earth

MDPI

Review

Research Trends Concerning the Danube Delta: A Specific Social-Ecological System Facing Climate Uncertainty

Mircea-Iosif Rus [1], Ionela Munteanu [2], Natașa Vaidianu [3] and Kamer-Ainur Aivaz [2,*]

[1] National Institute for Research-Development in Construction, Urbanism and Sustainable Territorial Development "URBAN INCERC", 117 Calea Floresti, 400524 Cluj-Napoca, Romania; mircearus2005@yahoo.com
[2] Faculty of Economic Sciences, Ovidius University of Constanta, Aleea Universitatii no.1, 900470 Constanta, Romania; ionela.munteanu@cig.ase.ro
[3] Faculty of Natural Sciences and Agricultural Sciences, Ovidius University of Constanta, 900527 Constanta, Romania; natasa.vaidianu@geo.unibuc.ro
* Correspondence: kamer.aivaz@365.univ-ovidius.ro

Abstract: This study seeks to examine the development of scientific literature concerning the Danube Delta, an exceptional ecosystem characterized by its rich biodiversity, which is facing challenges from both climate change and human activities. It aims to identify significant trends in research publications from 1862 to 2023. The methodology employed involves a thorough bibliometric examination of articles catalogued in the Scopus database, utilizing specific criteria to ensure the direct applicability of the research to the Danube Delta. The analysis centers on factors such as publication frequency, citation rates, as well as collaborations among institutions and across international borders, thus shedding light on the scientific contributions and their practical implications in protecting the region's unique ecosystem. The research findings indicate a notable surge in scholarly interest in the Danube Delta, particularly amidst growing global concerns regarding climate change. Furthermore, it is observed that highly cited studies often address issues related to habitat preservation, human impacts, and strategies for adapting to changing environmental conditions. The significance of international collaboration emerges as a crucial aspect in enhancing the caliber and relevance of research, underscoring the necessity for a coordinated global endeavor to study and safeguard this vital ecosystem. The research emphasizes the necessity of adopting a comprehensive and interdisciplinary methodology in studying the Danube Delta, offering insights for crafting conservation policies that address both local and global environmental concerns. Its findings offer a robust framework for steering future research endeavors and conservation initiatives, underscoring the crucial significance of international scientific cooperation in sustainably managing biodiversity amidst climate change challenges. While the study offers valuable insights, it is essential to acknowledge certain limitations, like underrepresentation of non-English language studies and methodological or modeling limitations. By acknowledging these limitations and exploring the suggested research avenues, future studies can further enhance our comprehension and management of the Danube Delta within the context of prevailing and forthcoming global challenges.

Keywords: climate uncertainty; biodiversity conservation; Danube Delta; bibliometric review; economic assessments; delta ecosystem

Academic Editor: Daniela Baldantoni

Received: 9 December 2024
Revised: 27 January 2025
Accepted: 28 January 2025
Published: 31 January 2025

Citation: Rus, M.-I.; Munteanu, I.; Vaidianu, N.; Aivaz, K.-A. Research Trends Concerning the Danube Delta: A Specific Social-Ecological System Facing Climate Uncertainty. *Earth* **2025**, *6*, 7. https://doi.org/10.3390/earth6010007

1. Introduction

The Danube Delta (Figure 1), renowned as one of Europe's most varied and dynamic ecosystems, faces mounting anthropogenic and natural challenges that jeopardize both

its biodiversity and ecological equilibrium [1]. This research endeavors to investigate the evolving landscape of scientific inquiry concerning the Danube Delta, emphasizing its significance and applicability amidst the backdrop of worldwide climate shifts and the imperative for biodiversity preservation. In this regard, it becomes crucial to discern the progression of scientific understanding regarding this distinct habitat and identify research avenues conducive to devising efficient management and conservation strategies [2].

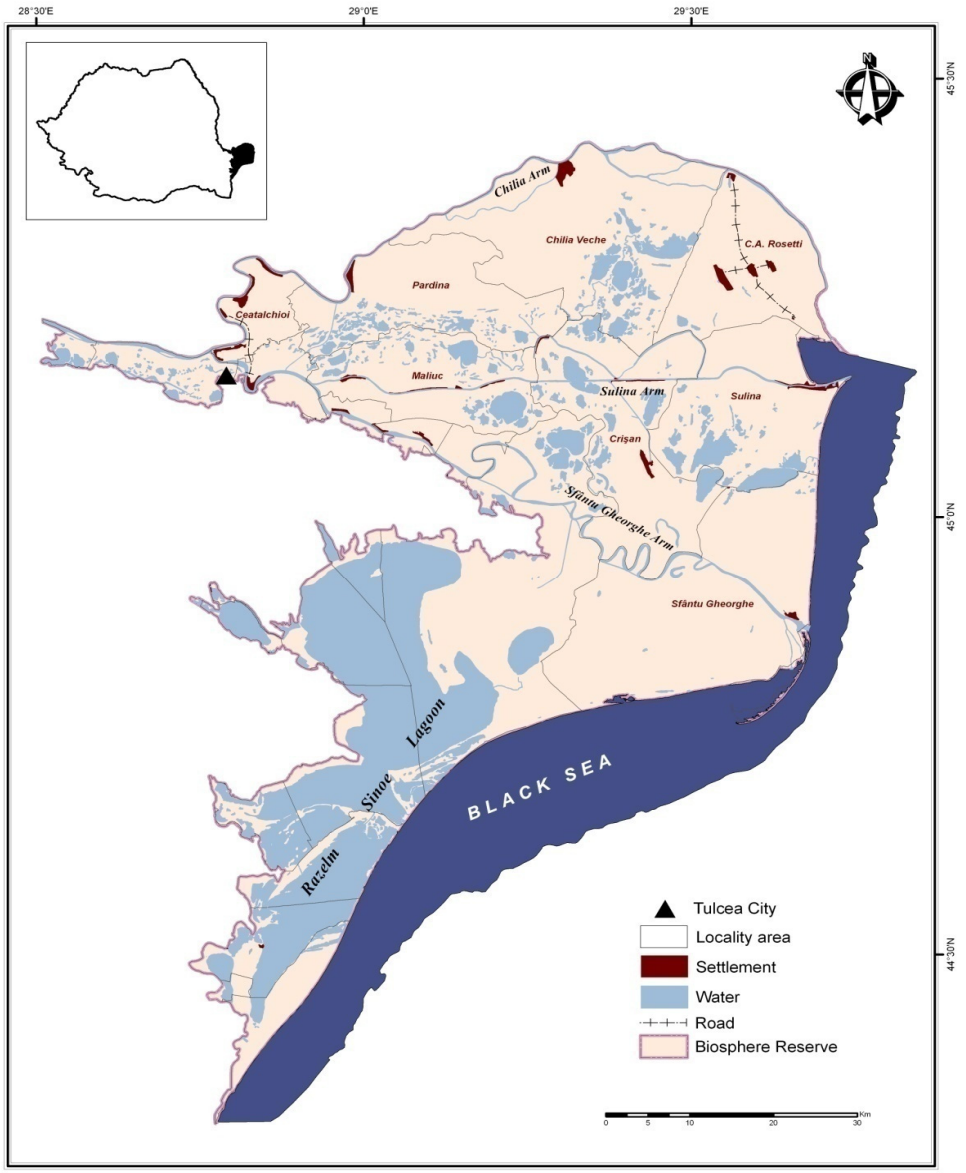

Figure 1. Danube Delta map.

The primary goal of this study is to evaluate the quantity and significance of scientific endeavors focused on the Danube Delta, aiming to identify significant patterns in research and underscore the most influential contributions within research. To achieve this, the analysis aims to track the progression of publications related to the Danube Delta throughout different time periods; investigate the influence of these studies and ascertain their scientific and practical importance; investigate the treatment of climate change and biodiversity conservation within the literature; identify the principal academic outlets and notable authors in this domain; and evaluate the role of international collaboration in fostering effective research endeavors within the region.

To accomplish the outlined objectives we employed a bibliometric approach, utilizing data from the Scopus database. The selection criteria encompassed articles containing the term "Danube Delta" in their title, abstract, or keywords, spanning the period from 1862 to 2023. Our analysis delved into the annual distribution of publications, assessed citation metrics to gauge the impact of the papers, and scrutinized inter-institutional and international collaborations evidenced through co-authorship.

Additionally, we utilized specialized software for co-citation network analysis and scientific mapping to discern and visually represent relationships among various research domains, representative authors, and institutions [3]. This methodological approach facilitated not only a quantitative examination of publications but also a qualitative comprehension of thematic evolution and the influence of studies on conservation and management policies in the Danube Delta.

The study's outcomes offer a comprehensive view of how scientific inquiry has adjusted to and addressed the ecological and climatic challenges facing the Danube Delta. Moreover, it aids in recognizing deficiencies in the current literature and proposing avenues for future research and public policy. By enhancing comprehension of the interplay between academic research and conservation policy enactment, the study fosters the development of more efficient and sustainable strategies for safeguarding this crucial ecosystem. Consequently, the research strives to contribute to the enhancement of scientific literature and to bring valuable insights to policymakers, researchers, and conservation practitioners.

2. Literature Review

The literature review in this study begins by delving into the influences of climate change, international collaboration, and economic strategies on the Danube Delta ecosystem. This section explores four research hypotheses by evaluating the existing literature, striving to find and integrate pertinent studies addressing the repercussions of climate change on extreme weather events and their impacts on biodiversity and ecosystem functionality within the Delta (Figure 2). Additionally, it examines the efficacy of adaptive management in biodiversity conservation and the significance of international collaborations in amplifying conservation efforts, elucidating how robust economic assessments can bolster financial viability and local advancement by valuing ecosystem services. Through this multifaceted approach, our aim is to furnish a comprehensive outlook on current and future strategies of effective management in one of Europe's most intricate and fragile aquatic ecosystems.

Hypothesis 1: *The impact of climate change is significantly altering the occurrence and severity of extreme weather events in the Danube Delta, potentially inducing rapid transformations in the structure and functionality of indigenous ecosystems.*

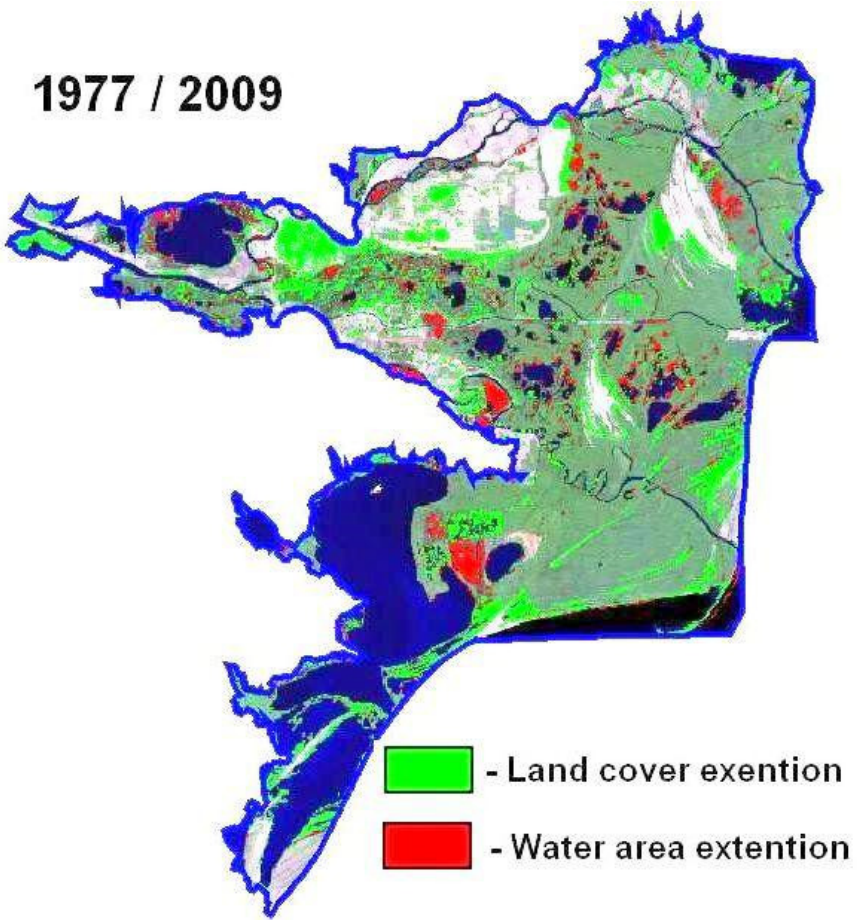

Figure 2. Land cover change detection in the Danube Delta (Starodubtsev, [4]).

Within the context of global climate change, the Danube Delta, recognized for its exceptional ecological significance, is confronted by substantial challenges that affect both biodiversity and socio-economic sustainability within the region [5]. Directly influenced by climate change, occurrences of extreme weather events like floods, droughts, and severe storms are escalating in frequency and intensity, as observed by researchers [6]. These developments bear profound implications for the ecosystems of the Danube Delta, thus warranting a thorough examination, as stipulated in Hypothesis 1. In recent years, the well-being of the people and wildlife living in the region has been increasingly threatened by climate change. To reduce the risks of climate change and to protect the Danube Delta and those who depend on it, the three countries sharing the Danube Delta (Romania, Moldova, and Ukraine) have endorsed the Danube Delta Climate Change Adaptation Strategy (CCAS).

Hypothesis 2: *Adaptive management strategies incorporating predictive modeling of long-term climate shifts positively influence biodiversity conservation efforts within the Danube Delta.*

Biodiversity conservation presents a multifaceted challenge, particularly in regions like the Danube Delta with intricate and diverse ecosystems. Renowned as one of Europe's most biodiverse areas, the Danube Delta harbors a remarkable array of plant and animal species, including numerous endemics and endangered species [7]. Against the backdrop of ongoing climate change, the adoption of adaptive management strategies grounded in predictive modeling becomes imperative for safeguarding and preserving this exceptional natural legacy [8]. The Danube Delta is a fragile region, characterized by several restrictive features, of which its physical restrictions (relief, hydrography) make many human activities

difficult, while human activities, locally and upstream, have modified and affected wetland ecosystems [9].

Utilizing predictive modeling of climate change empowers researchers and policymakers to foresee the potential impacts of climatic variability on ecosystems within the Danube Delta. These projections encompass scenarios such as escalating water levels, shifts in precipitation patterns, and heightened frequency of extreme events like droughts and floods, all of which directly influence habitats [10]. By incorporating such modeling into management blueprints, strategies can be devised to not only address immediate challenges but also anticipate forthcoming conditions, thereby optimizing conservation measures for sustained efficacy over the long term [11,12].

Hypothesis 3: *The extent of international collaboration in research pertaining to the Danube Delta correlates directly with the efficacy of biodiversity conservation initiatives amid climate uncertainty.*

The Danube Delta, known as one of Europe's most prized ecosystems, is confronted by significant hurdles amid the backdrop of climate change. These challenges transcend national boundaries and necessitate a unified and cooperative approach to biodiversity conservation.

The Danube Delta sits at the confluence of the Danube River and the Black Sea, forming a dazzling natural treasure and one of the most vibrant wetlands in Europe. Covering more than 4000 km^2, it is a living maze of rivers, lakes, marshes, mangrove forests, and reedbeds, home to an astonishing diversity of wildlife. Over 300 bird species, along with countless rare plants and animals, make their home in this dynamic ecosystem. Situated between temperate and subtropical climates, the Danube Delta serves as an essential resting place for migratory birds, making it globally important for biodiversity. However, this delicate balance is seriously threatened by climate change, with its future jeopardized by rising sea levels, changing water flows, pollution, threat of war, and habitat loss. Since its designation as a UNESCO World Heritage Site in 1991, the Danube Delta has gained global recognition, underlining the importance of transboundary collaboration to protect its unique ecosystems.

Engaging in international collaboration in scientific research yields multiple benefits, like the exchange of knowledge, expertise, and resources, which are pivotal in tackling the intricate issues posed by climate change [13]. The Danube Delta is part of several international environmental agreements, including the Ramsar Convention on Wetlands, which it joined in 1991, and the Convention on Biological Diversity (CBD). These frameworks are vital for ensuring the protection and sustainable management of the Danube Delta's rich biodiversity. Participation in such conventions enables the adoption of best practices from diverse cultural and scientific communities, combining traditional knowledge with cutting-edge scientific innovation. These agreements promote collaboration between countries and experts, encouraging the exchange of ideas and techniques on topics such as habitat restoration, sustainable fisheries, and climate resilience, promoting innovative approaches to environmental management [14].

Hypothesis 4: *The enactment of conservation policies grounded in comprehensive economic assessments within the Danube Delta enhances the financial viability of protective measures, thereby fostering local economic development through the valuation of ecosystem services.*

The Danube Delta, renowned for its remarkable biodiversity and serving as a critical habitat for numerous plant and animal species, exemplifies how well-managed natural ecosystems can yield substantial benefits to the local economy. Hypothesis 4 underscores the significance of incorporating economic assessments into conservation policies, positing

that this approach will not only enhance the financial efficacy of protective measures but also stimulate the local economy through the sustainable utilization of ecosystem services [15].

Robust economic evaluations facilitate the identification and quantification of ecosystem benefits, encompassing functions such as water purification, flood mitigation, carbon sequestration, and ecotourism [16]. By grasping the value of these services, decision-makers can allocate resources in a manner that maximizes the economic advantages of conservation. For instance, preserving wetlands in the Delta can curtail water treatment expenses in downstream urban centers and mitigate economic losses stemming from flooding.

Effective execution of conservation policies grounded in economic assessments necessitates collaboration among economists, ecologists, and policymakers [17]. This interdisciplinary approach holds the potential to engender strategies that harmonize biodiversity conservation with economic advancement. For instance, the establishment of nature parks or reserves can draw tourists, serving as significant revenue streams for local communities while concurrently fostering the preservation of natural habitats [18].

Examples from various regions across the globe demonstrate that protected areas can yield significant economic advantages [19]. In the Danube Delta, effectively managed ecotourism initiatives have demonstrated that biodiversity conservation can be economically viable. Visitors are drawn to the opportunity to observe rare bird species and pristine natural landscapes, generating revenue that supports both conservation efforts and local development [20]. However, such activities require careful planning and oversight to prevent harm to the ecosystem.

One of the primary benefits of integrating economic evaluations into conservation policies is to enhance the financial viability of these measures. By assigning value to ecosystem services in a manner that respects nature's ability to regenerate, sustainable revenue streams can be established. For instance, sustainable fisheries management can ensure the protection of species while also providing a steady income for fishermen [21].

Based on the above literature description, implementing conservation policies grounded in thorough economic assessments is imperative for ensuring the Danube Delta's effective and sustainable protection. This approach not only bolsters the financial viability of protective measures but also fosters local economic advancement by responsibly valuing ecosystem services. Consequently, the Danube Delta can emerge as a successful example of aligning conservation with economic development, showcasing that nature and the economy can flourish in tandem.

Significant changes in the governance of the Danube Delta include the introduction of European Commission regulations for the Danube in the 19th century following the authorization of the Danube River Commission after the signing of the Treaty of Paris in 1856, communist development initiatives in the mid-20th century, and conservation management led by the Danube Delta Biosphere Reserve Administration toward the end of the 20th century after the fall of the communist regime. The 1993 declaration of the Danube Delta as a biosphere reserve introduced new legal restrictions aimed at protecting its ecological integrity. Each major governance shift represents a response to different external pressures or internal priorities, whether they were related to economic development, political ideologies, or the need for environmental preservation.

3. Methodology

To conduct bibliometric research, the methodological approach is essential to ensure the selection of relevant academic literature. To investigate the objective of our research, a clear and precise search string was formulated. Our bibliometric sample sought to include all relevant documents containing both "Danube" and "Delta" in their title, abstract, or

keywords, refining the search to materials directly pertinent to the Danube Delta. We conducted our analysis on the research string "Danube" AND "Delta" in October 2024. Our search first obtained 1126 results matching our initial criteria. Afterward, we adjusted the publication timeframe by excluding the year 2024 from our dataset to prevent ongoing publications from influencing our analysis. The selected period, ranging from 1862 to 2023, was chosen to cover a wide spectrum of historical and modern literature, offering a thorough understanding of scholarly discussions over the years. Language criteria were then applied, with a focus on English-language publications (1042 out of 1126), ensuring accessibility and comprehensibility for researchers. Moreover, specific document types, such as articles and conference papers, were selected (943 out of 1042), targeting peer-reviewed publications recognized for their academic rigor and relevance. We excluded publications prior to 1980 from our analysis considering that our main source of literature was the Scopus platform, and the inclusion of earlier periods could have led to the omission of important manuscripts such as museum monographs or other manuscripts that focused on species occurrences, descriptions, or natural history.

The retrieved results were carefully evaluated to ensure alignment with the established criteria. Preprints and reviews were also excluded from our sample, leading to a pertinent sample comprising 917 manuscripts, obtained from 420 reputable sources indexed in Scopus, involving 2667 authors. The quality selection criteria encompassed factors such as journal impact factor, citation count, and the alignment of the studies with the research scope, ensuring that the final dataset of 917 manuscripts provided a comprehensive and credible representation of scientific contributions to the understanding and management of the Danube Delta. This evaluation process, while narrowing down the initial pool of documents, prioritized relevance and scholarly quality. Subsequently, data extraction ensued capturing essential bibliographic details from the selected documents, including authors, publication years, journals or conference titles, abstracts, keywords, and citation counts. Employing bibliometric techniques such as citation analysis and co-citation analysis, the extracted data were thoroughly analyzed to discern patterns, trends, and relationships within the literature.

4. Results and Discussion

4.1. Quantitative Evaluation of Sample Data

Figure 3 presents the number of articles published each year alongside the mean total citations per article. Notably, the publication output fluctuated over the years, with sporadic peaks observed. For instance, there was a single article published in 1862, followed by a period of no publications until 1916, when another article was published, with a notably high citation count of 24. Throughout the early to mid-20th century, publication frequency remained low, with intermittent spikes in certain years, such as 1940, 1968, and 1972, where one or more articles were published. However, from the 1980s onward, there was a noticeable increase in both publication frequency and citation rates, with fluctuations observed in some years, while others saw a steady rise in output. Overall, the data provides insight into the evolving trends in publication output and citation impact over a span of more than a century, highlighting periods of significant scholarly activity and influence.

Research on the Danube Delta benefits significantly from a diverse array of academic sources, each contributing unique perspectives and insights into the complex ecosystem of this vital region. The most relevant sources, based on the frequency of articles, encompass a broad spectrum of disciplines crucial for understanding and managing the Danube Delta's ecology and resources (Figure 4).

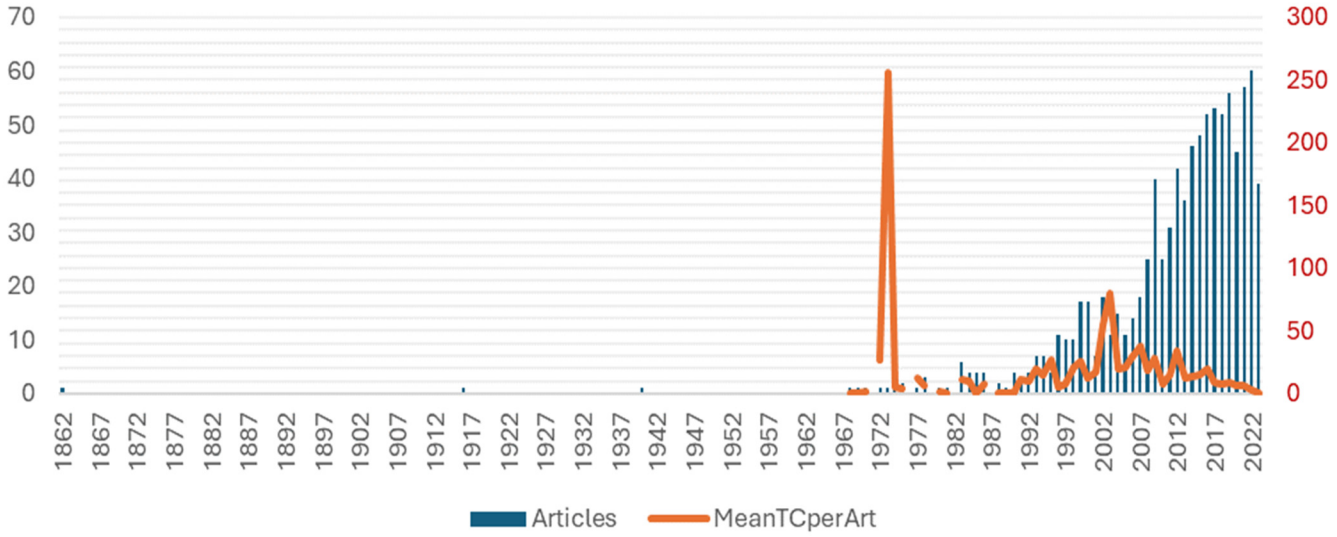

Figure 3. Evolution of scientific productivity and citations of research related to the Danube Delta.

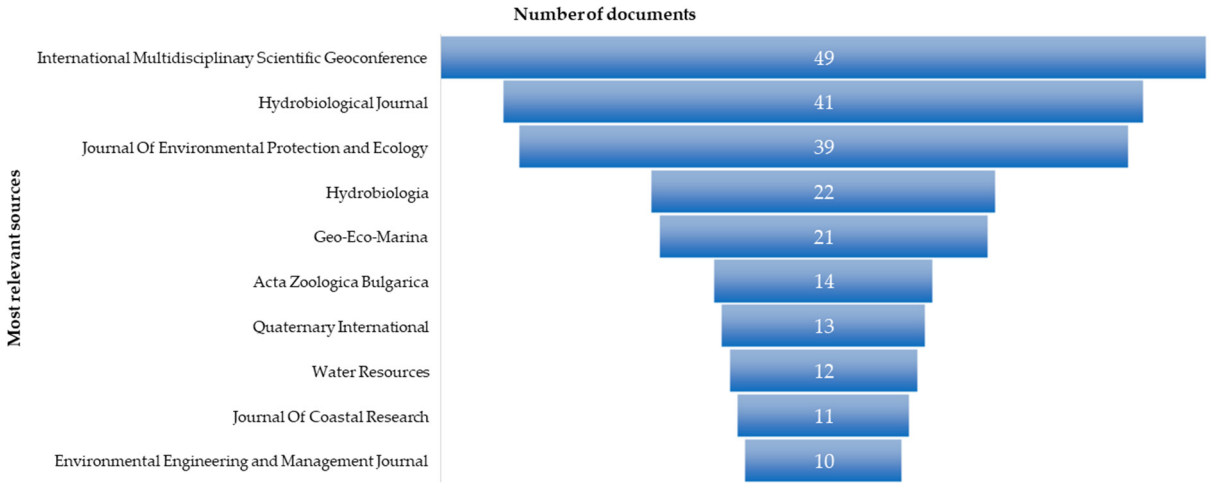

Figure 4. The most relevant sources, based on the frequency of articles.

Our analysis identified the *International Multidisciplinary Scientific Geoconference Surveying Geology* and *Mining Ecology Management* (SGEM) as the most relevant source leading the list, offering a multidimensional approach to the Danube Delta's geological, ecological, and management challenges. Following closely are journals such as the *Hydrobiological Journal* and the *Journal of Environmental Protection and Ecology*, emphasizing the importance of hydrobiology and environmental protection, respectively. Additionally, *Hydrobiologia* provides in-depth insights into freshwater ecosystems, while *Acta Zoologica Bulgarica* offers specific focus on the Danube Delta's fauna. These sources collectively form a robust foundation for research, guiding conservation efforts and sustainable development initiatives crucial for the preservation of the Danube Delta's ecological integrity.

When assessing the local impact of academic sources in the context of the Danube Delta, the H-index serves as a useful metric to gauge their influence within the research community [22]. Notably, journals like *Hydrobiologia*, *Estuarine*, and *Coastal and Shelf Science* demonstrate relatively higher H-index values, indicating a stronger local impact on research output and citation frequency. In examining the most relevant authors in Danube Delta research, several individuals emerge as key contributors to the field. Authors such as Tudor M. and Vespremeanu-Stroe A. stand out with 24 articles each, showcasing their significant research output and influence. Meanwhile, authors like Catianis I., Lyashenko A.V., and Giosan L. demonstrate notable fractionalized article counts, indicating their consistent and

impactful contributions relative to their total output. These authors likely play pivotal roles in advancing understanding across various aspects of Danube Delta research, from ecology and hydrology to environmental management and conservation. Their collective expertise enriches the scholarly discourse and informs efforts aimed at safeguarding the ecological integrity of this vital ecosystem.

Over the years, the authors have contributed significantly to the research on the Danube Delta, covering a broad spectrum of topics ranging from paleoecology to contemporary ecological assessments (Figure 5). Tudor Marian, PhD in environmental sciences, researcher, and general director at the "Danube Delta" National Institute for Research and Development, dedicated over 20 years to the research of various aspects specific to the Danube Delta, including flood risk analysis, tourism impact modeling, and water quality assessment, offering valuable insights for sustainable development planning and environmental management. Professor Vespremeanu-Stroe also contributed significantly to the research on the Danube Delta, focusing extensively on the paleoenvironmental evolution of the Danube Delta, exploring themes such as landscape evolution, coastal dynamics, and human-environment interactions throughout history. Their collective efforts have enriched our understanding of the complex dynamics within this unique ecosystem, addressing both contemporary challenges and historical contexts.

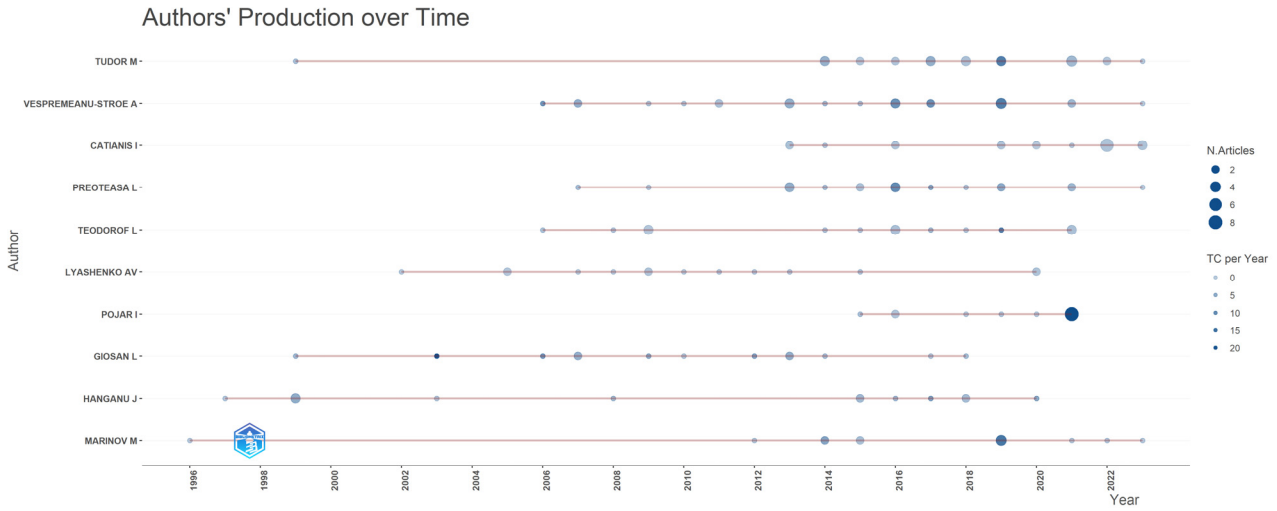

Figure 5. Authors' productivity over time.

Figure 5 provides a comprehensive overview of the authors' scholarly output, revealing intriguing trends in both article publication and total citations (TC) over the years. The brown lines visually depict the period of research dedicated by each author to the study of the Danube Delta's ecosystem and biodiversity, while the blue points reflect citation counts and the number of articles written per period. Initially, the number of articles published annually by the authors appears to steadily increase from 2010 to 2016, reflecting their growing research productivity. This upward trajectory in publication output suggests a period of prolific academic engagement, potentially fueled by expanding research interests or enhanced collaboration opportunities. Correspondingly, the total citations (TC) accrued by their work exhibit a similar upward trend during this period, indicating a growing impact within their respective fields. However, from 2017 onward, the rate of article production appears to plateau, suggesting a potential stabilization or shift in research focus. Interestingly, despite this plateau, the total citations (TC) continue to rise, indicating a sustained influence and ongoing relevance of their earlier contributions within scholarly discourse. The most productive authors identified according to our research data are mostly from Romania, likely to sharing common interests in delta conservation.

However, collaboration between authors transcends Romanian borders, also involving research collaborations with international researchers, as suggested in Figure 5.

The most relevant affiliations concerning Danube Delta research are primarily clustered around academic institutions and research centers located within Romania, particularly the University of Bucharest and the Danube Delta National Institute for Research and Development. The Danube Delta National Institute for Research and Development was founded in 1970 with the main objective to carry out fundamental and applied research for the scientific support of the management of the Danube Delta Biosphere Reserve. Its work focuses particularly on biodiversity conservation and sustainable resource use. Collaboration between the institute, academic institutions, and local governance has aimed to align socio-economic interests with the principles of conserving natural capital. Romanian research institutes, such as the Institute of Hydrobiology, Institute of Geography, and National Institute of Marine Geology and Geo-ecology (GEOECOMAR), as well as local universities, demonstrate a strong commitment to studying and understanding the ecological, hydrological, and environmental dynamics of the Danube Delta region. Their substantial contributions suggest a deep engagement in research activities ranging from ecological studies to environmental conservation efforts within this unique and ecologically significant region.

The analysis of corresponding authors' countries in the context of Danube Delta research reveals a notable dominance of Romanian authors, with a substantial majority of the articles originating from Romania (Figure 6). This dominance underscores Romania's pivotal role in studying and understanding the ecological dynamics of the Danube Delta, given its geographical proximity and vested interest in preserving this unique ecosystem. Furthermore, while Germany, the Ukraine, and the USA also contribute significantly to the literature, their contributions, when compared to Romania's, appear comparatively modest. However, it is worth noting the high MCP ratio for the USA and the Netherlands, indicating a relatively high level of collaboration among authors from these countries, potentially reflecting international interest and cooperation in Danube Delta research. Our analysis highlights the importance of international collaboration in addressing the complex challenges facing the Danube Delta and underscores the need for continued cooperation among researchers from various countries to ensure effective conservation and management strategies for this invaluable natural resource.

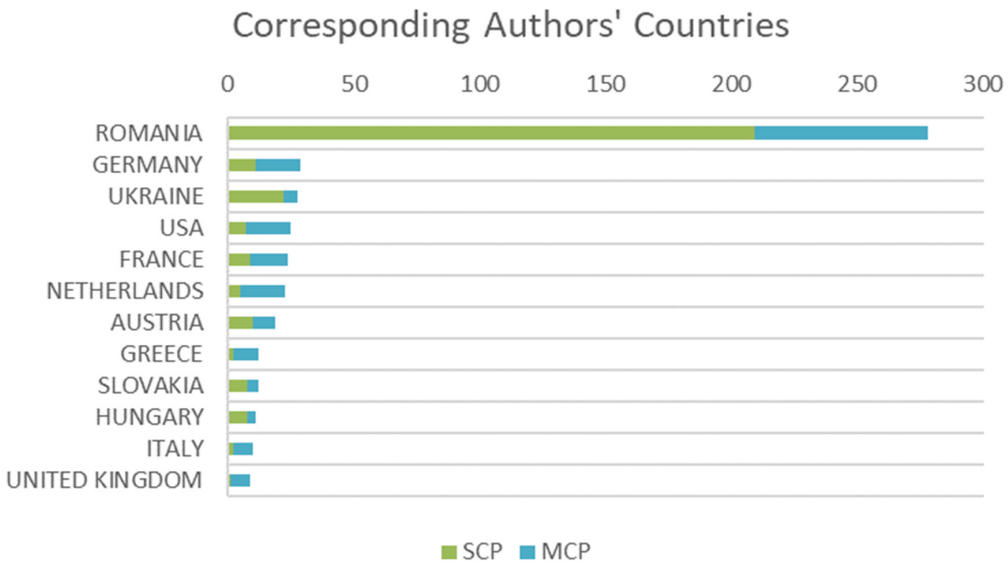

Figure 6. The corresponding authors' countries in the context of Danube Delta.

4.2. Science Mapping and Thematic Evolution

Figure 7 depicts a bibliometric thematic map that categorizes various topics pertinent to research concerning the Danube Delta. This map is segmented based on two dimensions: the level of significance (centrality) and the level of advancement (conceptual development). Relying on the bibliometric analysis of our sample data, this classification aids in comprehending the influence and progression of diverse research topics related to the Danube Delta. The thematic map is created based on Callon's centrality calculations [23], extracting the most representative keywords from our database and categorizing them into thematic classes according to the progression of their usage over time. The keywords represented in the Motor themes quadrant signify central and well-developed topics. The topics in the Basic themes quadrant are considered central but not yet fully developed. The Niche themes quadrant contains peripheral but well-developed topics, while the Emerging and Declining themes quadrant includes either emerging or declining, underdeveloped topics. This thematic map provides valuable insights for our analysis, categorizing studies on the Danube Delta by areas of interest and offering a comprehensive reflection of current research trends.

The green group of keywords ("Danube Delta", "Black Sea", and "Europe") is situated at the confluence of Motor and Basic themes. These topics are fundamental and fairly established in the literature, still necessitating research development for broader understanding of the region and the fragile characteristics of its ecosystems.

"Sediment", "sediment transport", and "environmental monitoring" are Motor themes keywords, exhibiting strong impetus for ongoing research, likely due to their significance in comprehending geomorphological and ecological processes [24,25].

"Delta", "Coastal zones", and "anthropogenic effect" appear as Emerging or Declining themes. These themes indicate a lower centrality and either increasing or decreasing relevance. Research on these themes has the potential to offer fresh insights into the long-term history and evolution of the Danube Delta [26]. However, they remain either insufficiently explored or are beginning to receive less emphasis in recent research endeavors. "Romania", "controlled study", and "wetland" stand at the confluence of Basic themes and Emerging or Declining themes, suggesting the need for research enhancement on subjects directly concerning the deltaic ecosystem, the wildlife, and the taxonomy of the region.

Niche themes encompass "nonhuman", "animals", and "human". Although pertinent, research on non-human fauna and the specific Romanian context of the Danube Delta is still in its nascent stages of development or is approached within a more restricted framework, thus giving them a niche profile [27].

Linking the bibliometric thematic map with the hypotheses of our study, it appears that Hypothesis 1, which posits that climate change is significantly influencing the occurrence and severity of extreme weather events in the Danube Delta, aligns closely with Motor themes keywords such as "sediment", "sediment transport", and "environmental monitoring". These keywords are central to understanding how shifts in climate may accelerate changes in sediment dynamics and transport processes, directly impacting riverine ecosystems. Environmental monitoring plays a crucial role in tracking these changes, providing critical data on how climate-induced transformations affect both the physical structure and ecological functionality of the delta.

The Danube Delta, situated at the confluence of continental and maritime climates, faces heightened vulnerability to climatic fluctuations. Over recent decades, there has been a concerning uptrend in the occurrence of extreme weather events. Floods are becoming more frequent not solely due to heavy precipitation but also due to elevated water levels in the Black Sea, influenced by glacial melting and thermal expansion of waters [28].

The floods have reshaped and also disrupted the habitats of both aquatic and terrestrial species, impacting breeding cycles and fauna migration [29].

Conversely, droughts are escalating in severity and duration, exerting pressure on freshwater reservoirs vital for agriculture, industry, and human consumption. Reduced water availability affects vegetation, diminishing the quality and quantity of natural habitats, which may precipitate a decline in biodiversity. Alterations in precipitation and temperature regimes can also influence the distribution and abundance of plant and animal species, reshaping ecological interactions and the Delta's natural equilibrium [30].

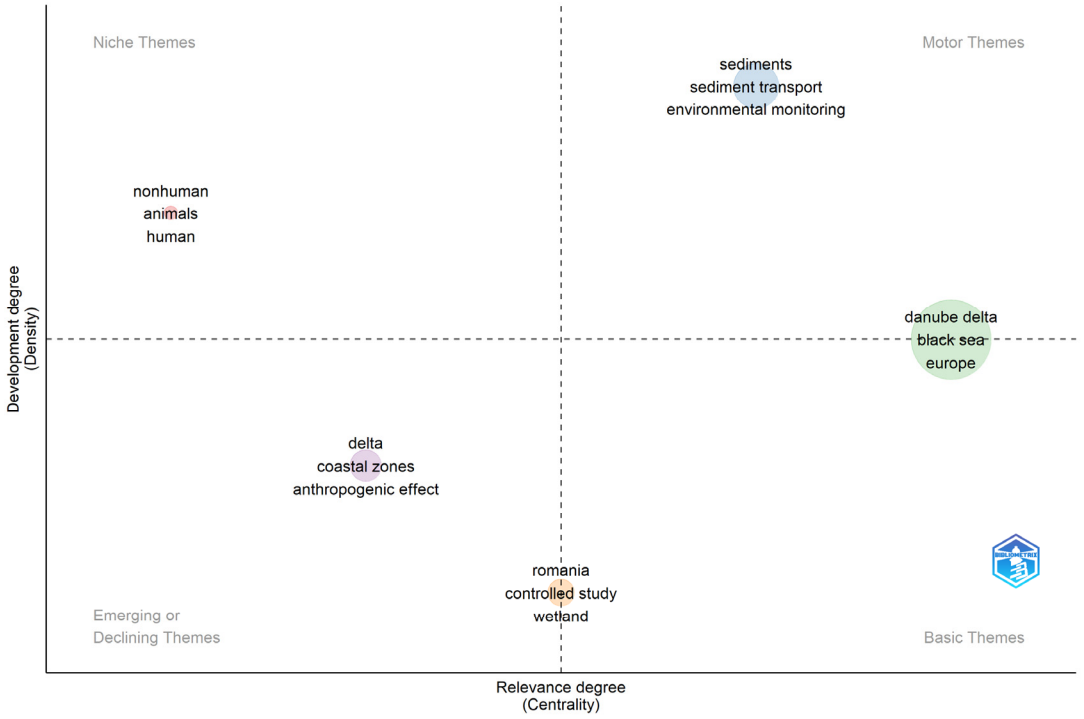

Figure 7. Bibliometric analysis organized as a thematic map.

Severe storms also play a significant role in reshaping coastal landscapes and can exacerbate issues such as soil erosion, sedimentation, and salinization. These phenomena pose threats to agriculture and fish farming, crucial economic activities for local communities, as highlighted by Anthony in 2022 [31]. Moreover, these extreme events can inflict damage on critical infrastructure, diminishing the resilience of both human communities and ecosystems to climate change [32].

The landscape has changed dramatically in the last two centuries. Large-scale reed cultivation, canalization of the Sulina branch of the Danube, communist land reclamation, fish farming and sea fishing operations, as well as forced migration and industrialization have created a mosaic of deltaic ecosystems [33].

Consequently, there is a pressing need to delve deeper into the interactions between extreme weather events and the ecological and socio-economic dynamics of the Danube Delta. An analysis of these interactions can furnish invaluable insights for devising effective adaptation strategies capable of mitigating the adverse impacts of climate change on this invaluable region [34]. Therefore, Hypothesis 1 not only underscores the impact of climate change on the Danube Delta but also advocates for a proactive approach to conserving biodiversity and natural resources, which is essential for the current and future well-being of the area.

Hypothesis 2, which suggests that adaptive management strategies using predictive modeling of long-term climate shifts enhance biodiversity conservation in the Danube Delta,

connects well with the confluence of Basic and Emerging or Declining themes keywords such as "Romania", "controlled study", and "wetland". These keywords highlight the importance of region-specific approaches, where controlled studies within Romanian wetlands can provide valuable insights into the effectiveness of adaptive strategies. As emerging climate patterns challenge wetland ecosystems, predictive models enable more informed conservation decisions, ensuring that biodiversity is preserved amid shifting environmental conditions.

Adaptive management entails consistently refining conservation strategies based on emerging insights and environmental fluctuations, as well as compliance to green tourism regulations or sustainable development goals [35]. This approach is particularly crucial in regions like the Danube Delta, where ecological shifts can occur swiftly and unpredictably. By integrating predictive modeling into these strategies, proactive adaptation is facilitated [36], enhancing the likelihood of successfully safeguarding biodiversity. For instance, if modeling forecasts heightened water salinity in specific zones, targeted restocking initiatives for species resilient to elevated salinity levels can be implemented, or adjustments can be made to freshwater flow.

Efficient execution of adaptive management necessitates collaboration among various stakeholders, spanning local and national governments, non-governmental organizations, and community members [37]. Additionally, ongoing ecosystem monitoring and regular assessment of conservation measures are imperative to ensuring their continued relevance and effectiveness in the face of evolving challenges [38]. The collection and analysis of ecological, climatic, and socio-economic data play a pivotal role in this endeavor, ensuring that decisions are well informed and tailored to the prevailing circumstances [39].

Therefore, in accordance with Hypothesis 2, the adoption of adaptive management strategies within the Danube Delta, which includes the integration of predictive climate change modeling, establishes a robust framework for biodiversity conservation. This not only enhances resilience to immediate alterations but also ensures effective long-term planning, thereby contributing to the sustainability of ecosystems and the collective welfare of communities reliant on these ecosystems [40]. Consequently, despite mounting pressures from global climate change, the Danube Delta can persist as a beacon of natural diversity.

Hypotheses 3 and 4, which emphasize the role of international collaboration and economically grounded conservation policies in enhancing biodiversity efforts in the Danube Delta, align with the confluence of Basic and Motor themes keywords such as "Danube Delta", "Black Sea", and "Europe", as well as Niche themes like "nonhuman", "animals", and "human". These keywords highlight the interconnectedness of regional and international efforts in addressing both ecological and economic challenges [23]. Despite ongoing research, there is a clear need to further explore the economic dimensions of conservation, as effective biodiversity strategies and ecosystem service valuations must consider the complex interactions between human and climate factors to support both environmental protection and local economic development in the Danube Delta region.

There exist numerous instances of international initiatives that have made significant contributions to biodiversity conservation in the Danube Delta. Projects funded by the European Union, cross-border cooperation schemes, and partnerships among universities and research institutions across different nations have yielded intricate studies examining the impacts of climate change on ecosystems. These collaborative endeavors have not only facilitated the exchange of data and resources but also the development of policies and strategic recommendations tailored to the specific requirements of the Danube Delta.

The synergy fostered by international collaboration can engender a deeper comprehension of ecological and climatic dynamics. For instance, climate and ecological models collaboratively devised by international teams can offer more precise forecasts and spot

critical areas necessitating urgent interventions [41]. Consequently, more effective conservation and adaptive management programs can be devised, designed, and executed with an enhanced understanding of global interdependencies [42].

While the advantages are evident, international collaboration also presents challenges, such as regulatory disparities, language and cultural barriers, and the complexity of coordinating activities and securing funding. These obstacles can hinder decision-making processes and complicate the implementation of conservation measures. Nevertheless, with meticulous planning and the utilization of modern communication and coordination technologies, these challenges can be surmounted [43].

Therefore, international collaboration in research concerning the Danube Delta not only amplifies the effectiveness of biodiversity conservation efforts but is imperative for adequately and efficiently addressing climate uncertainties. By amalgamating diverse endeavors and expertise, we can ensure the long-term and sustainable management of this crucial ecosystem, furnishing a unified and comprehensive response to present and future global challenges [44]. Thus, advocating for and enhancing international collaboration should be prioritized in conservation and research strategies for the Danube Delta.

Figure 8 depicts the connections among various research topics pertaining to studies on the Danube Delta. This diagram serves as a valuable tool for discerning the interrelationships among key topics in recent literature and for highlighting areas of significant research interest. The findings revealed four primary clusters, which were renamed to better incorporate each common conceptual framework: (a) the red cluster encompass environmental conservation aspects concerning the Danube Delta; (b) the blue cluster relates to hydrological insights; (c) the green cluster incorporates aspects related to ecological integrity; and (d) the purple cluster shares deltaic flora and fauna insights.

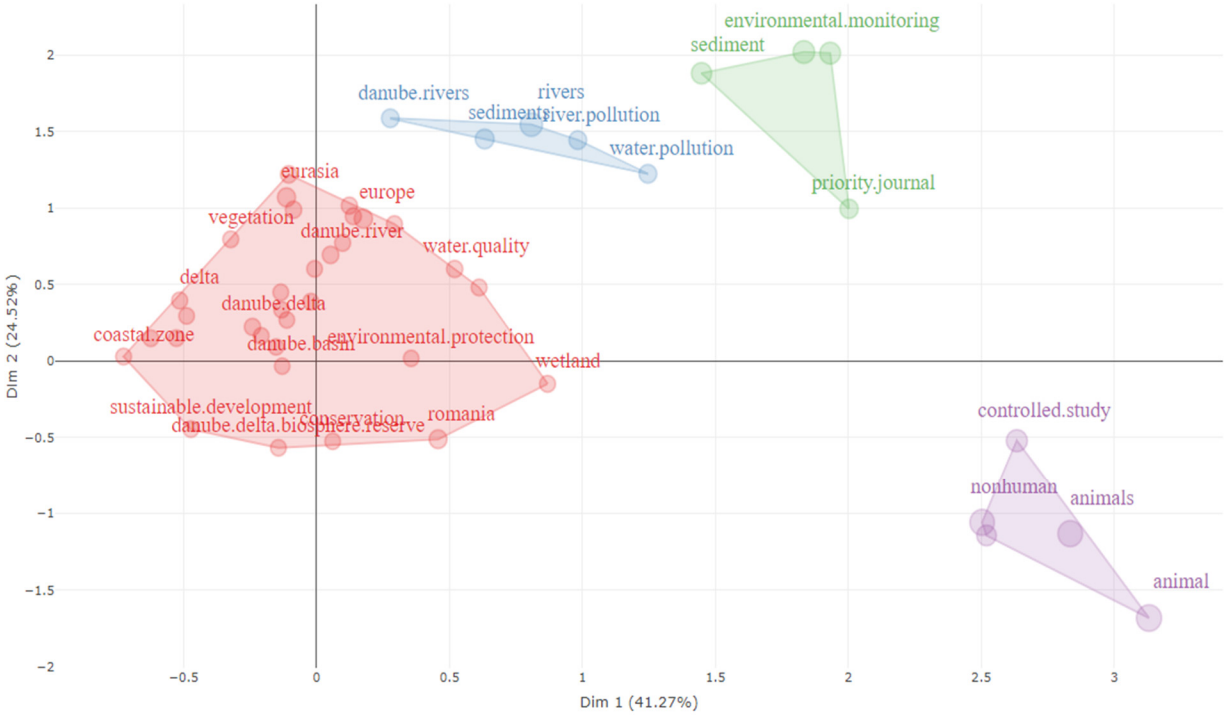

Figure 8. The connections between the various research topics were renamed according to the conceptual framework and cluster color: the red cluster: environmental conservation aspects concerning the Danube Delta; the blue cluster: deltaic hydrological insights; the green cluster: ecological integrity; the purple cluster: deltaic flora and fauna insights.

4.2.1. Environmental Conservation Efforts and Challenges in the Danube Delta

The red cluster (Central) encompasses terms associated with the geographical and conservation aspects of the Danube Delta, featuring keywords such as "Danube Delta", "coastal zone", and "sustainable development". The inclusion of terms like "environmental protection" and "biodiversity" underscores a pronounced emphasis on environmental conservation and protection within this region. Positioned at the center of the diagram, this cluster signifies that these themes are highly pertinent and play a crucial role in the research on the Danube Delta, underscoring the persistent concern regarding the impact of human activities and climate change on local biodiversity and ecosystems [45].

The inclusion of geographical terms such as Europe and Eurasia underscores the regional and continental relevance of the Danube River and Danube Delta research, emphasizing their extensive ecological and hydrological interconnectedness [46].

Relevant research strings for this cluster explore the complex geological and geomorphological processes that shape landscapes, with a particular focus on tectonic activity, sedimentary processes, and environmental impacts. Several studies emphasize the role of tectonic forces in landscape evolution, where interactions between plate movements and sediment deposition processes are key in understanding long-term geological changes. For instance, tectonic thrusting and fault systems have been shown to play significant roles in shaping orogenic belts and sedimentary basins, influencing both surface morphology and subsurface structures [47,48]. These tectonic movements, combined with sea-level fluctuations and sediment transport, also contribute to the formation and erosion of coastal environments, as demonstrated in studies focused on deltaic and fluvial systems [49].

Further research into sediment geochemistry and weathering processes highlights how chemical and physical alterations of sediments can offer insights into past environmental conditions, such as climate changes and historical sedimentation patterns [50,51]. The integration of geomorphological data with climate reconstructions reveals the critical role of paleoclimate variability in driving large-scale changes in sedimentary environments, which is essential for understanding the impacts of current climate shifts on coastal and marine systems [52].

Environmental impacts due to human activities, such as pollution and land use changes, are also explored, with studies pointing to the degradation of marine ecosystems due to chemical contamination and the need for sustainable management of sedimentary environments [53,54]. Researchers call for a comprehensive approach to studying both natural and anthropogenic influences on landscape evolution to inform conservation and management practices in the face of ongoing environmental changes.

Other scholars emphasize the critical relationship between environmental sustainability, economic valuation, and the integration of geoscientific knowledge into policy and management frameworks. Haberl et al. [55] underscore the importance of incorporating ecosystem service valuation into economic decision-making processes. They highlight how recognizing the economic value of natural ecosystems, such as wetlands and forests, can lead to more sustainable resource management and conservation efforts. Kim et al. [56] complement this by focusing on the role of geological sciences in understanding and mitigating the environmental impacts of human activities, particularly in resource-rich areas. Their study stresses the need for interdisciplinary collaboration between geoscientists, economists, and policymakers to ensure that natural resource exploitation aligns with long-term environmental sustainability goals.

Mazilu et al. [57] further explore the socio-economic dimensions of environmental degradation, emphasizing how unsustainable land use practices, driven by short-term economic gains, can lead to significant long-term ecological and economic costs. They militate for the integration of sustainable development principles into local and global

economic policies, advocating for more robust frameworks that balance ecological integrity with economic development.

Research regarding the environmental conservation and challenges in the Danube Delta highlights the interesting financial implications of conservation policies and underscores the potential for sustainable economic development through the strategic management of ecosystem services in the Danube Delta. Studies such as that by Aivaz and Șerbănescu have conducted hierarchical multifactor regression analyses to estimate the economic value of ecosystem services, highlighting the financial contributions of biodiversity conservation efforts to local economies [38]. Gastescu emphasizes the contribution of ecosystem services in supporting local fisheries and tourism industries, estimating that sustainable wetland management can generate long-term economic benefits through increased fish stock productivity and ecotourism revenues [9]. Another relevant example is provided by Lazar et al., who applied scenario-based modeling to evaluate the financial impacts of different conservation strategies in the Danube Delta, revealing that investments in wetland restoration yield high returns in terms of ecosystem resilience and local economic opportunities [40]. Giosan et al. illustrate the economic consequences of anthropogenic interventions by estimating the costs associated with habitat degradation and the corresponding benefits of implementing adaptive management strategies [47]. The case-specific examples emphasizing the impetus for research on economic valuation of the Danube Delta ecosystem integrate meaningfully with the incentives provided by the European regulatory system. The OECD reports on European wetland valuation provide concrete figures, showing that wetlands contribute significantly to water purification, flood regulation, and carbon sequestration, with an estimated value of up to several billion euros annually.

A common thread of the studies sharing this cluster is the impetus for a holistic approach to environmental management—one that integrates economic valuation, geoscientific insights, and sustainable policy frameworks to address the growing challenges posed by environmental degradation and resource over-exploitation.

4.2.2. Ecological Integrity of the Danube Delta

The green cluster (top right in Figure 8) addresses concerns related to environmental monitoring and pollution, featuring specific terms such as “sediment” and “environmental monitoring”. This cluster underscores the significance of ongoing monitoring of environmental factors influencing water quality and sediment, pivotal for preserving the ecological integrity of the Danube Delta [58]. The inclusion of the term “priority journal” implies that research in this domain is published in journals of high priority and relevance, underscoring the importance and influence of high-quality research in this sphere [59].

Studies relevant for this cluster demonstrate that invasive species pose significant threats to biodiversity, with ecosystems, especially in freshwater environments, particularly vulnerable to species invasions that disrupt native biodiversity and ecological balance [60]. Changes in river flows and sediment transport are essential in maintaining delta structures, influencing both marine and terrestrial ecosystems [61,62]. These shifts are further exacerbated by climate change, which intensifies sediment loss and affects deltaic stability, as seen in petroleum studies focusing on the Black Sea, where subsurface structures are crucial for understanding broader sedimentary patterns [63].

Land use changes and human interventions, such as damming and water management, critically alter natural sediment and nutrient flows, compounding the vulnerability of ecosystems to climate-induced risks like flooding and erosion [64]. The complex relationship between human activity, sediment fluxes, and ecosystem health is further highlighted in studies that advocate for integrated management strategies, combining environmental

monitoring with sustainable land use practices to mitigate long-term ecological damage and maintain biodiversity [65].

4.2.3. Deltaic Flora and Fauna

The purple cluster (bottom right in Figure 8) encompasses terms associated with controlled studies and research on non-human fauna, indicating a particular research focus on wildlife in the Delta. The terms "controlled study", "nonhuman", and "animals" underscore a systematic and structured approach to investigating the impact of environmental conditions on local fauna, crucial for elucidating biodiversity dynamics and ecological responses to external pressures [66–68].

Studies exploring this research path highlight the critical role of genetic diversity, disease ecology, and host–parasite interactions in maintaining ecosystem health and biodiversity. Several studies emphasize the importance of molecular tools in understanding population structure and dynamics, particularly in the context of wildlife diseases. For instance, genetic analyses reveal that pathogen transmission patterns in wildlife species are intricately linked to population genetics, where genetic diversity plays a key role in resilience to diseases [69]. These findings are complemented by studies on host–parasite relationships, showing how environmental changes and host genetic diversity affect disease prevalence, particularly in contexts of habitat degradation and climate change [70,71].

Zoonotic diseases are a central concern, with research pointing to the need for better surveillance systems, especially in regions where human-wildlife interactions are intensifying [72]. The emergence and spread of infectious diseases in both terrestrial and aquatic ecosystems are linked to changing environmental conditions, with parasites playing a significant role in shaping host population dynamics [73]. In a similar vein, studies investigating the genetics of invasive species provide insights into how non-native species can alter ecosystem function and increase the risk of disease outbreaks [74].

Research studies sharing common keywords included in the purple cluster stress the urgent need for integrating molecular, ecological, and epidemiological approaches to address the growing challenges posed by disease ecology in the context of global environmental changes. Effective biodiversity conservation strategies must account for the genetic underpinnings of disease resistance, the impacts of habitat alteration, and the dynamics of host–parasite interactions to safeguard both wildlife and human health.

In another research vein, studies emphasize the intricate interplay between biodiversity, species distribution, and environmental pressures. Keller et al. [75] focus on the ecological and physiological responses of aquatic organisms to habitat disturbances, emphasizing that the resilience of these species to environmental changes is tied to both genetic variability and habitat connectivity.

Audzijonyte et al. [76] explore species distribution patterns on a broader scale, analyzing how geographic, climatic, and anthropogenic factors contribute to shifts in species ranges. They particularly underscore the role of climate change in driving species migration and redistribution, with significant implications for conservation strategies.

Studies sharing common keywords included in the purple cluster highlight the critical need for integrated conservation approaches that account for habitat integrity, genetic diversity, and the growing impacts of climate change, emphasizing the vulnerability of freshwater ecosystems to both natural and human-induced environmental pressures.

4.2.4. Hydrological Insights Concerning the Danube Delta

The central blue cluster in the diagram comprises a collection of terms centered on water and river quality issues, underscoring the significance of investigating aquatic

resources within the broader context of Danube Delta research. This cluster sheds light on the hydrological dynamics and its ramifications on the region's ecosystems.

As one of Europe's most significant rivers, the Danube assumes a central role in nourishing and shaping the Danube Delta. Explorations of the Danube River are indispensable for understanding water flow patterns, sediment deposition, and ecological influences on the Danube Delta [77]. Water quality serves as a key indicator of the Danube Delta's ecological well-being, with concerns spanning contaminants, nutrients, and other elements impacting aquatic life and biodiversity. Studies sharing common keywords highlighted in this cluster emphasize the interconnectedness of physical and ecological processes across marine, riverine, and freshwater systems, calling for integrated management strategies that account for the cumulative impacts of human activities and climate change on aquatic ecosystems [4,14,78]. The need for adaptive conservation efforts, driven by robust scientific understanding of hydrological and ecological interactions, is a central theme across these works.

The studies highlighting the most relevant keywords for this cluster examine the complex dynamics of the Danube Delta's ecosystems and the critical role of hydrological and ecological processes in maintaining their health and functionality. Constantin et al. [79] focus on the interactions between physical oceanographic processes and marine ecosystems, particularly how changing coastal currents and upwelling patterns influence nutrient distribution and biological productivity. Their study underscores the vulnerability of these systems to climate variability, emphasizing the cascading effects on marine biodiversity and fisheries. Coops et al. [80] shift focus to riverine systems, exploring the impact of hydrological alterations, such as damming and water regulation, on river ecology. They demonstrate that changes in flow regimes and sediment transport significantly affect the structure and diversity of aquatic habitats, leading to shifts in species composition and ecosystem functionality.

Borza et al. [81] further complement previous findings by examining freshwater lakes, showing how both natural and anthropogenic factors—such as nutrient loading, climate change, and invasive species—alter the trophic dynamics and overall health of lake ecosystems.

Studies focusing on the Danube River and water quality underscore the imperative for continuous monitoring to identify and address environmental changes that may influence the Delta's biodiversity and ecological stability. References to geographical regions like Europe and Eurasia indicate that the Danube Delta transcends local or national boundaries, forming an integral part of a broader ecological and hydrological system with transboundary implications [82].

Climate change is one of the biggest threats to human development and nature in the Danube Delta, as these areas are very sensitive, with sea level rise, droughts, floods, storms, and heat wave effects impacting some of the most vulnerable people, disrupting food production, and threatening vitally important species, habitats, and ecosystems. Projections of climate change impacts on inter-species relations and individual response of species are of high uncertainty. Growing periods of the main commercial fish species and the number of fishing days may be prolonged, which will increase pressure on populations of the main industrial species. When speaking about tourism, due to a longer summer season, a higher number of visitors may be expected, leading to more pressure on the environment, unless managed wisely [83]. Maintaining the tourism industry within the region's ecological and socio-cultural carrying capacity is the basis for the entire adaptation action plan for the tourism sector in the Danube Delta sub-basin (CCAS) [84].

Careful management is crucial in the Danube Delta, as this area has been modified by human activities over time, but restoration initiatives demonstrate that the potential is very

high, representing an opportunity for ecosystem-based adaptation to climate change. From an economic point of view, the situation is a bit more complicated. High unemployment rates, low average incomes, and old dysfunctional infrastructures impede the development of fishery and other sectors. Regarding institutional conditions, they are favorable for successful adaptation due to the bilateral Romanian–Ukrainian Danube Delta Biosphere Reserve and Black Sea Basin regulatory instruments bringing together key stakeholders and users of natural resources.

However, the biggest challenge remains the uncertainty of long-term effects on the measures taken under current climate change conditions. The findings of this analysis offer valuable insights into the interconnectedness of various research areas within Danube Delta studies, shedding light on the prevailing concerns of the scientific community. Through the identification of these primary clusters of topics, researchers and decision-makers can more efficiently allocate resources and efforts toward addressing the most critical and influential issues [85]. Furthermore, emphasizing the significance of environmental monitoring and controlled animal studies underscores the ongoing necessity for precise data and rigorous methodologies to inform conservation and management decisions for the Danube Delta [86].

4.2.5. Implications of Research and International Collaboration for the Preservation of Danube Delta Ecosystems

The research initiatives revealed by our literature review demonstrate the complex and intricate effects that human interaction and climate change have on fragile ecosystems. Research rooted in international collaboration [43,48,87] is proving effective, primarily in fostering participation and knowledge exchange in addressing environmental challenges, to conserve a unique ecosystem such as the Danube Delta.

Research on the Danube Delta, conducted in the context of climate uncertainty and the need to conserve biodiversity, is an example of successful international collaboration. The efforts and incentives highlighted by research also resonate in various projects aimed at both protecting the region's unique ecosystems and mitigating the effects of climate change. A relevant example in this sense is the *DANUrB+ project*, launched in 2020 with Interreg Danube Transnational Programme funding, which involved organizations from eight Danube countries. The main objectives included the conservation of Danube Delta ecosystems, invasive species management, and restoration of degraded habitats, and the results achieved included the establishment of a common framework for biodiversity monitoring, the implementation of wetland restoration programs, and the creation of ecological corridors for species migration.

Another important project inspired by research advancements is Interreg-SEE, which brings together universities, research institutes, and NGOs from EU and Danube riparian countries. It aims at sustainable use of natural resources and studying the impact of climate change on the Danube Delta. Its achievements include the development of predictive models to assess climate impacts, the rehabilitation of habitats for migratory birds, and the creation of a database of endemic and threatened species in the region. The LIFE Danube Free Sky project addresses bird mortality caused by overhead power lines, working with organizations in Romania, the Ukraine, and Bulgaria. By implementing environmentally friendly technologies, the project has reduced bird mortality in protected areas by 30% and carried out awareness-raising campaigns for local communities. The WETLANDS International project also focuses on wetland restoration, working with government organizations and local communities in Romania and the Ukraine. Efforts have included creating natural dams to combat soil erosion, reducing CO^2 emissions by restoring peatlands, and protecting freshwater resources.

Another notable example is the Environmental Program for the Danube River Basin (EPDRB), funded by UNEP, GEF, and the World Bank, which has promoted integrated water resources management in the Danube region. The program has led to the establishment of common water protection standards, the reduction of nutrient pollution from agriculture, and the implementation of a water quality monitoring system.

This study complements the investigation on climate change impacts with a holistic approach, including economic and collaborative dimensions, aiming to add value to the existing literature by addressing the multifaceted nature of conservation challenges in the Danube Delta. The authors believe that such an integrated perspective is constructive for developing effective, adaptive policies that are both ecologically and socio-economically sustainable.

5. Conclusions

Our investigation delved into the dynamics of scholarly research concerning the Danube Delta, with a particular emphasis on the interplay between climate change and biodiversity. Through a bibliometric analysis, our study unveiled prominent trends, evaluated the influence of scientific literature, and underscored notable contributions stemming from international collaborations, as well as the impact of economic evaluations on conservation policies.

The bibliometric analysis unveiled a notable surge in publication volumes in recent decades, indicative of a heightened recognition of the Danube Delta's significance within the realms of climate change and biodiversity conservation. The scrutinized papers underscored the critical role of extreme weather events triggered by climate change, which exert profound impacts on the Danube Delta's biodiversity and ecological equilibrium. The publications underscored the imperative of implementing adaptive management strategies integrated with comprehensive predictive modeling to anticipate and mitigate adverse ramifications.

The Danube Delta is home to a diverse range of species that could be significantly impacted by climate change as follows: he Danube Delta is a critical habitat for many bird species, including the Eurasian otter, herons, and various migratory birds like the white-tailed eagle and the great egret—changes in water levels and temperature may affect their breeding and feeding grounds; when speaking about fish, some species, including the sturgeon, are vulnerable—climate change can alter water temperatures, flows, and the availability of spawning habitats, impacting fish populations; species such as frogs and turtles rely on specific wetland conditions that could change with shifts in climate, potentially leading to decreased populations or habitat loss; changes in water salinity, temperature, and land use can affect the growth of aquatic vegetation, which is essential for maintaining the ecosystem's balance and providing habitat for many species; and species like the European beaver and wild boar may also be affected as their habitats shift due to changes in water levels and vegetation patterns. The projected impacts of climate change, such as increased flooding, drought, and temperature fluctuations, pose serious threats to the biodiversity and ecological health of the Danube Delta. Conservation efforts and adaptive management strategies will be crucial in mitigating these impacts.

The study's outcomes affirm the hypothesis positing a direct correlation between heightened international collaboration and the efficacy of biodiversity conservation endeavors amidst climate uncertainties. Global partnerships not only broaden the knowledge and resource pool but also streamline the implementation of innovative and adaptive solutions crucial for managing the Danube Delta's intricate ecological challenges.

Another pivotal finding underscored by the study pertains to the significance of economic assessments in shaping conservation policies. The incorporation of robust economic

analyses elucidated that conservation measures not only safeguard natural resources but also foster local economic growth through the sustainable valuation of ecosystem services. Thus, policies grounded in a robust economic rationale are imperative for ensuring enduring financial and environmental sustainability.

The study's outcomes advocate for dynamic and adaptive conservation policies and management strategies tailored to the latest scientific insights and climate patterns concerning the Danube Delta. Additionally, continued promotion and expansion of international collaborations are paramount, given their role as catalysts for innovation and advancement in applied research.

Lastly, the study underscored the imperative of adopting an integrated approach encompassing ecological, social, and economic facets in the conservation of the Danube Delta. This holistic approach ensures the preservation of this invaluable habitat while maximizing benefits for both biodiversity and the human communities reliant on this ecosystem. Consequently, this research significantly enriches existing literature and furnishes a solid foundation for future conservation decisions.

6. Future Research Directions

The present study unveils various avenues for future research endeavors aimed at broadening our comprehension of the intricacies surrounding the Danube Delta and its interactions with climatic and anthropogenic factors. Building upon the attained results and identified trends, the necessity arises to delve into the long-term repercussions of climate change on the Danube Delta, encompassing scenarios of sea level rise and their ramifications on biodiversity and habitats. Subsequent research should prioritize comprehensive climate modeling endeavors to furnish more precise forecasts and evaluate diverse intervention scenarios.

To fortify the economic rationale underpinning conservation policies, future studies could undertake detailed analyses to ascertain the economic returns associated with different ecosystem services. This entails evaluating the economic advantages of regulatory services, such as flood control and carbon sequestration, vis-à-vis provisioning services such as fisheries and agriculture. Furthermore, an exhaustive examination of the efficacy and success of existing adaptive management strategies is warranted to pinpoint the most efficacious practices and areas warranting potential enhancements. Research efforts could encompass the development of novel techniques and technologies tailored for the monitoring and adaptive management of natural resources.

Given the paramount significance of international collaboration augmented by the present study, future research endeavors should explore innovative avenues to bolster cross-border cooperation and amplify its impact through the exchange of data, resources, and best practices.

7. Study Limitations

While the study offers valuable insights, it is essential to acknowledge certain limitations and to reflect on how these constraints may influence the interpretation of results and the broader conclusions drawn. Firstly, the bibliometric analysis relies on articles accessible in prominent databases, potentially leading to the underrepresentation of studies not indexed or published in languages other than English, thereby possibly impacting the comprehensiveness of the analysis. The reliance on English-language publications may introduce a selection bias by overlooking valuable insights from regional or non-indexed sources, which could affect the comprehensiveness of the analysis.

Moreover, the varied methodological approaches adopted in the reviewed studies may pose challenges in directly comparing results, thereby influencing interpretations and

overarching conclusions. Variations in methodological approaches across the reviewed studies may limit the generalizability of findings. The inherent limitations of bibliometric methods, such as the exclusion of qualitative assessments and contextual nuances, may also restrict the holistic understanding of the socio-ecological dynamics within the Danube Delta.

The climate models and predictions utilized to evaluate the impact of climate change on the Danube Delta may harbor limitations concerning accuracy and applicability at the local level, necessitating caution when extrapolating findings to the entire ecosystem. The study predominantly concentrates on scientific aspects, potentially overlooking the intricate interactions among social, economic, and political factors that influence the efficacy of conservation measures. By acknowledging these limitations and exploring the suggested research avenues, future studies can further enhance our comprehension and management of the Danube Delta within the context of prevailing and forthcoming global challenges.

To mitigate these challenges in future research, efforts should be directed toward incorporating multilingual and grey literature sources, adopting mixed-method approaches that combine quantitative bibliometric analysis with qualitative expert consultations, and utilizing more refined climate and economic models tailored to the specific characteristics of the region. Acknowledging these limitations will lead to the creation of new research pathways that will enhance the robustness and applicability of future findings, providing a more comprehensive and accurate basis for policymaking and conservation strategies.

Author Contributions: All authors contributed equally to this study. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: The original contributions presented in this study are included in the article. Bibliometric data was retrieved from www.scopus.com. Further inquiries can be directed to the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Damian, N. Fishing and its impact on the local communities of the Danube Delta biosphere reserve. *Rom. J. Geogr.* **2019**, *63*, 203–215.
2. Sbarcea, M.; Petrisor, A.I.; Petrisor, L.E. Mapping Potential Environmental Conflicts in the Danube Delta Biosphere Reserve. *Sci. Ann. Danub. Delta Inst.* **2019**, *24*, 175–182.
3. Aivaz, K.A.; Florea, I.O.; Munteanu, I. Economic Fraud and Associated Risks: An Integrated Bibliometric Analysis Approach. *Risks* **2024**, *12*, 74. [CrossRef]
4. Starodubtsev, V.M. Flow regulation impact on land cover changes in river deltas of the Black Sea basin. In Proceedings of the Conference: SWorld, Odessa, Ukraine, 17–28 June 2014.
5. Giosan, L.; Coolen, M.; Kaplan, J.; Constantinescu, S.; Filip, F.; Filipova-Marinova, M.; Kettner, A.J.; Thom, N. Early Anthropogenic Transformation of the Danube-Black Sea System. *Sci. Rep.* **2012**, *2*, 582. [CrossRef] [PubMed]
6. Nguyen, A.T.; Hens, L. Climate Change-Associated Hazards, Impacts, and Vulnerability at Regional Level. In *Human Ecology of Climate Change Hazards in Vietnam*; Springer Climate; Springer: Cham, Switzerland, 2019; pp. 37–60.
7. Iordache, G.; Malageanu, M. Assessment and representation of spatial changes of aquatic vegetation distribution in the Danube Delta. Case study: Babina, corciuvate and ciortic lakes—MatiŢa-merhei aquatic complex. *Geo-Eco-Marina* **2019**, *25*, 181–190.
8. Collste, D.; Pedercini, M.; Cornell, S.E. Policy coherence to achieve the SDGs: Using integrated simulation models to assess effective policies. *Sustain. Sci.* **2017**, *12*, 921–931. [CrossRef] [PubMed]
9. Gastescu, P. The biodiversity of the Danube Delta Biosphere Reserve reflected in the structure of the ecosystems. In *Water Resources and Wetlands, 5th International Hybrid Conference Water Resources and Wetlands, Tulcea, Romania, 8–12 September 2021*; Gastescu, P., Bretcan, P., Eds.; Romanian Limnogeographical Association: Târgovişte, Romania, 2021; pp. 1–19. Available online: http://www.limnology.ro/wrw2020/proceedings.html (accessed on 28 October 2024).

10. Petrisor, A.I. Assessment of the long-term effects of global changes within the Romanian natural protected areas. *Int. J. Conserv. Sci.* **2016**, *7*, 759–770.
11. Font-Barnet, A.; Nel-lo Andreu, M.G.; Rovira-Soto, M.T. A methodological proposal to co-design well-being experiences: The case of the Ebro Delta Natural Park and Els Ports Natural Park, Catalonia, Spain. *J. Ecotourism* **2022**, 1–16. [CrossRef]
12. Grönroos, C. On value and value creation in service: A management perspective. *J. Creat. Value* **2017**, *3*, 125–141. [CrossRef]
13. Stroe, D.M.; Cretu, M.; Tenciu, M.; Dima, F.M.; Patriche, N.; Tiganov, G.; Dediu, L. Age, Growth, and Mortality of Pontic Shad, Alosa immaculata Bennett, 1835, in the Danube River, Romania. *Fishes* **2024**, *9*, 128. [CrossRef]
14. Vaidianu, N.; Paraschiv, M.; Saghin, I.; Braghina, C. Social-ecological consequences of planning and development policies in the Danube Delta biosphere reserve, Romania. *Carpathian J. Earth Environ. Sci.* **2015**, *10*, 113–124.
15. Yao, Y.; Li, Z.; Zhou, X.; Parmak, M. Yachting Tourism Consumption Potential and Its Influencing Factors: Considering 12 Coastal Cities in China as Examples. *Sustainability* **2023**, *15*, 12490. [CrossRef]
16. Zheng, H.; Li, X.; Wan, J.; Xu, M.; Liu, S.; Yasir, M. Automatic Coastline Extraction Based on the Improved Instantaneous Waterline Extraction Method and Correction Criteria Using SAR Imagery. *Sustainability* **2023**, *5*, 7199. [CrossRef]
17. Andrei, J.V.; Panait, M.; Ene, C. Environmental protection between social responsibility, green investments and cultural values. In Proceedings of the 3rd International Conference Competitiveness of Agro-Food and Environmental Economy, Bucharest, Romania, 7 November 2014; The Bucharest University of Economic Studies: Bucharest, Romania, 2014; Volume 3, pp. 179–187.
18. Ge, Y.; Xu, G.; Zhang, Q.; Wang, X.; Li, T. Natural attributes or aesthetic attributes: Which is more valuable in recreational ecosystem services of nature-based parks considering tourists' environmental knowledge and attitude impacts? *J. Outdoor Recreat. Tour.* **2023**, *44*, 100699. [CrossRef]
19. Sangsanont, J.; Ratta Nakul, S.; Makkaew, P.; Precha, N.; Rukthanapitak, P.; Sresung, M.; Siri, Y.; Kitajima, M.; Takeda, T.; Haramoto, E.; et al. Wastewater monitoring in tourist cities as potential sentinel sites for near real-time dynamics of imported SARS-CoV-2 variants. *Sci. Total Environ.* **2023**, *860*, 160317. [CrossRef] [PubMed]
20. Nguyen, T.; Cook, S.; Ineland, V. Application of System Dynamics to Evaluate the Social and Economic Benefits of Infrastructure Projects. *Systems* **2017**, *5*, 29. [CrossRef]
21. Wang, Y.; An, L.; Chen, H.; Zhao, Y. Spatial Correlation and Influencing Factors of Tourism Eco-Efficiency in the Urban Agglomeration of the Yangtze River Delta Based on Social Network Analysis. *Land* **2022**, *11*, 2089. [CrossRef]
22. Norris, M.; Oppenheim, C. The h-index: A broad review of a new bibliometric indicator. *J. Doc.* **2010**, *66*, 681–705. [CrossRef]
23. Callon, M. Can methods for analysing large numbers organize a productive dialogue with the actors they study? *Eur. Manag. Rev.* **2006**, *3*, 7–16. [CrossRef]
24. Panin, N. Danube Delta. Genesis, evolution and sedimentology. *Révue Roum. Géologie Géophysique Géographie* **1989**, *33*, 25–36.
25. Panin, N. Danube Delta. Genesis, evolution, geological setting and sedimentology. *Geo-Eco-Marina* **1996**, *1*, 7–23.
26. Panin, N.; Tiron Duțu, L.; Duțu, F. The Danube Delta—An overview of its Holocene evolution. *Mediterranee* **2016**, *126*, 37–54. [CrossRef]
27. Rădoi, I.V.; Ducman, A.; Teodorescu, C.; Marin, M.; Gogioiu, A. The impact of the development of the local economy on the natural environment of the Danube delta, Romania. In *Public Recreation and Landscape Protection—With Sense Hand in Hand? Conference Proceedings*; Mendel University in Brno: Brno, Czech Republic, 2020; pp. 489–493.
28. Bărbulescu, A.; Deguenon, J. About the variations of precipitation and temperature evolution in the Romanian Black Sea Littoral. *Rom. Rep. Phys.* **2015**, *67*, 625–637.
29. Ernoul, L.; Roumieux, C.; Sandoz, A. Perception et adaptation au changement climatique dans les deltas méditerranéens. *Géoconfluences* **2020**, 1–12.
30. Vespremeanu-Stroe, A.; Constantinescu, Ş.; Tătui, F.; Giosan, L. Multi-decadal evolution and North Atlantic Oscillation influences on the dynamics of the Danube Delta shoreline. *J. Coast. Res.* **2024**, *50*, 157–162. [CrossRef]
31. Anthony, E. Impacted fluvial and coastal sediment connectivity in the Mediterranean: A brief review and implications in the context of global environmental change. In Proceedings of the Ninth International Symposium "Monitoring of Mediterranean Coastal Areas: Problems and Measurement Techniques", Livorno, Italy, 14–16 June 2022.
32. Lazăr, N.N.; Simionov, I.A.; Petrea, Ș.M.; Iticescu, C.; Georgescu, P.L.; Dima, F.; Antache, A. The influence of climate changes on heavy metals accumulation in Alosa immaculata from the Danube River Basin. *Mar. Pollut. Bull.* **2024**, *200*, 116145. [CrossRef]
33. Goriup, P.; Baboianu, G.; Chernichko, J. The Danube Delta: Europe's remarkable wetland. *Br. Bird* **2007**, *100*, 194–213.
34. Vespremeanu-Stroe, A.; Zainescu, F.; Tatui, F.; Pirvan, M.; Verga, M.; Preoteasa, L. Long-term evolution of Danube delta barrier islands under the influence of storms, floods and big breaches. In Proceedings of the European Geosciences Union General Assembly 2024 (EGU24), Vienna, Austria, 14–19 April 2024. (No. EGU24-18215).
35. Palazzo, M.; Gigauri, I.; Panait, M.C.; Apostu, S.A.; Siano, A. Sustainable tourism issues in European countries during the global pandemic crisis. *Sustainability* **2022**, *14*, 3844. [CrossRef]
36. Bollaert, E.; Mano, V.; Duarte, R.; Jaeggi, M. Numerical and physical modelling of future Rhône Delta (Switzerland). *La Houille Blanche* **2018**, *104*, 76–83. [CrossRef]

37. Gondo, R.; Mutanga, C.N. Impact of anthropological activities on land-use and land-cover changes in the lower Okavango Delta, Botswana. *Trans. R. Soc. S. Afr.* **2024**, *79*, 29–45. [CrossRef]
38. Aivaz, K.A.; Șerbănescu, M. Ecosystem Services Evaluation of The Danube Delta: An Analysis Using Hierarchical Multifactor Regression. *Stud. Bus. Econ.* **2024**, *19*, 5–21. [CrossRef]
39. Chirilă, S.D.; Răileanu, Ș.; David, L.O.; Covaliov, S.; Doroftei, M. An analysis of plant palatability on pastures of the delta: Case study, Danube Delta area, Romania. *Not. Bot. Horti Agrobot.* **2024**, *52*, 13568. [CrossRef]
40. Lazar, L.; Rodino, S.; Pop, R.; Tiller, R.; D'Haese, N.; Viaene, P.; De Kok, J.L. Sustainable Development Scenarios in the Danube Delta—A Pilot Methodology for Decision Makers. *Water* **2022**, *14*, 21. [CrossRef]
41. Yang, S.; Duan, Z.; Jiang, X. Spatial dynamics and influencing factors of carbon rebound effect in tourism transport: Evidence from the Yangtze-river delta urban agglomeration. *J. Environ. Manag.* **2023**, *344*, 118431. [CrossRef]
42. Velázquez-Ochoa, R.; Enríquez, S. Environmental degradation of the Mexican Caribbean reef lagoons. *Mar. Pollut. Bull.* **2023**, *91*, 114947. [CrossRef]
43. Truman, M.; Sarmiento, E. When this thing hit': Examining the impacts of the COVID-19 pandemic in the blues-based cultural economy of Clarksdale. *Soc. Cult. Geography.* **2023**, *25*, 1044–1063. [CrossRef]
44. Yee, J.Y.; Loc, H.H.; Poh, Y.L.; Vo-Thanh, T.; Park, E. Socio-geographical evaluation of ecosystem services in an ecotourism destination: PGIS application in Tram Chim National Park, Vietnam. *J. Environ. Manag.* **2021**, *29*, 112656. [CrossRef]
45. Laignel, B.; Vignudelli, S.; Almar, R.; Becker, M.; Bentamy, A.; Benveniste, J.; Birol, F.; Frappart, F.; Idier, D.; Salameh, E.; et al. Observation of the Coastal Areas, Estuaries and Deltas from Space. *Surv. Geophys.* **2023**, *44*, 1309–1356. [CrossRef]
46. Năvodaru, I.; Maximov, V. The spatial and temporal distribution of the shads in Black Sea—Marine zone of Danube Delta Biosphere Reserve. *Sci. Ann. Danub. Delta Inst.* **2014**, *20*, 95–100.
47. Giosan, L.; Donnelly, J.P.; Constantinescu, S.; Filip, F.; Ovejanu, I.; Vespremeanu-Stroe, A.; Vespremeanu, E.; Duller, G.A.T. Young Danube delta documents stable Black Sea level since the middle Holocene: Morphodynamic, paleogeographic, and archaeological implications. *Geology* **2006**, *34*, 757. [CrossRef]
48. Lankreijer, A.; Kováč, M.; Cloetingh, S.; Pitoňák, P.; Hlôška, M.; Biermann, C. Quantitative subsidence analysis and forward modelling of the Vienna and Danube basins: Thin-skinned versus thick-skinned extension. *Tectonophysics* **1995**, *252*, 433–451. [CrossRef]
49. Tessler, Z.D.; Vörösmarty, C.J.; Overeem, I.; Syvitski, J.P.M. A model of water and sediment balance as determinants of relative sea level rise in contemporary and future deltas. *Geomorphology* **2018**, *305*, 209–220. [CrossRef]
50. Winkels, H.J.; Kroonenberg, S.B.; Lychagin, M.Y.; Marin, G.; Rusakov, G.V.; Kasimov, N.S. Geochronology of priority pollutants in sedimentation zones of the Volga and Danube delta in comparison with the Rhine delta. *Appl. Geochem.* **1998**, *13*, 581–591. [CrossRef]
51. Sztanó, O.; Kováč, M.; Magyar, I.; Šujan, M.; Fodor, L.; Uhrin, A.; Rybár, S.; Csillag, G.; Tőkés, L. Late Miocene sedimentary record of the Danube/Kisalföld Basin: Interregional correlation of depositional systems, stratigraphy and structural evolution. *Geol. Carpathica* **2016**, *67*, 525–542. [CrossRef]
52. Giosan, L.; Filip, F.; Constatinescu, S. Was the Black Sea catastrophically flooded in the early Holocene? *Quaternary Science Reviews* **2009**, *28*, 1–6. [CrossRef]
53. Stanica, A.; Dan, S.; Ungureanu, V.G. Coastal changes at the Sulina mouth of the Danube River as a result of human activities. *Mar. Pollut. Bull.* **2007**, *55*, 555–563. [CrossRef] [PubMed]
54. Matenco, L.; Munteanu, I.; ter Borgh, M.; Stanica, A.; Tilita, M.; Lericolais, G.; Dinu, C.; Oaie, G. The interplay between tectonics, sediment dynamics and gateways evolution in the Danube system from the Pannonian Basin to the western Black Sea. *Sci. Total Environ.* **2016**, *543*, 807–827. [CrossRef]
55. Haberl, H.; Gaube, V.; Díaz-Delgado, R.; Krauze, K.; Neuner, A.; Peterseil, J.; Plutzar, C.; Singh, S.J.; Vadineanu, A. Towards an integrated model of socioeconomic biodiversity drivers, pressures and impacts. A feasibility study based on three European long-term socio-ecological research platforms. *Ecol. Econ.* **2009**, *68*, 1797–1812. [CrossRef]
56. Kim, K.H.; Lee, K.; Lee, H.S.; Rhee, C.W.; Shin, H.D. Lithofacies modeling by multipoint statistics and economic evaluation by NPV volume for the early Cretaceous Wabiskaw Member in Athabasca oilsands area, Canada. *Geosci. Front.* **2018**, *9*, 441–451. [CrossRef]
57. Mazilu, M.; Niță, A.; Drăguleasa, I.-A. Resilience of Romanian Tourism to Economic Crises and Covid-19 Pandemic. *WSEAS Trans. Bus. Econ.* **2023**, *20*, 328–341. [CrossRef]
58. Kimambo, O.N.; Mbungu, W.; Massawe, G.D.; Hamad, A.A.; Ligate, E.J. Rapid environmental flow assessment for sustainable water resource management in Tanzania's Lower Rufiji River Basin: A scoping review. *Heliyon* **2023**, *9*, e22509. [CrossRef]
59. Liu, C.; Sun, W.; Li, P.; Zhang, L.; Li, M. Differential characteristics of carbon emission efficiency and coordinated emission reduction pathways under different stages of economic development: Evidence from the Yangtze River Delta, China. *J. Environ. Manag.* **2023**, *330*, 117018. [CrossRef]

60. Leuven, R.S.E.W.; van der Velde, G.; Baijens, I.; Snijders, J.; van der Zwart, C.; Lenders, H.J.R.; bij de Vaate, A. The river Rhine: A global highway for dispersal of aquatic invasive species. *Biol. Invasions* **2009**, *11*, 1989–2008. [CrossRef]
61. Buijse, A.D.; Coops, H.; Staras, M.; Jans, L.H.; Van Geest, G.J.; Grift, R.E.; Ibelings, B.W.; Oosterberg, W.; Roozen, F.C.J.M. Restoration strategies for river floodplains along large lowland rivers in Europe. *Freshw. Biol.* **2002**, *47*, 889–907. [CrossRef]
62. Coleman, J.M.; Huh, O.K.; Jr, D.B. Wetland Loss in World Deltas. *J. Coast. Res.* **2008**, *24*, 1–14. [CrossRef]
63. Nikishin, A.M.; Okay, A.I.; Tüysüz, O.; Demirer, A.; Amelin, N.; Petrov, E. The Black Sea basin's structure and history: New model based on new deep penetration regional seismic data. Part 1: Basin's structure and fill. *Mar. Pet. Geol.* **2015**, *59*, 638–655. [CrossRef]
64. Armaş, I.; Avram, E. Perception of flood risk in Danube Delta, Romania. *Nat. Hazards* **2009**, *50*, 269–287. [CrossRef]
65. Tyler, A.N.; Hunter, P.D.; Spyrakos, E.; Groom, S.; Constantinescu, A.M.; Kitchen, J. Developments in Earth observation for the assessment and monitoring of inland, transitional, coastal and shelf-sea waters. *Sci. Total Environ.* **2016**, *572*, 1307–1321. [CrossRef] [PubMed]
66. Gül, M.; Küçükuysal, C. Geotourism activities via marine excursion: Muğla, SW Türkiye. *Geoheritage* **2023**, *15*, 64. [CrossRef]
67. Panin, N. The Danube Delta—The mid term of the geo-system Danube river—Danube Delta—Black Sea. Geological setting, sedimentology and holocene to present-day evolution. *Rev. Roum. Geol.* **2011**, *55*, 41–82.
68. Wang, S.; Chen, P.; Peng, W. Environmental assessment of regional cooperative elderly care: A case study of the Yangtze River Delta. *Econ. Change Restruct.* **2023**, *56*, 3979–4007. [CrossRef]
69. Coroian, C.O.; Muñoz, I.; Schlüns, E.A.; Paniti-Teleky, O.R.; Erler, S.; Furdui, E.M.; Mărghitaş, L.A.; Dezmirean, D.S.; Schlüns, H.; de la Rúa, P.; et al. Climate rather than geography separates two European honeybee subspecies. *Mol. Ecol.* **2014**, *23*, 2353–2361. [CrossRef]
70. Triantafyllidis, A.; Abatzopoulos, T.J.; Economidis, P.S. Genetic differentiation and phylogenetic relationships among Greek *Silurus glanis* and *Silurus aristotelis* (Pisces, Siluridae) populations, assessed by PCR–RFLP analysis of mitochondrial DNA segments. *Heredity* **1999**, *82*, 503–509. [CrossRef] [PubMed]
71. Kolodziejek, J.; Marinov, M.; Kiss, B.J.; Alexe, V.; Nowotny, N. The complete sequence of a West Nile virus lineage 2 strain detected in a Hyalomma marginatum marginatum tick collected from a song thrush (*Turdus philomelos*) in eastern Romania in 2013 revealed closest genetic relationship to strain Volgograd 2007. *PLoS ONE* **2014**, *9*, e109905. [CrossRef]
72. Cotar, A.I.; Falcuta, E.; Prioteasa, L.F.; Dinu, S.; Ceianu, C.S.; Paz, S. Transmission Dynamics of the West Nile Virus in Mosquito Vector Populations under the Influence of Weather Factors in the Danube Delta, Romania. *EcoHealth* **2016**, *13*, 796–807. [CrossRef] [PubMed]
73. Panteleit, J.; Keller, N.S.; Diéguez-Uribeondo, J.; Makkonen, J.; Martín-Torrijos, L.; Patrulea, V.; Pîrvu, M.; Preda, C.; Schrimpf, A.; Pârvulescu, L. Hidden sites in the distribution of the crayfish plague pathogen Aphanomyces astaci in Eastern Europe: Relicts of genetic groups from older outbreaks? *J. Invertebr. Pathol.* **2018**, *157*, 117–124. [CrossRef] [PubMed]
74. Rewicz, T.; Wattier, R.; Grabowski, M.; Rigaud, T.; Bącela-Spychalska, K. Out of the Black Sea: Phylogeography of the Invasive Killer Shrimp Dikerogammarus villosus across Europe. *PLoS ONE* **2015**, *10*, e0118121. [CrossRef]
75. Keller, B.E.M.; Lajtha, K.; Cristofor, S. Trace metal concentrations in the sediments and plants of the Danube Delta, Romania. *Wetlands* **1998**, *18*, 42–50. [CrossRef]
76. Audzijonyte, A.; Wittmann, K.J.; Väinölä, R. Tracing recent invasions of the Ponto-Caspian mysid shrimp Hemimysis anomala across Europe and to North America with mitochondrial DNA. *Divers. Distrib.* **2008**, *14*, 179–186. [CrossRef]
77. Murariu, G.; Ţopa, C.M.; Tudor, M. Trace elements in fish tissue with commercial value of the Danube Delta biosphere reserve. *Environ. Eng. Manag. J.* **2017**, *16*, 731–738.
78. Văidianu, N. *Danube Delta Biosphere Reserve. Partnership Between People and Nature for Sustainable Development*; ARS DOCENDI Publishing, University of Bucharest: Bucharest, Romania, 2013; ISBN 978-973-558-695-9.
79. Constantin, S.; Doxaran, D.; Constantinescu, Ş. Estimation of water turbidity and analysis of its spatio-temporal variability in the Danube River plume (Black Sea) using MODIS satellite data. *Cont. Shelf Res.* **2016**, *112*, 14–30. [CrossRef]
80. Coops, H.; Buijse, L.L.; Buijse, A.D.; Constantinescu, A.; Covaliov, S.; Hanganu, J.; Ibelings, B.W.; Menting, G.; Navodaru, I.; Oosterberg, W.; et al. Trophic gradients in a large-river Delta: Ecological structure determined by connectivity gradients in the Danube Delta (Romania). *River Res. Appl.* **2008**, *24*, 698–709. [CrossRef]
81. Borza, P.; Csányi, B.; Huber, T.; Leitner, P.; Paunović, M.; Remund, N.; Szekeres, J.; Graf, W. Longitudinal distributional patterns of Peracarida (Crustacea, Malacostraca) in the River Danube. *Fundam. Appl. Limnol.* **2015**, *187*, 113–126. [CrossRef]
82. Tănăsescu, M.; Constantinescu, S. The human ecology of the Danube Delta: A historical and cartographic perspective. *J. Environ. Manag.* **2020**, *262*, 110324. [CrossRef] [PubMed]
83. Schvab, A.; Vaidianu, N.; Sîrodoev, I.; Ratkajec, H.; Skolka, M.; Tudor, M.; Cracu, G.; Paraschiv, M.; Sava, D.; Florea-Saghin, I.; et al. Tourism impact models as sustainable development planning tools for local and regional authorities. *J. Urban Reg. Anal.* **2022**, *14*, 211–241. [CrossRef]

84. Nesterenko, M.; Dyakov, O.; Drumea, D.; Doroftei, M. *CCAS—Climate Change Adaptation Strategy and Action Plan for Danube Delta Region Romania—Ukraine—Moldova*. Kovbasko, O., Ionescu, C., Saaf, E.J., Eds.; 2021. Available online: https://awsassets.panda.org/downloads/2_danube_delta_adaptation_strategy.pdf (accessed on 20 September 2024).
85. Bărbulescu, A.; Dumitriu, C.Ș. Assessing water quality by statistical methods. *Water* **2021**, *13*, 1026. [CrossRef]
86. Tiller, R.; Destouni, G.; Golumbeanu, M.; Kalantari, Z.; Kastanidi, E.; Lazar, L.; Lescot, J.M.; Maneas, G.; Martínez-López, J.; Notebaert, B. Understanding Stakeholder Synergies Through System Dynamics: Integrating Multi-Sectoral Stakeholder Narratives into Quantitative Environmental Models. *Front. Sustain.* **2021**, *2*, 701180. [CrossRef]
87. Özmen, Ö.; Sârbu, R.; Săseanu, A.S.; Toader, C. The European Foundation for Quality Management (EFQM) Excellence Model in a Low Voltage Switchgear Company. *Amfiteatru Econ.* **2017**, *19*, 1064–1076.