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Scientometric review of the literature about genetic resources access and benefit sharing under the Convention on Biological Diversity: Current research and future directions

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Abstract

We conducted a scientometric on the United Nations' *Convention on Biological Diversity* (CBD) access to biological resources and benefit sharing (ABS) literature using the Scopus database. There were 723 publications by 2,225 authors broadly related to this topic of which 150 publications by 395 researchers focus on the topic. The literature reflected by keyword choices was diverse in disciplines (eg., social sciences, biological sciences), forms (eg., articles, books, and so on), journals/publishers, authors/affiliations, and themes. Significantly, the vast majority of authors (about 70%) only authored one publication. The literature divided between publications about complying *with* ABS as a regulatory hurdle to doing science, or *on* ABS examining social, legal and policy aspects of regulation. While the CBD is focussed on conservation and sustainable development, the literature was focused on a diversity of social, legal and policy debates. We highlight the importance of future research on ABS addressing conservation *per se*.

Keywords: Convention on Biological Diversity; access and benefit sharing; conservation; sustainable development; scientometric analysis

Introduction

The United Nations' *Convention on Biological Diversity* (1992; CBD) is the most important global agreement for conservation (Article 1).[1] It arose in response to declines in biodiversity due to human activities, issues that have only increased in importance and severity since, and often now referred to as the sixth mass extinction event.[2 3 4] At the end of the negotiation process, the CBD was a diplomatic compromise balancing conservation, technological development, regulated access to biological resources and international equity.[5] This agreement was essentially a "grand bargain" about biodiversity rich and developing South countries co-operating in conservation efforts in exchange for developed but relatively biodiverse poor North countries transferring technology and finances in a transaction for access to their genetic resources – called access and benefit sharing or ABS.[6 7 8] This accorded with the World Commission on Environment and Development (Brundtland Commission) linking fairness, equity and

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conservation[9] [10] and the focus in the CBD on conservation *and* sustainable development (CBD, Article 1).

The CBD confirmed that countries have legal authority and control (sovereignty) over their "genetic resources" (Preamble and Articles 3 and 15.1) and that access to these resources required prior informed consent (Article 15.5) and mutually agreed terms (Articles 15.4 and 15.7). The term "genetic resources" was defined as "genetic material of actual or potential value" and "genetic material" as "any material of plant, animal, microbial or other origin containing functional units of heredity" (Article 2). In practice, however, countries implementing the CBD have applied these terms broadly to include most biological materials and derivatives within their jurisdictions.[11] The later subsidiary agreement to the CBD, the *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization* (Nagoya Protocol), reinforced the CBD's sovereignty claims, and provided more details about the CBD's obligations and mechanisms, as well as adding some additional requirements such as measures for Traditional Knowledge associated with genetic resources and certificates of origin.[12] The legal mechanism for ABS under the CBD and Nagoya Protocol is a contract between the resource provide and the bioprospector wanting to access and use those accessed resources with the contracts recording prior informed consent and setting out mutually agreed terms that include benefit sharing (monetary and non-monetary) (Figure 1).

The CBD and Nagoya Protocol have spawned a considerable bureaucratic machinery with a number of governance bodies like the Conference of the Parties that meet bi-annually to review implementation of the CBD, and forums like the Subsidiary Body on Scientific, Technical and Technological Advice that provide expert advice to the various CBD bodies and forums (see Articles 23 and 25).[13] Running parallel with this formal machinery is a social, legal and policy debate in the academic literature about the merits of the outcomes of the various CBD bodies and forums, and specifically their decisions and the implementation of their decisions in Contracting Party laws. As a measure of the magnitude of this debate a search of the Scopus database for the term "genetic resources" in all fields returned over 97,000 publications for the period 1997-2019 including over 8,500 publications in 2019 when the term "convention on biological diversity" was also included. With the passing of the CBD's 25th anniversary of operation and the threshold of the post-2020 global biodiversity framework negotiations at the CBD to develop a strategic planning framework to plan, implement and evaluate the impacts of conservation actions taken, and a way to organise measurable goals and solutions through consistent, meaningful and transparent structures,[14] [15] this is now a suitable time to conduct a scientometric to assess the scope and coverage of academic literature and speculate about the

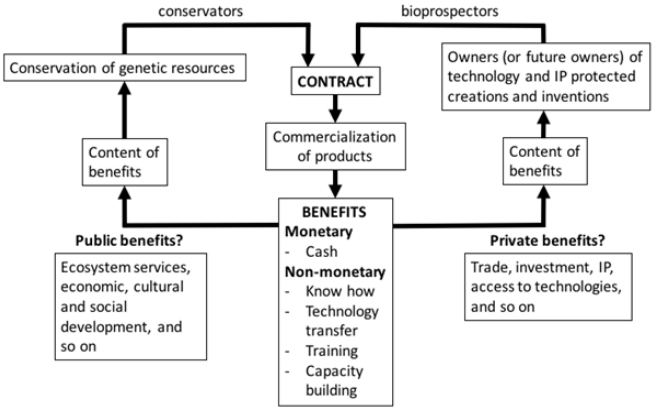

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Figure 1: Relationships among concepts regarding access and benefit sharing and the *Convention on Biological Diversity* (CBD) (A), and then how this applies to the creation of contracts to deal with benefit sharing from biological resources as conceived under the CBD and the Nagoya Protocol (B). *The model conceives conservers of "genetic resources" coming together with the owners of technology (and finance and intellectual property (IP)) to develop products, processes and services that might be commercialised, with the benefits (monetary and non-monetary) being shared between the conservators and technology owners addressing the market failure for conservation. Under the CBD and the Nagoya Protocol these will be unique agreements addressing the particular arrangements between the parties.*

possible research futures. Therefore, we conducted a scientometric review of academic literature about ABS in relation to the CBD (and Nagoya Protocol) to summarize the literature. Specifically, we wanted to see what research had been conducted, when and by whom, as well as identifying future research directions. This article sets out our methods, provides an analysis of the results and then provides an account of this evolving academic research.

Methods

Scientometric analysis is a methodology that is increasingly used to quantify patterns in academic literature using metadata available from comprehensive online databases.[16] It has been used in thousands of publications covering a diversity of research disciplines to address questions such as who does research, where, supported by who, making use of what literature and addressing what questions.[17] For the analysis of ABS research, we first identified the best databases in terms of the coverage of the research, allowing online searching using Boolean operators, and from which metadata about publications could be accessed, downloaded and used in other programs to identify patterns in the literature. The large international database Scopus best fitted these criteria based on preliminary analysis of databases including Scopus (https://www.scopus.com), Web of Science (https://www.webofknowledge.com), HeinOnline (https://home.heinonline.org/content/databases) and ProQuest (https://search.proquest.com/databases) (Table 1). While there were some publications listed in the Web of Science, HeinOnline and ProQuest that were not in Scopus, Scopus covered a greater diversity of literatures (including the social sciences) and comprehensive metadata about the literature can be downloaded and analysed to quantify and visualise relationships in the literature.[16]

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Table 1: Comparisons of Scopus, Web of Science, HeinOnline and ProQuest. The databases were searched for the terms “access and benefit sharing” AND “convention on biological diversity”. For Scopus this was “All documents” across “All fields”; for Web of Science this was “All databases”; for HeinOnline this was the “Law Journal Library” using a full text search; and for ProQuest this was the “Scholarly journals” and “peer reviewed” across all databases.

Database	Coverage	Search terms		
		“access and benefit sharing”	“convention on biological diversity”	“access and benefit sharing” AND “convention on biological diversity”
Scopus	21,950 journals + books and conference proceedings	1,313	10,981	723
Web of Science	21,177 journals + books and conference proceedings	251	1,129	85
HeinOnline	2,700 periodicals	971	7,309	811
ProQuest	11,610 publications	571	6,527	423

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We did two searches of the literature on Scopus. First we did a broad search on 3 September 2019 using the terms “access and benefit sharing” AND “convention on biological diversity” in all fields for all articles, book chapters, reviews, books and conference papers for all years. This captured all possible instances of the search terms in the literature, but it also included publications where the terms were not central to the publication and indeed may only have appeared in the reference lists/bibliographies. The hypothesis was that this strategy would identify the broadest scope of ABS literature including research in peripheral areas. We then repeated the search, again on 3 September 2019, but this time limited it to the publications that used the terms in titles, abstracts and/or keywords, and again for all years. The hypothesis was that publications focusing on ABS and CBD were more likely to prioritize the use of the terms in the titles, abstracts and/or keywords, but we recognise in doing so we may have excluded some relevant publications from this subset of publications from the broader search.

Metadata on all the resulting publications from both searchers, including authors, titles, journals, key words, affiliations, and so on, were downloaded as .csv (comma-separated values) files and imported into Microsoft Excel (https://products.office.com/en-au/excel) and the biometric visualisation program VOSviewer (https://www.vosviewer.com). Descriptive analyses of trends (such as the types of publications, accessibility, subject areas, and so on) were performed using Scopus’ analytical tools as well as Microsoft Excel (Table 2). VOSviewer, a software tool, was then used to construct and visualize networks in the literature based on keywords, co-citations, authors and countries of co-authors among others.[18 19] Citation analysis identifies prominent authors, documents and journals within a domain of knowledge and assumes that authors cite other authors or documents that they consider to be important for their own work.[20] Co-citation analysis is a variant of citation analysis and measures the frequency with which two units (such as authors, documents, journals, and so on) are cited together and assumes that the more two items are cited together, the more likely it is that their content is related.[20] The VOSviewer outputs are in the form of figures/maps where each element (such as a keyword, author, publication, and so on) appears as a circle with the distance between circles indicating the proximity of the elements and the lines represent co-occurrence between the elements.[21]

Methods

Overview

There is a large body of literature relating to ABS and CBD with 723 publications identified by searching Scopus using the terms “‘access and benefit sharing’ AND ‘convention on biological diversity’” across all fields. Of these, 50% were research articles, 25% were book chapters, 13% reviews, 9% books and 19 conference papers (Table 2). From this broad literature a subset of 150 publications were identified using the focused search of just titles, abstracts and/or keywords, of which 59% were articles, 25% were book chapters, 13% reviews, 7% books and just 3 conference papers (Table 2). Despite the differences in the number of publications between the broad and focused literature, they were similar proportions in terms of the types of publications (articles, books, and so on), accessibility (open access), subject areas, affiliations of authors and languages (Table 2).

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Table 2: Overview of publications. Scopus was searched for "access and benefit sharing" AND "convention on biological diversity" in all years in the broad search of all fields for all articles, book chapters, reviews, books and conference papers (723 publications) or the focused search of just the title, abstract and key words (150 publications).

Categories	Number of publications	
	Broad literature	Focused literature
Type of publication		
Articles	356 (49%)	88 (59%)
Book Chapters	179 (25%)	25 (17%)
Reviews	94 (13%)	19 (13%)
Books	64 (9%)	10 (7%)
Conference Papers	19 (3%)	3 (2%)
Accessibility		
Open access	123 (17%)	24 (16%)
Other	603 (83%)	126 (84%)
Subject areas		
Social Sciences	323 (30%)	56 (25%)
Agricultural and Biological Sciences	249 (23%)	49 (22%)
Environmental Science	205 (19%)	39 (18%)
Economics, Econometrics and Finance	112 (10%)	24 (11%)
Business, Management and Accounting	76 (7%)	12 (5%)
Biochemistry, Genetics and Molecular Biology	76 (7%)	25 (11%)
Medicine	52 (5%)	15 (7%)
Language		
English	702 (97%)	143 (95%)

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Chinese	9 (1%)	5 (3%)
French	7 (1%)	2 (1%)
Japanese	4 (1%)	1 (1%)
Spanish	3 (1%)	-
Number of authors		
Total authors	2,225	395
Total unique authors	1,765 (79%)	318 (81%)
Authors per publication	3.06	2.63
Authors with only one publication	1,525 (69%)	270 (68%)
Affiliations of authors		
Griffith University	24 (3%)	8 (5%)
Wageningen University	23 (3%)	5 (3%)
Fridtjof Nansen Institute	18 (2%)	6 (4%)
University of Edinburgh	13 (2%)	-
United Nations University, Japan	13 (2%)	2 (1%)
Universidade de Sao Paulo	12 (2%)	3 (2%)
Biodiversity International	12 (2%)	2 (1%)
University of Cape Town	-	5 (3%)
University of Central Lancashire	-	6 (4%)

Who published when, where and from where?

The first two publications on ABS and CBD in Scopus were produced in 1997 and examined the implications of intellectual property in plant and animal agriculture.[22] [23] Since then there has been a steady increase in research (Figure 2), nearly all of which is in English with a very few publications in Chinese, French, Japanese or Spanish (Table 2). From 2012 to 2018 there were 472 publications broadly related to this topic, of which 90 were focused on the topic, a rate of approximately 13 publications per year (Figure 2). Comparing various search terms shows that the terms “genetic resources and access and benefit sharing” closely tracked “convention on biological diversity and genetic resources”, and that this was a subset of a much larger literature from “genetic resources”, “convention on biological diversity”, and “genetic resources and convention on biological diversity” (Figure 2).

The main journals publishing broadly on ABS and CBD were *Biocontrol* (20 publications),

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Asian Biotechnology and Development Review (11), *Biodiversity and Conservation* (11), but reflecting the diversity of disciplines engaged in this research, there were over 265 different journals and others that published on ABS and the CBD (Table 3). Even the most common journal (*Biocontrol*) only accounting for 3% of the broad literature, while for the more focused literature, 5% was published in the *Asian Biotechnology and Development Review* (Table 3).

There was a great diversity of authors engaged with this literature, with 2,225 authors contributing to the broad literature of which 395 authored the focused literature (Table 2). Although there were a few authors repeatedly published on this topic, the vast majority of authors (68-69%) were not specialists on the topic, having only authored one publication (Table 2). The main authors identified in the broad literature were Charles Lawson (13 publications), Elisa Morgera (12), Joop van Lenteren (12), Matthew Cock (10), Sebastian Oberthür (10) and Kristin Rosendal (10), while for the focused subset of the literature it was Doris Schroeder (5), Rachel Wynberg (5), Charles Lawson (4), Michelle Rourke (4), Barbara Barratt (4), Kristin Rosendal (3), Sarah Laird (3), Carmen Richerzhagen (3) (Table 4).

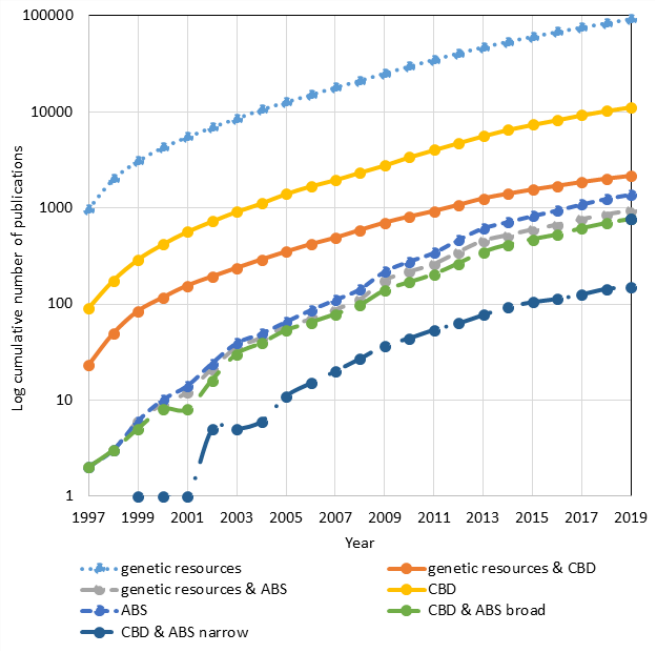

Figure 2: Cumulative number of publications (log scale) per year using various search terms in all fields of Scopus (broad search) from 1 January 1997 to 31 December 2019. The terms were: "genetic resources", "convention on biological diversity" (CBD), "genetic resources and convention on biological diversity", "access and benefit sharing" (ABS), "genetic resources and access and benefit sharing", and "convention on biological diversity and access and benefit sharing".

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Table 3: Top 10 most active journal. Scopus was searched for "access and benefit sharing" AND "convention on biological diversity" in all years for either all fields for all articles, book chapters, reviews, books and conference papers (broad search; 723 publications) or only fields of title, abstract and key words (focused search; 150 publications) in descending order. The Impact Factors and categories were derived from Incites (2018).

Journal	Number of publications	Impact factor	Categories
Broad search (723 publications)			
Biocontrol	20	0.806	Biotechnology and applied microbiology
Asian Biotechnology and Development Review	11	-	-
Biodiversity and Conservation	11	3.142	Biodiversity conservation Ecology Environmental science
International Environmental Agreements Politics Law and Economics	10	-	-
Ecological Economics	10	-	-
Environmental Policy and Law	9	-	-
Acta Horticulturae	8	-	-
Journal of World Intellectual Property	7	-	-
Biological Control	7	2.607	Biotechnology and applied microbiology Entomology
Resources	6	-	-
Focused search (150 publications)			
Asian Biotechnology and Development Review	7	-	-
International Environmental Agreements Politics Law and Economics	7	-	-

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Resources	4	0.806	Biotechnology and applied microbiology
Journal of Law and Medicine	3	-	-
Ecological Economics	3	-	-
Acta Horticulturae	3	-	-
South African Journal of Botany	3	-	-
Journal of World Intellectual Property	2	-	-
Biodiversity and Conservation	2	3.142	Biodiversity conservation Ecology Environmental science
Biocontrol	2	0.806	Biotechnology and applied microbiology

Table 4: Most prolific authors. Searching Scopus in either all fields for all articles, book chapters, reviews, books and conference papers (broad search; 723 publications) or only fields of title, abstract and key words (focused search; 150 publications).

Name	Number of publications	Country	Institution	Number as first author	Total citations
Broad search (723 publications)					
Lawson, C.	13	Australia	Griffith University	13	42
Morgera, E.	12	United Kingdom	University of Edinburgh	11	53
van Lenteren, J.C.	12	Netherlands	Wageningen University	4	625
Cock, M.J.W.	10	United Kingdom	CABI	3	302
Oberthür, S.	10	Belgium	Vrije Universiteit Brussel	9	68
Rosendal, K.	10	Norway	Fridtjof Nansen Institute	4	76
Focused search (150 publications)					

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Schroeder, D.	5	United Kingdom	University of Central Lancashire	2	54
Wynberg, R.	5	South Africa	University of Cape Town	4	66
Lawson, C.	4	Australia	Griffith University	4	9
Rourke, M.	4	Australia	Griffith University	3	6
Barratt, B.I.P.	4	New Zealand	AgResearch Invermay	1	121
Rosendal, K.	3	Norway	Fridtjof Nansen Institute	2	37
Laird, S.	3	United States	People and Plants International	1	12
Richerzhagen, C.	3	Germany	German Developmen t Institute	3	29
Robinson, D.	3	Australia	University of New	3	23
Dedeurwaerdere, T.	3	Belgium	Catholic University, Leuven	1	16
Zhao, F.-W.	3	China	Central University for Nationalities	2	4

The literature was predominantly produced by authors from the United States (132 and 32 publications for the broad and focussed literature respectively), United Kingdom (114 and 19), Australia (75 and 15), Germany (68 and 18) and Canada (63 and 15), although authors from 81 different countries have published in the broad literature (Figure 3). Based on author affiliations, a wide range of institutions contribute to the research, with Griffith University, Wageningen University and Research Centre, Fridtjof Nansen Institute, the University of Edinburgh, the United Nations University, Japan and the Universidade de Sao Paulo the main ones (Table 2). The main disciplines engaging ABS and CBD were Social Sciences (30% broad, 25% focused literature), Agricultural and Biosciences (23% and 22%), Environmental Science (19% and 18%), Economics, Econometrics and Finance (10% and 11%), Business, Management and Accounting (7% and 5%), Biochemistry, Genetics and Molecular Biology (7% and 11%)

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and Medicine (7% and 5%) (Table 2).

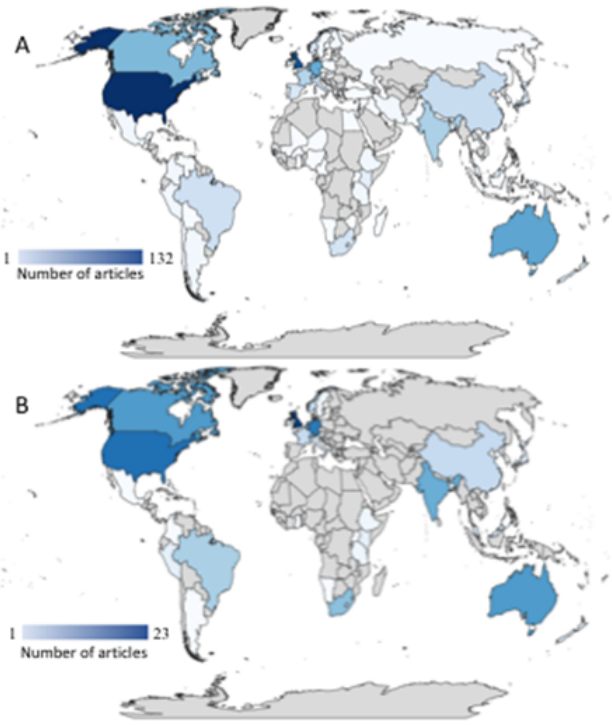

Figure 3: The national locations of the authors conducting research on ABS and CBD based on their listed affiliations for the: (A) broad literature searching all fields (723 publications); or (B) focused literature based on searching title, abstract and key words (150 publications). The shades of blue reflect the number of publications according to the country of affiliation of the authors. The image was generated in Microsoft Excel based on data from Scopus.

What themes were addressed in the research?

Research themes are reflected in the keywords selected by authors and editors. The array of keywords was diverse (2,821 broad and 785 focused literature). Common keywords included "biodiversity", "genetic resources", along with the original search terms "access and benefit(-)sharing" and "convention on biological diversity" (broad literature, Table 5). The emphasis on "genetic resources" (131 broad and 66 focused literature) reflect the main focus of "biodiversity", with other forms of biodiversity less common including "animal(s)" (45 and 5) "plant" (including "medicinal plant(s)") (10 and 1), and with "fungi", "microorganism" or "bacteria" rarely appearing. Around the core themes, there were keywords highlighting specific aspects of the ABS and CBD literature. This includes phrases relating to the CBD and associated regulations such as "nagoya protocol" (56 and 30), "intellectual property" (68 and 19), "international agreements" (21 and 7) and "patent" (24 and 4). The use of genetic resources was reflected in keywords such as "bioprospecting" (21 and 8), "biotechnology" (31 and 8), "medicinal plant(s)" (3 and 1) and "medical research" (3 and 1) among others. There were also sets of terms potentially relating to who could/should benefit including "traditional knowledge" (51 and 25), "traditional medicine" (16 and 4), "indigenous people(s)" (26 and 4), countries/regions such as "developing country" (3 and 1), "africa" (15 and 4) and "china" (2 and 1). Finally, there were keywords relating to conservation of biodiversity such as "conservation" (31 and 10), "sustainable development" (18 and 6) and "sustainability" (8 and 2), as well as "conservation management", "conservation planning", "conservation of natural resources" and "environmental protection".

Some keywords were clustered close together, while others were distinct when the co-occurrence of keywords were visualised in VOSviewer (Figures 4 and 5). For the broad literature "biological control" and associated keywords were, for example, a distinctly separate theme (Figure 4 (blue)). Other closely related clusters included themes around "conservation" (red), "access and benefit(-)sharing" (yellow), "environmental protection" (purple) and "intellectual property" (green) (Figure 4). These might be broadly

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grouped as biocontrol (blue), formal legal instruments (yellow), governance issues (red), environment and conservation (purple) and legal issues (green). In the focused literature there were distinct clustering around "convention on biological diversity" (green), "biodiversity" (red), "access and benefit(-)sharing" (green), "nagoya protocol" (blue), "conservation planning" (yellow) and "developing world" (purple) (Figure 5). In the focused literature clusters were broadly characterised as commercial concerns (blue), governance (green), conservation (yellow), law and policy issues (red) and emerging issues (purple) (Figure 5). Interestingly, the themes around "conservation" (Figures 4 (red) and 5 (yellow)) were generally separate and distinct from the other broader categories.

Table 5: The most common keywords in publications identified from Scopus using the terms "access and benefit sharing" AND "convention on biological diversity" in a broad search of all fields (723 publications) or the focused search of just titles, abstracts and key words (150 publications). The use of brackets "()" represents multiple uses of essentially the same keyword, such as "human" and "humans" represented as "human(s)".

Keywords	Number times appeared in publications	
	Broad search	Focused search
biodiversity	158	64
genetic resource(s)	131	66
access and benefit(-)sharing	81	63
convention on biological diversity	77	56
intellectual property (rights)	68	19
human(s)	60	15
nagoya protocol	56	30
traditional knowledge	51	25
biological control	49	3
animal(s)	45	5
biotechnology	31	8
conservation	31	10
indigenous people(s)	26	4
international cooperation	28	13

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environmental protection	25	13
nonhuman	25	7
patent	24	4
benefit sharing	24	13
bioprospecting	21	8
international agreement	21	7
conservation of natural resources	19	9
environmental legislation	18	4
sustainable development	18	6
environmental policy	17	2
genetics	17	5
sustainability	17	5
traditional medicine	16	4
knowledge	16	3
natural enemy	15	-
africa	15	4
agriculture	15	4
biocontrol agent	15	-
Total number keywords	2,821	785

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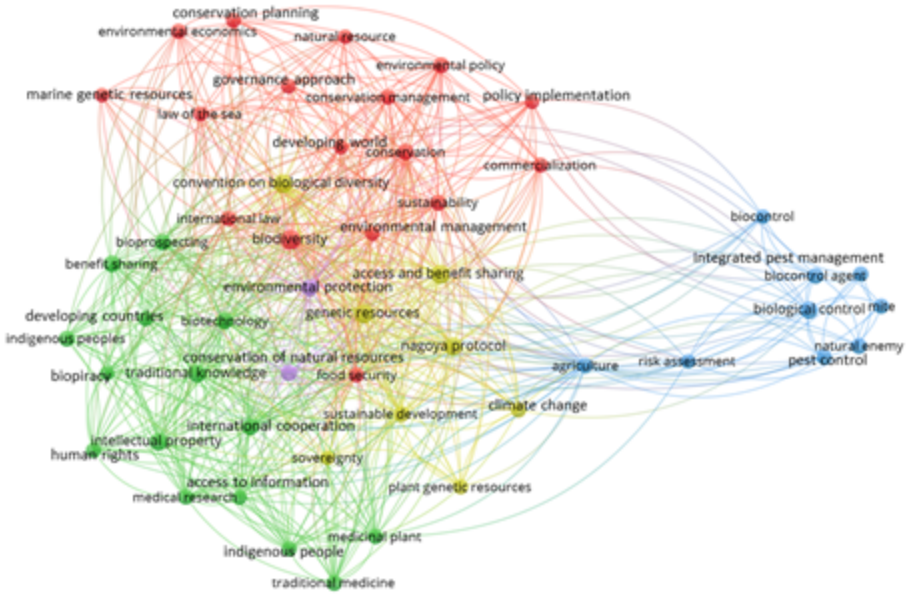

Figure 4: Visualisation of relationships between keywords for the broad literature identified by searching all fields (723 publications). The size of the circle reflects the number of times the keyword was listed in the literature with circles close together more likely to co-occur in the same publication, with colours indicating clusters of themes in key words. The image was generated in VOSviewer based on data from Scopus.

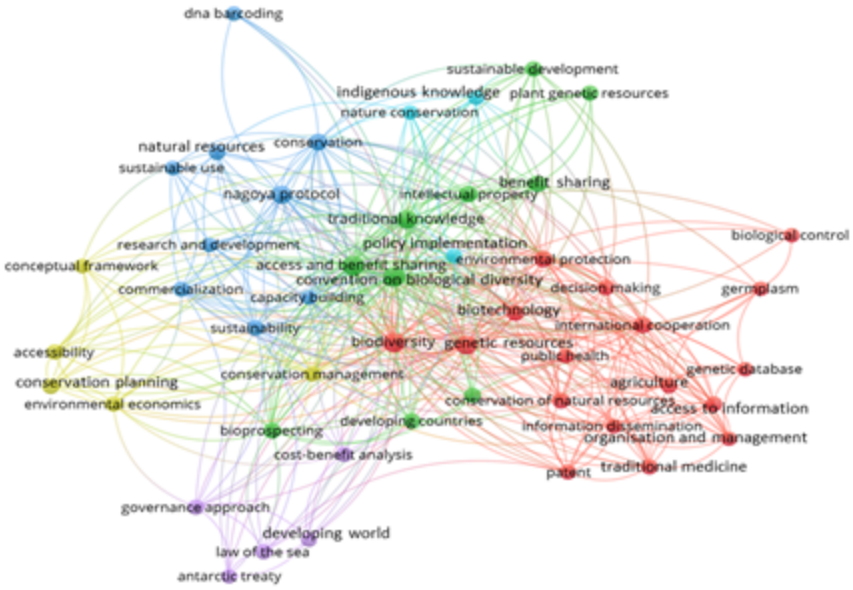

Figure 5: Visualisation of relationships between keywords for the focused literature identified by a focused search of only title, abstract and key words (150 publications). The size of the circle reflects the number of times the keyword was listed in the literature with circles close together more likely to co-occur in the same publication, with colours indicating clusters of themes in key words. The image was generated in VOSviewer based on data from Scopus.

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The underlying literature cited in the publications

In addition to the analysis of the current literature focused on ABS and CBD, it is possible to assess the underlying literature they relied on by analysing their reference lists/bibliographies. In terms of the underlying literature, there were some clear clusters and hence disciplines used in ABS and CBD research (Figure 6). A visualisation of the underlying literature showed journal clusters around law and commerce (*Economic Botany*, *Griffith Law Review*, *Journal of Ethnopharmacology*, and so on) (green), generalist review and policy (*Earth Negotiations Bulletin*, *Journal of World Intellectual Property*, and so on) (blue), international and environmental law and policy (*World Development*, *Environmental Policy and Law*, *Receil*, and so on) (red), general science (*Nature*, *Science*, *Biocontrol*, and so on) (yellow) and conservation (*Biodiversity and Conservation*, *Oryx*, and so on) (purple) based on the focused literature (Figure 6).

Similar to the journals, there are important specific publications regularly cited. The top five cited publications were Rachel Wynberg et al. (2009)[24] (48 citations), Elizabeth De Santo et al. (2011)[25] (41), Stephen Brush (2007)[26] (32), Juliana Santilli (2012)[27] (26) and Kirstin Rosendal (2006)[28] (25) (Table 6). The total citation rate (the number of citations divided by the number of years since publication), however, indicates that pivotal publications were by Elizabeth De Santo et al. (2011)[25] (5.1 citations per year) and Rachel Wynberg et al. (2009)[24] (4.8 citations per year) (Table 6).

A visualisation of the authors of the underlying literature shows a clear distinction between research on biocontrol around the author Joop van Lenteren (purple) and the rest of the literature with other clusters around the authors Sarah Laird, Rachel Wynberg and Daniel Robinson (red), Gerd Winter, Evanson Kamau and Frederic Perron-Welch (blue), Kristin Rosendal, Michael Halewood and Elisa Morgera (green) and Tom Dedeurwaedere (yellow) (Figure 7). A visualisation of authors by country confirms the main sources of literature were the United States and Europe (Figures 8 and 9). Based on the affiliations of authors cited in the focused literature, there are very few co-authorships affiliations across countries (Figure 9), while the broad literature involves a wide diversity of authors across many countries (Figure 8).

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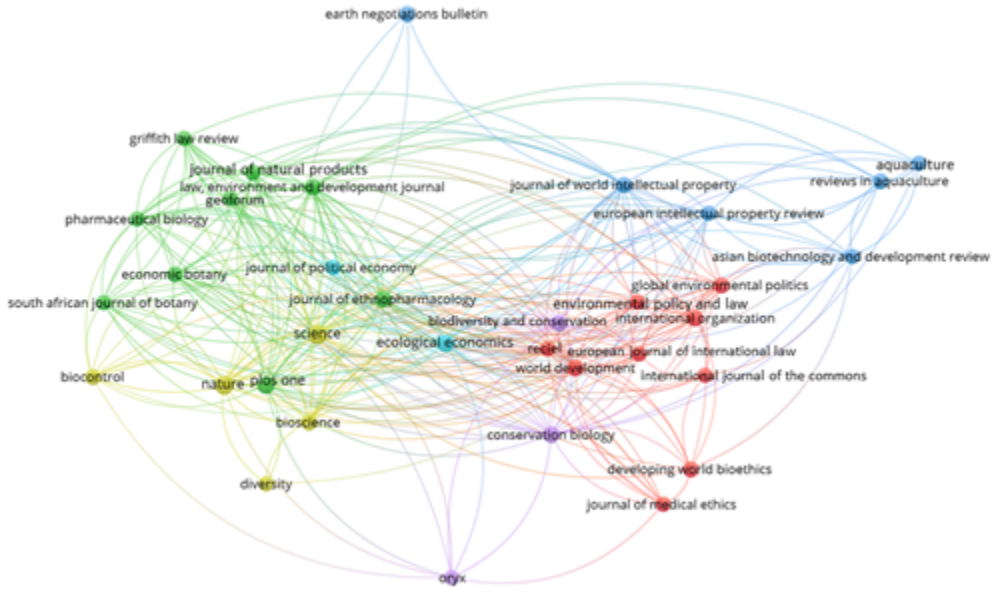

Figure 6: Key sources/journals in the reference list of the focused literature on ABS and CBD (150 publications) visualising co-occurring source journals. The size of the circle reflects the number of times the source occurred in the reference lists of the 150 publications, with circles close together more likely to co-occur in the reference lists of the same publications. Colours indicate clusters of co-occurring sources. The image was generated in VOSviewer based on data from Scopus.

Figure 7: Key authors of publications in the reference list of the 150 publications focused literature on ABS and CBD. The size of the circle reflects the number of times the author was listed in the reference list of one of the publications on ABS and CBD from Scopus, with circles with author tags close together more likely to co-occur in the same reference lists. Colours indicate clusters of co-occurring sources. The image was generated in VOSviewer based on data from Scopus.

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Table 6: Top 10 authors of publications by citations included in the reference lists of the focused literature search on ABS and CBD.

#	Lead author	Title	Journal/book publisher	Year published	Number of citations	Citation rate (y^{-1})	Open access
1	Wynberg R. et al.	Indigenous people, consent and benefit sharing: Lessons from the San-Hoodia case	Springer	2009	48	4.80	No
2	De Santo E. et al.	Fortress conservation at sea: A commentary on the Chagos marine protected area	*Marine Policy*	2011	41	5.13	No
3	Brush S.	Farmers' Rights and protection of traditional agricultural knowledge	*World Development*	2007	32	2.67	No
4	Santilli J.	Agrobiodiversity and the law: Regulating genetic resource, fo security and cultural diversity	Earthscan	2012	26	3.71	No
5	Rosendal K.	Balancing access and benefit sharing and legal protection of innovations from bioprospecting: Impacts on conservation of biodiversity	*Journal of Environment and Development*	2006	25	1.92	No
6	Siebenhüner B. and Suplie J.	Implementing the access and benefit sharing provisions of the CBD: A case for institutional learning	*Ecological Economics*	2005	23	1.64	No
7	Kamau E. and Winter G.	Genetic resource, traditional knowledge and the law: Solution for access and benefit sharing	Earthscan	2009	20	2.00	No
8	Oberthür S. and Rabitz F.	On the EU's performance and leadership in global environme governance: The case of the Nagoya Protocol	*Journal of European Public Policy*	2014	17	3.40	No
9	Martinez S. and Biber-Klemm S.	Scientists – Take action for access to biodiversity	*Current Opinion in Environmental Sustainability*	2010	16	1.78	No

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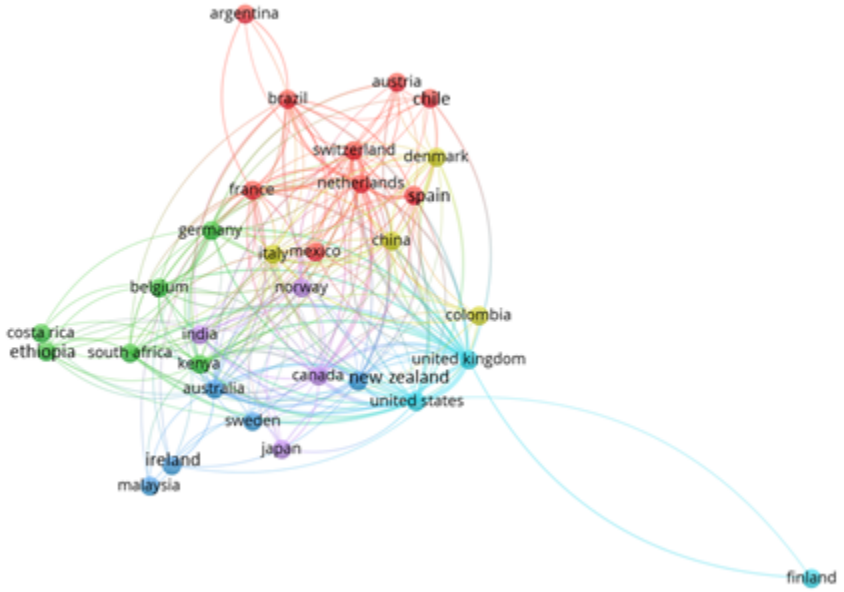

Figure 8: Countries of affiliation of authors used in the reference lists of the broad literature (723 publications). The size of the circle reflects the number of times the country affiliated with the authors occur in the reference lists of the publications on ABS and CBD from Scopus. Circles close together are more likely to co-occur among publications. Colours indicate clusters of co-occurring sources. The images were generated in VOSviewer based on data from Scopus.

Figure 9: Countries of affiliation of authors used in the reference lists of the focused literature on ABS and CBD (150 publications). The size of the circle reflects the number of times the country affiliated with the authors occur in the reference lists of the publications on ABS and CBD from Scopus. Circles close together are more likely to co-occur among publications. Colours indicate clusters of co-occurring sources. The images were generated in VOSviewer based on data from Scopus.

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Equity and access to the literature

Relatively few of the publications are open access (16-17% of publications, Table 2) including none of the top 10 most cited sources in the focused literature (Table 6). This has implications about equity in access as the majority of the literature requires some kind of institutional support to access hard copies or the capacity to fund database license fees for online access to the literature. It was also notable that almost all the publications were in English (Table 2). The consequence might be language barriers limiting publishing and readership.

The biocontrol literature

There was a distinct separation in publications on biocontrol and the rest of the literature on ABS and CBD, as highlighted by a tight cluster of publications around the author Joop van Lenteren and limited links to the rest of the literature (Figure 7). This separation was also apparent in keywords, with terms such as "biological control", "pest control", "biocontrol agent" and "integrated pest management" clustering together (blue) and distinct from other keywords (other colours) (Figure 4). The biocontrol literature is active, with many highly cited publications. For example, the Joop van Lenteren (2012)[29] and Joop van Lenteren et al. (2018)[30] publications in *BioControl* have citation and citation rates of 313 citations/34.77 citations per year and 80 citations/80.00 citations per year respectively. This is much higher than the rest of the focused literature, were the most cited publication by Rachel Wynberg et al. (2009)[24] has 48 citations/4.8 citations per year (Table 6).

These biocontrol publications focused on how ABS needs to be negotiated to implement biocontrol. For example, Joop van Lenteren (2012)[29] addresses ABS in the context of "[a]nother factor frustrating application of biological control is the increasing amount of guidelines and regulations … But the future of biological control might be really threatened by the plans concerning benefit sharing under the [CBD]" (p 16). Similarly, Matthew Cock et al. (2010)[31] say "[r]ecent applications of CBD principles have already created barriers to collection and export of natural enemies for [biocontrol] research … in several countries. If this approach is widely applied it will seriously compromise this very successful and environmentally safe pest management method" (p 201). These publications are then commonly cited by others. While these are important points, the overwhelming majority of the rest of the publications on biocontrol cite these works, and do not engage in more detail with ABS issues.

Discussion

The scientometric analysis highlights how there is a substantial body of academic research into ABS and the CBD (and Nagoya Protocol), and that it is very diverse in terms of who publishers (unique authors), where they publish (publishing destinations) and about what (subject areas). There appears to be an important separation between the literature dealing with biological research and development that has to comply *with* ABS and research *on* ABS. When accessing research

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materials or developing biological products, researchers in science and development have to comply *with* ABS in the same way that have to comply with other regulatory requirements, such as human ethics approvals, laboratory safety measures, publication submission requirements, and so on. This is most clearly illustrated by the biocontrol literature, where Joop van Lenteren (2012)[29] and Matthew Cock et al. (2010)[31] point out the regulatory hurdles posed by ABS for researching and developing biocontrol measures. They talk about how ABS is frustrating applying control measures[29] and is also creating barriers to collecting and exporting biocontrol agents.[31] In effect, this literature addresses how the requirements of ABS compliance affects other research and development.

Similar compliance issues have been raised in other research disciplines in science. This includes: (1) calls to re-think how international policy processes under the auspices of the United Nations now largely outside of mainstream scientific discourse and attention might re-engage the scientific endeavour fairly and equitably;[32] (2) that restrictive and complex regulations are limiting the transfer of biological material and associated data;[33] (3) the need for best practice knowledge sharing and the application of scientific research policies to meet complex ABS compliance standards;[34] (4) ABS is stifling research, hampering responses to disease outbreaks and jeopardising food safety;[35] (5) the "Byzantine labyrinth" of ABS laws threatens Brazilian biodiversity research;[36] and (6) ABS laws are curtailing biodiversity research and collaborations.[37] 38 Therefore, an important issue for future research is examining practical compliance issues with suggestions starting to emerge about better ways to address these issues.[39] [40]

Research *on* ABS involves examining the implementation, compliance and enforcement of regulations including research about the form and content of ABS legislation, policy and administration measures and social effects. This research is mainly focused around interpreting formal legal instruments, legal and regulatory issues, commercial concerns, social sciences, and so on. Compared to the literature engaged *with* ABS, the literature *on* ABS is very diverse, and might be considered as a governance literature. This broadly covered issues of how implementation, compliance and enforcement could be achieved through negotiated texts based on their interpretation, structure and form. This was addressed in essentially two ways: (1) As legal technicalities with regulation as the legal solution to a problem (the efficiency and effectiveness of regulation) – As an example, Juliana Santilli's *Agrobiodiversity and the Law: Regulating Genetic Resources, Food Security and Cultural Diversity* (2012) provides a detailed assessment of the nature, scope and definition of agrobiodiversity through a definition of relevant terms and an exegeses of the legal structures in domestic and international laws that impact agricultural biodiversity;[41] and (2) As broader policy questions – As an example, Kristin Rosendal's "Balancing Access and Benefit Sharing and Legal Protection of Innovations from Bioprospecting: Impacts on Conservation of Biodiversity" (2006) addresses the balance between the needs and interests of owners of genetic resources and technology owners when regulating (making rules) about biodiversity conservation, ABS and the protection of intellectual property.[28] This latter type of research often focusses on the question like "Can current proposals for handling

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existing [intellectual property] legislation, such as disclosure of origin and certificates of legal provenance, contribute to finding a balance between the [ABS] interests?" (p 428). This latter way also covered the diversity of interests affected by ABS laws and the interests of researchers proposing/commenting on problems that might have solutions within the regulatory matrix of ABS law, policy and administration. Future research is likely to address more of the domestic ABS implementation issues and comparative assessments as more and more countries enact ABS legislation, policy and administration measures. With the maturing of this literature there might be an expectation of more research addressing broader policy questions (and social effects) and less research addressing the specific legal technicalities of regulations.

This research *on* ABS theme also included literature around social political issues including the dominance of developed rich countries (North) compared to poor developing countries (South)[42] and the place of Indigenous Peoples and local communities based on their traditional knowledge associated with their resources.[43] Perhaps surprisingly, the predominance of English language literature and the very limited co-authorship across countries from the developing South suggest that there might be scope for engaging more diverse voices and interests. With the Nagoya Protocol expressly addressing traditional knowledge associated with genetic resources and some of the practical issues like certificates of origin this is likely to be a significant focus of future research.

More broadly than just considerations about ABS, historically conservation and development have been in conflict and difficult to reconcile.[44] [45] The present United Nations *Sustainable Development Goals* (SDGs) embrace the diverse and current social and environmental concerns and seeks a reconciliation between conservation and development as sustainable development.[46] Of particular relevance to ABS is Goal 15 to "protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss".[46] In this context sustainable development means "[d]evelopment that meets the needs of the present without compromising the ability of future generations to meet their own needs"[9] through maximizing environmental, economic and social systems.[47] Both the CBD and Nagoya Protocol (and the *Aichi Biodiversity Targets*)[12] set out standards for regulation as processes delivering both access to desirable resources and equitably sharing the outcomes from exploiting those resources that will ultimately promote sustainable development (Target 15.6).[46] Perhaps more importantly, the CBD's post-2020 global biodiversity framework, a strategic planning framework to plan, implement and evaluate the impacts of conservation actions, will expressly deal with the coherence and complementarity of this SDG framework (Decision 14/38).[14] This linkage between conservation and development reflects the original rationale for the CBD (and Nagoya Protocol) that advances in science and technology were increasingly taking biological materials and through research and development delivering profitable products to markets protected by intellectual property and other regulations. As such, ABS was about capturing some of that value and returning that to the source countries of those biological materials.[7] [8] In effect, the CBD implements an

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economic instrument that enables the possible future commercial values of the genetic resources to be traded for present monetary and non-monetary (like the transfer of technology) benefits that can flow back to conservation.[49 50] In economic terms this ABS law (or policy or administration) addresses the market failure for conservation by enabling restrictions to be imposed on genetic resources so that conservation that otherwise has no immediate value has a value and a potential to profit, and then conservation takes a higher priority when competing with other priorities avoiding biodiversity destruction and decline.[51 52] Intimately linked with conservation is sustainable development as the imperative to conserve biodiversity promotes development that is sustainable and not destructive of biodiversity. This then accords with the SDG Target 15.6 halting biodiversity loss while maximizing environmental, economic and social systems. As might be expected the broad range of keywords, publication destinations and citation rates for even the most cited publications accords with the very wide subject areas of sustainable development, and its dimensions of environment, economics and society. Sustainable development was not, however, the main focus of most ABS research with the keyword "sustainable development" (and "sustainability") uncommon in the literature (Table 5). In a broader context, that the ABS and the CBD (and Nagoya Protocol) literature cover diverse subject areas, and consequently a diversity of articles and journals, might be expected. This may also account for the many unique authors, keywords, publishing destinations and subject areas. The important point, however, is that despite the goals of the CBD being to promote sustainable development, this was not the focus of most ABS literature.

Similarly, there was limited research focused on conservation *per se* as the other original rationale for the CBD and a critical prerequisite for sustainable development. For instance, clusters of research around "conservation" were minor compared to the diversity of other issues (and keywords). Also only one out of ten of the most active journals, *Biodiversity and Conservation*, was focused on conservation *per se* and the main authors contributing to the ABS literature are not generally addressing conservation *per se*. For example, Kristin Rosendal's "Sharing and Legal Protection of Innovations from Bioprospecting: Impacts on Conservation of Biodiversity" (2006) addresses the balance between the needs and interests of owners of genetic resources and technology owners with no clear concept of conservation beyond accepting the broad political and scientific consensus about the need to stop and reverse the loss of biodiversity (p 430).[41] Similarly, Rachel Wynberg et al.'s "Indigenous people, consent and benefit sharing: Lessons from the San-*Hoodia* case" (2009) is framed around "the growing awareness and concern over the loss of biological diversity and what this loss means for the health of the planet and survival of the human species" (p xxix), but then only addresses the business between Indigenous Peoples and the bioprospecting industry and the San-Hoodia benefit-sharing and similar cases (p 4).[24] Perhaps this is best illustrated by the recent *Rooibos Benefit Sharing Agreement* in South Africa that was negotiated under the auspices of the CBD and Nagoya Protocol commitments and had no specific place for conservation in its complex outcomes despite delivering significant equity

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benefits for Traditional Knowledge holders.[48] Despite this apparent lacuna in publications about conservation *per se*, there are some publications that do engage with the conservation issues addressing conservation management and planning, environmental economics, taxonomy, ecological and bio-geographic investigations, and so on.[53 54] These are, however, peripheral to the main social, legal and policy debates.

Conclusion

With 25 years of ABS implementation under the CBD, the view of many researchers is that ABS regulation restricts the transfer of biological materials (and associated sequence data) imposing unreasonable bureaucratic burdens on researchers and others when accessing biological materials that could promote conservation.[37] Most importantly, while conservation was not the only imperative in the CBD and the subsequent Nagoya Protocol, the rationale for ABS was to deliver on a market failure for conservation through a market instrument (a contract) with consequences for both conservation and sustainable development. This instrument was designed to enable conservators to capture some of the benefits from exploiting biodiversity, and by increasing the value of conservation, they would prefer conservation and sustainable development over destructive uses, such as mining, forestry, urbanisation, and so on. The key SDG measures to halt biodiversity losses (Target 15) are addressed through the CBD and Nagoya Protocol ABS arrangements with the objective of conservation and sustainable development (CBD, Article 1; Nagoya Protocol, Article 1). The scientometric analysis shows that while research on ABS is active, an increasing focus on conservation *per se* and sustainable development is required.

Data

The data that support the findings of this study are openly available at Charles Lawson and Catherine Pickering, *Datasets for access and benefit sharing of genetic resources bibliometrics analyses* (2020) at https://research-storage.griffith.edu.au/owncloud/index.php/s/XxsM7wHJwQnGrzl, reference https://doi.org/10.25904/1912/392.

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References

1. Grubb, M., M. Koch, A. Munson, F. Sullivan, and K. Thomson. (1993). The “Earth Summit” agreements: A guide and assessment. Earthscan Publications Ltd, Abingdon-on-Thames. https://doi.org/10.4324/9780429273964

2. Díaz, S., J. Settele, E. Brondízio, H. Ngo, J. Agard, A. Arneth, P. Balvanera, K. Brauman, S. Butchart, K. Chan, and L. Garibaldi. (2019). Pervasive human-driven decline of life on Earth points to the need for transformative change. *Science* 366(6471): 1327. https://doi.org/10.1126/science.aax3100

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3. Ceballos, G., P. Ehrlich, and R. Dirzo. (2017). Biological annihilation via the ongoing sixth mass extinction signalled by vertebrate population losses and declines. *Proceedings of the National Academy of Sciences* 114(30): 89-96. https://doi.org/10.1073/pnas.1704949114

4. Monastersky. R. (2014). Life – A status report. *Nature* 516(7530): 159-161. https://doi.org/10.1038/516158a

5. Sánchez, V., and C. Juma. (1994). Introduction. In Sánchez, V., and C. Juma. *Biodiplomacy: Genetic resources and international relations*. African Centre for Technology Studies, Nairobi.

6. Svarstad, H. (1994). National sovereignty and genetic resources. In Sánchez, V., Juma, C. *Biodiplomacy: Genetic resources and international relations*. African Centre for Technology Studies, Nairobi.

7. Wynberg, R., and S. Laird. (2009). Bioprospecting, access and benefit sharing: Revisiting the "Grand Bargain". In Wynberg R., Schroeder D., Chennells R. (2009) Indigenous peoples, consent and benefit sharing: Lessons from the San-Hoodia case. Springer, Berlin. https://doi.org/10.1007/978-90-481-3123-5_5

8. Lawson, C., M. Rourke, and F. Humphries. (2020). Information as the latest site of conflict in the ongoing contests about access to and sharing the benefits from exploiting genetic resources. *Queen Mary Journal of Intellectual Property* 10(1): 7-33. https://doi.org/10.4337/qmjip.2020.01.01

9. World Commission on Environment and Development. (1987). Report of the World Commission on Environment and Development: Our Common Future. United Nations, New York.

10. United Nations General Assembly. (1987). Report of the World Commission on Environment and Development: Our common future, A/42/427. United Nations, New York.

11. Ad Hoc Open-Ended Working Group on Access and Benefit Sharing. (2010). *The Concept of 'Genetic Resources' in the Convention on Biological Diversity and How It Relates to a Functional International Regime on Access and Benefit Sharing*, UNEP/CBD/WG-ABS/9/INF/1. Secretariat to the Convention on Biological Diversity, Montreal.

12. Conference of the Parties to the Convention on Biological Diversity. (2010). *Report of the Tenth Meeting of the Conference of the Parties to*

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the Convention on Biological Diversity, UNEP/CBD/COP/10/27, [103] and Annex (Decision X/1, Annex 1 (Nagoya Protocol), pp 89-109 and Decision X/2, Annex (*Aichi Biodiversity Targets*) pp 116-124). Secretariat to the Convention on Biological Diversity, Montreal.

13. Secretariat to the Convention on Biological Diversity. (2007). *CBD Handbook* (3rd Edition). https://www.cbd.int/convention/refrhandbook.shtml. Accessed 14 November 2020.

14. Conference of the Parties to the Convention on Biological Diversity. (2018). *Report of the Fourteenth Meeting of the Conference of the Parties to the Convention on Biological Diversity*, UNEP/CBD/COP/14/14. Secretariat to the Convention on Biological Diversity, Montreal.

15. Erdelen, W. (2020). Shaping the fate of life on Earth: The post-2020 global biodiversity framework. *Global Policy*. https://doi.org/10.1111/1758-5899.12773

16. Mongeon, P., and A. Paul-Hus. (2016). The journal coverage of Web of Science and Scopus: A comparative analysis. *Scientometrics* 106(1): 213-228. https://doi.org/10.1007/s11192-015-1765-5

17. Mingers, J., and L. Leydesdorff. (2015). A review of theory and practice in scientometrics. *European Journal of Operational Research* 246(1): 1-19. https://doi.org/10.1016/j.ejor.2015.04.002

18. Centre for Science and Technology Studies. (2019). *VOSviewer*, Version 1.6.11. https://www.vosviewer.com. Retrieved 1 June 2019.

19. van Eck, N., and L. Waltman. (2009). Software survey: VOSviewer a computer program for bibliometric mapping. *Scientometrics* 84(2): 523-538. https://doi.org/10.1007/s11192-009-0146-3

20. Zupic, I., and T. Čater. (2015). Bibliometric methods in management and organization. *Organizational Research Methods* 18(3):429-472. https://doi.org/10.1177/1094428114562629

21. Haunschild, R., L. Bornmann, and W. Marx. (2016). Climate change research in view of bibliometrics. *Plos One* 11(7): e0160393. https://doi.org/10.1371/journal.pone.0160393

22. Lesser, W. (1997). Assessing the implications of intellectual property rights on plant and animal agriculture. *American Journal of Agricultural Economics* 79(5): 1584-1591.

OPEN ACCESS | Correspondence: Charles Lawson, c.lawson@griffith.edu.au. Received:October 20, 2020 Accepted: October 22, 2020 Published: January 18, 2021 Citation: Lawson, C, Pickering, C.. (2021). "Scientometric review of the literature about genetic resources access and benefit sharing under the Convention on Biological Diversity: Current research and future directions". Journal of Science and Law, 7(1): 1-30. doi:10.35005/daen-sd52

https://doi.org/10.2307/1244385

23. Lesser, W. (1997). Assessing the implications of intellectual property rights on plant and animal agriculture. *Canadian Journal of Agricultural Economics* 45(4): 351-359.

24. Wynberg, R., D. Schroeder, and R. Chennells. (2009). Indigenous people, consent and benefit sharing: Lessons from the San-Hoodia case. Springer, Berlin. https://doi.org/10.1007/978-90-481-3123-5

25. De Santo, E., P. Jones, and A. Miller. (2011). Fortress conservation at sea: A commentary on the Chagos marine protected area. *Marine Policy* 35(2): 258-260. https://doi.org/10.1016/j.marpol.2010.09.004

26. Brush, S. (2007). Farmers' rights and protection of traditional agricultural knowledge. *World Development* 35(9):1499-1514. https://doi.org/10.1016/j.worlddev.2006.05.018

27. Santilli, J. (2012). Agrobiodiversity and the law: Regulating genetic resource, food security and cultural diversity. Earthscan Publications Ltd, Abingdon-on-Thames. https://doi.org/10.4324/9780203155257

28. Rosendal, K. (2006). Balancing access and benefit sharing and legal protection of innovations from bioprospecting: Impacts on conservation of biodiversity. *The Journal of Environment & Development* 15(4): 428-447. https://doi.org/10.1177/1070496506294799

29. van Lenteren, J. (2012). The state of commercial augmentative biological control: Plenty of natural enemies, but a frustrating lack of uptake. *BioControl* 57(1): 1-20.

https://doi.org/10.1007/s10526-011-9395-1

30. van Lenteren. J, K. Bolckmans, J. Köhl, W. Ravensberg, and A. Urbaneja. (2018). Biological control using invertebrates and microorganisms: Plenty of new opportunities. *BioControl* 63(1): 39-59. https://doi.org/10.1007/s10526-017-9801-4

31. Cock, M., J. van Lenteren, J. Brodeur, B. Barratt, F. Bigler, K. Bolckmans, F. Cônsoli, F. Haas, P. Mason, and J. Parra. (2010). Do new access and benefit sharing procedures under the convention on biological diversity threaten the future of biological control? *BioControl* 55(2): 199-218. https://doi.org/10.1007/s10526-009-9234-9

32. Laird, S., R. Wynberg, M. Rourke, F. Humphries, M. Muller, and C. Lawson. (2020). Rethink the

OPEN ACCESS | Correspondence: Charles Lawson, c.lawson@griffith.edu.au. Received:October 20, 2020 Accepted: October 22, 2020 Published: January 18, 2021 Citation: Lawson, C, Pickering, C.. (2021). "Scientometric review of the literature about genetic resources access and benefit sharing under the Convention on Biological Diversity: Current research and future directions". Journal of Science and Law, 7(1): 1-30. doi:10.35005/daen-sd52

expansion of access and benefit sharing. *Science* 367(6483): 1200-1202. https://doi.org/10.1126/science.aba9609

33. Neumann, D., A. Borisenko, J. Coddington, C. Häuser, C. Butler, A. Casino, J. Vogel, G. Haszprunar, and P. Giere. (2018). Global biodiversity research tied up by juridical interpretations of access and benefit sharing. *Organisms Diversity & Evolution* 18(1): 1-12. https://doi.org/10.1007/s13127-017-0347-1

34. Smith, D., and H. Hinz, J. Mulema, P. Weyl, and M. Ryan. (2018). Biological control and the Nagoya Protocol on access and benefit sharing – A case of effective due diligence. *Biocontrol Science and Technology* 28(10): 914-926. https://doi.org/10.1080/09583157.2018.1460317

35. Kupferschmidt, K. (2018). Biologist raise alarm over changes to biopiracy rules. *Science* 361(6397): 14-15. https://doi.org/10.1126/science.361.6397.14

36. Bockmann, F., M. Rodrigues, T. Kohsldorf, L. Straker, T. Grant, M. de Pinna, F. Mantelatto, A. Datovo, J. Pombal, J. McNamara, and E. de Almeida. (2018). Brazil's government attacks biodiversity. *Science* 360(6391): 865-865. https://doi.org/10.1126/science.aat7540

37. Nijar, G., S. Louafi, and E. Welch. (2017). The implementation of the Nagoya ABS Protocol for the research sector: Experience and challenges. *International Environmental Agreements: Politics, Law and Economics* 17(5):607-621. https://doi.org/10.1007/s10784-016-9328-7

38. Prathapan, K., R. Pethiyagoda, K. Bawa, P. Raven, and P. Rajan. (2018). When the cure kills – CBD limits biodiversity research. *Science* 360(6396): 1405-1406. https://doi.org/10.1126/science.aat9844

39. Lawson, C., F. Humphries, and M. Rourke. (2019). The future of information under the CBD, Nagoya Protocol, Plant Treaty and PIP Framework. *Journal of World Intellectual Property* 22(3-4): 103-119. https://doi.org/10.1111/jwip.12118

40. Humphries, F., H. Muraki Gottlieb, S. Laird, R. Wynberg, C. Lawson, M. Rourke, M. Tvedt, M. Oliva, and M. Jaspars. (2020). A tiered approach to the marine genetic resource governance framework under the proposed UNCLOS agreement for biodiversity beyond national jurisdiction. *Marine Policy* https://doi.org/10.1016/j.marpol.2020.103910

OPEN ACCESS | Correspondence: Charles Lawson, c.lawson@griffith.edu.au. Received:October 20, 2020 Accepted: October 22, 2020 Published: January 18, 2021 Citation: Lawson, C, Pickering, C.. (2021). "Scientometric review of the literature about genetic resources access and benefit sharing under the Convention on Biological Diversity: Current research and future directions". Journal of Science and Law, 7(1): 1-30. doi:10.35005/daen-sd52

41. Santilli, J. (2012). Agrobiodiversity and the law: Regulating genetic resource, food security and cultural diversity. Earthscan Publications Ltd, Abingdon-on-Thames. https://doi.org/10.4324/9780203155257

42. Guneratne, C. (2012). Genetic resources, equity and international law. Edward Elgar Publishing, Cheltenham. https://doi.org/10.4337/9780857934956

43. Ageh, P., and N. Lall. (2019). Biopiracy of plant resources and sustainable traditional knowledge system in Africa. *Global Journal of Comparative Law* 8(2): 162-181. https://doi.org/10.1163/2211906X-00802003

44. Tallis, H., and J. Lubchenco. (2014). Working together: A call for inclusive conservation. *Nature* 515(7525): 27-28. https://doi.org/10.1038/515027a

45. Brown, K. (2002). Innovations for conservation and development. *The Geographical Journal* 168(1): 6-17. https://doi.org/10.1111/1475-4959.00034

46. United Nations General Assembly. (2015). Transforming our World: The 2030 Agenda for Sustainable Development, A/RES/70/1. United Nations, New York.

47. Barbier, E. (1987). The concept of sustainable economic development. *Environmental Conservation* 14(2):101-110. https://doi.org/10.1017/S0376892900011449

48. Schroeder, D., R. Chennells, C. Louw, L. Snyders, and T. Hodges. (2020). The Rooibos Benefit Sharing Agreement–Breaking New Ground with Respect, Honesty, Fairness and Care. *Cambridge Quarterly of Healthcare Ethics*, 29: 285-301. https://doi.org/10.1017/S0963180119001075

49. Richerzhagen, C. (2010). Effective Governance of Access and Benefit Sharing under the Convention on Biological Diversity. *Biodiversity and Conservation* 20(10): 2243-2261. https://doi.org/10.1007/s10531-011-0086-0

50. Trommetter, M. (2005). Biodiversity and International Stakes: A Question of Access. *Ecological Economics* 53(4): 573-583. https://doi.org/10.1016/j.ecolecon.2004.11.017

51. Swanson, T., and T. Goeschl, (2000). Property Rights Issues Involving Plant Genetic Resources: Implications of Ownership for Economic Efficiency. *Ecological Economics* 32(1): 75-92. https://doi.org/10.1016/S0921-8009(99)00072-5

OPEN ACCESS | Correspondence: Charles Lawson, c.lawson@griffith.edu.au. Received:October 20, 2020 Accepted: October 22, 2020 Published: January 18, 2021 Citation: Lawson, C, Pickering, C.. (2021). "Scientometric review of the literature about genetic resources access and benefit sharing under the Convention on Biological Diversity: Current research and future directions". Journal of Science and Law, 7(1): 1-30. doi:10.35005/daen-sd52

52. Janssen, J. (1999). 'Property Rights on Genetic Resources: Economic Issues. *Global Environmental Change* 9(4): 313-321. https://doi.org/10.1016/S0959-3780(99)00025-4

53. Chandra, A., and A. Idrisova. (2011). Convention on Biological Diversity: A review of national challenges and opportunities for implementation. *Biodiversity and Conservation* 20(14): 3295-3316. https://doi.org/10.1007/s10531-011-0141-x

54. Tancoigne, E., and G. Ollivier. (2017). Evaluating the progress and needs of taxonomy since the Convention on Biological Diversity: Going beyond the rate of species description. *Australian Systematic Botany* 30(4): 326-336. https://doi.org/10.1071/SB16017

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