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STRUCTURE REVIEW: SPATIAL BOUNDARIES IN FISHERIES GOVERNANCE AND MANAGEMENT PRACTICE

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Abstract:

This Systematic Literature Review (SLR) explores the significance of spatial boundaries in fisheries governance and management practice. Fisheries governance often relies on spatial demarcations, but challenges arise due to species migration, environmental changes, and human activities. The problem addressed in this review is the need for more effective existing spatial management strategies in ensuring sustainable fish populations. To address these challenges, a comprehensive search and analysis of peer-reviewed articles from databases such as Scopus and Web of Science was conducted, focusing on research published between 2018 and 2024. The methodology followed Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure a rigorous selection process, resulting in 26 high-quality studies being included in the final review. The findings were divided into three themes: (1) spatial governance and management in fisheries, (2) environmental drivers and species-specific behavior, and (3) technological and methodological fisheries research. The findings underscore the need for adaptive spatial boundaries that consider both ecosystem dynamics and socio-political factors. In conclusion, the review recommends dynamic spatial management practices that aim to strengthen governance frameworks and enhance conservation outcomes.

Keywords:

Boundary, Delineation, Demarcation, Fisheries Governance and Management

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Introduction

The spatial boundaries of fisheries governance and management represent a critical intersection between environmental stewardship, economic interests, and social responsibilities (Schuch, Gabbert, and Richter 2021; Song et al. 2017). In an era of heightened awareness of sustainability, the effective governance of fisheries resources has emerged as a pivotal concern for both local and global communities. The management of fisheries resources is inherently complex (Lewison, Johnson, and Verutes 2018), given the multifaceted nature of marine ecosystems, the migratory patterns of fish species, and the diverse range of stakeholders involved. At the heart of these complexities lie the spatial boundaries that define where and how fisheries management practices are implemented (Luo and Chi 2023).

Fisheries governance encompasses a framework of rules, norms, and strategies that are designed to manage fish stocks and ensure their sustainable use. The concept of spatial boundaries within this governance structure is multifaceted, encompassing legal, ecological, and socio-political dimensions. Legally, spatial boundaries are often delineated by national jurisdictions, Exclusive Economic Zones (EEZs), and international treaties. These boundaries determine which nations or organizations have the authority to manage and exploit marine resources. However, the ecological reality often transcends these human-imposed boundaries, as fish species frequently move across them, challenging traditional governance structures.

Literature Review

Spatial boundaries are fundamental in fisheries governance and management, as they delineate the areas within which specific policies and regulations are applied. The creation of Marine Protected Areas (MPAs) is a key strategy for managing fisheries within these defined boundaries, aiming to conserve marine biodiversity and sustain fish populations by limiting human activities (Khuu, Jones, and Ekins 2023). However, the effectiveness of MPAs is often challenged by the migratory nature of many marine species, which can move across these boundaries, complicating traditional governance structures (Hardesty-Moore et al. 2018). This issue is further exacerbated by the varying degrees of enforcement and compliance across different regions, particularly in areas where multiple countries share marine resources, leading to inconsistencies in policy implementation and potential overexploitation (Liu and Molina 2021).

In addition to MPAs, spatially explicit management tools, such as Ecospace and ECOSIM models, are increasingly used to simulate the impacts of different management scenarios within spatial boundaries (Romagnoni et al. 2015). These models have been applied, for example, in the Thermaikos Gulf in Greece, where they have demonstrated that combining spatial boundaries with reduced fishing effort can significantly boost the biomass of exploited stocks. However, there are concerns that fishing activities may shift to the edges of protected areas, potentially increasing pressure on adjacent ecosystems and undermining the benefits of spatial management. Thus, while spatial boundaries and management tools are essential for effective fisheries governance, their success relies on comprehensive and coordinated management approaches that address the ecological realities of species migration and the need for international cooperation (Song et al. 2017).

In conclusion, the management of fisheries within spatial boundaries is a complex and multifaceted issue that requires a holistic approach. The integration of ecological, legal, and socio-political considerations is crucial for effective fisheries governance. The establishment

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of MPAs, transboundary management strategies, and the use of spatially explicit management tools are all critical components of this approach. However, the success of these strategies ultimately depends on the cooperation and coordination of all stakeholders involved. The need for international collaboration and the development of adaptive management frameworks that can respond to the dynamic nature of marine ecosystems is essential for ensuring the sustainability of fisheries resources within spatial boundaries.

Methodology

The methodology employed in this study follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (PRISMA), a widely accepted standard for conducting Systematic Literature Reviews (SLRs). PRISMA ensures transparency, completeness, and consistency throughout the review process. By adhering to these guidelines, the study systematically identified, screened, and selected relevant literature, thereby enhancing the accuracy and rigor of the analysis. PRISMA also emphasizes the importance of randomized studies in minimizing bias and strengthening the evidence base. For this review, two major databases, Scopus and Web of Science, were selected due to their comprehensive indexing of peer-reviewed literature across diverse academic fields. While both databases offer broad and reliable coverage, it is essential to acknowledge their limitations, such as content gaps or variations in indexing detail, which were considered during the review process.

The PRISMA approach is organized into four key stages: identification, screening, eligibility assessment, and data extraction. During the identification stage, relevant studies are located through systematic database searches. This is followed by screening, where studies are reviewed against predefined criteria to remove those that are irrelevant or of low quality. The eligibility stage involves a closer evaluation of the remaining studies to confirm that they meet the inclusion requirements. Finally, in the data abstraction phase, information is extracted and synthesized from the selected studies to support meaningful and dependable conclusions. This structured process enhances the rigor of the systematic review, ensuring the results are reliable and helpful in guiding future research and practice.

Formation of Review Questions

Review questions are formulated to ensure the author complies with the vital steps of the SLR process, including identification, screening, quality appraisal, data extraction, and report development. (Haddaway, N. R., Macura, B., Whaley, P., & Pullin 2018; Lockwood, C., Munn, Z., & Porritt 2015; Mohamed Shaffril, Samsuddin, and Abu Samah 2021). Moreover, a well-defined review question helps readers determine whether the review addresses their information needs (Lockwood, C., Munn, Z., & Porritt 2015). To formulate the review questions, the authors employed the Population, Intervention, Comparison, or Context (PICo) mnemonic, a framework commonly used in systematic reviews, to craft questions for qualitative synthesis.

How do spatial management practices influence the sustainability and effectiveness of fisheries governance across various marine ecosystems?

Population: Marine ecosystems and fisheries.
Interest: Influence of spatial management practices.
Context: Sustainability and effectiveness of fisheries governance.

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What are the key environmental drivers and species-specific behaviours that must be considered for effective spatial governance in fisheries management?

Population: Marine species and their habitats.
Interest: Key environmental drivers and species-specific behaviors.
Context: Effective spatial governance in fisheries management.

In what ways do technological and methodological advancements enhance the capacity to monitor and manage spatial boundaries in fisheries governance?

Population: Fisheries management practices.
Interest: Technological and methodological advancements.
Context: Monitoring and managing spatial boundaries in fisheries governance.

These review questions are designed to guide further investigation into key areas of fisheries management, environmental impacts, and methodological approaches, each focusing on critical aspects of conserving and managing fish populations in spawning habitats.

Systematic Searching Strategies

After forming the research question, the review implemented systematic searching strategies, utilizing three primary processes in this stage: identification, screening, and eligibility (see Figure 1). This process ensures that the review encompasses a comprehensive search.

Identification

This study followed key steps of the systematic review process to collect a substantial body of relevant literature. The process began with the identification of keywords and related terms through the use of dictionaries, thesauri, and existing research. Once all relevant terms were established, search strings were developed and applied to the Scopus and Web of Science databases (see Table 1). This initial phase of the review yielded 184 publications related to the study topic from both databases.

Table 1: The Search String

Scopus	TITLE-ABS-KEY (demarcat* OR delineat* OR spatial* AND boundary* AND area*) AND (“fish* govern* area*” OR “fish* manage* area*” OR “fish* conserve* area*” OR “fish protect* area*” OR “marine* protect* area” OR “river protect* area*”) AND (“river* fish*” OR “marine* fish*” OR “sea fish*”) AND (LIMIT-TO (DOCTYPE , “ar”)) AND (LIMIT-TO (SRCTYPE , “j”)) AND (LIMIT-TO (LANGUAGE , “English”)) AND (LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2023) OR LIMIT-TO (PUBYEAR , 2024)) Date of Access: August 2024
WoS	TS=(demarcat* OR delineat* OR spatial* AND boundary* AND area*) AND ALL=(“fish* govern* area*” OR “fish* manage* area*” OR “fish* conserve* area*” OR “fish protect* area*” OR “marine* protect* area” OR “river protect* area*”) AND ALL=(“river* fish*” OR “marine* fish*” OR

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"sea fish*") and 2018 or 2019 or 2024 (Publication Years) and Article (Document Types) and English (Languages)
Date of Access: August 2024

Source: Authors (2024)

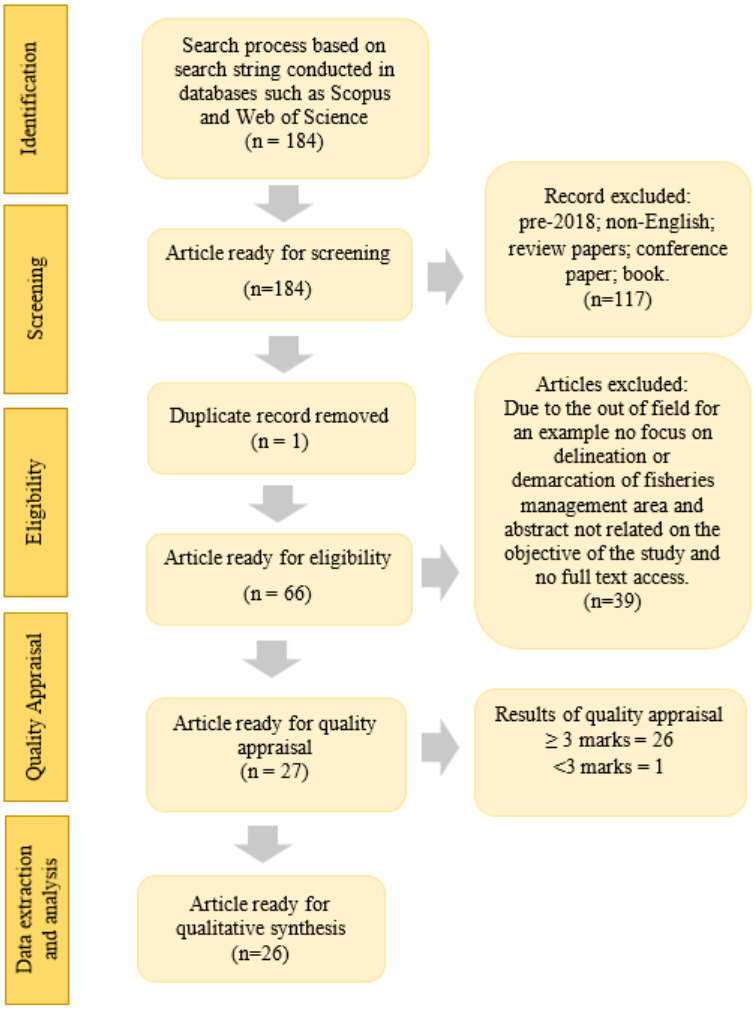

Figure 1. Systematic Searching Strategy

Screening

Screening constituted the second step in the systematic searching strategy, where the 184 articles were scrutinized to examine their suitability for inclusion in the review. The first criterion was the publication timeline, which encompassed 2018 and 2024. Accordingly, the authors' examination and search process on the selected database between 2018 and 2024 yielded a sufficient number of articles, increasing the authors' ability to select the most appropriate and relevant articles for the review. The second criterion relates to the publication type, where the authors only included journal articles (Linares-Espinós, E., Hernández, V., Domínguez-Escrig, J. L., Fernández-Pello, S., Hevia, V., Mayor, J., ... & Ribal 2018). Articles published in journals undergo a rigorous peer-review process to ensure quality. Therefore, selecting this publication type helps the authors maintain the quality of the content. The third criterion stipulates that the selected articles must offer primary rather than review or secondary data. The authors also focused on language in the context of this review. Only articles published

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in English were considered. Based on these criteria and the removal of one duplicated article, 117 articles were excluded from the review, resulting in 66 articles deemed suitable to progress to the next step, the eligibility process.

Eligibility

In this step, the authors re-screened all selected articles to verify their relevance in line with the study's inclusion criteria, addressing all review questions. During this stage, the authors conducted the screening process by reviewing the articles' titles and abstracts and, where necessary, examining the methodology section. Within this process, 39 articles were excluded because they lacked a focus on fisheries governance and management. Additionally, some articles were not directly related to the topic of boundaries. Consequently, the remaining 27 articles were deemed eligible for quality appraisal.

Quality Appraisal

The 27 articles selected for the quality appraisal process were crucial for minimizing bias and ensuring the quality and integrity of the selected articles (Haddaway, N. R., Macura, B., Whaley, P., & Pullin 2018; Mohamed Shaffril et al. 2021). All authors conducted the quality review through a group discussion in two sessions, initially by reading all the selected articles and then discussing their quality. In this study, we apply the quality assessment framework proposed by Anas Abouzahra et al. (2020), which consists of six questions for evaluating the quality of our SLR. These questions are as follows: (1) Is the purpose of the study clearly stated? (2) Is the interest and the usefulness of the work presented? (3) Is the study methodology established? (4) Are the concepts of the approach clearly defined? (5) Is the work compared and measured with other similar work? and (6) Are the limitations of the work mentioned? (Abouzahra, Sabraoui, and Afdel 2020). The scoring procedure for evaluating each criterion involves three possible ratings: "Yes" (Y) with a score of 1 if the criterion is fully met, "Partially" (P) with a score of 0.5 if the criterion is somewhat met but contains some gaps or shortcomings, and "No" (N) with a score of 0 if the criterion is not met at all. For a study to be accepted for the next process, the total mark derived from summing the scores must exceed 3.0. This threshold ensures that only studies meeting a certain quality standard proceed further.

Data Extraction and Analysis

This study employed an integrative analysis as a key assessment strategy to examine and synthesize a range of research designs, with a primary focus on quantitative methods. The aim was to identify relevant themes and sub-themes within the field of fisheries management. The process began with data collection, followed by a detailed review of 26 selected publications, as presented in Table 2. The authors carefully analyzed these studies for insights and statements aligned with the study's focus. The methodologies and findings of each study were examined to understand their contributions. Collaborating closely, the author and co-authors developed preliminary themes based on the gathered evidence. Throughout the data analysis, a log was maintained to capture reflections, interpretations, and emerging questions. These themes were then refined to ensure coherence and accuracy. To validate the findings, the themes were reviewed by three domain experts: one specializing in fisheries governance and two in institutional analysis and fisheries management. Their feedback helped ensure the clarity, relevance, and completeness of each sub-theme. Revisions were made based on expert input and the lead author's judgment to strengthen the study's overall validity.

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Research Findings

Table 2. Background of Selected Articles

No	Title and Author(s)	Source Title	Scopus	WoS
1	Spatiotemporal fishing effort simulations and restriction scenarios in Thermaikos Gulf, Greece (Northeastern Mediterranean Sea) (Dimarchopoulou et al. 2024)	Ocean and Coastal Management	/	
2	The spatio-temporal distribution of small-scale fisheries along the northern Panay Gulf, Philippines: Implications for management (Nochete and Baleña 2024)	Fisheries Research	/	
3	Operationalizing a fisheries social-ecological system through a Bayesian belief network reveals hotspots for its adaptive capacity in the southern North sea (Bacheler et al. 2024)	Journal of Environmental Management		/
4	A multi-scale tracking approach for conserving large migratory fish in an open coastal environment (Edwards et al. 2024)	Estuarine, Coastal and Shelf Science	/	
5	Red Snapper connectivity in the Gulf of Mexico (Vaz et al. 2023)	Marine and Coastal Fisheries	/	
6	Spatial distribution and seasonal variation of fish larvae in the upper 200 m of the Philippine Sea (Fang et al. 2023)	Frontiers in Marine Science	/	
7	Environmental drivers of sex-biased foraging behavior in Magnificent Frigatebird in Baja California Sur, Mexico (Giambalvo et al. 2022)	Avian Conservation and Ecology	/	
8	Identification of western South Atlantic stocks of the Lane snapper (*Lutjanus synagris*) from an otolith based multi-proxy approach (Dos Santos et al. 2022)	Fisheries Research	/	
9	A spatial statistical approach for identifying population structuring of marine fish species: European sprat as a case study (Lindegren et al. 2022)	ICES Journal of Marine Science	/	
10	Advances in the use of nighttime light data to monitor and assess coastal fisheries under the impacts of human activities and climate and environmental changes: A case study in the Beibu Gulf (Tian et al. 2022)	Marine Policy	/	
11	Opportunities to improve sustainability of a Marine Protected Area: Small-scale fishing in Loreto, Baja California Sur, Mexico (Armenta-Cisneros et al. 2021)	Regional Studies in Marine Science	/	

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12	Regionalization of benthic hard-bottom communities across the Pourtalès Terrace, Florida (Walker et al. 2021)	Deep-Sea Research Part I: Oceanographic Research Papers	/	
13	Identifying marine ecological production units in Vietnam (Bell et al. 2021)	ICES Journal of Marine Science	/	
14	Habitat use and movement patterns of reef manta rays *Mobula alfredi* in southern Mozambique (Venables et al. 2020)	Marine Ecology Progress Series	/	
15	Marine spatial planning, brexit and the island of Ireland (Ritchie et al. 2020)	Irish Geography	/	
16	Benthic diversity patterns and predictors: A study case with inferences for conservation (Vassallo et al. 2020)	Marine Pollution Bulletin	/	
17	Zoning of marine protected areas for biodiversity conservation in Bangladesh through socio-spatial data (Sarker et al. 2019)	Ocean and Coastal Management	/	
18	Hydrodynamic controls on connectivity of the high commercial value shrimp Parapenaeus longirostris (*Lucas, 1846*) in the Mediterranean Sea (Quattrocchi et al. 2019)	Scientific Reports	/	
19	Patterns in fish biodiversity associated with temperate reefs on the southeastern US continental shelf (Bacheler et al. 2019)	Marine Biodiversity		/
20	Threats to marine biodiversity in European protected areas (Mazaris et al. 2019)	Science of the Total Environment	/	
21	Mapping fishing activities and suitable fishing grounds using nighttime satellite images and maximum entropy modelling (Geronimo et al. 2018)	Remote Sensing	/	/
22	Ontogenetic partial migration is associated with environmental drivers and influences fisheries interactions in a marine predator (Lea et al. 2018)	ICES Journal of Marine Science	/	
23	Spawning migration movements of Mutton Snapper in Tortugas, Florida: Spatial dynamics within a marine reserve network (Feeley et al. 2018)	Fisheries Research	/	
24	Home range and foraging habitat preference of *Scopoli's* shearwater *Calonectris diomedea* during the early chick-rearing phase in the eastern Mediterranean (Karris et al. 2018)	Wildlife Biology	/	

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25	Human-induced gradients of reef fish declines in the Hawaiian Archipelago viewed through the lens of traditional management boundaries (Friedlander et al. 2018)	Aquatic Conservation: Marine and Freshwater Ecosystems	/
26	Population genetic subdivision of seagrasses, *Syringodium isoetifolium* and *Thalassia hemprichii*, in the Indonesian Archipelago (Wainwright, Arlyza, and Karl 2018)	Botanica Marina	/

Source: Authors (2024)

Result and Finding

Spatial Governance and Management in Fisheries

The governance and management of fisheries resources are critical and complex within defined spatial boundaries. The implementation and impact of spatial fisheries management strategies in the context of MPAs highlighted that the home range of manta rays is within the existing MPA boundaries (Venables et al. 2020). Similarly, identifying the size and location of fisheries-restricted areas is crucial for rebuilding fish stock biomass to achieve sustainable and healthy fish populations (Dimarchopoulou et al. 2024).

The success of spatial governance and management strategies is another significant aspect discussed in the literature. The influence of environmental factors, such as bathymetry and chlorophyll concentrations, on the distribution of core fishing areas has been demonstrated using nighttime satellite imagery to map fishing activities in the Philippines (Geronimo et al. 2018). Additionally, the importance of accounting for oceanic conditions in predicting the movement of predators, such as the tiger shark, must be emphasized (Lea et al. 2018). Local knowledge has been utilized to define the dynamics of spatially located fisheries resources in Baja California Sur, Mexico, which must also be identified (Armenta-Cisneros et al. 2021). Similarly, the involvement of local communities in the Panay Gulf, Philippines, is essential for identifying more effective management reforms. This approach underscores the necessity for spatial management strategies that are responsive to environmental changes and adaptable to dynamic environmental conditions (Nochete and Baleña 2024). The study found that these environmental predictors are crucial for determining the effectiveness of conservation areas, such as shark sanctuaries, suggesting that spatial management must be responsive to environmental changes to maintain its effectiveness. The integration of local knowledge and community involvement is highlighted as a critical factor in enhancing the effectiveness of spatial management strategies in fisheries governance. It relies heavily on the active participation of local stakeholders who provide valuable insights into the specific conditions and needs of their fishing grounds.

In conclusion, the literature underlines the necessity of integrating scientific data, environmental factors, and local knowledge into the spatial management and governance of fisheries. The effectiveness of these strategies depends on their ability to encompass critical habitats, adapt to environmental dynamics, and engage local communities in the decision-making process. The findings across various studies highlight the importance of a holistic approach to spatial management, where conservation efforts are aligned with the ecological and socio-economic realities of the fisheries they aim to protect.

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Environmental Drivers and Species-Specific Behaviour

The theme in fisheries management highlights the critical role that environmental conditions and species-specific behaviours play in shaping the spatial distribution, population structure, and management needs of marine species. The reviewed literature offers valuable insights into how these factors impact fisheries and conservation efforts across diverse marine environments. The foraging behaviour of the Magnificent Frigatebird in Baja California Sur, Mexico, has been explored utilizing GPS tracking to understand how environmental conditions and species-specific behaviour affect foraging area selection. The study found that frigatebirds preferred foraging areas close to their nesting colonies. However, some individuals ventured further, indicating variability in foraging strategies that may be linked to differences in sex and competition. This variability underscores the importance of incorporating behavioural data into MPA planning to ensure conservation efforts align with the spatial needs of different subpopulations. The study emphasizes the need for dynamic and flexible conservation boundaries that reflect the environmental and behavioural factors driving species distribution (Giambalvo et al. 2022).

The environmental and hydrodynamic factors influencing the connectivity of *Parapenaeus longirostris* (a key commercial shrimp species) in the Strait of Sicily have been focused on. The study employed particle-tracking models to assess connectivity between spawning and nursery areas under varying environmental conditions, revealing significant decadal changes in connectivity driven by hydrodynamic regimes (Quattrocchi et al. 2019). The study emphasizes the importance of considering temporal and spatial variations in environmental conditions when designing management plans, as static management boundaries may need to accommodate the dynamic nature of fish resource ecosystems. The connectivity patterns of Red Snapper in the Gulf of Mexico have been investigated. The study's modelling approach demonstrated that most Red Snapper recruitment occurred close to spawning sites. However, there was also significant larval exchange across state boundaries, indicating the importance of integrating environmental and behavioral data into management strategies. It requires interstate cooperation and consideration of the environmental drivers that influence larval dispersal and population connectivity (Vaz et al. 2023). Underwater video data have been used to identify key environmental drivers of fish diversity, including depth, substrate type, and water temperature, in reef fish biodiversity along the southeastern US Atlantic coast. The findings indicated that the highest species richness was in areas with moderate depths and high substrate relief (Bacheler et al. 2019). The study suggests that conservation strategies should focus on preserving habitats that support high biodiversity, as these areas are critical for maintaining the ecological integrity of fish populations.

Studies in the Florida Keys have revealed distinct spatial patterns driven by physiographic and geological features, emphasizing the need to tailor the spatial heterogeneity of benthic habitats to ensure the protection of fish ecosystems. Using habitat mapping to inform conservation boundaries is crucial (Walker et al. 2021). The need for integrated management approaches that account for the complex interactions between ecological, economic, and socio-cultural factors is examined, with a focus on the spatial dynamics and the impact of environmental changes. The integrated management emphasized the importance of considering detailed spatial dynamics in Marine Spatial Planning (MSP) to enhance the resilience of fisheries' Social-Ecological Systems (SES) in the face of environmental and anthropogenic pressures (Bacheler et al. 2024). In conclusion, the reviewed literature underscores the critical importance of considering environmental drivers and species-specific behaviours in the spatial

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management of marine resources. Effective fisheries governance requires dynamic and adaptive management strategies that reflect the complex and often changing relationships between species distribution, environmental conditions, and human activities. The integration of environmental data, behavioural insights, and advanced modelling techniques is essential for developing management plans that ensure the sustainability of marine ecosystems and the species they support.

Technological and Methodological Approaches to Fisheries Research

Recent advancements in technological and methodological approaches to fisheries management practice have significantly enhanced knowledge and understanding of meaningful monitoring and assessment of marine and inland fisheries' spatial boundaries, providing valuable insights into ecological patterns. Statistical approaches to identifying fish populations are one of the key technological innovations in fisheries research. Under changing climate conditions, a study has identified regions with differences in spatial abundance patterns, temporal dynamics, and population demographics and then demonstrated the application of a statistical method to assess population boundaries for the European sprat (*Sprattus sprattus*) (Lindegren et al. 2022). In areas with limited conventional monitoring tools, remote sensing technologies have proven crucial in monitoring fisheries activities. Using nighttime light remote sensing, they have enabled the mapping and monitoring of core fishing areas in coastal light fisheries in the Beibu Gulf. It underscored the growing importance of remote sensing as a tool for combating Illegal, Unreported, and Unregulated (IUU) fishing (Tian et al. 2022).

The Random Forest regression model has been employed to predict marine benthic diversity patterns by analyzing environmental factors, including sediment characteristics, depth, and distance from the coast. This methodological approach highlights the importance of comprehensively capturing areas of high biodiversity for spatial models that consider both biotic and abiotic factors in fisheries conservation planning (Vassallo et al. 2020). A study related to telemetry techniques provides critical data for the spatial management role of tracking the movement and behaviour of marine species. It demonstrates the effectiveness of a multi-scale telemetry approach in the Wadden Sea. The study highlights the significance of understanding migratory behaviour in conservation efforts for open coastal environments, where protected areas may not encompass the entire range of a species' movement (Edwards et al. 2024). Therefore, by aligning research with management strategies and telemetry, informed spatial planning can increase conservation results.

In conclusion, integrating technology with advanced methodologies to understand the spatial boundaries in the fisheries management environment has provided a comprehensive tool to improve fisheries management and conservation strategies. As the field develops, this approach will continue to evolve and become increasingly influential in addressing the complex challenges of environmental change and anthropogenic pressures on fisheries resource ecosystems.

Discussion and Conclusion

The limitation of current spatial management approaches is the need to conserve critical fish habitats for effective resource management within designated areas (Abdullah, Omar, and Yaakob 2016). The literature highlights the impact of research in Mozambique and Greece that prevents overfishing, underscoring the need for more existing MPAs (Bohorquez et al. 2023) to protect and expand protected areas. The success of spatial governance strategies and

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nighttime satellite imagery in the Philippines affects the core fish community's area. Additionally, studies on the movements of marine predators, such as tiger sharks, have emphasized the importance of adapting spatial management to changing oceanic conditions. Research in Mexico and the Philippines has demonstrated the importance of local input in defining the distribution of fisheries resources by incorporating local knowledge and community involvement to enhance the effectiveness of spatial management. Successful spatial management in fisheries governance requires integrating scientific data, environmental factors, and local knowledge to inform effective decision-making. These strategies must protect critical habitats, adapt to environmental changes, and involve local communities in the decision-making process. Therefore, a holistic approach to spatial management is vital to align conservation efforts with ecological and socio-economic realities (Belton et al. 2020).

The theme of "Environmental Drivers and Species-Specific Behaviour" in fisheries management examines how environmental conditions and species behaviours influence the distribution, population structure, and management strategies of marine species. Research on Magnificent Frigatebirds in Baja California Sur revealed that environmental conditions and behaviours influence foraging area selection, highlighting the importance of integrating behavioural data into MPA planning. Studies on commercial species, such as *Parapenaeus longirostris*, in the Strait of Sicily have shown how environmental and hydrodynamic factors affect connectivity between spawning and nursery areas. Understanding these dynamics is essential for sustainable exploitation and interstate cooperation in fisheries management. Conservation efforts should prioritize habitats that support high biodiversity to preserve reef fish populations. Detailed habitat mapping must inform conservation boundaries to protect vulnerable deep-sea ecosystems. Enhanced MSP is crucial for resilient fisheries management.

Recent advancements in fisheries research have played a crucial role in improving the management of spatial boundaries in marine ecosystems. The application of technological tools has enabled more accurate monitoring and assessment of fisheries, yielding valuable insights into ecological patterns and the impact of human activities on these ecosystems. Statistical methods are now being utilized to identify population structures of marine species, complementing genetic studies and helping to address the effects of climate change. These methods are vital for informing spatial management strategies and enhancing sustainable fisheries management practices. Remote sensing technologies, such as nighttime light monitoring, have become essential for tracking fishing activities in regions where traditional monitoring methods are insufficient. By mapping fishing areas and pressures, cross-regional MPAs can be proposed for more effective management. Spatially explicit models have contributed to a deeper understanding of biodiversity, highlighting the need to expand conservation efforts to sedimentary habitats beyond existing MPAs. Telemetry techniques play a critical role in tracking the movements and behaviours of marine species, particularly in coastal environments lacking adequate protected areas. The integration of these advanced approaches in fisheries research has significantly improved our comprehension of marine spatial boundaries, paving the way for more informed management and conservation strategies to address the challenges posed by environmental changes and human activities.

The governance and management practices of fisheries in Malaysia, Brunei, and Indonesia, particularly on Borneo Island, can significantly benefit from the theoretical frameworks provided by the Coral Triangle Initiative (CTI), Community-Based Management (CBM), and the Southeast Asian Fisheries Development Centre (SEAFDEC). These frameworks address

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ecological and socio-economic complexities inherent to the region, providing pathways for sustainable management and conservation of marine resources. The CTI focuses on preserving the rich biodiversity within the Coral Triangle by promoting spatial governance strategies tailored to protect critical marine habitats. The importance of aligning MPAs lies in the migratory patterns of species, such as manta rays, which have been studied to determine how these zones effectively support ecological balance (Venables et al. 2020). Within regions like Borneo, such strategic alignment is crucial for maintaining ecological integrity across national boundaries.

Furthermore, designing fisheries-restricted areas based on fish stock dynamics—a principle crucial for sustainable fisheries management in biodiversity hotspots such as the Coral Triangle—must be emphasized (Dimarchopoulou et al., 2024). CBM integrates local knowledge and stakeholder engagement in decision-making processes, highlighting the role of communities in fisheries governance. Armenta-Cisneros et al. (2021) demonstrated the importance of utilizing local insights to develop effective resource management strategies. This is particularly relevant in Borneo, where communities possess a profound understanding of marine ecosystems. The involvement of local communities, as noted by Nochete and Baleña (2024), ensures that governance strategies are contextually appropriate and enhance local stewardship of marine resources.

SEAFDEC contributes to improving fisheries management by harnessing technological advances and promoting regional cooperation. Studies by Lindegren et al. (2022) and Tian et al. (2022) demonstrated the integration of remote sensing and statistical methods to monitor fishing activities and enforce regulations, which are crucial for managing extensive and diverse marine areas, such as those surrounding Borneo. These technological tools facilitate better data collection and analysis, which is vital for adaptive management practices in the face of environmental and anthropogenic pressures. Additionally, understanding environmental drivers and species-specific behaviors is essential for effective management. Research by Giambalvo et al. (2022) and Quattrocchi et al. (2019) highlighted the importance of flexible management frameworks that respond to dynamic environmental conditions. Such adaptability is vital for the Coral Triangle and Borneo, regions that are highly susceptible to climate variability and ecological changes.

Spatial management and governance are essential for effective marine resource management in fisheries. Current strategies, such as MPAs, often fall short of protecting vital habitats for species conservation. Research indicates that only a small portion of species' habitats are within MPA boundaries, highlighting the need for more comprehensive management approaches. Properly sizing and locating fishing-restricted areas is crucial to avoid compromising conservation goals. Environmental factors, such as bathymetry and chlorophyll concentrations, influence core fishing areas, emphasizing the importance of adaptable management strategies. Local knowledge and community involvement are crucial in enhancing the effectiveness of spatial management. Incorporating behavioural data into MPA planning is crucial for the conservation of marine species. Spatially explicit models and telemetry techniques play a crucial role in tracking the movements of marine species and enhancing biodiversity conservation efforts. Technological advancements provide valuable insights into ecological patterns and the impact of human activities on marine ecosystems, addressing the challenges posed by environmental changes and anthropogenic pressures. In conclusion, the integration of the CTI, CBM, and SEAFDEC frameworks provides a comprehensive approach

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to fisheries governance in Malaysia, Brunei, Indonesia, and the island of Borneo. These frameworks emphasize the incorporation of scientific research, community involvement, and technological advancement to achieve sustainable fisheries management that aligns with both ecological and socio-economic needs.

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Conflicts of Interest
The authors declare that they have no conflicts of interest to report regarding the present study.

References
Abdullah, Nazirah Mohamad, Abdullah Hisam Omar, and Omar Yaakob. 2016. "Today's Problem, Tomorrow's Solutions: Lay Theory Explanations of Marine Space Stakeholder Management in the Malaysian Context." *Marine Policy*. doi: 10.1016/j.marpol.2016.08.004.

Abouzahra, Anas, Ayoub Sabraoui, and Karim Afdel. 2020. "Model Composition in Model Driven Engineering: A Systematic Literature Review." *Information and Software Technology* 125(May):106316. doi: 10.1016/j.infsof.2020.106316.

Armenta-Cisneros, M., M. A. Ojeda-Ruiz, E. A. Marín-Monroy, and A. Flores-Irigoyen. 2021. "Opportunities to Improve Sustainability of a Marine Protected Area: Small-Scale Fishing in Loreto, Baja California Sur, Mexico." *Regional Studies in Marine Science* 45. doi: 10.1016/j.rsma.2021.101852.

Bacheler, N. M., Z. H. Schobernd, K. C. Gregalis, C. M. Schobernd, B. Z. Teer, Z. Gillum, D. M. Glasgow, N. McNeill, M. Burton, R. Munoz, M. Kruse, J. Letschert, R. Cormier, H. Rambo, K. Gee, A. Kannen, J. Schaper, C. Möllmann, and V. Stelzenmüller. 2024. "Operationalizing a Fisheries Social-Ecological System through a Bayesian Belief Network Reveals Hotspots for Its Adaptive Capacity in the Southern North Sea." *Journal of Environmental Management* 49(5):2411–28. doi: 10.1007/s12526-019-00981-9.

Bacheler, Nathan M., Zebulon H. Schobernd, Kevan C. Gregalis, Christina M. Schobernd, Bradford Z. Teer, Zachary Gillum, Dawn M. Glasgow, Neil McNeill, Michael Burton, and Roldan Muñoz. 2019. "Patterns in Fish Biodiversity Associated with Temperate Reefs on the Southeastern US Continental Shelf." *Marine Biodiversity*. doi: 10.1007/s12526-019-00981-9.

Bell, J. B., N. V Nguyên, H. V Viet, M. H. Nguyen, H. T. Bùi, T. V Trâng, P. McIlwaine, A. Kenny, and B. K. Nguyen. 2021. "Identifying Marine Ecological Production Units in Vietnam." *ICES Journal of Marine Science* 78(4):1241–52. doi: 10.1093/icesjms/fsab047.

Belton, Ben, David C. Little, Wenbo Zhang, Peter Edwards, Michael Skladany, and Shakuntala H. Thilsted. 2020. "Farming Fish in the Sea Will Not Nourish the World." *Nature Communications*.

Bohorquez, John J., Anthony Dvarskas, Jennifer Jacquet, U. Rashid Sumaila, Janet A. Nye, and Ellen K. Pikitch. 2023. "A Novel Framework to Evaluate the Financial Sustainability of Marine Protected Areas." *Biological Conservation*. doi: 10.1016/j.biocon.2023.110083.

International Journal of Innovation and Industrial Revolution
IJIREV
EISSN: 2637-0972
Volume 7 Issue 22 (September 2025) PP. 52-68
DOI 10.35631/IJIREV.722004
Dimarchopoulou, D., I. Keramidas, K. Tsagarakis, V. Markantonatou, G. Halouani, and A. C. Tsikliras. 2024. "Spatiotemporal Fishing Effort Simulations and Restriction Scenarios in Thermaikos Gulf, Greece (Northeastern Mediterranean Sea)." *Ocean and Coastal Management* 247. doi: 10.1016/j.ocecoaman.2023.106914.

Edwards, J. E., A. D. Buijse, H. V Winter, A. van Leeuwen, and A. I. Bijleveld. 2024. "A Multi-Scale Tracking Approach for Conserving Large Migratory Fish in an Open Coastal Environment." *ESTUARINE COASTAL AND SHELF SCIENCE* 301. doi: 10.1016/j.ecss.2024.108737.

Fang, C., X. Wang, D. Sun, H. Zhai, D. Zhang, G. Liao, and C. Wang. 2023. "Spatial Distribution and Seasonal Variation of Fish Larvae in the Upper 200 m of the Philippine Sea." *Frontiers in Marine Science* 10. doi: 10.3389/fmars.2023.1110980.

Feeley, M. W., D. Morley, A. Acosta, P. Barbera, J. Hunt, T. Switzer, and M. Burton. 2018. "Spawning Migration Movements of Mutton Snapper in Tortugas, Florida: Spatial Dynamics within a Marine Reserve Network." *Fisheries Research* 204:209–23. doi: 10.1016/j.fishres.2018.02.020.

Friedlander, A. M., M. K. Donovan, K. A. Stamoulis, I. D. Williams, E. K. Brown, E. J. Conklin, E. E. DeMartini, K. S. Rodgers, R. T. Sparks, and W. J. Walsh. 2018. "Human-Induced Gradients of Reef Fish Declines in the Hawaiian Archipelago Viewed through the Lens of Traditional Management Boundaries." *Aquatic Conservation: Marine and Freshwater Ecosystems* 28(1):146–57. doi: 10.1002/aqc.2832.

Geronimo, R. C., E. C. Franklin, R. E. Brainard, C. D. Elvidge, M. D. Santos, R. Venegas, and C. Mora. 2018. "Mapping Fishing Activities and Suitable Fishing Grounds Using Nighttime Satellite Images and Maximum Entropy Modelling." *Remote Sensing* 10(10). doi: 10.3390/rs10101604.

Giambalvo, G., Y. V Albores-Barajas, C. Soldatini, M. P. R. Hernandez, and N. C. Rattenborg. 2022. "Environmental Drivers of Sex-Biased Foraging Behavior in Magnificent Frigatebird in Baja California Sur, Mexico." *Avian Conservation and Ecology* 17(2). doi: 10.5751/ACE-02202-170225.

Haddaway, N. R., Macura, B., Whaley, P., & Pullin, A. S. 2018. "ROSES RepOrting Standards for Systematic Evidence Syntheses: Pro Forma, Flow-Diagram and Descriptive Summary of the Plan and Conduct of Environmental Systematic Reviews and Systematic Maps." *Environmental Evidence* 7:1–8.

Hardesty-Moore, Molly, Stefanie Deinet, Robin Freeman, Georgia C. Titcomb, Erin M. Dillon, Keenan Stears, Maggie Klope, An Bui, Devyn Orr, Hillary S. Young, Ana Miller Ter Kuile, Lacey F. Hughey, and Douglas J. McCauley. 2018. "Migration in the Anthropocene: How Collective Navigation, Environmental System and Taxonomy Shape the Vulnerability of Migratory Species." *Philosophical Transactions of the Royal Society B: Biological Sciences*. doi: 10.1098/rstb.2017.0017.

Karris, G., S. Xirouchakis, I. Maina, K. Grivas, and S. Kavadas. 2018. "Home Range and Foraging Habitat Preference of Scopoli's Shearwater Calonectris Diomedea during the Early Chick-Rearing Phase in the Eastern Mediterranean." *Wildlife Biology* 2018. doi: 10.2981/wlb.00388.

Khuu, Duong T., Peter J. S. Jones, and Paul Ekins. 2023. "Development of Marine Protected Areas (MPAs) in Vietnam from a Coevolutionary Governance Perspective: Challenges of Unholy Alliances between the State, Businesses and NGOs." *Environmental Science and Policy*. doi: 10.1016/j.envsci.2023.103560.

Lea, J. S. E., B. M. Wetherbee, L. L. Sousa, C. Aming, N. Burnie, N. E. Humphries, N. Queiroz, G. M. Harvey, D. W. Sims, and M. S. Shivji. 2018. "Ontogenetic Partial Migration Is

International Journal of Innovation and Industrial Revolution
IJIREV
EISSN: 2637-0972
Volume 7 Issue 22 (September 2025) PP. 52-68
DOI 10.35631/IJIREV.722004

Associated with Environmental Drivers and Influences Fisheries Interactions in a Marine Predator." *ICES Journal of Marine Science* 75(4):1383–92. doi: 10.1093/icesjms/fsx238.

Lewison, Rebecca L., Andrew F. Johnson, and Gregory M. Verutes. 2018. "Embracing Complexity and Complexity-Awareness in Marine Megafauna Conservation and Research." *Frontiers in Marine Science*. doi: 10.3389/fmars.2018.00207.

Linares-Espinós, E., Hernández, V., Domínguez-Escrig, J. L., Fernández-Pello, S., Hevia, V., Mayor, J., ... & Ribal, M. J. 2018. "Methodology of a Systematic Review." *Actas Urológicas Españolas (English Edition)* 42(8):499–506.

Lindegren, M., M. Van Deurs, A. Maureaud, J. T. Thorson, and D. Bekkevold. 2022. "A Spatial Statistical Approach for Identifying Population Structuring of Marine Fish Species: European Sprat as a Case Study." *ICES Journal of Marine Science* 79(2):423–34. doi: 10.1093/icesjms/fsac007.

Liu, Owen R., and Renato Molina. 2021. "The Persistent Transboundary Problem in Marine Natural Resource Management." *Frontiers in Marine Science*. doi: 10.3389/fmars.2021.656023.

Lockwood, C., Munn, Z., & Porritt, K. 2015. "Qualitative Research Synthesis Methodological Guidance for Systematic Reviewers Utilizing Meta-Aggregation." *JBI Evidence Implementation* 13(3):179–87.

Luo, Guoqiang, and Zhixin Chi. 2023. "Conflicts and Challenges of Sustainable Fisheries Governance Cooperation under the Securitization of the Maritime Commons." *Fishes*. doi: 10.3390/fishes8010001.

Mazaris, A. D., A. Kallimanis, E. Gissi, C. Pipitone, R. Danovaro, J. Claudet, G. Rilov, F. Badalamenti, V. Stelzenmüller, L. Thiault, L. Benedetti-Cecchi, P. Goriup, S. Katsanevakis, and S. Fraschetti. 2019. "Threats to Marine Biodiversity in European Protected Areas." *Science of the Total Environment* 677:418–26. doi: 10.1016/j.scitotenv.2019.04.333.

Mohamed Shaffril, Hayrol Azril, Samsul Farid Samsuddin, and Asnarulkhadi Abu Samah. 2021. "The ABC of Systematic Literature Review: The Basic Methodological Guidance for Beginners." *Quality and Quantity* 55(4):1319–46. doi: 10.1007/s11135-020-01059-6.

Nochete, C. B., and R. B. Baleña. 2024. "The Spatio-Temporal Distribution of Small-Scale Fisheries along the Northern Panay Gulf, Philippines: Implications for Management." *Fisheries Research* 272. doi: 10.1016/j.fishres.2023.106935.

Quattrocchi, G., M. Sinerchia, F. Colloca, F. Fiorentino, G. Garofalo, and A. Cucco. 2019. "Hydrodynamic Controls on Connectivity of the High Commercial Value Shrimp Parapenaeus Longirostris (Lucas, 1846) in the Mediterranean Sea." *Scientific Reports* 9(1). doi: 10.1038/s41598-019-53245-8.

Ritchie, H., W. Flannery, A. M. O'hagan, S. Twomey, and C. O'mahony. 2020. "Marine Spatial Planning, Brexit and the Island of Ireland." *Irish Geography* 52(2):213–33. doi: 10.2014/igj.v52i2.1402.

Romagnoni, Giovanni, Steven Mackinson, Jiang Hong, and Anne Maria Eikeset. 2015. "The Ecospace Model Applied to the North Sea: Evaluating Spatial Predictions with Fish Biomass and Fishing Effort Data." *Ecological Modelling*. doi: 10.1016/j.ecolmodel.2014.12.016.

Dos Santos, J. B. Q., C. M. Chiessi, S. Crivellari, J. E. D. Vasconcelos Filho, N. S. Pereira, M. O. Freitas, and B. P. Ferreira. 2022. "Identification of Western South Atlantic Stocks

International Journal of Innovation and Industrial Revolution
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EISSN: 2637-0972
Volume 7 Issue 22 (September 2025) PP. 52-68
DOI 10.35631/IJIREV.722004

of the Lane Snapper (Lutjanus Synagris) from an Otolith Based Multi-Proxy Approach." *Fisheries Research* 253. doi: 10.1016/j.fishres.2022.106356.

Sarker, S., M. M. Rahman, A. K. Yadav, and M. M. Islam. 2019. "Zoning of Marine Protected Areas for Biodiversity Conservation in Bangladesh through Socio-Spatial Data." *Ocean and Coastal Management* 173:114–22. doi: 10.1016/j.ocecoaman.2019.03.002.

Schuch, Esther, Silke Gabbert, and Andries P. Richter. 2021. "Institutional Inertia in European Fisheries – Insights from the Atlantic Horse Mackerel Case." *Marine Policy*. doi: 10.1016/j.marpol.2021.104464.

Song, Andrew M., Joeri Scholtens, Johny Stephen, Maarten Bavinck, and Ratana Chuenpagdee. 2017. "Transboundary Research in Fisheries." *Marine Policy*. doi: 10.1016/j.marpol.2016.10.023.

Tian, H., Y. Liu, Y. Tian, Y. Jing, S. Liu, X. Liu, and Y. Zhang. 2022. "Advances in the Use of Nighttime Light Data to Monitor and Assess Coastal Fisheries under the Impacts of Human Activities and Climate and Environmental Changes: A Case Study in the Beibu Gulf." *Marine Policy* 144. doi: 10.1016/j.marpol.2022.105227.

Vassallo, P., C. Paoli, S. Aliani, S. Cocito, C. Morri, and C. N. Bianchi. 2020. "Benthic Diversity Patterns and Predictors: A Study Case with Inferences for Conservation." *Marine Pollution Bulletin* 150. doi: 10.1016/j.marpolbul.2019.110748.

Vaz, A. C., M. Karnauskas, M. Smith, L. S. Denson, C. B. Paris, M. Le Hénaff, and K. Siegfried. 2023. "Red Snapper Connectivity in the Gulf of Mexico." *Marine and Coastal Fisheries* 15(6). doi: 10.1002/mcf2.10275.

Venables, S. K., D. I. van Duinkerken, C. A. Rohner, and A. D. Marshall. 2020. "Habitat Use and Movement Patterns of Reef Manta Rays Mobula Alfredi in Southern Mozambique." *Marine Ecology Progress Series* 634:99–114. doi: 10.3354/meps13178.

Wainwright, B. J., I. S. Arlyza, and S. A. Karl. 2018. "Population Genetic Subdivision of Seagrasses, Syringodium Isoetifolium and Thalassia Hemprichii, in the Indonesian Archipelago." *Botanica Marina* 61(3):235–45. doi: 10.1515/bot-2017-0058.

Walker, B. K., C. Messing, J. Ash, S. Brooke, J. K. Reed, and S. Farrington. 2021. "Regionalization of Benthic Hard-Bottom Communities across the Pourtalès Terrace, Florida." *Deep-Sea Research Part I: Oceanographic Research Papers* 172. doi: 10.1016/j.dsr.2021.103514.