



Review

Conservation finance: What are we not doing? A review and research agenda

Simona Cosma^{a,*}, Giuseppe Rimo^b, Stefano Cosma^c

^a Department of Management, University of Bologna, Via Capo di Lucca, 34, 40126, Bologna, Italy

^b Department of Economics, University of Salento, Via per Monteroni, 73100, Lecce, Italy

^c Department of Economics Marco Biagi, University of Modena and Reggio Emilia, Modena, Italy



ARTICLE INFO

Keywords:

Conservation finance
Biodiversity conservation
Sustainable development
Bibliometrics
Literature review
Climate change

ABSTRACT

Conservation finance embraces a series of innovative financing mechanisms aimed at raising and managing capital to be used for the conservation of biodiversity. The climate emergency and the pursuit of sustainable development underline the criticality of financial support for achieving this goal. Funding for the protection of biodiversity, in fact, has long been disbursed by governments in a residual form, only after they have dealt with social needs and political challenges. To date, the main challenge of conservation finance is to identify solutions that not only generate new revenue for biodiversity, but also effectively manage and allocate existing funding to provide a mix of social and community benefits as well. The paper, therefore, aims to act as a wake-up call, urging academics working in economics and finance to turn their attention to resolving the financial problems faced by conservation. Through a comparative bibliometric analysis, the study aims to outline the structure of scientific research on the topic of conservation finance, to understand the state of the art, and to identify open questions and new research trends. The results of the study show that the topic of conservation finance is currently a prerogative of scholars and journals of ecology, biology and environmental sciences. Finance scholars pay very little attention to the topic and yet there are many opportunities/needs for future research. The results are of interest to researchers in banking and finance, policy-makers and managers.

1. Introduction

The term ‘conservation finance’ indicates the activity aimed at raising and managing capital to be used for the conservation of biodiversity (Clark, 2007).

The survival and well-being of humans and of all species in general necessarily require healthy, productive ecosystems. The aim of finance for biodiversity is to preserve and safeguard these ecosystems, trying, where possible, to overcome the shortcomings of governments, whose interventions are often influenced by short-term policy considerations (Mitchell et al., 2015). Funds for the protection of biodiversity have long been disbursed by governments in a residual form and only after they have dealt with social needs and political challenges. In addition to the problems related to funding shortages, additional conservation constraints are emerging in the form of structural and political factors that limit the effectiveness of spending and obstruct the creation of a favorable environment and adequate incentives for conservation (CFA, 2020).

Given the scarce resources historically allocated to biodiversity conservation (Waldron et al., 2013), conservation finance academics and practitioners have often focused on identifying the most disadvantaged geographical areas from the point of view of funding and calculating the amount of money needed to cover specific conservation objectives (McCarthy et al., 2012). Many of the world’s most biodiverse areas are found in places threatened by poverty, corruption, vast resource extraction and widespread development. Therefore, the fundamental role attributed to conservation finance is to generate new, diversified, long-term revenue streams for conservation. The primary challenge of conservation finance is to identify solutions that generate conservation revenue and effectively manage and allocate those funds to deliver a combination of social and community benefits (World Wide Fund for Nature, 2009).

Although the topic of financing for the protection of biodiversity is not a recent issue, it has gained current relevance from the growing need for new strategies to achieve the 17 Sustainable Development Goals, or SDGs, by the year 2030 as envisaged by the 2030 Agenda. In fact, for the

* Corresponding author.

E-mail addresses: simona.cosma@unibo.it (S. Cosma), giuseppe.rimo@unisalento.it (G. Rimo), stefano.cosma@unimore.it (S. Cosma).

achievement of sustainable development goals, including that relating to the protection of biodiversity, the direct involvement of the business sector and the mobilization of private savings are essential and crucial, and this implies a role for banks and financial institutions. At the same time, the issue's importance has been confirmed by the EU biodiversity strategy for 2030, which provides for the creation of protected areas comprising at least 30% of the EU's land and sea surface and the allocation of €20 billion per year for the protection and promotion of biodiversity through EU funds and national and private funding (Council of the European Union, 2022).

Given the current relevance of the topic and the critical issues mentioned, the purpose of this work is to map the existing literature and summarize the insights it provides on an interdisciplinary issue which seems not yet to have received the attention it deserves in finance studies, identifying strands, trends, and prospects for investigation. To achieve this, the following research questions (RQ) were formulated:

RQ1. How has the literature on “conservation finance” advanced over time?

- **RQ1.a** What were the most influential studies?
- **RQ1.b** Which were key references for the research on the topic?
- **RQ1.c** What are the main journals on this topic and how has the number of publications evolved?

RQ2. What are the main issues associated with conservation finance in the scientific literature?

The selected research approach is methodological, based on bibliometric inquiry to answer RQ1, and on the systematic review of the literature on the subject to answer RQ2 (Dabić et al., 2020).

To the best of our knowledge, this study presents the first bibliometric and systematic review on the theme of conservation finance, a great opportunity to highlight a very current issue.

The results of the analysis enable us to direct the attention of academics working in the fields of economics, banking and finance to a topic that has so far been studied mainly by experts in ecology and environmental sciences, by disproving the assumption that conservation finance can fulfil the role of procuring funds with no need to enhance the ability of the financial literature to manage risks, reduce funding gaps and create financial schemes and incentives capable of harmonizing (transforming) propensities and aligning the objectives of the supply and demand for capital with regard to the conservation of biodiversity.

The study is structured as follows: Section 2 analyzes the context and reasons for the importance of conservation finance; Section 3 describes the methodology adopted by the authors; Section 4 reports the results of the bibliometric analysis and Section 5 the mapping of the main contents and research areas. Section 6 contains the research agenda, some reflections on the main implications of the research and the concluding remarks. Section 7 concludes the review.

2. Finance and biodiversity conservation: an overview

2.1. Background

Due to human activities, the planet is experiencing a biodiversity crisis leading to the loss of species and the habitats that support them. The International Union for Conservation of Nature (IUCN) identified the main threats to biodiversity as changes in the way land and sea are used, illegal wildlife trade, pollution, invasive alien species and climate change. Moreover, continued human population growth and per capita consumption have resulted in unsustainable exploitation of the Earth's biodiversity, exacerbated by climate change, ocean acidification, and other anthropogenic environmental impacts. Considering the strong link between the economy and nature—about half of the world's GDP depends heavily or moderately on nature, according to an analysis by the World Economic Forum (2022)—a key element for success in the

transition to a sustainable future will be how governments and companies adapt to long-term dynamics, such as dependence on natural capital and its progressive exhaustion. The Global Futures project estimates that under a typical scenario, the costs of biodiversity loss in some countries could reach 4% of their GDP per year by 2050 (Johnson et al., 2020). These trends are further accentuated by climate change and its interaction with nature, which can trigger significant feedback effects and ‘tipping points’ (World Bank Group, 2020). In light of all these negative scenarios, biodiversity conservation actions are necessary, i.e. practices that aim to protect and preserve the richness and variety of species, habitats, ecosystems and genetic diversity on the planet (US MISSION GENEVA, 2010).

The theme of biodiversity conservation first played a central role in the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, Brazil, in 1992. The Convention on Biological Diversity (CBD), currently ratified by 196 countries, has as its objectives the conservation of biological diversity, the sustainable use of its components and the fair sharing of the benefits deriving from the use of genetic resources (CBD, 2000). In July 2021, the CBD published the first draft of a new global framework for biodiversity that will guide conservation actions until 2030 and provide a fundamental contribution to the implementation of the 2030 Agenda for Sustainable Development (CBD, 2021). The framework includes 21 goals and 10 proposed ‘targets’ for 2030. The key objectives include the need to ‘increase financial resources from all sources to at least US\$ 200 billion per year, including new, additional and effective financial resources, increasing by at least US\$ 10 billion per year international financial flows to developing countries, leveraging private finance, and increasing domestic resource mobilization, taking into account national biodiversity finance planning’. Therefore, the finance world's involvement in biodiversity conservation strategies is fundamental.

2.2. The role of finance in conservation

The practice of conservation finance dates to the creation in 1634 of the Boston Common, the first example in the United States in which autonomous people taxed themselves to purchase open spaces to provide public and private benefits (Levitt and Bergen, 2005). The term “conservation finance”, however, is quite recent; in recent years, various academics and practitioners have expressed themselves to provide an exhaustive definition (Table 1).

Despite the differences that characterize the various definitions existing in the literature, at the heart of the concept of conservation finance there is the basic belief that it is possible to align environmental, social and economic returns: the so-called triple bottom line. The benefits of the marriage of economics and ecology were explored in the 1970s and evolved in the 1980s to include discussions on sustainable development (Huwlyer et al., 2014). Companies have begun to reduce environmental damage by engaging in ‘corporate social responsibility’ (Stubbs, 2017). In the 1990s, the term ‘triple bottom line’ to indicate economic, environmental and social performance became a popular slogan among companies seeking for more than just financial gain. Economists refer to the ‘triple bottom line’ as ‘utility maximization’, where the utility can include economic, environmental, and social goals (Littlefield, 2011).

To date, conservation finance practices have gone beyond the simple concept of identifying and bridging the financial gap by mobilizing additional resources. Conservation finance can be seen as a framework characterized by four objectives to aim for, namely 1) reduction of conservation costs; 2) risk management and increase in the flow of capital; 3) disincentive of harmful actions; and 4) incentive for positive actions (CFA, 2020).

New approaches to conservation finance, therefore, aim to address conservation challenges from a holistic perspective, identifying the drivers of change and financial needs, exploring scenarios and planning businesses to find the most effective mix of solutions financial

Table 1
Various definitions of “conservation finance” provided by academics and practitioners.

Definitions	References
Conservation finance is the best place where people, land and money meet. Conservation finance involves raising and managing money to pay for conservation. As in for-profit markets, the money we need is capital for equity (ownership) and debt (loans) from the private sector.	Clark (2007)
Conservation finance generates new, long-term, and diversified sources of revenue for conservation. The principal challenge of conservation finance is to identify solutions that not only generate revenue for conservation, but also effectively manage and allocate this funding to provide a mix of community and social benefits as well.	World Wide Fund for Nature (2009)
Conservation finance is understood to be a mechanism through which a financial investment into an ecosystem is made – directly or indirectly through an intermediary – that aims to conserve the values of the ecosystem for the long term	Huwlyer et al. (2014)
Conservation finance, whether from public or private sources, is a subset field of finance that involves deploying funds for the conservation and restoration of ecosystems.	McFarland (2018)
Conservation finance is a form of financial structuring aiming to realign incentives so as to increase the pay-off to preservation relative to consumption.	Bose et al. (2019)
This paper proposes the definition of conservation finance as “mechanisms and strategies that generate, manage, and deploy financial resources and align incentives to achieve nature conservation outcomes.”	Conservation Finance Alliance (2020)
Conservation finance is defined as return-seeking private and public investments that intend to generate positive and measurable conservation benefits	Coalition for private investment in conservation (2021)
Conservation finance is the practice of raising and managing capital to support land, water, and natural resource conservation	www.conservationfinancenetwork.org

institutions able to harmonize the demand and supply needs of capital and manage their risks. A conservation financing solution can be defined as “an integrated approach to solve a problem or challenge through the specific use of financial and economic instruments” (UNDP, 2018). One of the objectives of implementing financial solutions is to produce a self-sufficient economic system that works to achieve sustainable management of nature while ensuring the alignment of different interests.

Governments and regulators, with the support of financial institutions and multilateral banks, hold the key to mobilizing finance, public and private, on the scale needed to transform the way we build, produce and consume, to protect nature while promoting sustainable poverty reduction (World Bank Group, 2020). In recognition of the economy’s strong dependence on natural assets, G7 leaders announced in 2021 that ‘our world must become not only net-zero but also nature-positive, for the benefit of both people and the planet’. A nature-positive approach enriches biodiversity, stores carbon, purifies water and reduces the risk of a pandemic. In short, treating nature positively improves the resilience of our planet and societies (World Economic Forum, 2021). A net-zero and nature-positive future must necessarily see a shift in the flow of private and public capital from polluting activities towards those with a low impact and with a green approach, to achieve important conservation objectives by 2030 and full recovery by 2050.

On May 20, 2020, the European Commission, adopting a proposal formulated by the EU on biodiversity for 2030, allocated 20 billion euros per year for the protection and promotion of biodiversity through EU

funds and national and private funding. The European Council highlighted the need to step up efforts to tackle the underlying causes of the loss of biodiversity and natural resources. In December 2020, the Council’s presidency reached a provisional political agreement with the Parliament on the extension beyond 2020 of the EU LIFE program for nature, biodiversity protection and the fight against climate change. The agreement foresees an increase in the budget for the period 2021–2027, in line to allocate 30% of the total expenditure of the long-term budget of the EU and the Next Generation EU instrument to action for the environment (Council of the European Union, 2022).

Despite the possibility of activating various financial instruments and mechanisms, the main sources of funding for biodiversity conservation continue to be inextricably linked to grants, donations and budget allocations from governments, and typical donors include mainly non-governmental organisations (NGOs), private companies and philanthropic foundations (WWF, 2009). There is still an important gap between the resources used and the resources necessary to achieve significant objectives.

According to recent research conducted by the Paulson Institute, The Nature Conservancy and Cornell Atkinson Center for Sustainability at Cornell University, financial flows in global biodiversity conservation in 2019 ranged from \$ 124 to \$ 143 billion. This represents an almost tripled funding compared to 2012 (Global Canopy Programme, 2012). However, it is still insufficient compared to the expenditure on agricultural, forestry and fishing subsidies that degrade nature, which turns out to be at least two to four times greater. According to the research, it is, therefore, necessary to spend another 598–824 billion dollars a year to be nature-positive by 2030, something that cannot be achieved only through government and philanthropic investments and recalls the role of the private investment (Paulson Institute, 2020).

Although public and governmental interest in sustainable living is growing, biodiversity continues to decline, undermining the well-being of two-fifths of humanity, leading to species extinction and intensifying climate change (International Science Council, 2018).

The role of conservation finance becomes much broader, moving from fundraising to aligning the objectives of investors, entrepreneurs and biodiversity.

3. Methodology

To construct a complete map of the CF studies, we used numerous complementary bibliometric analyses, primarily based on a database seek that accompanied the systematic overview protocol (Tranfield et al., 2003). The results of the different analyses were then compared to identify the most influential journals, authors and articles, allowing us to answer questions relating to the evolution of the conservation finance literature over time (RQ1a, RQ1b, RQ1c). The second step was the construction of a network diagram and the identification of the thematic clusters, which was followed by a systematic review of the most relevant contents that made it possible to identify the main topics related to conservation financing dealt with in the literature (RQ2).

3.1. Database and research protocol

To achieve the research objective relating to the construction of a map of scientific studies on conservation finance, a systematic search was carried out in May 2022 using the Scopus database (Purba et al., 2022; Vijayaraghavan et al., 2021). The search was carried out by selecting all the studies contained in the title, in the abstract or the keywords, the word ‘Conservation financ*’. Additional filters were included to limit the search to studies published in English and in peer-reviewed journals and to exclude articles from 2022 to avoid bias resulting from a low number of citations for the most recent articles (Khan et al., 2020). Cross Validation performed with Web of Science confirmed the adequacy of the Scopus database for the topic of investigation.

The research produced an initial sample of 112 documents, which underwent a further filtering process characterized by an independent reading of the abstracts of all articles. This phase led to the exclusion of six articles that dealt with other research topics unrelated to conservation finance. The final sample is therefore composed of 106 studies published in 63 journals. The sample size is consistent with that of other bibliometric studies (e.g. Pizzi et al., 2021), confirming the adequacy of the research design and protocol.

3.2. Bibliometric analysis

Bibliometrics applies statistical methods to study scientific activity in a research field (Zupic and Cater, 2015). This type of study combines two techniques: performance analysis and scientific mapping. Performance analysis is based on activity indicators that provide data on the volume and impact of research using a wide range of techniques, including word frequency analysis and citation analysis (Mingers and Leydesdorff, 2015). Scientific mapping is based on first and second-generation relationship indicators that provide a spatial representation of the relationship between different scientific elements (Caputo et al., 2019). Scientific mapping aims to reveal the structural and dynamic organization of know-how within the studies field.

In this study, we compare various bibliometric analyses, particularly co-citation, bibliographic coupling and co-occurrence of keywords. The analysis of co-citation measures the affinity between articles, authors or journals: if two documents are cited by a third party, it assumes the existence of a cognitive link between the two documents. The intensity of this constraint depends on the frequency with which the two documents are cited together in the scientific literature (De Bellis, 2005). The bibliographic coupling analysis examines when two articles cite a common third article, suggesting that the two articles may address a common theme (Kessler, 1963) and the third article can be an important source for the topic. The co-occurrence of keywords was also analyzed, a form of content analysis that allows us to investigate the conceptual structure of the field examined using the keywords provided by the authors (Callon et al., 1983). This analysis assumes that, when words are co-occurring in a document, the concepts related to those words should have some correlation. It makes it possible to identify the core topics on which research is most active in a specific area; the ‘emerging’ topics; the network of correlations between topics. The analysis of keywords allows the identification of thematic clusters using the contents investigated by the articles in the dataset. To carry out the analysis, by the best practices in the bibliometric field (Calvo et al., 2022; Purba et al., 2022; Tan et al., 2021), the Biblioshiny and VOSviewer software were used. Specifically, a network visualization was adopted, in which a tag and a circle represent the elements (keywords), the size of which varies according to the element’s importance. The greater the weight of an element (the greater its frequency), the larger the circle. The distance between two items in the display indicates the approximate correlation of the items in terms of the connection metric adopted (in our case, the co-occurrence). The closer the two elements are, the stronger their relationship. The different colors and the positioning of spaces wings of circles are used to group objects. The keywords were also analyzed through an overlay analysis, which consists of a graphical evaluation of the search trends. In particular, the overlay analysis promotes the understanding of the main topics discussed by academics over the years.

In summary, citation analysis focuses on the publications in the dataset, while citation analysis evaluates the cited references. The bibliographic coupling analyzes the connections between articles and thus obtains information about the importance of the publications in the data set for positioning in the network. On the other hand, the keyword analysis focuses on the examined content of the publications in the dataset, which allows the identification of thematic clusters. Therefore, the comparative application of these analyzes allows to limit the inherent methodological biases of each bibliometric indicator and provides a complete map of the area studied (Caputo et al., 2021).

4. Results

The bibliometric analysis made it possible to deepen the evolution of scientific fields related to the theme of conservation finance and to understand how academics have contributed to the macro-theme of finance for biodiversity conservation. The results are presented below by different analysis units: journals, authors, articles and, finally, the identification of the dominant themes through an analysis of keywords. The results of citations, co-citations and bibliographic coupling presented below provide a comparative framework that considers the past, present and future of the topic.

4.1. Analysis of the journals

The analysis of the journals provides evidence of the scientific journals that have contributed most to the development of the conservation finance issue. To date, 63 journals have at least one publication on the topic of conservation finance and 55 of these have received at least one citation. The average number of citations per journal is 31.02 with high variability (S.D. 56.01). The citation analysis (see Table 2) reveals that the highest number of citations is from the *Proceedings of the national academy of sciences of the United States of America* (352), followed by *Conservation letters* (196), *Conservation biology* (141), *Nature* (132) and *Biological conservation* (119). These journals are the most relevant on the topic of conservation finance. The co-citation analysis reveals which journals are most cited by the articles in our dataset: of the 2607 journals cited, 20 received at least 20 citations. Among the most cited sources, we find *Conservation biology* (153) followed by *Science* (121) and *Ecological economics* (102). The latter is the third most cited source as well as the only journal among the top 10 related to economic and financial issues. Finally, concerning the bibliographic coupling analysis of journals, the first five journals are highlighted in terms of Link Strength: *Conservation biology* (279), *Biodiversity and Conservation* (158), *World development* (117), *Biological conservation* (115), and *Proceedings of the national academy of sciences of United States of America* (114). These journals can therefore be considered the sources of reference or the “roots” of the literature on the subject.

The results show that the topic of conservation finance, although strongly linked to the world of finance and economic sciences, is much more explored and deepened by journals active in the biological and environmental sciences.

4.2. Analysis of the authors

The sample of articles taken into consideration highlights the presence of 355 authors for 106 publications; among them, 125 obtained at least 20 citations. The average number of citations per author is 26.28, with high variability (S.D. 68.65) synonymous with the fact that in the sample there are authors characterized by a very high number of citations and, at the same time, authors with little or no citations; the authors in third place for number of citations (436) published only two articles on the topic of conservation finance. The most cited author is Daniel C. Miller (Associate Professor of Environmental Policy, University of Notre Dame) followed by Timmons J. Roberts (Professor of Environmental Studies and Sociology, Brown University). The co-citation analysis shows that out of a total of 7858 authors cited, only 21 obtained more than 20 citations. This information highlights that the theme of conservation finance is strongly linked to the contributions provided by a small group of academics who have provided the basis for the study of the subject, including Balmford (Department of Zoology, University of Cambridge), Possingham (Center for Biodiversity and Conservation Science, University of Queensland) and Armsworth (Department of Ecology and Evolutionary Biology, University of Tennessee). Finally, bibliographic coupling allows us to highlight the most relevant authors in the network of citations, namely Armsworth (2821), Miller (2742), Spenceley (2401) and Roberts (1826). These authors are

Table 2
Comparison of citation, co-citation and bibliographic coupling of Journals.

Citation analysis			Co-citation analysis			Bibliographic coupling			
Source	Papers	TC	Source	TC	Source	Link Strength			
1	Proceedings of the national academy of sciences of the United States of America	3	352	1	Conservation biology	153	1	Conservation biology	279
2	Conservation letters	7	196	2	Science	121	2	Biodiversity and conservation	158
3	Conservation biology	10	141	3	Ecological economics	102	3	World development	117
4	Nature	1	132	4	Conservation letters	97	4	Biological conservation	115
5	Biological conservation	4	119	5	Nature	91	5	Proceedings of the national academy of sciences of the united states of America	114
6	World development	2	93	6	Biological conservation	88	6	Conservation letters	107
7	Annals of the American association of geographers	1	90	7	Bioscience	71		Journal of integrative environmental sciences	107
8	Tourism economics	1	75	8	Marine policy	65	7	Ecological economics	80
9	Ieee industrial electronics magazine	1	62	9	Plos one	61	8	Frontiers in marine science	75
10	Bioscience	2	49	10	Proceedings of the national academy of sciences	50	9	Journal of sustainable forestry	72
11	Parks	4	41	11	World development	47	10	Bioscience	68
12	Environmental research letters	2	37	12	Oryx	39	11	Tourism review international	64
13	Antipode	2	36	13	Ecosystem services	37	12	Annals of the American association of geographers	61
	Journal of sustainable forestry	4	36	14	Geoforum	33	13	Land use policy	56
	Oryx	3	36	15	Antipode	32	14	Environmental research letters	53
14	Ecological economics	4	34	16	Parks	25	15	Nature	51
	Ocean and coastal management	1	34	16	Journal of environmental management	25	16	Ecological applications	50
15	Reviews in fish biology and fisheries	1	32	17	Journal of environmental economics and management	23	17	Ocean and coastal management	42
	Science of the total environment	1	32		Ocean and coastal management	23	18	Ecosystem services	39

strongly integrated into the debate on conservation finance and their role in the network of citations is of absolute importance (see Table 3).

4.3. Analysis of the articles

The evolution of scientific production on conservation finance (Fig. 1) has experienced good growth since 1989, when Kathryn S. Fuller's article on debt-for-nature swaps was published in Environmental Science and Technology. The growth of scientific production in the last thirty years confirms the growing attention to the mechanisms of management and distribution of financial resources aimed at the conservation of biodiversity.

For the 106 articles included in the reference sample, an average number of citations per article is identified equal to 18.43 with high variability (SD 34.87). The co-citation analysis identifies the main theoretical references that led to the development of the conservation finance theme. Considering the 106 articles in our dataset, the results show that out of 5281 references cited, only 13 were cited more than three times. The reference studies for conservation finance scholars are highlighted below, characterized by a higher link strength:

- BIOFIN (2018), The biodiversity finance initiative. Available at: https://www.biofin.org/sites/default/files/content/publications/BIOFIN%20Workbook%202018_0.pdf
- OECD (2019), Biodiversity: Finance and the Economic and Business Case for Action. Available at: <https://www.oecd.org/environment/resources/biodiversity/g7-report-biodiversity-finance-and-the-economic-and-business-case-for-action.pdf>
- McCarthy, D. P., Donald, P. F., Scharlemann, J. P., Buchanan, G. M., Balmford, A., Green, J. M., ... & Butchart, S. H. (2012). Financial costs of meeting global biodiversity conservation targets: current spending and unmet needs. *Science*, 338(6109), 946–949.
- Armsworth, P. R., Fishburn, I. S., Davies, Z. G., Gilbert, J., Leaver, N., & Gaston, K. J. (2012). The size, concentration, and growth of biodiversity-conservation nonprofits. *BioScience*, 62(3), 271–281.

- Clark, S. (2007). A field guide to conservation finance. Washington, DC: Island Press.
- Margules, C. R., & Pressey, R. L. (2000). Systematic conservation planning. *Nature*, 405(6783), 243–253.

From the list just described it can be deduced how the theme of conservation finance is characterized by theoretical foundations connected not so much to academic studies, but the grey literature produced in the context of programs implemented by the United Nations (Biofin) or by organisations of a supranational nature such as the OECD.

Table 4 provides an overview of the most influential articles, classified based on the number of total citations, normalized citations and bibliographic coupling (link strength). Comparative analysis, using three different indicators, namely total citations, normalized citations and link strength, allows us to overcome the various biases incurred when they are studied individually. Total citations tend to reward older articles, while with normalized citations, articles that have had a greater impact, in terms of citations, are favoured compared to others published in the same year. Finally, the bibliographic coupling is necessary to identify the relevance of the articles within the study network of the sector. The joint analysis of the three indicators improves the quality of the study and avoids the omission of significant documents. The most relevant article for the total number of citations is the one published by Waldron et al. (2013); in terms of normalized citations, the ranking sees the article by Spenceley et al. (2021), the relevance of which is dictated by the topicality of the study, linked to the emergencies caused by the covid-19 pandemic in the context of biodiversity conservation. The articles most integrated into the debate, that is, which occupy the first five positions by bibliographic coupling index, are:

- *Topical themes in biodiversity financing* (Anyango-van Zwieten, 2021);
- *Explaining global patterns of international aid for linked biodiversity conservation and development* (Miller, 2014);
- *Biodiversity, governance and the allocation of international aid for conservation* (Miller, 2014);

Table 3
Comparison of citation, co-citation and bibliographic coupling of Authors.

Citation analysis			Co-citation analysis			Bibliographic coupling		
Rank	Author	TC	Rank	Author	TC	Rank	Author	Link strength
1	Miller D.C.	631	1	Balmford, A.	81	1	Armstrong P.R.	2821
2	Roberts J.T.	514	2	Possingham, H.P.	65	2	Miller D.C.	2742
3	Gittleman J.L.	436	3	Armstrong, P.R.	43	3	Spenceley A.	2401
	Kuhn T.S.	436	4	Kareiva, P.	39	4	Roberts J.T.	1826
	Nibbelink N.	436	5	Gaston, K.J.	38	6	Barborak J.R.	1610
	Redding D.	436	6	Miller, D.C.	36		Blye C.-J.	1610
	Waldron A.	436	7	Polasky, S.	31		Bricker K.	1610
4	Mooers A.O.	304	8	Brockington, D.	30		Báez A.	1610
5	Mooers A.	132	9	Agrawal, A.	28		Cahyadi H.S.	1610
	Tobias J.A.	132		Dudley, N.	28		Corrigan K.	1610
6	Dempsey J.	109	10	Wilson, K.A.	26		Halpenny E.	1610
7	Suarez D.C.	90	11	Ferraro, P.J.	25		Hvenegaard G.	1610
8	Armstrong P.R.	81		Pressey, R.L.	25		King D.M.	1610
9	Agrawal A.	78	12	Bode, M.	24		Leung Y.-F.	1610
10	Tisdell C.	75		Wunder, S.	24		Mandić A.	1610
	Wilson C.	75	13	Ando, A.W.	22		Mccool S.	1610
11	Ozansoy C.	62		Brooks, T.M.	22		Naidoo R.	1610
	Ustun T.S.	62		Buscher, B.	22		Newsome D.	1610
	Zayegh A.	62	14	Bishop, J.	21		Rüede D.	1610
12	Birkinshaw C.	56	15	Smith, R.J.	20		Sano J.	1610
	Gardner C.J.	56		Spenceley, A.	20		Santamaria V.	1610
	Harris A.	56	16	Naidoo, R.	19		Sarhan M.	1610
	Lewis R.E.	56		Roberts, J.T.	19		Sousa T.B.	1610
	Nicoll M.E.	56		Sullivan, S.	19		Zschiegner A.-K.	1610
	Rakotomalala D.	56		Verissimo, D.	19	7	Fovargue R.	1493
	Ratsifandrihamanana A.N.	56	17	Halpern, B.S.	18	8	Gittleman J. L.	1430
13	Goldstein J.H.	47	18	Fletcher, R.	17		Khun T.S.	1430
14	Koh L.P.	43		Parker, C.	17		Nibbelink N.	1430
	Phelps J.	43		Venter, O.	17		Redding D.	1430
	Steven R.	43		Waldron, A.	17		Waldron, A.	1430

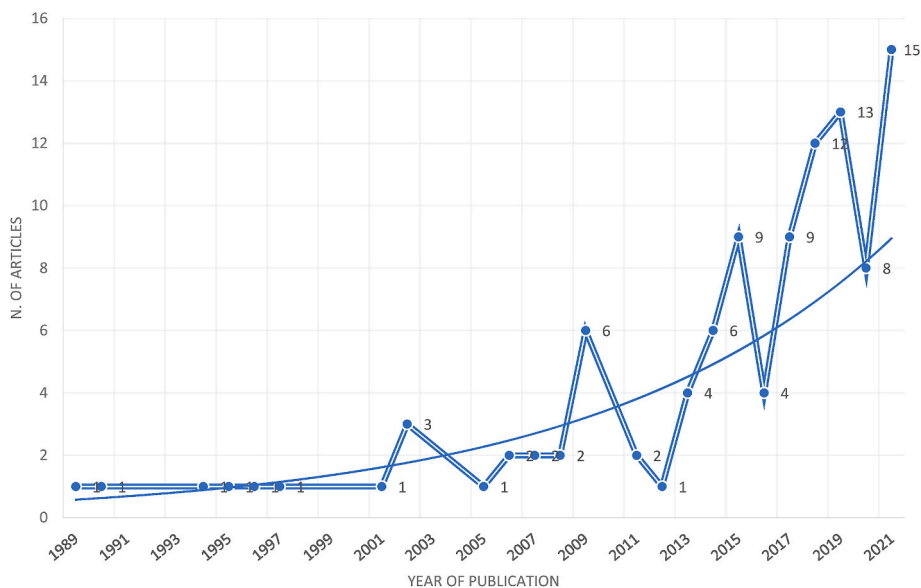


Fig. 1. Publication by year.

- Targeting global conservation funding to limit immediate biodiversity declines (Waldron et al., 2013)
- Filling the data gap - A pressing need for advancing MPA sustainable finance (Bohorquez et al., 2019).

5. Science mapping

Although the issue of biodiversity conservation has been strongly discussed and moderated by various legislative interventions by the United Nations and the European Community, conservation finance is a

historically neglected topic and has taken on greater relevance only in the past decade. From the *overlay analysis* of the keywords (Fig. 2), it is clear that conservation finance and the various financing instruments have received more attention since 2015, leading to new approaches, such as community conservation or market-based conservation linked to the involvement of local communities and market logic (tenders, auctions and subsidies). The overlay analysis also allows for seeing how the topic of protected areas has developed in the literature, i.e. geographical spaces especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and

Table 4
Identification of most influential papers according to Citations, Normalized Citations and Bibliographic Coupling.

Citations			Normalized citations			Bibliographic coupling		
Rank	Articles	TC	Rank	Articles	NC	Rank	Articles	Link strength
1	Waldron et al. (2013)	304	1	Spenceley et al. (2021)	7.64	1	Anyango-Vijayaraghavan et al. (2021)	107
2	Waldron et al. (2017)	132	2	Waldron et al. (2017)	4.68	2	Miller D.C. (2014)	106
3	Dempsey and Suarez (2016)	90	3	Gardner et al. (2018)	3.15	3	Miller et al. (2013)	88
4	Miller et al. (2013)	78	4	Dempsey and Suarez (2016)	2.98	4	Waldron et al. (2013)	77
5	Tisdell and Wilson (2001)	75	5	Miller D.C. (2014)	2.98	5	Bohorquez et al. (2019)	75
6	Miller D.C. (2014)	69	6	Waldron et al. (2013)	2.71	6	Gallo-Cajiao et al. (2018)	70
7	Ustun et al. (2013)	62	7	Venkataramanan et al. (2020)	2.61	7	Anyango-Van Zwieten et al. (2019)	68
8	Gardner et al. (2018)	56	8	Bishop et al. (2009)	2.28	8	Pinnschmidt A.A. (2021)	67
9	Phelps et al. (2011)	43	9	Thompson & Rog (2019)	2.22	9	Githiru et al. (2015)	66
10	Armsworth et al. (2012)	41	10	Bare et al. (2015)	2.21	10	Armsworth et al. (2012)	64
11	Bare et al. (2015)	37	11	Kroner et al. (2021)	2.18	11	Rylance et al. (2017)	64
12	Goldstein et al. (2006)	35	12	Bos et al. (2015)	2.03	12	Dempsey and Suarez (2016)	61
13	Bos et al. (2015)	34	13	Goldstein et al. (2006)	2.00	13	Silva et al. (2019)	56
14	Venkataramanan et al. (2020)	32	14	Tauli-Corpuz et al. (2020)	1.96	14	Salcido et al. (2009)	56
15	Fujita and Bonzon (2005)	32	15	Nelson F. (2009)	1.80	15	Fovargue R. (2019)	55
16	Eltringham S.K. (1994)	31	16	Silva et al. (2019)	1.71	16	Bare et al. (2015)	53
17	Milder J.C. (2011)	30	17	Bohorquez et al. (2019)	1.71	17	Iacona et al. (2016)	53
18	Spenceley et al. (2021)	28	18	Dempsey and Suarez (2016)	1.54	18	Waldron et al. (2017)	51
19	Kay K. (2018)	27	19	Kay K. (2018)	1.52	19	Armsworth et al. (2020)	50
20	Jupiter S. (2017)	27	20	Pickard & Pickerill (2002b)	1.50	20	Bos et al. (2015)	42
21	Pilgrim and Bennun (2014)	25	21	Githiru et al. (2015)	1.49	21	Iacona et al. (2017)	39
22	Githiru et al. (2015)	25	22	Czap et al. (2015)	1.49	22	Ando & Shah (2016)	39
23	Czap et al. (2015)	25	23	Zavaleta et al. (2008)	1.47	23	Steven et al. (2017)	38
24	Kauffman C.M. (2014)	25	24	Cumming et al. (2021)	1.36	24	Berghöfer et al. (2018)	38
25	Tauli-Corpuz et al. (2020)	24	25	Buckley & Mossaz (2018)	1.35	25	Chow J. (2015)	35
26	Buckley & Mossaz (2018)	24	26	Gallo-Cajiao et al. (2018)	1.30	26	Buckley & Mossaz(2018)	32

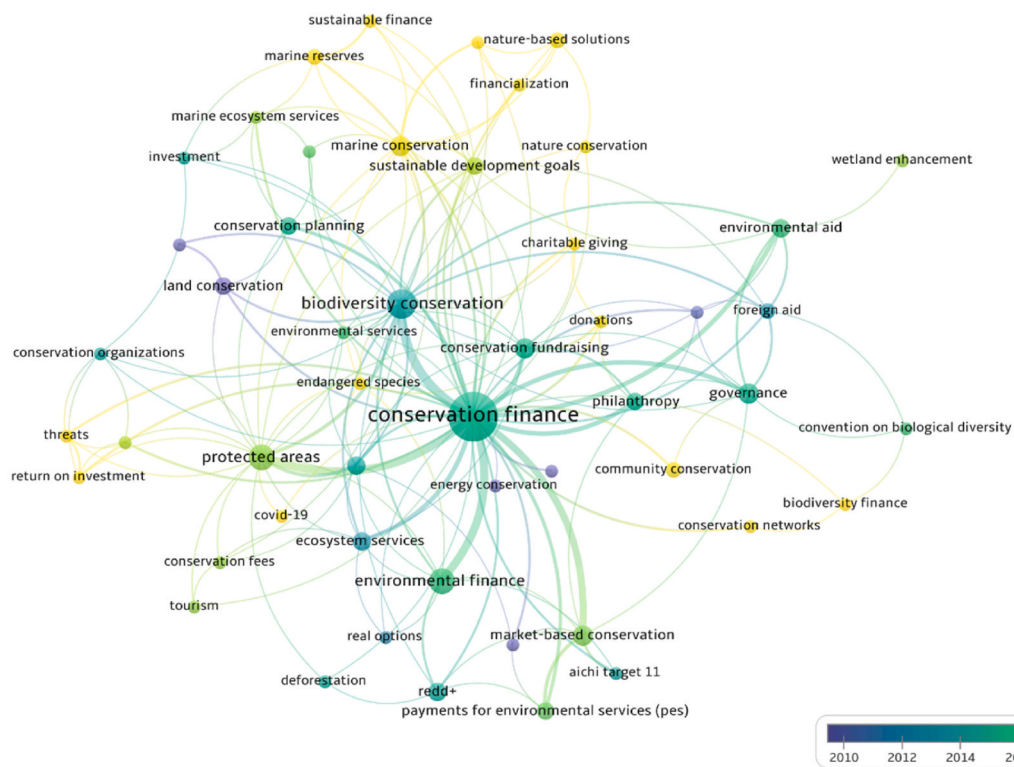


Fig. 2. Overlay diagram of the co-occurrence of keywords.

managed through legal or other effective means (Chape et al., 2003). The growing awareness of biodiversity loss has focused on the need to protect and safeguard natural environments and species. Several scholars have estimated the minimum land surface to be protected to stop the global biodiversity crisis (Allan et al., 2022). Furthermore, numerous articles have studied the financial needs of protected areas to identify problems and possible solutions.

A network analysis (Fig. 3) revealed three different areas of interest characterized by keywords and arguments that gravitate towards the concept of ‘conservation finance’. In detail, we can identify:

- A first thematic area closely linked to the study of financial mechanisms for the conservation of biodiversity (red cluster).

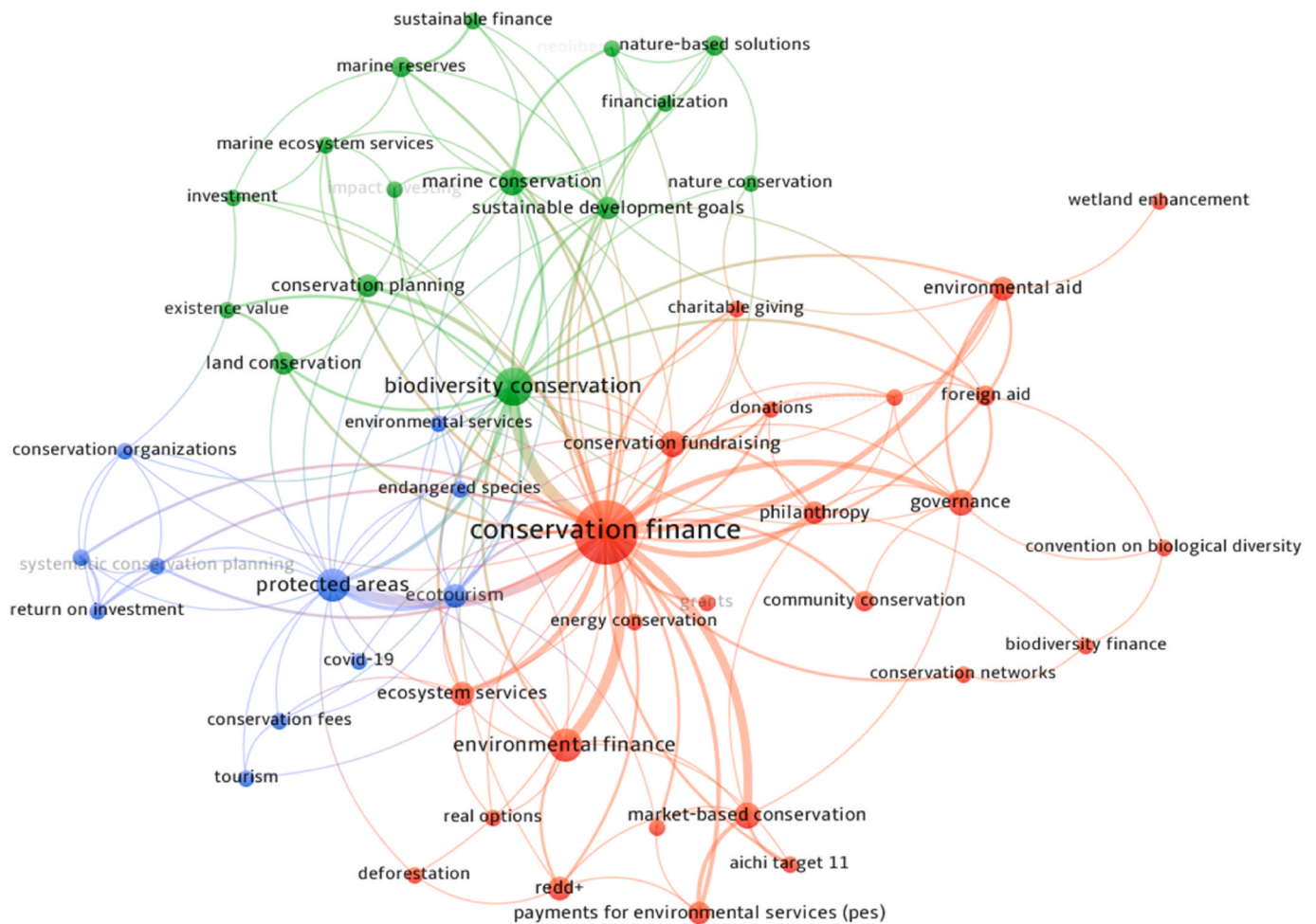


Fig. 3. Network diagram of the co-occurrence of keywords. Each node in a network represents a keyword. (1) the node size indicates the occurrence of the keyword, i.e. the number of times the keyword occurs (2) the link between nodes represents the co-occurrence between keywords (i.e., keywords that occur together or occur together), (3) the thickness of the link between keywords indicates the number of times the keywords occur together). Each colour represents a thematic cluster, where the nodes and links in that cluster can be used to explain the topic coverage (cluster) of topics (nodes) and the relationships (links) between topics (nodes) that manifest under that theme (cluster).

- A second area that analyzes the efforts undertaken and those still necessary for effectively safeguarding biodiversity, with a particular focus on marine ecosystems (green cluster);
- Finally, a third area that explores the theme of protected areas, financial needs and opportunities linked to tourism (blue cluster).

5.1. First research area: conservation finance mechanisms and instruments

The first cluster (red cluster) includes studies that address the issue of conservation underfunding (sources and causes) and of the “innovative” financial instruments used for the purpose.

With respect to the issue of underfunding and the different sources, Waldron et al. (2013) highlight the unmet needs of countries containing a high percentage of biodiversity and propose an increase in international assistance to improve the relative adequacy of global funding for biodiversity conservation. Dempsey and Suarez (2016) critically evaluate some existing funding mechanisms. They believe that investments remain small, marginal and geographically limited. The capital market in this emerging sector appears to be “slow and clumsy”, with low liquidity and often low expectations of returns. Even when initiatives

labelled “market-based conservation” work, they often do not reflect what is advertised. In the context of funding for biodiversity conservation, Miller (2014) analyzes international aid, currently still the most significant source of funding for conservation in biodiversity-rich developing countries, highlighting on the one hand an increase in aid over time and on the other the factors that guide funders’ choice of countries: geostrategic interests, be they geographical, military or political, and the perceived “good governance” of the recipient country (Miller, 2014). From the point of view of public investments, however, a more recent study (Seidl et al., 2020) reveals that global investments in biodiversity have steadily increased. The data also indicate a rise in the percentage of total national public investment dedicated to biodiversity.

About the possible causes of conservation underfunding, Waldron et al. (2017) address the main obstacle to investment decisions, namely the dominant uncertainty relating to the actual usefulness of any investment in conservation. To this end, a model is presented that can demonstrate how conservation spending is able to reduce the rate of biodiversity loss, by empirically quantifying how conservation investments have reduced biodiversity loss in 109 countries (signatories of the Convention on Biological Diversity and Sustainable Development

Goals). Phelps et al. (2011) highlight the risks associated with REDD + projects¹ and the so-called carbon credits they generate: volatility in the carbon credits market, the time horizon of REDD + projects and possible divergence with the duration of the investments provided.

Concerning the most recently activated financing mechanisms, Anyango-van Zwieten (2021) explores PES (Payments for Ecosystem Services) mechanisms.² McFarland (2015) describes the opportunities associated with REDD +, a tool based on the PES model in which governments, private landowners, concession holders and communities are compensated for undertaking activities that mitigate greenhouse gas emissions from deforestation and forest degradation. Gallo-Cajiao et al. (2018) analyze the projects extracted from crowdfunding platforms: they report good resource mobilization and see crowdfunding as an important financial mechanism for the conservation of biodiversity, with strong potential for expansion and with great opportunities deriving from its ability to mobilize funds spatially. McGowan et al. (2020) delve into the issue of incentivized debt conversion,³ a financing mechanism that can help countries with a heavy debt burden to strengthen their long-term domestic investments in nature conservation. The study proposes an approach of prioritizing debt conversion opportunities based on their potential return-on-investment.

5.2. Second research area: protection of terrestrial and marine ecosystems and blue economy

The green cluster contains studies that focus on the protection of terrestrial and marine ecosystems and on the concepts underlying the definition of the blue economy.

Concerning the state of the art on marine ecosystems in 2015, the study by Bos et al. (2015) examines the status of marine conservation funding and identifies the associated challenges, recommending possible ways forward. Problems related to funding scarcity, underdevelopment, poor use of financial mechanisms, and the disconnect between funding and conservation planning are highlighted. The study proposes possible solutions, including the definition of specific financial strategies, more research and development of ad hoc financial mechanisms and the involvement of companies to reduce the funding gap for the conservation of marine ecosystems.

Regarding the blue economy, the United Nations 2030 Agenda defines *Life under water* (goal 14) among the 17 Sustainable Development Goals and focuses attention on the possibility of mobilizing finance for the conservation of marine environments. Christiansen's study (2021) analyzes the use of blended finance for financing the blue economy, which involves the development of tools such as blue carbon initiatives, individual transferable quotas (ITQs) for fishing rights, blue bonds, private financing for marine protected areas and parametric insurance

¹ These projects offer pollution-producing private companies the possibility of offsetting their emissions through "carbon credits" generated by forest conservation projects. Carbon credits operate rather like equities representing the right to emit carbon dioxide. These credits are generated by deforestation prevention projects. By buying these bonds on the carbon market, companies can claim to have offset a certain volume of their emissions by preventing emissions elsewhere. Basically, the use of offsetting allows these private companies to promise net-zero emissions by 2050 without having to give up their fossil fuel business.

² PESs rely on incentives to induce behavioral changes and aim to compensate individuals or communities for actions that increase the provision of ecosystem services (water purification, flood mitigation or carbon sequestration).

³ Incentivized debt conversions are defined as voluntary transactions that involve the cancellation or restructuring of a portion of a country's sovereign debt, often with better rates or more favorable repayment terms, in exchange for the country's binding commitment to comply with the terms of the debt swap agreement. These agreements typically include measures to deliver positive environmental or social outcomes.

policies for coral reefs. At the same time, new investment and financing instruments involving the private sector have also been developed, based on investment funds, marketing strategies and certification schemes. In 2018, the World Bank launched the PROBLUE trust fund which promotes investments for economic growth at ocean borders through major infrastructure developments within a blue economy framework.

A wide debate has developed around the blue economy that addresses some of its critical issues, such as the concern that the blue economy may do more to promote extraction in the oceans, through territorialization processes, than to encourage environmental sustainability and protect the rights of coastal dwellers. Satizábal et al. (2020) point out that, by combining growth and sustainability, the nascent blue economy agenda is stepping up economic investment and extraction in the oceans. The study focuses on the case of the archipelago nation of the Philippines.

5.3. Third research area: protected areas and tourism

The blue cluster contains numerous studies investigating biodiversity from the point of view of protected areas (PA), analyzing their financial needs and evaluating the opportunities offered by tourism.

The study by Pascal et al. (2021) highlights the benefits of marine protected areas (MPAs), which include providing food and income for local communities and greater resilience to the impacts of climate change. However, insufficient funding for effective management and demand for MPA expansion remains a challenge affecting developing countries. To this end, the study examines the issue of impact investing. The article presents the case study of the Dominican Republic, with a description of the collaborative management agreement, business model and impact investment implemented for one of the largest MPAs in the Caribbean; the role that this form of investment can play in restoring marine biodiversity, creating significant job opportunities and improving tourism is then described.

The article by Tauli-Corpus et al. (2020) explores the critical issues associated with public funding. The authors shed light on a reality characterized by mainly state-managed protected areas. However, their analysis of the contribution of governments and the international community in the expansion of protected areas, underlines that such interventions often produce costs for indigenous peoples and local communities (IPLC) in terms of violation of rights and conflicts.

The studies by Githiru et al. (2015) and Pilgrim and Bennun (2014), on the other hand, investigate the issue of biodiversity offsets⁴ for the financing of Protected Areas. Githiru et al. (2015), in particular, discuss a number of challenges and potential benefits arising from compensation mechanisms of this kind. The problems of measuring what is lost and what is gained in the context of these operations are highlighted, alongside the difficulty of predicting whether the compensation will produce the expected results and the risks of inequity related to the fact that governments could justify development projects on the basis that any damage to biodiversity would be compensated, while underestimating the potentially destructive impact of the proposed project. However, the principle of additionality on which these operations are based establishes that biodiversity compensation should guarantee conservation outcomes higher than those that would have occurred if the compensation had not taken place. This makes offsets an instrument potentially capable of overcoming the scarcity of funding for Protected Areas.

However, the compensation principle has its challenges and risks and is still an extremely controversial approach, attracting supporters and

⁴ Biodiversity offsets represent conservation actions, implemented by the private sector or by governments, aimed at compensating for the residual and inevitable impact on biodiversity caused by infrastructure development, mining and oil exploration projects.

opponents. While some commentators strongly support biodiversity offsets, others question not only the effectiveness of the tool in achieving long-term conservation benefits, but also the moral and ethical implications of attempting to do so. Critics (Evans et al., 2015; Sullivan and Hannis, 2015) argue that the treatment of biodiversity as a commodity that can be traded or measured relative to other commodities is specific to a worldview that puts aside cultural and spiritual values and the intrinsic worth of nature and ecosystems.

In the same research area, there are also studies that analyze the theme of the financing of protected areas by looking at the revenues deriving from the tourism sector. Rylance et al. (2017), addressing the problem of scarcity of resources for conservation activities in protected areas, assess the extent to which tourism contributes to the financing of biodiversity for the management of PAs in southern African countries. Analyzing the Fifth National Country Reports (produced in 2014/2015), they conclude that, although tourism is a significant source of income for PA authorities in southern Africa, the way in which resources are reinvested in conservation management remains ambiguous. The incompleteness and inconsistency of reporting at the national level represent a missed opportunity to motivate greater financial support. The need to maximize tourism revenues is therefore raised, compatibly with the design of a sustainable tourism plan within the Protected Areas. Furthermore, some studies show that in situ tourism has positive effects in strengthening pro-conservation attitudes (Tisdell and Wilson, 2001). Another important contribution is made by Armsworth et al. (2020), who address the issue of resource allocation for protected areas by regional or local offices. To improve the definition of priorities at a global or continental level, the authors present a continuous spatial optimization approach for land protection strategies that aim to improve biodiversity conservation on large territorial scales.

6. Discussion

The protection of biodiversity is an important issue for the future of our planet, as it is closely connected to climate change, social well-being and the global economy.

This gives conservation finance a critical role, linked to the generation of new, long-term, diversified sources of income for conservation. According to the definition of the World Wide Fund for Nature (2009), conservation finance's primary challenge is to identify solutions that not only generate conservation revenue, but effectively manage and allocate this funding also to provide a mix of social and community benefits.

In the literature, 'Conservation Finance' is a multidisciplinary research topic that ranges from a more heterogeneous area dedicated to the measurement of the funding gap and innovative forms of intervention, especially public, for the protection of biodiversity, up to strands of literature dedicated to the safeguarding of specific ecosystems. In this work we attempted to answer two research questions. To the first question (RQ1: *How has the literature on "conservation finance" advanced over time?*), the results of the bibliometric analysis allow us to give an answer divided into the following three questions.

RQ1 .a: What were the most influential studies?

As Table 3 indicates, the study by Waldron et al. (2013), is the most influential work in the field of conservation finance. Waldron et al. (2013) created a statistical model to identify countries where funding is significantly below expected levels. The subsequent work by Waldron et al. (2017) and the study by Dempsey and Suarez (2016) are the other two most-cited studies on the topic of conservation finance to date. At the same time, the study by Spenceley et al. (2021), addressing the issue of the effect of COVID-19 on the tourism sector in protected areas, attracted the greatest attention from researchers, reporting the highest number of normalized citations.

RQ1 .b Which were key references for the research on the topic?

The articles most integrated into the debate are those by Anyango-van Zwieten (2021), Miller (2014) and Miller et al. (2013). In particular, the first author identifies the topical themes on conservation financing, i.e. underfunding, inefficient funding distribution and the pursuit of innovative financial mechanisms, Miller (2014) examines global patterns of international aid for biodiversity and Miller (2014) identifies the nature, scope and trends of international aid for biodiversity projects, revealing the drivers of allocative choices.

RQ1 .c What are the main journals on this topic and how has the number of publications evolved over time?

The 106 studies in the sample were published in 63 different periodicals, of which eight were not cited: the topic is only covered by a relatively small number of journals, revealing limited attention from the literature. Among these, the most influential on the issue, considering the sources most co-cited by conservation finance studies, are *Conservation Biology* (153) followed by *Science* (121) and *Ecological Economics* (102). *Conservation Biology* (279), *Biodiversity and Conservation* (158) and *World Development* (117) are essential journals for scholars on the subject. The results show that the journals most interested in conservation finance are periodicals active in the biological and environmental sciences rather than finance and economics journals.

The timeline of conservation finance publications reveals that, although the first article on the subject was Debt-for-Nature Swaps, published in 1989 by Kathryn S. Fuller, the articles by Waldron and Miller published between 2013 and 2017 are the cornerstone of contemporary research in the field. The topic has shown gradual growth, but with a surge in 2015, probably linked to the appearance of the 2030 Agenda and the importance it gives to the theme of biodiversity and, above all, to the role of the financial system in making it possible to channel private resources towards sustainable development goals.

To the second research question (RQ2. *What are the main issues associated with conservation finance in the scientific literature?*) the systematic review reveals that, although the common thread that binds all conservation finance publications is the evidence of an unsatisfied need for funding for the protection of biodiversity and the possible negative consequences deriving from some financing schemes or their effective use, there are three main thematic areas of scientific research in this area:

- 1) Studies that observe the existing financing methods, criticalities, inefficiencies and related risks in terms of achieving the general interest of environmental and market protection.
- 2) Studies that investigate the paths started and indicate those to be taken for the effective protection of terrestrial and marine ecosystems, and the blue economy, which is also at the center of a debate on the underlying logic.
- 3) Studies that investigate the issue of biodiversity from the point of view of protected areas, evaluate the benefits and risks of biodiversity offsetting and analyze the possible funding sources from tourism within the protected areas.

Ultimately, the results obtained in this study confirm the substantial lack of interest of scholars in the banking and finance sector for issues concerning the protection of biodiversity. The cause could lie in the lack of attention to an activity that does not seem to be significantly linked to companies' economic and financial performance, which, in turn, leads to a reflection on the effective internalization of the "triple bottom line" concept on the part of researchers and businesses themselves. This undoubtedly reflects the delay in the inclusion of the concept of "public good and social value" within corporate performance and result variables that describe the "good of the company", and the tendency of the financial literature to focus on more limited and better measurable environmental protection phenomena.

Table 5
Research agenda.

Cluster	Theme	Future research area	Main references
Cluster 1 (red)	The strategic importance of finance in the conservation of biodiversity	<ul style="list-style-type: none"> • Future research could trace biodiversity financial flows through new networks between traditional and emergent actors • The concept of blended finance need more investigation • Future research could evaluate success rates of crowdfunding projects for conservation and the variables that explain them (donor motivation) • Further research could study crowdfunding projects that also includes other societal goals, such as poverty alleviation • Further research could explore the outcomes of crowdfunding projects for conservation • Additional process- or case-based research is required to better understand the relationship between biodiversity need and governance in shaping biodiversity aid allocation. • Understanding where biodiversity aid has been directed and why may help answer whether and under what conditions aid is effective • Systematic evaluation of biodiversity aid effectiveness remains a research frontier • Future research can compare whether and under what conditions strict or mixed aid is more effective in reaching conserving goals • Further research could attempt to estimate the operational, management, and transactional costs associated with executing debt conversions • Future research should provide an approach to assess the socio-economic impacts of PES at different spatial scales and levels of beneficiaries • Further research should address long-term effects of PES schemes and REDD + funding. • What are the conservation gains provided by revolving funds? Which types of properties sell more quickly, or are more likely to recover costs and how does this interact with property market conditions? • Research applying portfolio theory to conservation planning is still in its infancy, with many advances still needed 	Anyango-van Zwieten, N. (2021), Gallo-Cajiao et al. (2018), Phelps et al. (2011), Miller et al. (2013), Miller (2014), Hardy et al. (2018),
Cluster 2 (green)	Safeguarding biodiversity and marine systems	<ul style="list-style-type: none"> • Increased research on and development of finance mechanisms for marine conservation are needed • Financial planning should be integrated into conservation planning, and involve key stakeholders • The scope of marine conservation finance should include financial planning to generate revenue and economic incentives at the scale of individual conservation initiatives; • Businesses need to be engaged to reduce the gap in conservation funding for marine ecosystems, with different approaches taken for different types of businesses 	Bos et al. (2015), McGowan et al. (2020), Bishop et al. (2009)
Cluster 3 (blue)	The financial needs of protected areas	<ul style="list-style-type: none"> • A Plan for sustainable development of tourism within the protected areas should be implemented • Future research could explore the real costs of PAs in order to provide a more thorough analysis of the requirements of PA financing • A comparative analysis of the financing of different national PA agencies and their models for revenue retention would be a worthwhile avenue of investigation. • Such research can also identify synergies or trade-offs among conservation and human welfare outcomes and the factors shaping them 	Rylance et al. (2017), Spenceley et al. (2021), Cumming et al. (2021), Bohorquez et al. (2019)

6.1. Research agenda

Deepening of clusters: The bibliometric analysis has pointed to a series of future research directions, the discussion of which may expand knowledge in the context of conservation finance, even outside the thematic clusters identified (Table 5).

The low level of involvement of Banking and Finance scholars has prevented the full exploitation of the potential of Finance's cognitive, analytical and development tools in issues of biodiversity protection.

Following the definition of conservation finance provided by the World Wide Fund for Nature (2009), there is ample space for research aimed at developing knowledge and innovation, especially on tools capable of measuring, managing and transferring the risks deriving from investments in biodiversity protection, which will enable the sector to attract more private capital, in addition to intervention measures.

Effective risk measurement in conservation finance would provide the basis for more efficient management and allocation of resources. Above all, it would make it possible to specify the value created by these investments, from both an economic and a social point of view. In this sense, future research could trace the financial flows of biodiversity from government bodies, markets, local communities and emerging actors within conservation networks and identify the real ability to satisfy the conservation funding gap, optimizations and synergies of PES mechanisms and REDD + projects, seeking to assess their long-term results and socio-economic impacts for various categories of beneficiaries.

The issue of international aid deserves further study, as its impact may depend on various factors specific to the recipient countries. In-depth analyses can be carried out to identify the factors with the greatest influence on aid's success in terms of conservation. Another research frontier is the systematic assessment of aid's effectiveness,

which could help the international community in planning actions and in achieving shared biodiversity conservation objectives. With reference to the debt conversion mechanisms described above, future research could try to estimate their operating and management costs. Conservation finance scholars could also investigate revolving funds, programs used by government agencies or land funds to increase the amount of land and private areas protected for biodiversity, and study their conservation gains. In addition to the evaluation of impact and effectiveness, the research could analyze the different tools or mechanisms for partnerships between the state, financial intermediaries, markets and civil society useful for creating the necessary incentives to achieve social and environmental goals.

The research lines indicated are transversal concerning protecting marine ecosystems and the sustainability of protected areas. These are research areas that have studied issues related to specific ecosystems but require financial research to strengthen the capacity of conservation planning and measure the effectiveness of sustainable development policies comparatively, ordering the initiatives and giving priority to those with greater social added value.

The misalignments and instability of public interventions concerning the needs of territorial planning and conservation, the fragmentation of initiatives and methods of intervention and the under-sizing of resources with respect to the financial needs identified may be better resolved by innovative financial schemes that optimize final value by using the available public resources and the benefits deriving from biodiversity conservation to attract new private capital guided by ESG-oriented management mandates.

Authors' proposals

Due to the heterogeneous nature of conservation finance research and the prevalence of studies in ecology or biological and environmental science journals, there has been a lack of focus on more technical and specifically financial themes.

Future research should apply a financial perspective to investigate the causes of uncertainties that limit or prevent the intervention of the financial system and the correct allocation of resources. This will go hand-in-hand with the analysis of the value of conservation to be measured and demonstrated.

The current literature still presupposes, rather than demonstrating, that the allocation of funding and investments to the protection of biodiversity generates positive impacts in terms of the specific objectives pursued and of a more general social and environmental nature. From this perspective, future research should investigate the outcomes and effectiveness of the various projects. The availability of data referable to individual biodiversity conservation projects is increasing significantly. The reports generated by companies that finance environmental and social projects, as well as institutions that manage public projects, report a large amount of information but, individually, do not offer the possibility to make the assessments mentioned and generalize the results. The advent of big data and machine learning techniques can help support the research and development of analytics in this direction.

As well as measuring the conservation value generated, it is also important to investigate and study how this value manifests itself and is distributed among the subjects involved: financiers, financed subjects, stakeholders, users, states and local communities, and the world community (planet). The possibility of identifying new financial intervention schemes to reduce the funding gap is closely linked to these research guidelines.

The financial system includes a set of markets, financial intermediaries, services and contracts that meet the financial needs of the economic system. However, to be activated, these elements must find well-specified variables, including financial flows, risk, return and value, in their economic and social sense. Financing conservation projects implies facing critical uncertainty and risks, long time horizons, high construction costs, difficulties in assessing the probability of success and uncertain economic returns, which make traditional decision-making and financial resource allocation criteria ineffective.

Theoretically contributing to measuring and determining these variables means gradually helping to solve some of the problems that private capital encounters in meeting conservation funding needs.

This will be the task of future research in the field of conservation finance, which must go on to study the economic and social sustainability of financing for the protection of biodiversity and, if this is not achievable, must help to identify and study the correction mechanisms required to make it so. In this perspective, numerous further lines of research are opening up aimed at identifying and exploring portfolio selection criteria (to optimize the aggregate risk/return) or methods for risk sharing among potential participants, forms of public incentives, public interventions, and private and any other participatory schemes capable of making the payoff of conservation projects acceptable and broadening the pool of possible private investors (institutional and non-institutional).

Research on the correct methodological approaches aimed at identifying the real expected negative (financial costs and needs) and positive (prices and revenues) financial flows, revenues and opportunity costs, not limited only to the economic sphere but extended to environmental and social aspects, can further contribute to calculating projects' true value and enabling more efficient allocation of existing resources, leaving sustainable projects to private finance and using public funding for all the other interventions not sustainable by the market but considered ethically and ecologically important.

There is also scope for work by 'financial literacy' scholars. The dissemination of knowledge regarding the economic, environmental and social causes and consequences of biodiversity loss could help to channel financial resources into this area by raising awareness and encouraging internal and external stakeholders to exercise active, democratic citizenship by putting pressure on management and governance bodies.

6.2. Contribution, implications and limitations

The main contribution of this work is that it provides a review of the literature on conservation finance through a bibliometric and network analysis, addressing the absence of a comprehensive assessment of the existing literature and suggesting future research directions in the field of banking and finance studies to support conservation objectives.

The study has several implications. The thematic map and the timeline of studies enable policymakers, researchers and managers to understand the current status of the field and frame future pathways. In particular, the results allow policymakers to appreciate the main complexities, inefficiencies and challenges in financing biodiversity and to improve their support for achieving this goal. The identification of emerging issues permits scholars to investigate frontier issues, suggest solutions to the critical issues highlighted and support the removal of obstacles to adequate conservation funding. Finally, the findings may increase managers' awareness of the possible financing mechanisms that can be activated and their respective advantages and disadvantages.

This study has some limitations. First, the studies considered came exclusively from the Scopus database. Using multiple databases (e.g. Web of Science) could help create a larger sample of studies to be analyzed. Furthermore, the study provides an overview of the topic of conservation finance rather than exploring the contents covered in the articles in the sample in depth. These limitations create new avenues for investigation.

7. Conclusion remarks

The authors performed a bibliometric analysis of 'conservation finance'. They selected 112 articles from the Scopus database and used various bibliometric tools, such as Biblioshiny programming software and VOSViewer, to identify the most influential sources, authors and articles on the topic. Co-citation, bibliographic coupling and co-occurrence analyses of the keywords were performed, followed by a network analysis and a review of the contents. The results highlight

banking and finance scholars' lack of attention to the theme of conservation finance. Finance can play a significant role in helping companies achieve the goal of protecting biodiversity by improving the effectiveness and efficiency of existing financing mechanisms and helping remove existing financial criticalities. The study suggests multiple directions for future research.

Author contributions

All authors contributed to the study conception and design. Specifically, the first draft of the manuscript was written by Simona Cosma; material preparation and analysis were performed by Giuseppe Rimo; review and supervision were performed by Stefano Cosma.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

References

- Allan, J.R., Possingham, H.P., Atkinson, S.C., Waldron, A., di Marco, M., Butchart, S.H.M., Adams, V.M., Kissling, W.D., Worsdell, T., Sandbrook, C., Gibbon, G., Kumar, K., Mehta, P., Maron, M., Williams, B.A., Jones, K.R., Wintle, B.A., Reside, A.E., Watson, J.E.M., 2022. The minimum land area requiring conservation attention to safeguard biodiversity. *Science* 376, 1094–1101. <https://doi.org/10.1126/science.abl9127>, 1979.
- Anyango-van Zwieten, N., 2021. Topical themes in biodiversity financing. *J. Integr. Environ. Sci.* <https://doi.org/10.1080/1943815X.2020.1866616>.
- Armsworth, P.R., Benefield, A.E., Dilkina, B., Fovargue, R., Jackson, H.B., le Bouille, D., Nolte, C., 2020. Allocating resources for land protection using continuous optimization: biodiversity conservation in the United States. *Ecol. Appl.* 30 <https://doi.org/10.1002/eap.2118>.
- WWF, 2009. Guide to Conservation Finance: Sustainable Financing for the Planet [WWW Document]. URL: http://awsassets.panda.org/downloads/wwf_guide_to_conservation_finance.pdf. accessed 5.5.22.
- Bos, M., Pressey, R.L., Stoeckl, N., 2015. Marine conservation finance: the need for and scope of an emerging field. *Ocean Coast Manag.* 114, 116–128. <https://doi.org/10.1016/j.ocecoaman.2015.06.021>.
- Bose, S., Dong, G., Simpson, A., 2019. Conservation Finance and Payment for Ecosystem Services, pp. 311–338. https://doi.org/10.1007/978-3-030-05624-7_13.
- Callon, M., Courtial, J.-P., Turner, W.A., Bauin, S., 1983. From translations to problematic networks: an introduction to co-word analysis. *Soc. Sci. Inf.* 22, 191–235. <https://doi.org/10.1177/053901883022002003>.
- Calvo, D.C., Luna, H.J., Arango, J.A., Torres, C.I., Rittmann, B.E., 2022. Determining global trends in syngas fermentation research through a bibliometric analysis. *J. Environ. Manag.* 307, 114522 <https://doi.org/10.1016/j.jenvman.2022.114522>.
- Caputo, A., Marzi, G., Maley, J., Silic, M., 2019. Ten years of conflict management research 2007–2017. *Int. J. Conflict Manag.* 30, 87–110. <https://doi.org/10.1108/IJCM-06-2018-0078>.
- Caputo, A., Pizzi, S., Pellegrini, M.M., Dabić, M., 2021. Digitalization and business models: where are we going? A science map of the field. *J. Bus. Res.* 123, 489–501. <https://doi.org/10.1016/j.jbusres.2020.09.053>.
- CBD, 2000. Sustaining Life on Earth. How the Convention on Biological Diversity Promotes Nature and Human Well-Being [WWW Document]. URL: <https://www.cbd.int/doc/publications/cbd-sustain-en.pdf>. accessed 5.10.22.
- CBD, 2021. A New Global Framework for Managing Nature through 2030: First Detailed Draft Agreement Debuts [WWW Document]. URL: <https://www.cbd.int/article/draft-1-global-biodiversity-framework>. accessed 5.11.22.
- CFA, 2020. Conservation Finance: A Framework [WWW Document]. URL: <https://www.landconservationnetwork.org/sites/default/files/Conservation+Finance+Framework.pdf>. accessed 5.10.22.
- Chape, S., Blyth, S., Fish, L., Fox, P., Spalding, M., 2003. 2003. United Nations list of protected areas [WWW Document]. URL: <https://portals.iucn.org/library/sites/library/files/documents/UNLNP-2003.pdf>. accessed 7.20.22.
- Christiansen, J., 2021. Fixing fictions through blended finance: the entrepreneurial ensemble and risk interpretation in the Blue Economy. *Geoforum* 120, 93–102. <https://doi.org/10.1016/j.geoforum.2021.01.013>.
- Clark, S., 2007. A Field Guide to Conservation Finance. In: *Conservation Finance 2021: an Unfolding Opportunity*. Island Press, Washington DC. Coalition for private investment in conservation, 2021. <http://cpicfinance.com/wp-content/uploads/2021/09/CPIC-Conservation-Finance-Report-2021.pdf>.
- Conservation Finance Network, 2020. Conservation Finance Network: where Conservation Meets Capital. Retrieved October 17, 2022, from: <https://www.conservaionfinancenetwork.org/about-cfn>.
- Council of the European Union, 2022. Biodiversity: How the EU Protects Nature [WWW Document]. URL: <https://www.consilium.europa.eu/en/policies/biodiversity/>. accessed 5.10.22.
- Dabić, M., Maley, J., Dana, L.-P., Novak, I., Pellegrini, M.M., Caputo, A., 2020. Pathways of SME internationalization: a bibliometric and systematic review. *Small Bus. Econ.* 55, 705–725. <https://doi.org/10.1007/s11187-019-00181-6>.
- De Bellis, N., 2005. La citazione bibliografica nell'epoca della sua riproducibilità tecnica: bibliometria e analisi delle citazioni dallo Science Citation Index alla Cybermetrica.
- Dempsey, J., Suarez, D.C., 2016. Arrested development? The promises and paradoxes of “selling nature to save it. *Ann. Assoc. Am. Geogr.* 106, 653–671. <https://doi.org/10.1080/24694452.2016.1140018>.
- Evans, D.M., Altwegg, R., Garner, T.W.J., Gompper, M.E., Gordon, I.J., Johnson, J.A., Pettorelli, N., 2015. Biodiversity offsetting: what are the challenges, opportunities and research priorities for animal conservation? *Anim. Conserv.* 18, 1–3. <https://doi.org/10.1111/acv.12173>.
- Gallo-Cajiao, E., Archibald, C., Friedman, R., Steven, R., Fuller, R.A., Game, E.T., Morrison, T.H., Ritchie, E.G., 2018. Crowdfunding biodiversity conservation. *Conserv. Biol.* 32, 1426–1435. <https://doi.org/10.1111/cobi.13144>.
- Githiru, M., King, M.W., Bauche, P., Simon, C., Boles, J., Rindt, C., Victorine, R., 2015. Should biodiversity offsets help finance underfunded Protected Areas? *Biol. Conserv.* <https://doi.org/10.1016/j.biocon.2015.07.033>.
- Global Canopy Programme, 2012. The Little Biodiversity Finance Book: a guide to proactive investment in natural capital (PIN) [WWW Document]. URL: https://www.cbd.int/financial/hlp/doc/literature/LittleBiodiversityFinanceBook_3rd%20edition.pdf. accessed 7.6.22.
- Huwylar, F., Käppeli, J.R., Serafimova, K., Eric, S., Tobin, J., 2014. Conservation Finance: Moving beyond Donor Funding toward an Investor-Driven Approach [WWW Document]. URL: <https://www.cbd.int/financial/privatesector/g-private-wwf.pdf>. accessed 5.4.22.
- International Science Council, 2018. Global Biodiversity Continues to Decline according to new reports from IPBES [WWW Document]. URL: <https://council.science/current/news/global-biodiversity-continues-to-decline-according-to-new-reports-from-ipbes/>. accessed 3.10.22.
- Johnson, J.A., Baldos, U., Hertel, T., Nootenboom, C., Polasky, S., Roxburgh, T., 2020. Global Futures: Modelling the Global Economic Impacts of Environmental Change to Support Policy-Making [WWW Document]. URL: https://www.wwf.org.uk/sites/default/files/2020-02/Global_Futures_Technical_Report.pdf. accessed 7.5.22.
- Kessler, M.M., 1963. Bibliographic coupling between scientific papers. *Am. Doc.* 14, 10–25. <https://doi.org/10.1002/asi.5090140103>.
- Khan, A., Hassan, M.K., Paltrinieri, A., Dreassi, A., Bahoo, S., 2020. A bibliometric review of takafal literature. *Int. Rev. Econ. Finance* 69, 389–405. <https://doi.org/10.1016/j.iref.2020.05.013>.
- Levitt, J.N., Bergen, L.K., 2005. From Walden to Wall Street: Frontiers of Conservation Finance.
- Littlefield, E., 2011. Impact investing: roots & branches. *Innovations: Technol. Gov.* 6, 19–25. https://doi.org/10.1162/INOV_a_00078.
- McCarthy, D.P., Donald, P.F., Scharlemann, J.P.W., Buchanan, G.M., Balmford, A., Green, J.M.H., Bennun, L.A., Burgess, N.D., Fishpool, L.D.C., Garnett, S.T., Leonard, D.L., Maloney, R.F., Morling, P., Schaefer, H.M., Symes, A., Wiedenfeld, D.A., Butchart, S.H.M., 2012. Financial costs of meeting global biodiversity conservation targets: current spending and unmet needs. *Science* 338, 946–949. <https://doi.org/10.1126/science.1229803>, 1979.
- McFarland, B.J., 2015. International finance for REDD+ within the context of conservation financing instruments. *J. Sustain. For.* <https://doi.org/10.1080/10549811.2015.1017109>.
- McFarland, B.J., 2018. The origins and history of conservation finance. In: *Conservation of Tropical Rainforests*. Springer International Publishing, pp. 121–131. https://doi.org/10.1007/978-3-319-63236-0_6.
- McGowan, J., Weary, R., Carriere, L., Game, E.T., Smith, J.L., Garvey, M., Possingham, H.P., 2020. Prioritizing debt conversion opportunities for marine conservation. *Conserv. Biol.* 34, 1065–1075. <https://doi.org/10.1111/cobi.13540>.
- Miller, D.C., 2014. Explaining global patterns of international aid for linked biodiversity conservation and development. *World Dev.* 59, 341–359. <https://doi.org/10.1016/j.worlddev.2014.01.004>.
- Mingers, J., Leydesdorff, L., 2015. A review of theory and practice in scientometrics. *Eur. J. Oper. Res.* 246, 1–19. <https://doi.org/10.1016/j.ejor.2015.04.002>.
- MISSION GENEVA, U.S., 2010. The importance of biodiversity for development [WWW Document]. URL: <https://geneva.usmission.gov/2010/04/20/usaid-biodiversity/>. accessed 5.3.22.
- Mitchell, M., Lockwood, M., Moore, S.A., Clement, S., 2015. Scenario analysis for biodiversity conservation: a social-ecological system approach in the Australian Alps. *J. Environ. Manag.* 150, 69–80. <https://doi.org/10.1016/j.jenvman.2014.11.013>.
- Pascal, N., Brathwaite, A., Bladon, A., Claudet, J., Clua, E., 2021. Impact investment in marine conservation. *Ecosyst. Serv.* 48 <https://doi.org/10.1016/j.ecoser.2021.101248>.
- Paulson Institute, 2020. Financing Nature: Closing the Global Biodiversity Financing Gap [WWW Document]. URL: <https://www.paulsoninstitute.org/conservation/financing-nature-report/>. accessed 7.10.22.
- Phelps, J., Webb, E.L., Koh, L.P., 2011. Risky business: an uncertain future for biodiversity conservation finance through REDD+. *Conserv Lett* 4, 88–94. <https://doi.org/10.1111/j.1755-263X.2010.00155.x>.

- Pilgrim, J.D., Bennun, L., 2014. Will biodiversity offsets save or sink protected areas? *Conserv Lett* 7, 423–424. <https://doi.org/10.1111/conl.12145>.
- Pizzi, S., Venturelli, A., Variale, M., Macario, G.P., 2021. Assessing the impacts of digital transformation on internal auditing: a bibliometric analysis. *Technol. Soc.* 67, 101738 <https://doi.org/10.1016/j.techsoc.2021.101738>.
- Purba, L.D.A., Md Khudzari, J., Iwamoto, K., Mohamad, S.E., Yuzir, A., Abdullah, N., Shimizu, K., Hermana, J., 2022. Discovering future research trends of aerobic granular sludge using bibliometric approach. *J. Environ. Manag.* 303, 114150 <https://doi.org/10.1016/j.jenvman.2021.114150>.
- Rylance, A., Snyman, S., Spenceley, A., 2017. The contribution of tourism revenue to financing protected area management in Southern Africa. *Tourism Rev. Int.* 21, 139–149. <https://doi.org/10.3727/154427217X14912408849449>.
- Satizábal, P., Dressler, W.H., Fabinyi, M., Pido, M.D., 2020. Blue economy discourses and practices: reconfiguring ocean spaces in the Philippines. *Maritime Studies* 19, 207–221. <https://doi.org/10.1007/s40152-020-00168-0>.
- Seidl, A., Mulungu, K., Arlaud, M., van den Heuvel, O., Riva, M., 2020. Finance for nature: a global estimate of public biodiversity investments. *Ecosyst. Serv.* 46, 101216 <https://doi.org/10.1016/j.ecoser.2020.101216>.
- Spenceley, A., McCool, S., Newsome, D., Báez, A., Barborak, J.R., Blye, C.J., Bricker, K., Cahyadi, H.S., Corrigan, K., Halpenny, E., Hvenegaard, G., King, D.M., Leung, Y.F., Mandić, A., Naidoo, R., Rüede, D., Sano, J., Sarhan, M., Santamaria, V., Sousa, T.B., Zschiegner, A.K., 2021. Tourism in protected and conserved areas amid the covid-19 pandemic. *Parks* 27, 103–118. <https://doi.org/10.2305/IUCN.CH.2021.PARKS-27-SIAS.en>.
- Stubbs, W., 2017. Sustainable entrepreneurship and B corps. *Bus. Strat. Environ.* 26, 331–344. <https://doi.org/10.1002/bse.1920>.
- Sullivan, S., Hannis, M., 2015. Nets and frames, losses and gains: value struggles in engagements with biodiversity offsetting policy in England. *Ecosyst. Serv.* 15, 162–173. <https://doi.org/10.1016/j.ecoser.2015.01.009>.
- Tan, H., Li, Jialing, He, M., Li, Jiayu, Zhi, D., Qin, F., Zhang, C., 2021. Global evolution of research on green energy and environmental technologies: A bibliometric study. *J. Environ. Manag.* 297, 113382 <https://doi.org/10.1016/j.jenvman.2021.113382>.
- Tauli-Corpuz, V., Alcorn, J., Molnar, A., Healy, C., Barrow, E., 2020. Cornered by PAs: adopting rights-based approaches to enable cost-effective conservation and climate action. *World Dev.* 130, 104923 <https://doi.org/10.1016/j.worlddev.2020.104923>.
- Tisdell, C., Wilson, C., 2001. *Wildlife-based Tourism and Increased Support for Nature Conservation Financially and Otherwise: Evidence from Sea Turtle Ecotourism at Mon Repos, Tourism Economics*.
- Tranfield, D., Denyer, D., Smart, P., 2003. Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *Br. J. Manag.* 14, 207–222. <https://doi.org/10.1111/1467-8551.00375>.
- UNDP, 2018. *The BIOFIN Workbook 2018: Finance for Nature. The Biodiversity Finance Initiative [WWW Document]*. URL: https://www.biofin.org/sites/default/files/content/knowledge_products/BIOFIN%20Workbook%202018.pdf. accessed 4.2.22.
- Vijayaraghavan, K., Biswal, B.K., Adam, M.G., Soh, S.H., Tsen-Tieng, D.L., Davis, A.P., Chew, S.H., Tan, P.Y., Babovic, V., Balasubramanian, R., 2021. Bioretention systems for stormwater management: recent advances and future prospects. *J. Environ. Manag.* 292, 112766 <https://doi.org/10.1016/j.jenvman.2021.112766>.
- Waldron, A., Mooers, A.O., Miller, D.C., Nibbelink, N., Redding, D., Kuhn, T.S., Timmons Roberts, J., Gittleman, J.L., 2013. Targeting global conservation funding to limit immediate biodiversity declines. *Proc. Natl. Acad. Sci. USA* 110, 12144–12148. <https://doi.org/10.5061/dryad.p69t1>.
- Waldron, A., Miller, D.C., Redding, D., Mooers, A., Kuhn, T.S., Nibbelink, N., Roberts, J. T., Tobias, J.A., Gittleman, J.L., 2017. Reductions in global biodiversity loss predicted from conservation spending. *Nature* 551, 364–367. <https://doi.org/10.1038/nature24295>.
- World Bank Group, 2020. *Mobilizing private finance for nature [WWW Document]*. URL: <https://thedocs.worldbank.org/en/doc/916781601304630850-0120022020/original/FinanceforNature28Sepwebversion.pdf>. accessed 6.4.22.
- World Economic Forum, 2021. *What is “nature positive” and why is it the key to our future? [WWW Document]*. URL: <https://www.weforum.org/agenda/2021/06/what-is-nature-positive-and-why-is-it-the-key-to-our-future/> (accessed 6.20.22).
- World Economic Forum, 2022. *Putting Nature at the Heart of the Global Financial System [WWW Document]*. URL: <https://www.weforum.org/agenda/2022/05/nature-positive-net-zero-global-financial-system/>. accessed 7.3.22.
- Zupic, I., Cater, T., 2015. Bibliometric methods in management and organization. *Organ. Res. Methods* 18, 429–472. <https://doi.org/10.1177/1094428114562629>.