Ocean Research Advisory Panel

May 21-22, 2024

NOAA Fisheries Southeast Regional Office
263 13th Ave S
St. Petersburg, Florida

ORAP Members Present:

Mary Glackin, Co-Chair
Christopher Ostrander, Co-Chair
Claudia Benitez-Nelson
Derek Brockbank
Jorge Corredor
Danielle Dickson
Tim Gallaudet
Eunah Hoh
Sandra Knight
Tommy Moore (virtual)
Claire Paris-Limouzy
Purnima Ratilal-Makris
Edward J. Saade (virtual)
Ana Spalding (virtual)
Maria Tzortziou
Kawika Winter

Also Present:

Viviane Silva, ORAP Designated Federal Officer
Victoria Kromer, ORAP Alternate Designated Federal Officer
Jessica Snowden, Acting Co-Chair, IWG-Ocean Decade and Deputy Director, NOAA Global Ocean Monitoring and Observing Program
Ann Zinkann, Global Ocean Monitoring and Observing Program, NOAA OAR
Monty Graham, Director, Florida Institute of Oceanography
Nicole Raineault, Chief Scientist, Florida Institute of Oceanography
Rodney E. Cluck, Chief, Division of Environmental Sciences, Bureau of Ocean Energy Management
Julie Pullen, Chief Scientist, Propeller Ventures
Emily Nocito, Policy Advisor for Domestic Engagement with the UN Ocean Decade, NOAA/OAR
Katie Geddes, Office of Research, Transition, and Application, NOAA OAR

Day 1, May 21, 2024

Meeting Opening & Review Agenda

Viviane Silva, ORAP Designated Federal Officer; Chris Ostrander and Mary Glackin, ORAP Co-Chairs

Ms. Silva opened the meeting at 9:00 a.m. and provided logistics for the meeting. ORAP members introduced themselves and Co-Chairs Glackin and Ostrander reviewed the agenda and objectives for the meeting, which included discussing the ORAP's approach to the Ocean Policy Committee (OPC) tasking, receiving briefings from the two ORAP subgroups on their tasking progress, and hearing from invited speakers on ocean data initiatives and emerging technologies. By the end of the meeting, they hoped to explore ways to advance the work of the two subgroups to ensure their work products are actionable once delivered.

Ocean Decade Initiatives

Jessica Snowden, Acting Co-Chair, IWG-Ocean Decade & Deputy Director, NOAA Global Ocean Monitoring and Observing Program

Ms. Snowden provided a brief overview of the UN Ocean Decade initiative and how they are using science to address long-term global ocean goals. She started by saying that the UN Ocean Decade aims by 2030, to have the ocean we want, that's achieved by the science that we need. So, this was proclaimed in 2017 by the UN General Assembly. The Ocean Decade identified 10 challenges that when tackled through multiple efforts, should lead to seven 4 key outcomes for this ocean that we want. By 2030, the UN Ocean Decade aims to identify the required knowledge for sustainable ocean development, generate comprehensive knowledge and understanding of the ocean, and increase the use of ocean knowledge through a variety of different actions. The Ocean Decade U.S. is composed of non-federal experts in order to complement the Interagency Working Group on the Ocean Decade (IWG-OD, which is the federal component) implementing and tracking the initiative's programs, projects, activities, and contributions. These two groups have collaborated on identifying themes and "Ocean Shots" that, if approved and supported by the U.S., are linked to other ongoing efforts in the broader Decade framework. To identify Ocean Decade activities, regular calls go out to the community for contributions. The U.S. presently has the most submitted actions and is also the leading nation in contributions, though the U.S. identified no new contributions to the Decade during the most recent call, call six.

A Data Coordination Group, composed of about 23 ocean scientists and engineers from around the world, was stood up to develop the Ocean Decade Data and Information Strategy, which was published in May 2023. Their vision for the Decade is to set in motion the elements that will facilitate the development of a trusted, inclusive, and interconnected ocean data and information ecosystem that is actively used for decision making to support sustainable ocean management. The strategy includes five objectives based primarily around FAIR (findable, accessible, interoperable, reusable) data principles as well as building trust in the data itself, including transparency on data provenance, terms of use, and

proper storage and retrieval of the data. The strategy envisions co-designing with and empowering a digitally literate global community that understands and promotes the value of data management and sharing. The goal is to build on what already exists, better connect them, and ultimately make it easier to find, access, and use ocean data. Ms. Snowden discussed in detail the five strategic objectives, which include: (1) Establish a globally distributed ocean digital ecosystem allowing sharing and equitable access of multidisciplinary data, information, and knowledge by all; (2) Improve data and information discovery and usability; (3) Build trust in data and information shared across the digital ecosystem; (4) Prioritize digital solutions that support decisions for sustainable ocean management; and (5) Expand, empower, and mobilize global communities to advance and maintain the ocean digital ecosystem. A draft implementation plan for the Decade Ocean Strategy is currently out for comment. The U.S. has made strides both in building broader data capacity and using co-design principles to make improvements. Realizing the goals of the strategy will take much longer than ten years, but they are transformative efforts and will drive this work forward in a positive direction.

Building off the recent UN Ocean Decade Conference in 2024, they anticipate the Vision 2030 white papers will be published in late summer/early fall and will help communities focus on priorities for the second half of the Decade. IWG-OD is heavily focused on the seventh call for UN Decade actions, which aims to fill gaps in funding and resources, as well as incentivize new initiatives and capacity development as part of the Ocean Decade. Ms. Snowden sought any suggestions the ORAP might have for the IWG-OD on how federal agencies could better promote the most transformational science via the Ocean Decade and how federal agencies might do more to leverage the Ocean Decade themes for NOAA's science and service mission.

Co-Chair Ostrander asked for Ms. Snowden's thoughts on leveraging data to promote transformational science to achieve the aims of the Ocean Decade. Ms. Snowden said that the U.S. needs to show up on the global stage. Having convening power is very powerful in the absence of resources. Federal agencies could be more intentional about sharing what they are already doing and allow for more co-design. They could share information about technology advancements, particularly lower cost technologies, and investments they are making. Holding and recording workshops for communities to find out how data is used is valuable. Federal agencies need to think about how they can integrate that level of outreach and engagement wherever they can.

Dr. Knight asked why the efforts of the IWG and the Subcommittee on Ocean Science and Technology (SOST) do not include setting the federal standards for ocean data. Ms. Snowden agreed there is more that the SOST and its subordinate bodies could do to encourage application of existing standards, but she did not think they should be involved in the details of the work being done by the data community. Holding federal agencies accountable to ensure they are making progress towards achieving the standards may be a space where the IWG-OD and SOST could be valuable. Internationally, the standards being developed align well with the U.S. Integrated Ocean Observing System (IOOS) standards, but the degree to which they are being implemented is a challenge. The changes do come with a cost, but they can be done, as IOOS has demonstrated.

Dr. Gallaudet said that the ORAP's Data Subgroup is currently discussing to recommend the development of a National Ocean Data Strategy (NODS), which would get all the agencies to work together and approach ocean data in the same way. He also stated that advancing technologies, such as uncrewed systems, eDNA, AI-enabled models, and 'omics, can help do the transformational sciences they are discussing.

Co-Chair Glackin said putting a sharper priority on implementing the current standards would yield positive results, along with reasonable and trackable performance measures over the next five years with tied benefits to them. She asked if Ms. Snowden's sense was that federal agencies were about at their limit with what they could take on and interagency priorities are competing with agency mandates. Ms. Snowden thought this was correct. Sharing resources across federal agencies has been an ongoing challenge. Burn out in the federal government is real and there may be some confusion in the agencies about what leadership really wants to see done. Some of that messaging may not be as strong as it could be to encourage federal agency participation in the IWG-OD.

Ann-Christine Zinkann, Global Ocean Monitoring and Observing Program (GOMO), NOAA, commented that one of the key areas where the UN Ocean Decade could help is in strengthening international engagement and getting NOAA data into operational services in the U.S. and beyond. The UN Decade Data group has worked hard to streamline the data standards so that they meet international requirements. The World Meteorological Organization's revamp of its WMO Information System (WIS 2.0) may provide a good opportunity for all federal agencies to rethink how they are contributing data.

Dr. Moore said that in order to make the increasing volumes of data more accessible and usable, there needs to be more emphasis on data interpretation and manipulation tools that are publicly available. This should be underscored by discussions on data standards to ensure data is interoperable and findable. An assessment of existing data sets would also be valuable, specifically looking at which ones are being widely used and which are not.

Mr. Saade asked about the technical structure that is being discussed on the global scale and if the UN Ocean Decade program had decided on a technical methodology to manage all the data. Dr. Zinkann discussed the work of an international team brought together by the data group of the Ocean Decade who have released a strategy and are working on an implementation plan for how they will bring all this together. There is also a Data Collaboration Center tackling this in regard to grants and projects to ensure best practices are being implemented within the various programs.

Dr. Benitez-Nelson said she appreciated the idea that whatever strategy is developed nationally has to interface internationally. She asked if there have been implementation approaches that have facilitated other countries' national data science plans that could help inform what the U.S. is doing. Ms. Snowden said that many countries are doing this well, but was unable to point to any one in particular that would serve as an exemplar of how it should be done. The U.S. has been a leader in this space and has already developed many best practices with its partners. The U.S. and others are currently looking at how to share data that does not meet the identified data standards but still may have some utility for local users. Dr. Zinkann highlighted several specific efforts underway in this space.

Dr. Spalding commented on the value of specifically calling for "the science we need for the ocean we want." There is also a need to train people to think about how this information is going to be used and how it can be communicated.

Subgroup Presentations and Discussion Ocean Data

Ed Saade (Ocean Data Chair) and Team

Mr. Saade provided an update on the Data subgroup progress and discussed the approach the team is taking to address the OPC task. He started by reviewing the Ocean Data Group's modified task: Highlight Ocean Data areas that need immediate attention and highlight existing partnerships and opportunities to leverage, expand, and consolidate data services. These include: (1) Fostering data sharing from federal and non-federal partners and incentivizing industry/academic "derivative" products; (2) Increasing the transparency of ocean data; (3) Exploring new technologies and innovation pathways to increase Ocean Data Accessibility and Usability; (4) Including social science data needed to facilitate incorporation of the human dimension in ocean activities; and (5) Acknowledging data sovereignty for indigenous peoples and tribal nations. Mr. Saade then turned to the main focus of the group's draft report, developing a National Ocean Data Strategy (NODS) that includes data management practices, standards, and an evaluation of quality through uncertainty quantification and validation practices. He presented an outline of what will be included in the draft report and sought the feedback of the full ORAP. A NODS is needed to not only make federal sources of ocean data more accessible, but to take advantage of the increasing opportunities for ocean data sharing and acquisition that fosters new scientific, federal and local government, industry, philanthropic, and community-driven research programs and facilitates public-private partnerships. The Data subgroup performed an initial assessment of the work federal agencies have been doing to move towards a NODS and found that, while progress has been made, significant federal effort is still needed to support a holistic strategy for the federal government that also allows for local, state, and regional governments, as well as private, philanthropic, and other partners to effectively collaborate and coordinate activities to advance understanding of the nation’s ocean and coasts. Government agencies currently have limits to their abilities to efficiently process and incorporate ocean data from new sources, including new technologies, into the decision-making process. In some cases, the data management infrastructure has not kept pace with the nearly exponential increase in data that the public and private sectors are now collecting. The subgroup explored examples of existing partnerships and opportunities to leverage, expand, and consolidate data services, particularly Regional Ocean Partnerships (ROPs).

Dr. Knight noted that conducting an inventory or assessment of programs is not the purview of this committee. A higher level look at what the needs are is better aligned. The previous presentation underscored that there is not a unified or integrated national strategy for data management practices and quality assurance. These will be important parts of the report.

Dr. Benitez-Nelson said a critical component of this is how best to provide guidance to various stakeholders on how to implement the next steps.

Dr. Gallaudet discussed his experiences as part of the development of the National Ocean Mapping, Exploration, and Characterization (NOMEC) Strategy and said it would be a good model to look to as the ORAP moves forward and makes its recommendations to the OPC. He encouraged members to look to NOMEC and its growth into a larger effort as a model for moving forward and issuing a final deliverable.

Mr. Brockbank encouraged the ORAP to think about this as a National Ocean Data Strategy rather than a Federal Ocean Data Strategy, ensuring that this encompasses local community data, industry data, and more. They also need to think about ways to incentivize standardization and interoperability without disincentivizing low-tech, low-cost sensors that communities are now able to use.

Co-Chair Ostrander said there are many good data standards, quality control mechanisms, and management practices, but no consensus on which to use. The challenge is how to align on either crosswalking those standards to ensure interoperability or on adoption of common processes between the federal government, states, and users. Dr. Tzortziou pointed to examples of coordination and consensus seeking, including the International Ocean Colour Coordinating Group who are developing protocols for collections that complement NASA's collections. The community knows these protocols need to be followed in order to publish data that can be used for satellite validation. She recommended starting with smaller communities as test cases and then thinking about how it can be implemented across a larger scale and across different kinds of data sets.

Co-Chair Glackin said the recommendation should recognize the need to pivot from the way things are currently being done as quickly as possible and try to achieve adoption of improved standards perhaps through grant requirements. She suggested there may be lessons learned from when IOOS went through this process that could be elevated to the national level.

Dr. Ratital-Makris commented on the need for the data to be assimilated and interpreted in order to be useful. She also said the report needs to be clear on what is meant by data availability and that it should include raw data, processed data, and interpreted data.

Ms. Dickson said that the report should acknowledge the importance of data interoperability, not only from ocean data, but also atmospheric, sea ice, terrestrial hydrological, and coastal mapping data. She would also like to see federal agencies consider encouraging/requiring scientists receiving grants for long-term monitoring data to create a compilation data file that provides all the data that has been collected by that project that is added to annually. This would be greatly beneficial to future scientists that work with the data.

Dr. Spalding suggested explicitly calling for partnerships as part of the strategy and perhaps even standing them up and supporting them so that it is not left up to the scientist to do. They also need to consider who the users are and how they use this data. Users have varying levels of comfort with using this kind of information and that needs to be built into the report. Social science also needs to be part of this effort, as well as making data more accessible.

Dr. Moore suggested not only considering the different kinds of end users, but also the different types of people collecting the data. He suggested the ORAP consider recommending some type of federal oversight or guidance group on data standards that would be funded externally from a project or request for proposals. He also suggested that the subgroup should discuss the inclusion of state and private data and how to go about encouraging others to contribute what they collect.

Co-Chair Glackin commented that the report should acknowledge the value of the earth systems data they are referring to and that it will be increasingly used at a variety of levels. Co-Chair Ostrander agreed and said it would be worth emphasizing the many different use cases for how ocean data is consumed.

Co-Chair Ostrander said they should make clear that data volumes and standard robustness exist across a wide spectrum when looking at physical oceanographic, biological, or social science. They are all very different systems with different levels of maturity and levels of data consumption. Linkages to international programs and partnerships would be a good consideration.

Dr. Knight commented that they need to figure out how to incentivize people to contribute their earth systems data. She also said that it is important to understand the potential implications of AI ingesting bad data that users then rely on.

Dr. Corredor commented on the issue of incorporating low-precision high-accuracy data that could serve a variety of purposes even if it does not meet the highest standards. Dr. Hoh added that the subcommittee should consider data submission from citizen scientists.

Dr. Spalding suggested organizing the report into recommendations on data management, services, needs, partnerships, and policy opportunities. Co-Chair Glackin thought the report could include more actionable proposals and a recognition that this is going to take years to get done. She suggested the subgroup review this discussion and distribute a further iteration of the draft over the summer, with the understanding that there can be future follow-up groups that focus on particular aspects of the strategy and develop them further in the future. She pointed to the format of National Academies reports as a good example to follow in structuring the next draft. Co-Chair Ostrander suggested defining what is in scope and what is out of scope in the executive summary.

Florida Institute of Oceanography (FIO)

Monty Graham, FIO Director; Nicole Raineault, FIO Chief Scientist

Dr. Graham provided some background on FIO's programming, focusing in particular on Peerside, a new cohort-based program to sustain early career mentoring across maritime and ocean STEAM opportunities. FIO is an entity of the State of Florida and its operations are designed to serve the state's needs and provide the access point for the ocean environment to the state and its university system. Florida has the third largest ocean economy in the U.S. and it is primarily driven towards tourism, which focuses FIO's training programs on things like water quality, ocean observing, and mapping. FIO's Peerside mentoring program is currently in its second year of development. The program aims to sustain mentoring over a long period of time to build community for ocean science, technology, engineering,

arts, and mathematics. Peerside takes a cohort approach across varied career options, leveraging an extensive network of partnerships. The development of a capable ocean STEAM workforce for the nation cuts across every federal department and the current administration has recognized the importance of this through its executive orders. With the large number of retirements on the horizon just within NOAA, there is an opportunity to find ways to rebuild the structure of the workforce in federal agencies. Dr. Raineault provided further details on the operations and offerings of the program. The 2024 summer cruise missions include collecting photogrammetry of two shipwrecks and exploring how they interact with the environment, exploring geological features, coral restoration and collections, and shark kinematics, physiology, and tracking. FIO has worked to broaden its Peerside partnerships to include federal and state agencies, industry, academia, and philanthropy. As they move forward, they are hoping to develop a NOPP and aim to ultimately have partners to sponsor or co-sponsor expeditions in exchange for science and the production of a trained workforce. They hope this program will provide a blueprint for other programs across the nation.

Co-Chair Glackin asked what lessons FIO has learned in making partnerships with industry successful and what entices the private sector to want to collaborate. Dr. Graham said that FIO looks to the private sector for demand signals that focus their training programs. Dr. Raineault added that the private sector recognizes the gaps in their own workforce and they view partnering with FIO as a good opportunity. Having a professional level ROV platform that can offer many opportunities for the partners' technological innovations is also a draw.

Dr. Benitez-Nelson asked how FIO is thinking about all of the data management requirements and reporting needs that come with receiving funds and interacting with a large number of different partners. Dr. Graham said they are drawing on the oversight they have from the RESTORE Act Center of Excellence program, which has a rigorous data management process.

Dr. Knight said it sounded like the Peerside program mostly focuses on research vessels, but there is a much larger workforce gap across the entire maritime industry. She asked if they were considering broadening the program by partnering with maritime institutes, the Navy, MARAD, the offshore wind industry, or others dependent on building out the workforce pipeline. Dr. Graham said they are beginning to bring on people from the maritime institutes who have requirements for at-sea work. They are eager to explore additional partnership opportunities in the future but they are currently focused on the development stage.

Insights from the Perspective of the Bureau of Ocean Energy Management (BOEM) Regarding the National Ocean Priorities

Rodney E. Cluck, Chief, Division of Environmental Sciences, Bureau of Ocean Energy Management

Dr. Cluck provided background on the mission of BOEM, whose management authority was expanded in the Inflation Reduction Act (IRA) to include the areas around the U.S. territories. Prior to the IRA's passage, BOEM had never done work in the territories. BOEM has released its strategic plan for FY24-28

that aligns well with national ocean priorities. It addresses managing energy and mineral resources in a sustainable way, advancing technology, and stresses the importance of engaging with tribal nations and indigenous communities. Renewable energy is a key area in BOEM's current workload and there are currently 34 active leases for commercial offshore wind with many more in various stages of development. BOEM's oil and gas program anticipates three oil and gas lease sales in the next few years, while its science program is responsible for monitoring the effects of those activities. Marine mineral work has historically focused on beach renourishment projects, but BOEM now has jurisdiction of critical minerals. They are assessing what environmental impacts mining for polymetallic nodules at the bottom of the ocean might have for the ecosystem. BOEM has been tasked with developing regulations for marine carbon sequestration and are currently pulling together a partnership to better understand the science and potential environmental implications of these activities. BOEM's Environmental Studies Program serves all BOEM regions and programs by conducting baseline research, oversight of construction projects, and monitoring for the lifetime of each project. With a budget of $30 million a year, they have to focus on key areas of interest and they rely heavily on their federal and private partners. Wind developers can now pay BOEM to conduct the required analysis and the agency will ensure regulatory compliance. Acoustic monitoring requirements for offshore wind developers present an excellent opportunity to create a passive acoustic monitoring array along the coast. Large platforms in the ocean present many possibilities and BOEM needs to think about how best to leverage them. BOEM employs several tribal liaisons that work directly with tribes and has contributed to the creation of the Ocean Justice Strategy among other efforts to address EEJ in the communities they work with.

Dr. Winter asked Dr. Cluck's perspectives on the ORAP's discussion on developing a NODS. Dr. Cluck said BOEM is actively communicating with National Centers for Environmental Information (NCEI) and IOOS on the flood of data that is going to be coming in from developers. They are confident they can handle it if they get more resources. The existing institutions can be very useful, but require improvements to make data more accessible.

Dr. Gallaudet encouraged Dr. Cluck to look into work done by Victor Vescovo examining deep sea benthic habitats that were disturbed 75 years ago and have not grown back.

Dr. Ratital-Makris asked if Dr. Cluck was aware of any action plans at a national level on protecting wildlife and ocean conservation for the long term. Dr. Cluck said he views his program as being responsible for holding the line to ensure environmental protection is a foremost consideration for any project. Federal agencies need to rely on the data and science to inform their decision making.

Public Comment

Irene Polnyi, Director of Field Research, Carbon to Sea Initiative, commented on the work of her organization to understand whether the ocean can be used to safely and permanently remove and store billions of tons of C02. The program has issued over $20 million in grants globally and is currently the largest ocean alkalinity enhancement (OAE) R&D program. They have developed programs to support the emergence of responsible ocean-based carbon removal sector through field research, policy, and community building. The program is completely nonprofit and outcome-agnostic, which means that they

are committed to deliver the science regardless of whether it supports the advancement of OAE. They have been thrilled with the increasing attention paid to Ocean-Based Carbon Dioxide Removal (CDR) by the federal government and are encouraged by efforts to develop a federal marine CDR research program. Ms. Polnyi commented on the need for public-private cooperation on data management related to ocean-based carbon dioxide removal field research. Understanding the effectiveness and impact of ocean-based CDR approaches in the real world cannot be achieved without controlled field experiments where these approaches are tested and observed. Field trials help to develop ways to test different dispersal methods that optimize for CDR efficacy and measurement technologies and increase the certainty that CDR has taken place. To ensure that OAE research can be compared and useful beyond a project-by-project basis, it is critical to align on key parameters and data management best practices so that early research methods can support the analysis necessary to inform whether and when to consider scaling marine CDR approaches.

Sol Kahoohalahala commented from a Native Hawaiian perspective on deep sea extraction. The deep ocean is the source of all created things in the indigenous Hawaiian genealogy, informing their knowledge of the integral connection of all life. Given the federal government's emphasis on including the Native perspective in their work and the need to be sensitive to their cultures, he asked how this perspective fit within the discussion of whether or not it is appropriate to explore for deep sea nodules and assess their potential for extraction. He wanted to be assured that Native people were being consulted on the work BOEM is undertaking so as to avoid a future in which policy decisions have been made without accounting for Native perspectives, knowledge, and practices related to the deep sea.

Technology Needs in the Biogeochemical Observing/Data Space

Julie Pullen, Chief Scientist at Ocean Climate Tech VC Fund Propeller Ventures

Dr. Pullen presented on larger trends and drivers in the markets emerging around technology needs, particularly in relation to biogeochemistry and monitoring, reporting, and verification. Propeller Ventures helps businesses quantify their risk with respect to climate. Scrutiny of their operations and processes helps them understand the paths to decarbonization and allows them to make more ambitious targets around net zero. Climate-related disclosures are currently driving this work, but these will be followed by nature-related disclosures, coming in as a companion to the declarations countries are making around protecting 30 percent of their lands and oceans by 2030. The carbon accounting market associated with these activities has grown significantly, to $15.31 billion in 2023 and estimated to be worth $64.39 billion by 2030. There are many start-up companies coming in to meet the needs associated with carbon accounting. A few years ago, the Task Force on Climate-Related Financial Disclosures looked across sectors and found that 4,000 companies are disclosing their risk, with 92 of the 100 largest companies doing so and setting interim targets. Still, it is not happening fast enough to meet the decarbonization pledges. Very little VC spending is currently going towards oceans, though it is growing rapidly because the opportunity is so great. Ocean-based activities can supply around 30 percent of the annual emissions reductions that are needed. The private sector is assimilating information around where opportunity lies in the ocean space and one of these key areas is in carbon removal. The voluntary carbon removal market growth is expected to be enormous, even by lower

estimates, and there is a great economic opportunity for start-ups or multinational companies to be part of the solution. NOAA funding has been going into this space through grants, the NOPP program, and directly into ocean CDR and measurement, reporting, and verification (MRV)research. Other ways the federal government can contribute funding is through the CIA's In-Q-Tel program or DoD's Office of Strategic Capital, as there are national security considerations relevant to these technologies. Dr. Pullen cited the Ocean Research Climate Alliance and Renaissance Philanthropy as philanthropic organizations active in funding fundamental discoveries about how some of these processes are working and how scalable they may be for carbon removal.

Co-Chair Glackin asked about partnerships that the government should consider that would be critical to de-risk technologies or where it can leverage innovations from the private sector. She also asked where Dr. Pullen thought the largest investments will be in the biogeochemical space and what investments are the most urgently needed. Dr. Pullen said she highlighted carbon removal in her presentation because of how it has spurred the attention of the private sector. Alongside the nature risk quantification is the drive around 30x30 and the quantifications associated with biodiversity or ecocredits that may ultimately be used to finance the protection of Marine Protected Areas. A whole host of sensing modalities could help to grow this market. The research community recognizes the value of the fundamental observational data sets provided by the federal government and the private sector is increasingly relying on them. This points a way towards thinking about how the complementarity of observations can be carried out across the full enterprise and across the federal landscape as different agencies are focused on different parts of the earth system.

Ms. Dickson asked if Dr. Pullen had experiences to share from the private sector about some of the challenges and barriers industry encounters in entering into federal partnerships and how they might be addressed. Dr. Pullen said the mismatch in the timescales of progress between federal and private sectors often leads to frustrations. A careful consideration of what activities can proceed in parallel and what crossover points provide opportunities for funding or advancing program outcomes could help avoid issues with divergent pacing.

Day 2, May 22, 2024

Meeting Opening

Viviane Silva (DFO); Chris Ostrander and Mary Glackin (Co-Chairs)

Ms. Silva reopened the meeting at 8:30 a.m. and the Co-Chairs reviewed the agenda for the day.

Subgroup Presentation and Discussion: Biogeochemical Observing Technologies (BOT)

Danielle Dickson & Maria Tzortziou (BOT Co-Chairs) and Team

Co-Chairs Dickson and Tzortziou provided an update on the BOT subgroup progress and discussed the approach the team is taking to address the OPC task. The subgroup is preparing a draft report to offer an

initial set of recommendations to the OPC about opportunities to leverage public-private partnerships to advance emerging marine biogeochemical observing technologies and national ocean science initiatives. The draft report will identify barriers and challenges as well as some examples of key technologies that are mature for investment. The key emerging marine biogeochemical technologies highlighted in the draft report included microfluidics applications for ocean biogeochemistry, acoustics and ultrasonic technologies for ocean monitoring, autonomous instruments for Arctic observations, noninvasive imaging from unoccupied aerial systems, eDNA, advanced sensors for carbon-related chemistry and a new platform for marine environmental pollutant monitoring called Digital Sample Freezing Platform. Under each of these, the draft report includes a section on current and potential technology applications and another on technology, market, and industry maturity level. Members of the subgroup briefly presented their initial findings on each of the technologies and discussed the challenges and barriers to partnerships. The subgroup discussed several possible recommendations, and Co-Chair Dickson encouraged members to think about recommendations on convenings, communicating about partnership mechanisms and funding opportunities, and Cooperative Research and Development Agreements (CRADAs). The subgroup sought feedback from the full ORAP on the overall direction of the draft report and will continue gathering information in its preparation. They did not necessarily want to include all of these items in the initial report and wanted input on which two or three emerging technologies to focus on, as well as guidance on how broad or detailed the recommendations should be.

Co-Chair Ostrander said the barriers and challenges represent as broad of a spectrum as the technologies presented, making focusing in on specific recommendations challenging. He recommended narrowing it down to just a few, particularly those that have cross-cutting challenges.

Dr. Benitez-Nelson said the broad spectrum of sensors presented was impressive and thought the broadness would speak to more federal agencies than if the report focused on just two or three with more limited application. She asked how these particular technologies were selected to be highlighted. Dr. Tzortziou said the list emerged from a combination of the members' experience and from reports they reviewed. The subgroup discussed additional technologies but opted for a narrowed list. Ms. Dickson added that they looked to the priorities in the Ocean Climate Action Plan and thought about how they could draw on members' networks and expertise to pull out key emerging technologies that were relevant to those priorities.

Dr. Spalding recommended more clearly aligning the potential uses with the technologies needed in the report. She also suggested the National Biodiversity Strategy as a possible guiding document. While large corporations have a lot of guidance and lines on what they can and cannot do, ocean start-ups have much less oversight and may benefit from this guidance. ORAP might want to consider how to make sure this guidance is effective for the people that need it.

Co-Chair Glackin said that her inclination would be to highlight technologies that would have a broad impact so that multiple agencies could see their role in this. She agreed that it would be difficult for agencies to pull actions out of the second part of the report. She recommended narrowing down the number of technologies addressed and going deeper on the recommendations.

Dr. Knight noted that not every agency can use CRADAs or SBIRs as contracting vehicles. The Weather Service has made use of testbeds, which have been very effective. There are other mechanisms as well that could be discussed in the report.

Dr. Gallaudet discussed a White House summit he was involved in, sponsored by OPC. The summit brought together academia, industry, and several agencies and featured breakout sessions on different topics. The deliverable for NOAA from the summit included over 10 signed agreements establishing a variety of productive partnerships. He suggested recommending something similar and offered to share the summit report with ORAP members. He also recommended highlighting Other Transactional Authority as a useful funding mechanism.

Dr. Benitez-Nelson suggested aligning how the highlighted technologies will help facilitate and address activities agencies are committed to, such as renewable energy, biodiversity, and EEJ. She commented that one issue with current partnerships and testbeds is that they tend to be centered in Southern California or Massachusetts, which is very limited. A larger contingency needs to be engaged to think about the oceans.

Mr. Saade discussed some of what he's been seeing on the industry side related to new technologies. Industry has embraced the idea of getting eDNA sensors deployed, particularly in the offshore wind market, and this is being developed with private funding. There is also intense interest in microplastics and the ability to detect them, along with any other degradation in the sediments around construction sites. Newer satellite systems are having a profound impact on the ability to send massive amounts of data at sea, which allows for new ways of doing work offshore, including operating autonomous vessels.

Dr. Hoh said that the health sector receives a lot of funding to create technologies that can be useful in other areas. When industry looks to bring these technologies to other sectors, such as the environmental pollution sector, they are looking at what the government actions and regulations are in these spaces. If there is not substantial federal funding available to move it forward, they will not necessarily implement their technology outside of the health sciences. A lot of the technology needed already exists; it is just a matter of changing optimization to a new sector, which requires government input and actions to initiate it.

Dr. Moore said the biggest challenge for innovation in ocean technologies is the lack of a market and of available financing. The main reason only a small number of institutions do maritime work is that it is prohibitively expensive and challenging. Innovative forms of funding are needed to incentivize work in the marine environment, such as creating new markets. Community benefits agreements attached to new offshore wind leases could be expanded to include direct funding towards basic research. He also said that they need to focus the report by keeping in mind who the audience is. When the subgroup makes recommendations, it is important to consider what federal agencies can take up and move forward with. It is also important to be as specific as possible.

Dr. Spalding suggested each of the working groups follow the same themes as a way to organize the information and bring together the two subgroups' reports. She also wondered if the subgroup could

come up with a way of organizing the material in terms of technological readiness to provide a prioritization for OPC to think about how to implement them.

Dr. Winter pointed to the degree to which many of these issues are existential for Pacific Islanders. He would like to see some prioritization of the issues that take these communities' needs into account. He also stated that the goal should not just be to understand the ocean, but to care for the ocean and how these technologies can be leveraged to do that has been missing from the conversation.

Following the conclusion of the public meeting, the two subgroups convened to create annotated outlines and reach further agreement on the way forward with their reports. The BOT subgroup will provide the ORAP a more comprehensive outline of where they are headed within a month following the meeting, continue to expand on it over the summer, and have another discussion at the September meeting.

ORAP Discussion and Next Steps

ORAP Co-Chairs & Members

Co-Chair Glackin announced that the ORAP charter had been renewed and thanked Ms. Silva for her hard work on getting this done. The charter includes a staggering of terms by creating one, two, and three-year appointments. She also reminded members that the subcommittees have the authority to bring in outside expertise. If any members are interested in contributing to a committee they are not currently on, they should reach out to the Co-Chairs.

The next ORAP meeting is scheduled for September 4 and 5 in Honolulu, Hawaii. There will also be a meeting in Washington, D.C., on December 3 and 4. From 2025 on, the ORAP expects to only have two in-person meetings a year, though interim virtual meetings would be possible.

Adjourn

Viviane Silva (DFO) & ORAP Co-Chairs

Ms. Silva adjourned the meeting at 11:35 a.m.