

1. Additional curated events following the model of the Ocean Biodiversity TechSurge are needed to foster co-design among industry, government agencies, researchers, technology engineers, and philanthropy for solutions on collecting and managing marine biodiversity information.

2. The government should encourage and support opportunities for collaborative approaches for monitoring, data management, and technology development that advance sustainable development and successful conservation action.

3. Industry should establish a think tank that allows multi-sector reviews of laws, gaps, and suggests ways to fund sustainable development including conservation efforts.

4. Federal and industry programs should actively promote the development of ocean biodiversity monitoring technologies with low-interest loans and other incentives.

These efforts should incentivize technology innovation and integration of multi-sensor and multi-platform approaches to support informed decision-making about ocean uses that depend, affect, or promote biodiversity change. Integrative approaches should fuse data and information from multiple sensors, platforms, and research efforts, including genetics, acoustics, remote sensing, imagery, and platforms such as autonomous underwater vehicles, airborne drones, or moored platforms for data collection. Consideration should be given to big data and cloud-based solutions where possible to aggregate, process, and synthesize data from diverse methods and data providers.

Specific opportunities exist with technologies such as:

- **Multi-Sensor Approaches Combining Multiple Sensors and Platforms:** Examples include methods to identify species by linking bio-acoustics, imagery, environmental DNA (eDNA), remote sensing, and traditional species and environmental observing techniques. For example, acoustic monitoring helps identify key areas for targeted surveys, while eDNA provides confirmation of species in residence, making sensor fusion critical for better data and biodiversity monitoring.

- **Remote Sensing:** Satellite data, such as data from the new NASA PACE (Plankton, Aerosol, Cloud, ocean Ecosystem) mission, provide invaluable large-scale monitoring capabilities. These data are best used in combination with in-situ data for confirmation, site-specific, and subsurface insights.

- **Autonomous Systems:** Autonomous underwater vehicles and drones offer great potential for biodiversity monitoring, especially in hard-to-reach areas. However, financial and logistical constraints have, to date, limit their scalability, presenting an opportunity for innovation in enabling autonomous platform access in remote areas or difficult environments.

- **AI & Machine Learning:** AI-based tools hold potential to transform data analysis, and to expand species identification and data availability from new or existing datasets using advanced image recognition algorithms or deep learning for analysis of passive or active acoustics, offering potential to fill data gaps or inform modeling efforts, in some cases without significant new data collection. The growing volume of data presents a chance to develop innovative AI-driven solutions.

- **Interoperability in observations, monitoring results, data, and assessments among private organizations, research, and government sectors.** Adoption across sectors of globally agreed data standards for ocean biology and biodiversity information will lead to improved interoperability among industry, academia, and government and foster stronger collaboration. The use of existing frameworks, such as the Essential Ocean Variables, Essential Biodiversity Variables, and data formatting standards like Darwin Core should be exposed to broader multi-sector observers and users of information. Developing shared frameworks and methodologies will ensure consistency across biodiversity monitoring technologies, across ecosystems, and across time, and will help scale these methodologies effectively, such as for industry decision-making, resource management, or for regional and national assessments.

Ultimately, these actions will lead to growth of a workforce equipped to apply technology and data solutions to monitor biodiversity, conduct sound biodiversity science, and benefit human communities and economies while ensuring availability of resources for the future.

Biodiversity Technologies Demonstration

The TechSurge included an exhibition space where companies presented and showcased their latest tools and technologies to the TechSurge attendees during a networking reception. Thank you to the following innovators:

OceanSpace™
Sensing Solutions for Managing Aquatic Ecosystems

eDNA Explorer

FlowCam®
Yokogawa Fluid Imaging Technologies, Inc.

SEATREC

WILDLIFE COMPUTERS

Sonardyne

COASTAL MONITORING ALLIANCE

DeTect™
INTELLIGENT SENSORS

Acknowledgements

MTS[1] and NOPP[2], along with the event's organizing partners, GOOS, NOAA, the Integrated Ocean Observing System (IOOS), and the Marine Biodiversity Observation Network (MBON), thanks the speakers, moderators, panelists, exhibitors, and attendees for engaging in the discussions. MTS and NOPP appreciate the planning committee and production team for the time and effort it took to run the Ocean Biodiversity TechSurge. Events like this would not be possible without financial support, and MTS thanks their silver sponsors (MBON and Marine Life 2030) for their contributions. The NOPP team and Breakout Session notetakers who all contributed to the writing of this report.

[1] The development of MTS's Ocean Enterprise Initiative and this conference was made possible through funding by the Department of Commerce NOAA – grant, in support of the Resilient Coastal Communities and Economies Strategy Priority detailed in NOAA-NFA-NFAPO-2021-2006626.

[2] Support for the NOPP Office was provided by NOAA via contract to Integrated Systems Solutions, Inc. (Contract/Task Order #1305M419DNCNA0016/1305M322FNRMA0216).

Appendix A: Agenda

Day 1: Benefits of a Globally Scaled Ocean Biodiversity Knowledge Network October 1, 2024 | Venue: Sheraton Inner Harbor Hotel | Baltimore, MD		
8:00	**Continental Breakfast**	
9:00	**Welcome, Introduction & Logistics**	H. VanSumeren, Ocean Enterprise Initiative
	Keynote	*Moderator*: H. VanSumeren Keynote: Nicole LeBoeuf, NOAA NOS
Topic 1: The Value of Biodiversity: Understanding the demand for biodiversity information & technology to support culture, conservation, and a sustainable Blue Economy		
9:55	**Topic 1 Panel**	*Moderator*: T. Rouleau, TBD Economics LLC *Panelists*: • C. Hudson, Lenfest Ocean Program • A. Dehgan, Conservation X Labs • D. Weeden, Mashpee Wampanoag Tribe • N. Harshadeep (Harsh), World Bank • T. Male, Environmental Policy Innovation Center
10:50	**Networking Break**	
Topic 2: Aggregating Demand for Development and Conservation: Opportunities, Challenges, and Real-World Applications		
11:10	**Topic 2 Panel**	*Moderator*: Dr. Westerholm *Panelists*: • R. Cluck, BOEM • L. LaFeir, New England Aquarium • E. Shumchenia, RWSC • G. Murphy, Fugro • S. Gittings, Office of National Marine Sanctuaries
12:05	**Lunch**	

01:05	**Topic 2 Presentations**	*Moderator*: Dr. Westerholm *Speakers*: • H. Ruhl, Monterey Bay Aquarium Research Institute • A. Dvarskas, Ørsted • P. Thielen, Johns Hopkins Applied Physics Laboratory • S. E. Craig, NASA
Topic 3: Technology and Data Innovations for Biodiversity Monitoring, Reporting, Verification, Forecasting and Integration		
02:05	**Topic 3 Panel**	*Moderator*: J. Sobin, Kongsberg Discovery *Speakers*: • J. Hagan, Northwest Indian Fisheries Commission • S. Formel, USGS • B. Helmuth, Proteus Ocean Group • G. Bebe, Black in Marine Science • M. Pitts, Ocean Exchange
03:00	**Networking Break**	
03:15	**Topic 3 Presentations**	*Moderator*: C. Hoffman, Ocean Enterprise Initiative *Speakers*: • C. Simms, Nortek Group • Y. Chao, Seatrec, Inc. • J. Coogan, Coastal Monitoring Alliance • A. Adams, Aquatic Labs
04:15	**Breakout Session**	All Participants
05:15	**Networking Reception &. Tech Café** *(optional)*	*Exhibitors*: • Wildlife Computers • FlowCam • Coastal Monitoring Alliance • Seatrec • Sonardyne • eDNA Explorer • OceanSpace • DeTect

Day 2: Powering Solutions: Advancing Ocean Biodiversity Technologies for Applications from Finance to Conservation October 2, 2024 | Venue: Sheraton Inner Harbor Hotel | Baltimore, MD		
8:00	**Continental Breakfast**	
9:00	**Welcome, Introduce Speaker**	A. Leonardi, NOPP
9:05	**Keynote**	*Moderator*: A. Leonardi, NOPP *Keynote*: J. Pullen, Propeller
Topic 3: Technology and Data Innovations for Biodiversity Monitoring, Reporting, Verification, Forecasting, and Integration *(Continued)*		
9:50	**Topic 3 Presentations** *(Continued)*	*Moderator*: F. Muller-Karger, University of South Florida *Speakers*: • K. Yamahara, Monterey Bay Aquarium Research Institute • M. Ogburn, Smithsonian Environmental Research Center • G. Singer, eDNAtec Inc • T. Murray, University of South Florida Institute for Marine Remote Sensing
10:50	**Networking Break**	
11:10	**Topic 3 Presentations** *(Continued)*	*Moderator*: F. Muller-Karger, University of South Florida *Speakers*: • E. Cuevas, Oceanographic Research Institute, Universidad Autónoma de Baja California • P. Ratilal, Northeastern University • M. Medina, Southern California Coastal Ocean Observing System (SCCOOS)
12:00	**Lunch**	

Topic 4: Financial Tools to Scale Biodiversity Conservation		
01:00	**Topic 4 Panel**	*Moderator*: J. Pullen, Propeller *Panelists*: • S. Muaddi, T. Rowe Price • M. R. Cayten, Climate Asset Management • C. McClung, The Nature Conservancy
01:45	**Topic 4 Presentations**	*Moderator*: Z. Willis, MTS *Speakers*: • T. Rouleau, TBD Economics • J. Stanfor, eDNA Explorer • N. Fiertz, The Stimson Center • S. Singh, WWF
02:45	**Networking Break**	
Topic 5: Implementation and Next Steps		
03:00	**Town Hall: Reflection on what we have learned and how we might proceed together**	*Moderators*: Planning Team Committee Members
04:00	**Adjourn**	

Appendix B: Discussion Summary

Day 1 - Welcome & Introduction

Hans VanSumeren (Ocean Enterprise Initiative) welcomed attendees to the Marine Technology Society's (MTS) first Ocean Biodiversity TechSurge, designed to foster collaboration across sectors to advance US ocean biodiversity technologies and knowledge. Approximately 40% of attendees were from the for-profit sector, with others from government, non-profit, academia, and intergovernmental organizations. The outcomes of the event aim to support needs articulated by the community for great coordination of and investment in ocean biodiversity science and stewardship, and discussions were recorded, and articles were encouraged for a future MTS journal publication.

Keynote

Nicole LeBoeuf (National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), gave a keynote speech at the Ocean Biodiversity TechSurge, emphasizing the complex, interdisciplinary nature of ocean biodiversity loss and the necessity of cross-sector collaboration across conservation, technology, finance, climatology, and social science. She highlighted the importance of engaging the technology community to build a foundation for ocean science and stewardship and stressed the role of open data platforms like MBON and Ocean Biodiversity Information System (OBIS) in supporting local decision-making. LeBoeuf advocated for increased federal agency engagement with the private sector due to the scale of investment needed, and she emphasized the need for evidence-based metrics and indicators for monitoring, reporting, and verification to attract investment and ensure accountability. LeBoeuf also discussed the need for accessible and affordable technologies and data.

Topic 1: The Value of Biodiversity

The "Value of Biodiversity" panel, moderated by Tracy Rouleau, discussed the need for biodiversity information and technology for culture, conservation, and the "Blue Economy." Speakers from organizations like Conservation X Labs, the World Bank, and the Environmental Policy Innovation Center presented tools, funding initiatives, and market-based solutions like biodiversity credits. Representatives from the Lenfest Ocean Program and Mashpee Wampanoag Tribe emphasized the importance of community involvement and integrating indigenous knowledge. Q&A focused on the diverse values of biodiversity and lessons from other communities and countries.

During a Q&A session, panelists discussed the multifaceted value of biodiversity, including economic opportunities estimated at $10 trillion and 400 million jobs, and the importance of considering local benefits beyond mere conservation. A concern was raised about the lack of a U.S. national biodiversity law, highlighting the need to recognize biodiversity's crucial role in economies, culture, and communities. The discussion expanded to learning from others, with emphasis on intergenerational knowledge transfer from indigenous communities and examples like England's low-cost financing for nature investment, encouraging similar policies in the U.S.

Topic 2: Aggregating Demand For Development and Conservation

The "Aggregating Demand for Development and Conservation" panel, moderated by Dave Westerholm, featured Rodney Cluck (BOEM) discussed their partnership-driven passive acoustic monitoring network and funding challenges, Letise LaFeir (New England Aquarium) highlighted their conservation work and the demand for real-time whale detection technology, and Emily Shumchenia (RWSC) emphasized the importance of data standardization for understanding offshore wind impacts. Greg Murphy (Fugro) outlined their commitment to net-zero emissions and nature-focused projects, while Steve Gittings (Office of National Marine Sanctuaries) stressed the critical role of biodiversity in ecosystem integrity and the need for comprehensive data to manage sanctuaries effectively, concluding that biodiversity should be a priority for all ocean users.

During the Q&A session, Westerholm questioned panelists about information gaps, data interoperability, and the prioritization of biodiversity amid competing interests. Panelists emphasized the need for strategic and standardized data management, recognizing that current systems are outdated and lack coordinated funding. They also discussed the complexities of balancing resource use and protection in marine sanctuaries, the importance of open data sharing, and the reality that economic and political factors often outweigh environmental concerns in decision-making. Furthermore, the panel addressed how to measure the impact of operational activities on biodiversity and differentiate these impacts from natural changes, agreeing that long-term ecosystem monitoring is crucial for understanding success, which would involve biodiversity growth, equilibrium, and the ability to attribute changes to specific causes.

Topic 3: Technology and Data Innovations for Biodiversity MRV

The Ocean Biodiversity TechSurge's panel, moderated by Jake Sobin, on "Technology and Data Innovations for Biodiversity MRV" featured diverse perspectives on advancing ocean biodiversity knowledge. John Hagan (NIFC) highlighted tribal use of eDNA for fisheries management. Steve Formel (USGS) emphasized the importance of recognized biodiversity data standards and the undervalued role of data managers. Millicent Pitts (Ocean Exchange) noted a funding gap in data analytics for ocean conservation startups and called for stronger market signals. Germain Bebe (BIMS) showcased initiatives to promote inclusivity and biodiversity research, including eDNA collection. Brian Helmuth (Proteus Ocean Group) introduced their concept for an underwater research station to revolutionize ocean engagement and science. The subsequent discussion focused on fostering open data ecosystems, public-private partnerships, and attracting the next generation to this critical field.

During the Q&A session, panelists discussed strategies such as sharing data usage building blocks, inviting data standard developers to collaborate, exploring industry partnerships (like with the cruise industry), creating more user-friendly APIs, and employing blockchain for data provenance. The panel also addressed catalyzing private-public partnerships by facilitating startup interactions with funders and providing early-stage support. To attract the next generation, suggestions included industry-focused academic programs, K-12 conservation education and mentorship, increasing government remote jobs, and lowering the barrier of entry.

Day 2: Welcome & Introduction

Alan Leonardi (National Oceanographic Partnership Program (NOPP)) welcomed attendees to the second day of the TechSurge conference. He described NOPP's history and mission, emphasizing that both independently and together, MTS and the NOPP Office are bringing the ocean community together to understand stakeholder needs and capabilities, including promoting the collaborative research, technological advancement, community engagement, and policy making needed to advance the ocean enterprise.

Keynote

Julie Pullen (Propeller) discussed her transition from academia to venture capital due to increasing risks from supercharged climate events impacting oceans. She highlighted visionary and collaborative efforts addressing these challenges and the importance of supporting ocean vitality. In the Q&A, Pullen emphasized the crucial role of industry and the private sector in creating markets for ocean biodiversity technologies through customer identification and insetting models. She noted the potential of ocean-centered emissions reduction and carbon removal for venture capital and advised scientists to focus on de-risking science for market application, while suggesting pilot projects with government valuation as a key next step.

Topic 4: Financial Tools to Scale Biodiversity Conservation

The "Financial Tools to Scale Biodiversity Conservation" panel, moderated by Julie Pullen, featured Megan Reilly Cayten of Climate Asset Management (CAM), Christine McClung of The Nature Conservancy (TNC), and Samy Muaddi of T. Rowe Price. Cayten discussed CAM's investments in nature-based projects and a global seaweed carbon removal initiative, emphasizing the need for science to enable market development. McClung highlighted TNC's focus on blue carbon ecosystems and their BC Plus program to link conservation with business models for private financing. Muaddi explained T. Rowe Price's shift towards impact investing, including a blue bond partnership with the World Bank and sustainability-linked bonds, noting the importance of science expertise in their proactive approach to outcome-oriented investments and the potential for structuring bonds with biodiversity-related KPIs.

During the Q&A session, Christine McClung discussed financing beyond carbon markets, emphasizing that businesses contributing to ecosystem restoration are good investments. Julie Pullen asked Megan Reilly Cayten about large ocean funds and the risks to nature-based assets. Cayten noted the difficulty in valuing biodiversity from a market perspective and the importance of payment for ecosystem services. Regarding risk, CAM accounts for weather-related impacts. Samy Muaddi asked about the future of the field, and Cayten expressed hope for payment based on outcomes sustaining human life. Both McClung and Cayten stressed the importance of communication and connection between the scientific and financial communities.

Topic 5: Implementation and Next Steps

The Ocean Biodiversity TechSurge concluded with a town hall discussion where attendees synthesized key takeaways and identified opportunities for advancing ocean biodiversity initiatives. There was interest in more TechSurge events with more breakout sessions earlier in the day. Attendees emphasized the need for financial experts and scientists to collaborate on use cases for ocean biodiversity technologies and financial mechanisms, potentially leading to multi-sector pilot projects. The possibility of studying existing philanthropy-funded projects and creating cross-training opportunities (e.g., webinars) to help scientists understand finance was also discussed. Recommendations for future event participants included restoration-focused companies, maritime shipping, the cruise industry, commercial fishing, AI companies, data managers, entrepreneurs, and those subject to mitigation policies.

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