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**U.S. Integrated Ocean Observing System
Advisory Committee**

April 12, 2024

The Honorable Richard W. Spinrad, PhD
Undersecretary of Commerce
for Oceans and Atmosphere and
NOAA Administrator
1401 Constitution Avenue NW, Room 5128
Washington, DC 20230

Dear Dr. Spinrad,

Rick

On behalf of the U.S. Integrated Ocean Observing System (IOOS)[®] Advisory Committee, I present to you recommendations that the committee has formulated as part of Phase 2 of their Work Plan. The recommendations cover two topics: 1) the National Oceanographic Partnership Program (NOPP), offering ways to further enhance and strengthen the Program, and 2) Marine Life, with a focus on improving the integration of biological measurements across IOOS.

We hope these recommendations prove useful to you and will be implemented quickly by NOAA and the Interagency Ocean Observation Committee (IOOC), where applicable. We look forward to having you join us at our next public meeting on June 12 - 14, 2024, so that we can further discuss these recommendations and hear initial progress and plans NOAA is making to address them. As always, we are happy to be of assistance in supporting NOAA and its mission.

Regards,

Scott Rayder
Chair, U.S. IOOS Advisory Committee

National Oceanographic Partnership Program

The National Oceanographic Partnership Program (NOPP) is fundamentally a program designed to facilitate and promote partnerships in the marine community across federal agencies, industry and academia.

Background and Observations

The National Oceanographic Partnership Program (NOPP) is a multi-agency program established by Congress in 1997 by Public Law 104-201 “to improve the nation’s knowledge of the ocean with the goals of promoting national security, advancing economic development, protecting quality of life and strengthening science education and communication.” There are 20 federal agencies participating in NOPP working together and with partners in state and tribal governments, academia, and the private sector. This congressionally authorized partnership program permits federal and non-federal participants to coordinate and enhance research in the ocean and education by sharing resources to support common goals. NOPP was reauthorized in 2021 to strengthen and continue to facilitate ocean-related partnerships and advance ocean research and education.

Since its beginning in 1997, NOPP has funded over \$500 million in support of over 300 research and education projects involving over 600 partners, and the National Oceanic and Atmospheric Administration (NOAA) has been a major contributor to NOPP since its inception. NOPP projects span a broad range of topics, such as a focus on ocean observing systems and infrastructure, marine resources, sensor development, and ocean education. Importantly, establishing the Integrated Ocean Observing System (IOOS) was one of NOPP’s early accomplishments. IOOS regional associations, along with the IOOS Office, have been active participants in NOPP projects. IOOS has leveraged NOPP partnerships and funding from NOAA, National Aeronautics and Space Administration (NASA), Bureau of Ocean Energy Management (BOEM), Office of Naval Research (ONR), National Science Foundation (NSF) and industry in the tens of millions of dollars for over a decade that have advanced marine life observations and have been a key part of the effort to fill that critical gap in the System.

NOPP has been instrumental in supporting innovation and integration among its partners. A noteworthy success of NOPP, through the Interagency Working Group, has been the meetings of the federal partners that has been fundamental to establishing and maintaining partnerships and developing solicitations for projects. The IOOS program at NOAA has been a contributor to NOPP projects focused on ocean observation and observing technology to enhance IOOS capabilities. However, IOOS was established to be the integrated system for U.S. coastal observation, and the IOOS program office should not be alone in advancing IOOS capacity and innovation.

Also of note has been the commitment of industry and academia to participate in NOPP projects. Representatives from industry provided a few suggestions and comments from an industry perspective on potential improvements for NOPP. These include (1) the partnership

with industry could be improved if industry was provided more information on the context and background of NOPP proposals from a “big picture perspective, and (2) having a better and clear understanding of the underlying requirements for the NOPP solicitations so industry can respond in way that meets the short-and long-term needs of NOAA resulting in improvements in technology development and market investment.

Total NOPP funding peaked in FY2019 at about \$34 million and declined to about \$15 million in FY2021. For many years, ONR played a lead role in supporting NOPP and the NOPP office, and provided the backbone for funding through Broad Agency Announcements (BAAs). A major challenge for NOPP and NOAA in the past was that agency funding often varied from year to year, making long-term commitments difficult. However, it is noteworthy that NOAA now has direct appropriations to support NOPP and the NOPP office, but still depends on the interagency process for funding projects solicited through BAAs. It is also noted that the IOOS Program Office is committed to continue to fund NOPP projects, subject to the availability of funds, to advance new technology, sensor development, and data management.

Of particular note and importance is that NOAA, in conjunction with NOPP agencies, recently announced \$24 million in funding for research in marine carbon dioxide removal projects. Using funds from NOAA’s NOPP appropriation and the Inflation Reduction Act, a total of 17 projects will be supported in partnership with elements of NOAA, Department of Energy (DOE), ONR, NSF and the ClimateWorks Foundation.

NOAA recently organized to take a leadership role in supporting NOPP and has designated a senior program manager (Jeremy Weirich) for NOPP, who is also the co-chair of the NOPP Interagency Working Group. In addition, the NOPP Program Office was re-established in September 2022 to provide administrative support to NOPP and its member agencies, filling a void that resulted from the absence of a Program Office for a few years. Taken together, the active leadership of NOAA in NOPP and the reestablishment of the NOPP Program Office are critical steps (1) to provide the opportunity to strengthen and revitalize NOPP as a leader in supporting multi-sector partnerships, (2) to seek additional funding to support NOPP projects, and (3) to provide leadership in innovation in the marine community, along with transition of research to operational implementation.

The IOOS Advisory Committee is encouraged by and fully endorses management and funding actions taken by NOAA to support NOPP, especially the significant investment in NOPP through the Carbon Dioxide Removal Project and the commitment of the IOOS Office to funding NOPP projects. However, there are remaining opportunities to further enhance and strengthen NOPP as indicated by the following recommendations.

Recommendations

- 1. NOAA should provide leadership, through NOPP, for interagency collaboration and coordination to enhance national observing programs, meeting national priorities that require an interagency approach.** IOOS is a critical piece of all national observing efforts and should be leveraged to enhance and better connect agency observing programs. Given the alignment of

IOOS expertise working across stakeholders and partners, the agencies can develop plans that sustain and grow observing capacity in a holistic way. This will also require continuing to fund NOPP projects that support NOAA needs and innovations in ocean technology and ensuring a stable core funding base for a sustained NOPP program.

2. **IOOS should work with NOPP leadership and appropriate sponsor agencies to develop a process that clearly identifies observing/sensing requirements for NOPP projects far in advance**, so that industry and academia, as partners, can invest in the technology that enhances NOAA's mission, encourages innovation, supports industry and academia investments in research and technology, and the ultimate transition of technology to IOOS and other sustained observing programs. In addition, the IOOS Program Office can provide leadership to improve communication and coordination with NOPP partners.

3. **NOAA and the IOOC should expand public-private partnerships, including working with philanthropic organizations, and assess ways to utilize innovative or alternate funding mechanisms other than BAAs to fund NOPP projects.** NOAA and the IOOC agencies should leverage entities like the IOOS Regional Associations, which are experienced in accepting and distributing funds from different sectors to support projects and PIs across the community.

Develop a Coherent National Backbone for Living Coastal Resources

The Integrated Ocean Observing System (IOOS) is a distributed system that brings together state, federal, academic, commercial, NGO and indigenous communities to provide an integrated national ocean observing capability for the US coastal zone. While this core partnership is the unique strength of IOOS, it has yet to achieve its full potential as a truly integrated observing system. This could be accomplished by collecting, in a uniform comparable manner, a common set of environmental observations and developing a national backbone for core biological measurements.

Implementing such a sampling scheme should adhere to the guidelines developed by the Global Ocean Observing System (GOOS) Biology and Ecosystems panel (BioEco Panel) as much as possible. While biological monitoring is inherently complex, the GOOS BioEco Panel, with significant community engagement, has identified a set of Essential Ocean Variables (EOV) for biology and ecosystems. Each EOV has a specification sheet developed by the GOOS BioEco Panel that documents the background and justification for the measurements, along with a description of the derived products, supporting variables, and, in some cases, the societal drivers and pressures the EOV addresses. Example EOVS include but are not limited to Ocean Color, Phytoplankton Biomass and Diversity, Marine Turtles, Birds and Mammals Abundance and Distribution, Fish Abundance and Distribution, Macroalgal Canopy and Cover and Harmful Algal Blooms¹. While many EOVS are still under development, they can serve as a starting point for defining the IOOS backbone for biological monitoring. Adopting a common set of standards and protocols will be critical for validating and calibrating remotely sensed ocean color and for consistent documentation of the ocean Phytoplankton concentrations. This will enable the connection of local or regional measurements to the GLOBAL observing systems. Climate signals require that we measure physics and chemistry in a standard manner with robust quality control and assurance to extract the potential changes. For example, most of the current ocean acidification technologies vary in the precision of their measurements by orders of magnitude. What is most concerning is that although a few instruments are employed within coastal zones to monitor the pH of coastal waters, many of the devices deployed have error ranges that exceed the change in pH predicted over the next 100 years.

While many potential biological observations can be made, not all are operational. GOOS differentiates EOVS in the concept, pilot, and mature phases. Mature EOVS are those that can deliver routine measurements in an operational context. BioEco EOVS considered mature include animal-tracking upper trophic levels and passive and active acoustics. The Animal Telemetry Network (ATN) is an excellent example of a national IOOS operational system, which enables researchers from any Regional Association (RA) to access data. Passive acoustics is another system currently operating nationally within the National Oceanic and Atmospheric Administration (NOAA), including the Sanctuary Soundscape Monitoring Program. These existing efforts within NOAA and the National Estuarine Research Reserve System (NERRS)

¹ A complete list of Essential Ocean Variables (EOV) can be found at <https://goosocean.org/what-we-do/framework/essential-ocean-variables/>.

should be integrated into or at least accessible through IOOS. Finally, some of the EOVs are relevant across disciplines. For example, ocean acoustics is a cross-Panel EOV tracked by the GOOS Physics and Climate Panel and the BioEco panel. Ocean color is a cross-Panel EOV tracked by the GOOS Biogeochemistry Panel and the BioEco panel.

As many promising emerging technologies are on the horizon, now is the time to establish standard practices and procedures. The RAs can serve as a test bed to develop and test these new observation tools but with an emphasis on implementing these new techniques as part of an integrated national system. These pilot observational tools include measurements of eDNA, which show much promise but remain in the early phases of development and interpretation.

Recommendations for enhancing and building new capabilities focused on marine living resources include:

1. ***Develop a national inventory of biological measurements routinely made across IOOS regions.*** IOOS should develop a National Assessment of what type of biological data are being collected, who is collecting it, and where it is being stored. This inventory should include basic information such as the measure's specific measurement, latency, precision, sensitivity of the measurements taken, methods, and post-processing techniques. These data could be augmented with the extensive bathymetric and habitat data collected by private entities associated with offshore energy development, marine protected areas, and fishing.
2. ***Identify core biological measurements and standards across the IOOS enterprise. Develop the capacity to ensure the development of a specific biological capability across the IOOS enterprise. IOOS should incorporate the GOOS framework for marine life observations to the extent possible.*** One of the goals of IOOS is to detect a change in marine ecosystems due to a shifting climate. To this end, IOOS should implement consistent measurements across the RAs of the base of the food chain, including phyto and zooplankton. This should be done using equivalent methodologies and standards, such as cytobots. Measurements of upper trophic levels can be collected using passive acoustics (i.e., soundscapes) and the ATN. The Sanctuary Soundscape Monitoring Project and the NOAA Ocean Noise Reference Station Network currently carries out such measurements. Soundscapes provide baseline measurements of noise-producing marine animals, weather, and anthropogenic activities.
3. ***IOOS should fully implement the ATN (ARGOS and acoustic tracking systems) and ensure that key sentinel species are measured routinely. Implementation would include tracking data collected by all federal agencies.*** Biological patterns are mobile (advective transport, fish migration, etc.) and require integrated measurements over regional scales. Therefore, providing standardized measurements across the regions is critical to delivering data streams to meet the needs of potential stakeholders (management, conservation, research, commercial). This will be critical to collect relevant information from climate impacts to effective management and conservation.