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RESEARCH ARTICLE

Conservation Policy: Helping or hindering science to unlock properties of plants and fungi

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Societal Impact Statement

Biodiversity loss is happening at an unprecedented rate. Understanding and protecting biodiversity has never been more urgent, and scientific research is key to this. Fair and transparent access and benefit sharing policies enable research to take place, whilst supporting sustainable livelihoods of communities and ensuring benefits are shared. Current national legislation has been unevenly implemented and, in this article, we recommend frameworks be developed to standardize the provision and use of genetic resources for non-commercial research.

Summary:

- Access to genetic resources for scientific research is vital to support and promote the conservation and sustainable use of the world's biodiversity. The regulatory framework for research is stipulated by Access and Benefit Sharing (ABS) legislation at a national level, but other elements – legal transparency, respect, cooperation, and trust – are essential for its effective and sustainable implementation. Despite the intention of this "ABS regime" to protect natural resources and associated knowledge from misappropriation, several studies have questioned whether national regulatory approaches have led to constraints on research and conservation.
- We analyse evidence and provide case studies on how these regulations are affecting research. We find that the number of Internationally Recognized Certificates of Compliance (IRCC) of the Nagoya Protocol (NP), the key compliance mechanism of the ABS system, doubled in the six months prior to February 2020 and analyse why this may be the case.
- Additionally, a survey of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Authorities in 28 countries, found differences in the way the Registered Scientific Institute scheme is interpreted and used to facilitate scientific research.

- Our results suggest while the regulatory systems are perceived as hindering research and conservation, regulatory mechanisms enabling responsible research are becoming increasingly functional. We argue that functional and transparent systems are needed for both regulators and researchers, to ensure that non-commercial research can continue smoothly, and present conclusions to support research for the benefit of all countries and partners involved, through appropriate frameworks for implementation and reporting.

KEYWORDS

biodiversity conservation, CBD, CITES, Nagoya Protocol, non-commercial, taxonomy

1 | BACKGROUND

There is an urgent need to halt biodiversity loss (Bongaarts, 2019; Mace et al., 2018). We focus on two key biodiversity conservation conventions: The Convention on Biological Diversity (CBD) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). We examine whether adequate measures are in place to ensure the conventions support and enable the research vital to combatting biodiversity loss.

While Article 15 of the CBD states the authority to determine access to genetic resources rests with the national governments', this article looks at how different countries have reacted to both the CBD and the Nagoya Protocol (NP) promoting simplified measures for non-commercial research purposes. We focus on non-commercial research aimed at understanding the world around us, which is vital to supporting conservation (Beck, 2019). Our examples concentrate on aspects of plant and fungal research including taxonomy, seed biology, ecological interactions, ecosystem services, the effects of climate change, and genomic studies.

1.1 | The Convention on Biological Diversity: establishment, development, and protocols

The CBD (1992, currently 196 Parties) is the overarching United Nations Convention to tackle biodiversity loss, focusing on three objectives: (a) the conservation of biological diversity; (b) the sustainable use of the components of biodiversity; and (c) the fair and equitable sharing of benefits arising from the utilization of genetic resources (GR). The CBD recognizes the sovereign rights of States over their natural resources and their authority to determine access to GR through national legislation (Article 15 (1) CBD) and encourages Parties to develop conditions for facilitated access to GR for environmentally sound uses (Article 15 (2) CBD). A major reason many ratified the Convention (Davis, 2018) was that the CBD mechanism of sharing benefits from GR would act as an incentive for countries to invest in conservation.

However, measures to regulate access to GR (Davis & Borisenko, 2017; Rosendal & Andresen, 2016) have brought criticism that overly complex legislation is hampering scientific research (Alves et al., 2018; Neumann et al., 2018; da Silva & de Oliveira, 2018; Smith, da Silva, Jackson, & Lyal, 2017). Although regulatory access measures are only one of the reasons countries are failing to see expected benefits needed to support national conservation efforts (Dalle, 2015; Vogel, Alvarez-Berrios, Quinones-Vilches, & Medina-Muniz, 2011), they have a major impact. While some countries (like Australia) have included a facilitated access procedure for researchers doing non-commercial research (AUDAWP, 2020)), others have resisted because of concerns over keeping track of how their GR are used. Ethiopia's introduction of a facilitated access procedure (Negarit, 2006; Negarit-Gazeta, 2009) (Box 1) demonstrated their expectation that this system would increase both commercial and non-commercial benefits, but these have not been realized (Dalle, 2015). Parties to the CBD have become increasingly concerned (Neumann et al., 2018; Prathapan, Pethiyagoda, Bawa, Raven, & Rajan, 2018) that complex and time-consuming access procedures are stifling the non-commercial research needed to support the objectives of the Convention, (such as Articles 7 and 8 of the CBD) (Bockmann et al., 2018; Rodrigueza & Antonellib, 2009). Consequently, in the negotiation stage of a new ABS regime (2002–2010), Parties were specifically urged to address these issues (UNEP, 2010).

The CBD's Nagoya Protocol on Access to Genetic Resources and Benefit Sharing (NP), agreed in 2010 and in force since 2014, has provided more clarity on how access legislation should be framed. The NP introduced a legally binding compliance regime to enforce benefit sharing (da Silva, 2019) and encourages Parties to implement "simplified measures on access for non-commercial research purposes" (Article 8a NP). The aim of this was to facilitate biodiversity research that underpins conservation and sustainable use, and takes into account the need to address a change of intent (commercial/non-commercial) for such research (Schindel & Du Plessis, 2014).

Parties to the Protocol are also to "encourage" the development and use of codes of conduct, guidelines and best practices or standards in relation to ABS (NP Article 20 (1)), these can be crucial in building trust in non-commercial research. To ensure compliance with national legislation (NP Article 6(3)(e)), parties should issue a permit, as evidence that access to GR was based on prior informed consent and mutually agreed terms. Parties are required to make information

on the permit available to the ABS Clearing-House (ABSCH) (Article 14 (2)(c)), which constitutes an "Internationally Recognized Certificate of Compliance" (IRCC). The IRCC is a major innovation of the NP and is key to the compliance regime of the ABS system.

1.2 | Convention on International Trade in Endangered Species (CITES)

CITES (1975, currently 183 Parties) establishes regulatory measures for Parties to prevent species decline due to international trade (CITES, 2020). CITES regulates the international trade of over 30,000 plant species, and while the Conference of the Parties agrees that species of fungi are covered by CITES, to-date none have been listed. Permits allowing the trade in CITES listed species can only be issued if CITES Authorities are satisfied that trade will not be detrimental to the survival of the species and the specimens were legally obtained.

To accommodate research, CITES recognized that an exemption from the general permit system was needed to facilitate research in CITES specimens (Article VII, paragraph 6 of CITES) (CITES, 2020), and the establishment of the Registered Scientific Institute (RSI) scheme (Roberts & Solow, 2008). The promotion and implementation of the RSI scheme in each Party is a responsibility of the individual state, and thus, it may be enacted differently. For instance, in criteria and lengths of validity, or in reporting mechanisms to the CITES Authorities. Despite the exemption, many scientists have expressed that permits can be costly and time consuming to obtain. A long-standing concern has been that the RSI scheme does not work, ultimately impeding the free movement of specimens for scientific purposes (Raven, 2007; Roberts, 2005; Zelenko, 2005).

Below we explore the extent to which these mechanisms (ABS for CBD, and RSI for CITES) have been effective in supporting biodiversity research (Pauchard, 2018), examining claims that international policy frameworks have had a detrimental effect (Wynberg & Laird, 2018).

2 | METHODS

We focused on 20 countries where analyses of ABS legislation data were available (Sirakaya, 2019). They were selected based on biodiversity richness, signatory status to the NP, age of ABS framework, economic status and we also aimed to include at least one country per continent. We examined trends from the ABSCH website of the CBD, (https://absch.cbd.int/reports) to analyse access, looking at whether countries had introduced favourable measures on access for non-commercial research purposes (Figure 1) and whether this had any impact on levels of the collection of plant and fungal material. By the term "favourable" here, we mean any measure (such as quicker time-frames, simpler systems, shorter application forms, less onerous procedures) that makes access quicker or easier for non-commercial researchers. For instance, a country switching from an in-country paper-based system to an electronic system accepting global applications. This phrase includes both measures put in place following the CBD's call for Parties to "create conditions to facilitate access to genetic resources for environmentally sound uses" and later measures in response to the NP to introduce "simplified measures on access for non-commercial research purposes".

Secondly, beyond our focus countries, we gathered the total number of IRCCs that have been issued by Parties (as at February 2020) as an indication of research carried out since the NP came into force (October 2014). All data were downloaded (Figure 2)

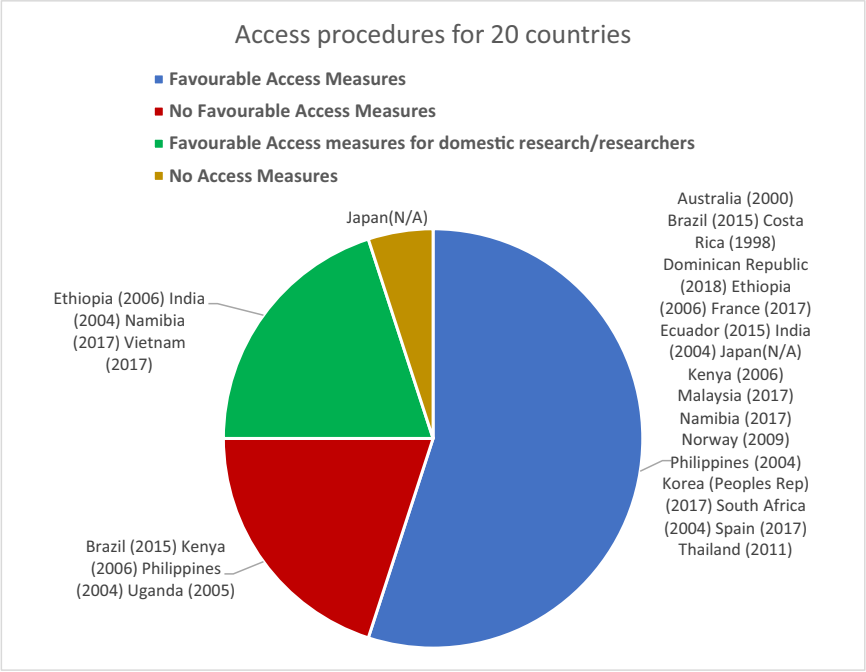

FIGURE 1 Differences in access procedures among the countries surveyed. The term "favorable" here means any measure (such as quicker time-frames, simpler systems, shorter application forms, less onerous procedures) that makes access quicker or easier for non-commercial researchers. Due to the select sampling of countries there may be an undue bias depicted in the diagram

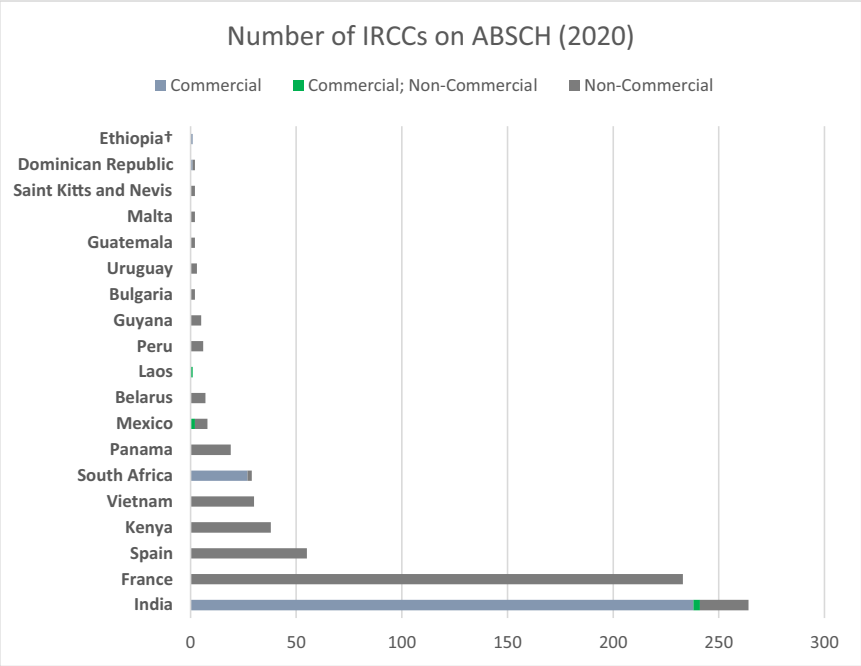

FIGURE 2 Total number of Internationally Recognized Certificates of Compliance (IRCCs) and type for each focal country. †: According to the Ethiopian Biodiversity Institute (EBI), 895 IRCCs have been granted for users to access GR of the country for both commercial and non-commercial research (13 and 882 respectively). Due to technical difficulties, these have not yet been uploaded to the Access and Benefit Sharing Clearing House (ABSCH)

and a full analysis of all IRCCs (2014 to 2019) of two chosen countries, Kenya and Vietnam, was carried out as an exemplar study to highlight non-commercial research. Individual case studies were obtained from experts in the following countries: Ethiopia (Box 1), Brazil (Box 2) and South Africa (Box 3).

The CITES website was consulted (cites.org) to identify the RSIs available in each country. A questionnaire was emailed to the CITES Management and Scientific Authorities of the applicable 20 study countries (Sirakaya, 2019) and the European Member States, of which the United Kingdom (UK) was a part at the time of writing (Table 1). The consultation was carried out in early January 2020, for 4 weeks, and contained 10 open questions. Participants were asked to provide additional information on the use of the RSI scheme and annual reports if available (and applicable as a national requirement). Only completed reports, covering the five years from 2014 to 2019, were analysed.

3 | RESULTS

3.1 | Favorable access procedures

Australia was one of the first to introduce a simpler permitting system for non-commercial research, using a standard form to minimize transaction costs in 2000. In 1998, Costa Rica introduced access legislation to encourage research, with an online system and standard permit forms (Figure 1). Ethiopia adopted domestic legislation facilitating access for non-commercial purposes before the adoption of the NP (Box 1).

Since 2014, several more countries have introduced "simplified" measures for non-commercial research. France, Spain, Malaysia, and the Republic of Korea all introduced legislation in 2017, and the Dominican Republic in 2018 (Figure 1). Under its original access legislation, Brazil (Provisional Act n° 2.186-16/2001;), did not require authorization for fundamental research (da Silva & de Oliveira, 2018), however, the 2015 Biodiversity Law, now requires all research to be registered electronically (SisGen). Operational since November 2017, this has attracted some criticism from Brazilian scientists (Box 2). Several countries, including Namibia, Malaysia, and Vietnam (Figure 1), introduced simplified access procedures for non-commercial research, but only for research taking place in-country, for national researchers, or researchers based at national institutions. Restricting simplified access procedures in this way suggests that countries remain concerned about how they can track the use of GR once these resources have been exported.

There is evidence that, despite some simplified measures, legal obstacles still exist for non-commercial research scientists (Bockmann et al., 2018). The demarcation between commercial and non-commercial research is unclear, guidance is needed to enable countries to enact adequate measures, ensuring changes of use or intent are tracked and benefits are shared (Pauchard, 2018). Legal certainty and effective user country compliance procedures are all vital (Beck, 2019; Wynberg & Laird, 2018), while limited capacity, lack of legal enforcement and follow-up mechanisms for ABS procedures have also been identified as critical gaps obstructing proper implementation (Dalle, 2015).

3.2 | Internationally Recognized Certificates of Compliance (IRCC)

As of 1st February 2020, the ABSCH website had registered more than double the total number of IRCCs registered six months

BOX 1 Case study: Ethiopia

The Ethiopian government enacted ABS Proclamation No. 482/2006 and its Regulation in 2009. The Proclamation relates to in situ and ex situ GR and associated traditional knowledge. It sets out a clear system with differentiated requirements for commercial and non-commercial research.

Applications for non-commercial research must be in accordance with the form specified in Annex II of the Regulation (Negarit-Gazeta, 2009) and do not need detailed information on finance, the use of GR or its derivatives. Furthermore, there is no commercial benefit sharing arrangement, although non-monetary benefits are expected (i.e. co-authored publications and data sharing). The researcher retains the material for the research period only and must return unused material to the provider on completion of the research. Access permits for non-commercial research are issued in under an hour and are free.

According to the legislation, any foreign user of GR for non-commercial use needs to additionally obtain an export permit, which is an official document authorizing export of the GR from Ethiopia. A Material Transfer Agreement (MTA) is then made between the host organization, the researcher and the Provider (Ethiopian Biodiversity Institute). Under the Ethiopian legislation foreign researchers need to submit an official letter from their National Competent Authority (NCA), assuring they will "uphold and enforce" the Ethiopian access legislation. Due to divergent interpretations of the role of NCAs under the NP, user country NCAs have found this impossible to comply with and this has practically halted the export of material from Ethiopia for research.

BOX 2 Case study: Brazil

In Brazil, not a Party to the NP, current ABS legislation regulates access to genetic heritage (GH) and associated traditional knowledge for research, technological development, and economic use of products. The wider term "genetic heritage" here means information as well as physical material (da Silva, 2019). Benefit sharing is only required when there has been commercial use. The previous "authorization" required by previous legislation (Provisional Act nº 2,186-16/2001), has been replaced by the need to register *all* research in the online National System for Genetic Heritage and Associated Traditional Knowledge Management (SisGen), which can be done during the research and technological development with GH. Foreign researchers must be associated with public or private Brazilian scientific and technological research institutions in order to register research involving Brazilian GH.

The current Brazilian ABS legislation has been argued to add complexity for non-commercial researchers (Alves et al., 2018) and in particular for the depositing of bacteria in international culture collections meaning that bacterial taxonomists have been unable to publish the description of new bacterial species (Pers. comm M da Silva). According to the International Code of Nomenclature of Prokaryotes, for acceptance of a new bacteria species, a culture of the type strain should be deposited in two different countries' publicly accessible culture collections, where unrestricted subcultures must be available. Brazilian research organizations are working with the Environmental Ministry within the Sectoral Chamber of the Academy of the Genetic Heritage Management Council (CGEN) to address these issues (da Silva, 2019).

earlier (1,192 in Figure 2) (Aviles-Polanco, Jefferson, Almendarez-Hernandez, & Beltran-Morales, 2019). This is possibly due to more focus on the NP within the CBD Global Biodiversity Framework in 2020. Eight of our 20 focal countries had uploaded IRCCs (Figure 2), representing 95% of the total. Three IRCCs were issued for non-commercial purposes with potential commercialization, 59% for non-commercial and the remaining 41% were for commercial purposes (Figure 1). These figures represent only 4% of the Parties who have signed up to the NP. As India had not identified the uses of their IRCCs, these were excluded, and the following results refer to the remaining 652 IRCCs. Less than a third of the Kenyan non-commercial IRCCs issued were for research related to plants or fungi (Figure 3). Similarly, just under half of the IRCCs in Vietnam were for research related to plants (Figure 3).

We assessed the source and users of GR, in Kenya, 92% of all non-commercial research permits were issued by Government agencies (n = 12) and one issued by an academic institute (n = 1). Vietnamese permits for plant and fungi GR were issued by academic or research institutions (n = 12), for material obtained from in situ sources, with only one permit, issued by a museum, for ex situ sourced material.

Half of the 12 permit holders for plant and fungi research in Kenya were based in-country. Foreign users accessing plant and fungi GR in Kenya were from USA (n = 3) and China (n = 1). The users of the remaining two IRCC permits for plant and fungi research in Kenya were confidential (n = 2). In contrast, 13 users accessing plant and fungi GR in Vietnam were foreign, representing five countries: South Korea (n = 9), China, Belgium, Germany, and Ireland (n = 1 each). These relatively small numbers probably reflect that countries have only recently engaged with the IRCC process.

BOX 3 Case study: South Africa

South Africa has an access permitting system that is similar for both commercial and non-commercial research (Pauchard, 2018). The conservation authority, South African National Parks (SANParks) developed its research permit application system for both domestic and foreign scientists within the provision of the National Environment Management Act for Protected Areas (NEMPAA). Guidance documents and templates are available online for the scientific community's use. SANParks Scientific Services review applications for their relevance and contribution to management objectives and approve or reject on a quarterly basis. Mostly applications are amended, and the research is permitted. The main inconvenience to SANParks in the processing of permits arises from hasty or last-minute submissions, often lacking information critical for proper review. Consequently, undue pressure is placed on SANParks staff by applicants, who have not planned for aspects of legislation compliance. Overall, the research application framework for permission to conduct research in SANParks works well despite some late or inadequate submissions. The Cape Research Centre (Fynbos and Succulent Karoo Biomes) received 391 applications from 2011–2019 and of these only nine were rejected, a 98% approval rate over eight years. None of these permits has been uploaded to the ABSCH, as non-commercial research is exempted from the ABS regime in South Africa (Pauchard, 2018).

3.3 | Registered scientific institutions (RSIs)

To date, 74 Parties of CITES have registered their scientific institutions with the CITES Secretariat, with a total of 857 scientific institutions being listed in the past five years (2014–2019). Australia, Austria, Denmark, Italy, Germany, Spain, and the UK have all registered new scientific institutions, from one RSI registered in Denmark to 17 in Australia (Figure 4).

Many respondents provided confirmation of RSI successes and challenges:

- Six countries encourage scientific institutions and scientists to register with the scheme;
- Spain has a streamlined application procedure for scientific exchange of materials;
- Germany has detailed information and guidance about their RSI scheme on the Scientific Authority homepage, and actively advises scientists;
- Austria, Australia, Denmark, and the UK contact scientific institutions about the RSI scheme, and deal with ad-hoc registration requests;
- Ethiopia, the Philippines, and Italy stated that the promotion of RSI scheme is inadequate;
- Croatia, Ethiopia, Italy, Germany, Greece, Philippines, and Denmark have not encountered difficulties in implementation;
- Austria and Croatia criticized the scheme as it does not encourage new research on CITES taxa;
- Norway, UK, Spain, and Denmark received between 5% and 10% of the total number of expected annual reports;
- The UK noted most institutions do not use the scheme regularly, and some failed to record both incoming and outgoing exchanges;
- Eleven consulted Parties did not have recent reports to share or were otherwise not able to share these. The UK shared annual reports for the five years ranging 2014 to 2019 from the Royal Botanic Gardens, Kew (Figure 5).

Parties consulted noted the registration of institutions involved in non-commercial research is necessary, but had difficulties using the scheme or interpreting its language i.e. the scheme could not be used where CITES was not implemented in both countries involved in the process of exchange. Respondents noted the definition of an eligible "'specimen" for the simplified procedure is unclear to the RSIs involved, and widespread misunderstanding of conditions of use exist. Some parties felt the registration and inventory process for scientific collections of an institution involves more effort and time, compared to applying for a one-time CITES permit.

TABLE 1 List of the CITES Parties consulted, 12 Parties responded with full completed questionnaires

CITES Parties of the European Union with at least one Registered Scientific Institution	CITES Parties (identified by Sirakaya, 2019) with at least one Registered Scientific Institution
Austria	Australia
Croatia	Ethiopia
Denmark	Norway
Germany	Philippines
Greece	
Italy	
Spain	
United Kingdom	

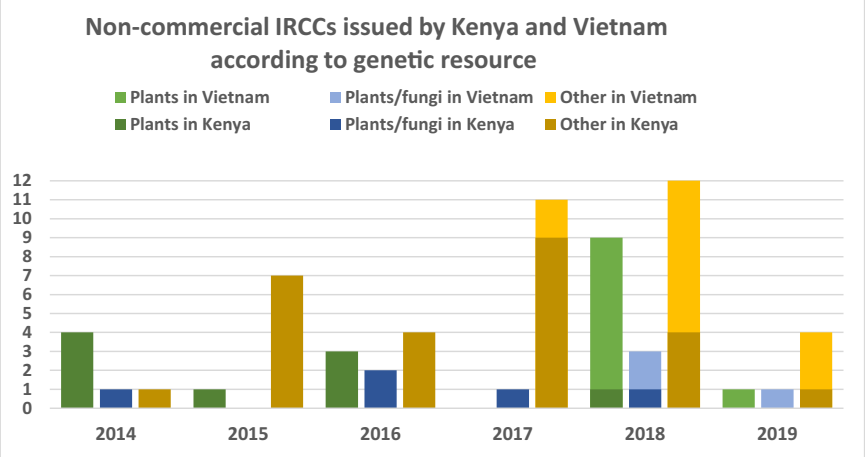

FIGURE 3 Non-Commercial Internationally Recognized Certificates of Compliance (IRCCs) issued by Kenya and Vietnam according to type of genetic resource

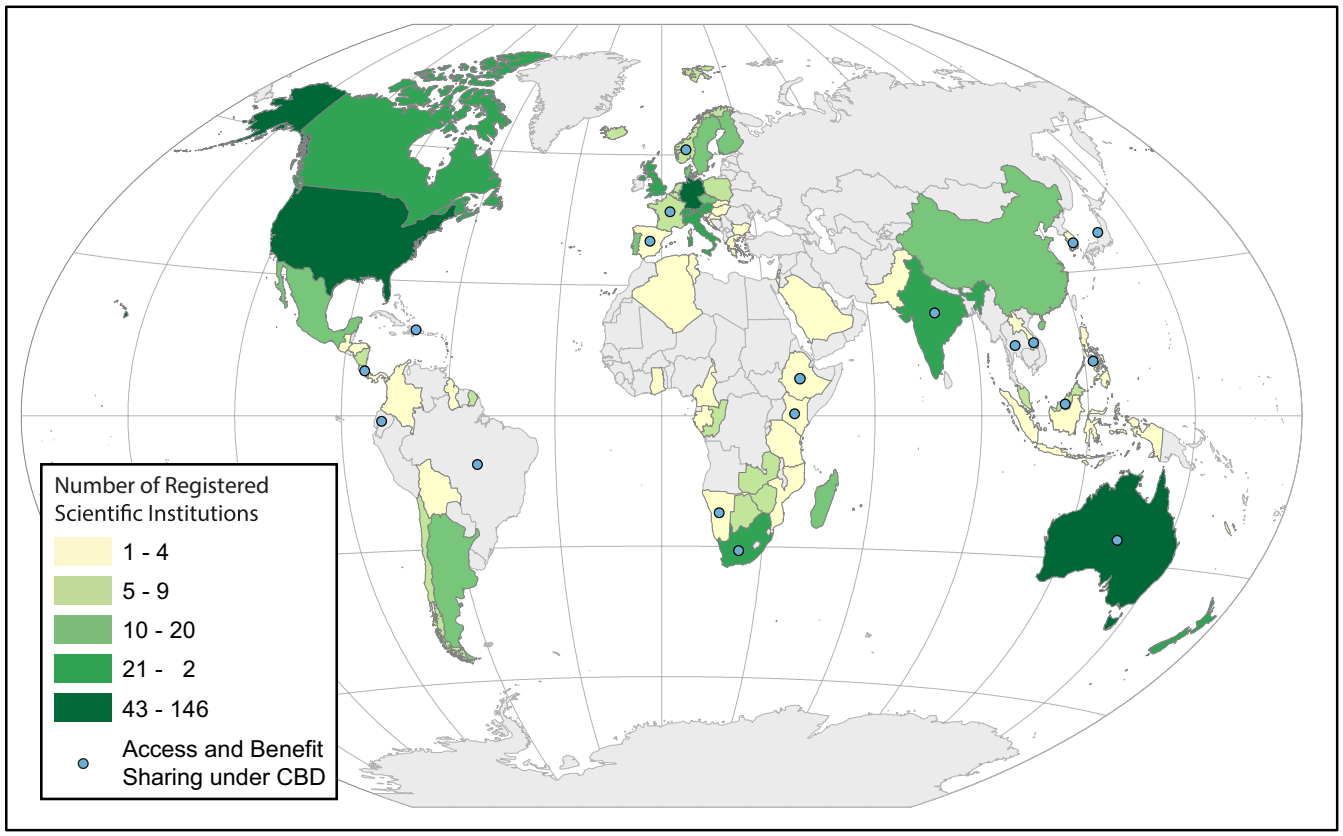

FIGURE 4 Map showing countries with ABS under the CBD and those with CITES RSIs

4 | DISCUSSION

Access to GR for research and conservation to halt the global loss of biodiversity is urgently required. Despite over 250 years of botanical and taxonomic research, less than 20% of terrestrial species diversity have been catalogued (Thomson et al., 2018). To accelerate biodiversity research and conservation, strong international research partnerships are required, supported by clear national legislation covering access and compliance to facilitate research and ensure benefit sharing.

Fears of illegal acquisition of GR have led to restrictive measures and distrust of research institutions (Reichman, 2019). Restrictions on access to work with species in situ and ex situ create barriers to important international collaborative research. The CBD, in Article 15 (6) states that scientific research should be carried out with the "full participation of and where possible in" provider countries. Efforts should be made to support this and otherwise, research should lead to non-monetary benefit sharing, such as the training of taxonomists in situ (Jojan, Dsouza, Mukerjee, Rao, & Shanker, 2018). Providers in biodiverse countries have limited capacity for tracking

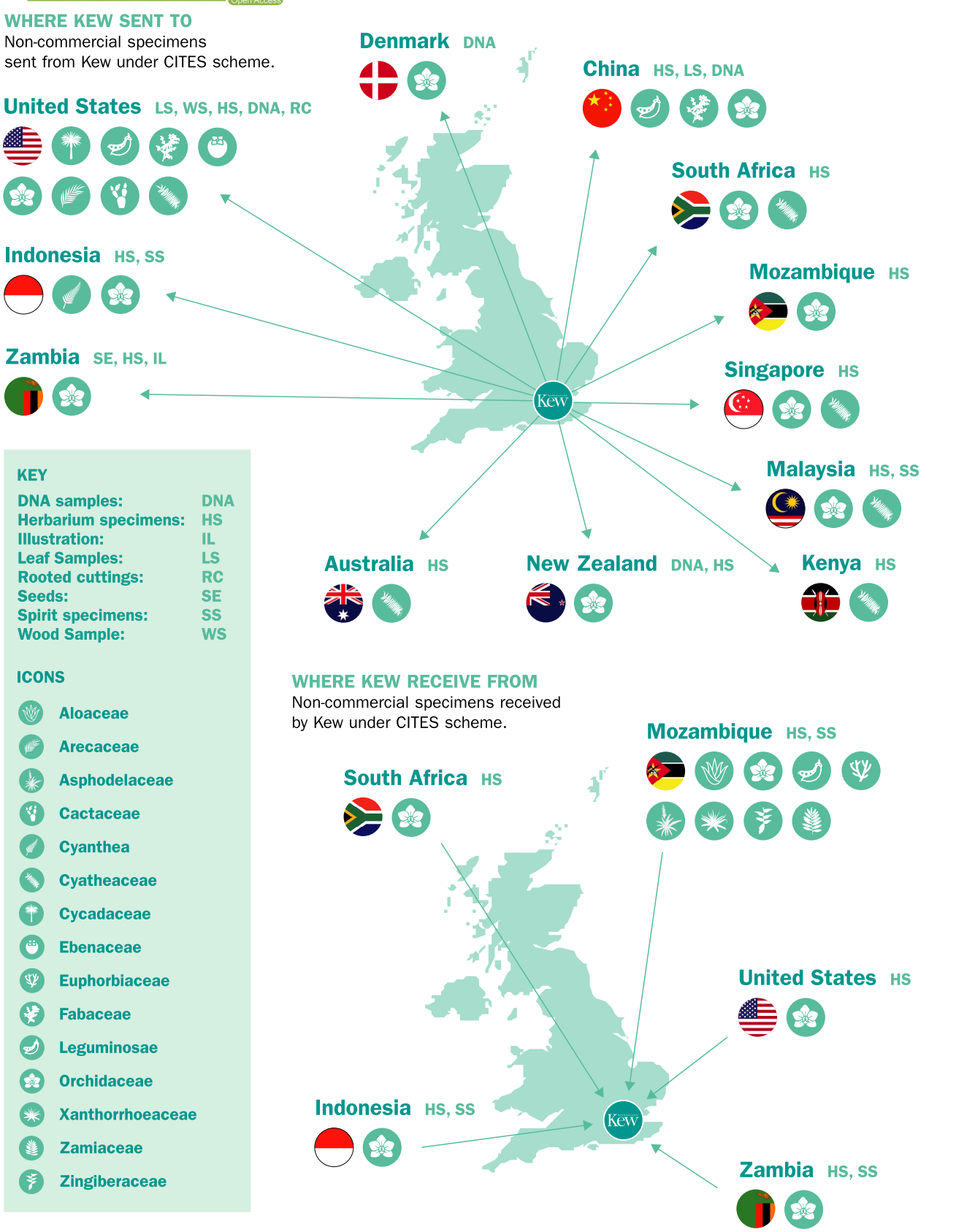

FIGURE 5 Movement of CITES plant specimens for RSI Royal Botanic Gardens Kew in the UK. Between 2014 and 2019, Kew Gardens donated, exchanged, or loaned 725 non-commercial CITES scientific specimens with several RSIs around the globe: herbarium specimens, seeds, DNA samples, leaf samples, wood samples, spirit specimens, illustrations, and rooted cutting of specimens. During the same period, Kew Gardens received 253 herbarium and spirit of CITES scientific specimens

and enforcing agreed terms and conditions of national ABS procedures meaning user country compliance measures are vital to build trust and ensure that benefits are shared and actions are taken if not. Simultaneously, the non-commercial research sector needs to continue to work hard to develop and use best practices and sectoral codes of conduct (Davis, 2018) ensuring that they can navigate the developing national legislations, ABS agreements are in place and prior informed consent obtained (Kariyawasam & Tsai, 2018; Wynberg, 2017). Effective implementation of compliance measures, legal transparency, and certainty will be critical to deliver the CBD objectives.

IRCCs provide a vital means to track the use of GR, supporting compliance, and identifying any change of use. Our research shows that the use of the ABSCH IRCC has doubled between August 2019 and February 2020. However, as of 1 February 2020, only 19 of 123 Parties to the NP have uploaded IRCCs, and so the research covered is only a tiny fraction of what is carried out and required. We acknowledge the increase in IRCCs detected does not necessarily mean more research is taking place, but a reflection that Parties are engaging with the IRCC process. However, we predict the ABSCH will become an important source of information and must adapt accordingly. Currently the platform is not easily searchable. As data increases with more uploads, we suggest modifications to ensure it is a useable tool, a view supported in recent discussions of the Informal Advisory Committee to the ABS Clearing-House (CBD, 2020). IRCCs provide evidence of research types being conducted with clear agreements, and this article is the first to quantitatively analyse them for plant and fungal research.

We found that there is potential for simplified access procedures to have an increasing benefit for non-commercial research. We note the proportions of commercial and non-commercial permits vary greatly between countries, with India and South Africa (Box 3) uploading much smaller proportions of permits for non-commercial research. Reflecting the variety of ABS legislation implemented at a national level and different approaches to what constitutes access (Laird et al., 2020), it appears that certain national legislation is already providing easier access procedures for non-commercial research. In many cases, non-commercial research will not activate a country's access procedures. This occurs in South Africa (Box 3), where a smaller proportion of non-commercial research permits have been uploaded as certain non-commercial research does not meet access requirements. However, in Ethiopia, where national access legislation covers non-commercial research a higher proportion have been uploaded. It may be countries do not upload their non-commercial research permits due to lack of capacity or technological difficulties, or especially if they are too numerous. More investment is needed, both in terms of infrastructure and training, to ensure that all countries have the capacity to use and upload IRCCs to the ABSCH. Examples of such infrastructure include improved connectivity to the internet and computer equipment, as well as trained technicians to capture data, but also training in the development of in-country systems.

Our analyses of IRCCs from Kenya and Vietnam show that only a small proportion of benefit sharing is related to plants and fungi, despite their critical links to livelihoods (Dhanda, Williams, & Cowell, 2019) and their potential to address sustainable development goals (Antonelli, Smith, & Simmonds, 2020). Further analysis of IRCCs from more countries will provide a better representation of the data and could aid in determining the impacts on conservation critical research.

Ultimately, whilst aimed at correcting centuries of inequitable use of biological resources (Wynberg & Laird, 2018), current ABS policy processes are seen as inflexible (Pisupati & Bavikatte, 2014; Prathapan et al., 2018). There is no clear way to differentiate the point at which non-commercial research becomes commercial (Neumann et al., 2018), and this has made it hard for provider countries to create workable national legislation. Consequently, there have been calls for the current ABS system, based on physical access to material and the bilateral contract model, to be reappraised (Laird et al., 2020).

We had mixed findings on the CITES RSI scheme as an example of a process designed to expedite and facilitate non-commercial research. Although a list of RSIs is available on the CITES website, it is only updated every five years as the validity of the registration within each country is different. There is currently no formal reporting mechanism to the CITES Secretariat to check if RSIs are compliant, yet some Parties conduct audits and review reports. The data from the UK's annual report proved useful in identifying and confirming research collaborations (Dhanda et al., 2019) (Figure 5). Many respondents answered favorably about the scheme as it eases access to collections, improves exchange times, and reduces administrative burdens. However, the scheme also appears to be a significant hurdle for scientific institutions by only providing exemption to specimens already part of a collection when an institute registers and not to specimens added after registration, thus restricting future research.

A standard set framework such as CITES has for RSIs could lead to the creation of a central database of registered institutions. Such a system would require users to adopt agreed best practices governing collection, curation, and collaboration, to ensure measures are in place to track (and secure approval for) changes of use. There is scope within the NP (Article 20) for Parties to "consider the adoption" of best practice standards and codes of conduct which could be the basis for research institutes to register and adhere to.

5 | CONCLUSIONS

We have shown that the use of IRCCs is key in the compliance regime of the NP and encourage measures to increase the capacity of Parties to use the ABSCH platform, uploading information and IRCCs. Once more IRCCs are available, we recommend further analysis of the data, to ascertain patterns in commercial and non-commercial research. To support this, the platform can be modified for more functionality to work as a searchable tool. We also hope

that Parties are encouraged to re-evaluate the benefits of the CITES RSI scheme, promoting it adequately with scientists and researchers who use scientific specimens for research purposes. We would support the creation of a standard and simplified registration template, addressing compliance measures, such as reporting and new specimen additions to existing collections.

While we hope this article will encourage providers of GR to implement simplified access measures for non-commercial research to support the vital conservation work that is needed, we recognize that to support compliance, researchers need to provide information to aid Parties in differentiating between commercial and non-commercial research. We urge researchers to follow the many established codes of conduct, guidelines, and best practices to build trust and develop strong international partnerships.

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AUTHOR CONTRIBUTIONS

C.W., C.C., and A.W. conceived the ideas, C.W., C.C., V.V., and A.W. designed the methodology; C.W., A.W., and V.V. collected the data; V.V., C.W., and A.W. collated and analysed the data; C.C. led the writing of the manuscript. M.S. (Box 2), G.D. (Box 1), D.W. (Box 3), and W.A. (Box 3) wrote case studies, A.A., P.S., P.K., and A.S. contributed references and text, and M.W. provided synthesis and comments on the manuscript. All authors contributed critically to the drafts and gave final approval for publication.

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