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EDITED AND REVIEWED BY
Heliana Teixeira,
University of Aveiro, Portugal

*CORRESPONDENCE
Tomaso Fortibuoni
tomaso.fortibuoni@isprambiente.it

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Editorial: Changes in estuarine fishery ecosystems under multiple stressors

Tomaso Fortibuoni[1]* and Cui Liang[2]

[1]Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA), Ozzano dell'Emilia, Italy, [2]Institute of Oceanology, Chinese Academy of Sciences (CAS), Qingdao, China

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Editorial on the Research Topic
Changes in estuarine fishery ecosystems under multiple stressors

Introduction

Estuaries support numerous species, from fish to invertebrates, many of which rely on these environments for critical stages of their life cycles (Beck et al., 2001). Nevertheless, despite their ecological significance, in recent decades, the health and sustainability of estuarine ecosystems have deteriorated, driven by a multitude of stressors (Little et al., 2017). The cumulative impacts of these stressors have caused profound shifts in the biodiversity, abundance, and distribution of fish species (Peterson and Lowe, 2009). If not addressed, the degradation of estuaries threatens not only local fish populations but the future of global fisheries.

The complexity of estuarine ecosystems means that they do not respond to environmental pressures uniformly. Significant shifts in food webs, species diversity, and resource availability may occur in response to cumulative pressures (e.g., St. George et al., 2024; Lauchlan and Nagelkerken, 2020). These findings underscore the importance of implementing adaptive management strategies that can respond to the nuanced ways estuarine ecosystems are changing.

The focus of this Research Topic was on studies that use ecological or other methods to explore how estuarine fishery ecosystems respond to environmental changes. Understanding changes in estuarine fishery ecosystems and their food webs can improve our knowledge of the abundance, distribution, and potential of fishery resources provided by estuaries, especially if supported by long-term time series. In addition, in a context of multiple pressures, such as the impacts of fishing activities, climate change and other environmental stressors on estuarine environments and thus on fishery resources, the role of management strategies is critical to mitigate the threats and to ensure sustainable development of estuarine fishery ecosystems.

The studies under this Research Topic explored the importance of habitat conservation and the role of biodiversity within these ecosystems by studying the relationship between habitat integrity and species distribution and survival through its trophic interactions, energy flows and habitat use throughout their lifecycle.

The role of habitat conservation: lessons from the cubera snapper

One critical insight into the relationship between habitat and species survival comes from the study of the cubera snapper, the largest snapper in the Atlantic Ocean (Miranda da Silva et al.). Research integrating both scientific data and indigenous knowledge has revealed the importance of estuarine and mangrove habitats as nursery grounds for juvenile cubera snappers. These habitats are essential to the early life stages of the species, providing shelter, food, and protection from predators.

Empirical data collected using underwater cameras, alongside insights from local fishers, showed a clear reliance of cubera snapper juveniles on mangrove habitats. However, the occurrence of juveniles in these habitats varies significantly based on the level of coastal development and habitat degradation in different estuarine systems. Where mangroves were removed or degraded, cubera snapper juveniles are far less likely to be found. Pollution and overfishing exacerbate this issue, reducing the quality of the remaining habitats.

The cubera snapper study underscores the importance of conserving not only the species themselves but the habitats they rely on. Without intact estuarine and mangrove ecosystems, many fish species could see their populations decline drastically, impacting broader marine food webs and the fisheries that depend on them (Arceo-Carranza et al., 2021).

Mangrove ecosystems: a model for conservation

Dongzhaigang Bay in Hainan, China, provides a glimpse into how mangrove ecosystems can function when well-preserved. Using advanced modelling techniques like Ecopath and Ecospace, researchers have mapped the trophic interactions and energy flows within this mangrove ecosystem, highlighting its high ecotrophic efficiency (Jiang et al.). This means that a significant portion of the primary and secondary production in the bay is transferred to higher trophic levels, supporting a diverse and stable ecosystem (Eddy et al., 2021).

However, despite this relative stability, the ecosystem still faces pressures from human activities. Overfishing, pollution, and habitat encroachment continue to threaten the delicate balance of the mangrove ecosystem. The findings from Dongzhaigang Bay emphasize the need for ongoing monitoring and data collection to understand the impacts of human activities better and guide future conservation efforts.

Climate change and shifting species compositions in the Gulf of Mexico

In many temperate and subtropical ecosystems, the impacts of climate change are becoming increasingly apparent (e.g., Palacios-Abrantes et al., 2022). Rising water temperatures and changing salinity levels have led to shifts in species distributions, with some species moving into new areas while others retreat. This shift is creating new challenges for local fisheries as the species composition in these bays changes in response to environmental conditions.

Species like the common snook and southern flounder, once rare in certain bays, are becoming more common, while species that once dominated are declining (Torres Ceron et al.). These shifts have important implications for fisheries management, as traditional fishing practices and policies may no longer align with the current ecological reality. Understanding how climate change is altering species distributions is critical for adapting management strategies to ensure sustainable fisheries in the future (Hidalgo et al., 2022).

The importance of biodiversity: insights from Hainan Island

A substantial gap between what we know about the fish species in the shallow waters of the tropical continental shelf in China and their actual diversity remains despite extensive research. This gap highlights the need for continued exploration and identification of species, especially in regions like Hainan Island, which are hotspots for marine biodiversity.

Research using DNA barcoding and molecular identification approaches in the waters surrounding Hainan Island has revealed the extraordinary biodiversity of fish species in this region (Zhang et al.). The findings from this research are a stark reminder that our understanding of marine ecosystems is still incomplete. Many species remain understudied, and without a comprehensive understanding of the biodiversity within these ecosystems, it will be challenging to protect them effectively. DNA barcoding offers a promising tool for identifying and cataloguing marine species, contributing to a more accurate understanding of marine biodiversity and helping to guide conservation efforts (Gostel and Kress, 2022).

Conclusion: a call for integrated management and conservation

Estuarine ecosystems are increasingly threatened by coastal development and climate change (Mahoney and Bishop, 2017). To protect the biodiversity and productivity of estuarine fisheries, an integrated approach to management is needed. This approach must combine scientific research with local knowledge, as demonstrated by the cubera snapper study, as well as innovative technologies (e.g. DNA barcoding) and modelling (e.g., Ecopath) to develop effective conservation strategies. To combat the decline of estuarine ecosystems, it is crucial to examine how these environments have changed over time (e.g., Gulf of Mexico case study).

Conserving estuarine ecosystems is not only about protecting individual species; it is about preserving the intricate web of life that supports global fisheries. The challenges are immense, but with a deeper understanding of how estuarine ecosystems function and respond to stressors, there is hope that we can restore and protect these vital ecosystems for future generations.

Author contributions

TF: Writing – original draft, Writing – review & editing, Conceptualization. CL: Writing – review & editing.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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