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REVIEW

National level use of International Union for Conservation of Nature knowledge products in American National Biodiversity Strategies and Action Plans and National Reports to the Convention on Biological Diversity

Shelby D. McCay[1,2] | **Thomas E. Lacher Jr**[2]

[1]Texas A&M Natural Resources Institute, Texas A&M University, College Station, Texas

[2]Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, Texas

Correspondence
Shelby D. McCay, 1919 Oakwell Farms Parkway, Suite 100, San Antonio, TX 78218, USA.
Email: shelby.mccay@ag.tamu.edu

Abstract

The Convention on Biological Diversity (CBD) currently serves as the multilateral environmental framework for protecting biodiversity. Parties to the CBD are required to develop and submit National Biodiversity Strategies and Action Plans (NBSAPs) and National Reports. These documents serve as the instruments used by governments and stakeholders to identify their priorities, implement, and track progress to the CBD. The International Union for Conservation of Nature (IUCN) has produced biodiversity and conservation knowledge products that are fundamental for tracking the progress of targets such as the Aichi Biodiversity Targets. We examined if countries in the Americas are using knowledge products based on IUCN standards to help construct their documents; 234 documents were analyzed for knowledge product keywords. The IUCN Red List of Threatened Species was mentioned in 91.8% of keyword-coded segments. IUCN publications, Protected Areas Categories, Key Biodiversity Areas, the Red List of Ecosystems and World Database on Protected Areas had 8.2% of the remaining segments. Further studies should investigate awareness of knowledge products among national focal points for the CBD to determine their limited use in document development. IUCN knowledge products should continue to form an integral part of future indicators during this critical moment for biodiversity conservation.

KEYWORDS

biodiversity, conservation, convention on biological diversity, key biodiversity areas, knowledge products, National Reports, NBSAPs, policy, protected areas, Red List

1 | INTRODUCTION

Biodiversity loss continues to be an increasing concern to conservationists, governments, society, and policymakers. The planet is currently experiencing the sixth mass extinction of species (Pimm et al., 2014), biological annihilation of vertebrate populations globally (Ceballos, Ehrlich, & Dirzo, 2017) and ongoing global declines in

biodiversity (McCauley et al., 2015; Newbold et al., 2015; WWF, 2018). People care about species extinctions for intrinsic reasons, but there is increasing evidence suggesting that biodiversity loss will have major impacts for ecosystem functions and services and ultimately for human wellbeing (Millennium Ecosystem Assessment, 2005; Secretariat of the Convention on Biological Diversity, 2014) and both are continuing to deteriorate worldwide (Díaz, Settele, Brondízio, et al., 2019). Many indicators are showing that the rate of loss does not appear to be significantly slowing (Butchart et al., 2010; Tittensor et al., 2014) and half of the important sites for biodiversity conservation are currently unprotected (Butchart et al., 2012).

In response to the growing biodiversity crisis, the United Nations (UN) held the Conference on Environment and Development (UNCED), also known as the Earth Summit, from June 3–14, 1992 in Rio de Janeiro, Brazil. The purpose of the conference was to create a platform for UN Member States and a variety of non-governmental representatives to collaborate on finding solutions to the increasing development and sustainability issues throughout the world (UN, 1997). The three "Rio Conventions"—the Convention on Biological Diversity (CBD), the United Nations Framework Convention on Climate Change (UNFCCC) and the United Nations Convention to Combat Desertification (UNCCD)—were important products of this international effort. The CBD was opened for signature on June 5, 1992 at the Earth Summit and remained open until June 4, 1993 (CBD[c], n.d.). It was quickly endorsed by the international community with 168 countries (85% of the global community) becoming signatories and it entered into force on December 29, 1993, which was 90 days after the 30th ratification (CBD[c], n.d.). The CBD currently serves as the key multilateral environmental agreement to provide a framework for protecting global biodiversity and to date a total of 196 countries have signed the CBD and are considered Parties (CBD[f], n.d.), with the United States of America (U.S.) having signed but not ratified and the Holy See (Vatican City) having not signed the CBD. Therefore, both are considered non-Parties.

Two supplementary agreements have been added to the CBD since its creation: the Cartagena Protocol on Biosafety (adopted in 2000) and the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (adopted in 2014). The Cartagena Protocol regulates the movements of living modified organisms (LMOs) resulting from current biotechnology between countries (CBD, 2012). The Nagoya Protocol serves as a transparent legal framework for the implementation of the fair and equitable sharing of benefits originating from the use of genetic resources, including traditional knowledge (TK) associated with these resources (Secretariat of the CBD, 2011). In 2010, at the tenth Conference of the Parties (COP), the world's governments adopted the 2020 Strategic Plan for Biodiversity and its associated 20 Aichi Targets (COP, 2010). This Strategic Plan and the 20 Targets represent their commitment to biodiversity conservation and sustainability.

Article 6(a) of the CBD requires its 196 Parties to the convention to develop and submit a National Biodiversity Strategy and Action Plan (NBSAP), or equivalent instrument, to the CBD Secretariat to illustrate how the country plans to conserve biodiversity within its boundaries (CBD, 1992). NBSAPs serve as the principal instruments used by governments and stakeholders to identify priorities and implement the CBD at the national level (CBD [d], n.d.). There is no set schedule for NBSAP production, though many countries have regularly revised and updated their NBSAPs to create new versions of the document (Clabots & Gilligan, 2017). Multiple Parties have submitted a single NBSAP to the Convention and therefore have one version of the document. NBSAPs are generally prepared through stakeholder processes involving environmental ministries, civil society organizations, indigenous groups, local communities, non-governmental organizations (NGOs), intergovernmental organizations (IGOs) and scientists (Clabots & Gilligan, 2017; NBSAP Forum, 2018). Aichi Biodiversity Target 17 set 2015 as the date for Parties to have developed, adopted as a policy instrument and started implementation of their updated NBSAP (CBD, 2010). As of August 2020, 191 of 196 (97%) Parties have met the target of submitting NBSAPs (CBD [d], n.d.).

At its second meeting, the COP decided the first National Reports to the CBD should "focus in so far as possible on the measures taken for the implementation of Article 6 of the Convention, as well as the information available in national country studies on biological diversity" (COP,1995). Parties are obliged to submit a National Report to the CBD Secretariat on a four-yearly basis and are considered at alternate meetings of the COP (CBD [e], n.d.). These documents outline the measures the country has taken to implement their NBSAP and overall objectives of the CBD and how successful these efforts have been for biodiversity conservation (CBD[e], n.d.). They are critical for monitoring the implementation success of the current NBSAP and providing a foundation for preparing future NBSAPs.

Biodiversity conservation and management in developing countries has been a priority for the CBD since it was first adopted, but expenditures on biodiversity conservation in these countries account for less than half of the global total spent (Parker, Cranford, Oakes, &

Leggett, 2012). Countries of the Americas, including the Caribbean, hold a large proportion of the planet's biodiversity, with 7 out of 17 considered to be "megadiverse" (Mittermeier, Robles Gil, & Mittermeier, 2005) and holding nine designated biodiversity hotspots (CEPF, n.d.; Myers, Mittermeier, Mittermeier, Fonseca, & Kent, 2000). In addition, many American countries, particularly in Central and South America, are suffering some of the most dramatic declines in species populations and biodiversity (WWF, 2018). The majority of CBD implementation studies have been conducted in European countries (Marino, Marucci, Palmieri, & Gaglioppa, 2015; Meyerhoff, Angeli, & Hartje, 2012; Popescu, 2014; Sarkki et al., 2016; Wolff, Gondran, & Brodhag, 2018), or at a global scale (Henders, Ostwald, Verendel, & Ibisch, 2018; Prip, 2018) and the few focused on American countries are not recent enough to include additions such as the Nagoya Protocol, or updated goals of the CBD, in particular the 2020 Strategic Plan and Goals (Aguilar-Stoen & Dhillion, 2003; Febles, 2009). For these reasons, the scope of this study was limited to American countries and European held territories in the Americas.

2 | KNOWLEDGE PRODUCTS BASED ON IUCN STANDARDS

Since its founding in 1948, the International Union for Conservation of Nature (IUCN) has grown into the world's largest and most diverse environmental network, consisting of 1,300-member organizations and 10,000 experts from both government and civil society organizations (IUCN, n.d.). It is considered the global authority on the natural world with six commissions dedicated to broad conservation areas (species survival, environmental law, protected areas, economic and social policy, ecosystem management, and communication and education) (IUCN, n.d.). Over the past 50 years, the IUCN Commissions, Secretariat, members and partners (such as the United Nations Environmental Programme's World Conservation Monitoring Center [UNEP-WCMC]) have been producing biodiversity and conservation knowledge products that are fundamental for tracking the progress of the 2010 targets for reducing biodiversity loss (Mace & Baillie, 2007) (Figure 1). The United Nations Development Programme (UNDP) defines a good knowledge product as "relevant; based on an assessment of demand, audience needs, and unbiased evaluation; timely; clearly and consistently written and presented; developed through participatory processes; and easily accessible" (UNDP, 2009). These knowledge products have also been essential in tracking the Millennium Development Goals (Sachs et al., 2009), 10 out 20 of the Aichi Targets and

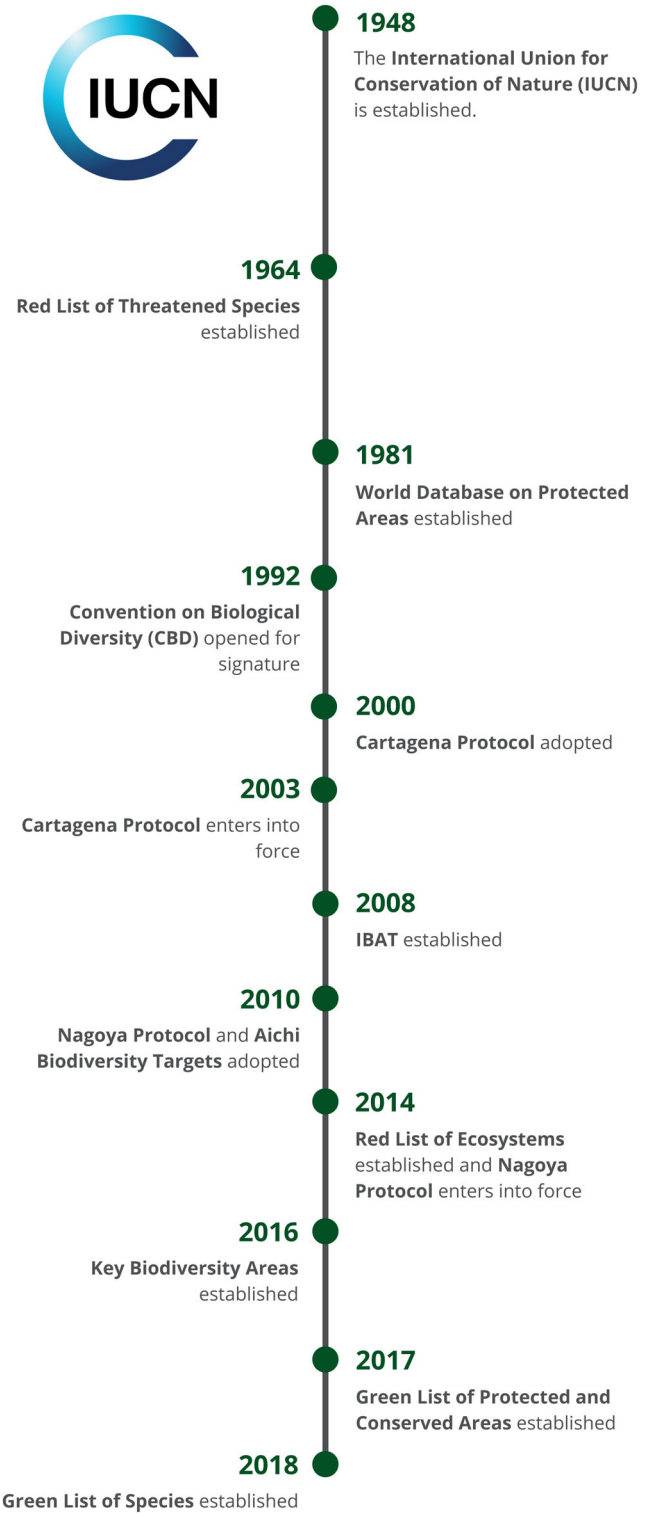

FIGURE 1 Timeline of IUCN knowledge product establishment and CBD milestones. CBD, Convention on Biological Diversity; IUCN, International Union for Conservation of Nature

7 out of the 17 UN Sustainable Development Goals (Brooks et al., 2015). They are also heavily used in determining disbursement of financial resources to developing

countries for conservation projects through the Global Environment Facility (Lacher Jr., Boitani, & de Fonseca, 2012) and have the potential to be used in NBSAP development and National Reports to the CBD. The IUCN is particularly well suited for helping to maintain these knowledge products as it has legitimacy with governments, civil society, and the scientific community (Brooks et al., 2015). These knowledge products help bridge the gap of translating research data into conservation action by placing the data into a useful format for informing biodiversity conservation related decisions (Lacher Jr. et al., 2012). All of the standards for each knowledge product have been approved by the IUCN's governing bodies and so have an enduring basis, allowing for consistent and comparable monitoring and reporting over time. Each has their own institutional arrangement, rules, procedures, specific data sets, standards, governance, tools, quality control, capacity building and process for deriving biodiversity related indicators and are underpinned by varying multi-institutional governance processes, which is appropriate given their very different subject matter focus.

2.1 | IUCN Red List of threatened species

The IUCN Red List of Threatened Species (Red List) is the oldest of the IUCN knowledge products, established in 1964, and is the world's most comprehensive source of information for the global conservation status of animal, fungi, and plant species (Hoffmann et al., 2008; IUCN, 2012a)). Its overarching goal is to provide sound information on the status, trends and threats to species to educate, inform and catalyze biodiversity conservation actions (IUCN, 2012a); Smart, Hilton-Talor, & Mittermeier, 2014), to serve as a "barometer of life" across species and ecosystems (Stuart, Wilson, McNeely, Mittermeier, & Rodríguez, 2010) and to assist in conservation planning efforts (Hoffmann et al., 2008; Rodrigues, Pilgrim, Lamoreux, Hoffmann, & Brooks, 2006). The IUCN Council adopted the latest standard (Version 3.1) for this product in 2001 and all subsequent assessments since January 2001 have used this latest adopted version of the Categories and Criteria (IUCN, 2012c). The Red List is tasked with objectively assessing and documenting the extinction risk of species and as of July 2020, more than 32,000 globally assessed species are threatened with extinction (IUCN, 2020). The Red List provides a snapshot of the current status of assessed species, but it should not be seen as a complete assessment of the planet's biodiversity as extinction risk assessments have only been completed for approximately 5% of described species (IUCN, 2020). The current assessment process has developed over the past 40 years (Appendix S1).

The Red List Index (RLI) shows trends in the status of species groups based on genuine improvements or declines in their extinction risk to qualify them for listing in more threatened or less threatened Red List Categories (IUCN, 2020). The methodology was first applied to birds (Butchart et al., 2004) and has since been revised (Butchart et al., 2007) and applied to other groups (Butchart et al., 2005; Butchart et al., 2010; Hoffmann et al., 2010). As of January, 2019, an RLI has been calculated for birds, mammals, amphibians, corals and cycads and all display an overall heightened extinction risk over time (IUCN 2019). The RLI was used to report against the CBD, 2010 target and has been adopted as an indicator for measuring global progress towards many of the Aichi Biodiversity Targets (IUCN, 2012a; Vié, Hilton-Taylor, & Stuart, 2009). The RLI can be disaggregated by geographic regions to allow for reporting at regional and national levels (Han et al., 2017; Rodrigues et al., 2014) and guidelines are available for calculating the index at the national and regional level (Bubb et al., 2009). In addition, a sampled Red List Index was developed by Baillie et al. (2008) for under assessed taxonomic groups, such as invertebrates (Collen et al., 2012). This method has been tested on birds (Baillie et al., 2008), plants (Brummitt et al., 2015), reptiles (Böhm et al., 2013) and since revisited by Henriques et al. (2020).

National red lists are generally led and produced by national-level intuitions and are considered a major indicator to monitor progress toward biodiversity targets (Zamin et al., 2010). Available national red lists are housed on the National Red List Alliance website (www.nationalredlist.org). National red lists have the potential to inform the global Red List if country endemic species are assessed following the IUCN Regional and National Red List guidelines (IUCN, 2012b). This is particularly useful for species currently unassessed at the global level (Brooks et al., 2015). The number of national, subnational and regional red lists produced have been increasing, but they have had unequal geographical coverage with regions having the highest threat to biodiversity being the ones having developed fewer lists (Azam, Gigot, Witte, & Schatz, 2016; Zamin et al., 2010).

2.2 | IUCN red list of threatened ecosystems

The IUCN Red List of Threatened Ecosystems has three main objectives: (a) to globally assess all ecosystem types for their risk of collapse by 2025 and to update these assessments at regular intervals; (2) to provide technical

assistance for developing Red Lists of Ecosystems at sub-global levels; and (3) to support assessments of individual ecosystem types that are deemed valuable by stakeholders (IUCN, 2012a), Brooks et al., 2015). The IUCN launched the Red List of Ecosystems (https://iucnrle.org/) consultation process in 2008, produced Version 1 (Rodríguez et al., 2011) of the knowledge product in 2011, scientific foundations (Keith et al., 2013), guidelines for application (IUCN, 2015) and has subsequently refined the Categories and Criteria in Version 1.1 (Bland, Keith, Miller, Murray, & Rodríguez, 2017). The product was formally adopted in 2014 by the IUCN (IUCN Council Decision C/83/17). The Red List of Ecosystems serves as an empirically based means for conservation to engage with spatial planning and decision making at the local, national, regional and global levels (IUCN, 2012a); Brooks et al., 2015). To date, 2,821 ecosystems in 100 countries have been assessed using the approved guidelines, categories and criteria (Bland et al., 2019). Many published assessments exist for countries included in our study (Appendix S2).

The Red List of Ecosystems has a wide range of users and can be used in a variety of ways including scientific knowledge and understanding for policy maker use, indicating biodiversity status and trends (Rowland et al., 2019), policymaking, prioritizing investment and resources, conservation planning, land use planning, climate change impacts at the ecosystem level and materials and systems to support capacity building efforts (IUCN, 2012a). In addition, it can be used to monitor the implementation of the CBD (Aichi Target 5) and sites designated under the Ramsar Convention on Wetlands of International Importance (IUCN, 2012a; Sievers et al., 2020).

2.3 | World database of protected areas—Protected planet

Protected Planet's main purpose is to document and map designated protected areas globally (UNEP-WCMC et al., 2019) through its the goal of, by 2020, becoming the singular and leading global platform for providing the world's decision-makers and practitioners with the best available information and tools for the planning and management of the planet's protected areas (Brooks et al., 2015). It is a knowledge product created jointly between the IUCN, its World Commission on Protected Areas (WCPA) and UNEP and is jointly managed by UNEP-WCMC. It was established in 1981 (IUCN, 2012a) and was mandated to provide the UN List of Protected Areas and the World Database on Protected Areas (WDPA; Brooks et al., 2015).

Dudley (2008) defined protected areas, associated governance types and management categories and this standard has been endorsed by IUCN (WCC-2012-Res-040, 2012). Information for the WDPA is updated monthly and is primarily gathered from government data providers or NGOs working with governments, but it can come from other sources, such as private land trusts (Brooks et al., 2015). As data is increasingly coming from other sources, the validation and verification protocols are being stringently applied and require peer-review from official entities or authoritative institutions (such as the IUCN WCPA membership) to ensure the quality of the datasets (Brooks et al., 2015).

Protected Planet is used as the primary indicator for tracking biodiversity status and trends for protected areas globally (Millennium Development Goal 7, Aichi Targets for the CBD, Sustainable Development Goals, the Global Biodiversity Outlook, the Global Environment Outlook and Protected Planet Report), regionally (regional Protected Planet Reports and regional agreements) and nationally (country status reports for the CBD Programme of Work on Protected Areas, World Heritage Convention, Ramsar Convention; Brooks et al., 2015; IUCN, 2012a). In addition, WDPA data are also used for policymaking, public and private site management, and contributing to the IUCN Protected Areas Management Categories system (IUCN, 2012a).

2.4 | Key biodiversity areas

The main objective of the Key Biodiversity Areas (KBA) knowledge product is to provide information and analyses on the locations of relevant biodiversity sites that significantly contribute to the global persistence of biodiversity and to inform and advise appropriate management of these sites (Brooks et al., 2015). In 2004, the IUCN requested that the SSC, in partnership with IUCN members, begin a worldwide consultative process to agree on a standardized methodology to allow countries to be able to identify KBAs through drawing on data from the Red List and other existing datasets, in addition to building on existing approaches (e.g., Important Bird and Biodiversity Areas [IBAs] and Alliance for Zero Extinction [AZE] sites; Brooks et al., 2015). The Global Standard for the Identification of KBA were established in 2016 (IUCN, 2012a; IUCN, 2016). Sites may qualify as global KBAs if they meet one or more of 11 criteria. These criteria are clustered into five categories: threatened biodiversity; geographically restricted biodiversity; ecological integrity; biological processes; and, irreplaceability (IUCN, 2016). Although not all the criteria may be relevant to all elements of biodiversity, the thresholds

associated with each of the criteria may be applied across all taxonomic groups, other than micro-organisms, and ecosystems (IUCN, 2016). All proposed KBAs must undergo independent scientific review prior to official site nomination with full documentation meeting the approved standards (KBA Standards and Appeals Committee 2019). Sites are reviewed and confirmed or rejected by the KBA Secretariat as KBAs (KBA Standards and Appeals Committee,2019).

The KBA approach has been developed over the last 40 years by BirdLife International and others with more than 15,000 sites identified as IBAs (BirdLife International, 2019), AZE sites (American Bird Conservancy, 2019), Important Plant Areas (PlantLife, 2019), and Prime Butterflies Areas, among others (IUCN, 2012a). Currently 3,069 KBAs have been identified in American countries and European held territories in the Americas (World Database of Key Biodiversity Areas, 2019). All KBA data are housed in the World Database of KBA (http://www.keybiodiversityareas.org/home). The uses of the KBA knowledge product include: an indicator of biodiversity status and trends (based on protected area coverage), policymaking (particularly in tracking Aichi Targets 11 and 12), conservation planning, public and private site management, support for local and indigenous communities and communication (IUCN, 2012a).

2.5 | IUCN Green list of protected and conserved areas

The IUCN Green List of Protected and Conserved Areas Programme (IUCN Green List Programme) aims to achieve, increase and promote protected and conserved areas that deliver successful conservation outcomes through effective and equitable governance and management (IUCN & WCPA, 2017). The Green List of Protected Areas concept started to take shape in 2008 and in 2012, at the World Conservation Congress, four IUCN Resolutions supported its development (IUCN and WCPA, 2017). The WCPA and IUCN's Global Protected Areas Programme convened a global development and consultation process to create and test a new Standard; these were finalized and produced in 2017 (IUCN and WCPA, 2017). The Programme is built around a Sustainability Standard defined by ISEAL as "a standard that addresses the social, environmental or economic practices of a defined entity, or a combination of these" (ISEAL, 2013).

The IUCN Green List of Protected and Conserved Areas Standard (IUCN Green List Standard) includes a set of 17 criteria categorized under four components (good governance, sound design and planning, effective management and successful conservation outcomes), with 50 indicators to help track successful conservation in protected and conserved areas (IUCN & WCPA, 2017) (Appendix S3). This knowledge product is designed to assist national governments and their community partners to track and try to achieve Aichi Target 11 and can be used as an indicator of biodiversity status and trends (through protected area coverage), protected area management, and certification (IUCN, 2012a).

2.6 | IUCN Green status of species

The IUCN Green Status of Species (formerly the IUCN Green List of Species) was mandated by a resolution of IUCN members in 2012 and a preliminary framework was developed for comprehensively assessing species recovery and conservation success (Akçakaya et al., 2018). The authors proposed a definition of a fully recovered species that "emphasizes viability, ecological functionality, and representation; and use counterfactual approaches to quantify degree of recovery." (Akçakaya et al., 2018). In addition, a set of four conservation metrics were calculated (a) conservation legacy; (b) conservation dependence; (c) conservation gain; and (d) recovery potential (Akçakaya et al., 2018). The preliminary framework has since been tested using a diverse set of animal and plant species and will continue to be developed to further use in measuring species recovery (Stephenson, Workman, Grace, & Long, 2020).

3 | INTEGRATED BIODIVERSITY ASSESSMENT TOOL

The Integrated Biodiversity Assessment Tool (IBAT) (https://www.ibat-alliance.org/) was established in 2008 and draws together data from three IUCN knowledge products – the IUCN Red List, the WDPA and KBAs—to help individuals and businesses incorporate biodiversity conservation considerations into their management decisions and overall project planning. It also offers IBAT Country Profiles through the IBAT for Research and Conservation Planning (https://conservation.ibat-alliance.org/nbsap/display) portal that deliver relevant biodiversity data that are disaggregated from global datasets to help support national level conservation planning and reporting. IBAT is not a knowledge product in itself as it does not have standards, but the information within it can support the revision of NBSAPs, target and indicator development, implementation, monitoring and reporting to the CBD. Lastly, it provides an avenue to harmonize data used by governments, businesses and relevant stakeholders.

4 | KNOWLEDGE PRODUCTS WITHOUT IUCN STANDARDS

4.1 | Global invasive species database

The Global Invasive Species Database (GISD) is managed by the IUCN Invasive Species Specialist Group (ISSG) and was developed in 2001 as a part of a global initiative led by the Global Invasive Species Programme (GISP; IUCN, 2012a). It is a freely available, searchable online source (http://www.iucngisd.org/gisd/) of information about introduced species from all taxonomic groups that negatively affect native biodiversity and natural ecosystems (IUCN, 2012a). The GISD provides information to support decision making concerning prevention and management of invasive species at local, national, regional and global levels (IUCN, 2012a). The ISSG has recently developed and launched the Global Register of Introduced and Invasive Species (GRIIS) (http://griis.org/) to address and support the achievement of Aichi Biodiversity Target 9 through compiled, annotated, verified, open source national level checklists of introduced and invasive species (Pagad, Genovesi, Carnevali, Schigel, & McGeoch, 2018). This knowledge product was not included in this study as it is not currently based on IUCN standards.

4.2 | ECOLEX: The gateway to environmental law

ECOLEX is an internet-based information service on environmental law and is operated jointly by the Food and Agriculture Organization, the IUCN, and UNEP (IUCN, 2012a). It is considered the most comprehensive global source of information concerning national and international environmental and natural resources-based laws (IUCN, 2012a). The overall objective of ECOLEX is "to increase knowledge of, and build capacity on, environmental law at local, national and global levels, to support the achievement of sustainable development" (IUCN, 2012a). This knowledge product was not included in this study as it is not currently based on IUCN standards.

5 | METHODS

5.1 | Study design and methods

The goal of this study is to examine if all American countries and European held territories in the Americas are using knowledge products based on IUCN standards to help construct their NBSAPs or National Reports. The design and methodology used in this study was based on those found in Clabots and Gilligan (2017) and the sampling frame included all American countries (Appendix S4: Table S1) and European held territories in the Americas who are Parties to the CBD (Appendix S4: Table S2). This produced a total of 39 countries with the United States being the only non-party country. The document dataset included all NBSAPs and National Reports submitted by each individual country that were available and accessible as of the CBD search portal through February 2019 (https://www.cbd.int/countries/). This produced an overall sample size of 234 documents (69 NBSAPs and 162 National Reports). The majority of NBSAPs were Version 1 (48.5%) or Version 2 (41.2%) and the remaining were Version 3 (8.8%) or Version 4 (1.5%). The National Reports were relatively evenly dispersed among reporting versions; first report (17.6%), second report (18.2%), third report (19.5%), fourth report (21.4%) and fifth report (23.3.%). Keywords were selected based on the four knowledge products based on IUCN standards: the IUCN Red List of Threatened Species (including the Green Status of Species), the Red List of Ecosystems, the World Database of KBA and the World Database on Protected Areas (including Protected Planet, the Protected Area Management Categories and the Green List of Protected Areas) (Table 1). Keyword searches were performed in English, Spanish and French using MaxQDA qualitative analysis software's lexical search function in all documents (Table 1). Keyword searches were not performed in Portuguese or Dutch as all countries with these official languages had all their documents written in English.

5.2 | Keyword categories

For Red List results, codes were further categorized into one of the following categories based on the context of how it was used in the document (Global Red List, National Red List, Red List Categories, Red List Index). For IUCN results, codes were further categorized IUCN Publications or IUCN workshops based on the context of how it was used in the document. For example, many countries cited IUCN produced publications in their documents and/or mentioned IUCN involvement in stakeholder workshops related to document development.

5.3 | Analysis

The final keyword counts were tabulated for each document and percentages were calculated for each individual

TABLE 1 Keyword search terms

English	Spanish	French
IUCN	IUCN/UICN	IUCN
Red List(s)	Lista Roja/Listas Rojas	Liste Rouge/Listes Rouges
Red Book(s)	Libro Rojo/Libros Rojos	Livre Rouge/Livres Rouges
Red List of Ecosystems	Lista Roja de Ecosistemas	Liste rouge des écosystèmes
Protected planet/world database of protected areas/WDPA	Planeta protegido/Base de datos mundial sobre áreas protegidas/WDPA	Planète protégée/Base de données mondiale sur les aires protégées/WDPA
Key Biodiversity Area(s)/KBA	área clave de biodiversidad/áreas clave de biodiversidad/KBA	zone clé de la biodiversité/zones clés pour la biodiversité/KBA
Green List	Lista Verde	Liste verte
IBAT	IBAT	IBAT
Critically endangered/CR	en peligro crítico/CR	Danger critique/CR
Endangered/EN	en peligro de extinción/EN	en voie de disparition/EN
Vulnerable/VU	Vulnerable/VU	Vulnerable/VU
Near threatened/NT	cerca de amenazado/NT	quasi menace/NT
Least concern/LC	menor preocupación/LC	moindre preoccupation/LC
Data deficient/DD	datos deficientes/DD	données insuffisantes/DD
Extinct/EX	Extinto/EX	Disparu/EX
Extinct in the wild/EW	extinto en la naturaleza/EW	Éteint à l'état sauvage/EW
Not evaluated/NE	no evaluado/NE	non évalué/NE
Species of special concern	especies de especial preocupación	espèces préoccupantes
Threatened	amenazado	menacé

keyword category to determine overall frequency across all NBSAPs and National Reports using MAXQDA's subcode statistics tool (MAXQDA , 2018). To track temporal trends in product use, the total number of keyword codes were divided by the total number of documents submitted per year to the CBD Secretariat to produce an average number of keyword codes per document for each year (1998–2018). The same average codes per document analysis was performed for each individual product as well to see potential differences in trends for each across time. This analysis was also performed for each country to examine which are using the most knowledge products. An average keyword codes per document was used because documents varied in length from 4 pages (Brazil's NBSAP Version 2) to 495 pages (Peru's Fifth National Report).

There are limitations with the study's design that should be considered when interpreting the results. It is important to note that NBSAPs and National Reports are continually published on the CBD website as the CBD Secretariat receives them, but this study will only contain the most recent country document produced as of February 2019. In addition, the keyword set chosen was limited to knowledge products based on IUCN standards, therefore the Global Invasive Species Database and ECOLEX were excluded from the analysis. Lastly, keywords were translated from English to Spanish and French via a Google Translate and therefore the results may not include all possible mentions of keywords in these languages.

6 | RESULTS

6.1 | IUCN knowledge product use

A total of 196 documents had at least one mention of an IUCN knowledge product and 42 had no mention of any of the knowledge products. There was a total of 7,103 coded segments for IUCN knowledge products across all documents. The vast majority of coded segments (91.8%) dealt with the IUCN Red List of Threatened Species. IUCN publications, Protected Areas Categories, KBAs, the Red List of Ecosystems and WDPA had small percentages of the remaining coded segments (8.2% total; Figure 2). There was no mention of the Green Status of Species or the Green List of Protected and Conserved Areas or the Green List of Species in any of the documents.

6.2 | Red list of threatened species use

A total of 189 documents had at least one mention of the Red List and 49 had no mention of the Red List. There was a total of 6,514 coded segments and the majority of coded segments are referencing the Categories for species (73.6%; Figure 3). Mentions of the global Red List, the countries' national red list, IUCN publications, Red List workshops and the Red List Index comprised the remaining coded segments (26.4%; Figure 3).

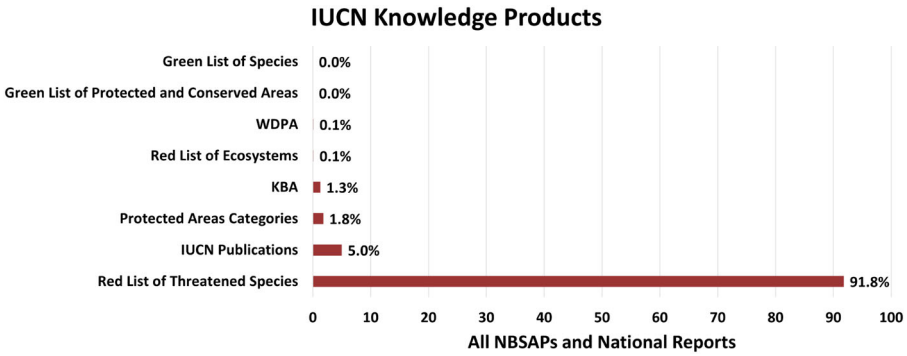

FIGURE 2 Overall use of IUCN knowledge products across all NBSAPs and National Reports. IUCN, International Union for Conservation of Nature; NBSAPs, National Biodiversity Strategies and Action Plan

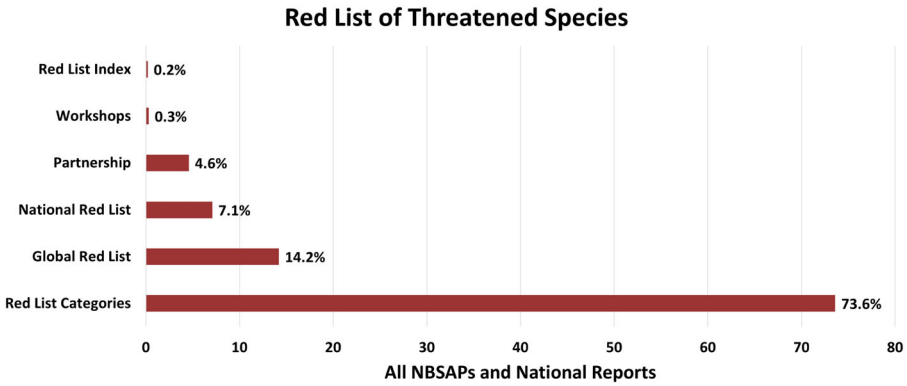

FIGURE 3 Use of IUCN Red List data across all NBSAPs and National Reports. IUCN, International Union for Conservation of Nature; NBSAPs, National Biodiversity Strategies and Action Plan

6.3 | Red list categories use

A total of 139 documents had at least one mention of the Red List Categories and 99 had no mention of the Red List Categories. There was a total of 4,786 coded segments and the majority of the segments dealt with "Threatened" species categories (critically endangered, endangered, vulnerable; 82%; Figure 4). The other categories (near threatened, extinct, data deficient, least concern, extinct in the wild and not evaluated) comprised the remaining coded segments (18%; Figure 4).

6.4 | Temporal trends in IUCN knowledge product use

The average number of IUCN knowledge product coded segments per year (from 1998 to 2018) was 30.8. The highest average occurred in 2012, with an average of 135 coded segments per document and the lowest average occurred in 2001 with an average of 1.9 coded segments per document. When looking at the individual products, the IUCN Red List of Threatened Species had the highest average number of coded segments across all years (1998–2018) with its highest average occurring in 2012 with an average of 136 coded segments per document and its lowest average occurring in 2001 with an average of 1.88 coded segments per document (Figure 5). The WDPA had the lowest average number of coded segments across all years (1998–2018) with its highest average occurring in 2011 with an average of 0.1 coded segments per document and its lowest average occurring in 2014 with an average of 0.08 coded segments per document (Figure 5).

6.5 | Country level results

The country with the highest average number of knowledge products per document was Haiti with an average of 389.3 codes per document and the countries with the lowest average were Nicaragua and St. Kitts and Nevis with an average of 0.7 and 0.8 codes per document (Appendix S5: Figure S1). Haiti's high average number of coded segments was driven by the high number of IUCN knowledge keywords (1075) included in its most recent (fifth) National Report. Only 4 out of 10 countries with the highest average are considered IUCN State and/or Government Agency members (Dominican Republic, Ecuador, and two countries with territories, the Netherlands and the United Kingdom). There were 24 countries (Appendix S5: Figure S2) with one or more documents with no coded segments for knowledge products. Grenada had the largest number of documents (five total)

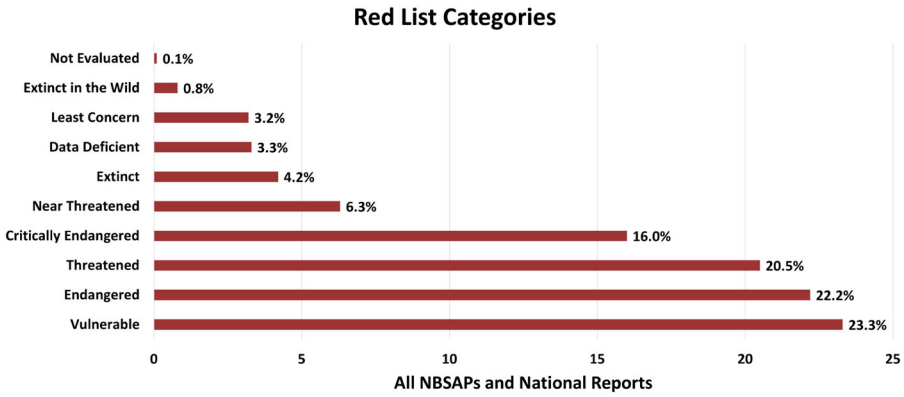

FIGURE 4 Use of IUCN Red List categories across all NBSAPs and National Reports. IUCN, International Union for Conservation of Nature; NBSAPs, National Biodiversity Strategies and Action Plan

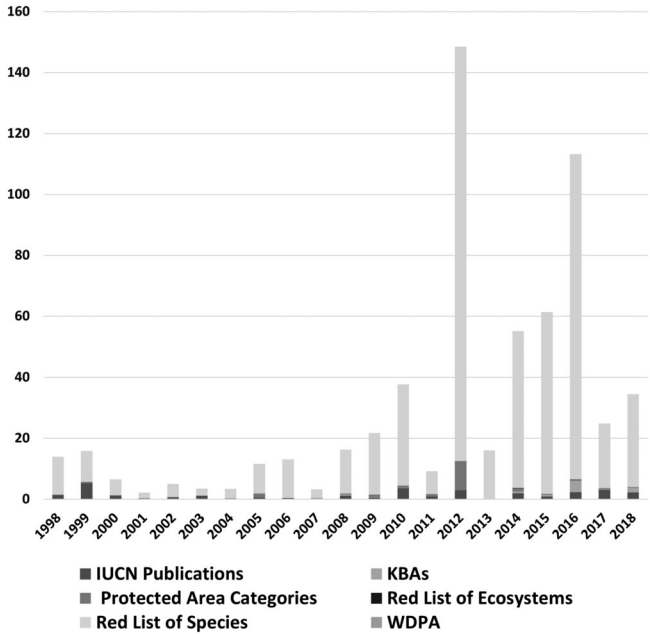

FIGURE 5 Average number of IUCN knowledge product codes per document. IUCN, International Union for Conservation of Nature

without coded segments for knowledge products (Appendix S5: Figure S2).

7 | DISCUSSION

Trends in biodiversity status are quite difficult to track due to the considerable genetic, species and ecosystem diversity, the multitude of ecological interactions, and the presence of synergistic pressures impacting biodiversity (Schmeller et al., 2018). The unevenness in the geographic distribution of established biodiversity monitoring poses a great challenge for conservation as those areas holding the greatest amount of biodiversity face the most severe threats and generally have the least amount of human capacity to respond to these threats (Brooks, Lamoreux, & Soberón, 2014) creating critical challenges for conservation (Lacher Jr. et al., 2012). There are a multitude of challenges when it comes to implementing the CBD through NBSAPs and National Reports, including lack of institutional capacity, financial resources, knowledge and accessible information, economic policy, stakeholder cooperation and involvement and integration and mainstreaming of biodiversity into other sectors (Chandra & Idrisova, 2011; Morgera & Tsioumani, 2011). Lack of resources, institutional limitations and lack of awareness of the CBD among key societal groups and local administrators have been identified as major impediments for many Mesoamerican countries in fulfilling their obligations to the CBD (Aguilar-Stoen & Dhillion, 2003; Chandra & Idrisova, 2011).

Aichi Target 17 (the development of updated NBSAPs) is considered one of the most important to achieve to make progress on the others (Adenle, .Stevens, & Bridgewater, 2015). Many of the first version NBSAPs were largely developed by consultants, environmental ministries and NGOs, with minimal input or participation by community groups and interested bodies (Herkenrath, 2002). Major international non-governmental and intergovernmental biodiversity organizations are assisting developing countries, including many American countries, in updating and maintaining their NBSAPs but progress remains slow (Adenle et al., 2015) due to a lack of capacity at the national level in creating regulatory policies for biodiversity conservation (Adenle, 2012), low levels of implementation of the CBD, the lack of an accountability framework (Ulloa, Jax, & Karlsson-Vinkhuyzen, 2018), and issues with raising and maintaining funding by the CBD (Adenle et al., 2015). NBSAP development and maintenance can offer a unique opportunity for national governments, stakeholders, NGOs and intergovernmental organizations, such as the IUCN, to engage with and transform national biodiversity policies and actions (Adenle et al., 2015).

The lack of WDPA usage in NBSAPs and National Reports was an unsurprising result of this study. The

most likely explanation is that data in the WDPA are submitted directly by the national governments themselves, therefore countries are using their own national level data sets for protected areas instead of the global level data sets. This has been demonstrated to occur for the WDPA, as governments do not always provide the timeliest updates for the product, therefore it does not contain the most up to date maps (Han et al., 2017). In addition, governments do not always interpret public land use objectives and definitions as the WDPA defines the categories, leading to an overestimation of both the number and extent of protected areas (Han et al., 2017). The WDPA is of more interest for large-scale global or regional analyses of protected areas, rather than national level analyses.

The heavy use of the Red List of Threatened species is likely due to its long history as a knowledge product and the relevance of the information it provides to a multitude of different audiences and stakeholders (Brooks pers. comm. 2019). On the other hand, the absence of the Green List of Protected and Conserved Areas, the Green List of Species, IBAT and the minimal usage of KBAs and the Red List of Threatened Ecosystems in these documents is likely due to their recent development and use as IUCN knowledge products. The majority of these products were mandated and developed within the last decade and have had their standards either finalized very recently (IUCN, 2016; IUCN & WCPA, 2017; Keith et al., 2013) or still in the development stage (Akçakaya et al., 2018). For these reasons, the knowledge products have not had a large enough amount of time to be taken up into the process of development and updating NBSAPs and National Reports; governments and agencies crafting these documents may not be aware these knowledge products currently exist. Further studies should investigate if there is awareness of IUCN knowledge products among appointed national focal points for the CBD, particularly in those countries with low levels of knowledge product use and for knowledge products with recently developed standards, to determine reasons why they may, or may not being using them in NBSAP and National Report Development and explore potential avenues to increase awareness and use at the national level.

Specific characteristics that strengthen the likelihood of biodiversity conservation knowledge products being used in decision- and policy-making have not been identified to date (Weatherdon et al., 2017). Potential barriers to knowledge product use in national level biodiversity policy making include limited data accessibility, discoverability and digestibility (Wetzel et al., 2015) and incompatible policy narratives of governments, policymakers and conservation scientists (Rose, Brotherton, Owens, & Pryke, 2018). Additional reasons include the data being too globally aggregated, a lack of capacity in the assessment process, and poor ability to disaggregate these global data sets for regional, subregional, and national planning and policy making (Brooks et al., 2015; Brooks et al., 2016; Han et al., 2017).

IBAT is a key product for this need as it provides a simple spatial tool for national governments to access country and site level reports containing disaggregated data from the Red List of Threatened Species, KBAs and Protected Planet. The extensive use of IBAT by business and industry demonstrates its utility (IBAT, 2019), but use of these tools by national governments, the CBD and CBD national focal points needs to be encouraged. IBAT country profiles are disseminated annually to focal points for SDG indicators in National Statistical Offices, but these offices are not responsible for producing NBSAPs or National Reports so the low uptake of this product is unsurprising (Brooks pers. comm. 2019). In addition, individuals creating NBSAPs and National Reports are likely citing the underlying data from the Red List, KBAs and Protected Planet rather than IBAT itself. The National Red List and KBA assessment processes are the two knowledge products that can be easily applied and implemented at the national level (Brooks et al., 2015; IUCN, 2012c; IUCN, 2016). Currently, a little over half (54%) of the countries included in this study have a national Red List listed on ZSL's National Red List site. The majority of national Red Lists tend to focus on a species group or a mix of species from different taxonomic groups and so do not offer a comprehensive assessment of the extinction risk for the country's entire flora and fauna. Only one country (Guyana) does not have any KBAs designated. The use of KBAs in NBSAPs and National Reports spiked in 2016 and they are likely to continue to increase in future use since they are at a proper scale for national level implementation.

There are mixed results when it comes to using global versus national data sets as indicators for biodiversity. Han et al. (2017) found that major indicators at the national scale can substantially vary depending if they were produced from a national process (such as a national Red List) or from a disaggregated global data set (such as the global Red List) due to differences in methodology. National red lists are produced one of two ways: (a) publishing an unchanged subset of the global Red List that includes those species that reproduce in the country or at any life stage regularly visit the country; or (b) to assess species' extinction risk within the country and publish a national Red List (IUCN, 2012b). They argue that, when available, countries should use their own nationally derived indicators to monitor biodiversity status and trends, but that disaggregated global data sets have their

place in filling gaps in the national data (Han et al., 2017), such as those found in IBAT country profiles. Better harmonization between national and global datasets will ensure more informed national level conservation policies (Rodrigues et al., 2006). The combination of these knowledge products, particularly those that can easily be disaggregated to the regional, subregional and national level, have great potential for enhancing biodiversity conservation planning (Azam et al., 2016), particularly the Red List, KBAs and Protected Planet (Brooks et al., 2016). Knowledge products can also be combined to enact targeted conservation actions that also contribute to achieving multiple Aichi Targets, such as protecting designated Alliance for Zero Extinction (AZE) sites (Targets 11 and 12) (Butchart et al., 2012; Funk, Conde, Lamoreux, & Fa, 2017). AZE sites are also a key component in the KBA framework (Brooks et al., 2016).

This reporting burden can be alleviated if knowledge products remain current with their data, maintain high quality, and can be disaggregated to national levels (Brooks et al., 2015). Three main actions could incentivize broader use of products at the national level: (a) improved training and increased resources need to be provided to experts on the national scale; (b) better marketing of the knowledge products to national and local actors; and (c) better support from the international community and expanding on the experience of using these products (Azam et al., 2016). In addition, the long-term sustainability of knowledge products needs be strengthened through a variety of strategies including focusing on scientists and institutions as key users, implementing techniques for increasing data contributions, and minimizing duplicated efforts (Costello et al., 2014).

Indicators derived from IUCN knowledge products are applicable to half the Aichi Targets and 7 out of 17 of the SDGs, however annual investment into these knowledge products is currently only a fraction of what is needed to maintain their currency, quality and scope (Brooks et al., 2015; Hoffmann et al., 2008). It is estimated that the financial and human capacity invested between 1979 and 2013 to bring the Red List of Threatened Species, the Red List of Threatened Ecosystems, Protected Planet and KBAs to their current data levels was approximately $160 million (USD) and 293 person years (Juffe-Bignoli et al., 2016). More than half of this financing was through philanthropic avenues and it is estimated that it will cost approximately $114 million to reach pre-defined baselines of data coverage for the products and once this baseline is achieved the annual maintenance cost will be approximately $12 million (Juffe-Bignoli et al., 2016). If these knowledge products are to be maintained at the quality needed to accurately track biodiversity targets, sustainable long-term financing mechanisms need to be established to ensure they are continuing to be updated and accurate as possible (Costello et al., 2014). In addition, these knowledge products are indebted to the thousands of data contributors and scientists who volunteer their time and expertise in ensuring the continuity and quality of the product. These financial costs are a small price to pay for gold-standard indicators of our planet's biodiversity status and trends.

Many factors, including differing time frames, scales and consistency in data collection coverage and methodologies, make it a challenge to create a complete picture of the status and trends of global and national biodiversity (Weatherdon et al., 2017). The international community developed necessary indicators to track (Walpole et al., 2009) but failed to meet the 2010 global targets of significantly reducing the rate of biodiversity loss (Morgera & Tsioumani, 2011) and it is clear that it is not on track to achieve the majority of the CBD's 2020 Aichi Targets as many of the targets are ambiguous, complex, redundant, and lack quantifiability (Butchart, Marco, & Watson, 2016; Mcowen et al., 2016; Tittensor et al., 2014). In addition, this breadth of targets creates large reporting requirement for countries, the vast majority of which use nationally generated indicators instead of global indicators recommend by the CBD (Bhat et al., 2019). This reporting has become increasingly unfeasible for smaller states (Brooks et al., 2015), particularly when the CBD's scope entails action by a wide range of both national and local authorities who often work in isolation of one another (Morgera & Tsioumani, 2011). Less than half (46%) of the 54 elements that form the Aichi Targets have available and quantifiable indicators (Mcowen et al., 2016). Biodiversity targets need to be more easily quantified in the future and to have a smaller number of more focused objectives with specific sub targets to highlight specific actions to take to reduce biodiversity loss (Butchart et al., 2016). NBSAPs and National Reports need to take into account potential synergies and tradeoffs between existing, such as the Sustainable Development Goals, and future biodiversity targets (Di Marco, Butchart, Visconti, et al., 2016; Stafford-Smith, 2014) and to help spur future knowledge product development and implementation, particularly for the marine realm (Weatherdon et al., 2017).

To address these concerns, the CBD recently mandated the Biodiversity Indicators Partnership (BIP) as a global initiative fostering development and delivery of a global suite of biodiversity indicators to be used by the CBD and other biodiversity related MEAs to better track progress for future goals (BIP Secretariat, 2017;

Rounsevell et al., 2020). The development of the post-2020 global biodiversity framework for the CBD provides a window of opportunity to set out an ambitious plan with specific goals for biodiversity recovery, development of measurable and relevant indicators of progress and to agree upon actions that collectively will be able to achieve the goal of CBD's 2050 vision (Mace et al., 2018; Rounsevell et al., 2020). Knowledge products based on IUCN standards should continue to form an integral part of future indicators during this critical moment for biodiversity conservation.

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CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

AUTHOR CONTRIBUTIONS

Both authors were involved in conceiving the idea and designing the study. S.M. collected and analyzed the data. S.M. led the writing of the manuscript with support from T.L.

DATA AVAILABILITY STATEMENT

This article was based on publicly available date; we downloaded NBSAPs and National Reports from the CBD Search NBSAPs and National Reports website: https://www.cbd.int/nbsap/search/.

ETHICS STATEMENT

This study used publicly available data and required no approval from a university ethics board.

ORCID

Shelby D. McCay https://orcid.org/0000-0002-8726-4783

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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