Drones to the Rescue: Participatory Mapping for the Ocean Decade

Drones al Rescate: Cartografía Participativa para la Década del Océano

Des Drones au Secours : Cartographie Participative pour la Décennie de l'Océan

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EXTENDED ABSTRACT

How can off-the-shelf drones, web-mapping technologies, and participatory methods advance sustainable development and align with the UN Ocean Decade's vision? The Participatory-Uncrewed Aerial Systems (P-UAS) approach is a transformative methodology that bridges local ecological knowledge with participatory mapping techniques to support the 17 Sustainable Development Goals (SDGs) (Baldwin et al 2021; UNDP 2022). Grounded in the principles of good governance and community engagement, participatory mapping harnessing the power of drone technology and analysis dashboards, offers a versatile tool that can be easily leveraged to support the Ocean Decade and the broader framework of Agenda 2023.

The methodology adopts a user-centric and demand-driven approach focused on capacity-building, inclusivity, and empowerment amongst a range of scales and stakeholders (Baldwin et al. 2013). A P-UAS framework, using DJI© drones and DroneDeploy© photogrammetry analysis software, has been developed over the last seven years enabling a diverse array of stakeholders to quickly learn how to plan ecosystem-based drone mapping surveys, execute field data collection, and use web-mapping analysis dashboard tools to extract meaningful data insights and create a range of ecosystem-based information (Baldwin et al 2022). The P-UAS training model has proven highly effective across various scales and levels of stakeholders across the Caribbean, nurturing geospatial understanding of relationships between ecological health, social well-being, economic development, and collaborative management solutions (Baldwin 2023).

Caribbean case studies spanning from 2016 to 2023 highlight how the P-UAS approach is instrumental in supporting the development of a Blue Economy, improving the collection of geospatial data, and enhancing the management and sustainable use of marine resources. P-UAS applications for our Oceans include:

Conservation and Protected Areas

P-UAS's versatility is evident in its capacity as a tool to identify critical habitats, mitigate invasive species, and monitor biodiversity. By capturing high-resolution data, it aids in the preservation and management of marine protected areas. Simultaneously, it empowers public outreach and educational campaigns by providing engaging visual content that fosters awareness and understanding of the importance of conservation.

Disaster Preparedness and Response

The real-time data collection capabilities enhance both disaster preparedness and response efforts. P-UAS's ability to provide highly accurate mapping information, the ability to flag issues and remotely share visual multimedia and data aids the identification of vulnerabilities, rapid decision-making and improved coordination of emergency responses during natural disasters, ultimately improving mitigation and minimizing impacts.

Marine Spatial Planning

A multi-scaled collaborative approach to Marine Spatial Planning (MSP) is crucial for aligning ocean governance with the 2030 Agenda and its commitment to managing and protecting marine and coastal ecosystems. P-UAS offers invaluable support to MSP by providing high-resolution data for collaboratively mapping habitats, resources, and space-uses as well as monitoring changes over time. By capturing evolving coastal dynamics and a better understanding of ecosystem dynamics, P-UAS can assist informed and adaptive management of marine resources, contributing to sustainable fisheries, conservation, and tourism development.

Blue Economy and Sustainable Fisheries

P-UAS can play a vital role within the Blue Economy by supplying geospatial information on marine resources, ecosystems, and human activities to promote the growth of maritime industries while ensuring the well-being of our oceans. Integration of drone-acquired data with stakeholder insights empowers well-informed decisions, promotes resource allocation equity, and facilitates innovative financing mechanisms. By providing ecosystem-based data on marine resources and human activities can support innovation as well as accountability for balanced and equitable growth by fostering economic prosperity while safeguarding the marine environment.

Embracing innovative technological solutions can address complex challenges and the achievement of Agenda 2030 and the goals of the Ocean Decade. The P-UAS approach is a powerful tool to advance sustainable development of our

Figure 1. Illustration showcasing the impact of Participatory-Uncrewed Aerial Systems (P-UAS) for the UN Ocean Decade and achieving the 17 SDGs by fostering multi-scale collaboration, sustainable blue growth, justice, partnerships,

oceans (Figure 1). Driven by multi-scaled cooperation and transformative change, this simple yet effective approach holds the potential to be scaled globally and revolutionize the development of a Blue Economy and the realization of the UN Ocean Decade's vision. Its success is attributed to its incremental capacity-building initiatives, integration of local knowledge systems, and at its core a user-centered participatory approach, which has proven effective across different regions and sectors. Environmental practitioners, researchers, and policymakers alike are urged to explore the world of drone technology and its potential for improving data-driven environmental management. ning healthy ecosystems, and thus are more likely to participate in collaborations with researchers and resource managers.

Here we present a model of a boundary organization, Bonefish & Tarpon Trust, that as part of its structure incorporates marine recreational fishery stakeholders, scientists, and resource managers in the process of threat assessment, research, education, advocacy, and conservation. Bonefish & Tarpon Trust was founded as a non-profit, non-governmental organization in 1998 (originally called Bonefish Tarpon Unlimited) by recreational fishers and fishing guides concerned about declines in populations of Bonefish (Albula vulpes) and Atlantic Tarpon (Megalops atlanticus) in the Florida Keys (USA). The organization has matured into a fisher-integrated, science-based, conservation organization that focuses on conservation of the recreational flats fishery for Bonefish, Tarpon, Permit (*Trachinotus falcatus*), and common Snook (*Centropomus undecimalis*), and more broadly the ecosystem that supports these and similar fishery species. Conceptually, BTT strategically connects with fishers/the fishing community, fisheries and resource managers, and scientific researchers, and acts as both a collaborator with, and intermediary between, these sectors that traditionally have not experienced sufficient or consistent communication to drive conservation success. Collaboration with the scientific community ensures that high standards are maintained for research, applying the most advanced methods. Frequent interaction with resource management agencies ensures that any research is addressing management needs or knowledge gaps, and enhances communication channels between the agencies and fishers. BTT integrates fishers throughout the process. For example, the integration with fishers is often structured as either an informed nested or parallel mixed-methods approach (Kinnebrew et al. 2021), whereby fishers are queried about perceptions of the fishery to help guide research efforts, are consulted about projects as the projects are designed, participate in data collection, and advocate for application of research findings to management and conservation. This approach is being increasingly applied by conservation and outdoor recreation organizations (Raynal et al. 2020). In all cases, communication is based on an extended period of building relationships rather

than a project-specific interaction. Although the model used by BTT focuses on the recreational flats fishery, this same approach can be applied to other fisheries.

KEYWORDS: Marine conservation, recreational fisheries, coproduction, stakeholder engagement

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