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Editorial
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An ocean of science, worms, and humaneness:
a tribute to Paulo Lana

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An ocean of science, worms, and humaneness: a tribute to Paulo Lana

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The scientific community recently suffered an irreplaceable loss with the passing of Paulo Lana, a world-renowned marine biologist whose career was marked by profound contributions to oceanographic research, marine conservation, and education. This special article collection is dedicated to celebrating Paulo's extraordinary legacy as a scientist, mentor, and human being.

Paulo earned his doctorate in Biological Oceanography from the University of São Paulo in 1984. His work as a founding faculty of the Centro de Estudos do Mar at the Federal University of Paraná (UFPR) was pivotal in consolidating marine research in Brazil. He helped establish the Marine Sciences program, a critical foundation for oceanographic studies, which remains an influential force in shaping research and policy. His pioneering contributions extended to marine conservation and understanding estuarine and coastal ecosystems, particularly in benthic habitats.

His profound impact on marine sciences in Brazil and beyond continues to resonate, especially as we reflect on his numerous achievements and contributions. Throughout his career, Paulo distinguished himself as a visionary marine biologist, a leading voice in the study of benthic ecosystems, and a dedicated educator who significantly shaped the field of marine science. One of his major contributions was his leadership in the study of polychaetes, a group of marine worms essential to understanding marine biodiversity and ecosystem functioning. In addition to taxonomy, his research spanned the broader dynamics of benthic communities, contributing to conservation strategies critical to Brazil's unique coastal ecosystems.

Beyond his scientific contributions, Paulo's legacy as an educator is one of his most cherished roles. Over his 40-year tenure at UFPR, he advised more than 100 master and doctoral students, and postdoctoral researchers. His passion for teaching and fostering young scientists extended well beyond the classroom, inspiring a generation of oceanographers and marine biologists committed to addressing the environmental challenges of Brazil's coastal regions.

Paulo's leadership within the scientific community was internationally recognized. He was an esteemed member of several scientific committees, serving as President of the International Polychaetology Association. His scholarly output was prolific, comprising over 200 articles, books, and book chapters, solidifying his place among Brazil's most influential marine scientists.

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His sudden passing in 2022 was a tremendous loss to the global scientific community. His colleagues remember him for his intellectual rigor, humility, kindness, and deep commitment to environmental advocacy. His life's work, which integrated scientific research with practical conservation efforts, leaves a lasting imprint on how we understand and protect marine ecosystems.

The articles in this special volume are authored by people who cherished Paulo, or feel their lives and careers were touched or inspired by him. All authors have expressed their connection to Paulo in the Acknowledgements section of their texts. Unsurprisingly, all texts deal with subjects closer to Paulo's themes, namely, polychaete taxonomy and ecology, mangrove and estuarine ecology, and environmental quality, reflecting both the scope of Paulo's influence and the urgent environmental issues facing marine systems today. From taxonomic studies to ecological assessments, the articles offer a comprehensive exploration of species diversity, environmental impacts, and governance within Brazilian and global marine ecosystems.

Several articles examine the taxonomy and phylogeny of annelids. Alves et al. (2024) explore the distribution of *Namalycastis abiuma*, showing through molecular and morphological analysis that this species, long believed to have a broad distribution, may be limited to a specific region, prompting the identification of a new species in Brazilian waters. Expanding on this theme, Ogawa et al. (2024) and Hutchings et al. (2024) describe new species within the genera *Sphaerosyllis* and *Loimia*, providing updated descriptions and identification tools that deepen our understanding of these often-overlooked species. Similarly, Simioni and Garraffoni (2024) revisit Professor Ernst Marcus's foundational work, redescribing *Aeolosoma* species from original collections to improve taxonomic clarity for future studies. Díaz-Díaz et al. (2024) describe *Lumbrineris lanai*, which they consider the only valid species of Lumbrineridae recorded to date on Robinson Crusoe Island in the Juan Fernández Archipelago in Chile. Santos and Rizzo (2024) describe *Aberranta magnumlanai*, from the Brazilian continental slope. This species belongs to a rarely collected group of polychaetes and is the first record of the genus in the southern hemisphere. Fukuda et al. (2024) present *Exogone paulolanai* as part of their thorough overview of the known diversity of the genus in the country. The authors also developed an identification key to the species currently found along the Brazilian coast. Radashevsky (2024) reviews records of *Polydora* species from Brazil, describes two new species, *P. paulolanai* and *P. nonatoi*, and emphasizes the critical need for molecular data to support accurate identification of the genus. Identification keys and annotated checklists on polychaetes from hard substrates are presented by Álvarez et al. (2024b) for Sepetiba Bay (Brazil), and for the Hesionidae family by Marques et al. (2024). Both papers also discuss the status and distribution of many species along the Brazilian coast, calling for the systematic revision of species with problematic descriptions.

Based on the Annelida collection database from the National Museum (MN) of the Federal University of Rio de Janeiro (UFRJ), Messias et al. (2024) show the use of interactive visual representations of the collection's metadata as tools to solve collection management tasks, as well as to recognize global patterns present in databases. Collections are also the topic addressed by Petti et al. (2024), who present an overview of the history and taxonomic knowledge of the four main Brazilian scientific collections of polychaetes, offering a comprehensive picture of their current situation and highlighting the challenges for the future.

Research on benthic ecology is well represented by studies examining the roles of bottom-dwelling taxa in supporting ecosystem functions and their responses to the environment. Baldeija and Lercari's (2024) bibliometric analysis emphasizes the importance of meiofauna research in Latin America, especially in Brazil, where collaborations are expanding. Meanwhile, Schmidt and Diele's (2024) study of the mangrove crab *Ucides cordatus* explores how conspecifics support the recruitment of juveniles in mangrove environments, highlighting the ecological connections that sustain these crucial habitats. To support aquaculture, Afonso et al. (2024) evaluated the reproductive cycle of *Crassostrea gasar* oysters cultivated in open systems under different environmental conditions.

Gimenez et al. (2024) review current trait-based approaches to assessing the connections between macrobenthic communities and soft marine sediments, considering both response and effect traits, highlighting the value of these techniques for research into animal-sediment relationships. Hannon and Schulze's (2024) two-year survey on *Alitta succinea* populations contributes insights into the reproductive cycles of this polychaete species, showing the role of benthic communities in maintaining food webs and nutrient cycling within coastal ecosystems. Metri et al. (2024) investigated the fauna on buoys in Paranaguá's port access channel, revealing a dominance of invasive species in areas with higher salinity. This dominance is attributed to the species' adaptations to marine influences, tidal exchanges, and salinity barriers within the inner estuary. Lira et al. (2024) provide a comprehensive review and empirical data on the ecological association between Syllidae polychaetes and sponges, summarizing information on their reproductive patterns, feeding habits, and role in the association. They also describe *Branchiosyllis lanai* and provide an updated identification key for *Branchiosyllis* species on the Brazilian coast. Through a comprehensive bibliometric analysis, Nascimento et al. (2024) assess the status and the 60-year evolution of polychaete research in Brazil. The authors call for more creativity and audacity to pursue common goals in collaboration with countries of the global south, to enhance the quality of scientific research and promote research networks. The work by Álvarez et al. (2024a) experimentally investigates the regeneration capabilities of *Nainereis aurantiaca*, which has important ecological implications. The species shows remarkable and robust head regeneration but cannot regenerate the gut and the branchial segments.

This special article collection also addresses the contamination levels and environmental impacts of pollution and climate change on marine organisms. In a first report for Brazil, Nagai et al. (2024) show the high contamination of Brazilian beaches by plastic biomedia. Baudisch et al. (2024) evaluate the applicability and reliability of the Abundance/Biomass Curves method to assess the level of organic pollution in non-vegetated tidal flats. Ozorio et al. (2024) study the effects of an experimental diesel spill on *Scolelepis goodbodyi*, a polychaete used as a sentinel species, and assess the role of biomarkers in detecting pollution exposure. In a complementary study, Maia and Troncoso (2024) examine how littorinid snails respond to extreme climatic events across temperate and tropical estuaries, noting the resilience of these species while acknowledging their vulnerability in a changing climate. Together, these studies highlight the importance of benthic organisms in ecosystem monitoring, illustrating their role as indicators of environmental health in affected areas.

The focus on other biological communities deals with how marine organisms interact with environmental factors. Mafra Jr et al. (2024) analyze harmful algal blooms in the Paranaguá Estuarine Complex, documenting the presence of toxin-producing algae and their potential health risks to local fauna and communities. In another plankton study, Menezes et al. (2024) evaluate copepod functional diversity in response to El Niño and seasonal changes, contributing data on how these important organisms adapt to climatic variability. Miotto et al. (2024) add to this section a survey of the avifauna of the Paranaguá Estuarine Complex, recording the diversity and conservation status of waterbirds in this World Heritage site. This study emphasizes the need for ongoing monitoring to safeguard the region's ecological and cultural value.

Innovative approaches to environmental assessment are also featured, with studies using technology to monitor and manage coastal zones. Silva et al. (2024a) use drones to assess the environmental status of restinga vegetation, while Luersen et al. (2024) apply numerical modeling to study sediment transport on an eroding beach. Noernberg and Rodrido (2024) present direct hydrodynamic measurements from the upper shoreface of a sandy beach in distinct oceanographic conditions, thus providing insights to quantify and model longshore sediment transport dynamics and morphological changes along sandy coastlines. Silva et al. (2024b) reviewed and collected coastal topo-bathymetric data to create flood maps and sea-level rise models for the Paranaguá Estuarine Complex case study. These studies demonstrate the potential of advanced tools in addressing the challenges of

ecosystem monitoring, offering practical solutions for improved coastal management and conservation.

Finally, the collection includes a significant piece on governance and resilience, examining the socio-political aspects of environmental stewardship. Telles and Pinotti (2024) analyze the participative governance structures of the Paranaguá Bay Zone, calling for more inclusive governance frameworks that empower local communities in conservation efforts. Their findings emphasize the importance of community engagement in policymaking, promoting transparent and responsive governance to strengthen socio-ecological resilience in estuarine regions.

In addition to the scientific knowledge it contributes, this set of articles highlights Paulo's legacy, as most of them feature authors who were directly influenced by him as advisees or research collaborators. Indeed, Paulo's mentorship led many of his alumni to become close to his entire family, to whom we are deeply grateful and dedicate this special volume. After his passing, his family maintained close contact, continued supporting his students, and took pride in every tribute that kept his dreams and school alive. To paraphrase a favorite quote among his undergraduate students: "Teaching and science should not be a steeplechase, but a joyful party where everyone dances with everyone else. So, help others and seek help from others to move forward, always remembering that the starting conditions are very difficult for many of us".

Preparing this special issue was far from smooth sailing, as we strived to meet the high standards of quality that Paulo set for his work. Evaluating the submitted articles and making editorial decisions was no easy task, and writing this editorial was a bittersweet experience: while it is an honor and a joy to pay tribute to our dear friend, it also serves as a heartfelt reminder of his loss. For those of us fortunate enough to share friendship, mentorship, projects, and time with Paulo, we are reminded of how turbulent, challenging, and profoundly inspiring the ocean can be. Capturing what Paulo represents to so many would probably require a collection of theses. We hope this special article collection of Ocean and Coastal Research stands as a fitting tribute to a man whose legacy will continue to guide marine science in Brazil and around the world for years to come.

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