

Citizen Science for Security

Harnessing Collaborative Citizen Science for Enhanced Security and Environmental Resilience in the Indo-Pacific

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Abstract

The Indo-Pacific region grapples with increasing volatility due to geopolitical tensions among major powers and the multifaceted impacts of climate change. In this context, both military and civilian stakeholders require comprehensive biodiversity data urgently. This article explores how collaborative citizen science initiatives, utilizing platforms like iNaturalist, can meet this demand. Drawing on experiences from marine biodiversity projects in the Maldives, Sri Lanka, and Palau, conducted alongside defense conferences and field expeditions, the paper examines the challenges, opportunities, and implications of such efforts. It offers recommendations for future projects, including strategies for addressing sampler bias and maximizing the utility of time series data. Additionally, it highlights advancements in technology, such as underwater housings for smartphones, as catalysts for broadening participation and enhancing data collection efforts.

The term *citizen science* refers to initiatives in which volunteers, typically not professional scientists or working outside their field of training, collect data for research purposes.¹ Mass participation projects involving citizen scientists have predominantly occurred in the fields of ecology (e.g., wildlife surveys) and astronomy. Historically, modern oceanography originated from a collaboration between the British Royal Navy and naturalists during the *Challenger* Expedition (1872–1876), aimed at collecting data on various oceanic features, including temperatures, seawater chemistry, currents, marine life, and seafloor geology.² While military personnel have traditionally been involved in military science, their direct participation in modern environmental or citizen science has been limited, albeit

¹ Leslie Ries and Karen Oberhauser, “A Citizen Army for Science: Quantifying the Contributions of Citizen Scientists to our Understanding of Monarch Butterfly Biology,” *BioScience* 65, no. 4 (April 2015): 419–30, <https://doi.org/>.

² “New citizen science project launched for U.S. Navy weather observations from World War II,” *Pacific Marine Environment Laboratory*, 6 April 2021, <https://www.pmel.noaa.gov/>.

with exceptions such as weather monitoring and butterfly tagging.³ A notable contemporary example of military involvement in marine citizen science is seen in coral restoration efforts in Sri Lanka.⁴

How Does iNaturalist Work?

iNaturalist operates as an online social network where individuals share biodiversity information to enhance mutual understanding of nature. Additionally, it serves as a crowdsourced system for species identification and recording organism occurrences. Users contribute observations, and the platform can support projects that aggregate data based on various criteria such as spatial area, time, specific biota, events, or organizations. As the largest citizen science network globally, iNaturalist boasts more than 158 million observations encompassing 431,284 species, contributed by 2,826,318 observers and 327,490 projects.⁵

Findings from Three Marine Citizen Science Initiatives

In 2022, a citizen science project was launched alongside the 2022 Indo-Pacific Environment Security Forum, aimed at fostering a deeper understanding of marine biodiversity. The project, centered around the Kurumba Resort on Vihamanafushi Island in the Maldives, encouraged conference participants to engage in snorkeling, photographing marine life, and uploading their findings to iNaturalist.⁶ To date, a total of 497 observations representing 227 species have been recorded by 13 observers and 78 identifiers, with data collection ongoing.

In 2023, a second project, Coral Reef Restoration Sri Lanka, was conducted in conjunction with the 2023 Indo-Pacific Environment Security Forum and field trip. This initiative yielded 155 observations across 83 species, documented by 5 observers and 33 identifiers.⁷

Additionally, in 2023, a third project focusing on the marine biodiversity of Palau was initiated alongside a Coastal Resilience Workshop. This endeavor amassed 5,402 observations spanning 1,001 species, contributed by 71 observers and 371 identifiers.⁸

³ Woods Hole Oceanographic Institute, “The Challenger Expedition,” *Dive and Discover*, 2024, <https://divediscover.whoi.edu/>.

⁴ Christine Luciano, “10,000 monarchs (and counting): Fort Hood Soldiers, civilians contribute as ‘citizen scientists’,” *US Army*, 21 October 2022, <https://www.army.mil/article/>.

⁵ Sri Lanka Navy, “Workshop on ‘Coral Species Identification and Reef Restoration’ held in Trincomalee,” *Ministry of Defence Sri Lanka*, 2022, <https://www.defence.lk/>.

⁶ “Observations,” *iNaturalist*, 2024, <https://www.inaturalist.org/>.

⁷ “Vihamanafushi Island (Kurumba,Resort) Maldives,” *iNaturalist Australia*, 2022, <https://inaturalist.ala.org.au/>.

⁸ “Coral Reef Restoration Sri Lanka,” *iNaturalist Australia*, 2023, <https://inaturalist.ala.org.au/>.

Engagement in citizen science projects by defense entities offers both regional and personal advantages. These include enhanced community, scientific, and policy knowledge, as well as personal benefits such as improved health and well-being, heightened scientific literacy, and positive shifts in attitudes and behaviors, particularly regarding environmental stewardship. Participation also fosters increased feelings of responsibility and success, alongside cognitive, political, social, and economic empowerment.

Citizen Science Impact

Quantifying the impact of citizen science presents challenges, yet a recent review identified over 500 marine and coastal citizen science projects across Europe. This equates to approximately one marine citizen science project per ~85 km of coastline, signaling exponential growth since 1990. Among these projects, beach-based initiatives are most prevalent, comprising 60 percent of the total, with an average project duration of 18–20 years.⁹

The benefits of citizen science for individuals are manifold, fostering positive collaboration between defense entities, civilians (including traditional owners), and other stakeholders. Such collaboration facilitates knowledge sharing, mutual trust, confidence, and respect regarding environmental issues and solutions.¹⁰ Projects promoting communal participation also have the potential to enhance security, cohesion, and trust within communities, contributing to peace rather than conflict.¹¹

For the scientific community, citizen science offers numerous advantages, including the ability to fill data gaps in regions of scarcity and expand monitoring beyond the constraints of research or authority budgets.¹² The surge in citizen science activity stems from both government or researcher-led initiatives and grassroots community projects.¹³ Furthermore, advancements in technology, such as underwater phone cases, have bolstered participation rates.¹⁴

⁹ “Marine biodiversity of Palau,” *iNaturalist Australia*, 2023, <https://inaturalist.ala.org.au/>.

¹⁰ Carlos Garcia-Soto et al., “Marine Citizen Science: Current State in Europe and New Technological Developments,” *Frontiers in Marine Science* 8 (24 March 2021), <https://doi.org/>.

¹¹ Doug Weir, “Can citizen science help close the environmental monitoring gap in conflicts?,” *Conflict and Environment Observatory*, 8 July 2020, <https://ceobs.org/>.

¹² David W. Walker, Magdalena Smigaj, and Masakazu Tani, “The benefits and negative impacts of citizen science applications to water as experienced by participants and communities,” *WIREs Water* 8, no. 1 (January–February 2021): e1488, <https://doi.org/>.

¹³ Florian Krampe, Farah Hegazi, and Stacy D. VanDeveer, “Sustaining peace through better resource governance: Three potential mechanisms for environmental peacebuilding,” *World Development* 144 (August 2021): 105508, <https://doi.org/>.

¹⁴ *Indo-Pacific Strategy of the United States* (Washington, DC: The White House, February 2022), <https://www.whitehouse.gov/>.

Citizen science outcomes typically fall into three categories: research, individual impacts, and policy or action. Beyond scholarly impacts, citizen science programs yield a plethora of beneficial outcomes. Project websites disseminate summaries of findings, raw data, and biodiversity information to thousands of visitors and media outlets, with many findings featured in popular press articles and other public forums.

The role of citizen scientists in environmental research is pivotal. While professional scientists face limitations in data collection due to constraints in time, funding, and manpower, the military possesses ample resources and an increasing interest in environmental security. Citizen science provides a popular platform for education, data-driven management, and fostering stronger community connections.

Limitations

Citizen science data, particularly from mass participation projects, often exhibit an “unstructured” nature, meaning that the times and locations of samples lack adherence to statistical design.

A persistent concern regarding citizen science revolves around data quality. It is undeniable that low-cost sensors cannot attain the precision of contemporary research-grade instrumentation. However, advancements in super materials and artificial intelligence may be narrowing this gap over time.

Policy Recommendations for Enhancing Citizen Science and Environmental Security

The following policy recommendations outline strategies for strengthening citizen science initiatives in collaboration with defense entities to bolster environmental security.

Project Design and Implementation: Design and implement at least one citizen science project in collaboration with partner countries, organizations, and communities at various levels and focusing on mutually agreed areas of interest, leveraging existing projects in regions like the Maldives, Sri Lanka, and Palau for comparison and continuity.

Training Initiatives: Provide comprehensive training for defense personnel and community members in citizen science methodologies, including online and field training on technology, project management, and communication, to facilitate meaningful participation in projects.

Resource Allocation: Ensure adequate resources for citizen science participation by providing compensation and necessary resources to defense personnel and civilians involved in priority projects, including provisions for transportation, meals, equipment such as cameras and underwater housings, and other essential gear.

Data Reporting: Establish a system for rapid and accessible data reporting at local, national, and global scales, with a focus on simplicity and ease of integration and sharing, utilizing platforms like iNaturalist for efficient data management and dissemination. Standardize reporting mechanisms, including the implementation of a simple report card system for national and global reporting requirements.

Climate Neutrality: Prioritize climate neutrality in all projects and activities, ensuring that greenhouse gas emissions are measured, mitigated, and offset to minimize environmental harm. Military facilities should lead by example by implementing mitigation strategies to reduce their environmental footprint.

Marine Plastic Pollution Reduction: Address the serious threat of marine plastic pollution by implementing measures to reduce, recycle, and clean up marine debris. Plastic pollution poses significant ecological threats to marine ecosystems, including coral reefs, marine organisms, and food networks, necessitating proactive measures for mitigation and prevention.

Conclusion

In conclusion, we emphasize the pivotal role of environmental security in safeguarding both human and national interests across the expansive Indo-Pacific region. Military-civilian collaboration through citizen science emerges as a paramount practice, poised for expansion through bilateral and multilateral partnerships. The *Indo-Pacific Strategy of the United States* underscores the imperative to bolster collective regional capabilities for addressing environmental and natural threats, alongside combating transnational issues such as weapons trafficking and drug trade.¹⁵

Citizen science offers a tangible, mutually beneficial avenue to operationalize this strategy, fostering enhanced leadership, regional capacity building, and knowledge exchange between defense entities and local communities. As global security challenges like climate change, extreme weather events, marine plastic pollution, and biodiversity loss escalate, there is a growing imperative for defense entities to engage, collaborate, and proactively address these issues alongside civilian stakeholders.

Notably, effective emergency response efforts hinge on established partnerships and collaboration between defense entities and communities, cultivated during peacetime initiatives like citizen science projects. Therefore, to optimize the benefits for defense entities, communities, and the environment, we propose six strategic recommendations. These recommendations encompass leadership and collaboration, comprehensive training, resource allocation, streamlined reporting mechanisms, and the implementation of climate-neutral projects. By embracing

¹⁵ *Indo-Pacific Strategy of the United States*.

these recommendations, defense entities can fortify their commitment to environmental security while fostering resilience and cooperation across the Indo-Pacific region. ♻️

Adjunct Associate Professor Adam Smith

Dr. Smith holds postgraduate degrees in science and management and serves as the CEO of Reef Ecologic Pty Ltd, an environmental consultancy based in Queensland, Australia. He is a prominent figure at defense conferences and workshops in the Indo-Pacific Region, frequently participating as a speaker, facilitator, and scientist. In 2023, he was honored with an Australia Day medal for Environment Excellence and Sustainability.

Admiral Piyal De Silva, Sri Lanka Navy, Retired

Admiral De Silva, the 23rd Commander of the Sri Lanka Navy and former ambassador of Sri Lanka to Afghanistan, boasts extensive experience in counterterrorism, counternarcotics, countersmuggling, disaster management, and marine environment conservation. He holds a Master of Business Administration in Human Resource Management and a Master of Science in Military Science and National Security Strategic Studies. Recognized with the Gold award for Professional Excellence in the marine defense sector in 2022, Admiral De Silva is also a PADI diving instructor and specialty Instructor in marine resource management.

Chris Sholes

Mr. Sholes, serving as the command environment officer with US Indo-Pacific Command, brings 25 years of experience in environmental remediation and international environmental security policy development to the table. Overseeing a myriad of projects ranging from USD 40,000 to USD 2.3 million in collaboration with partner nation agencies, he has demonstrated expertise in addressing diverse environmental concerns. Notably, Sholes spearheaded the creation of the Pacific Environmental Security Partnership, fostering collaboration with 34 countries to enhance policy development and environmental capacity building across the Indo-Pacific region. His certifications in project management and contract administration further augment his ability to facilitate military-civilian collaboration opportunities on an international scale.

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