National Level Use of IUCN Knowledge Products in the New World: A Study of National Biodiversity Strategies and Action Plans and National Reports to the Convention on Biological Diversity

A Professional Paper

By

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Abstract:

Biodiversity loss continues to be an increasing concern to conservationists, governments, society and policymakers. The Convention on Biological Diversity (CBD) currently serves as the key multilateral environmental agreement to provide a framework for protecting global biodiversity. Parties to the CBD are required to develop and submit a National Biodiversity Strategies and Action Plan (NBSAP) and National Reports to the CBD. These documents serve as the principal instruments used by governments and stakeholders to identify priorities, implement and track progress of the CBD at the national level. New World countries hold a large proportion of the planet's biodiversity and are suffering some of the most dramatic declines in species populations and biodiversity. Over the past 50 years, the IUCN has been producing biodiversity and conservation knowledge products that are fundamental for tracking the progress of the many international targets, such as the Aichi Biodiversity Targets and the Sustainable Development Goals. The goal of this study is to examine if New World countries are using IUCN knowledge products to help construct NBSAPs or National Reports. 234 documents (69 NBSAPs and 162 National Reports) were analyzed for IUCN knowledge product keywords. 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. 89.4% of keyword coded segments dealt with the IUCN Red List of Threatened Species. IUCN publications, GBIF, Protected Areas Categories, KBAs, GISD, ECOLEX, the Red List of Ecosystems and WDPA had small percentages of the remaining coded segments (10.6% total). There was no mention of GRIIS, IBAT, the Green List of Species or the Green List of Protected and Conserved Areas or the Green List of Species in any of the documents. Further studies should investigate awareness levels of IUCN knowledge products among appointed national focal points for the CBD, particularly in those countries with low levels of knowledge product use, 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. IUCN knowledge products should continue to form an integral part of future indicators during this critical moment for biodiversity conservation.

Keywords: IUCN, Knowledge Products, NBSAPs, National Reports, Convention on Biological Diversity, Biodiversity, Conservation, Policy, Red List, Key Biodiversity Areas, WDPA, ECOLEX, GISD.

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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 and 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 *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 the ultimate products of this international effort. The CBD was quickly endorsed by the international community and entered into force the following year with 168 countries (85% of the global community) becoming signatories. The CBD currently serves as the key multilateral environmental agreement to provide a framework for protecting global biodiversity and has three main objectives, "(1) conservation of biodiversity; (2) the sustainable use of its components; and (3) the fair and equitable sharing of benefits

arising from genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and technologies and by appropriate funding" (CBD(b) n.d.). Its overall vision is "By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people." To date, a total of 196 countries have signed the CBD and are considered Parties (CBD(d) n.d.), with the United States of America (U.S.) and the Holy See (Vatican City) being the only two having not signed and therefore are considered non-Parties.

Only 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 "governs the movements of living modified organisms (LMOs) resulting from modern biotechnology from one country to another" (CBD 2012). The Nagoya Protocol "provides a transparent legal framework for the effective implementation of the fair and equitable sharing of benefits arising out of the utilization of genetic resources, including traditional knowledge (TK) associated with genetic resources" (CBD(a) n.d.). 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 (CBD(e) n.d.). This Strategic Plan and the 20 Targets represent their commitment to biodiversity conservation and sustainability.

Article 6(a) of the CBD requires parties to the convention to develop and submit a National Biodiversity Strategies and Action Plan (NBSAP); or equivalent instrument, to the CBD Secretariat every 10 years to illustrate how the country plans to conserve biodiversity within their boundaries and territories (if applicable). NBSAPs serve as the principal instruments used by governments and stakeholders to identify priorities and implement the CBD at the national level (CBD(c) n.d.). They are generally prepared through stakeholder processes involving environmental ministries, civil society organization, indigenous groups, local communities, non-governmental organizations (NGOs), intergovernmental organizations

(IGOs) and scientists (Clabots and Gilligan 2017). Parties are also obliged to submit a National Report to the CBD Secretariat every 3-5 years: 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. These reports are critical for monitoring the implementation success of the current NBSAP and providing a foundation for preparing future NBSAPs.

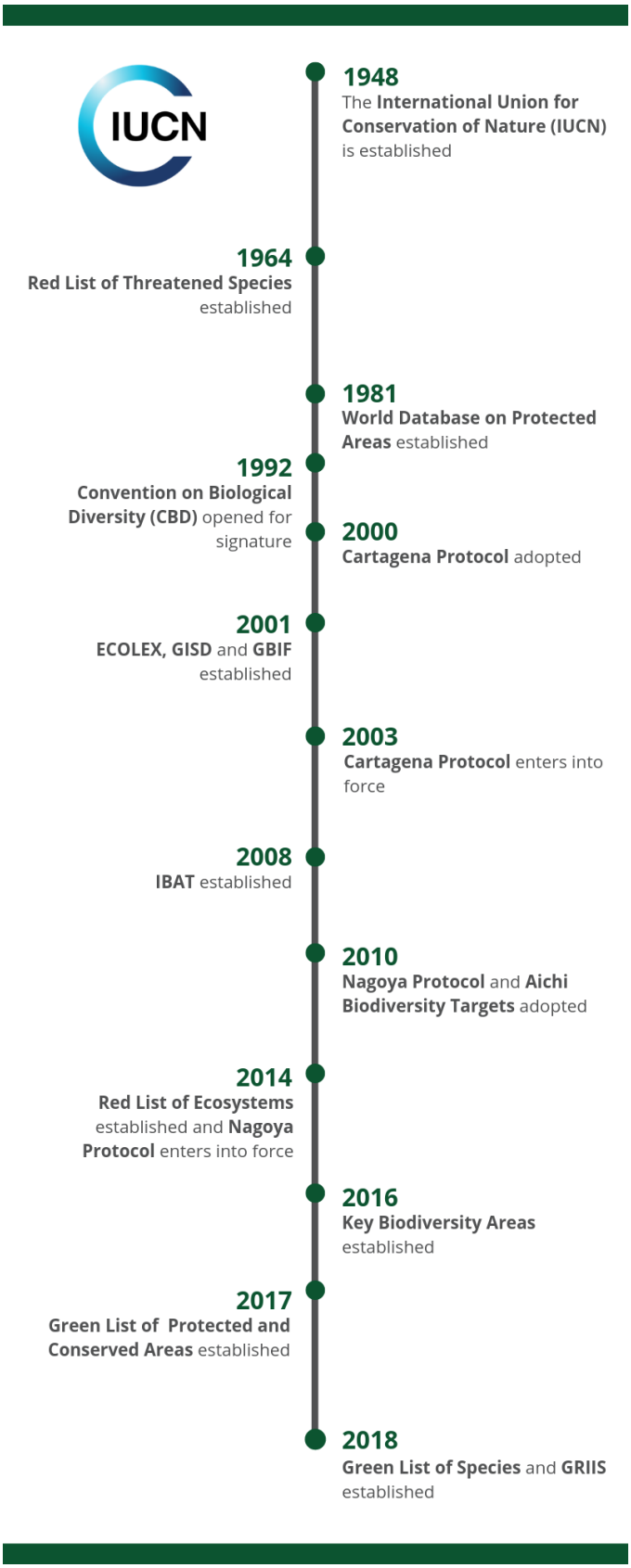
Biodiversity conservation and management in developing countries has been a priority for the CBD since it was first adopted, but expenditures on biodiversity in these countries account for less than half of the global total spent on biodiversity (Parker *et al.* 2012). New World countries hold a large proportion of the planet's biodiversity; with 7 out of 17 considered to be "megadiverse" (Mittermeier *et al.* 2005) and holding nine designated biodiversity hotspots (Myers *et al.* 2000, CEPF n.d.). In addition, many New World 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 Old World countries (Meyerhoff *et al.* 2012, Propescu 2014, Marino *et al.* 2015, Sarkki *et al.* 2016, Wolff *et al.* 2018), or at a global scale (Henders *et al.* 2018, Prip 2018) and the few focused on New World 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 and Dhillion 2003 and Febles 2009). For these reasons, the scope of this study will be limited to New World countries and territories.

IUCN Knowledge Products

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). 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.). Every four years the IUCN hosts the World Conservation Congress to set priorities and agree on future work programs; these Congresses facilitate knowledge sharing to help strengthen several key MEAs, including the CBD (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 and Baillie 2007) (**Figure 1**). 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 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 (GEF) (Lacher *et al.* 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 (through its more than 200 state and government agency members), civil society (through their more than 1,000 NGO members) and the scientific community (with more than 15,000 individual specialists in six expert, volunteer Commissions) (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 *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.

Figure 1: Timeline of IUCN Knowledge Product Establishment and CBD Milestones



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 conservation status of animal, fungi and plant species (Hoffman *et al.* 2008, IUCN 2012(a)). Its overarching goal is to "provide information on the status, trends and threats to species in order to inform and catalyze action for biodiversity conservation" (IUCN 2012(a)), to serve as a "barometer of life" across species and ecosystems (Stuart *et al.* 2010) and to assist in conservation planning efforts (Rodrigues *et al.* 2006, Hoffman *et al.* 2008). To achieve this goal, the Red List aims to: "(1) Establish a baseline from which to monitor the change in status of species; (2) Provide a global context for the establishment of conservation priorities at the local level; and (3) Monitor, on a continuing basis, the status of a representative selection of species (as biodiversity indicators) that cover all the major ecosystems of the world." (IUCN 2012a). The Red List is tasked with objectively assessing and documenting the extinction risk for more than 96,900 species (IUCN 2019) based in their status, trends and threats (Smart, Hilton-Taylor and Mittermeier 2014). As of January 2019, more than 26,500 globally assessed species are threatened with extinction (IUCN 2019).

The standards for Red List assessments were developed through a consultative process (Mace *et al.* 2008), which was initiated by the "Road to extinction" conference in 1984 (Fitter and Fitter 1987), and finished with revised and approved standards in 2000 (IUCN Council Decision C/51/35). All assessments must follow the standards outlined in the IUCN Red List Categories and Criteria, Version 3.1 (IUCN 2012b), the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN SPSC 2014) and the Guidelines for Application of IUCN Red List Criteria at Regional and National Levels, Version 4.0 (if applicable) (IUCN 2012c). Species are assessed as one of nine mutually-exclusive global extinction risk categories: Not Evaluated (NE); Data Deficient (DD); Least Concern (LC); Near Threatened (NT); Vulnerable (VU); Endangered (EN); Critically Endangered (CR); Extinct in the Wild (EW); and Extinct (EX) based on documented evidence of the status and trends in one of five areas: size of the range and

decline, rates of decline in population size, small population size and decline, small population size alone and quantitative analysis and modeling of demographic data (Mace *et al.* 2008).

The Red List is produced and managed in coordination with the IUCN Global Species Programme, the IUCN Species Survival Commission (SSC), which houses the Red List Unit, and the Red List Partnership: Arizona State University; BirdLife International; Botanic Gardens Conservation International; Conservation International; Nature-Serve; Royal Botanic Gardens, Kew; Sapienza University of Rome; Texas A&M University and Zoological Society of London (IUCN 2019). The Red List Unit is responsible for managing the data associated with Red List assessments, maintaining the website (www.iucnredlist.org), creating derived data products and analyses from assessment data, verifying assessments and training Red List assessors. The minimum documentation for all assessments includes the taxonomic identity, a geographic range map, justified application of the IUCN Red List Categories and Criteria, application of IUCN classification schemes for threats and actions needed for the species, description of its habitat and literature cited (IUCN SPSC 2014). Assessments must follow the appropriate guidelines produced by the IUCN SSC Standards and Petitions Sub-Committee (SPSC) (IUCN 2012c), meet the required supporting information standards and pass an independent review before final review and publication by the Red List Unit. The Red List has a wide range of users including businesses, conservationists, governments, policy makers, researchers and students and is used for a variety of purposes; including evaluating the status of biodiversity, monitoring the changing state of biodiversity, informing policy, influencing resource allocation, informing conservation planning, improving decision-making processes, guiding scientific research priorities and communication and raising awareness (IUCN 2012a).

A Red List Index (RLI) can be calculated for entire taxonomic groups that have been assessed against the IUCN Red List Categories and Criteria two or more times and provides an indicator of the change in the aggregate extinction risk of the taxonomic group. 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 (4, 5, 6, 8, 9, 10, 11, 12, 13, and 14) (Vié, Hilton-Taylor and Stuart 2009, IUCN 2012a). 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 (SRLI) has been developed by Baillie *et al.* (2008) so entire taxonomic groups do not need to be fully censused to monitor trends in extinction risk and has been used in plants (Brummitt *et al.* 2015).

All species assessed on the Red List should be reassessed every 10 years to ensure the information in the account and the current trend of the species is kept up to date for proper extinction risk assessment. If the assessment is not updated, the species will be marked as "in need of updating" in order to indicate that the data included in the account are old and may no longer be relevant for assessment and planning purposes. Raising resources to facilitate reassessments of species and comprehensively assessed taxonomic groups is proving difficult to accomplish and even harder to maintain (Brooks *et al.* 2015); innovative methods to fast-track and conduct reassessments at a lower cost are needed in order to ensure the Red List continues to maintain the same data quality and species assessments (Rondini *et al.* 2014).

National red lists are generally led and produced by national-level intuitions, including NGOs and government agencies and are considered a major indicator to monitor progress towards biodiversity targets (Zamin *et al.* 2010). All available national red lists are housed on the National Red List Alliance website (www.nationalredlist.org) which is currently run by the Zoological Society of London (ZSL). While national red lists do not always follow the IUCN produced standards, they have the potential to inform the global Red List if national endemics are included in the assessment process and they include two additional extinction risk categories: Regionally Extinct (RE) and Not Applicable (NA). This is

particularly useful for species currently unassessed at the global level, as many species of plants and invertebrates are (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 red lists (Zamin *et al.* 2010, Azam *et al.* 2016).

Red List of Threatened Ecosystems

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 and has subsequently refined the Categories and Criteria in Version 2 (Keith *et al.* 2013). The product was formally adopted in 2014 as "Categories and Criteria for assessing the risks to ecosystems" by the IUCN (IUCN Council Decision C/83/17). Its three main objectives are (1) to assess all ecosystem types (terrestrial, freshwater, marine and subterranean) for their risk of collapse (through loss of area, degradation or major functional change) globally by 2025 and update these assessments at regular intervals; (2) to provide technical support to efforts developing Red Lists of Ecosystems at sub-global levels; and (3) to support the use of the Categories and Criteria in assessing individual ecosystem types that are deemed valuable by stakeholders (IUCN 2012a, Brooks *et al.* 2015). The status of the Earth's ecosystems will be able to be monitored and identify those with a high probability of degradation, functional decline and loss through the use of a unified system for assessment, with a consistent and accepted scientific framework (IUCN 2012a). The IUCN Red List of Ecosystems will also serve 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).

The Red List of Ecosystems is jointly managed and governed by the IUCN Commission on Ecosystem Management (CEM) and the IUCN Global Ecosystem Management Programme (GEMP). A CEM-GEMP Steering Committee oversees the implementation of the Categories and Criteria and a Committee for Scientific Standards (CSS), promotes the use of high scientific standards, ensures quality control and

impartiality in the assessments (Brooks *et al*. 2015). Since the Red List of Ecosystems is a relatively new knowledge product, it is still being piloted at the regional and national level (Brooks *et al.* 2015), but published assessments exist for some New World countries and countries who hold New World territories; including the Alaskan Giant Kelp Forests (Keith 2013), Brazil (IUCN 2015, Manzon and Nunes de Cunha 2015), Caribbean coral reefs (Keith and Spalding 2013) Chile (Alaniz *et al.* 2016, Ministerio del Ambiente de Chile 2015), Colombia (Etter *et al.* 2017, Etter *et al.* 2015), Costa Rica (Herrera 2015), El Salvador (Crespin and Simonetti 2015), France (UICN Comité Français 2018, Carré and Teillac-Deschamps 2014, Carré *et al.* 2012), Meso-American Reefs (Bland *et al.* 2017), North American Great Lakes (Faber-Langendoen and Bakowsky 2013), Temperate and Tropical Forests of the Americas (Ferrer-Paris *et al.* 2019), U.S. estuaries (Mahoney and Bishop 2017) and Venezuela (Oliveira-Miranda 2013, Oliveira-Miranda *et al.* 2013, Oliveira-Miranda *et al.* 2010).

The IUCN CEM and GEMP have two parallel capacity building strategies for this knowledge product. The first is to develop the technical capacity to carry out periodic global assessments through targeted partnerships between the IUCN and academic researchers (Brooks *et al.* 2015). The second is to respond to relevant national and regional level stakeholder groups with a task force of trained assessors (Brooks *et al.* 2015). Global indicators of change in aggregate risk of ecosystem collapse will not be available till at least 2030 due to the 2025 target completion date for the first global Red List of Ecosystems; however national and regional level indicators will be available for select countries and regions based on their individual level assessments (Brooks *et al.* 2015). The Red List of Ecosystems has a wide range of users including businesses, conservationists, land use planners and policy makers and can be used in a variety of ways including scientific knowledge and understanding for policy maker use, indicator of biodiversity status and trends, 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).

World Database of Protected Areas – Protected Planet

Protected Planet 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). Its main purpose is to document and map designated protected areas globally (UNEP-WCMC, IUCN and NGS 2019). The vision for this knowledge product is "a world where the global community recognizes the value of protected areas and their contribution to achieve conservation and development goals, and is empowered to take positive action to maintain and improve their integrity in the face of global change taking decisions based on the best possible information." (Brooks *et al.* 2015). Protected Planet has the goal of, by 2020 "becoming the unique and prominent global platform providing the world's decision-makers and the community of practitioners with the best possible global information, knowledge and tools for the planning and management of protected areas." (Brooks *et al.* 2015). In addition, Protected Planet has four main objectives: "(1) delivery of the WDPA as the authoritative and credible data set of protected areas globally); (2) connection (through communication tools for interacting with key target audiences); (3) analysis (development of the set of analytical tools that can track progress in achieving conservation targets); and (4) change (promoting implementation of biodiversity and environmental policies and best practice guidance)" (Brooks *et al.* 2015).

A protected area was defined by Dudley (2008) as "a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values", along with definitions of associated protected area governance types and management categories. This standard has been endorsed by IUCN (WCC-2012-Res-040). 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 Plant Reports and regional agreements) and nationally (country status reports for the CBD Programme of Work on Protected Areas, World Heritage Convention, Ramsar Convention) (IUCN 2012a, Brooks *et al.* 2015). In addition, WDPA data are also used for policymaking, public and private site management, public engagement and raising awareness, and contributing to the IUCN Protected Areas Management Categories system (IUCN 2012a) and are published through IBAT and IBAT for Business (Brooks *et al.* 2015).

ECOLEX: The Gateway to Environmental Law

In the 1960's, the IUCN Environmental Law Centre (ELC) created a comprehensive information system on environmental laws (ELIS), one of the first computerized legal information systems which still continues to be one of the main assets for capacity building activities for the IUCN Environmental Law Programme (IUCN 2012a). The dissemination of environmental legislation in digital form was first mandated by the Governing Council of UNEP in 1995 and spurred cooperation between UNEP and the IUCN on this activity (IUCN 2012a). In 2001, UNEP, the IUCN and the FAO signed a partnership agreement in order to integrate their data and each partner contributes to ECOLEX through developing and maintaining particular datasets (FAO = legislation, IUCN = treaties and legal and policy literature, UNEP = court decisions) (IUCN 2012a). ECOLEX now provides information on 2174 treaties, 11,984

treaty decisions, 156,297 national laws and regulations, 40,225 legal and policy literature records and 2,563 court decisions (ECOLEX 2019).

ECOLEX is an internet-based information service on environmental law and is operated jointly by the Food and Agriculture Organization (FAO), 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 environmental and natural resources fields covered include 15 major subject areas: agriculture, air and atmosphere, cultivated plants, energy, environment general, fisheries, food, forestry, land and soil, livestock, mineral resources, sea, waste & hazardous substances, water and wild species and ecosystems (IUCN 2012a). The online portal includes extensive information on "multilateral and bilateral environmental treaties, national legislation, court decisions and law and policy literature' including monographs, articles from periodicals, and grey literature, as well as related news and links to other web- sites" and includes search functions using a variety of terms including country name, geographical area and river basins (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).

Taken together, this pool of national, regional and global policies and legal instruments constitutes the entirety of controls, incentives and remedial mechanisms that govern the relationship between people and the environment, yet much of this informational wealth can be difficult to access (IUCN 2012a). FAO, IUCN and UNEP receive an increasing number and variety of requests for data and assistance in finding information on environmental law topics from academia, governments, NGOS, companies and members of the public (IUCN 2012a). A future challenge for ECOLEX is developing links between their knowledge product and other data providers to build common knowledge products, particularly for biodiversity (IUCN 2012a). Potential tools could include links between legal instruments and scientific data on species and protected areas, monitoring biodiversity policy response, developing or improving national environmental legislation and public and private site management (IUCN 2012a).

Key Biodiversity Areas

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 Key Biodiversity Areas (KBAs) through drawing on data from the Red List and other existing datasets, in addition to building on existing approaches (Brooks *et al.* 2015). After extensive consultation, development, input and testing of the proposed thresholds, The Global Standard for the Identification of Key Biodiversity Areas were established in 2016 (IUNC 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 (terrestrial, inland water, and marine) (IUCN 2016). All proposed KBAs must undergo independent scientific review prior to official site nomination with full documentation meeting the documentation 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). KBAs are sites significantly contributing to the global persistence of biodiversity that are identified at national levels using globally standardized criteria (IUCN 2012a, IUCN 2016). The main objective of the KBA knowledge product is "to provide information and analyses on the spatial location and relevant biodiversity of sites that contribute significantly to the global persistence of biodiversity to inform and guide appropriate management of these sites." (Brooks *et al.* 2015).

The KBA approach has been developed over the last 40 years by BirdLife International and others with more than 15,000 sites identified as Important Bird and Biodiversity Areas (IBAs) (BirdLife International 2019), Alliance for Zero Extinction (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 New World countries and territories (World Database of Key Biodiversity Areas

2019). All KBA data is housed in the World Database of Key Biodiversity Areas (http://www.keybiodiversityareas.org/home) and is managed by BirdLife International (BirdLife International 2019). The uses of the KBA knowledge product include: an indicator of biodiversity status and trends, policymaking (particularly in tracking Aichi Targets 11 and 12), conservation planning, public and private site management, support for local and indigenous communities and communication and raising awareness (IUCN 2012a).

Global Invasive Species Database (GISD)

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 (including their ecology, spread, management and impacts) that negatively affect native biodiversity and natural ecosystems (IUCN 2012a). This knowledge product aims to "increase public awareness about invasive species and to facilitate effective prevention and management activities by disseminating specialist's knowledge and experience to a broad global audience" (IUCN 2012a).

The GISD includes profiles for over 850 species that each include descriptions and images for identification of each species, invasiveness history, advice for early detection and response, and information about potential introduction and dispersal pathways and vectors (IUCN 2012a). For species that have established themselves, the GISD provides detailed management information for eradication and control techniques and valuable reference materials (IUCN 2012a). Each GISD species profile also includes the names and contact information of experts who can provide advice and further management information (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). This knowledge tool has a

wide range of users including businesses, conservationists, and policy makers who use it for management, communication and raising awareness, data, and analyses (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 *et al.* 2018).

IUCN Green List of Protected and Conserved Areas

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 IUCN Green List of Protected and Conserved Areas Programme (IUCN Green List Programme) "aims to encourage, achieve, and promote effective, equitable and successful protected areas in all partner countries and jurisdictions." (IUCN and WCPA 2017). The overarching objective of the Programme is "to increase the number of protected and conserved areas that deliver successful conservation outcomes through effective and equitable governance and management." (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 and WCPA 2017). The Standard is meant to provide an international benchmark for quality that encourages improved performance and achieve conservation objectives and improved results (IUCN and WCPA 2017). The Standard is reviewed at least every five years, in accordance with the ISEAL Code, in order to ensure consistency and quality (IUCN

and WCPA 2017). Indicators can be adapted to the national, subnational and regional level scales (IUCN and WCPA 2017). A "Green List" site is one that is currently evaluated and achieves all established Criteria, across all four components (IUCN and WCPA 2017). The Standard is "implemented through a jurisdictional approach, tailored to each country or region where the IUCN Green List of Protected and Conserved Areas is adopted." (IUCN and WCPA 2017). This is to allow for flexibility for each jurisdiction to be able to implement the Standard appropriately within their national context. Sites wishing to achieve "Green List" status must go through three phases; application, candidate, and Green List; and must demonstrate and maintain successful implementation of the Standard (IUCN and WCPA 2017). The Programme has a global partnership with Accreditation Services International (ASI) in order to ensure independence and credibility of decision-making that is ultimately in compliance with all ISEAL Codes of Good Practice (IUCN and WCPA 2017). Sites achieving a Green List certification are profiled on the Protected Planet Portal and receive support from the Programme to help maintain its status (IUCN and WCPA 2017). Each site receives a mid-term and final year review in order to ensure it maintains its compliance with the established Criteria and Components (IUCN and WCPA 2017). In the final year, the site manager must begin a renewal process to justify continued performance and adherence to the Standard, and thereby renew their status for a further period, usually five years (IUCN and WCPA 2017). This knowledge product is designed to assist national governments and their community partners to track and try to achieve Aichi Target 11 (a requirement of this target is the "effective and equitable management of protected areas") and can be used as an indicators of biodiversity status and trends, protected area management, and certification (IUCN 2012a).

IUCN Green List of Species

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 to be able to "(1) demonstrate impact of conservation efforts to date (conservation legacy); (2) identify dependence of a species on conservation actions (conservation dependence); (3) quantify expected gains resulting from conservation action in the medium term (conservation gain); and (4) specify requirements to achieve maximum plausible recovery over the long term (recovery potential)." (Akçakaya *et al.* 2018). This knowledge product was published in the literature very recently and is still in development; therefore, it is unlikely that any countries will have included it in their NBSAP or National Report.

Integrated Biodiversity Assessment Tool (IBAT)

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. This information 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.

The Global Biodiversity Information Facility (GBIF)

The Global Biodiversity Information Facility (GBIF) was established in 2001 and is an open access biodiversity database with thousands of contributing scientists worldwide. It was devised by the OECD Megascience Forum, which was initiated by a meeting of the OECD country's research ministers and has been recognized by the CBD as the "leading source of primary biodiversity data" (Costello *et al.* 2014). Financial support for this database is provided by the majority of countries since it supports their

commitments and policies under the CBD and other international agreements to make biodiversity data freely and publicly available (Costello *et al.* 2014).

Study Goal

The goal of this study is to examine if New World countries are using IUCN knowledge products to help construct NBSAPs or National Reports.

Study Design and Methods

The design and methodology used in this study was based on those found in Clabots and Gilligan (2017) and the sampling frame included all New World countries (**Table 1**) and Old World countries holding New World territories who are Parties to the CBD (**Table 2**). 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 through the CBD search portal through February 2019 (https://www.cbd.int/countries/). These conditions 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 remining were Version 3 (8.8 %) or Version 4 (1.5%). The National Reports were relatively evenly dispersed among reporting versions; 1st Report (17.6%), 2nd Report (18.2%), 3rd Report (19.5%), 4th Report (21.4%) and 5th Report (23.3.%). Keywords were selected based on all IUCN knowledge products included in the IUCN Knowledge Products Publication (IUCN 2012a) and the categories in the IUCN Red List of Threatened Species (**Table 3**). Keyword searches were performed in English, Spanish and French using MaxQDA qualitative analysis software's lexical search function in all documents (**Table 3**). Keyword searches were not performed in Portuguese for Brazilian documents as they were all written in English.

Table 1: Countries and Territories included with CBD Ratification Status

Country Name	Ratification Status (Year)
Antigua and Barbuda	Ratified - 1993
Argentina	Ratified - 1995
Bahamas	Ratified - 1993
Barbados	Ratified - 1994
Belize	Ratified - 1994
Bolivia	Ratified - 1995
Brazil	Ratified - 1994
Canada	Ratified -1993
Chile	Ratified - 1994
Costa Rica	Ratified - 1994
Colombia	Ratified - 1995
Cuba	Ratified - 1994
Dominica	Party by Accession - 1994
Dominican Republic	Ratified - 1997
Ecuador	Ratified- 1993
El Salvador	Ratified - 1994
Grenada	Ratified - 1994
Guatemala	Ratified - 1995
Guyana	Ratified - 1994
Haiti	Ratified - 1996
Honduras	Ratified - 1995
Jamaica	Ratified - 1995
Mexico	Ratified - 1993
Nicaragua	Ratified - 1996
Panama	Ratified - 1995
Paraguay	Ratified - 1994
Peru	Ratified - 1993
Saint Kitts and Nevis	Ratified - 1993
Saint Lucia	Party by Accession - 1993
Saint Vincent and the Grenadines	Party by Accession - 1996
Suriname	Ratified - 1996
Trinidad and Tobago	Ratified - 1996
United States of America	Non-Party
Uruguay	Ratified - 1994
Venezuela	Ratified- 1994

All country and document data retrieved from the CBD website's country profiles: https://www.cbd.int/countries/.

Table 2: Territories, Governing Countries and CBD Ratification Status

Governing Country	Territory Name	Ratification Status (Year)
United Kingdom	Anguilla	Ratified - 1994
	Bermuda	
	British Virgin Islands	
	Cayman Islands	
	Montserrat	
	Turcs and Caicos Islands	
Netherlands	Aruba	Accepted - 1994
	Bonaire	
	Curacao	
	Saba	
	Sint Eustatius	
	Sint Maarten	
Denmark	Greenland	Ratified - 1994
France	Guadeloupe	Ratified - 1994
	Martinique	
	Saint Barthelemy	
	Sint Martin	
	Saint Pierre and Miquelon	
United States	Puerto Rico	Non-Party
	US Virgin Islands	

All country and document data retrieved from the CBD website's country profiles: https://www.cbd.int/countries/.

Table 3: Keyword Search Terms

English	Spanish	French
IUCN	IUCN/UICN	IUCN
Red List(s)	Lista Roja/Listas Rojas	Liste Rouge/Listes 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
ECOLEX	ECOLEX	ECOLEX
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
Global Invasive Species Database/GISD	Base de datos global de especies invasoras/GISD	Base de données mondiale sur les espèces envahissantes/GISD
Global Register of Introduced and Invasive Species/GRIIS	Registro global de especies introducidas e invasoras/GRIIS	Registre mondial des espèces introduites et envahissantes/GRIIS
Green List	Lista Verde	Liste verte
IBAT	IBAT	IBAT
Global Biodiversity Information Facility/GBIF	Infrestructura Mundial de Información en Biodiversidad and Centro y Organización de Información Global de Biodiversidad/GBIF	Infrastructure mondiale de l'information sur la biodiversité/GBIF
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 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
- IUCN Partnership
- Workshop

Analysis

The final keyword counts were tabulated for each document and percentages were calculated for each individual keyword category to determine overall frequency across all NBSAPs and National Reports using MAXQDA's subcode statistics tool. 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 analysis was performed for each individual product as well to see potential differences in trends for each across time. The same analysis was also performed for each country to examine which are using the most knowledge products. An average was used because documents vary in length from 4 pages (Brazil's NBSAP Version 2) to 495 pages (Peru's Fifth National Report).

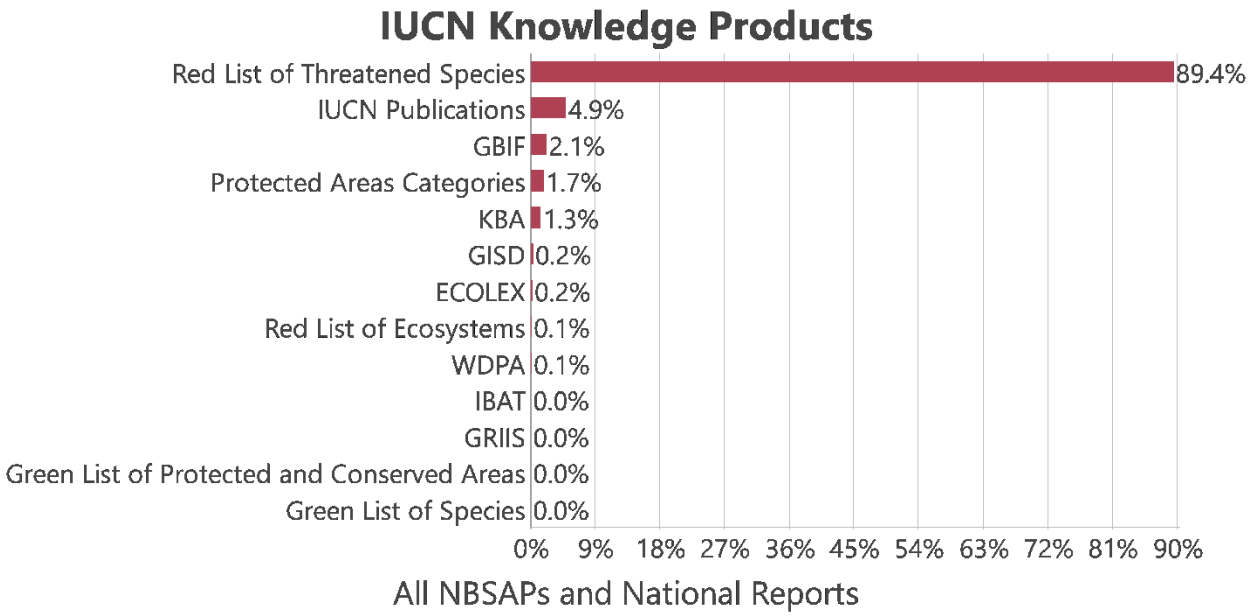
There are limitations with the study's design that should be considered when interpreting the results. It is important to note that NBSAPs and National Reports are continually published on the CBD website as the CBD Secretariat receives them, but this study will only contain the most recent country document produced through February 2019.

Results

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 7,287 coded segments for IUCN knowledge products across all documents. The vast majority of coded segments (89.4%) dealt with the IUCN Red List of Threatened Species. IUCN publications, GBIF, Protected Areas Categories, KBAs, GISD, ECOLEX, the Red List of Ecosystems and WDPA had small percentages of the remaining coded segments (10.6% total) (**Figure 2**). There was no mention of GRIIS, IBAT, the Green List of Species or the Green List of Protected and Conserved Areas or the Green List of Species in any of the documents.

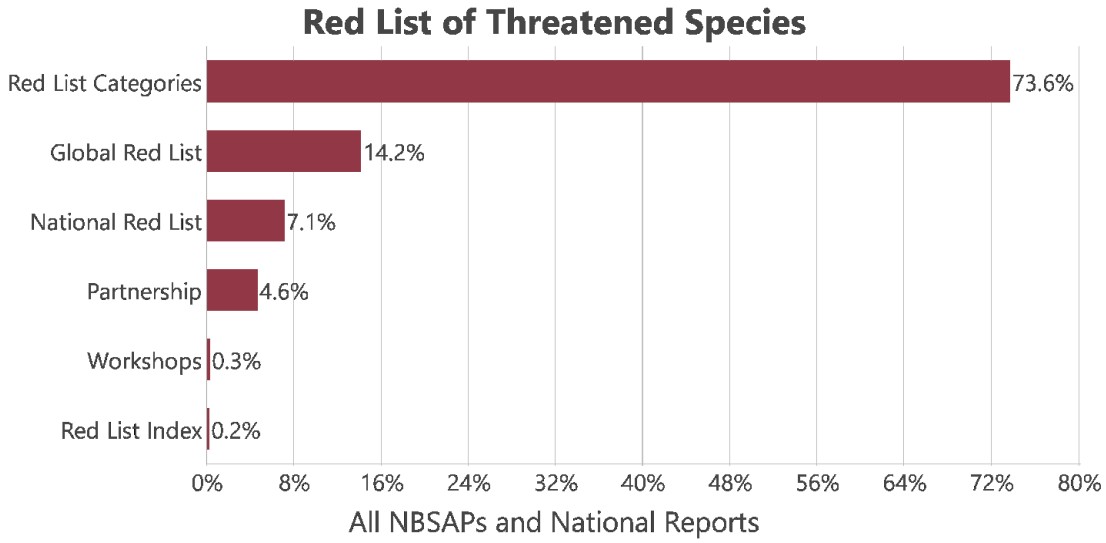
Figure 2: Overall use of IUCN Knowledge Products across all NBSAPs and National Reports



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, partnerships with the IUCN, Red List workshops and the Red List Index comprised the remaining coded segments (26.4%) (**Figure 3**).

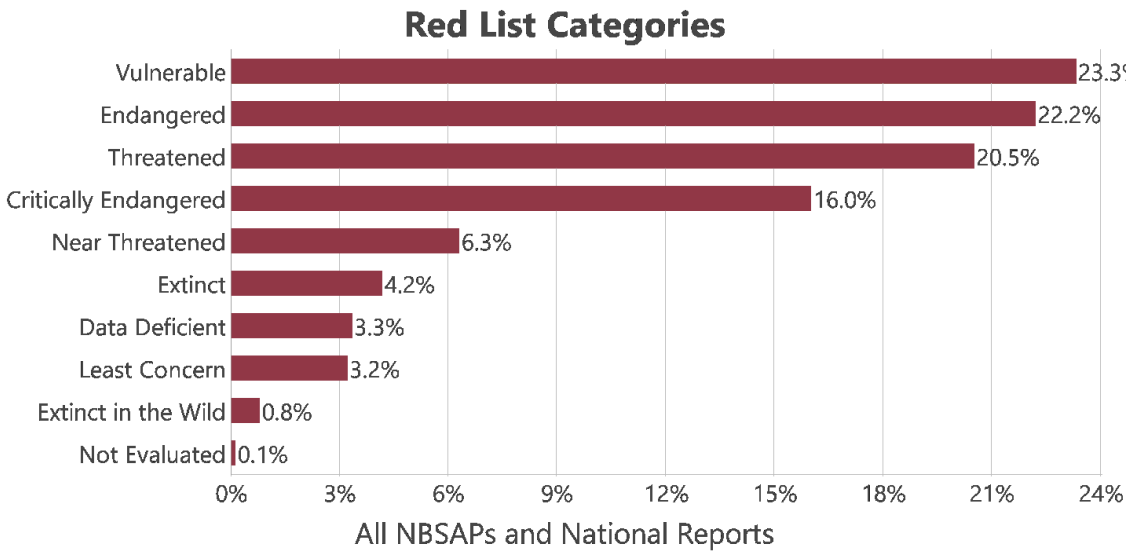
Figure 3: Use of Red List Data across all NBSAPs and National Reports



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**).

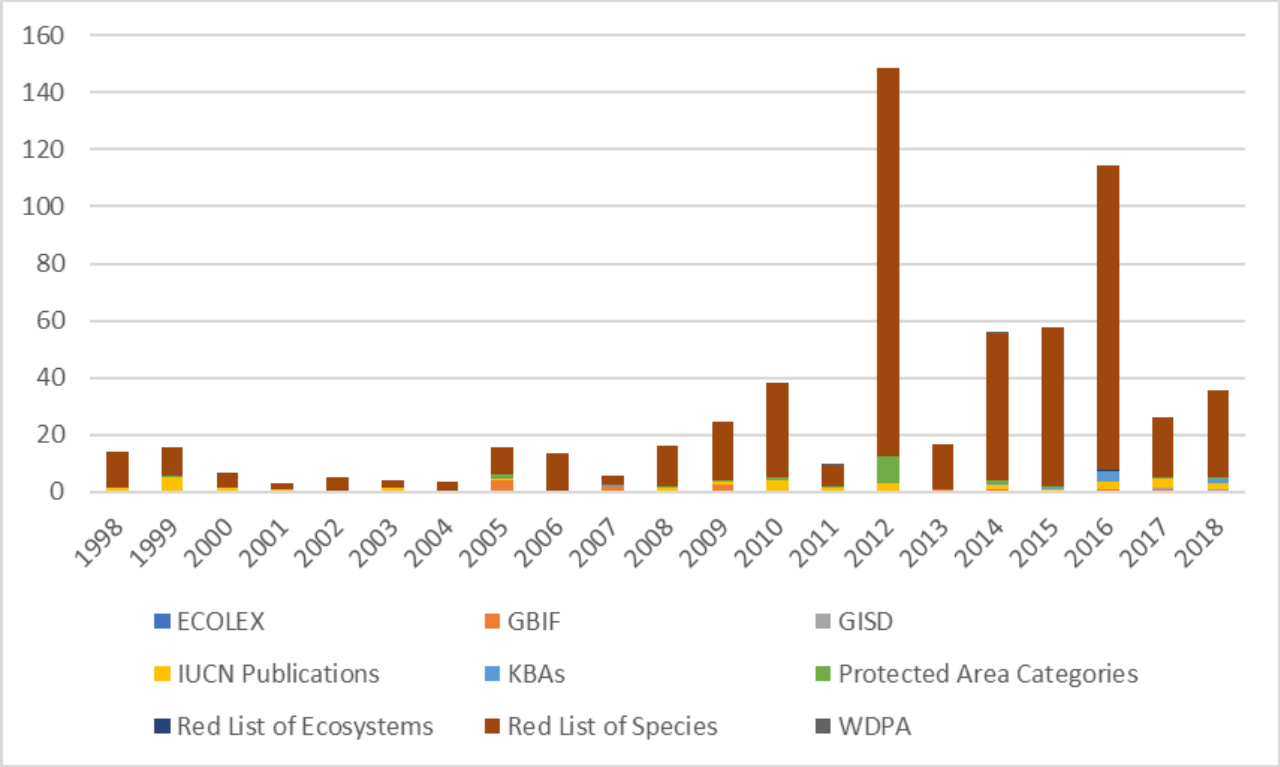
Figure 4: Use of IUCN Red List Categories across all NBSAPs and National Reports



Temporal Trends in IUCN Knowledge Product Use

The average number of IUCN knowledge product coded segments per year (from 1998-2018) was 30.1. The highest average occurred in 2012, with an average of 148.5 coded segments per document and the lowest average occurred in 2001 with an average of 2.9 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**).

Figure 5: Average number of individual IUCN knowledge product codes per document, NBSAPs and National Reports (1998-2018)



Green List of Protected and Conserved Areas, Green List of Species, GRIIS and IBAT not included since did not have any coded segments.

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 (**Figure 6**). Haiti's high average number of coded segments was driven by the high number of IUCN knowledge keywords (1075) included in its most recent (5th) National Report. There were 24 countries (**Figure 7**) with one or more documents with no coded segments for knowledge products. Grenada had the largest number of documents (5 total) without coded segments for knowledge products (**Figure 7**).

Figure 6: Average Number of IUCN Knowledge Product Coded Segments Per Document (All NBSAPs and National Reports)

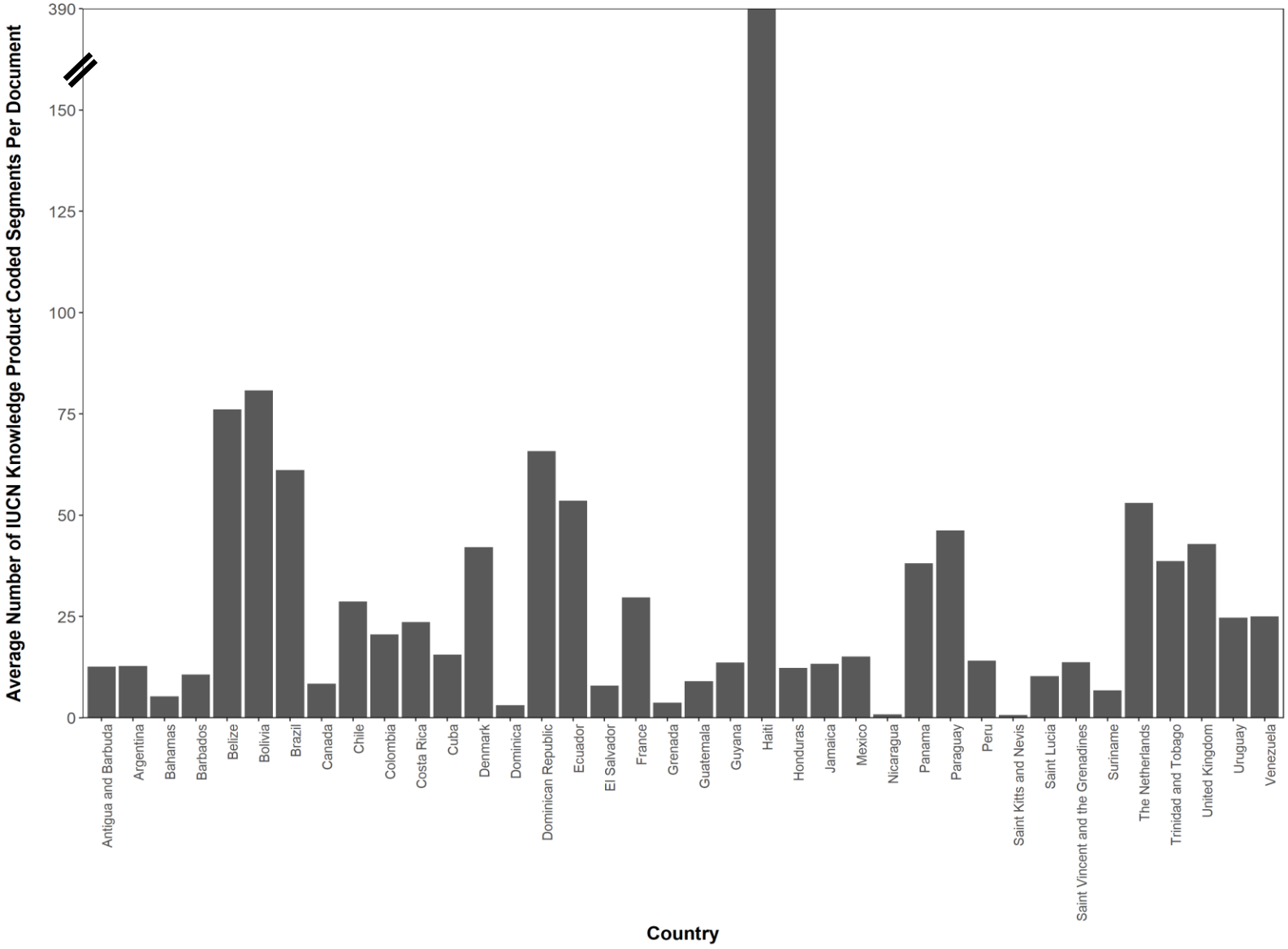
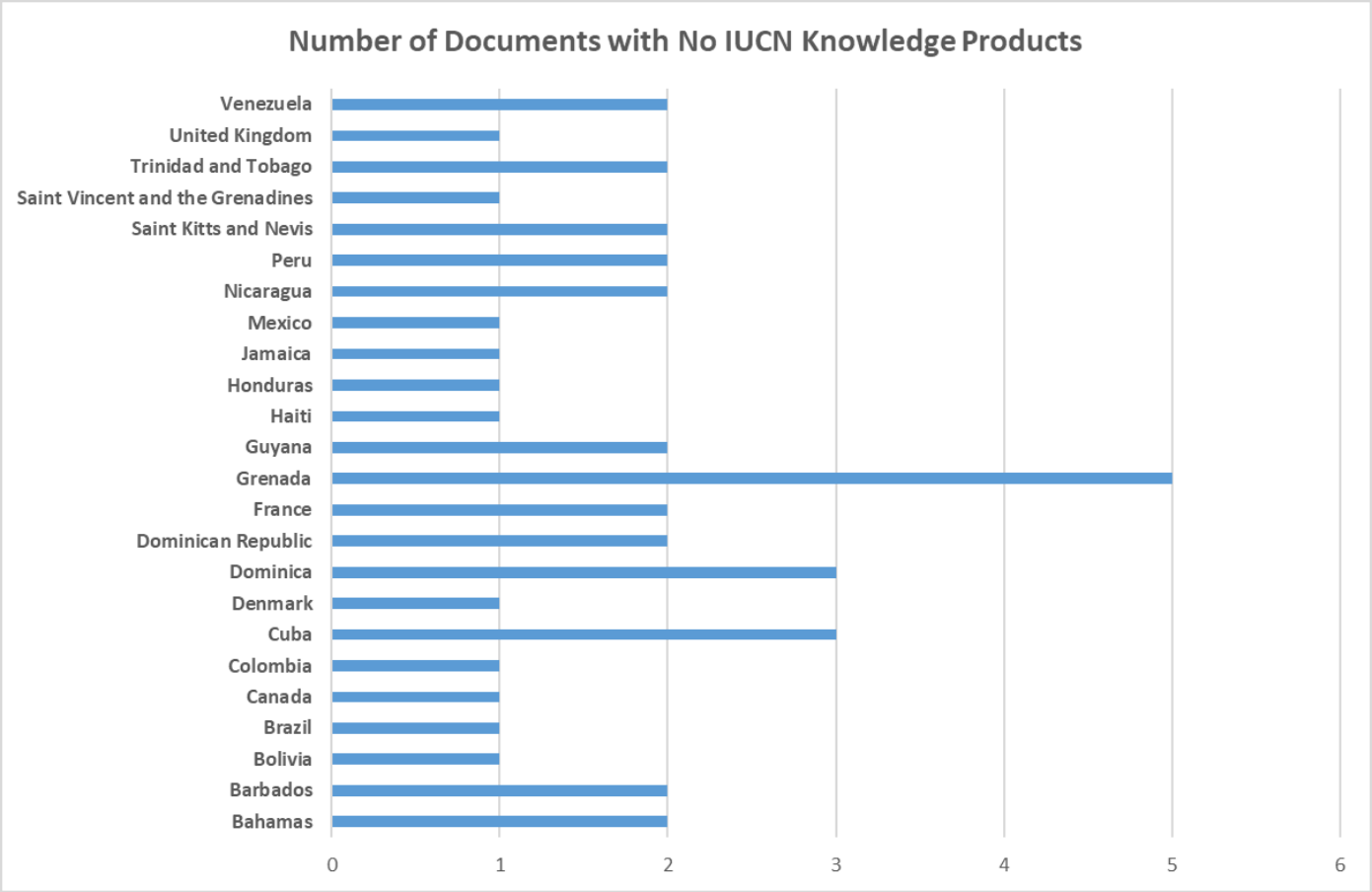


Figure: 7: Number of documents per country with no IUCN Knowledge Product Coded Segments



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, Lamoreaux, and Soberón 2014) creating critical challenges for conservation (Lacher *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 (Morgera and Tsioumani 2010, Chandra and Idrisova 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 and Dhillion 2003; Chandra and Idrisova 2011).

Aichi Target 17 (the development of updated NBSAPs) is considered one of the most important to achieve in order to make progress on the others (Adenle *et al.* 2015). Many of the first version NBSAPs were largely developed by environmental ministries and NGOs, without other stakeholder or industry input (Herkenrath 2002). Major international non-governmental and inter-governmental biodiversity organizations are assisting developing countries, including many New World 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 *et al.* 2018), and issues with raising and maintaining funding by the CBD (Adenle *et al.* 2015). Ulloa *et al.* (2018) suggest a voluntary peer review mechanism be put in place for the CBD as a "facilitating mechanism for the exchange of best

practices and lessons learned in the preparation, updating and implementation of NBSAPs. Its objectives are to: provide country-specific feedback; facilitate peer and individual learning; and enable greater transparency and public and peer accountability." NBSAP development and maintenance has the ability to 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 one of the more surprising results of this study and thus begs the question of why it is not being utilized for the development and maintenance of these documents. A potential reason is that countries are using their own national level datasets for protected areas due to a mismatch between national and global level datasets. 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). Better synergies between the WDPA and national governments could potentially facilitate more use of these products in future NBSAPs and National Reports to the CBD.

The absence of the Green List of Protected and Conserved Areas, the Green List of Species, GRIIS, 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 (Keith *et al.* 2013; IUCN 2016; IUCN and WCPA 2017) 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, 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 information 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, policy-makers and conservation scientists (Rose *et al.* 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 datasets for regional, subregional and national use (Brooks *et al.* 2015; Brooks *et al.* 2016; Han *et al.* 2017). Countries need to have the ability to be able to use these products at a national scale by being able to disaggregate the data or implement national level assessment processes if they are to increase the use of the knowledge products in their national level planning and policy making. IBAT is a key product for this need as 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, but use of these tools by national governments needs to be encouraged. The National Red List and KBA assessment processes are the two knowledge products that can be easily applied and implemented at the national level (IUCN 2012c; Brooks *et al.* 2015; 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 and 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. 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). 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 *et al.* 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, continue to be comprehensive in scope, and 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: (1) improved training and increased resources need to be provided to experts on the national scale; (2) better marketing of the knowledge products to national and local actors; and (3) 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 Sustainable Development Goals, however annual investment into these knowledge products is currently only a fraction of what is needed to maintain their currency, quality and scope (Hoffman *et al.* 2008; Brooks *et al.* 2015). 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 they 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.

IUCN knowledge products could also be used in conjunction with the essential biodiversity variables (EBVs) framework: genetic composition, species populations, species traits, community composition, ecosystem structure and ecosystem function (Pereira *et al.* 2013) to serve as a globally consistent long- and short-term indicators of the status of biodiversity. Schmeller *et al.* (2018) further proposed a suite of eight EBVs (abundance, allelic diversity, body mass index, ecosystem heterogeneity, phenology, range dynamics, size at first reproduction and survival rates) that would contribute to tracking 15 out of the 20 Aichi Targets. In addition, many of these proposed EBVs are interlinked, overlap with one another, act at differing timescales and at different variance magnitudes and so are able to serve as early warnings for one and another and allow for predictions (Schmeller *et al.* 2018). EBVs have the potential to serve as global (Pereira *et al.* 2013), regional, and national level indicators for biodiversity monitoring (Turak *et*

al. 2017, Vihervaara *et al.* 2017). A combination of knowledge products has been essential for tracking how well countries are meeting the Aichi Targets (Butchart *et al.* 2010, Butchart *et al.* 2012, Butchart *et al.* 2016) and how well they will meet future biodiversity targets.

Conclusion

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 failed to develop necessary indicators to track (Walpole *et al.* 2009) and meet the 2010 global targets of significantly reducing the rate of biodiversity loss (Morgera and Tsioumani 2010) 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 (Tittensor *et al.* 2014, Butchart *et al.* 2016, Mcowen *et al.* 2016). In addition, this breadth of targets creates a large reporting requirement for countries, which 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 and Tsioumani 2010). Less than half (46%) of the 54 elements that form the Aichi Targets have available and quantifiable indicators (Mcowen *et al.* 2016). The Aichi Targets needed to have a stronger scientific basis, instead of a political one, to be more easily quantified in the future and for a smaller number of more focused targets 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 and future biodiversity targets (Stafford-Smith 2014; Di Marco *et al.* 2016) 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). 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). IUCN knowledge products should continue to form an integral part of future indicators during this critical moment for biodiversity conservation.

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