diversity

MDPI

Review

Exploring the Research Landscape of Endemic Catadromous Fishes: A Comprehensive Bibliometric Study and PRISMA Review

Lekima K. F. Copeland [1,*], Brian L. Stockwell [1] and Susanna Piovano [1,2]

[1] School of Agriculture, Geography, Environment, Ocean and Natural Sciences, The University of the South Pacific, Suva 1168, Fiji
[2] UMR SENS (Savoirs, Environnement, Sociétés), Institut de Recherche pour le Développement (IRD), 34199 Montpellier, France
* Correspondence: s11021517@student.usp.com.fj

Abstract: Catadromous species are a common component of riverine ecosystems in island nations in the South Pacific; however, the bulk of these species remain poorly explored. This study sought to offer a comprehensive bibliometric analysis of the scientific literature on endemic and catadromous fishes using the PRISMA approach. We examined 317 documents from 106 sources between 1952 and 2022. These documents were written by a total of 595 authors with an average citation per document of 22.95. During this time span, 66 of 106 journal sources produced fewer than one article. Growth was slowest in the first 20 years (1952–1972) and peaked in 2005, accounting for 5.68% (18 documents) of the total of research papers across the study period. Our study documents a rise in scientific research on endemic and catadromous fishes in developing nations and regions. The data can be used by researchers, policymakers, and conservation managers to identify study gaps and trends in the field of endemic and catadromous fish studies. This study's primary contribution is a comprehensive analysis of the available literature that indicates research trends and gaps and potential future research pathways. The implementation of the bibliometric approaches utilized in this analysis can serve as a model for various research fields globally, including countries in the South Pacific. This broadened scope allows for a more comprehensive understanding of the research environment, ultimately leading to enhanced management and conservation of various biological groups. While the focus of this study was on endemic catadromous fish species, the application of this methodology extends beyond this group, providing valuable insights into a wide range of taxa.

Keywords: diadromous; migratory; South Pacific

Citation: Copeland, L.K.F.; Stockwell, B.L.; Piovano, S. Exploring the Research Landscape of Endemic Catadromous Fishes: A Comprehensive Bibliometric Study and PRISMA Review. *Diversity* **2023**, *15*, 825. https://doi.org/10.3390/d15070825

Academic Editors: Luis Moreira Da Costa and Simon Blanchet

Received: 10 April 2023
Revised: 22 June 2023
Accepted: 26 June 2023
Published: 30 June 2023

1. Introduction

Diadromous fish are characterized by their life cycles that involve migration between freshwater and marine environments as they undergo significant physiological changes to adapt to the varying salinity levels [1]. These species typically spawn in one habitat and complete their growth and development in another, leveraging the advantages of both environments for their survival and reproduction [1]. For example, Jenkins et al. [2] estimated that more than 98% of freshwater ichthyofauna in Fiji are diadromous, with amphidromous and catadromous species dominating life history strategies. These riverine communities are poorly understood components of the island aquatic ecosystems in the South Pacific. While some diadromous fish groups, such as salmonids, have been extensively researched, many diadromous species native to the South Pacific lack crucial biological and ecological data. This makes assessment of the conservation status of many diadromous fish challenging [3–5]. Wetland ecosystems in the South Pacific islands have not been extensively documented. Significant freshwater lakes, swamps, marshes, and rivers are found on the largest volcanic, high islands in the Pacific Ocean. Further research on the unique diadromous species in the South Pacific is essential to better understand and conserve these vital ecosystems.

In the South Pacific, several diadromous fish populations, particularly catadromous species, have declined in abundance and distribution owing to invasive species and migration barriers [2,6,7]. Catadromous fishes, exemplified by eels, spend most of their lives feeding and growing in fresh water but migrate to the ocean for reproduction [8,9]. Although comprehensive scientific knowledge about these species is limited, local observation, anecdotal evidence, and partial studies have indicated that many of these fish populations are not as abundant as they once were, with some becoming uncommon or extirpated in sections of their former range [2]. This decline is concerning, but assessing the precise status of these catadromous fish populations remains challenging due to the scarcity of comprehensive scientific data [10,11]. Thus, more research is needed to better understand and effectively manage these catadromous fish populations in the South Pacific.

Few quantitative investigations have been conducted on the biology and ecology of the catadromous riverine species in the South Pacific. The migration of catadromous fauna between freshwater and marine habitats transcends jurisdictional boundaries, performs unique services to ecosystems, and is frequently the focus of significant fisheries [2,12,13]. Catadromous fishes are especially sensitive to environmental changes owing to their lengthy and fragile migration routes [4]. The pelagic larval phase of these species is also a crucial stage in their life history that maintains connectivity between populations from different catchments and islands [11,14]. Understanding the conditions under which distinct life cycles occur in the South Pacific islands is essential for understanding the ecology of the structure and development of fish communities as well as for successfully managing and preserving local freshwater fish stocks.

1.1. South Pacific River Fish

The freshwater fish communities in Australia, New Zealand, and the small South Pacific islands are somewhat depauperate [15,16]. Ostariophysi, which constitutes approximately 88% of the world's freshwater ichthyofauna, is largely absent [17,18]. Isolation, island size, and distance from their centers of origin tend to make tropical Pacific islands even more impoverished [19]. Furthermore, climatic events, such as storms, floods, and droughts, can result in the local extinction of freshwater species on oceanic islands [20]. Therefore, these freshwater areas typically have diminished fish populations [21].

Owing to their volcanic origin, most tropical Pacific islands lack well-developed estuarine habitats, have a minimal variety of stream habitats, and are characterized by fast-moving streams with numerous waterfalls. Only diadromous species that enter estuaries have colonized these isolated freshwater environments in the Pacific [11]. These conditions facilitate the colonization by gobies, gudgeons, and eels (Gobiidae, Eleotridae, and Anguillidae, respectively), known for their climbing and crawling abilities [6,10]. Consequently, diadromous species dominate the indigenous ichthyofauna [10]. Six native families of teleostean fish (Anguillidae, Eleotridae, Gobiidae, Kuhliidae, Mugilidae, and Syngnathidae) and two introduced families (Cichlidae and Poecillidae) are commonly found on these tropical islands [11,22].

1.2. Using Bibliometric Analysis and the PRISMA Method to Analyze Research on Endemic and Catadromous Fishes

Bibliometric analysis is an indispensable tool for analyzing research patterns and future research orientations [23,24] and has been used to evaluate seven ecologically important species [25]. It helps identify research trends, key publications, and opportunities for collaborations [26]. While literature reviews provide a broad perspective, they have limitations due to difficulties defining relevant contributions [27]. In contrast, bibliometric analysis offers a reliable and quantitative method to visualize, categorize, integrate, and summarize bibliographic data [26]. Recent applications include plotting research on aquaculture [28], plastic pollution in aquatic systems [29,30], trends in fisheries science [31], and global dam removal patterns [23].

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) is a systematic review method for identifying, selecting, and critically evaluating relevant research as well as collecting and analyzing data from included studies [32–34]. PRISMA includes a 27-item checklist for authors and a four-phase flow diagram.

Bibliometric analysis and the PRISMA method were chosen for this study due to their ability to provide a comprehensive and systematic overview of existing research on endemic catadromous fishes. These methods allow for a quantitative assessment of research trends and patterns which can help identify knowledge gaps and highlight areas where future research is needed. By combining these methods, we can obtain a more complete understanding of the current state of research on endemic catadromous fish species and use this information to inform future research directions and conservation efforts.

Our main objectives are: (1) identifying research themes in the study of endemic catadromous fish species; (2) pinpointing key journals, institutions, and authors in this research domain; and (3) highlighting potential avenues for future research.

2. Materials and Methods

2.1. Species Database

To construct a species database, we used public information sources and the R package "rfishbase" to gather migratory life history and taxonomy data from Fishbase for "endemic" and "catadromous" fish [35]. Additionally, we supplemented our search for endemic and catadromous fish using the Boolean operator search phrase "site:fishbase.se AND Catadrom*" AND "Endemic" on the Google search engine. Finally, we manually reviewed the information in the species database to identify relevant endemic and catadromous species. Our criteria for relevance were based on the species being endemic to a specific country and exhibiting a catadromous life-history, wherein they spawn in saltwater and live part of their lives in freshwater environments.

2.2. Literature Retrieval and Inclusion Criteria

After refining our list of endemic and catadromous species, we searched the ISI Web of Science (WoS) core collection and Scopus bibliographic databases on September 18, 2022. The following terms were used to search for relevant studies: "*Anguilla dieffenbachii*" OR "*Cottus kazika*" OR "*Kuhlia malo*" OR "*Kuhlia salelea*" OR "*Macquaria novemaculeata*" OR "*Mesopristes elongatus*" OR "*Mesopristes kneri*" OR "*Notesthes robusta*" OR "*Percalates colonorum*" OR "*Potamalosa richmondia*" OR "*Pseudaphritis urvillii*" OR "*Pseudomyxus capensis*" OR "*Rhombosolea retiaria*". The 13 species in our study represent 100% of all known endemic catadromous species within the research area. The following search criteria were applied to this review: (1) only peer-reviewed journal articles were included, and (2) all publications were written in English. There were no limitations in the retrieval period. A total of 236 and 289 papers were downloaded in the Bibtex format from the Web of Science and Scopus databases, respectively (Figure 1). Data refinement was performed using Open-Refine® free software (3.6.2). This was done to ensure uniformity in author names and keywords and the removal of duplicates and institutions prior to the bibliometric analyses in R [36].

2.3. Data Analyses

Bibliometric data were analyzed using RStudio Version 4.1.0 interface, which includes an installed bibliometric library and packages for data organization, network visualization, and contextual mapping of bibliometric indices [26]. The Bibliometrix package provides a set of quantitative tools for analyzing metadata in WoS and Scopus using the R statistical programming platform. Identical records from the WoS and Scopus databases were combined using R commands and were treated as one record in the analysis.

R codes, developed by Aria and Cuccurullo [26], were used to retrieve information on the country of the corresponding authors, the most relevant sources and institutions, the most relevant keywords, the productivity of the top authors over time, the co-citation network, and the country collaboration. The H-index was calculated within the Bibliometrix

package using a method based on the citation counts of each paper by an author or within a dataset. The H-index is defined as the maximum value of h such that the given author or dataset contains h papers that have each been cited at least h times [26]. Lotka's Law was applied via Bibliometrix to ascertain the number of authors contributing a specific number of articles, providing an understanding of the productivity distribution among authors. According to Lotka's Law, the number of authors contributing n articles is roughly $1/n^2$ of those contributing a single article, thus aiding in identifying the most productive authors within the dataset [26]. Finally, the combined articles from both databases were exported in CSV format from RStudio and uploaded to Biblioshiny for further keyword occurrence and country network analysis [26].

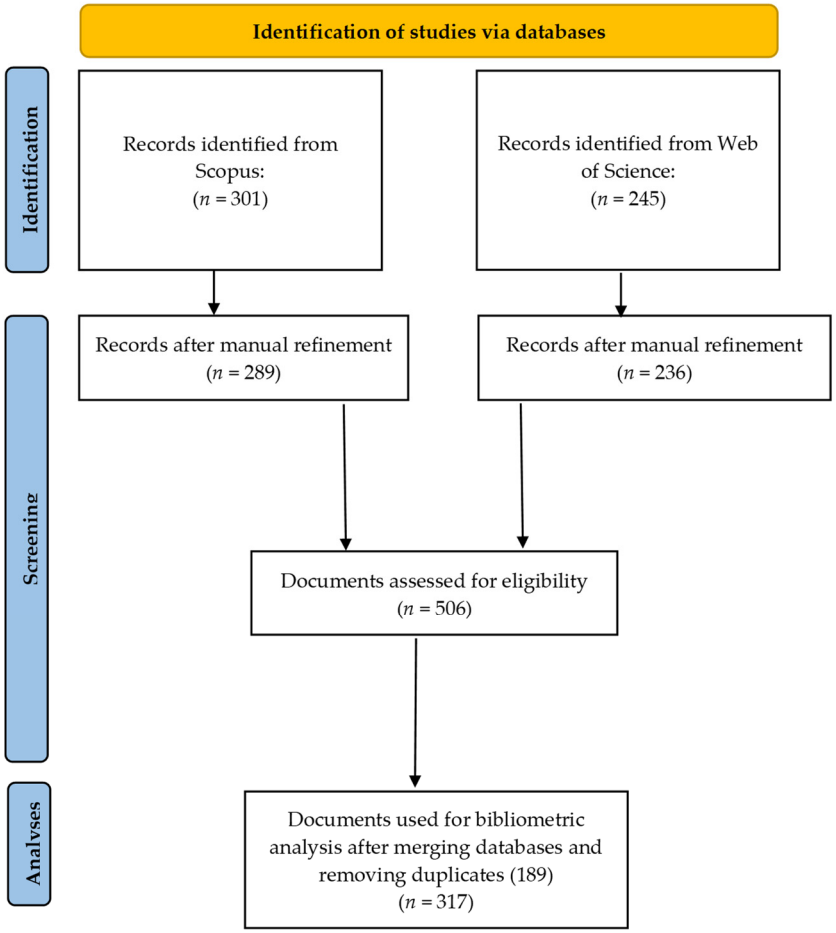

Figure 1. Data collection flow diagram using the PRISMA approach for Scopus and Web of Science Database.

3. Results and Discussion

3.1. Biogeography of Endemic Catadromous Fish

Out of 34,721 fish species enlisted in Fishbase, diadromous fishes constitute approximately 2.4% of global fish diversity, with catadromous species accounting for 0.2% (77 species). McDowall [37] estimated this number to be around 250 species exhibiting this unique trait, indicative of the rarity of catadromy. The highest diversity of catadromous fish species is observed at latitudes between 10° and 30° south [38].

Endemic catadromous fishes were discovered in nine countries worldwide (Figure 2). Australia is home to five species, followed by New Zealand with two species. The remaining seven countries each had one species. Interestingly, the distribution of most endemic catadromous species is restricted to the southern hemisphere. The only exception is Japan, which is in the northern hemisphere and has the endemic sculpin *Cottus kazika*.

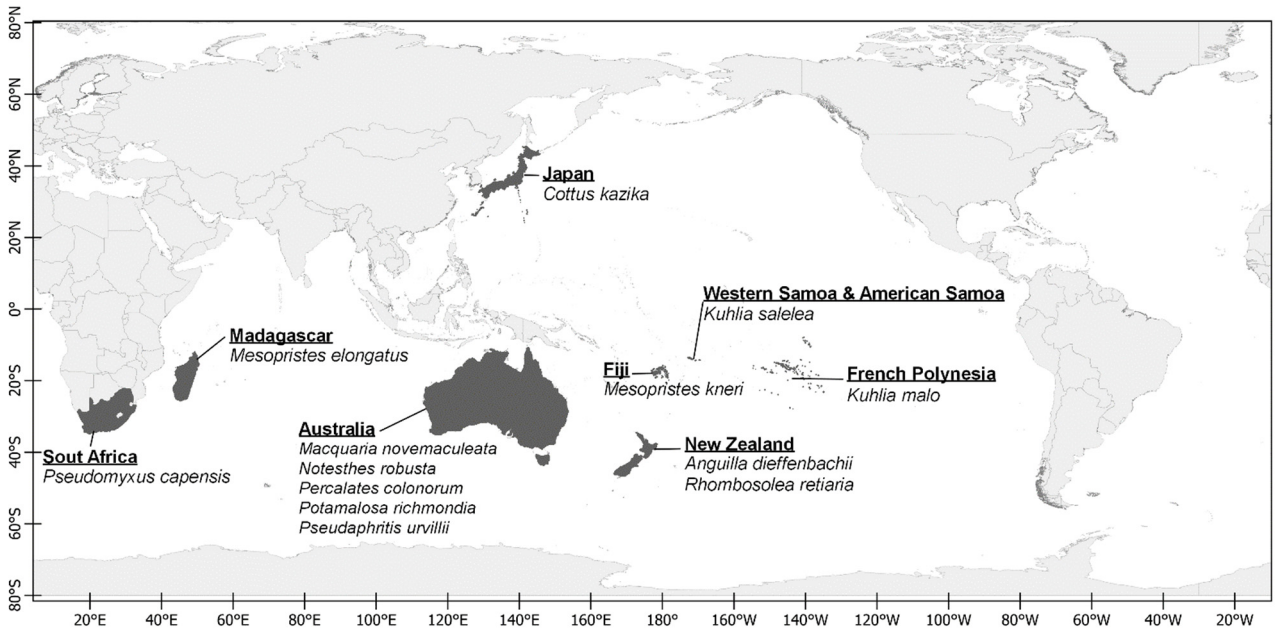

Figure 2. Global distribution of endemic catadromous fishes.

Anguillid eels are among the most well-known and diverse catadromous groups. Although they have a large distribution, they have not developed entirely freshwater lineages or even produced landlocked forms [37]. We have limited information about the biology of other species in the genus *Anguilla* despite 11 out of the 15 species being found in the Pacific Ocean and neighboring islands. Australasian species that have been examined the most are *Anguilla australis*, *A. reinhardtii*, and *A. dieffenbachii*. It is noteworthy that *A. dieffenbachii* is endemic to New Zealand. Marui et al. [39] compared the early life history between temperate eels and Pacific tropical eels using otolith microstructure and microchemistry and found that the pelagic larval duration was the longest for the endemic catadromous eel *A. dieffenbachii* compared to the other *Anguilla* spp. in the study.

The Indo-Australian Archipelago, often referred to as Wallacea, is recognized as a region where species and ecosystems from the Indomalayan region and Pandora region overlap. This overlap has led to the unique distribution of several species, as observed in the fish family Phallostethidae [40]. Similarly, this overlap could potentially be the driving factor behind the wide distribution of *Mesopristes* [40]. There are five species within the genus *Mesopristes*. Three, *M. argenteus*, *M. iravi*, and *M. cancellatus*, have extensive distributions throughout the East Indies and the New Guinea region, while *M. kneri* and *M. elongatus* are endemic to Fiji and Madagascar, respectively [41,42]. A recent study by Feutry et al. [20] suggested that the catadromous species of the tropical fish genus *Kuhlia* descended from a marine progenitor and that a catadromous lineage also gave rise to a marine lineage, a pattern that matches predictions from the productivity hypothesis. The limited resources in tropical inshore marine habitats, the isolated nature of freshwater environments of tropical islands, and the adaptability of migratory traits are significant factors in the evolution of diadromy in Kuhliidae and possibly in other groups [20]. This work by Feutry et al. [20] is a crucial steppingstone toward understanding the role of diadromy in diversification and adaptation in unstable settings.

In summary, the South Pacific appears to be a hotbed for endemic catadromous species. Future research needs to focus on uncovering the precise evolutionary mechanisms that have led to the emergence of such diversity in this region. More in-depth studies into the genus *Kuhlia* and similar tropical catadromous species would help shed light on the evolution of these unique organisms and how their migratory behaviors have been shaped by their habitats. Such insights are essential for the conservation of these species and their habitats in an ever-changing world.

3.2. Bibliometric Analyses and Findings

We reviewed 317 documents from 106 sources which were published between 1952 and 2022. A total of 595 authors contributed to these documents and had an average citation rate of 22.95 per document (Table 1). Among the 317 documents, 259 (81.70%) were multi-authored studies, while 58 (18.30%) were single-authored studies. The international co-authorship was 2.21%.

Table 1. Summary information about the meta-data obtained from Scopus and Web of Science from 1952–2022.

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	1952–2022
Sources (journals, books, etc.)	106
Documents	317
Annual growth rate %	2.74
Document average age (years)	20.80
Average citations per document	22.95
Average citations per year per document	1.15
References	12,414
DOCUMENT CONTENTS	
Keywords plus (ID)	1669
Author's keywords (DE)	953
AUTHORS	
Authors	595
Authors of single-authored documents	36
AUTHOR COLLABORATION	
Single-authored documents	58
Co-authors per documents	3.19
International co-authorships %	2.21
DOCUMENT TYPES	
Article	306
Proceedings	5
Review	6

The international collaboration index of multi-authored studies indicates that the field of endemic catadromous fish research is becoming more interdisciplinary, with researchers from diverse backgrounds working together. This interdisciplinary approach can lead to more comprehensive and integrated understandings of these species and their ecosystems. Figure 3 shows the number of articles published between 1952 and August 2022. Using Lotka's law to analyze the scientific output related to endemic catadromous fishes, we found a beta coefficient of 1.80 and a constant of 0.34. The Kolmogorov–Smirnoff goodness of fit test yielded a value of 0.88 (p = 0.99, K–S two sample test). Our analysis using Lotka's law showed no significant difference between the expected number of highly productive authors and the observed number of highly productive authors. Moreover, the beta coefficients and goodness of fit indicated that scientific output related to endemic catadromous fishes has the potential to increase in the future.

Research on endemic catadromous fishes has an annual growth rate of 3.89%, indicating an increase over time. The steady growth in research on endemic catadromous fishes could be attributed to several factors. One possible factor is the increasing awareness of the importance of biodiversity and the need for conservation efforts to protect endangered species and their habitats. Since these fishes are unique in their migration patterns and adaptations, understanding their biology and ecology can contribute to more effective conservation strategies.

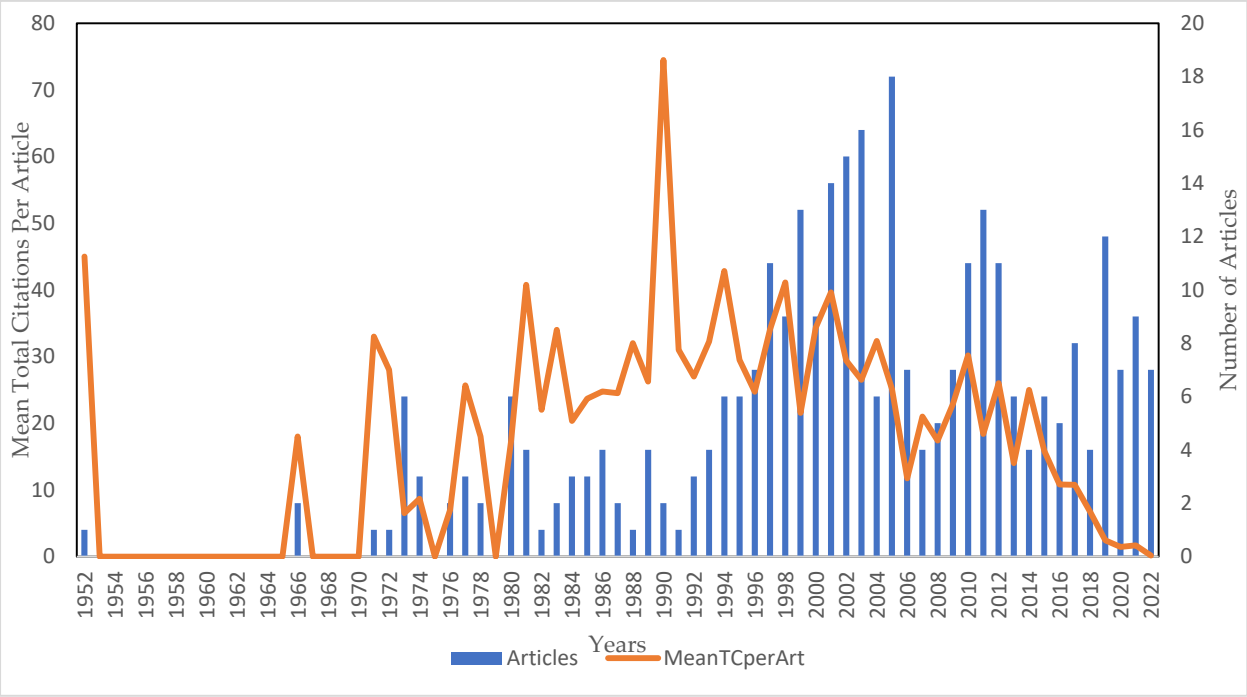

Figure 3. Annual number of research articles on endemic catadromous fish from 1952 to 2022. MeanTCperArt = mean total citation per article.

After the first article by Burnet [43] in 1952 on the ecology of the endemic New Zealand eel *A. dieffenbachii*, research output on endemic catadromous fishes fluctuated throughout the survey period. The slowest growth occurred in the first 20 years (1952–1972; Figure 3). An increased number of published documents was registered from 1999, peaking in 2005. This peak alone accounted for 5.68% (18 documents) of the total research papers during the study period. The slow nonlinear growth in the study period reflects variations in regional distribution of research efforts on endemic catadromous fishes.

Regarding annual scientific production, the endemic New Zealand eel, *A. dieffenbachii*, has received the most attention. The large number of publications may be due to the fact that most leading authors in this research area are from developed countries, such as Australia, New Zealand, and Japan, while only a few are from low-income countries, such as South Pacific island countries. Increased funding for research in developing countries, such as Fiji and Madagascar, could sustain the trend of increasing output, particularly for these poorly understood species. Despite New Zealand and Australia being home to seven endemic catadromous species, 25% of research has been centered on *A. dieffenbachia* and *M. novemaculeata*, which are both culturally and economically significant species [44].

3.3. Most Productive Authors

Out of the 595 authors who researched endemic catadromous fish, three (0.50%) had more than 10 publications (Figure 4). It is worth noting that Jellyman began his research in 1977 and has published 45 articles since then. This was followed by Lockman and Young in 16 and 12 articles, respectively. These three top authors are from New Zealand and the United States of America.

While Jellyman's comprehensive contributions have significantly influenced our understanding of endemic catadromous fish and inspired further investigations by fellow researchers, the concentration of publications among a limited number of scholars emphasizes the need for expanding the collaborative network in this discipline. An international co-authorship of 2.21% for collaborative studies, which is relatively high in some fields, indicates a positive move towards interdisciplinary collaboration with researchers from different backgrounds contributing together.

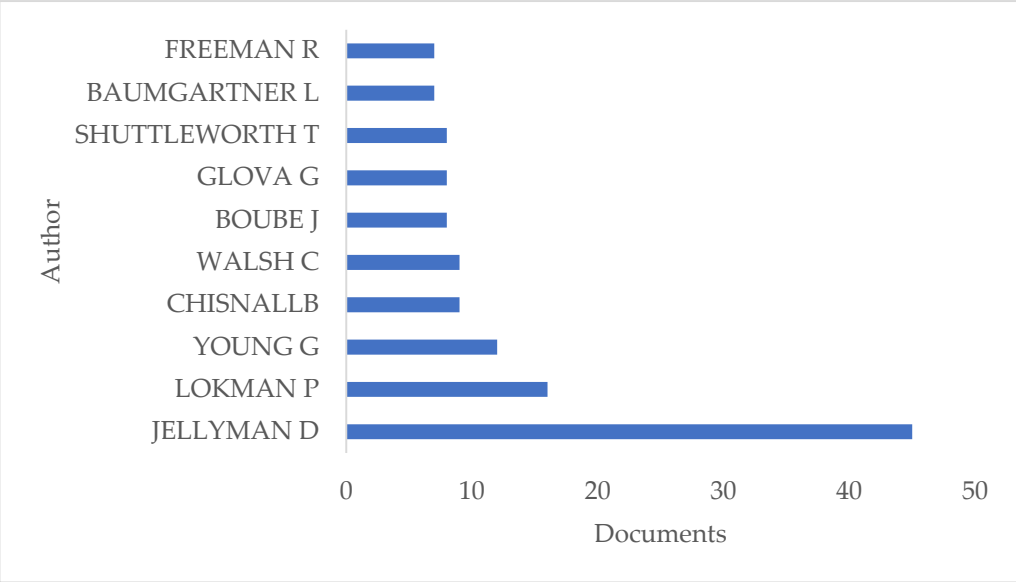

Figure 4. Most productive authors for endemic catadromous fishes research.

Despite this progress, further fostering collaboration and inviting a wider range of researchers from other countries into this field could prove beneficial in diversifying perspectives, enhancing scientific accuracy, and advancing a more inclusive understanding of endemic catadromous fish. This increased collaboration could potentially broaden the knowledge base, facilitate a richer exchange of ideas and expertise, and encourage the emergence of novel research directions [45].

3.4. Number of Articles Published by Sources and Influential Publications

Figure 5 presents the ten most relevant journal sources according to the number of publications. These top ten sources account for 53% (168 documents) of all the publications during the study period. The New Zealand Journal of Marine and Freshwater Research recorded the highest number of publications (56), followed by the Journal of Fish Biology and Marine and Freshwater Research (29 and 28 documents, respectively). This implies that these three journals are especially influential and may be considered leading platforms for research in this field.

Nonetheless, the fact that 67 out of 106 journal sources published one article during this period also reveals a broad range of journals covering the topic of endemic catadromous fishes, albeit to a lesser extent. This diversity in journal sources indicates that the study of endemic catadromous fishes extends beyond a single discipline, encompassing multiple scientific areas, such as ecology, marine biology, and ichthyology, among others.

The influence of a scientific publication can be assessed using citation analysis [46]. Table 2 presents the ten most significant publications according to total citations. The work by Unmack [47], which investigated the biogeographic patterns of obligate freshwater fishes in Australia, and the work by Lokman et. al. [48], which determined steroid profiles in *A. dieffenbachii* related to their preparation for spawning migration, represent some of the most influential research in the domain of endemic catadromous fishes. In addition, Davies et al. [49] examined sublethal responses of *P. urvillii* to pesticides, while other published studies with more than 80 citations have primarily focused on *A. dieffenbachii*. These include the study by Arai et al. [50], which examined the evidence of different habitat uses of *A. dieffenbachii* by measuring strontium and calcium levels in silver eels from otoliths. Hicks [51] examined the food web of *A. dieffenbachii* by analyzing stable isotopes of carbon and nitrogen and fish gut content. Jowett and Richardson [52] studied habitat preferences in New Zealand streams, and Lokman et al. [53] analyzed the importance of androgens in migratory fishes, especially *A. dieffenbachii*. It is worth noting that these influential publications and authors are associated

with institutions in developed countries, such as Australia and New Zealand. This suggests that the research infrastructure, resources, and funding in these countries may have facilitated high-quality research on their endemic catadromous fishes. These developed countries may have greater access to advanced research equipment, experienced researchers, and funding opportunities, which contribute to the production of influential publications.

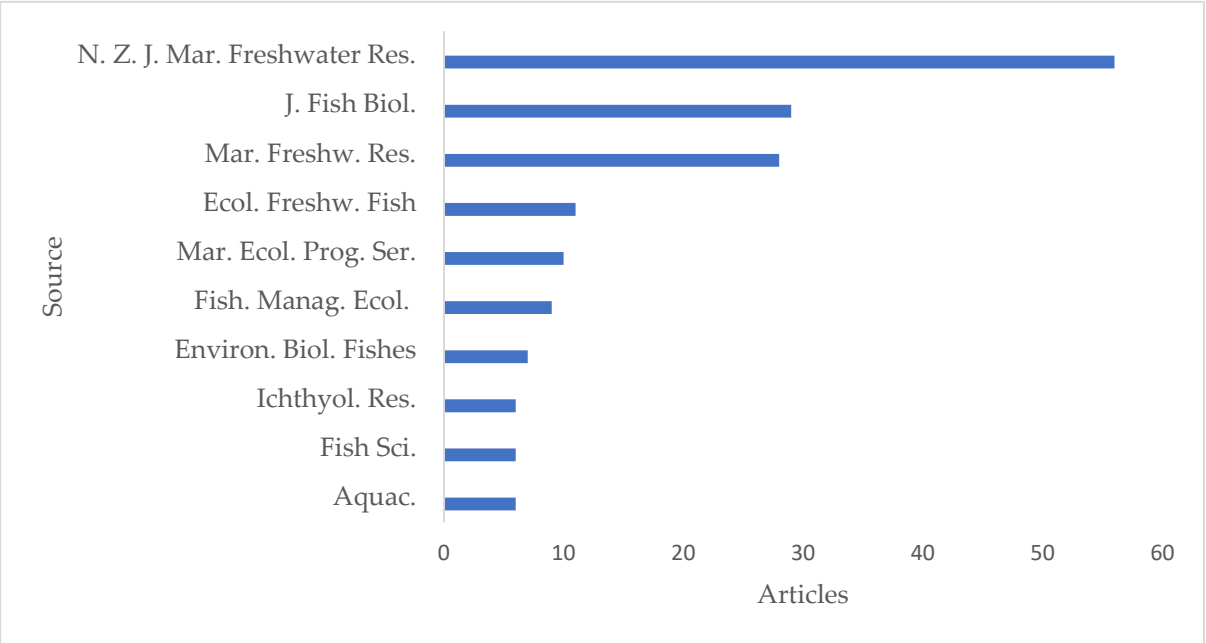

Figure 5. Top ten journals with the highest number of publications for endemic catadromous fishes.

Table 2. Top ten influential papers for endemic catadromous fishes. All 317 documents used in this bibliometric analysis can be found in the Supplementary Materials.

Paper	DOI	Total Citations	TC per Year	Normalized TC
Unmack P, 2001 [47]	10.1046/j.1365-2699.2001.00615.x	258	11.22	6.51
Lokman P, 1998 [48]	10.1023/A:1007719414295	121	4.65	2.94
Davies P, 1994 [49]	10.1002/etc.5620130816	110	3.67	2.57
Arai T, 2004 [50]	10.3354/meps266213	103	5.15	3.19
Grigaltchik V, 2012 [54]	10.1098/rspb.2012.1277	102	8.50	3.92
Mallen-Cooper M, 2003 [55]	10.1002/rra.714	99	4.71	3.74
Jowett I, 1995 [52]	10.1080/00288330.1995.9516635	93	3.21	3.15
Lokman P, 2002 [53]	10.1016/S0016-6480(02)00562-2	88	4.00	2.99
Ruus A, 2002 [56]	10.1002/etc.5620211114	88	4.00	2.99
Hicks B, 1997 [51]	10.1080/00288330.1997.9516796	86	3.19	2.52

3.5. Global Research Distribution and Collaboration

The global distribution of publications showed that 23 countries have participated in the field of endemic catadromous fishes research, of which 5 countries have been affiliated with more than 10 publications. The distribution of the studies among the countries showed that the origin of the research was mainly from Australia (39%), New Zealand (37%), and Japan (11%). Japan had the highest international scientific collaboration (Multiple Country Publication (MCP) = 5), followed by Australia and New Zealand at 4 and 3 collaborative publications each (Figure 6). Related research into freshwater biodiversity has found that developed countries, such as the United States, China, European countries, Australia, and Japan are leading countries regarding freshwater biodiversity research [57]. A systematic review by Alahuhta et al. [58] on biodiversity in freshwater ecosystems found a lack of research in Africa and South Asia. Similarly, a bibliometric study on trends in fishing

from 2000 to 2009 found a prominent decline in publications in Oceania compared to other developed countries [31]. This lack of information from developing countries is concerning as they are experiencing a severe biodiversity crisis due to population and economic growth which has led to the overexploitation of aquatic resources and biodiversity loss [6,59].

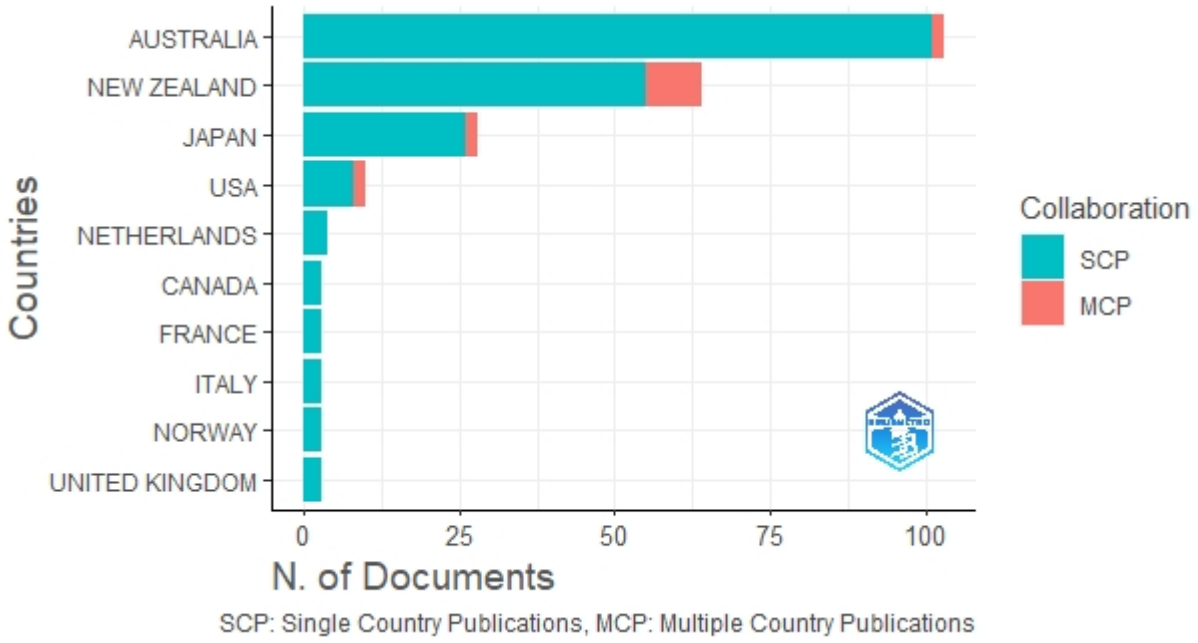

Figure 6. Corresponding author country productivity.

The oceanic islands of the South Pacific are hotspots for freshwater biodiversity. When species richness is adjusted for the ecoregion area, the islands of New Caledonia, Vanuatu, and Fiji are special freshwater fish regions [60]. Compared to large continental masses, such as Europe, Asia, and America, connectivity between marine and freshwater habitats is very high for South Pacific countries. For instance, Jenkins et al. [2] in Fiji record over 98% of the known riverine ichthyofauna having some facet of their lifecycle in the marine environment. Published research in these South Pacific countries has primarily been on the description of new species in the region, especially for amphidromous species [61–65]. Scientific research since the turn of the 21st century in these South Pacific countries on catadromous fishes has been carried out primarily by French researchers based at the French Natural History Museum [11,13,66] or in Japan [67–69].

The biased geographic scientific output can be attributed to differing levels of financial resources available for stud in different regions of the world [70]. The lack of state-of-the-art research facilities impedes local and foreign-supported research in these countries. For instance, laser ablation otolith microchemistry analyses for life-history studies of South Pacific riverine fish are often sent to institutions in Australia, New Zealand, Japan, or France. In addition to the lack of specialized equipment, scientific research in developing countries is hindered by the purchasing power of available funds as most equipment and supplies are imported from the United States or Europe.

3.6. Evolution and Future Themes

Keywords chosen by authors are significant as they represent the main concepts communicated to readers and the scientific community [71]. Among the 953 keywords, 19 met the threshold (minimum number of occurrences = two). The most frequently appearing keywords were "*A. dieffenbachii*" (total link strength 104) and "*A. australis*" (total link strength 91), which had strong links to "growth rates" and "New Zealand" (Figure 7). The prominence of keywords associated with "eels" is largely due to research carried out by Jellyman (n = 45 articles, Figure 4) on the endemic New Zealand eel that has been in

existence for the past 40 years. Noteworthy is the small distance between the keywords *A. dieffenbachii*, *A. australis,* spawning, migration, and growth rates. These are two clusters that deal with life-history information for *A. dieffenbachii* (keywords: hatching, gonad maturation, and otoliths).

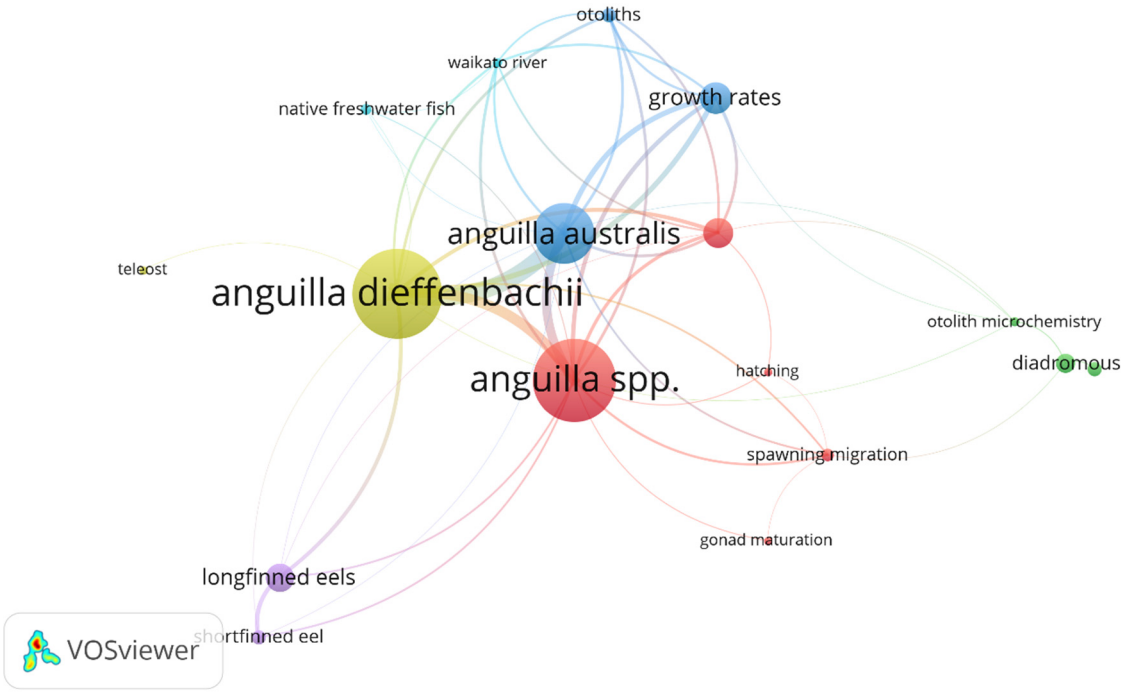

Figure 7. Authors' keyword co-occurrences. Each node depicts an author's keyword, and the node diameter represents the number of documents. The thickness of the connecting lines between the authors' keywords represents the link strength. Distances between the keywords mean relatedness in terms of co-occurrence links; that is, closer keywords indicate closer relatedness among them. Lines represent the strongest co-occurrences. There are 6 clusters, 49 links, and a total link strength of 257.

Regarding future themes, it is crucial to address research gaps in life-history information and conservation strategies for the lesser-studied endemic catadromous species, including those in developing countries. One approach to tackling these gaps is to consider the pressing unanswered questions in fish migration, as identified in the article by Lennox et al. [72]. These questions cover themes such as the internal state of migrating individuals, navigational mechanisms, locomotor capabilities, external drivers of migration, and threats to migratory fish, including climate change. To advance our understanding of fish migration, future research should examine the relative contributions of genetic and environmentally-induced variation in migratory behavior, utilize phylogeny-based comparative approaches, and focus on population-level variation [73,74]. Further studies are needed on the role of climate change, the consequences of anthropogenic impacts, and the reciprocal feedback loop between migration and genetic admixture. By addressing these challenges, we can develop best practices for adaptive management that maintain genetic and phenotypic diversity, promote establishment success, reduce extinction risk, and increase ecosystem productivity and resilience [75,76].

To understand the temporal variation in research topics, Table 3 lists the top 10 keywords during the periods 1952–1990, 1991–2000, 2001–2010, and 2011–2021. In the early period of 1952 to 1990, most keywords reflected a research focus on the native eels of Australia and New Zealand, especially regarding the diet, condition, and environmental factors of these species. Between 1991 and 2000, research was still heavily focused on *A. australis* and *A. dieffenbachii*, including the endemic *Galaxis fasciatus*, and studies were focused on distribution, habitat, and histology. The turn of the century saw more

research on *A. dieffenbachii*, *A. australis,* and *M. novemaculeata,* especially regarding genetics research (keywords: conservation genetics, hybridization, and microsatellites). The period of 2011–2021 saw continued research on endemic *A. dieffenbachii* and *M. novemaculeata*. The emergence of improved fisheries technology, such as radiotelemetry to study aquatic fauna, has drastically improved our fisheries knowledge. Jellyman [77] reviewed the use of radio and acoustic telemetry in studies on freshwater fish in New Zealand. It is evident that this period saw an increased number of studies on the ecology of this endemic species, with keywords such as acoustic telemetry, conservation, fish passage, and migration being prominent during this period.

Table 3. Occurrence of the top 10 keywords in the published literature covering endemic catadromous fishes in the four periods from 1952 to 2022. KW refers to keywords, and F refers to the frequency of the occurrence.

1952–1990		**1991–2000**		**2001–2010**		**2011–2022**	
KWs	**F**	**KWs**	**F**	**KWs**	**F**	**KWs**	**F**
Anguilla dieffenbachii	11	*Anguilla dieffenbachii*	11	*Anguilla dieffenbachii*	7	New Zealand	6
Anguilla australis	10	*Anguilla australis*	8	Australian bass	4	Acoustic telemetry	5
Anguillidae	5	Fish	5	Freshwater eel	3	*Macquaria novemaculeata*	4
Floods	3	Distribution	4	Growth	4	Diadromy	4
Nematodes	3	Eels	3	*Anguilla australis*	4	Conservation	4
Condition	2	*Galaxias fasciatus*	3	*Macquaria novemaculeata*	3	Aggression	3
Diet	2	Habitat	3	Conservation genetics	2	*Anguilla dieffenbachii*	3
Eels	2	Longfinned	3	Downstream migration	2	Temperature	3
Environmental factors	2	Shortfinned	3	Hybridization	2	Fish passage	3
Lakes	2	Histology	2	Microsatellites	2	Migration	3

Table 3 indicates that some prominent factors were not adequately esteemed by the authors' keywords, such as climate change. Climate change, as a universal, emerging threat, has shifted the population of vulnerable freshwater organisms worldwide to a large extent [6,78–80]. Research on climate change impacts has primarily been on *A. dieffenbachii*, *M. novemaculeata,* and *P. colonorum*. These studies have examined the effect of climate warming on the recruitment and growth of the population productivity of *P. colonorum* [81], elevated salinity and temperature impacts on *M. novemaculeata* [82], global warming effects on the predator–prey interactions of *M. novemaculeata*, and the implications of increased water temperature on glass eels' recruitment of *A. dieffenbachii* [83].

4. Conclusions

In conclusion, this review highlights an increase in scientific research on endemic catadromous fishes in the South Pacific which is primarily driven by New Zealand and Australian researchers and their international collaborations. However, there is a clear bias in the research towards a few species, notably the New Zealand longfin eel *A. dieffenbachii* and the Australian bass *M. novemaculeata*. This geographical bias is concerning, especially as developing countries and territories in the region are expected to face increasing pressure on their natural resources in the coming decades. It is crucial to improve the scientific understanding of fish that are endemic and catadromous in these countries and territories through future collaboration and research. Furthermore, the application of bibliometric tools used in this study could potentially serve as a model for South Pacific countries to better understand their research landscape. Overall, a comprehensive understanding of these catadromous fishes is crucial to mitigate the pressures that will arise from projected infrastructure development and land use changes in the region.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/d15070825/s1, Table S1. List of papers used for this bibliometric analysis.

Author Contributions: Conceptualization, L.K.F.C. and S.P.; methodology, L.K.F.C.; software, L.K.F.C.; validation, L.K.F.C.; formal analysis, L.K.F.C.; investigation, L.K.F.C.; data curation, L.K.F.C.; writing—original draft preparation, L.K.F.C.; writing—review and editing, B.L.S. and S.P.; supervision, B.L.S. and S.P. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the University of the South Pacific Scholarship for Excellence in Research and Innovation, which is a Ph.D. scholarship awarded to L.K.F.C. as part of his Ph.D. research (USP AURC Grant no. FD031-FST15-71502-001).

Institutional Review Board Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: We thank Jasha Dehm for his assistance in Figure 2.

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

References

1. Rulifson, R.; McDowall, R. Diadromy in Fishes: Migrations between Freshwater and Marine Environments. *Bioscience* **1989**, *39*, 565–566. [CrossRef]
2. Jenkins, A.P.; Jupiter, S.D.; Qauqau, I.; Atherton, J. The Importance of Ecosystem-Based Management for Conserving Aquatic Migratory Pathways on Tropical High Islands: A Case Study from Fiji. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2010**, *20*, 224–238. [CrossRef]
3. Jonsson, B.; Waples, R.S.; Friedland, K.D. Extinction Considerations for Diadromous Fishes. *ICES J. Mar. Sci.* **1999**, *56*, 405–409. [CrossRef]
4. McDowall, R.M. Different Kinds of Diadromy: Different Kinds of Conservation Problems. *ICES J. Mar. Sci.* **1999**, *56*, 410–413. [CrossRef]
5. Pippard, H. *The Current Status and Distribution of Freshwater Fishes, Land Snails and Reptiles in the Pacific Islands of Oceania*; IUCN: Gland, Switzerland, 2012; pp. 1–76.
6. Jenkins, A.P.; Jupiter, S.D. Spatial and Seasonal Patterns in Freshwater Ichthyofaunal Communities of a Tropical High Island in Fiji. *Environ. Biol. Fishes* **2011**, *91*, 261–274. [CrossRef]
7. Lin, H.-Y.; Jupiter, S.D.; Jenkins, A.P.; Brown, C.J. Impact of Anthropogenic Disturbances on a Diverse Riverine Fish Assemblage in Fiji Predicted by Functional Traits. *Freshw. Biol.* **2017**, *62*, 1422–1432. [CrossRef]
8. Myers, G.S. Usage of Anadromous, Catadromous and Allied Terms for Migratory Fishes. *Copeia* **1949**, *1949*, 89–97. [CrossRef]
9. McDowall, R.M. Diadromy: Origins and Definitions of Terminology. *Copeia* **1992**, *1992*, 248–251. [CrossRef]
10. Keith, P. Biology and Ecology of Amphidromous Gobiidae of the Indo-Pacific and Caribbean Regions. *J. Fish Biol.* **2003**, *63*, 831–847. [CrossRef]
11. Feutry, P.; Tabouret, H.; Maeda, K.; Pécheyran, C.; Keith, P. Diadromous Life Cycle and Behavioural Plasticity in Freshwater and Estuarine Kuhliidae Species (Teleostei) Revealed by Otolith Microchemistry. *Aquat. Biol.* **2012**, *15*, 195–204. [CrossRef]
12. Tsukamoto, K. Spawning of Eels near a Seamount. *Nature* **2006**, *439*, 929. [CrossRef] [PubMed]
13. Feutry, P.; Vergnes, A.; Broderick, D.; Lambourdière, J.; Keith, P.; Ovenden, J.R. Stretched to the Limit; Can a Short Pelagic Larval Duration Connect Adult Populations of an Indo-Pacific Diadromous Fish (*Kuhlia rupestris*)? *Mol. Ecol.* **2013**, *22*, 1518–1530. [CrossRef] [PubMed]
14. Lord, C.; Brun, C.; Hautecoeur, M.; Keith, P. Insights on Endemism: Comparison of the Duration of the Marine Larval Phase Estimated by Otolith Microstructural Analysis of Three Amphidromous *Sicyopterus* Species (Gobioidei: Sicydiinae) from Vanuatu and New Caledonia. *Ecol. Freshw. Fish* **2010**, *19*, 26–38. [CrossRef]
15. McDowall, R.M. Hawaiian Biogeography and the Islands' Freshwater Fish Fauna. *J. Biogeogr.* **2003**, *30*, 703–710. [CrossRef]
16. Wallis, G.P.; Trewick, S.A. New Zealand Phylogeography: Evolution on a Small Continent. *Mol. Ecol.* **2009**, *18*, 3548–3580. [CrossRef]
17. Darlington, P.J.J. *Zoogeography: The Geographical Distribution of Animals*; Wiley & Sons: New York, NY, USA, 1957.
18. Conway, K.W.; Lujan, N.K.; Lundberg, J.G.; Mayden, R.L.; Siegel, D.S. Microanatomy of the Paired-Fin Pads of Ostariophysan Fishes (Teleostei: Ostariophysi). *J. Morphol.* **2012**, *273*, 1127–1149. [CrossRef]
19. Powell, J.H.; Powell, R.E. The Freshwater Ichthyofauna of Bougainville Island, Papua New Guinea. *Pac. Sci.* **1999**, *53*, 346–356.
20. Feutry, P.; Castelin, M.; Ovenden, J.; Dettaï, A.; Robinet, T.; Cruaud, C.; Keith, P. Evolution of Diadromy in Fish: Insights from a Tropical Genus (*Kuhlia* Species). *Am. Nat.* **2013**, *181*, 52–63. [CrossRef]
21. Smith, G.C.; Covich, A.P.; Brasher, A.M.D. An Ecological Perspective on the Biodiversity of Tropical Island Streams. *BioScience* **2003**, *53*, 1048. [CrossRef]

22. Fitzsimons, J.M.; Parham, J.E.; Nishimoto, R.T. Similarities in Behavioral Ecology among Amphidromous and Catadromous Fishes on the Oceanic Islands of Hawai'i and Guam. *Environ. Biol. Fishes* **2002**, *65*, 123–129. [CrossRef]
23. Ding, L.; Chen, L.; Ding, C.; Tao, J. Global Trends in Dam Removal and Related Research: A Systematic Review Based on Associated Datasets and Bibliometric Analysis. *Chin. Geogr. Sci.* **2019**, *29*, 1–12. [CrossRef]
24. Munim, Z.H.; Dushenko, M.; Jimenez, V.J.; Shakil, M.H.; Imset, M. Big Data and Artificial Intelligence in the Maritime Industry: A Bibliometric Review and Future Research Directions. *Marit. Policy Manag.* **2020**, *47*, 577–597. [CrossRef]
25. Nikolic, N.; Baglinière, J.-L.; Rigaud, C.; Gardes, C.; Masquilier, M.-L.; Taverny, C. Bibliometric Analysis of Diadromous Fish Research from 1970s to 2010: A Case Study of Seven Species. *Scientometrics* **2011**, *88*, 929–947. [CrossRef]
26. Aria, M.; Cuccurullo, C. Bibliometrix: An R-Tool for Comprehensive Science Mapping Analysis. *J. Informetr.* **2017**, *11*, 959–975. [CrossRef]
27. Olisah, C.; Adams, J.B. Analysing 70 Years of Research Output on South African Estuaries Using Bibliometric Indicators. *Estuar. Coast. Shelf Sci.* **2021**, *252*, 107285. [CrossRef]
28. Natale, F.; Fiore, G.; Hofherr, J. Mapping the Research on Aquaculture. A Bibliometric Analysis of Aquaculture Literature. *Scientometrics* **2012**, *90*, 983–999. [CrossRef]
29. Kasavan, S.; Yusoff, S.; Rahmat Fakri, M.F.; Siron, R. Plastic Pollution in Water Ecosystems: A Bibliometric Analysis from 2000 to 2020. *J. Clean. Prod.* **2021**, *313*, 127946. [CrossRef]
30. Leal Filho, W.; Dedeoglu, C.; Dinis, M.A.P.; Salvia, A.L.; Barbir, J.; Voronova, V.; Abubakar, I.R.; Iital, A.; Pachel, K.; Huthoff, F.; et al. Riverine Plastic Pollution in Asia: Results from a Bibliometric Assessment. *Land* **2022**, *11*, 1117. [CrossRef]
31. Jarić, I.; Cvijanović, G.; Knežević-Jarić, J.; Lenhardt, M. Trends in Fisheries Science from 2000 to 2009: A Bibliometric Study. *Rev. Fish. Sci.* **2012**, *20*, 70–79. [CrossRef]
32. Kisely, S.; Chang, A.; Crowe, J.; Galletly, C.; Jenkins, P.; Loi, S.; Looi, J.C.; Macfarlane, M.D.; McVie, N.; Parker, S. Getting Started in Research: Systematic Reviews and Meta-Analyses. *Australas. Psychiatry* **2015**, *23*, 16–21. [CrossRef]
33. Gough, D.; Richardson, M. Systematic Reviews. In *Advanced Research Methods for Applied Psychology*; Routledge: Oxfordshire, UK, 2018; pp. 63–75.
34. Page, M.J.; Moher, D.; Bossuyt, P.M.; Boutron, I.; Hoffmann, T.C.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; Akl, E.A.; Brennan, S.E.; et al. PRISMA 2020 Explanation and Elaboration: Updated Guidance and Exemplars for Reporting Systematic Reviews. *BMJ* **2021**, *372*, n160. [CrossRef] [PubMed]
35. Boettiger, C.; Lang, D.T.; Wainwright, P.C. Rfishbase: Exploring, Manipulating and Visualizing FishBase Data from R. *J. Fish Biol.* **2012**, *81*, 2030–2039. [CrossRef] [PubMed]
36. Williamson, E.P. Fetching and parsing data from the web with OpenRefine. *Program. Hist.* **2017**, 6. [CrossRef]
37. McDowall, R.M. Diadromy, Diversity and Divergence: Implications for Speciation Processes in Fishes. *Fish Fish.* **2001**, *2*, 278–285. [CrossRef]
38. Alò, D.; Lacy, S.N.; Castillo, A.; Samaniego, H.A.; Marquet, P.A. The Macroecology of Fish Migration. *Glob. Ecol. Biogeogr.* **2021**, *30*, 99–116. [CrossRef]
39. Marui, M.; Arai, T.; Miller, M.; Jellyman, D.; Tsukamoto, K. Comparison of Early Life History between New Zealand Temperate Eels and Pacific Tropical Eels Revealed by Otolith Microstructure and Microchemistry. *Mar. Ecol. Prog. Ser.* **2001**, *213*, 273–284. [CrossRef]
40. Parenti, L.R.; Ebach, M.C. Evidence and Hypothesis in Biogeography. *J. Biogeogr.* **2013**, *40*, 813–820. [CrossRef]
41. Vari, R.P. The Terapon Perches (Percoidei, Teraponidae): A Cladistic Analysis and Taxonomic Revision. *Bull. AMNH* **1978**, *159*, 5.
42. Yoshino, T.; Yoshigou, H.; Senou, H. Mesopristes Iravi, a New Terapontid Fish (Perciformes: Terapontidae) from Rivers of Iriomote Island, the Ryukyu Islands. *Ichthyol. Res.* **2002**, *49*, 234–239. [CrossRef]
43. Burnet, A.M.R. Studies on the Ecology of the New Zealand Long-Finned Eel, *Anguilla dieffenbachii* Gray. *Mar. Freshw. Res.* **1952**, *3*, 32–63. [CrossRef]
44. Noble, M.; Duncan, P.; Perry, D.; Prosper, K.; Rose, D.; Schnierer, S.; Tipa, G.; Williams, E.; Woods, R.; Pittock, J. Culturally Significant Fisheries: Keystones for Management of Freshwater Social-Ecological Systems. *Ecol. Soc.* **2016**, *21*, 22. [CrossRef]
45. Johnson, T.R. *Integrating Fishermen and Their Knowledge in the Science Policy Process: Case Studies of Cooperative Research in the Northeastern U.S.*; Rutgers The State University of New Jersey, School of Graduate Studies: New Brunswick, NJ, USA, 2007.
46. Belter, C.W. Measuring the Value of Research Data: A Citation Analysis of Oceanographic Data Sets. *PLoS ONE* **2014**, *9*, e92590. [CrossRef] [PubMed]
47. Unmack, P.J. Biogeography of Australian Freshwater Fishes: Biogeography of Australian Freshwater Fishes. *J. Biogeogr.* **2001**, *28*, 1053–1089. [CrossRef]
48. Lokman, P.M.; Vermeulen, G.J.; Lambert, J.G.D.; Young, G. Gonad Histology and Plasma Steroid Profiles in Wild New Zealand Freshwater Eels (*Anguilla dieffenbachii* and *A. australis*) before and at the Onset of the Natural Spawning Migration. I. Females. *Fish Physiol. Biochem.* **1998**, *19*, 325–338. [CrossRef]
49. Davies, P.E.; Cook, L.S.J.; Goenarso, D. Sublethal Responses to Pesticides of Several Species of Australian Freshwater Fish and Crustaceans and Rainbow Trout. *Environ. Toxicol. Chem.* **1994**, *13*, 1341–1354. [CrossRef]
50. Arai, T.; Kotake, A.; Lokman, P.; Miller, M.; Tsukamoto, K. Evidence of Different Habitat Use by New Zealand Freshwater Eels *Anguilla australis* and *A. dieffenbachii*, as Revealed by Otolith Microchemistry. *Mar. Ecol.-Prog. Ser.* **2004**, *266*, 213–225. [CrossRef]

51. Hicks, B. Food Webs in Forest and Pasture Streams in the Waikato Region, New Zealand: A Study Based on Analyses of Stable Isotopes of Carbon and Nitrogen, and Fish Gut Contents. *N. Z. J. Mar. Freshw. Res.* **1997**, *31*, 651–664. [CrossRef]
52. Jowett, I.; Richardson, J. Habitat Preferences of Common, Riverine New Zealand Native Fishes and Implications for Flow Management. *N. Z. J. Mar. Freshw. Res.* **1995**, *29*, 13–23. [CrossRef]
53. Mark Lokman, P.; Harris, B.; Kusakabe, M.; Kime, D.E.; Schulz, R.W.; Adachi, S.; Young, G. 11-Oxygenated Androgens in Female Teleosts: Prevalence, Abundance, and Life History Implications. *Gen. Comp. Endocrinol.* **2002**, *129*, 1–12. [CrossRef]
54. Grigaltchik, V.S.; Ward, A.J.W.; Seebacher, F. Thermal Acclimation of Interactions: Differential Responses to Temperature Change Alter Predator–Prey Relationship. *Proc. R. Soc. B Biol. Sci.* **2012**, *279*, 4058–4064. [CrossRef]
55. Mallen-Cooper, M.; Stuart, I.G. Age, Growth and Non-Flood Recruitment of Two Potamodromous Fishes in a Large Semi-Arid/Temperate River System. *River Res. Appl.* **2003**, *19*, 697–719. [CrossRef]
56. Ruus, A.; Sandvik, M.; Ugland, K.I.; Skaare, J.U. Factors Influencing Activities of Biotransformation Enzymes, Concentrations and Compositional Patterns of Organochlorine Contaminants in Members of a Marine Food Web. *Aquat. Toxicol.* **2002**, *61*, 73–87. [CrossRef] [PubMed]
57. Ho, L.; Goethals, P. Research Hotspots and Current Challenges of Lakes and Reservoirs: A Bibliometric Analysis. *Scientometrics* **2020**, *124*, 603–631. [CrossRef]
58. Alahuhta, J.; Erős, T.; Kärnä, O.-M.; Soininen, J.; Wang, J.; Heino, J. Understanding Environmental Change through the Lens of Trait-Based, Functional, and Phylogenetic Biodiversity in Freshwater Ecosystems. *Environ. Rev.* **2019**, *27*, 263–273. [CrossRef]
59. Kingsford, R.T.; Watson, J.E. Climate Change in Oceania—A Synthesis of Biodiversity Impacts and Adaptations. *Pac. Conserv. Biol.* **2011**, *17*, 270–284. [CrossRef]
60. Abell, R.; Thieme, M.; Revenga, C.; Bryer, M.; Kottelat, M.; Bogutskaya, N.; Coad, B.; Mandrak, N.; Balderas, S.; Bussing, W.; et al. Freshwater Ecoregions of the World: A New Map of Biogeographic Units for Freshwater Biodiversity Conservation. *BioScience* **2008**, *58*, 403–414. [CrossRef]
61. Jenkins, A.; Boseto, D. *Schismatogobius vitiensis*, a New Freshwater Goby (Teleostei: Gobiidae) from the Fiji Islands. *Ichthyol. Explor. Freshw.* **2005**, *16*, 75–82.
62. Jenkins, A.P.; Mailautoka, K. *Hippichthys albomaculosus*, a New Species of Freshwater Pipefish (Pisces: Syngnathidae) from Fiji. *Int. J. Ichthyol.* **2010**, *16*, 6.
63. Keith, P.; Marquet, G.; Watson, R.E. *Akihito futuna*, a New Species of Freshwater Goby from the South Pacific (Gobioidei: Sicydiinae). *Cybium* **2007**, *6*, 471–476.
64. McCosker, J.E.; Boseto, D.; Jenkins, A. Redescription of *Yirrkala gjellerupi*, a Poorly Known Freshwater Indo-Pacific Snake Eel (Anguilliformes: Ophichthidae). *Pac. Sci.* **2007**, *61*, 141–144. [CrossRef]
65. Watson, R.E.; Keith, P.; Marquet, G. *Akihito vanuatu*, a New Genus and New Species of Freshwater Goby (Sicydiinae) from the South Pacific. *Cybium* **2007**, *31*, 341–349.
66. Feutry, P.; Keith, P.; Pécheyran, C.; Claverie, F.; Robinet, T. Evidence of Diadromy in the French Polynesian Kuhlia Malo (Teleostei: Percoidei) Inferred from Otolith Microchemistry Analysis. *Ecol. Freshw. Fish* **2011**, *20*, 636–645. [CrossRef]
67. Hewavitharane, C.A.; Pickering, T.D.; Rico, C.; Mochioka, N.; Hewavitharane, C.A.; Pickering, T.D.; Rico, C.; Mochioka, N. Early Life History of Tropical Freshwater Eels (*Anguilla* spp.) Recruiting to Viti Levu, Fiji Islands, in the Western South Pacific. *Mar. Freshw. Res.* **2020**, *71*, 452–460. [CrossRef]
68. Hewavitharane, C.A.; Pickering, T.D.; Rico, C.; Mochioka, N. Species Identification and Morphological Differences of Anguillid Glass Eels Recruiting to Viti Levu Island of Fiji in the Western South Pacific. *Aquac. Sci.* **2017**, *65*, 357–366.
69. Hewavitharane, C.A.; Pickering, T.D.; Ciro, R.; Mochioka, N. Species Composition, Abundance and Seasonal Recruitment Patterns of Freshwater Eels (*Anguilla* Spp.) to Viti Levu, Fiji Islands, in the Western South Pacific. *Mar. Freshw. Res.* **2018**, *69*, 1704–1711. [CrossRef]
70. Barber, P.H.; Ablan-Lagman, M.C.A.; Ambariyanto; Berlinck, R.G.; Cahyani, D.; Crandall, E.D.; Ravago-Gotanco, R.; Juinio-Meñez, M.A.; Mahardika, I.N.; Shanker, K.; et al. Advancing Biodiversity Research in Developing Countries: The Need for Changing Paradigms. *Bull. Mar. Sci.* **2014**, *90*, 187–210. [CrossRef]
71. Vošner, H.B.; Kokol, P.; Bobek, S.; Železnik, D.; Završnik, J. A Bibliometric Retrospective of the Journal Computers in Human Behavior (1991–2015). *Comput. Hum. Behav.* **2016**, *65*, 46–58. [CrossRef]
72. Lennox, R.J.; Paukert, C.P.; Aarestrup, K.; Auger-Méthé, M.; Baumgartner, L.; Birnie-Gauvin, K.; Bøe, K.; Brink, K.; Brownscombe, J.W.; Chen, Y.; et al. One Hundred Pressing Questions on the Future of Global Fish Migration Science, Conservation, and Policy. *Front. Ecol. Evol.* **2019**, *7*, 286. [CrossRef]
73. Bloom, D.D.; Burns, M.D.; Schriever, T.A. Evolution of Body Size and Trophic Position in Migratory Fishes: A Phylogenetic Comparative Analysis of Clupeiformes (Anchovies, Herring, Shad and Allies). *Biol. J. Linn. Soc.* **2018**, *125*, 302–314. [CrossRef]
74. Gurevitch, J.; Koricheva, J.; Nakagawa, S.; Stewart, G. Meta-Analysis and the Science of Research Synthesis. *Nature* **2018**, *555*, 175–182. [CrossRef]
75. Hughes, A.R.; Inouye, B.D.; Johnson, M.T.; Underwood, N.; Vellend, M. Ecological Consequences of Genetic Diversity. *Ecol. Lett.* **2008**, *11*, 609–623. [CrossRef]
76. Waldman, J.; Wilson, K.A.; Mather, M.; Snyder, N.P. A Resilience Approach Can Improve Anadromous Fish Restoration. *Fisheries* **2016**, *41*, 116–126. [CrossRef]

77. Jellyman, D. A Review of Radio and Acoustic Telemetry Studies of Freshwater Fish in New Zealand. *Mar. Freshw. Res.—MAR Freshw. RES* **2009**, *60*, 321–327. [CrossRef]
78. Merg, M.-L.; Dézerald, O.; Kreutzenberger, K.; Demski, S.; Reyjol, Y.; Usseglio-Polatera, P.; Belliard, J. Modeling Diadromous Fish Loss from Historical Data: Identification of Anthropogenic Drivers and Testing of Mitigation Scenarios. *PLoS ONE* **2020**, *15*, e0236575. [CrossRef] [PubMed]
79. Domisch, S.; Araújo, M.B.; Bonada, N.; Pauls, S.U.; Jähnig, S.C.; Haase, P. Modelling Distribution in European Stream Macroinvertebrates under Future Climates. *Glob. Change Biol.* **2013**, *19*, 752–762. [CrossRef]
80. Woodward, G.; Perkins, D.M.; Brown, L.E. Climate Change and Freshwater Ecosystems: Impacts across Multiple Levels of Organization. *Philos. Trans. R. Soc. B Biol. Sci.* **2010**, *365*, 2093–2106. [CrossRef] [PubMed]
81. Morrongiello, J.R.; Walsh, C.T.; Gray, C.A.; Stocks, J.R.; Crook, D.A. Environmental Change Drives Long-Term Recruitment and Growth Variation in an Estuarine Fish. *Glob. Change Biol.* **2014**, *20*, 1844–1860. [CrossRef]
82. O'Mara, K.M.; Wong, M.Y.L. Body Size Mediated Effects of Multiple Abiotic Stressors on the Growth and Social Behaviour of an Estuarine Fish, Australian Bass (*Macquaria novemaculeata*). *Environ. Biol. Fishes* **2016**, *99*, 95–104. [CrossRef]
83. August, S.M.; Hicks, B.J. Water Temperature and Upstream Migration of Glass Eels in New Zealand: Implications of Climate Change. *Environ. Biol. Fishes* **2008**, *81*, 195–205. [CrossRef]