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# Protected Area Effectiveness in the Scientific Literature: A Decade-Long Bibliometric Analysis

**Javier Martínez-Vega [1,*] and David Rodríguez-Rodríguez [2]**

[1] Institute of Economy, Geography and Demography, Spanish Research Council (IEGD-CSIC), 28037 Madrid, Spain
[2] European Topic Centre, University of Malaga, 29010 Malaga, Spain; davidrr@uma.es
* Correspondence: j.martinez@csic.es

**Abstract:** Protected areas (PAs) aim to safeguard biodiversity and ecosystem services in the long term. Despite remarkable growth in the area covered by PAs in recent years, biodiversity trends still show worrisome outcomes. Here, we conducted a systematic literature review (SLR) of scientific articles focusing on the ecological effectiveness of PAs that were published in the 2010–2019 decade using Scopus in order to show the latest publication trends in that research field. After three consecutive screenings, we analyzed a final census sample of 76 articles that used semiexperimental research designs. We assessed 3 thematic variables (i.e., related to ecological effectiveness) and 13 bibliometric variables through descriptive statistics, Spearman correlation tests, and Kruskal–Wallis difference tests. Our results demonstrate the growing size of research teams working on this topic, broader international collaboration, and greater length of the articles published on this subject. During that decade, the number of normalized citations (+28%) and the mean field-weighted citation impact (FWCI) of the set of reviewed articles (33% higher than expected) increased. We also observed an increase in open access publications (+13%). However, this mode of publication did not ensure more citations. Finally, we observed a positive correlation between the number of normalized citations and the inclusion of Supplementary Data in the articles.

**Keywords:** biodiversity conservation; ecological effectiveness; terrestrial realm; marine realm; systematic literature review



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## 1. Introduction

Systematic literature reviews (SLRs) are recognized as a useful tool for ascertaining the state of the art in a given field of research [1]. Typically, SLRs are conducted following a predefined protocol [2,3] where the criteria are explicitly stated before the review is conducted. The search terms and strategies are specified, including the names of the databases and the search period. Pittway [4] outlines seven key principles behind SLRs: transparency (i), clarity (ii), integration (iii), focus (iv), equality (v), accessibility (vi), and coverage (vii). SLRs are regarded as a standardized method for literature review that is replicable, transparent, objective, unbiased and rigorous, and therefore superior to other approaches for conducting literature reviews [5,6].

SLRs began in the mid-1990s as a novel way of conducting literature reviews. Their initial development was linked to the Evidence-based Medicine Working Group [2,7]. In the last decades, several SLRs have been addressed, especially focused on the medical fields of: epilepsy [8], chronic fatigue syndrome [9], Parkinson's disease treatment [10], sleep apnea [11], dementia [12], and infections [13]. More recently, there have been some interesting contributions in other disciplines as a result of the growing number of scientific publications. These relate to the social sciences [14], information systems [5], agriculture [15], climate change [16], forest fires [17,18], soil erosion [19], marine litter in transitional waters [20], and tropical marine science [21].

Bibliometric analyses are used for a variety of purposes, such as finding trends in journals, author or article performance, exploring collaboration patterns, or eliciting research interest on certain topics [22]. Other authors point out that bibliometric analyses are useful to understand patterns of research on a given topic, identify research gaps, and understand networks of collaborators on that topic [23,24]. Parallel to SLRs and bibliometric analyses, protected area (PA) effectiveness emerged as a research field in the early 2000s with the landmark publication "Evaluating Effectiveness. A framework for assessing the management of protected areas" [25]. Since those days, mostly qualitative and subjective PA assessment systems [26,27] have paved the way to increasingly objective, accurate and complex semi-experimental research designs [28–30]. Studies applying SLR on PAs are scarce. We only found few precedents. Caveen et al. [31] conducted a SLR to determine the ecological effects of Marine Protected Areas (MPAs). Another study conducted a SLR that selected a sample of 407 national park studies to investigate the sociodemographic and psychographic characteristics of visitors, their behavioral patterns, and their integration in management activities [32]. On the other hand, bibliometric studies are also increasing in more specific research topics such as terrestrial PAs [33,34] and MPAs [35]. Despite this progress, bibliometric analyses from SLRs on the global effectiveness of PAs on land and at sea are still missing.

In this study, we assessed a carefully selected census sample of scientific studies focusing on PA effectiveness in conserving biodiversity resulting from an SLR as a means of showing the recent publication trends in that research field.

## 2. Materials and Methods

### 2.1. Systematic Literature Review

We conducted a SLR of peer-reviewed articles published in English in journals in Scopus from 2010 until the end of 2019 (Figure 1). We selected that time range because relevant international decisions on PA effectiveness spanning until 2020 that are likely to have had a reflection in the scientific literature were made at the beginning of that decade [36], as well as on literature manageability grounds.

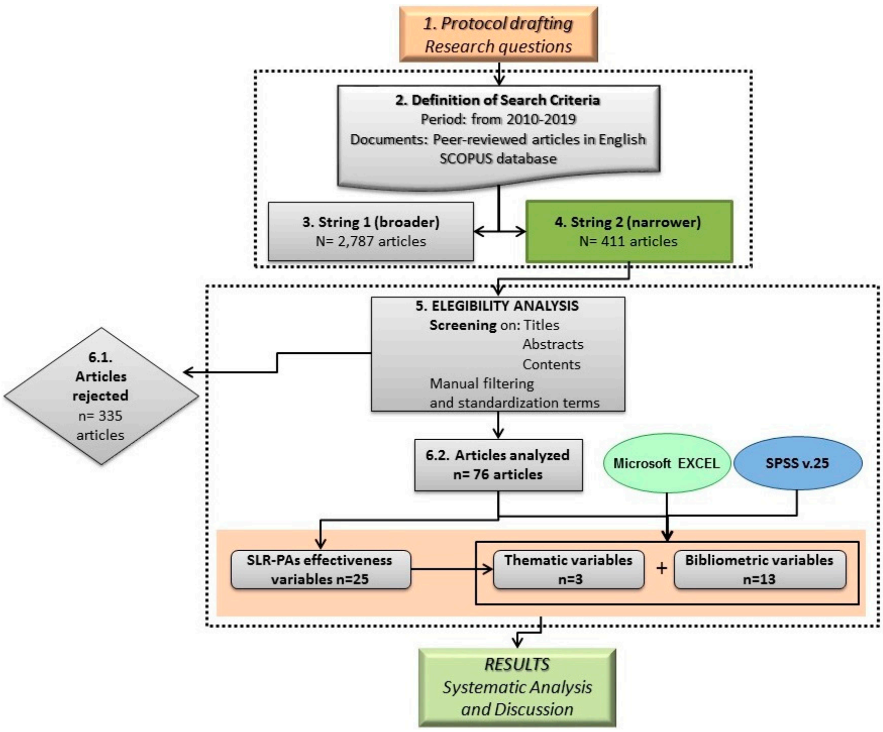


**Figure 1.** Methodological Flowchart.

We tested two search strings using keywords in the articles' titles:

- String 1 (broader): ('protected area' or 'MPA' or 'reserve' or 'natura 2000 site' or 'park') AND ('effect' or 'impact' or 'effectiveness' or 'performance' or 'efficacy'): 2787 articles.
- String 2 (narrower): ('protected area' or 'MPA' or 'reserve' or 'natura 2000 site' or 'park') AND ('effect' or 'impact' or 'effectiveness' or 'performance' or 'efficacy') AND ('biodiversity' or 'gene' or 'genetic' or 'species' or 'ecosystem' or 'habitat' or 'land' or 'environment *'): 411 articles.

We kept the selection from string 2 as a better balance between data comprehensiveness and manageability. After three consecutive screenings on titles, abstracts and content, a final census sample of 76 articles were selected and analyzed (Supplementary Materials). The protocoled procedure to carry out the SLR ensured that the final sample of articles only contained thematically focused and scientifically valid quantitative studies that used reliable semiexperimental research designs to assess (M)PA ecological effectiveness. A full version of the protocol used for the SLR can be accessed in the Supplementary Materials.

### 2.2. Bibliometric Analysis

We retrieved thirteen relevant bibliometric variables and three thematic variables for each article from relevant databases (Supplementary Materials) according to the literature [17,19,24,33,37,38] and a consultation with specialists in bibliometrics. The three thematic variables related to PA effectiveness were: the type of research design used in the evaluation of ecological effectiveness, biodiversity outcomes, and the Human Development Index—HDI—of the studied country.

Descriptive statistics were computed for most variables in Excel. For the variables "number of centers" and "HDI of the country of first authors", we did not take into account the multiple affiliations of the authors, just the first one. We used SPSS v. 25 software to perform Spearman correlation tests on most variables in the protocol due to the non-normality of some variables in order to ascertain relationships among them and clarify some results for $\alpha = 0.05$. Kruskal–Wallis tests were also performed for some relevant categorical variables after verifying non-normality for $\alpha = 0.05$.

## 3. Results

### 3.1. Articles' Metrics

There was an almost constant increase in the publication of quantitative studies on (M)PA ecological performance using complete or incomplete semiexperimental research designs between 2010 and 2019 (Figure 2).

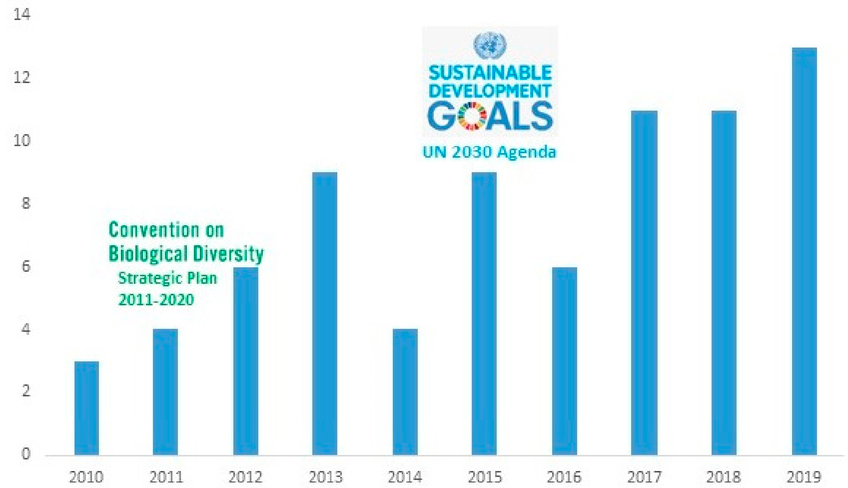


**Figure 2.** Number of scientific articles on protected areas' ecological effectiveness published between 2010 and 2019 resulting from a systematic literature review using Scopus.

The 76 articles were written by 71 different main authors, with three of them leading more than one study: Rodríguez-Rodríguez ($n$ = 3), Russ ($n$ = 3), and da Silva ($n$ = 2). In total, 44.7% of the articles included international collaborations. Table 1 summarizes a number of article-related bibliometric metrics from the reviewed articles.

**Table 1.** Statistics of some article-related bibliometric indicators.

| Indicator | Mean ± SD |
|---|---|
| Number of authors | 4.50 ± 2.68 |
| Number of centers | 3.00 ± 2.02 |
| Number of pages | 12.33 ± 5.24 |
| Number of references | 60.12 ± 25.77 |
| Normalized citations | 3.95 ± 3.89 |
| Field-weighted citation impact (FWCI) | 1.33 ± 1.23 |
| Normalized usage counts | 109.51 ± 332.66 |

The first authors' institutions were from 27 countries. Institutions from five countries: the USA (14.5% of the articles), China (10.5%), Australia (9.2%), Spain (9.2%), and the UK (9.2%) led over 50% of the PA effectiveness articles in the 2010–2019 decade. We also noted an increase in collaborations between different institutions. Likewise, we noted increasing trends in the average number of authors (Figure 3a) as well as in the average number of pages (Figure 3b) and references contained in each article (Figure 3c). The average number of centers in which the authors of published articles worked between 2015 and 2019 increased by 22% compared with the 2010–2014 period. In the second half of the decade under analysis, the publication of articles with Supplementary Data almost doubled compared with those published in the first half of the decade. At the same time, we observed a greater effort by authors to publish in open access (OA) journals. At the beginning of the decade, no article was published in OA mode compared with 61.5% in the last years of the decade.

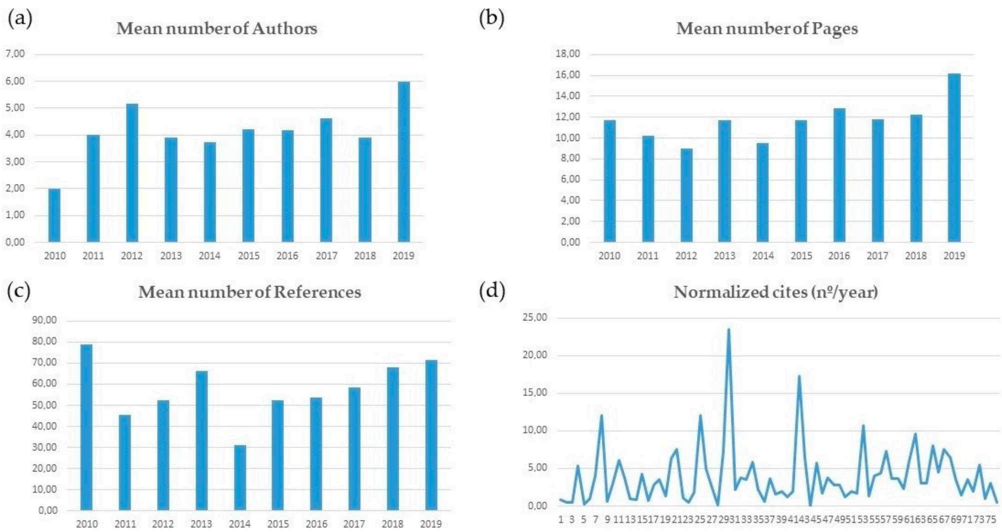


**Figure 3.** Time trends in scientific production over the last decade on protected areas' ecological effectiveness: (**a**) mean number of authors per year; (**b**) mean number of pages per year; (**c**) mean number of references contained in articles published each year; (**d**) normalized citations of each article, from 1 (2010) on the left on the $x$-axis to 76 (2019) on the right.

An increasing trend in normalized citations towards the end of the analyzed period was observed (Figure 3d). Thirty-five percent of the articles exceeded the average number of normalized citations. Considering normalized citations, 12% of the articles were ranked above the 90th percentile, each exceeding 7.5 citations per year. The most cited one reached 23.5 citations/year. These articles covered broad topics, ranging from land-use change, deforestation, landscape, vulnerability, and conflicts between human activities and biodiversity conservation. Most of them focused on terrestrial ecosystems. According to the average FWCI, the global production on the ecological effectiveness of PAs published between 2010 and 2019 was more cited than expected. Moreover, 44% of all the analyzed articles registered an FWCI greater than 1. In the top 10, eight articles exceeded the 90th percentile value (3.3) and three of them exceeded the value of 5.

The scientific production on the effectiveness of PAs between 2010 and 2019 focused on terrestrial PAs. These accounted for 66% of the selected articles, compared with 25% that studied MPAs. Articles analyzing coastal ecosystems were the minority (slightly less than 10%). The countries to which the greatest numbers of articles refer (Figure 4) were Spain and China (8 articles each), followed by Brazil (6) and Tanzania (4). On the other hand, our results show that PAs of maximal protection (IUCN categories I and II) attracted most of the research (50% of the articles analyzed).

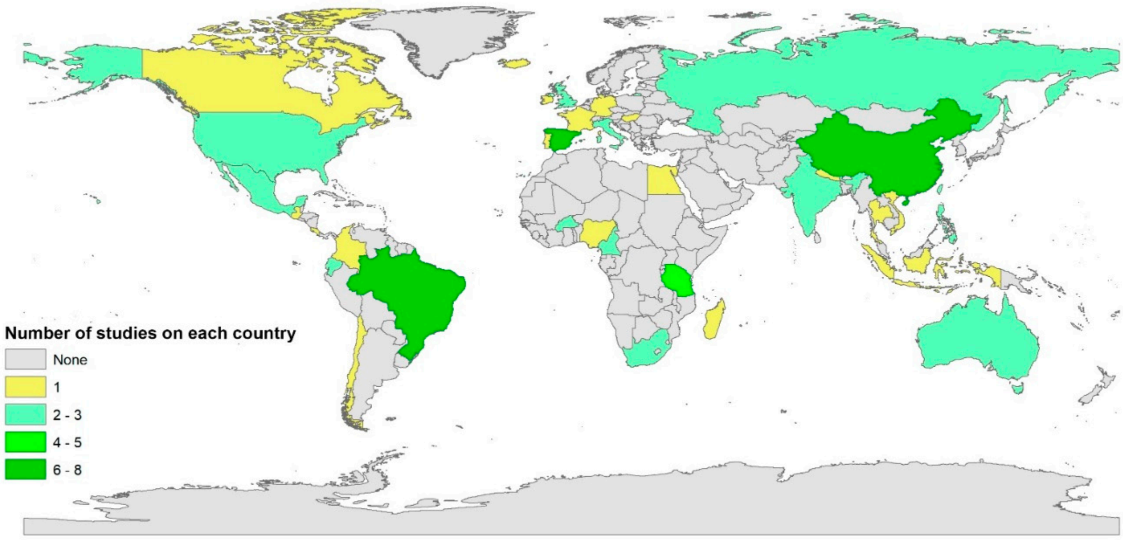


**Figure 4.** Geographical scope of the studies by country from 2010 to 2019.

Over 40% of the studies were funded by national institutions (Figure 5). However, articles funded by international programs (EU, UN-UNEP, IUCN, NASA, and National Geographic, among others) have tripled in the second half of the decade analyzed concerning the 2010–2014 period.

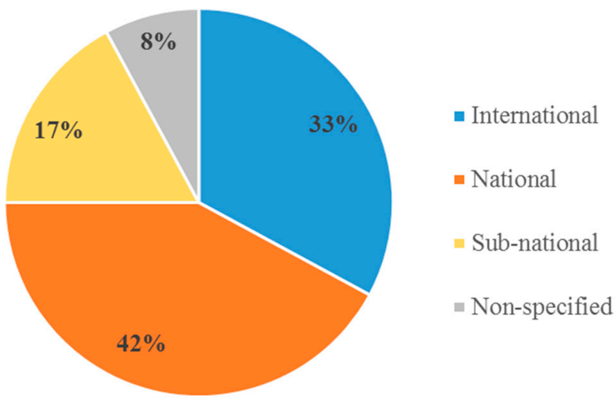


**Figure 5.** Scope of the institutions funding the studies.

*3.2. Journals' Metrics*

The 76 selected studies were published in 57 different journals. Twenty percent of them ($n$ = 15) were published in just four journals (Table 2): *Biological Conservation* ($n$ = 4), *Conservation Letters* ($n$ = 4), *PLoS One* ($n$ = 4), and *Ecological Indicators* ($n$ = 3). All of them were classified in the first quartile, have Impact Factors close to or higher than 3, and were in the best positions of the Journal Ranking (values > 0.75). The first two journals have many aspects in common: they are closely linked to conservation science, especially the conservation of biological diversity. However, they consider the multiple dimensions of conservation, from purely biological aspects to sociological and economic ones. They accept both theoretical and empirical research with a mainly pragmatic approach.

**Table 2.** Top 10 journals publishing articles about the ecological effectiveness of protected areas.

| Journal Name | Number of Articles | Quartile | Average Impact Factor | Journal Ranking by Subject Category | Total Citations | Total Normalized Citations (No./Year) |
|---|---|---|---|---|---|---|
| *Conservation Letters* | 4 | 1 | 5.246 | 0.90 | 281 | 34.36 |
| *Biological Conservation* | 4 | 1 | 4.151 | 0.91 | 158 | 19.33 |
| *PLoS One* | 4 | 1 | 2.762 | 0.74 | 46 | 13.42 |
| *Ecological Indicators* | 3 | 1 | 3.814 | 0.83 | 93 | 21.00 |
| *Ecology and Society* | 2 | 1 | 2.755 | 0.85 | 27 | 4.73 |
| *Regional Environmental Change* | 2 | 1 | 2.704 | 0.78 | 35 | 5.83 |
| *Biodiversity and Conservation* | 2 | 2 | 2.301 | 0.69 | 43 | 4.43 |
| *Aquatic Conservation: Marine and Freshwater Ecosystems* | 2 | 1 | 2.164 | 0.68 | 9 | 2.25 |
| *Ocean and Coastal Management* | 2 | 2 | 2.012 | 0.69 | 28 | 5.61 |
| *Fisheries Research* | 2 | 1 | 1.920 | 0.77 | 19 | 2.82 |

Quartile: Seven of the ten journals maintain the same quartile throughout the time series analyzed. Only three journals (*PLoS One*, *Regional Environmental Change*, and *Aquatic Conservation*) have changed their quartiles between years. In those cases, we selected the dominant quartile. In case of a tie, the best of them was chosen. The Impact Factor and Journal Ranking figures are average values over the years of publication of the selected articles. In the last two columns, we express the sum of citations and normalized citations of the articles, from their publication date to the present (April 2022).

Broadly, 50% of the journals were in the first quartile in the year when the articles were published (Supplementary Materials). The mean Impact Factor of those journals in the years when the articles were published was 2.79 $\pm$ 1.45. The normalized average ranking (0–1) of the journals according to their Impact Factor in the year of publication was 0.68 $\pm$ 0.24, corresponding to the second quartile. The authors of the 76 articles published their results progressively in journals with a higher Impact Factor. The average annual Impact Factor of the journals where the selected articles were published almost tripled over the decade. In 2010, the average Impact Factor was 1.16, while in 2018 it reached 3.37, and 3.02 in 2019.

Just over 30% of the articles were published in journals indexed in the Directory of Open Access Journals (DOAJ). Among them, four articles were published in *PLoS One*, three in *Conservation Letters*, two in *Scientific Reports*, two more in *Ecology and Society*, and one in *Global Ecology and Conservation*. Over 55% of the articles were published in three journal categories: Environmental Sciences, Ecology, and Biodiversity Conservation (Figure 6).

Articles published in journals belonging to the categories Biodiversity Conservation, Geography, Tourism, Remote Sensing, and Agricultural Sciences achieved the highest normalized number of citations (Figure 7) while obtaining considerably more citations than expected compared with other similar papers (FWCI index). On the contrary, articles published in journals included in the categories Zoology and Fisheries obtained worse results in terms of research impact if we consider normalized citations, FWCI, and normalized usage counts. In an intermediate position was the group of studies published in the Multidisciplinary Sciences category. They achieved an average of 3.63 citations per year but obtained fewer citations than expected (FWCI = 0.75).

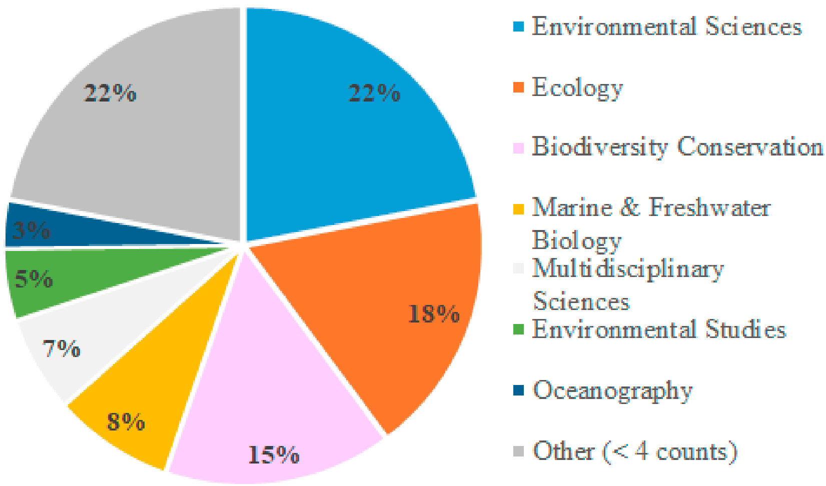


**Figure 6.** Subject categories of journals publishing the articles from the systematic literature review.

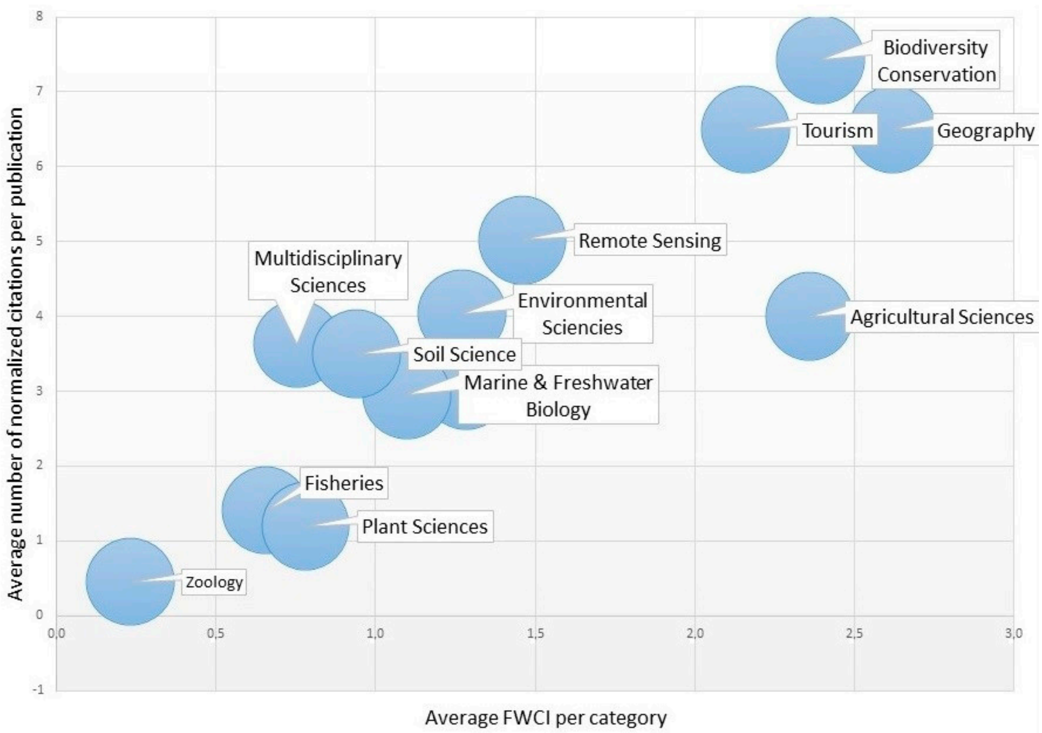


**Figure 7.** Relationship between the mean FWCI (Field-Weighted Citation Impact) ($x$-axis) and the average number of normalized citations of articles according to each subject category of the publishing journals ($y$-axis).

### *3.3. Correlations*

The Supplementary Materials show the complete results of the Spearman correlation analyses. In summary, we highlight that:

1. Very strong and significant correlations occurred between the following variables: Quartile and Journal Ranking by subject category ($r_s(66) = -0.900; p = 0.000$), Impact Factor and Journal Ranking by subject category ($r_s(64) = 0.870; p = 0.000$), and Normalized citations and FWCI ($r_s(72) = 0.888; p = 0.000$).
2. There was a strong negative correlation between Quartile and Impact Factor ($r_s(65) = -0.795; p = 0.000$).
3. Finally, moderate correlations were found between the following variables:

Method and Journal Ranking by subject category ($r_s(68) = 0.417; p = 0.000$), Normalized citations and Journal Ranking by subject category ($r_s(68) = 0.403; p = 0.001$), Normalized citations and Impact Factor ($r_s(65) = 0.510; p = 0.000$), HDI of the study country and HDI of the first author's institution ($r_s(72) = 0.427; p = 0.000$), Normalized usage counts and Number of references ($r_s(61) = 0.401; p = 0.001$), Number of authors and Number of centers ($r_s(74) = 0.562; p = 0.000$), and Number of pages and Number of references ($r_s(74) = 0.590; p = 0.000$).

Next, we summarize the results of the Kruskal–Wallis tests:

1. Studies that used more complete semiexperimental methods were published in journals with a higher Impact Factor in the year of publication ($\chi^2_{(2)} = 8.34; p = 0.015$).
2. Studies with Supplementary Data had more Normalized citations ($\chi^2_{(1)} = 8.32$; $p = 0.004$), more Normalized usage counts ($\chi^2_{(1)} = 4.48; p = 0.034$), higher Impact Factor ($\chi^2_{(1)} = 9.02; p = 0.003$), FWCI ($\chi^2_{(1)} = 6.66; p = 0.010$), greater Number of centers ($\chi^2_{(1)} = 5.51; p = 0.019$), Number of article pages ($\chi^2_{(1)} = 4.76; p = 0.029$), and Number of references ($\chi^2_{(1)} = 7.02; p = 0.008$). In addition, they were more articles published by the first authors' institutions in countries with a very high HDI ($\chi^2_{(1)} = 9.76; p = 0.002$) and by research funding institutions with a higher scope ($\chi^2_{(1)} = 6.07; p = 0.014$).
3. OA articles were more frequent by the first authors' institutions in countries with a very high HDI ($\chi^2_{(1)} = 6.64; p = 0.010$) and by research funding institutions with a larger scope ($\chi^2_{(1)} = 10.14; p = 0.001$).
4. International collaboration led to a greater Number of authors ($\chi^2_{(1)} = 12.29; p = 0.000$), centers ($\chi^2_{(1)} = 26.40; p = 0.000$), and article pages ($\chi^2_{(1)} = 3.87; p = 0.049$).

## 4. Discussion

### *4.1. Bibliometric Assessment*

The adoption of Aichi Target 11 by the international community in 2010 [36] most likely sparked scientific interest and thus publications on PA effectiveness in that decade, as shown from our data. In addition to the increase in scientific productivity, the Aichi Targets seem to have contributed to increasing the quality and extent of international collaborations of researchers in this field [39]. Moreover, the adoption of the 2030 Agenda for Sustainable Development and its Sustainable Development Goals [40], namely SDG 14 and SDG 15, is likely to have promoted a wider scientific interest in the topic of sustainability, (M)PAs, and their areas of influence [41–43]. Furthermore, scientists are increasingly interested in predictive models on PAs and their surroundings through future projections until 2025, 2030 or 2050 under different scenarios that consider biodiversity as a priority target [44–48]. The concurrence of these scientific interests has likely increased publications, especially between 2015 and 2019. This phenomenon has not only occurred in the field of (M)PAs [23,35,49] but also in other thematic fields, especially those related to natural and anthropogenic risks that have negative effects on natural resources, sustainability and landscape ecology such as land-use changes [15], forest fires [17,18,38] or ecotourism [24].

National legal and institutional frameworks prioritize lines of research related to biodiversity conservation in the most stringent PA categories (IUCN categories I and II) [33,50]. This is probably why these attract most of the research. On the other hand, previous studies have confirmed that terrestrial PAs concentrate the bulk of the analyses of (M)PAs in contrast to MPAs [49], likely reflecting the later emergence of MPA effectiveness studies and marine conservation science in general [51,52].

The increase in the average number of authors, institutions, pages, references, and the inclusion of Supplementary Data indirectly demonstrates the growing size of the research teams working on this topic, the increasing collaboration among them, and the greater depth of the studies addressed. The slight increase in international collaboration in authorship, which we observed in the second half of the decade under analysis compared with the first half (+4%) can probably be attributed to the interest of scientists to improve their academic prestige, scientific recognition, and improved access to research funding [53].

Contrary to Abramo and D'Angelo [54], in the field of PA effectiveness, the number of citations received by articles is not influenced by the number of authors. Bezak et al. [19] concluded that, compared with other variables, the number of authors had a small relative impact on the normalized number of citations. On the other hand, they pointed out that global studies receive many more citations than regional or local studies. Although articles with international collaborations do not necessarily receive more normalized citations, our results show that they tend to be published in journals with higher prestige (Impact Factor and quartile) [55] or better positioned in the ranking according to their subject categories.

The correlation of standardized citations with other variables is a subject of controversy. On the one hand, and in contrast to what some authors point out [56,57], our results show that there were no statistically significant differences in the number of normalized citations according to the OA or non-OA status of articles. On the other hand, our results are consistent with those of Piwowar et al. [58]. These authors showed that the public sharing of detailed research data (Supplementary Data) is significantly associated with an increase in citations, regardless of the journals' Impact Factor, publication date, and authors' country of origin. This correlation may further motivate researchers to share their Supplementary Data. Although some authors [59] showed that coauthored articles achieved a higher number of normalized citations than those published by a single author, our results show a weak correlation between the two variables. This could be due to multiple causes. Bornmann [60] showed that greater collaboration (measured in number of authors, number of affiliations, and number of countries) is associated with higher citation impact. However, it is unclear whether the increase in citations was based on the higher quality of the articles, which benefit from the expert inputs of more scientists, or on other factors. Similarly, Tahamtan et al. [61] indicated that many factors influence the number of citations. Some are closely related to authors, including their number. Other explanatory factors are related to the article itself (e.g., quality; novelty and interest of the topic; methodology; and study design) and the journal (Impact Factor; language; scope; publication form). Moreover, contrary to the results of other authors [37], we obtained a very weak correlation between normalized citations and the number of centers.

The strongest correlations among Impact Factors, namely journals' ranking in their respective disciplines, the quartiles to which they belong, the normalized number of citations, and the FWCI, seem logical if we consider the close relationship between these variables and the fact that the FWCI index takes into account the number of citations over three years. A possible explanation is that pointed out by Seglen [62] and Bezak et al. [19]: articles usually receive their citations independently of the journals in which they are published. That is, the impact of the journal is determined by its articles and not vice versa. On the other hand, articles covering a wide variety of subtopics related to the main topic, in this case the effectiveness of PAs, was probably the reason why they received more citations [17]. Conceptually, the articles that used more complex methods—for example, complete semiexperimental research designs—tended to be published in journals better positioned in the ranking of their respective disciplines.

An increasing proportion of the academic literature produced on the effectiveness of PAs was OA, even higher than that noted by some authors in other disciplines such as Chemistry, Biology, Social Sciences or Physics [57]. Our data show an association between the scope of funding agencies and OA. Likewise, they show an association between OA and the presence of Supplementary Material. One possible explanatory reason is that many international agencies, in particular the EU, require that the results from the research they fund be publicly disclosable through OA publication schemes [63]. The commitment of national or local agencies to open science is likely to be lower.

McCabe and Snyder [64] considered all articles published between 1996 and 2005 in a sample of the top 100 titles in ecology, botany, multidisciplinary sciences, and biology. They concluded that open access boosts citations, but the effect is much more modest than in previous estimates. They suggested that the optimistic figures previously found are largely overestimated due to poor controls. Furthermore, they showed that open access causes a significant increase in citations in top journals, and a significant decrease in citations in bottom-ranked journals, according to the sample they used. Recent work [65] has addressed a systematic review of citations of open access and subscription-based articles. They concluded that a slight majority of the articles studied had an open access citation advantage (OACA). Multidisciplinary studies were significantly and positively associated with OACA. OACA was shown to be more common in Social Sciences, Medical and Health Sciences, and Natural Sciences, although there were no statistically significant associations. Whether or not OACA exists has been a topic of much discussion over the past two decades. Although there has been substantial research to address this question, the findings have been somewhat inconclusive.

Finally, we noted increasing interest in holistic approaches to research. Alongside natural studies, the human dimension should be integrated as a route to understanding sustainability [66]. For example, in the field of Oceanography, progress is being made from the study of Marine Reserves to that of Marine Protected Areas. This paradigm shift occurs simultaneously with international political commitments [35]. To address other complex environmental problems, such as wildfire risk, the need for an interdisciplinary approach and collaboration between experts from different scientific areas is also evident [38,67]. Journals belonging to the thematic categories of Environmental Sciences and Ecology are the priority when publishing in this field [33,49]. Multidisciplinary Science journals occupy a significant position too, most likely due to the large thematic breadth of these categories.

### *4.2. Systematic Literature Review and Bibliometric Procedure*

Boell and Cecez-Kecmanovic [6] are of the opinion that SLRs are very useful in meta-studies that identify and summarize evidence from a body of previous research. However, they acknowledged that the assumptions of scientific objectivity and replicability that SLRs are supposed to have can be misleading as, despite the existence of a protocol, someone who does not have the needed level of erudition and critical knowledge of the study field could arrive at different results in the selection of publications and probably in the selection of content [6,15]. Réchauchère et al. [15] raised the desirability of the combined use of an automatic method of bibliographic selection in a database (e.g., WOS and/or Scopus) together with selection by human experts. This mixed process requires careful reading of titles, keywords, and abstracts of the automatically preselected articles. In addition, this approach requires the use of precise criteria to limit the risk of bias and ensure a level of transparency in the analytical process. In our study, in addition to taking this mixed procedure into account, we performed a training on a sufficient sample of articles to reach a reasonable level of agreement and strengthen objectivity in the selection of articles to review (See Supplementary Materials).

Bibliometric studies are usually performed on a large volume of documents, including gray literature [19]. However, a content analysis based on a mixed procedure (automatic selection together with expert judgment) is not feasible on a very large set of documents. Basic descriptors (keywords) in SLRs do not usually provide sufficient information for accurate and precise in-depth analysis of specialized topics such as the one we intended to address here. Automatic selections of articles very often return misleading results based, for instance, on ambiguous or inaccurate terms used by different authors. Actually, most of the automatically preselected articles in our SLR were not related to our criteria on PA ecological effectiveness (see exclusion criteria in Supplementary Materials). The variables for measuring such specific topics as PA effectiveness require thorough reading of the articles' titles, keywords and abstracts by experts. Reading the full text is often necessary, and highly recommended, to properly understand meanings and nuances which is nevertheless not always attainable.

### 4.3. Methodological Remarks

Arguably, our bibliometric analysis is incomplete because, in our literature review, we have not expanded the search to other complementary databases such as WOS or Google Scholar and because we have excluded nonscientific articles. It could be argued that publications such as reports or conference proceedings incorporate emerging ideas before publication in scientific journals [24]. However, it is common to use Scopus as a suitable and comprehensive database to perform SLRs [17,18,38]. Some authors [18,68] justify the exclusion of books, book chapters or proceedings because their content may be published in other formats and thus incur duplicity with articles. Moreover, resorting just to the peer-reviewed literature most likely enhanced the quality of the data sources used for our SLR [69].

In methodological terms, the latest bibliometric trends point to the use of software (e.g., VOSviewer) and other tools, such as CiteSpace [35], to generate network visualization maps based on bibliographic data (co-authorship and countries). Their objective is to determine the relationships between authors, journals, keywords, and countries in a given research field [23,49]. Other authors [19] are experimenting with machine learning tools (Generalized boosted regression tree and BRT) to perform bibliometric analyses.

## 5. Conclusions

Over the last decade, there was a steady growth in the number of articles published on the ecological effectiveness of PAs, using complete or incomplete semiexperimental research designs. Among other triggers, international biodiversity and sustainability targets adopted along the first half of the 2010–2020 decade are likely to have promoted scientific interest and boosted international collaboration in this field. Our results demonstrate the growing size of the research teams working on this topic, the increasing collaboration among them, and the greater depth of the studies addressed. However, the geographic scope of lead authors' institutions was limited to some countries, with five of them accumulating over half of the PA effectiveness publications in that decade. The number of normalized citations and the Impact Factor also increased over the decade. The average FWCI of the articles studied was higher than expected.

The studies concentrated on countries with high biodiversity or that protect large proportions of their terrestrial or marine areas (Spain, China, Brazil, and Tanzania) [70–75]. However, the research focused mainly on terrestrial PAs. Most papers were published in journals included in the categories Environmental Sciences, Ecology and Biodiversity Conservation, notably in the journals *Conservation Letters*, *Biological Conservation* and *Plos One*. Lead authors worked in institutions in a wide variety of countries, especially in those with high HDIs. We observed a greater effort by authors to publish in OA during the previous decade. However, publishing in OA or a greater number of authors and collaborating institutions did not ensure more citations. In turn, we observed a positive correlation between the number of standardized citations and the inclusion of Supplementary Data in the papers.

Methodologically, the design of a detailed protocol facilitated the collection of environmental and bibliometric variables and their organization in a database. However, total inter-reviewer consistency in the selection of articles for review and in data retrieval could not be ensured and should not generally be expected, especially when assessing highly specialized qualitative data.

**Supplementary Materials:** The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/land11060924/s1, Table S1: Statistical results of the thematic and bibliometric indicators used; Table S2: Results of the Spearman correlation analyses.

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## References

1. Gough, D.A.; Oliver, S.; Thomas, J. *An Introduction to Systematic Reviews*, 2nd ed.; SAGE: London, UK, 2012.
2. Chalmers, I.; Altman, D.G. *Systematic Reviews*; BMJ Publications: London, UK, 1995.
3. Basten, D.; Sunyaev, A. A Systematic Mapping of Factors Affecting Accuracy of Software Development Effort Estimation. *Commun. Assoc. Inf. Syst.* **2014**, *34*, 51–86. [CrossRef]
4. Pittway, L. Systematic literature reviews. In *The SAGE Dictionary of Qualitative Management Research*; Thorpe, R., Holt, R.R., Eds.; SAGE: London, UK, 2008.
5. Okoli, C.; Schabram, K. A Guide to Conducting a Systematic Literature Review of Information Systems Research. *SSRN* **2010**. [CrossRef]
6. Boell, S.K.; Cecez-Kecmanovic, D. On being 'systematic' in literature reviews in IS. *J. Inf. Technol.* **2015**, *30*, 161–173. [CrossRef]
7. Guyatt, G.; Cairns, J.; Churchill, D.; Cook, D.J.; Haynes, B.; Hirsh, J.; Irvine, J.; Levine, M.; Levine, M.; Nishikawa, J.; et al. Evidence-Based Medicine: A New Approach to Teaching the Practice of Medicine. *JAMA* **1992**, *268*, 2420–2425. [CrossRef]
8. Ross, S. *Management of Newly Diagnosed Patients with Epilepsy: A Systematic Review of the Literature*; Agency for Healthcare Research and Quality: Rockville, MD, USA, 2001.
9. Levine, C.; Ganz, N.; Estok, R.; Ludensky, V. *Systematic Review of the Current Literature Related to Disability and Chronic Fatigue Syndrome*; U.S. Department of Health and Human Services, Public Health: Rockville, MD, USA, 2002. Available online: https://www.ncbi.nlm.nih.gov/books/NBK36735/ (accessed on 15 April 2022).
10. Levine, C. *Diagnosis and Treatment of Parkinson's Disease: A Systematic Review of the Literature*; U.S. Department of Health and Human Services, Public Health: Rockville, MD, USA, 2003.
11. SBU. Obstructive Sleep Apnoea Syndrome: A Systematic Literature Review. Available online: https://www.ncbi.nlm.nih.gov/books/NBK447983/ (accessed on 31 January 2022).
12. Bowes, A.; Dawson, A. *Designing Environments for People with Dementia: A Systematic Literature Review*; Emerald Publishing: Bingley, UK, 2019; ISBN 978-1-78769-974-8.
13. Anaya-Baz, B.; Maldonado, N.; Palacios-Baena, Z.R.; Palomo, V.; Pezzani, M.D.; Chiesi, S.; Razzaboni, E.; Compri, M.; Tacconelli, E.; Rodriguez-Baño, J. Systematic literature review of the burden and outcomes of infections due to multidrug-resistant organisms in Europe: The ABOUT-MDRO project protocol. *BMJ Open* **2020**, *10*, e030608. [CrossRef] [PubMed]
14. Petticrew, M.; Roberts, H. *Systematic Reviews in the Social Sciences: A Practical Guide*; Blackwell: Malden, MA, USA, 2006. [CrossRef]
15. Réchauchère, O.; Bispo, A.; Gabrielle, B.; Makowski, D. (Eds.) *Sustainable Agriculture Reviews 30: Environmental Impact of Land Use Change in Agricultural Systems*; Springer: Cham, Switzerland, 2018. [CrossRef]
16. Nadal-Romero, E.; Rodríguez-Caballero, E.; Chamizo, S.; Juez, C.; Cantón, Y.; García-Ruiz, J.M. Mediterranean badlands: Their driving processes and climate change futures. *Earth Surf. Process. Landf.* **2021**, *47*, 17–31. [CrossRef]
17. de Santana, M.M.M.; Mariano-Neto, E.; de Vasconcelos, R.N.; Dodonov, P.; Medeiros, J.M.M. Mapping the research history, collaborations and trends of remote sensing in fire ecology. *Scientometrics* **2021**, *126*, 1359–1388. [CrossRef]
18. Santos, S.M.B.D.; Bento-Gonçalves, A.; Vieira, A. Research on Wildfires and Remote Sensing in the Last Three Decades: A Bibliometric Analysis. *Forests* **2021**, *12*, 604. [CrossRef]
19. Bezak, N.; Mikos, M.; Borrelli, B.; Alewell, C.; Alvarez, P.; Anache, J.A.A.; Baartman, J.; Ballabio, C.; Biddoccu, M.; Cerdà, A.; et al. Soil erosion modelling: A bibliometric analysis. *Environ. Res.* **2021**, *197*, 111087. [CrossRef]
20. Renzi, M.; Pauna, V.H.; Provenza, F.; Munari, C.; Mistri, M. Marine Litter in Transitional Water Ecosystems: State of The Art Review Based on a Bibliometric Analysis. *Water* **2020**, *12*, 612. [CrossRef]
21. Partelow, S.; Schluter, A.; von Wehrden, H.; Janig, M.; Senff, P. A Sustainability Agenda for Tropical Marine Science. *Conserv. Lett.* **2018**, *11*, e12351. [CrossRef]
22. Donthu, N.; Kumar, S.; Mukherjee, D.; Pandey, N.; Lim, W.M. How to conduct a bibliometric analysis: An overview and guidelines. *J. Bus. Res.* **2021**, *133*, 285–296. [CrossRef]
23. Appolloni, L.; Buonocore, E.; Fulvio Russo, G.; Franzese, P.P. The use of remote sensing for monitoring Posidonia oceanica and Marine Protected Areas: A systemic review. *Ecol. Quest.* **2020**, *31*, 7–17. [CrossRef]

24. Liu, S.; Li, W.Y. Ecotourism Research Progress: A Bibliometric Analysis During 1990–2016. *SAGE Open* **2020**, *10*, 2158244020924052. [CrossRef]
25. Hockings, M.; Stolton, S.; Dudley, N. *Evaluating Effectiveness: A Framework for Assessing the Management of Protected Areas*; IUCN: Gland, Switzerland; Cambridge, UK, 2000.
26. Ervin, J. *Rapid Assessment and Prioritization of Protected Area Management (RAPPAM) Methodology*; WWF: Gland, Switzerland, 2003.
27. Stolton, S.; Hockings, M.; Dudley, N.; MacKinnon, K.; Whitten, T.; Leverington, F. Reporting Progress in Protected Areas a Site-Level. In *Management Effectiveness Tracking Tool*, 2nd ed.; 2007. Available online: http://assets.panda.org/downloads/mett2_final_version_july_2007.pdf (accessed on 31 January 2022).
28. Mas, J.F. Assessing protected areas effectiveness using surrounding (buffer) areas environmentally similar to the target area. *Environ. Monit. Assess.* **2005**, *105*, 69–80. [CrossRef] [PubMed]
29. Andam, K.S.; Ferraro, P.J.; Pfaff, A.; Sanchez-Azofeifa, G.A.; Robalino, J.A. Measuring the effectiveness of protected area networks in reducing deforestation. *Proc. Natl. Acad. Sci. USA* **2008**, *105*, 16089–16094. [CrossRef] [PubMed]
30. Spracklen, B.D.; Kalamandeen, M.; Galbraith, D.; Gloor, E.; Spracklen, D.V. A global analysis of deforestation in moist tropical forest protected areas. *PLoS ONE* **2015**, *10*, e0143886. [CrossRef]
31. Caveen, A.; Polunin, N.; Gray, T.; Stead, S. *The Controversy over Marine Protected Areas: Science Meets Policy*; Springer: Cham, Switzerland, 2015. [CrossRef]
32. Slabbert, L.; Du Preez, E.A. Where did all the visitor research go? A systematic review of application areas in national parks. *J. Hosp. Tour. Man.* **2021**, *49*, 12–24. [CrossRef]
33. Correia, R.A.; Malhado, A.C.M.; Lins, L.; Gamarra, N.C.; Bonfim, W.A.G.; Valencia-Aguilar, A.; Bragagnolo, C.; Jepson, P.; Ladle, R.J. The scientific value of Amazonian protected areas. *Biodivers. Conserv.* **2016**, *25*, 1503–1513. [CrossRef]
34. van Wilgen, B.W.; Boshoff, N.; Smit, I.P.J.; Solano-Fernandez, S.; van der Walt, L. A bibliometric analysis to illustrate the role of an embedded research capability in South African National Parks. *Scientometrics* **2016**, *107*, 185–212. [CrossRef]
35. Picone, F.; Buonocore, E.; Chemello, R.; Russo, G.F.; Franzese, P.P. Exploring the development of scientific research on Marine Protected Areas: From conservation to global ocean sustainability. *Ecol. Inform.* **2021**, *61*, 101200. [CrossRef]
36. CBD. COP 10 Decision X/2: X/2. Strategic Plan for Biodiversity 2011–2020. 2010. Available online: https://www.cbd.int/decision/cop/?id=12268 (accessed on 31 January 2022).
37. Hoepner, A.G.F.; Benjamin, K.; Scholtens, B.; Yu, P.S. Environmental and ecological economics in the 21st century: An age adjusted citation analysis of the influential articles, journals, authors and institutions. *Ecol. Econ.* **2012**, *77*, 193–206. [CrossRef]
38. Vigna, I.; Besana, A.; Comino, E.; Pezzoli, A. Application of the Socio-Ecological System Framework to Forest Fire Risk Management: A Systematic Literature Review. *Sustainability* **2021**, *13*, 2121. [CrossRef]
39. Nguyen, M.H.; Vuong, Q.H. Evaluation of the Aichi Biodiversity Targets: The international collaboration trilemma in interdisciplinary research. *Pac. Conserv. Biol.* **2021**. [CrossRef]
40. United Nations. *Transforming our World: The 2030 Agenda for Sustainable Development*; United Nations: New York, NY, USA, 2015. Available online: https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf (accessed on 31 January 2022).
41. Gratzer, G.; Keeton, W.S. Mountain Forests and Sustainable Development: The Potential for Achieving the United Nations' 2030 Agenda. *Mt. Res. Dev.* **2017**, *37*, 246–253. [CrossRef]
42. Ament, J.M.A.; Collen, B.; Carbone, C.; Mace, G.M.M.; Freeman, R. Compatibility between agendas for improving human development and wildlife conservation outside protected areas: Insights from 20 years of data. *People Nat.* **2019**, *1*, 305–316. [CrossRef] [PubMed]
43. Maestro, M.; Pérez-Cayeiro, M.L.; Chica-Ruiz, J.A.; Reyes, R. Marine protected areas in the 21st century: Current situation and trends. *Ocean Coast. Manag.* **2019**, *171*, 28–36. [CrossRef]
44. Martinuzzi, S.; Radeloff, V.C.; Joppa, L.N.; Hamilton, C.M.; Helmers, D.P.; Plantinga, A.J.; Lewis, D.J. Scenarios of future land use change around United States' protected areas. *Biol. Conserv.* **2015**, *184*, 446–455. [CrossRef]
45. Gallardo, M.; Martínez-Vega, J. Modeling Land-Use Scenarios in Protected Areas of an Urban Region in Spain. In *Geomatic Approaches for Modeling Land Change Scenarios*; Camacho Olmedo, M.T., Paegelow, M., Mas, J.F., Escobar, F., Eds.; Springer: Cham, Switzerland, 2018; pp. 307–328. [CrossRef]
46. Gollnow, F.; Göpel, J.; de Barros Viana Hissa, L.; Schaldach, R.; Lakes, T. Scenarios of land-use change in a deforestation corridor in the Brazilian Amazon: Combining two scales of analysis. *Reg. Environ. Chang.* **2018**, *18*, 143–159. [CrossRef]
47. Armenteras, D.; Murcia, U.; González, T.M.; Barón, O.J.; Arias, J.E. Scenarios of land use and land cover change for NW Amazonia: Impact on forest intactness. *Glob. Ecol. Conserv.* **2019**, *17*, e00567. [CrossRef]
48. IPBES. *Global Assessment Report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*; Brondízio, E.S., Settele, J., Díaz, S., Ngo, H.T., Eds.; IPBES Secretariat: Bonn, Germany, 2019.
49. Duan, P.; Wang, Y.; Yin, P. Remote Sensing Applications in Monitoring of Protected Areas: A Bibliometric Analysis. *Remote Sens.* **2020**, *12*, 772. [CrossRef]
50. Götmark, F.; Kirby, K.; Usher, M.B. Strict reserves, IUCN classification, and the use of reserves for scientific research: A comment on Schultze et al. (2014). *Biodivers. Conserv.* **2015**, *24*, 3621–3625. [CrossRef]
51. Ferreira, H.M.; Magris, R.A.; Floeter, S.R.; Ferreira, C.E. Drivers of ecological effectiveness of marine protected areas: A meta-analytic approach from the Southwestern Atlantic Ocean (Brazil). *J. Environ. Manag.* **2022**, *301*, 113889. [CrossRef] [PubMed]

52. Zeng, X.; Chen, M.; Zeng, C.; Cheng, S.; Wang, Z.; Liu, S.; Zou, C.; Ye, S.; Zhu, Z.; Cao, L. Assessing the management effectiveness of China's marine protected areas: Challenges and recommendations. *Ocean Coast. Manag.* **2022**, *224*, 106172. [CrossRef]
53. Kwiek, M. What large-scale publication and citation data tell us about international research collaboration in Europe: Changing national patterns in global contexts. *Stud. High. Educ.* **2021**, *46*, 2629–2649. [CrossRef]
54. Abramo, G.; D'Angelo, C.A. The relationship between the number of authors of a publication, its citations and the impact factor of the publishing journal: Evidence from Italy. *J. Informetr.* **2015**, *9*, 746–761. [CrossRef]
55. Franceschet, M.; Costantini, A. The effect of scholar collaboration on impact and quality of academic papers. *J. Informetr.* **2010**, *4*, 540–553. [CrossRef]
56. Tang, M.; Bever, J.D.; Yu, F.H. Open access increases citations of papers in ecology. *Ecosphere* **2017**, *8*, e01887. [CrossRef]
57. Piwowar, H.; Priem, J.; Larivière, V.; Alperin, J.P.; Matthias, L.; Norlander, B.; Farley, A.; West, J.; Haustein, S. The state of OA: A large-scale analysis of the prevalence and impact of Open Access articles. *PeerJ* **2018**, *6*, e4375. [CrossRef]
58. Piwowar, H.A.; Day, R.S.; Fridsma, D.B. Sharing Detailed Research Data Is Associated with Increased Citation Rate. *PLoS ONE* **2007**, *2*, e308. [CrossRef]
59. Gazni, A.; Didegah, F. Investigating different types of research collaboration and citation impact: A case study of Harvard University's publications. *Scientometrics* **2011**, *87*, 251–265. [CrossRef]
60. Bornmann, B. Is collaboration among scientists related to the citation impact of papers because their quality increases with collaboration? An analysis based on data from F1000Prime and normalized citation scores. *J. Assoc. Inf. Syst.* **2016**, *68*, 1036–1047. [CrossRef]
61. Tahamtan, I.; Safipour Afshar, A.; Ahamdzadeh, K. Factors affecting number of citations: A comprehensive review of the literature. *Scientometrics* **2016**, *107*, 1195–1225. [CrossRef]
62. Seglen, P.O. Citation rates and journal impact factors are not suitable for evaluation of research. *Acta Orthop. Scand.* **1998**, *69*, 224–229. [CrossRef]
63. European Commission. EU Support for Open Access, What It Means, How Its Integrated into the Funding Programmes, Advice for Projects and Working with EU Countries. 2022. Available online: https://ec.europa.eu/info/research-and-innovation/strategy/strategy-2020-2024/our-digital-future/open-science/open-access_en (accessed on 12 April 2022).
64. McCabe, M.J.; Snyder, C.M. Identifying the effect of Open Access on citations using a panel of science journals. *Econ. Inq.* **2014**, *52*, 1284–1300. [CrossRef]
65. Langham-Putrow, A.; Bakker, C.; Riegelman, A. Is the open access citation advantadge real? A systematic review of the citation of open access and subscription-based articles. *PLoS ONE* **2021**, *16*, e0253129. [CrossRef]
66. Martínez-Vega, J.; Rodríguez-Rodríguez, D.; Fernández-Latorre, F.M.; Ibarra, P.; Echeverría, M.; Echavarría, P. Proposal of a System for Assessment of the Sustainability of Municipalities (Sasmu) Included in the Spanish Network of National Parks and Their Surroundings. *Geosciences* **2020**, *10*, 298. [CrossRef]
67. Chuvieco, E.; Aguado, I.; Jurdao, S.; Pettinari, M.L.; Yebra, M.; Salas, J.; Hantson, S.; de la Riva, J.; Ibarra, P.; Rodrigues, M.; et al. Integrating geospatial information into fire risk assessment. *Int. J. Wildland Fire* **2012**, *23*, 606–619. [CrossRef]
68. Vasconcelos, R.N.; Lima, A.T.C.; Lentini, C.A.D.; Miranda, G.V.; Mendonça, L.F.; Silva, M.A.; Cambuí, E.C.B.; Lopes, J.M.; Porsani, M.J. Oil spill detection and mapping: A 50-year bibliometric analysis. *Remote Sens.* **2020**, *12*, 3647. [CrossRef]
69. Mengist, W.; Soromessa, T.; Legese, W. Method for conducting systematic literature review and meta-analysis for environmental science research. *MethodsX* **2020**, *7*, 100777. [CrossRef]
70. IUCN. IUCN Green List of Protected and Conserved Areas. IUCN. Gland and Cambridge. 2021. Available online: https://www.iucn.org/theme/protected-areas/our-work/iucn-green-list-protected-and-conserved-areas (accessed on 13 June 2022).
71. Protected Planet. Protected Planet Report 2020. Coverage. Chapter 3. 2020. Available online: https://livereport.protectedplanet.net/chapter-3 (accessed on 13 June 2022).
72. Rodríguez-Rodríguez, D.; Martínez-Vega, J. Protected area effectiveness against land development in Spain. *J. Environ. Manag.* **2018**, *215*, 345–357. [CrossRef] [PubMed]
73. Zhang, L.; Luo, Z.; Mallon, D.; Li, C.; Jiang, Z. Biodiversity conservation status in China's growing protected areas. *Biol. Conserv.* **2017**, *210*, 89–100. [CrossRef]
74. Vieira, R.R.S.; Pressey, R.L.; Loyola, R. The residual nature of protected areas in Brazil. *Biol. Conserv.* **2019**, *233*, 152–161. [CrossRef]
75. Burgess, N.D.; Butynski, T.M.; Cordeiro, N.J.; Doggart, N.H.; Fjeldså, J.; Howell, K.M.; Kilahama, F.B.; Loader, S.P.; Lovett, J.C.; Mbilinyi, B.; et al. The biological importance of the Eastern Arc Mountains of Tanzania and Kenya. *Biol. Conserv.* **2007**, *134*, 209–231. [CrossRef]