



# Biodiversity research in the Netherlands and worldwide

What published academic research tells us

# Executive summary

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## This report reveals the current state of biodiversity research in the Netherlands and worldwide. The analysis covers the impact of biodiversity research globally on industry and policy.

Biodiversity research globally is characterized by above average impact, with a Field-Weighted Citation Impact (FWCI) of 1.22, and an even higher FWCI of 2.40 in the Netherlands.

Scientists involved in biodiversity research are truly collaborating across borders, with 37% of all biodiversity research publications globally including authors from more than one country. The proportion is even higher in Europe, with 70% of publications demonstrating international collaboration, and remarkably high in the Netherlands, with 83% of all biodiversity research publications.

Worldwide, Europe leads the way in biodiversity research output with 41% of all publications in the field, twice the share of the nearest runner-up, the US, which accounts for 21%. In recent years, Europe's lead has widened. While the UK, Germany, and France might lead in Europe in terms of output, when we consider citation impact a different picture emerges with Sweden, Switzerland, and the Netherlands taking center stage.

Publications arising from academia-industry collaborations in biodiversity research are highly impactful. Moreover, we also observe that publications from the Netherlands on

biodiversity research are highly cited in policy documents around the world, illustrating the global impact of the country's research on policy and politics.

Key countries in the Global South such as Brazil, Mexico, and South Africa, all with their own rich and diverse ecosystems, contribute more substantially to biodiversity research than might be expected on the basis of their overall contribution to research. Moreover, publications arising out of collaboration with African researchers are characterized by exceptional high citation impact, with FWCI of over 3. Specifically, Dutch-African collaborations in biodiversity research demonstrate a FWCI of 3.5, illustrating the high impact of research efforts involving Africa.

In the Netherlands, many universities and specialized research institutes contribute to biodiversity research, but Wageningen University & Research, Naturalis Biodiversity Center, Utrecht University and the University of Amsterdam lead the way in terms of scholarly output. Wageningen University & Research is in a league of its own, with twice the number of publications as its closest rival, Utrecht University.

Overall, global research in biodiversity is a story of quality, far-reaching impact, partnership, and collaboration.

# Key findings

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## Global biodiversity research is characterized by:



### Above average scientific impact

The FWCI for global research in biodiversity is 1.22, 22% above the overall average for research across all disciplines.



### High level of international collaboration

Of all biodiversity research publications, 37% include authors from more than one country. This proportion is substantially higher than for research publications across all disciplines globally (21%). Biodiversity research publications from European countries are highly international, with 70% including authors from more than one country.



### Strong contribution from Europe

As a region, Europe contributes 41% of all biodiversity research publications, ahead of the US (21%) and China (16%), with strong contributions from Latin America (16%) and Africa (7%). Within Europe, the UK, Germany, and France lead the way in overall scholarly output, but Sweden, the Netherlands, and Switzerland lead in citation impact.



### High relative activity in key Global South countries

Brazil, Mexico, and South Africa publish substantially more on biodiversity research than their overall contribution to global research, while Russia, India, China, and Japan publish relatively less.



### International collaboration with African scholars has outstanding impact

International collaboration on biodiversity research with African scholars achieves high FWCI scores of 3 or more. African-Dutch collaboration, in particular, has a FWCI of 3.5 while that between Africa and Switzerland, Brazil and Sweden are above 4, illustrating the strength of Global North-South and South-South partnerships in biodiversity research.

## Biodiversity research in the Netherlands demonstrates:



### High scientific impact globally

The FWCI of biodiversity research in the Netherlands is 2.40, more than twice the global average for publications in general and double that for biodiversity research, on par with other research leaders like Sweden and Switzerland.



### Strong international collaboration

Of all biodiversity research publications produced by the Netherlands, 83% include authors from more than one country. This is a higher proportion than the 63% of the country's publications in general that have one or more international co-authors and much higher than the biodiversity research field worldwide (37%).



### Highly impactful academic-corporate collaboration

Among the most prolific European countries, the Netherlands is the frontrunner in academic-corporate collaboration with 6% of biodiversity research publications, followed by Sweden and Switzerland.



### Strong impact on biodiversity policies worldwide

Dutch research is widely cited in policy documents globally, demonstrating the international impact of the country's biodiversity research on policy and politics.



### Significant contribution from leader Wageningen University & Research

Wageningen University & Research is the only Dutch university in the global top 10 of most prolific academic institutions in biodiversity research and is in a league of its own nationally in terms of the number of biodiversity research publications, producing more than twice the volume of its closest rival, Utrecht University.

# Preface

World-famous thanks to its role in Alice's Adventures in Wonderland<sup>1</sup>, the dodo has become a symbol of human-induced extinction. The flightless bird was first recorded by Dutch sailors, who encountered it on the uninhabited island of Mauritius, in 1598. The dodo was even described and pictured in an early Elsevier publication, *Of the Indies*, both natural and medical<sup>2</sup>, by the Dutch naturalist Willem Piso. In the years following its 'discovery', the bird was widely hunted by sailors and invasive species such as dogs, cats, and pigs, while its forest habitat was destroyed. By 1662, less than a century after the arrival of the Dutch on Mauritius, the dodo had gone extinct.



Since the beginning of time, our planet has experienced immense changes and extinctions. But today, these events are occurring at an unprecedented rate. Just like the case of the dodo, many of the underlying reasons can be traced back to human activity. In the last 200 years, as the modern industrial era has come of age, with humans communicating and interacting on a global scale, we have increasingly contributed to habitat loss, unsustainable resource use, the spread of invasive species, and pollution. While combating climate change is finally on political leaders' agendas, it is concomitant with a much bigger problem: the loss of biodiversity.

At Elsevier, we believe that biodiversity loss is the next 'big challenge' facing the global community, after climate change. We consider it vitally important that we highlight this topic. If biodiversity declines further, so will the quality of human life on earth. The air we breathe, the land we live on, and the food we eat all depend on biodiversity. Action on protecting biodiversity in politics, business, and society at large will, directly or indirectly, be informed by scientific research. That is why Elsevier — the world's largest provider of scientific literature — is uniquely positioned to feed the global discussion on biodiversity. It is also our responsibility.

Since the launch of the United Nations' Sustainable Development Goals (SDGs), Elsevier has worked closely with the research community to map the ever-changing research landscape around sustainability and its related themes. Our first report in 2015, *Sustainability Science in the Global Research Landscape*<sup>3</sup>, highlighted the

<sup>1</sup> Lewis Carroll, *Alice's Adventures in Wonderland* (Macmillan, 1865).

<sup>2</sup> *De Indiae utriusque re naturali et medica libri quatuordecim* (Elsevier, Amsterdam, 1658).

<sup>3</sup> Sustainability Science in a Global Landscape. (2015) <https://www.elsevier.com/en-gb/about/corporate-responsibility/sustainability-science-in-a-global-landscape>

tremendous growth in sustainability research. In 2020, our follow up report, *The Power of Data to Advance the SDGs*<sup>4</sup>, was the first to map the research landscape to the 17 SDGs and their underlying targets. Since then, we have focused on key topics such as clean energy<sup>5</sup>, gender equality<sup>6</sup>, and health<sup>7</sup>.

We recognize our own responsibility to tackle climate change and, for more than 15 years, have been taking action to minimize the impact of our operations on the environment with a priority to reduce carbon emissions to achieve net zero by no later than 2040<sup>8</sup>. We are supported in our efforts by the active participation of colleagues around the world and guided by our independent climate advisory board<sup>9</sup>. In 2023, our focus on biodiversity reflects the increasing importance of this topic and the critical need to understand trends and insights in research and innovation. We hope this will be the start of a long-term focus supporting our collective efforts to protect, restore, and enable biodiversity to flourish.

Our company's roots can be traced back to the Netherlands of the late 16th century, the same time the Dutch first encountered the dodo in Mauritius. Today, a large part of Elsevier's workforce is still based in Amsterdam, a region's whose inhabitants are likely to witness the effects of rising sea levels directly in the coming decades. Despite its crucial role in the global ecosystem, biodiversity finds itself under threat in the Netherlands. Not only is the country's biodiversity significantly below the European average, emissions of nitrogen oxides and ammonia as the result of agriculture, transport, and industry have been too high for many years according to experts.

This report aims to provide an overview of biodiversity research in the Netherlands and analyze it in an international context. While knowledge alone is insufficient to change people's behavior, it may serve as a first step towards action. Dutch biodiversity research is of exceptional quality, the result of intense international collaboration, and the basis of policymaking around the world. Elsevier hopes that the findings in this report will inspire politicians, business leaders, and informed readers throughout the Netherlands and internationally to take biodiversity to heart. If we do not act now, biodiversity loss will not only lead to the extinction of species like the dodo but also potentially the end of humankind.

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<sup>4</sup> *The Power of Data to Advance the SDGs*. (2020) <https://www.elsevier.com/connect/sdg-report>

<sup>5</sup> *Pathways to Net Zero: The Impact of Clean Energy Research*. (2022). <https://www.elsevier.com/connect/net-zero-report>

<sup>6</sup> Elsevier's reports on gender in research: <https://www.elsevier.com/connect/gender-report>

<sup>7</sup> *Clinician of the Future: a 2022 report*. (2022). <https://www.elsevier.com/connect/clinician-of-the-future>

<sup>8</sup> Elsevier Corporate Responsibility: <https://www.elsevier.com/about/corporate-responsibility/climate-action>

<sup>9</sup> Climate Advisory Board: <https://www.elsevier.com/about/corporate-responsibility/climate-action/climate-advisory-board>

The report was very much a team effort with crucial contributions from Paola Barr, Valeria Rinaudo, and many other Elsevier colleagues who are sincerely thanked here.

Dr. Michiel Kolman

Senior Vice President,  
Academic Ambassador, Elsevier



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# Introduction

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Biodiversity encompasses all life on Earth and its loss can have serious consequences. A better understanding through research is essential to protecting and preserving biodiversity in the Netherlands and globally.

The term biodiversity refers to the variety of life on Earth at all levels. From genes to entire ecosystems consisting of plants, animals, and other organisms. It not only includes rare, threatened, or endangered species, but encompasses every living thing: from microbes and fungi to trees and other plants, animals, and humans. The loss of biodiversity is a serious concern because it can have significant consequences for the planet and human societies. When species disappear, ecosystems become less resilient and less able to adapt to changing conditions, which can lead to further species loss and ecosystem collapse. This, in turn, will affect human health and well-being, as we depend on ecosystems for essential resources such as food, water, and medicine.

Biodiversity is facing a number of significant threats in current times, with human activities having a major impact on the planet's natural resources. The destruction and fragmentation of natural habitats, such as forests, wetlands, and coral reefs, is one of the most significant. Deforestation, urbanization, and land-use changes for agriculture and infrastructure development are often the cause. Rising global temperatures, changes in rainfall patterns, and more frequent extreme weather events, all arising from human activities, are also having significant impacts on biodiversity. These include changes in species distribution and behavior, as well as changes in the timing of seasonal events like flowering and migration. Pollution from sources such as agriculture, industry, and urbanization can have negative impacts on biodiversity, damaging plant communities and leading to declines in aquatic species. At the same time, overexploitation, such as overfishing or hunting, can lead to declines in species populations and, ultimately, extinction. Finally, invasive species, often introduced intentionally or

accidentally by humans, can outcompete native species and disrupt ecosystems, leading to declines in biodiversity and changes to ecosystem functions.

There is an urgent need to address the threats to biodiversity and protect the planet's natural resources. This requires a global effort to reduce greenhouse gas emissions, protect habitats, and promote sustainable practices in agriculture, fishing, and other industries. It also requires a greater recognition of the value of biodiversity and the role it plays in supporting life on Earth. By taking action to protect and conserve biodiversity, we can help to ensure a healthy and sustainable future for ourselves and future generations.

*“It is essential to bend the curve of ongoing global biodiversity decline. For that, we need high quality scientific research to understand the dynamics of biodiversity loss and to assess what needs to be done in terms of mitigating measures and policies.”*

Arthur P. J. Mol, Rector Magnificus,  
Wageningen University & Research

## Current state of biodiversity in the Netherlands

To assess the current state of biodiversity in the Netherlands, one key indicator is the internationally recognized Relative Mean Species Abundance of Originally Occurring Species (or MSA). It is employed in the United Nations Environment Programme's (UNEP) Global Environment Outlook (GEO)<sup>10</sup>, which is a series of reports reviewing the state of the global environment, the Convention on Biological Diversity's (CBD) Global Biodiversity Outlook<sup>11</sup>, and the OECD Environmental Outlook<sup>12</sup>. For further information, see<sup>13</sup> (in Dutch).

Historically, the MSA was about 95% globally and 85% in Europe in 1700. By 2010, the MSA was estimated to be around 70% globally and even less in Europe as a whole (at around 50%). In the Netherlands, by 2010, however, the MSA was approximately 15%, significantly less than the European average. By way of comparison, this represents a steep decline since 1900, when the Netherlands' MSA was still over 40%. The Netherlands' dramatically low MSA figure of 15% is the combined result of a historic loss of natural habitats and the declining quality of the remaining natural areas. The quality of rural areas in the country has declined as a result of agricultural intensification and urbanization.

### Published academic research as a starting point

Published academic research in biodiversity is invaluable for advancing knowledge and understanding of biodiversity conservation and management. It provides a rigorous and systematic analysis of the ecological, social, economic, and policy aspects of biodiversity, and generates evidence-based insights that can inform policy and decision-making.

Academic research in this area covers a wide range of topics, from understanding the ecological processes that maintain biodiversity to examining the social and economic drivers of biodiversity loss and exploring policy and governance mechanisms for biodiversity conservation. Through peer-reviewed publications, academic research in biodiversity policy is disseminated widely to inform and influence policy

at local, national, and international levels. In this way, academic research plays a critical role in advancing our understanding of biodiversity and supporting the development of effective policies and practices for its conservation and sustainable use. This report aims to provide an overview of biodiversity research worldwide and Dutch biodiversity research in particular. It compares the scope and impact of biodiversity research from other regions, nations, and countries around the world, in addition to highlighting the role of biodiversity research in the Netherlands within the academic landscape, in collaboration with industry, and in shaping of international policy. Finally, the report provides an analysis of biodiversity research funding in the Netherlands.

*“It is rather sad to see that the country in which biodiversity is so under pressure and has one of the worst scores in biodiversity values globally, is among the most productive and influential in biodiversity research. One can only hope that the Netherlands’ strong reputation in biodiversity research will translate into more action protecting and restoring critical biodiversity values in the Netherlands.”*

Peter H. Verburg, VU Amsterdam

<sup>10</sup> UNEP's Global Environment Outlook: <https://www.unep.org/geo/>

<sup>11</sup> Convention on Biological Diversity's Global Biodiversity Outlook: <https://www.cbd.int/gbo/>

<sup>12</sup> OECD Environmental Outlook: <https://www.oecd.org/environment/indicators->

[modelling-outlooks/oecd-environmental-outlook-1999155x.htm](https://www.oecd.org/environment/indicators-modelling-outlooks/oecd-environmental-outlook-1999155x.htm)

<sup>13</sup> Compendium voor de Leefomgeving: Biodiversiteit: <https://www.clo.nl/indicatoren/nl1440-ontwikkeling-biodiversiteit-msa>

## Methodology

To gain a comprehensive understanding of the current landscape of biodiversity research, a thorough methodology was employed in this report. We used Elsevier's Scopus, a comprehensive, source-neutral abstract and citation database curated by independent subject matter experts. Scopus contains a vast array of publication types, including articles, reviews, conference papers, book chapters, editorials, and abstract reports (for further details, see APPENDIX B). By querying Scopus, a broad range of relevant publications on the topic of biodiversity can be gathered. Data was gathered for the period from 2017 until 2022, unless otherwise stated in the report.

In addition, we sought to gain insights into the funding of biodiversity research by using Funding Institutional, a database that harvests data directly from funder websites. This data is then standardized and curated by Elsevier, enriched with Scopus ASJC categories ('All Science Journal Classification' which adds research discipline categories to funding opportunities and awarded grants<sup>14</sup>), Scopus Author

IDs (which connect researcher names with awarded grants), and Scopus Affiliation IDs (which connect affiliation names with awarded grants) to remove any ambiguities.

To ensure the capture of a comprehensive set of biodiversity research-related publications, we conducted several tests using different search terms relevant to the field. We then created a search string composed of multiple terms, which targeted titles, abstracts, and keywords, to retrieve a broad set of relevant publications.

For this report, we identified biodiversity research by using specific terms, such as biodiversity, species richness, species diversity, ecosystem diversity, phylogenetic diversity, functional diversity, conservation biology, and ecological diversity. We used the same terms to identify funding opportunities related to biodiversity research. Our search string for identifying relevant research was as follows: TITLE-ABS-KEY("biodiversity" OR "species richness" OR "species diversity" OR "ecosystem diversity" OR "phylogenetic diversity" OR "functional diversity" OR "conservation biology" OR "ecological diversity").

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<sup>14</sup> There are 27 Scopus ASJC categories, ranging from medicine to engineering to business management, each with subcategories.

# 1 Global scholarly output on biodiversity

## What is the current state of biodiversity research growth, impact, and coverage globally? Which regions, countries, and institutes are the largest contributors and what is their impact on the field?

Scholarly output on biodiversity has increased significantly in recent years. Based on Scopus data from 2017 to 2022, a total of 142,625 publications were produced on biodiversity research during this period (FIGURE 1-1). In most academic fields, the US and China are usually the largest contributors, followed by Europe. In the biodiversity research field, however, Europe has taken the lead. The largest proportion of publications are by authors at European universities (41%), followed by the US (21%), and China (16%), with strong contributions from Latin America (16%) and Africa (7%). This analysis also allows the identification of information gaps, such as South and Southeast Asia where there are dense human populations and important biodiversity hotspots. Most publications in biodiversity research (93%) have ten authors or less; the rest between ten and 50 contributors; and a few were produced by large groups of over 1,000 authors, so-called “kilo papers”.

The quality of global biodiversity research, one of the measures of which is the Field-Weighted Citation Impact (FWCI), is 1.22, which is higher than the global average FWCI of 1.00 across all disciplines. Although it is not the only indicator of research quality, this report will use FWCI for convenience throughout. In addition, biodiversity research publications tend to be highly international with 37% the result of international collaboration, which is almost twice the global average of 21%.



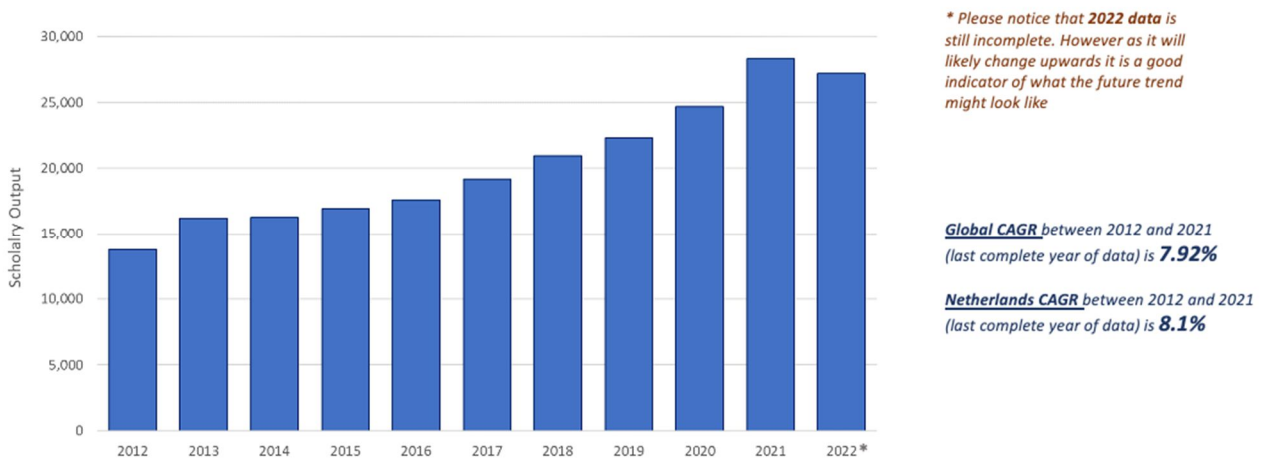
FIGURE 1-1  
Global scholarly output from 2017-2022, showing FWCI and percentage of publications demonstrating international collaboration in biodiversity.  
Source: Scopus.

### A growing trend

There has been growing global interest in biodiversity research in recent years, which has intensified since 2018 and gained further momentum following the COVID-19 pandemic. Published research on biodiversity

grew at an average annual rate of 7.9% globally between 2012 and 2021, with the Netherlands showing a slightly higher growth rate of 8.1% per year over the same period. In the past five years, the growth rate in

biodiversity publications has increased even further to 10.3% globally and 10.5% in the Netherlands (FIGURE 1-2). This trend could be attributed to an amplified international focus on biodiversity as a result of the signing of the Paris Agreement in 2015<sup>35</sup> and the UN Biodiversity Conferences of 2018 and 2021-2022.



**FIGURE 1-2**  
Global scholarly output in biodiversity research from 2012 to 2022, showing CAGR values for the Netherlands and the world. Note: the data for 2022 is incomplete but gives an indicator of the future trend.  
*Source: Scopus.*

Europe’s leadership in biodiversity research is a relatively recent phenomenon. If research output from a larger data set ranging from 2000-2022 is analyzed, the US dominates the field with around 80,000 publications (FIGURE 1-3). China is the second largest producer of scholarly output over this period, with almost 40,000 publications. Within Europe, the most prolific countries are the UK, Germany, and France. The Netherlands is ranked 12<sup>th</sup> with a total of around 10,000 articles published since 2000.

<sup>35</sup> The Paris Agreement: [https://unfccc.int/process-and-meetings/the-paris-agreement?gclid=CjwKCAjwx\\_eiBhBGEiwA15gLN9xfGK2DoZY0N8lqoruOTf-O1qf7UMvfGM1QbGNQBLLTWO36KTBwxC3doQAvD\\_BwE](https://unfccc.int/process-and-meetings/the-paris-agreement?gclid=CjwKCAjwx_eiBhBGEiwA15gLN9xfGK2DoZY0N8lqoruOTf-O1qf7UMvfGM1QbGNQBLLTWO36KTBwxC3doQAvD_BwE)

*Biodiversity and climate issues ignore national boundaries. Almost all issues need international collaboration but it's even more true in Europe where countries share species, legislation, people flux, and market rules to name a few. Maintaining a high degree of international collaboration is vital and in biodiversity and climatic sciences this collaboration translates directly into meaningful outputs.*

Vincent Devictor, CNRS, Institut des Sciences de l'Evolution de Montpellier, France, Editor-in-Chief of *Biological Conservation*

Almost two-thirds of biodiversity research published between 2000 and 2022 can be categorized under agricultural and environmental sciences. However, biodiversity research overall is becoming highly multidisciplinary over time, with increased contributions from a large variety of subject areas including social sciences, immunology, and engineering (FIGURE 1-4). This likely reflects how fields like health and engineering are now actively considering nature and nature-based solutions as part of their core focus.

Publications by country (count of the 15 most prolific countries)

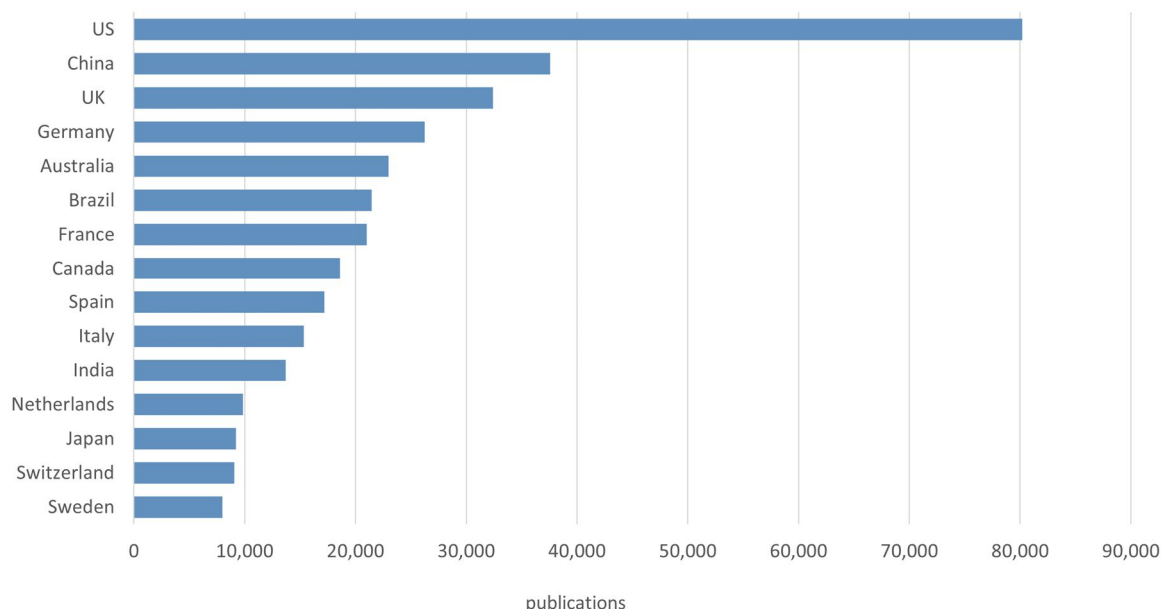
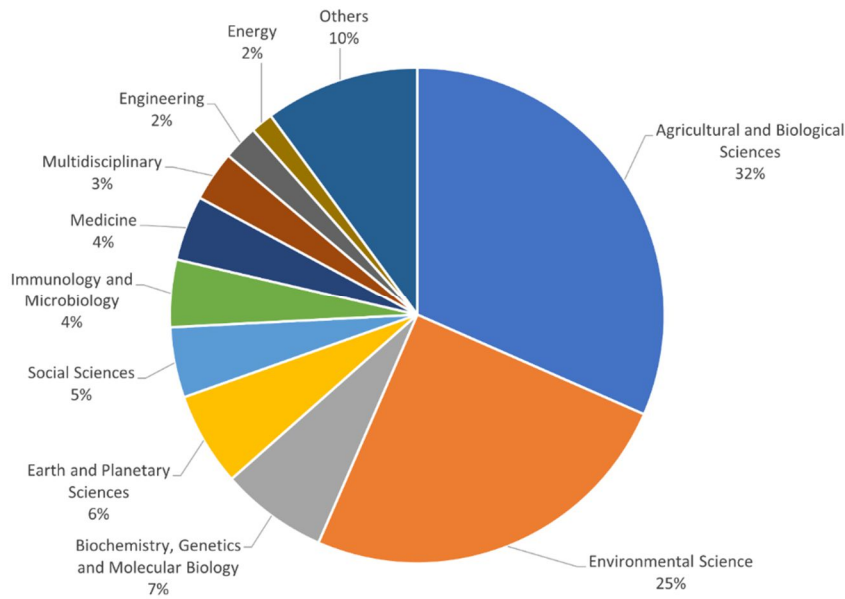


FIGURE 1-3

Number of publications in biodiversity research by country from 2000-2022, for the top 15 most prolific producers.

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**FIGURE 1-4**  
 Publications in biodiversity research from 2000-2022 by subject area.  
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### Most prolific European countries in biodiversity research

In terms of the quality of research output, the top 12 most prolific European countries in biodiversity shown in TABLE 1-5 are also high performers with FWCI that exceed the global average of 1.22. The only exception is Russia, whose biodiversity research output has a FWCI of 0.97. Among these European countries, some produce exceptionally impactful biodiversity research. The Netherlands is among the strongest performers, with a FWCI of 2.40, almost 2.5 times the global average for all disciplines. Although the Netherlands ranks only 8<sup>th</sup> in terms of output, it ranks in the top 3 in terms of citation impact together with Sweden and Switzerland.















Countries/Regions	Relative Activity Index (RAI)	Scholarly Output ↓	Field-Weighted Citation Impact ↓	International Collaboration (%) ↓	Academic-Corporate Collaboration (%) ↓
 United Kingdom	1.45	13,493	2.13	78.7	4.6
 Germany	1.55	12,144	1.94	74.5	3.6
 France	1.77	8,982	1.91	73.6	4.3
 Spain	1.79	7,917	1.71	71.9	3.7
 Italy	1.34	7,492	1.73	58.3	3.8
 Russian Federation	0.96	4,413	0.97	36.1	1.5
 Switzerland	2.01	4,326	2.44	84.3	5.3
 Netherlands	1.55	4,229	2.40	83.2	5.8
 Sweden	1.90	3,582	2.38	82.7	5.0
 Poland	1.46	3,285	1.33	47.9	1.9
 Portugal	2.46	3,144	1.68	77.4	3.8
 Czech Republic	2.63	2,834	1.79	74.3	2.3

TABLE 1-5

Publications in biodiversity research for top 12 most prolific European countries, from 2017-2022.

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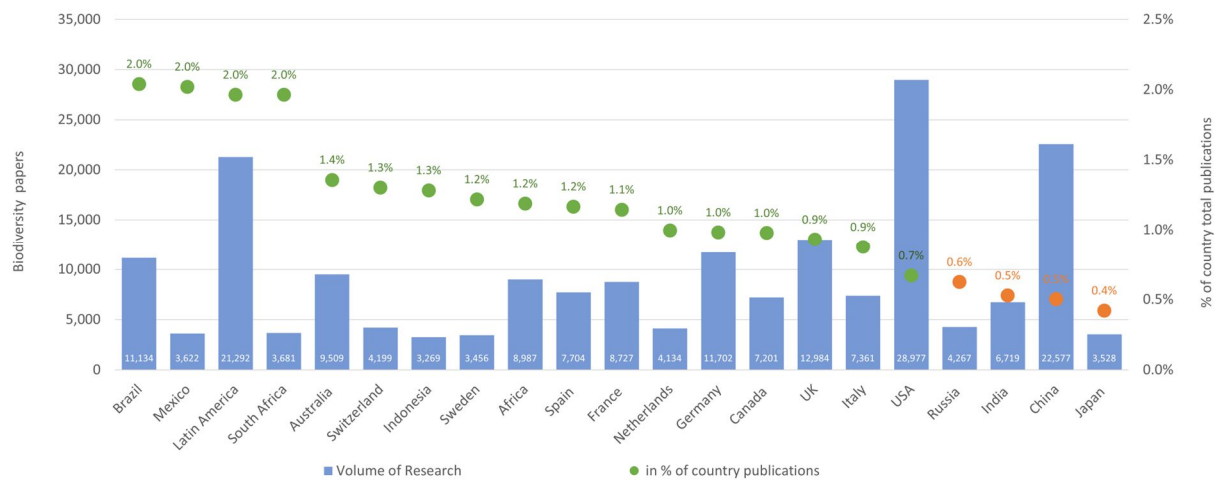
In TABLE 1-5, Relative Activity Index (RAI) indicates a country's comparative degree of specialization within the field of biodiversity research. It is calculated by dividing a given country's share of publications within a field by the global share for that particular field. All the top 12 European countries, except for Russia (which has a RAI of 0.96), have a higher level of specialization in biodiversity research than the global average, with notable leaders including Portugal (RAI of 2.46) and Czechia (RAI of 2.63). By this indicator, the Netherlands — with an RAI of 1.55 — may be considered an average player in this European league.

The biodiversity research publications of these European countries, with the exceptions of Poland and Russia, show a remarkably high percentage of international collaboration, in general with more than 70% of national output on the topic the result of international collaboration — well above the global average of 37%. Within this European top 12, the Netherlands shows an exceptionally high level of international collaboration (with 83% of publications) together with Sweden and Switzerland. In fact, the Netherlands is the absolute frontrunner in academic-corporate collaboration, followed by Sweden and Switzerland.

## Scholarly output and relative activity in Europe and worldwide

In terms of relative output, next to Europe as a whole, the Global South takes a leading position in biodiversity research. This is especially the case for Brazil, Mexico, and the Latin American region in general (which includes all countries on the American continent from Mexico south and includes the Caribbean), where around 2% of these nation's total research output is devoted to biodiversity, the highest share of any region studied here. In FIGURE 1-6, the green dots denote a relative contribution above the global average, while the red dots denote contributions below the global average (Russia, India, China, and Japan). Latin American countries possess a wealth of biodiversity within their borders, with a high number of unique and endemic species. This rich diversity makes these countries important centers for conservation and research, which is recognized by international organizations and funding agencies.





**FIGURE 1-6**  
 Scholarly output in biodiversity research by country (in blue), from 2017-2022, showing the relative share of biodiversity research publications as a percentage of total output where green dots denote more activity and red dots less activity than the global average.  
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The US and China lead in terms of absolute numbers of biodiversity research publications globally, as expected given the size of the research enterprise in these countries, but Latin America is a strong contender in third place. In Europe, the UK, Germany, and France contribute the largest number of publications. However, relative to their total research output, Switzerland, Sweden, and Spain score highly as well. The Netherlands is a strong player in the middle category with almost 1% of its scholarly output dedicated to biodiversity research, 55% above the global average.

In Europe, in particular, the focus on biodiversity has increased since the start of the COVID-19 pandemic. In FIGURE 1-7, which depicts the growth of biodiversity research in terms of absolute numbers of publications between 2012 and 2021, there is development in all five regions, but especially in Europe, China, and Latin America. European countries had already claimed a strong position in 2019 but have since accelerated beyond all other contenders. This clearly shows that Europe has come to dominate biodiversity research in recent years. Note: the five regions in FIGURE 1-7 were selected on the basis of research activity. The US, Europe, and China are the three most research-intensive regions. To get a sense of the Global South’s involvement in biodiversity research, it is positioned with African and Latin American regions as a whole.

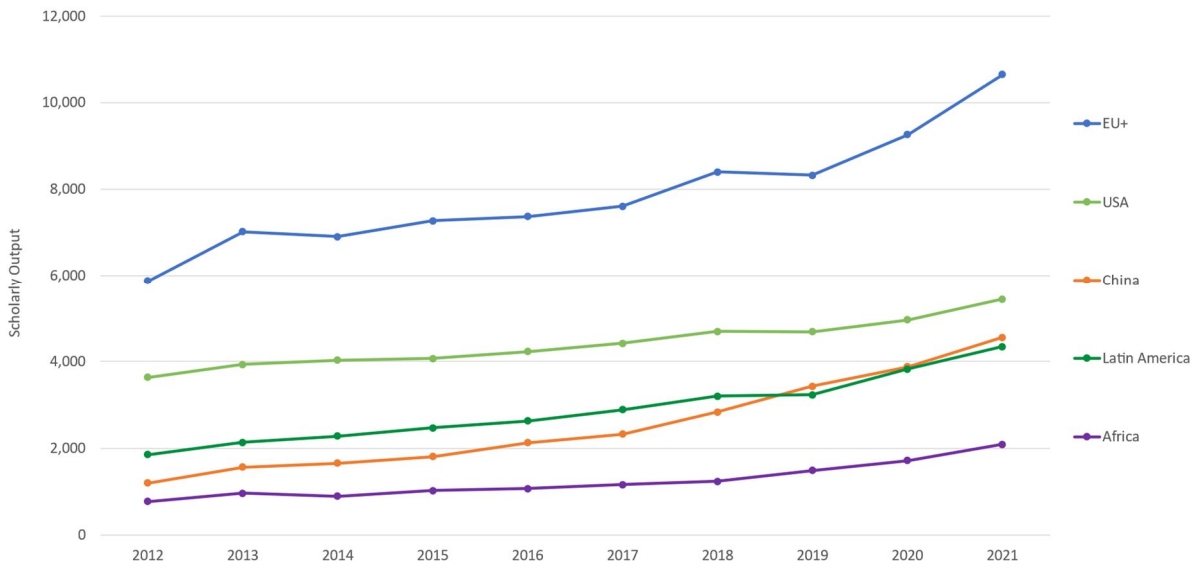


FIGURE 1-7  
 Scholarly output in biodiversity research for Europe, the US, China, Latin America, and Africa from 2012-2021.  
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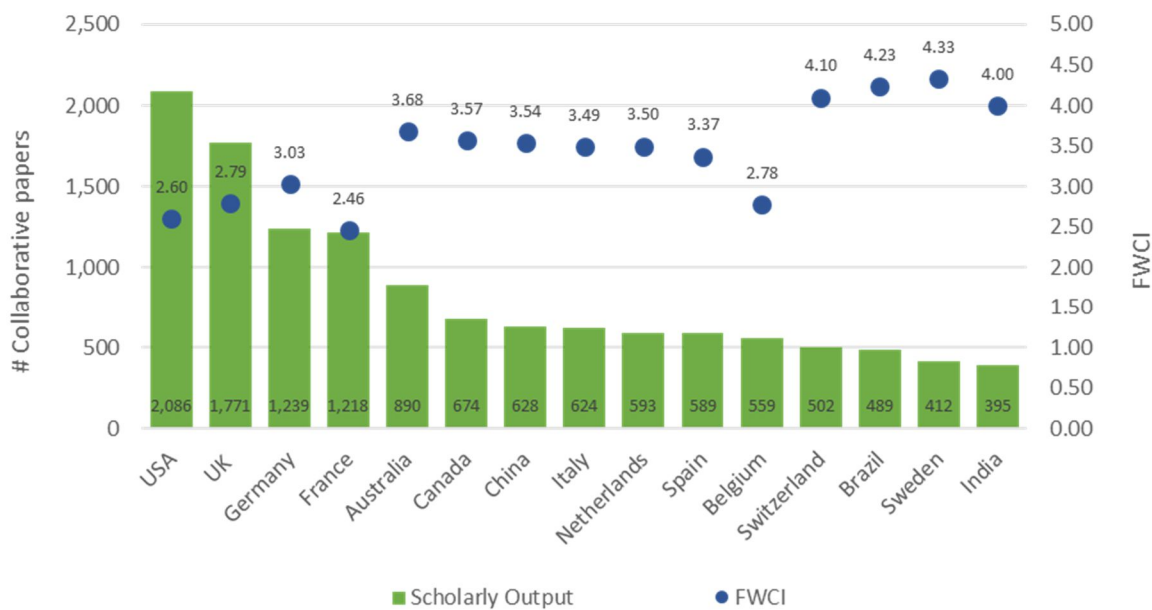
In TABLE 1-8, the top 10 ranking of most the prolific universities in biodiversity research reveals a truly international spectrum, with strong players from around the world including the Global South. Wageningen University & Research comes in 9<sup>th</sup> position as the sole Dutch university in this ranking.

Most prolific Universities	Scholarly Output
University of Chinese Academy of Sciences	2,937
Université de Montpellier	1,945
Universidade de São Paulo	1,882
Université PSL	1,846
Smithsonian Institution	1,555
Universidad Nacional Autónoma de México	1,531
Sorbonne Université	1,477
University of Queensland	1,366
Wageningen University & Research	1,366
Friedrich Schiller University Jena	1,329

TABLE 1-8  
 Most prolific universities in biodiversity research globally from 2017-2022.  
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## Biodiversity research in Africa

Africa is a continent with an incredible diversity of flora and fauna, including many endemic species that cannot be found elsewhere in the world. This diversity is thanks to a variety of factors, including the continent's vast size, varied landscapes and habitats, and complex geological history. However, many African countries also face significant environmental challenges, such as habitat loss, climate change, and poaching. These challenges have led to a growing awareness of the importance of preserving and understanding natural resources and ecosystems. This may also explain why African scholarly activity in biodiversity is much higher than might be expected.



**FIGURE 1-9**  
Scholarly output in biodiversity research by country from 2017-2022 showing the number of collaborative publications with African countries and the corresponding FWCI.  
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Between 2017 and 2022, African scholars contributed to over 10,000 publications on biodiversity research with an average FWCI of 1.36, well above the global average of 1.0 for all publications and 1.22 for biodiversity research publications. FIGURE 1-9 reveals the global distribution of collaborative publications on biodiversity research between African researchers and other countries, along with the corresponding FWCI. Among the most frequent partners with Africa are researchers from the Global North and China. There is relatively little South-South collaboration in the field. Brazil, in 13<sup>th</sup> position, is the sole research partner from the Global South but the resulting collaborative publications achieve a very high average FWCI of 4.23.

Internationally collaborative biodiversity publications including at least one contributor from Africa show exceptionally high FWCIs of over 3 in general and, in some cases, over 4. As a collaborative partner, the Netherlands ranks in 9<sup>th</sup> position, with publications achieving a strong FWCI of 3.50, indicative of both high-quality contributions to international research in general and with African collaborators in particular.

## 2 Biodiversity research in the Netherlands

### What is the current state of biodiversity research growth, impact, and coverage in the Netherlands? Which institutes and industrial partners are the largest contributors and what is their impact on the field?

The Netherlands published approximately 420,000 publications between 2017 and 2022, of which around 1% are related to biodiversity research (FIGURE 2-1). This translates to a RAI of 1.55, indicating that biodiversity is a research area of importance for the Netherlands. Dutch research publications on biodiversity are also often cited, achieving a FWCI of 2.40, well above the country's average of 1.71 across all disciplines and the global average for biodiversity research of 1.22. The Netherlands distinguishes itself in the research community by being particularly international: 62.5% of its total research output is produced in collaboration with international partners. When it comes to biodiversity research, this is even more pronounced. No less than 83% of biodiversity research publications from the Netherlands include an international partner. Finally, scholarly output in biodiversity from the Netherlands has shown outstanding growth in recent years, with an average annual growth rate of 10.5%.



FIGURE 2-1  
Scholarly output in biodiversity research from the Netherlands for 2017 to 2022, showing the FWCI and percentage of publications demonstrating international collaboration.  
Source: Scopus.

FIGURE 2-2 shows the various research areas that make up biodiversity research in the Netherlands. It also reveals the size of these areas in terms of published output and how interconnected they are through citations. FIGURE 2-3 shows how the field has developed over time. We can see large, long-standing clusters of activity in soil and plant studies, as well as farming. Since then, clusters of activity around microorganisms and genetics have appeared. More recently, the biodiversity research field in the Netherlands has expanded into the social sciences, human health implications, and policy. The data depict how biodiversity is now being recognized as an important factor in human well-being, while research on the topic is leading to concrete policymaking at an international scale.

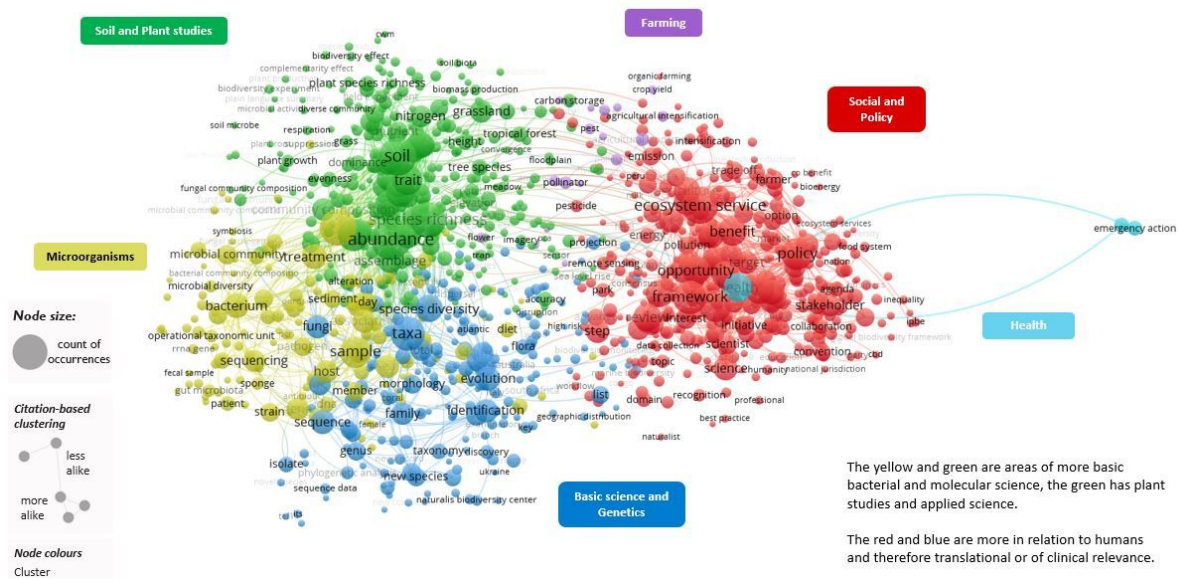


FIGURE 2-2

Network visualization chart identifies clusters of related entities. Nodes and edges represent the relationships between different keywords, with nodes representing keywords and edges citations or co-authorships. The size of each node indicates the count of occurrences of the keyword in the publication set. The colors indicate topical clusters of keywords.

Source: The charts are based on keywords extracted from Dutch biodiversity publications from 2017-2022 using VOSviewer. The data was uploaded into VOSviewer using exported data from Scopus. [www.vosviewer.com/](http://www.vosviewer.com/)

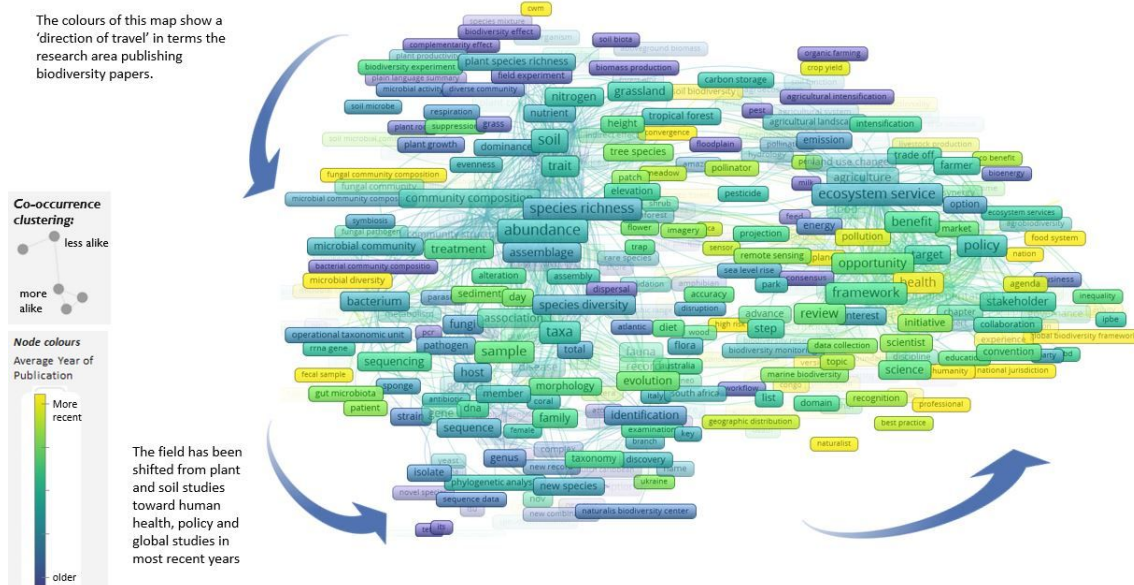


FIGURE 2-3

Timeframe-based network visualization chart reveals which topics are most recent or older. The node colors correspond to the timeframe, with the lighter colors representing the most recent topics and the darker colors the older topics. The visualization allows the development of a research field to be tracked over time or the identification of emerging trends.

Source: The charts are based on keywords extracted from Dutch biodiversity publications from 2017-2022 using VOSviewer. The data was uploaded into VOSviewer using exported data from Scopus. [www.vosviewer.com/](http://www.vosviewer.com/)



Focusing on the most impactful articles in biodiversity research produced by the Netherlands (FIGURE 2-4) reveals a number of specific subfields. As well as health-related publications (on genetics, disease, food, and nutrient recycling) and those on policy-related topics (framework, opportunity, etc.), specific attention is also being paid to ecosystems, Sustainable Development Goals<sup>16</sup>, carbon storage, and the microbiome. Biodiversity research is not just about the basic science, the indexing of all living organisms including animals, plants, and microorganisms, as well as measuring the biodiversity of ecosystems, but also encompasses genetic, species, and ecosystem diversity, along with the interactions and relationships between organisms and their environment. Biodiversity is part of more important and broader developments in ecosystem health and resilience, with a crucial role in providing essential ecosystem services that support human well-being, such as clean air and water, nutrient cycling, and pollination.

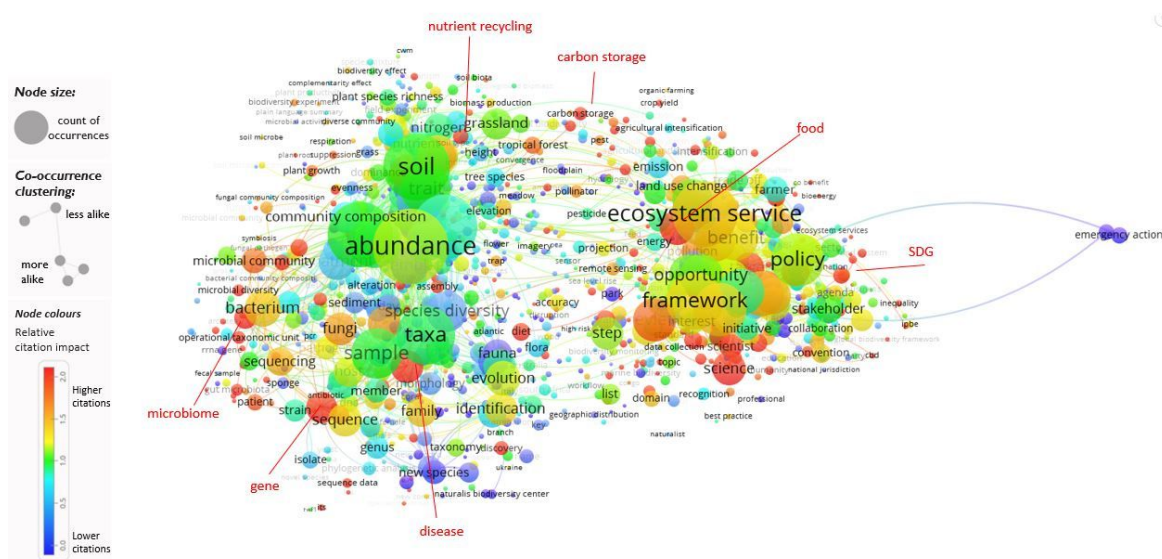


FIGURE 2-4

Chart reveals relative citation impact of subtopics within the scholarly output of the Netherlands in biodiversity research. The node colors correspond to the number of citations, with the warmer colors representing higher numbers of citations and the cooler colors fewer citations.

Source: The charts are based on keywords extracted from Dutch biodiversity publications from 2017–2022 using VOSviewer. The data was uploaded into VOSviewer using exported data from Scopus. [www.vosviewer.com/](http://www.vosviewer.com/)

The most-cited article (with over 3,500 citations to date) in biodiversity research from the Netherlands, for example, was published in *The Lancet* in 2019 and discusses how enhancing biodiversity in the food system is indispensable to food security and sustainable development<sup>17</sup>. The second-most cited article (with over 1,500 citations) is an analysis of the dramatic decline in flying insects over a period of 27 years<sup>18</sup>.

<sup>16</sup> Sustainable Development Goals (SDGs) were launched by the United Nations in 2015 as “the blueprint to achieve a better and more sustainable future for all” by addressing the challenges faced by the world.

<https://sdgs.un.org/>, <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>

<sup>17</sup> Willett, W., et al., Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet Commissions*, 393 (10170), 447–492 (2019). [https://doi.org/10.1016/S0140-6736\(18\)31788-4](https://doi.org/10.1016/S0140-6736(18)31788-4)

<sup>18</sup> Hallmann, C.A., et al. More than 75 percent decline over 27 years in total flying insect biomass in protected areas. *PLoS ONE*, 12 (10): e0185809 (2017). <https://doi.org/10.1371/journal.pone.0185809>

*“I’m not surprised by the Netherlands’ outsized role in research or international collaboration; centers such as the Naturalis Biodiversity Center play a major role in biodiversity analysis, data aggregation, and collaboration. Collaboration helps provide baseline data and builds the capacity needed to monitor, target, and conserve biodiversity better, especially in highly diverse countries that may lack the capacity to conduct such analysis without collaboration.”*

Alice Hughes, University of Hong Kong and Editor-in-Chief of *Climate Change Ecology*

### Most prolific Dutch universities in biodiversity research

Looking at the role that individual Dutch universities play in biodiversity research reveals that Wageningen University & Research is in a league on its own (TABLE 2-5). This institution is responsible for more than twice the number of publications of the runner-up, Utrecht University. Naturalis Biodiversity Center and the University of Amsterdam (UvA) are also strong contributors in this national ranking.

The quality of Dutch universities’ output in biodiversity research is high across the board. All institutions in the top 12 most prolific producers of biodiversity research score over 2 in terms of FWCI. The output of most of these institutions show a high proportion of international collaboration, led by Twente University. Around 6% of biodiversity research publications from Dutch universities include academic-corporate collaboration, but the University of Amsterdam stands out with 10.8%.













Institution	Scholarly Output ↓	Field-Weighted Citation Impact ↓	International Collaboration (%) ↓	Academic-Corporate Collaboration (%) ↓
 Wageningen University & Research	1,364	2.82	80.9	7.0
 Utrecht University	599	2.44	80.1	6.0
 Naturalis Biodiversity Center	503	1.99	87.3	5.0
 University of Amsterdam	437	2.69	85.6	10.8
 University of Groningen	336	2.35	80.4	4.8
 Leiden University	333	2.43	76.3	6.6
 Vrije Universiteit Amsterdam	309	2.81	86.7	7.8
 Radboud University Nijmegen	308	2.98	77.3	7.8
 University of Twente	129	2.61	88.4	7.8
 Delft University of Technology	95	2.34	73.7	4.2
 IHE Delft Institute for Water Education	81	2.71	82.7	3.7
 Erasmus University Rotterdam	57	2.25	57.9	3.5

TABLE 2-5

Scholarly output in biodiversity for the top 12 most prolific institutions in the Netherlands for 2017–2022, showing FWCI and the percentage of international and corporate publications.

Source: Scopus.

## Most prolific authors in biodiversity research in the Netherlands

At the level of individual researchers, TABLE 2-6 shows the top 12 most prolific producers of biodiversity research publications in the Netherlands. Most major Dutch universities are represented but Wageningen University & Research has three authors in the top 12 and VU Amsterdam two authors. The three most productive authors nationally are W. Daniel Kissling of the University of Amsterdam, Andrew K. Skidmore of the University of Twente, and Peter H. Verburg of VU Amsterdam.

Two of the top 12 researchers, Peter H. Verburg of VU Amsterdam, who is mainly active within environmental geography, and Pedro Willem Crous, director of Westerdijk Fungal Biodiversity Institute, stand out for having an *h*-index of over 100<sup>29</sup>. While the *h*-index is widely used in bibliometrics as an indicator of a scientist or scholar's research output, it is dependent on the age of the author and is not without controversy in the Netherlands and other scientific nations. Alternative means of comparing individual researchers based on awards and recognition are increasingly being developed and adopted that do not include the *h*-index. TABLE 2-6 also lists the share of publications in the most cited journals for these most prolific authors in the Netherlands.











Author	Affiliation	Scholarly Output ↓	Publications in Top 5% Journal Percentiles by CiteScore Percentile (%) ✓	<i>h</i> -index ✓
1. Kissling, Wilm Daniel	 University of Amsterdam	52	57.7	44
2. Skidmore, A. K.	 University of Twente	43	46.5	76
3. Verburg, Peter H.	 Vrije Universiteit Amsterdam	43	58.1	101
4. Geisen, Stefan	 Wageningen University & Research	41	64.1	41
5. Cornelissen, Johannes H.C.	 Vrije Universiteit Amsterdam	40	57.5	87
6. Crous, Pedro Willem	 Centraalbureau voor Schimmelcultures	40	60.6	123
7. Hautier, Yann	 Utrecht University	35	54.3	33
8. Huijbregts, Mark A.J.	 Radboud University Nijmegen	35	65.7	63
9. Mommer, Liesje	 Wageningen University & Research	35	54.3	53
10. ter Steege, H.	 Naturalis Biodiversity Center	35	31.4	45
11. Van Bodegom, Peter Michiel	 Leiden University	35	48.6	60
12. Kleijn, David	 Wageningen University & Research	33	75.0	56

TABLE 2-6

Scholarly output in biodiversity research for the top 12 most prolific researchers in the Netherlands for 2017-2022, showing their share of publications in most cited journals (top 5% of journals by CiteScore Percentile) and *h*-index.

Source: *Scopus*.

<sup>29</sup> An *h*-index of 100 means the researcher has authored (or co-authored) 100 publications each of which have achieved at least 100 citations each. The metric is an indication of high citations but favors older authors because an author can only have an *h*-index equal to or lower than the total number of their publications.



*Perspective: W. Daniel Kissling,  
University of Amsterdam (UvA)*

Biodiversity loss is pervasive and now very high on the political agenda. This is evident in the recently adopted Kunming-Montreal Global Biodiversity Framework of the CBD and the EU Biodiversity Strategy for 2030.

This report provides an interesting perspective on biodiversity research in the last decade and shows that published academic research in the Netherlands has made an extraordinary international contribution, with a high scientific and policy impact and strong international embedding. To continue this important role, the Netherlands needs to be at the forefront of the digital transformation in biodiversity research.

Biodiversity research increasingly relies on ecoinformatics, artificial intelligence, and big data, using advances in computing, new technologies, large and diverse data sources, sophisticated statistics, satellite and airborne remote sensing, and automated data capture from digital sensors. Biodiversity research, therefore, must build strong links to disciplines such as informatics, computer vision, Earth Observation, and data science. Recent investments into large-scale research infrastructures funded by the Dutch Research Council (NWO) under the National Roadmap are promising first steps, such as the ARISE infrastructure for species recognition and the LTER-LIFE digital twins of ecosystems. The Dutch biodiversity research community should also contribute to biodiversity monitoring through developing Essential Biodiversity Variables (EBVs) and biodiversity indicators for a European Biodiversity Observation Network (EuropaBON) or the CBD's global biodiversity framework. Excellent research on biodiversity with an impact for society and policy is strongly supported by the new EU Biodiversity Partnership (Biodiversa+) and the Horizon Europe framework program.

Biodiversity researchers should also work together with EU institutions and agencies (e.g., EEA, JRC, ESTAT, ESA, European GBIF nodes), national governments, environmental ministries, non-governmental organizations (NGOs), citizen science platforms, and the business sector. This will help to improve the conservation, restoration, and sustainable use of biodiversity, crucial for reversing the loss of biodiversity and the degradation of ecosystems.

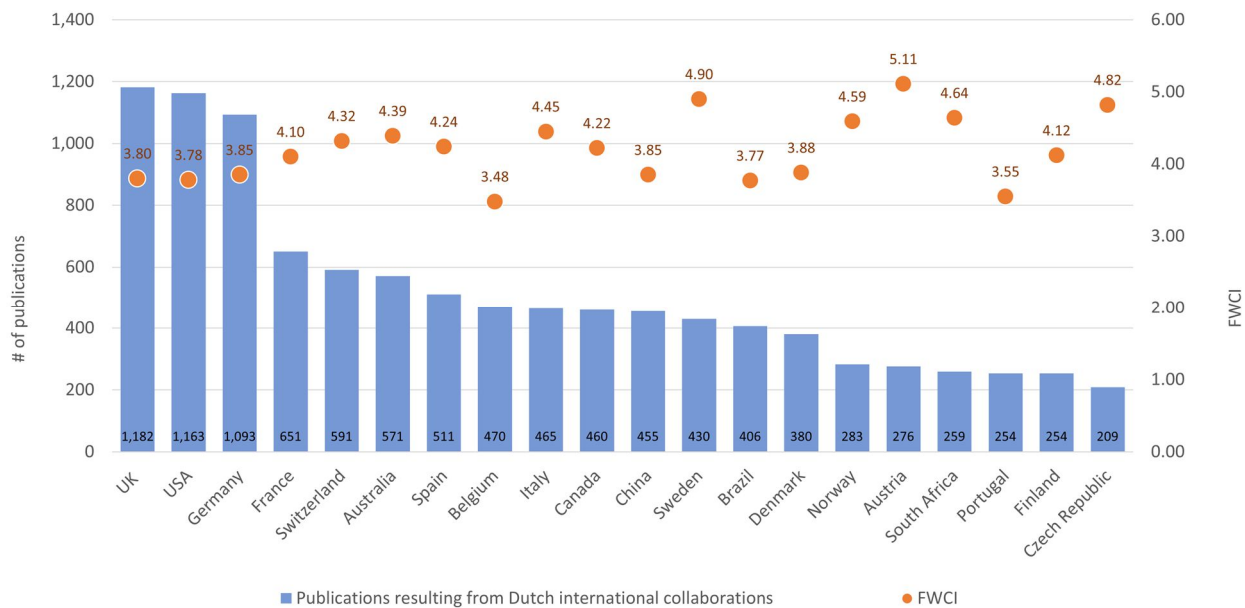
## Dutch-international collaboration in biodiversity research

Biodiversity researchers in the Netherlands collaborate with a wide range of international partners and institutions, with specific collaborations and partnerships varying depending on the research focus and objectives. Some countries where Dutch researchers have active collaborations in biodiversity research include:

- **Germany:** Dutch researchers collaborate extensively with their counterparts in Germany on topics such as the ecology of freshwater systems, the impact of climate change on ecosystems, and the conservation of biodiversity in European habitats.
- **UK:** the Netherlands has a long history of working with the UK, particularly in the areas of evolutionary biology and ecology. Collaborative projects tend to focus on topics such as the evolution of social behavior in animals, the impact of habitat fragmentation on wildlife populations, and the conservation of endangered species.
- **US:** collaboration with US academics and scientists covers a wide range of topics in biodiversity, including the ecology of marine ecosystems, the impact of climate change on Arctic and Antarctic ecosystems, and the genetics of endangered species.
- **Brazil:** Dutch and Brazilian scholars work together on a variety of topics related to the ecology and conservation of Amazonian rainforests, including the impacts of deforestation and climate change on biodiversity, the ecology of fish and other aquatic species, and the use of

remote sensing and other technologies for monitoring forest ecosystems.

- **South Africa:** researchers in the Netherlands cooperate with colleagues in South Africa on a variety of topics related to the ecology and conservation of African savannas and other ecosystems, including the impacts of climate change and human activities on wildlife populations, the ecology of carnivores and herbivores, and the conservation of endangered species such as rhinos and elephants.



**FIGURE 2-7**  
Number of collaborative publications in biodiversity research from the Netherlands with top 20 partner countries (in blue), for 2017-2022, showing the FWCI in each case (red dot).  
*Source: Scopus.*

FIGURE 2-7 shows the number of publications in biodiversity research resulting from Dutch-international collaborations with various countries, from 2017 to 2022, as well as the average FWCI of those publications. Unsurprisingly, the Netherlands mainly collaborates with other institutions from the Global North, particularly the UK, the US, and Germany. Brazil and South Africa are the only representatives of the Global South in 13<sup>th</sup> and 17<sup>th</sup> places, respectively. It is impressive that all the Netherlands' international collaborations show remarkably high FWCI values of more than three and or even four times the global average. Collaborative publications between the Netherlands and Sweden and Norway have exceptionally high impact with FWCI scores of 4.85 and 4.52, respectively.

*“This report underlines that Wageningen University & Research is highly committed to biodiversity research and collaborates with partners around the world to increase our knowledge to protect and enhance terrestrial and marine biodiversity.”*

Arthur P. J. Mol, Rector Magnificus, Wageningen University & Research

## The Netherlands' academic partners in Europe

Institution	Scholarly Output ↓	Field-Weighted Citation Impact ∨
1.  Friedrich Schiller University Jena	250	4.48
2.  Leipzig University	249	4.46
3.  Martin Luther University Halle-Wittenberg	247	4.55
4.  Université de Montpellier	195	4.63
5.  Swedish University of Agricultural Sciences	168	5.41
6.  University of Oxford	160	5.39
7.  University of Copenhagen	153	5.22
8.  Université PSL	138	3.71
9.  University of Zurich	130	4.89
10.  Ghent University	125	3.46
11.  Swiss Federal Institute of Technology Zurich	125	6.85
12.  University of Göttingen	125	5.33

*The most prolific academic collaborators are all within Europe*

TABLE 2-8

The Netherlands' top 12 academic partner institutions in biodiversity research within Europe, for 2017-2022, showing the scholarly output and FWCI in each case.











Source: Scopus.

When looking at the Netherlands' top 12 academic partners within Europe in terms of biodiversity research publications, there are no outliers. It is worth noting that the country's top three partners are from the same country: Germany. This is not an anomaly, it is common to have more connections with neighboring countries more generally, as well as in research, as collaborations are easier to establish and tend to be more frequent. The citation impacts of publications arising from the Netherlands' collaborations are, however, extremely high across the board — partnerships with five institutions in Sweden, the UK, Germany, and Switzerland score over 5 in FWCI. Publications from the Netherlands' collaboration with the Swiss Federal Institute of Technology in Zurich on biodiversity research have an average FWCI of 6.85.

*“This report confirms that the Dutch science community is an important contributor of knowledge to accelerate understanding of global effects of biodiversity on ecosystem services. The progressive understanding of the urgency and complexity of unprecedented biodiversity loss is reflected by the shift towards multidisciplinary, planetary and human health, and policy.”*

Liesje Mommer, Wageningen Biodiversity Initiative, Wageningen University & Research

## The Netherlands' academic partners outside Europe

Institution	Scholarly Output ↓	Field-Weighted Citation Impact ✓
1.  Smithsonian Institution	112	5.01
2.  University of British Columbia	89	6.32
3.  University of Queensland	85	5.77
4.  University of Minnesota Twin Cities	84	9.29
5.  University of Florida	82	5.33
6.  Universidade de São Paulo	77	5.92
7.  University of California at Davis	64	4.94
8.  Macquarie University	61	4.55
9.  Universidad Nacional Autónoma de México	60	5.22
10.  University of Stellenbosch	59	6.36

*The most prolific academic collaborators outside Europe are reported here*

TABLE 2-9

The Netherlands' top ten academic partners in biodiversity research outside Europe, for 2017-2022, showing the scholarly output and FWCI in each case.

Source: Scopus.

The top ten institutions outside of Europe that produce the most collaborative biodiversity research publications with the Netherlands, shown TABLE 2-9, reveal a truly global distribution from the US, Canada, and Australia to Brazil, Mexico, and South Africa. The leading institution is the Smithsonian, which is involved in research projects around the globe and produced more than 100 publications in collaboration with the Netherlands between 2017 and 2022. The citation impact is exceptionally high across the top ten, with FWCI values ranging from 4.5 to 9.3.

The highest FWCI score of 9.29, which was achieved with the University of Minnesota, warrants closer analysis. The most prolific universities in the Netherlands involved in collaborating with the University of Minnesota are Wageningen University & Research (40 co-authored publications, with an average FWCI of 12.20), Utrecht University (20 co-authored publications, FWCI 7.11), and VU Amsterdam (14 co-authored publications, FWCI 11.23).

The collaboration between Netherlands and the University of Minnesota resulted in 84 publications in total, of which ten had fewer than ten authors, 47 had 40 to 50 authors, 11 had between 50 and 100 authors, and 16 had more than 100 authors. One publication, the aforementioned article by Willetts et al., has achieved the highest impact to date, with a FWCI of 191.11. Two other publications, on a plant database<sup>20</sup> (53.95) and communal microbial diversity catalogue<sup>21</sup> (31.06), have also received high numbers of citations, with the latter including co-authors from the Universities of Groningen and Wageningen.

<sup>20</sup> Kattge, J., et al., TRY plant trait database – enhanced coverage and open access. *Global Change Biology*, **26** (1), 119-188 (2019). <https://doi.org/10.1111/gcb.14904>

<sup>21</sup> Thompson, L.R., et al., A communal catalogue reveals Earth's multiscale microbial diversity. *Nature*, **551** (7661), 457-463 (2017). <https://doi.org/10.1038/nature24621>

## Most prolific corporate collaborations with Dutch institutions












Institution	Scholarly Output ↓	Field-Weighted Citation Impact ↓
 Unilever	16	2.76
 German Collection of Microorganisms and Cell Cultures	13	7.09
 General Electric	13	1.67
 EURAC Research	12	13.15
 Alphabet Inc.	8	18.35
 Danone S.A.	8	2.31
 Flamingo Land	7	6.16
 Royal Dutch Shell PLC	7	1.76
 AZTI	6	10.82
 DSM Food Specialties	6	2.49
 Novo Nordisk Foundation	5	13.75

TABLE 2-10

The Netherlands' top 11 most prolific corporate collaborations in biodiversity research, for 2017-2022, showing the scholarly output and FWCI in each case.

Source: Scopus.

While, on average, only around 6% of publications on biodiversity research from Dutch institutions include collaboration with a corporate partner, the University of Amsterdam stands out with 10.8% (TABLE 2-10). Generally, however, the actual number of publications of this type is so small that the largest contribution is 16 articles with British-Dutch consumer goods multinational Unilever. Statistical conclusions based on so little data are considered unreliable, so we will not delve much deeper into this issue. Although it is not easy to define what would be an optimal level of academic-corporate collaboration in biodiversity research, the findings of this analysis may reflect a lack of economic appeal of the topic.

One surprising outcome of the analysis, however, is that Google's parent company Alphabet Inc. collaborated on eight publications that generated an incredible average citation impact of 23.8 (data not shown). This figure is dominated by a single article on machine-learning-based species identification and distribution prediction co-authored by seventeen institutions from the US, Switzerland, France, the Netherlands, and Czechia<sup>22</sup>.

## Impact of Dutch biodiversity research on policy

Biodiversity policy in the Netherlands is aimed at protecting and preserving the country's rich biodiversity. The Dutch government has adopted a number of measures to achieve this goal, including the establishment of protected nature reserves and the promotion of sustainable land use practices. In

<sup>22</sup> Joly, A., et al., Overview of LifeCLEF 2022: An Evaluation of Machine-Learning Based Species Identification and Species Distribution Prediction. *Lecture Notes in Computer Science*. (2022).

addition, the government works closely with local communities, NGOs, and scientific institutions to implement biodiversity conservation projects and raise awareness of the importance of biodiversity.

In 2020, the European Commission approved the European Green Deal<sup>23</sup>, a set of policy initiatives with the overarching goal of achieving climate neutrality in 2050. As part of the Green Deal, the Commission presented its Biodiversity Strategy for 2030<sup>24</sup> in May 2020. This strategy aims to put Europe's biodiversity on the path to recovery by 2030. Action points include establishing a larger EU network of protected areas on land and at sea, launching an EU nature restoration plan, and working towards the successful adoption of an ambitious global biodiversity framework under the UN's CBD.

This legally binding international treaty, which was adopted in 1992, aims to promote the conservation, sustainable use, and fair and equitable sharing of the benefits arising from the world's biological diversity. The Convention is a key instrument for global biodiversity governance and has been ratified by 196 countries, including the Netherlands. It also provides a framework for developing national strategies and action plans to conserve and use biodiversity sustainably, as well as cooperation on transboundary conservation efforts. The Convention is instrumental in promoting scientific research and knowledge-sharing, together with encouraging public participation in biodiversity conservation.

In December 2022, the UN's Biodiversity Conference (COP15)<sup>25</sup> in Montreal, Canada, ended with a landmark agreement to guide global action on nature through 2030. The Kunming-Montreal Global Biodiversity Framework<sup>26</sup>, as agreed during COP15, includes concrete measures to halt and reverse nature loss, including protecting 30% of the planet and 30% of degraded ecosystems by 2030. The Framework also contains proposals to increase finance for developing countries.

### Impact of Dutch biodiversity research on policy

Since 2017, 842 biodiversity-related publications from the Netherlands (equivalent to 20% of the country's total output on the topic) have been cited in 2,040 policy documents in 40 different countries. So far, in 2023 alone, more than 60 policy documents citing Dutch research in biodiversity have been published. These publications have also achieved high citation levels of FWCI 4.40: well above the both the Dutch (FWCI 2.40) and global (FWCI 1.22) average for biodiversity research publications.

Recent policy documents citing Dutch biodiversity research range from a case study of the Mekong River in Cambodia by the World Health Organization<sup>27</sup>, a consultation on agricultural emission mitigation efforts in Germany<sup>28</sup>, efforts to enhance nature provision in urban environments in the Netherlands<sup>29</sup>, UN solutions on carbon dioxide removal<sup>30</sup>, and EU reports on food security<sup>31</sup> and biomass production and use<sup>32</sup>.

The biodiversity research publication most cited in policy documents discusses natural climate solutions and was authored by a group of Dutch and international authors<sup>33</sup>. This article has served as input for policies around the world in Germany, Sweden, France, the UK, the US, and Canada, to mention a few, in

<sup>23</sup> European Green Deal: [https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal\\_en](https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en)

<sup>24</sup> European Commission Biodiversity Strategy for 2030: [https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030\\_en](https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en)

<sup>25</sup> United Nations Biodiversity Conference: <https://www.cbd.int/conferences/2021-2022>

<sup>26</sup> The Kunming-Montreal Global Biodiversity Framework: <https://www.cbd.int/gbf/>

<sup>27</sup> World Health Organization: 'The Riverine food environments and food security: a case study of the Mekong River, Cambodia.'

<sup>28</sup> German Government: 'The Stakeholder Consultation Workshop Report: Barriers to mitigating emissions from agriculture.'

<sup>29</sup> PBL Netherlands Environmental Assessment Agency: 'Enhancing Urban Nature Provision in the Netherlands.'

<sup>30</sup> UN CEPAL: 'Nature-based solutions and carbon dioxide removal.'

<sup>31</sup> Council of the European Union: 'Drivers of food security.'

<sup>32</sup> EU: 'Biomass production, supply, uses and flows in the European Union.'

<sup>33</sup> Griscom, B. W., et al. Natural climate solutions. *Proceedings of the National Academy of Sciences of the USA*, **114** (44), 11645-11650 (2017). <https://www.pnas.org/doi/10.1073/pnas.1710465114>



addition to the UN. The scope of these policies ranges from emissions from agriculture, carbon removal, the link between climate change and health, as well as the impact of biodiversity on nutrition and health, to many other policy issues.

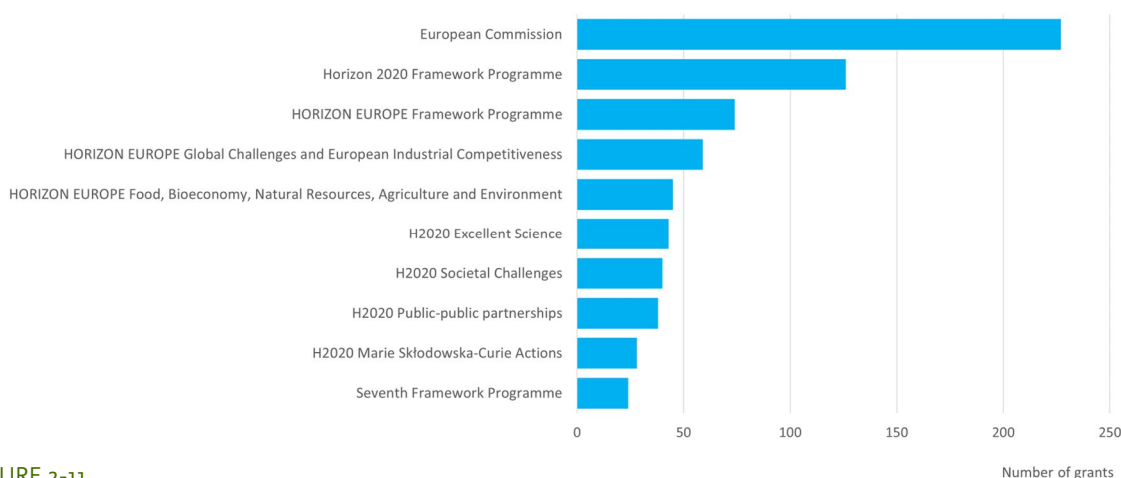
It is evident that biodiversity research publications from the Netherlands are cited by world-renowned institutions around the globe. Dutch biodiversity research influences policy not only in close neighbors such as Germany, for example, but also at internationally. Furthermore, the topics covered by this research are diverse, from food security to carbon dioxide removal to future fuels. This global impact is a testament to the outstanding quality of biodiversity research being performed at institutions in the Netherlands.

## The funding of biodiversity research in the Netherlands

We have identified 300 grants relating to biodiversity research that can be attributed or co-attributed to the Netherlands. Most funding came from the EU, either as direct grants from the European Commission or through funding programs such as Horizon Europe and Horizon 2020. The number of grants, as depicted in FIGURE 2-11, can only tell part of the story, as the amount of each grant can vary enormously. A handful of high-value grants could result in an overall higher funding level than many grants of modest size.

The Dutch institutions with the largest number of awarded grants in biodiversity research were:

- Wageningen University & Research
- Naturalis Biodiversity Center
- University of Amsterdam
- Radboud University Nijmegen
- Utrecht University
- Royal Netherlands Academy of Arts and Sciences
- Leiden University
- University of Groningen



**FIGURE 2-11**  
Top ten funders of biodiversity research in the Netherlands by number of grants, 2012-2022. Note: there may be some overlap in the funder categories. Source: *Funding Institutional*.

# Conclusion

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Both globally and in the Netherlands, biodiversity research is a story of high quality and impact, partnership and collaboration.

Global biodiversity research is of high quality and growing steadily. The European contribution is leading the rest of the world and has grown in strength over time compared with the US, China, Latin America, and Africa. Considering the relative contribution of nations to biodiversity research, the Global South is clearly outperforming the Global North: countries like Brazil, Mexico, and South Africa contribute twice the number of publications in biodiversity (normalized for their overall scholarly contribution) as expected, while Russia, India, China, and Japan underperform.

Based on the key findings in this report, it is evident that biodiversity research from the Netherlands is highly regarded by the international community. Despite ranking only 8<sup>th</sup> in publication output within Europe, the country's scholarly output is highly impactful globally and characterized by strong international collaboration. Wageningen University & Research, in particular, stands out as a leading institution in biodiversity research both globally and in the Netherlands.

The report also highlights that the Netherlands is leading the way within Europe when it comes to academic-corporate collaboration in biodiversity research. The high level of citation of Dutch biodiversity research in policy documents globally further underscores the importance of the country's research in shaping policy around the world. Biodiversity research in the Netherlands has also shown robust double-digit growth year on year since 2017.

While the findings in this report demonstrate the impressive impact of Dutch biodiversity research, it is important to note that, in practice, the country's own biodiversity is facing significant challenges. The Netherlands' intensive agricultural practices and urbanization puts pressure on the natural environment and has led to habitat fragmentation and loss. This highlights the critical need for continued research and action to understand and protect the country's

biodiversity better, to address the root causes of biodiversity loss, and to ensure that biodiversity research in the Netherlands continues to impact national and international policy. For these efforts to succeed, they need to be economically and socially appealing as well.

*“The report provides a useful summary of the outsized biodiversity research in Dutch universities, its importance in a broader societal context, and key research groups and institutions. International collaboration by Dutch researchers stands. Despite a relatively low priority from the government, Dutch scientists have a globally significant impact in biodiversity and environmental research, with most financial support from the European Union.”*

Professor Andrew Skidmore,  
University of Twente



# Appendix A

## Glossary of terms

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In Scopus, institutions are classified into one of four main sectors: Corporate, Academic, Government, and Medical. **Academic-corporate collaboration** refers to scholarly output in which there is at least one author with an academic affiliation and at least one author with a corporate affiliation. The metric indicates the degree of collaboration between academic and corporate affiliations (universities and industry working together in a research).

A **citation** is a formal reference to earlier work in another publication or patent, most frequently other publications. A citation is used to credit the originator of an idea or finding and typically indicates that the earlier work supports the claims of the work citing it. The number of citations received by a publication from subsequent publications can be used as an indication of the quality or importance of the reported research.

**CiteScore** calculates the average number of citations received in four calendar years by five types of peer-reviewed documents (research articles, review articles, conference proceedings, data papers, and book chapters) published during the same four years.

**Field-Weighted Citation Impact (FWCI)** is an indicator of mean citation impact and compares the actual number of citations received by a publication with the expected number of citations for publications of the same document type (article, review, or conference proceeding), publication year, and subject area. When the publication is classified in two or more subject areas, the harmonic mean of the actual and expected citation rates is used. The indicator is, therefore, always defined with reference to a global baseline of 1.0 and intrinsically accounts for differences in citation accrual over time, differences in citation rates for different document types (e.g., reviews typically attract more citations than research articles), as well as subject specific differences in citation frequencies overall, over time, and by document type. It is one of the most sophisticated indicators in the modern bibliometric toolkit.

The ***h*-index** is a numerical measure of the productivity and impact of an individual researcher's output. It is calculated based on the number of publications that have been cited a certain number of times, with the researcher's *h*-index being the highest number of publications that have each been cited that many times. For example, an *h*-index of 10 means that the researcher has published 10 papers that have each been cited at least 10 times. The *h*-index is often used as a metric for evaluating the influence and relevance of a researcher's work in their field. However, the *h*-index is dependent on a researcher's age and alternative means of comparing individuals based on rewards and recognition are increasingly being considered.

**International collaboration** in this report is indicated by publications with at least two different countries listed in the authorship byline.

**Relative Activity Index (RAI)** is defined as the share of an entity's publications (region, country, or institution) in a subject relative to the global share of publications in the same subject. A value of 1.0 indicates that an entity's research activity in a field corresponds exactly with the average global activity in that field; higher than 1.0 implies a greater emphasis, while lower than 1.0 suggests a lesser focus.

**Scholarly output** describes the products of scholarly activity, such as journal articles, books, book chapters, conference papers, and other forms of research dissemination.

# Appendix B

## Sources

Elsevier journals (left) and books and book chapters (right) with most published articles in biodiversity research, 1998- 2022:

Forest Ecology And Management	(3,545)	Encyclopedia Of Biodiversity Second Edition	(249)
Biological Conservation	(3,190)	Imperiled The Encyclopedia Of Conservation Volume 1 3	(99)
Science Of The Total Environment	(3,099)	Advances In Ecological Research	(94)
Ecological Indicators	(2,232)	Encyclopedia Of The World S Biomes	(78)
Agriculture Ecosystems And Environment	(1,460)	Encyclopedia Of Ecology Five Volume Set	(77)
Marine Pollution Bulletin	(1,420)	Encyclopedia Of The Anthropocene	(67)
Journal Of Environmental Management	(988)	Encyclopedia Of Ecology	(59)
Soil Biology And Biochemistry	(931)	Encyclopedia Of Inland Waters Second Edition	(54)
Environmental Pollution	(922)	Advances In Marine Biology	(44)
Ecological Modelling	(826)	Encyclopedia Of Inland Waters	(35)
Estuarine Coastal And Shelf Science	(800)	Braconidae Of The Middle East Hymenoptera Taxonomy Distribution	(30)
Ecological Engineering	(790)	Biology And Biocontrol Benefits Of Parasitoid Wasps	
Molecular Phylogenetics And Evolution	(772)	Encyclopedia Of Evolutionary Biology	(25)
Trends In Ecology And Evolution	(711)	Advances In Agronomy	(24)
Global Ecology And Conservation	(701)	Microbial Diversity In The Genomic Era	(24)
Landscape And Urban Planning	(684)	Encyclopedia Of Ocean Sciences	(23)
Bioresource Technology	(680)	Methods In Enzymology	(22)
Marine Environmental Research	(611)	Rivers Of Europe	(20)
Chemosphere	(610)		
Deep Sea Research Part II Topical Studies In Oceanography	(573)		
Palaeogeography Palaeoclimatology	(573)		

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**VOSviewer** is a software tool for constructing and visualizing bibliometric networks. These networks may include journals, researchers, or individual publications, for instance, and can be constructed based on citation, bibliographic coupling, co-citation, or co-authorship relations. VOSviewer also offers text mining functionality that can be used to construct and visualize co-occurrence networks of important terms extracted from a body of scientific literature.

<https://www.vosviewer.com/>



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