Universidade de Aveiro
2021

ANA BARBARA ABREU GONÇALVES

2010 – 2020: A década da biodiversidade: uma perspectiva geral.

2010 – 2020 the decade of biodiversity: an overview.

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2010 – 2020 the decade of biodiversity: an overview.

Tese apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Doutor em Biologia e Ecologia das Alterações Globais (BEAG), realizada sob a orientação científica do Doutor Professor Henrique Miguel Pereira, Director do Grupo de Investigacao em Conservacao da Biodiversidade do German Centre for Integrative Biodiversity Research (iDiv) e do Professor Doutor Amadeu Soares, professor catedrático do Departamento de Biologia da Universidade de Aveiro

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Palavras-chave

Biodiversidade, objetivos de conservação, agenda global, política de conservação, metas de Aichi, mecanismos de compensação, áreas protegidas, Convenio da Diversidade Biológica, Protocolo de Nagoya.

Resumo

A biodiversidade está no cerne da Convenção das Nações Unidas sobre Diversidade Biológica (CDB), um acordo multilateral internacionalmente vinculativo, que estabelece o quadro de acção global sobre questões relacionadas com a biodiversidade e, por conseguinte, orienta o desenvolvimento de estratégias nacionais para a conservação e utilização sustentável da diversidade biológica. A convenção tem dois acordos complementares: o Protocolo de Cartagena (não abrangido por este trabalho) e o Protocolo de Nagoya, para além do já mencionado quadro global de objectivos de conservação, que coordena os esforços internacionais de conservação da biodiversidade. Este trabalho analisa a forma como o movimento ambiental e de conservação cresceu e ganhou um lugar no centro da agenda política, científica e da sociedade civil deste século e analisa os ganhos que a conservação da biodiversidade alcançou em duas décadas de compromissos globais para a conservação da biodiversidade. Até onde é que chegámos realmente?

As metas de Aichi são as metas internacionais de conservação do Plano Estratégico para a Biodiversidade 2011-2020 da Convenção sobre a Diversidade Biológica. Emergiram como uma versão SMARTer da meta Global Biodiversity 2010, quando esta meta não foi alcançada. Preocupantemente, o Global Biodiversity Outlook 4, já em 2014, sugeria que a maioria das metas de Aichi também não seriam alcançadas em 2020. No Capítulo IV, avaliamos as metas de Aichi em relação a dois grupos de características. O primeiro é o quadro SMART que pergunta se as metas são específicas, mensuráveis, orientadas para a ação, realistas e limitadas no tempo. O segundo, consideramos algumas outras características: semântica, ciência, aspectos socioeconómicos e progressividade temporal, que consideramos permitirem uma avaliação complementar do quadro SMART. A fim de avaliar cada uma das metas para cada uma destas características, utilizámos a metodologia Delphi e pedimos a um grupo de peritos em biodiversidade que pontuasse as metas. No geral, os peritos em biodiversidade que participaram no nosso estudo não consideraram as metas de Aichi SMART, com excepção das metas 10 e 14.

Neste trabalho, no capítulo III, analisamos mais de perto a meta 11 de Aichi, que visa "assegurar 17% da superfície terrestre dentro das áreas protegidas até 2020, tornando um sistema de áreas protegidas (AP) ecologicamente representativo e bem interligado". Esta meta procura também alcançar uma gestão eficaz e equitativa

das áreas protegidas. Contudo, a distribuição descontinua e a forma como as categorias de gestão da UICN se traduzem no terreno estão atualmente a pôr em risco a proteção da biodiversidade. É importante notar que nem todas as áreas protegidas estão igualmente bem protegidas e a consecução da meta 11 coloca desafios diferentes aos diferentes países. Investigámos a distribuição das actuais categorias de áreas protegidas da IUCN contra o uso do solo na Europa (28 Estados-Membros) e no Brasil e constatámos que, em ambas as regiões, o nível de presença humana no uso do solo não pode ser descontado, mesmo para as categorias de protecção mais elevadas da IUCN. Como previsto, a proporção de presença humana dentro das áreas protegidas era, para todas as categorias, mais elevada na UE do que no Brasil, não sendo a diferença entre elas tão significativa como se tinha anticipado. Ambas as regiões têm mais do dobro da área de áreas protegidas sob categorias de gestão sustentável (III-VI) do que sob categorias de protecção rigorosa (I & II). Esta é uma discussão importante, tendo em conta que existe um movimento crescente no sentido de se atribuir até 50% da superfície do planeta sob algum tipo de estatuto de protecção no âmbito do quadro para a biodiversidade pós-2020. Outra ideia que tem vindo a ganhar terreno é o envolvimento do sector privado e a necessidade de ter em conta os seus contributos para os objectivos globais de conservação da biodiversidade. No Capítulo II, o conceito de compensação da biodiversidade. As compensações em matéria de biodiversidade são mecanismos compensatórios cada vez mais utilizados para abordar os impactos ecológicos resultantes das actividades humanas. Analisamos a literatura científica sobre compensações da biodiversidade, publicada entre 1999 e 2014. Verificámos que os estudos de compensação da biodiversidade têm aumentado ao longo do tempo. A maioria dos estudos foi levada a cabo nos EUA. O desenvolvimento de esquemas de compensação da biodiversidade enfrenta desafios conceptuais e práticos. Os desafios conceptuais discutidos na literatura são: escolha do sistema métrico, entrega espacial das compensações, equivalência, adicionalidade, tempo, longevidade, rácios e reversibilidade. Os desafios práticos referidos na literatura são: cumprimento, monitorização, transparência e calendário da libertação de créditos. Entre estes, a escolha do sistema métrico e da localização é fundamental e está relacionada com a natureza multidimensional da biodiversidade e com os valores que a sociedade atribui à biodiversidade. As métricas harmonizadas, como as Variáveis de Biodiversidade Essencial (VBE), ajudam a enfrentar estes desafios, proporcionando a comparabilidade da perda e ganho de biodiversidade entre locais.

Finalmente, no Capítulo V, analisamos a implementação do Protocolo de Nagoya. O Protocolo de Nagoya (NP) sobre Acesso e

Partilha de Benefícios (ABS) é um acordo suplementar à Convenção sobre Diversidade Biológica (CDB) e tem por objectivo estabelecer orientações para os países fornecedores e utilizadores dos recursos genéticos (GR) e/ou conhecimentos tradicionais associados (TK), de modo a que o acesso a esses recursos se processe em condições mais justas e transparentes. Tais condições devem ser resolvidas e negociadas pelas partes envolvidas. Apesar de muitas questões não terem sido abordadas com suficiente pormenor ou clareza para ajudar as partes no PN a aplicá-las a nível nacional e, sobretudo, a garantir a devida diligência e o cumprimento a nível internacional, o PN constituiu um passo importante para a protecção da biodiversidade e a luta contra a biopiratária. Ao analisarmos o estado de implementação do PN na região do Sistema de Integração Centro-Americano (SICA), como nosso estudo de caso, esperamos não só contribuir para uma melhor visão global do estado de implementação do PN, após quatro anos da sua entrada em vigor, mas também colmatar uma lacuna de conhecimentos sobre o PN numa região para a qual nem sempre a informação é facilmente acessível aos utilizadores internacionais que pretendam cumprir o PN.

keywords

Biodiversity, conservation targets, global agenda, conservation policy, Aichi targets, biodiversity offsets, protected areas, Convention of Biological Diversity, Nagoya Protocol

Abstract

Biodiversity sits at the core of the United Nations Convention on Biological Diversity (UN CBD), an internationally-binding multilateral agreement, which sets the global action-framework on biodiversity-related issues and hence, guides the development of national strategies for the conservation and sustainable use of biological diversity. The convention has two supplementary agreements: the Cartagena Protocol (not covered in this work) and the Nagoya Protocol besides the already mentioned global conservation targets framework, which coordinate international conservation efforts and curb the pace of the current biodiversity crisis. This work looks at how the environmental and conservation movement has grown and gained a seat in the center of the political, scientific and civil society agenda of the century and analyses what gains has biodiversity conservation attained in two decades of global commitments taken for biodiversity conservation. How far have we really got?

The Aichi targets are the international conservation targets featured on the Strategic Plan for Biodiversity 2011-2020 of the Convention on Biological Diversity. They unfolded as a SMARTer version of the 2010 Global Biodiversity target, once it was clear the target would not met. Worryingly, the Global Biodiversity Outlook 4 in 2014, had already suggested that most of the Aichi targets would also not be met in 2020. On Chapter IV we assess whether the targets against two groups of characteristics. The first is the SMART framework that asks whether target are specific, measurable, action-oriented, realistic and time-bound. The second, we consider a few other characteristics: semantics, science, socio-economic aspects and time-progressiveness, that we felt allow for a complementary assessment of the SMART categories. In order to assess each of the targets for each of these characteristics, we used the Delphi methodology to ask a group of biodiversity experts to score the targets. Overall, the biodiversity experts that participated in our study did not considered the Aichi targets to be SMARTly designed, with the exception of targets 10 and 14.

In this work, in Chapter III, we take a closer look at Aichi target 11, which aims *"to secure 17% of the terrestrial surface within protected areas by 2020, making an ecologically representative and well-connected system of protected areas"* (PAs). This target also seeks to achieve effective and equitable management for these areas. However, uneven distribution and how IUCN management categories translate on the ground are currently

jeopardising protection of biodiversity. Importantly, not all protected areas are equally well protected and reaching target 11 presents different challenges for different countries. We investigated the distribution of the existing IUCN protected area categories against land use for Europe (28-member states) and Brazil and found that in both regions the level of human presence on land use cannot be discounted even for the higher protection IUCN categories. As expected, the proportion of human presence inside protected areas was for all categories higher in the EU than in Brazil, being the difference between them not as significant as anticipated. Both regions have more than double the area of protected areas under sustainable management categories (III-VI) then under strict protection categories (I & II). This is an important discussion in the light that there is a growing movement pushing for up to 50% of the planet´s surface to become assigned under some sort of protection status in the post-2020 Biodiversity Framework. Another idea that has been gaining track is the involvement of the private sector, and the need to account for their contributions towards biodiversity conservation global targets. In Chapter II, the concept of biodiversity offsets. Biodiversity offsets are compensatory mechanisms increasingly used to address ecological impacts resulting from human activities. We review the scientific literature on biodiversity offsets, published between 1999 and 2014. We found that biodiversity offset studies have increased through time. The majority of studies have been carried out in the USA. The development of biodiversity offsets schemes faces conceptual and practical challenges. The conceptual challenges discussed in the literature are: choice of metric, spatial delivery of offsets, equivalence, additionality, timing, longevity, ratios and reversibility. The practical challenges reported in the literature are: compliance, monitoring, transparency and timing of credits release. Amongst these, choice of metric and location are paramount and are related to the multidimensional nature of biodiversity and the values society places on biodiversity. Harmonized metrics such as the Essential Biodiversity Variables (EBVs) help to address these challenges by providing comparability of biodiversity loss and gain amongst locations.

Finally, in Chapter V, we look at the implementation of the Nagoya Protocol. The Nagoya Protocol (NP) on Access and Benefit-sharing (ABS) is a supplementary agreement to the Convention on Biological Diversity (CBD) and aims to establish guidance to both provider and user countries of genetic resources (GRs), and/or associated traditional knowledge (TK) so that access to those resources happen under fairer and more transparent conditions. Such conditions are to be settled and negotiated by the parties involved. Despite many issues not being addressed in enough detail, or with enough clarity, to assist the parties to NP implementing it at national level and above all ensuring due diligence and compliance at international level, the NP has marked an important step for the protection of biodiversity and the fight against biopiracy. Looking at the status of implementation of the NP, since it´s adoption in the Central American Integration System (SICA) region, as our study region, we hope to not only contribute to a better overview of the status of implementation of the NP worldwide, after four years of it coming into force, but also to fulfil a gap in knowledge concerning the NP in a region for which information is not always easily accessible for international users wanting to comply with the NP.

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CHAPTER I - INTRODUCTION

Biodiversity sits at the core of the United Nations Convention on Biological Diversity (UN CBD), an internationally-binding agreement which, defines biodiversity in its Article 2 as: "*the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems*". Hence, biodiversity encapsulates the concepts of "biological" and "diversity" into one word and refers to not only the diversity of life forms on Earth but also the variability within and among them.

The CBD is the only global framework for action on biodiversity-related issues and it emerged as result of decades of increasing concerns related to the "health" of the natural World and the impact humans have been having on it ever since the Industrial Revolution. Initially, during the 19th century, issues related to the impact of air pollution drove much of the environmental movement but after the World War II, in the 20th century, several environmental disasters brought to the fore the costs of environmental negligence and the environmental movement grew more systematic and broadened its scope. Concepts such as setting aside natural areas for its own value i.e. "intrinsic value" (protected areas concept) and conservation efforts targeting specific species started to be advocated. With the adoption of the CBD, in 1992, we, as the human species, recognize that biodiversity conservation is a common concern for humankind – because of its finite nature – as well as our dependence on it for our survival and wellbeing – hence, the pressing need to sustainably make use of its resources.

The CBD entered into force in 1993 and has three main goals:

1) the conservation of biological diversity

2) the sustainable use of its components, and

3) the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

Helping to bring the above goals into practice, the CBD has two supplementary Protocols: the Cartagena Protocol on biosafety (not covered in this work) and the Nagoya Protocol on genetic resources and benefit sharing, which sets a legally binding framework to implement the 3rd goal of the CBD. Since the early days of the environmental movement the vision and interpretation on biodiversity conservation has changed immensely. In opposition to the "intrinsic value" approach to conservation, when the environment movement started to gain adepts and under which value is derived from a moral commitment of respect toward an "object" for what it is, its innate existence, nature, independent of human affairs (Oksanen, 1997; MacShane, 2007) stands the "sustainable use" approach. The latter emerged in the 90´s, advocated by the CBD, and slowly a shift towards "instrumental value" of biodiversity became mainstream (Karlsson-Vinkhuyzen et al., 2017). "Instrumental value" attributes value to something in relation to other desired ends (trade off) from an anthropocentric perspective. Essentially value is attributed by comparison, evaluating the tradeoffs of alternative management strategies, sometimes between conflicting desired ends: conservation versus economic development for example is the most common situation. The decision to go for a specific management strategy requires quantitative estimates of the costs and benefits of the outcomes, such as the value of biodiversity lost or conserved. In many ways, the debate between these two approaches to conservation is philosophical in nature and they can be the further apart the more rigid the approach is towards either end of the spectrum. The "instrumental value" approach has gained more adepts and strongly influenced conservation management in the past two decades, in line with the CDB framework. In an effort to better support decision makers faced with the challenge to balance conservation and development projects in a given situation, several economic instruments have been applied to conservation (Justus et al, 2009; Karlsson-Vinkhuyzen et al., 2017). A "win-win" approach is always the preferred one, as advocated by the CBD. An indicative monetary value related to biodiversity loss, or the cost of restoring a lost service provided by it, are approaches that have typically been used to support decision-making processes. An example of an instrument is for instances the "Total Economic Value" (TEV), which enables commercial and/or extractive values to be taken into account in the decision-making process but also non-market values, such as ecological functions and non-use benefits, making the process more robust and comprehensive.

Efforts to make sustainable development a reality, have been on the international agenda since 1972 with the Stockholm Summit on Sustainable Development. However, it is in the early 2000´s with the adoption of the Millennium Development Goals (MDGs), at the United Nations (UN) General Assembly, as a framework to halve the incidence of poverty and hunger until 2015 in the World, that a clear complex connection between biodiversity and sustainable development is made evident (U.N., 2005; Sachs et al.,2009). In the 6th Conference of the Parties (COP) to the CDB, in 2002, declines in biodiversity and a wave of growing extinctions (Tilman et al,1994) prompted the adoption of the 2010 Global Biodiversity target: "to achieve by 2010 a significant reduction of the current rate of biodiversity loss at global, regional and national level, as a contribution to poverty alleviation and to the benefit of all life on Earth" (www.cbd.int/2010-target). This goal was incorporated into the MDGs framework in recognition of the impact biodiversity plays on human's well-being and the therefore determinant role it holds in the fight against poverty and hunger (Sachs et al, 2009). Come the time, the 2010 Global Biodiversity target was however not met (GBO3, 2010; Walpole et al.,2009). Scientific studies and reports argued that the 2010 Global Biodiversity was too vague and difficult to measure (Mace et al, 2007; Walpole et al, 2009; GBO3, 2010; Mace et al., 2010). Global progress towards the 2010 Global Biodiversity target, was guided by a set of 22 cross-disciplinary headline indicators adopted in 2006 by the CBD. Studies claim that at the time, the selection of indicators was more influenced by the availability of data then the result of an assessment for rigour and relevance (Mace and Baillie, 2007). In 2010 the CBD adopted a new Strategic Plan for Biodiversity, which included 20 conservation targets, the Aichi Targets (AT), which set the roadmap for nations to safeguard biodiversity until 2020. Unlike the 2010 Global Biodiversity target, parties to the CBD agreed on the need to smartly design biodiversity goals and so a SMART framework, i.e. specific, measurable, ambitious, realistic and time-bound, an approach for target setting borrowed from the business world, guided the process (Maxwell et al, 2015). The new bite-size 20 biodiversity goals brought many improvements, such as for example addressing the state of biodiversity, bringing into focus the agents of pressure and drivers of change on biodiversity as well as integrating the third objective of the CBD on access and benefit sharing – as translated in the Nagoya Protocol adopted in 2010, and biodiversity issues across many sectors (Brooks et al. 2015). However, as the 2010–2020 decade now comes to an end it is yet again unquestionable that most of the Aichi Targets have not been met (Marque et al., 2014; Hagerman and Pelai, 2016; IPBES, 2019).

The present biodiversity crisis is unmatched despite increasing efforts from the international community and society to slow biodiversity loss. The aim of this thesis was to contribute a general reflection on the opportunities the past shortcomings to address the biodiversity crisis can offer: learning with past mistakes. Hence, in this work, the main commitments to act and address the crisis of biodiversity made back in 2010 within the framework of the CBD, through the Strategic Plan for Biodiversity, which included 20 concrete targets, the Aichi targets, and the Nagoya Protocol, which addressed the issue of biopiracy, are discussed and analyzed. This work starts with a review of biodiversity offsets, one of the instruments increasingly used to compensate ecological impacts resulting from human activities, and the main challenges inherent to its application on the ground. The Strategic Plan for Biodiversity for 2010-2020 is then addressed, in particular Aichi target 11 which aimed to secure 17% of the terrestrial surface within protected areas by 2020. A comparison between Europe and Brazil IUCN protected areas classification is explored. Still addressing the Strategic Plan for Biodiversity for 2010-2020, a group of biodiversity experts is asked to overall assess how SMARTly designed they consider the Aichi targets to be and ask experts to further rate the importance a proposed list of other criteria would be in the future of setting biodiversity targets. Finally, the advancements related to the implementation of the Nagoya Protocol in Central America as well as the challenges are presented.

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CHAPTER II: Biodiversity Offsets: from current challenges to harmonized metrics

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1.Introduction

Biodiversity offsets are a mechanism to compensate unavoidable impacts of a project or plan on biodiversity through conservation or restoration actions (BBOP, 2013; Bull et al., 2013). Compensatory measures should only be considered after exhausting the previous steps on the mitigation hierarchy: avoidance and minimization (Kiesecker et al, 2009). If avoiding and minimizing the impacts did not neutralize the negative effects of a project development on biodiversity, then compensatory measures such as biodiversity offsets potentially become the next step. Biodiversity offsets are different from other ecological compensatory measures because they target residual impacts and enforce measurable outcomes, that is, losses to biodiversity caused by the project and the gains obtained by the conservation action are quantified in the same way and must be comparable (DEFRA, 2012; BBOP, 2013).

Hence, not all compensatory actions are offsets. For a compensatory action to qualify as a biodiversity offset, a range of criteria should be met. Besides compensating for residual ecological damage (Ten Kate et al., 2004, BBOP, 2012) and delivering quantifiable outcomes, an often-stated goal of biodiversity offsets is to deliver 'no net loss' of biodiversity, and preferably net gain (BBOP, 2013). However, most biodiversity offsets compensate for one or just a few dimensions of biodiversity, like species composition, habitat structure, ecosystem function or cultural values (McKenney, 2005; Crowe et al, 2010), and it can be difficult to achieve full equivalence between the impact and the biodiversity offset. Finally, biodiversity offsets should prove additionality. Additionality refers to the conservation benefit or gain produced as a result of delivering an offset that would have not arisen in the absence of the compensation action (McKenney, 2005; Kiesecker et al, 2009; Madsen et al, 2010). The additional conservation value generated by an offset is the difference between the outcome of when a biodiversity offset is put in place relative to when is not (Maron et al, 2013). The most common form of guaranteeing 'additionality' is though habitat restoration (Maron et al, 2012). But additionality can also be achieved through measures like habitat creation (BBOP, 2012; Morris et al., 2006) or by affording protection to areas under imminent, or projected, biodiversity loss (BBOP, 2013; Gibbons et al, 2007). Biodiversity offsets gained momentum in the last decade in the policy arena and within the private sector (Crowe and Ten Kate, 2010; Madsen et al., 2011; Burgin, 2008). There is an increasing number of policies, directly or indirectly, referring to biodiversity offsets, such as the EU No Net Loss initiative for 2015, part of the EU 2020 Bio-diversity Strategy (EC, 2011). In the private sector, a growing number of investment institutions demand offsetting as a condition to access credit, for example the International Finance Corporation has a performance standard that requires development projects to consider biodiversity offsets (IFC,2012). However, the implementation of biodiversity offsets still faces many challenges (Bull et al, 2013; McKenney and Kiesecker, 2010). Bull et al. (2013) distinguishes two main types of challenges: conceptual issues which can be addressed by ecological research; and practical issues related to the governance and implementation of biodiversity offsets. Solving these challenges, could allow biodiversity offsets to mature and deliver the promised benefits locked in the concept behind them, thus creating new opportunities for conservation. Here we aim to understand how the academic community has contributed to solve these pressing issues and how future research can enhance biodiversity offsets implementation.

2.Conceptual and practical challenges in the biodiversity offsets literature

We used the ISI Web of Science database to search for scientific published literature on biodiversity offsets be-tween 1999 and 2014. We selected articles that specifically analysed biodiversity offsets and not ecological compensation measures in a broader sense. For each paper we identified which biodiversity offsets challenges were analysed according to the following categories: equivalence, location, additionality, timing, longevity, currency, ratios, reversibility, compliance, monitoring, transparency and credit issuing (Table 1).

Table 1. Conceptual and practical issues on biodiversity offsets. (Adopted from: McKenney and Kiesecker, 2010 and Bull et al., 2013)

Conceptual	Practical
Equivalence	*Compliance*
Whether the loss of biodiversity in one location can be compensated by gains on another location, for instances demonstrate No Net Loss	Whether existing regulations and guidelines are followed
Location	*Monitoring*
Spatial allocation of offsets in relation to impacts (on-site versus offsite)	How well offsets ecological performance is followed after implementation stage is over
Additionality	*Transparency*
A new contribution to biodiversity conservation that results from the offset delivery	How transparent is the process of biodiversity offsets implementation and monitoring
Timing	*Credit issuing*
	At what stage of offset implementation are the credits issued to the impact proponent

Addressing the temporal lag between impact occurrence and compensation benefits accruing (prior versus after)

Longevity

How long offsets are expected to last for, for example, in perpetuity versus for a long as impact occurs

Ratios

The use of ratios, or multipliers, is commonly used as a strategy to manage uncertainty in offset delivery, for example, correction for time lags

Reversibility

Whether impacts are permanent or temporary and whether the impacted biodiversity has the capacity to fully or partially return to its previous state once the impact is removed

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We performed a literature review to understand the extent to which the research community has contributed to solve the most pressing theoretical and practical issues, identified by Bull (2013) and McKenney and Kiesecker (2010) related to the implementation of biodiversity offsets (Table 1). We searched the ISI Web of Science by topic using the following individual search terms: biodiversity offsets OR biodiversity markets OR biodiversity credits OR wetland banking OR conservation banking. The search was further refined for articles and reviews published between 1999 and 2014, in English language only, and classified to fall into environmental sciences ecology or biodiversity conservation research areas. There has been a great number of non-scientific reports (grey literature) published on biodiversity offsetting, which have greatly contributed for advancing our understanding of them (e.g. work by Business and Biodiversity Offset Program), however we intentionally restricted our search to scientific literature because we wanted to understand how much attention the academic community is giving to the development of biodiversity offsets.

The search yielded a total of 6,768 prospective papers. Subsequently, each of the papers was screened to determine their relation to biodiversity offsets. A total of 207 papers were kept for further analysis. For each paper conceptual and practical issues were identified and noted down using the typology of Table 1. One paper could discuss more than one issue. For more details on the specific published studies analysed, see the excel table named ***Annex I***.

We found that research effort on biodiversity offsets has been increasing in the last fifteen years (Figure 1). About 57% of the studies been led by an author affiliated to an USA institution (Figure 1). This result is not surprising since the USA has pioneered biodiversity offsetting with the wetland mitigation program in the early 1970s (Ambrose, 2004).

The wetland mitigation program focused exclusively on offsetting wetlands lost to development and in 1990 a goal of no net loss of area or functional capacity was established under the Clean Water Act (EPA, 1990). Since then, the goal of no overall loss of function and area has been applied to other habitats as well as to impacts on protected species, both in the USA and abroad (Gibbons and Lindenmayer, 2007; Burgin, 2008; Bekessy et al., 2010). The USA Wetland Mitigation program has in many ways influenced the different biodiversity offset schemes worldwide (Burgin, 2008; Boisvert et al., 2013). In recent years, scientific research on biodiversity offsets has gained importance in Europe (Figure 1).

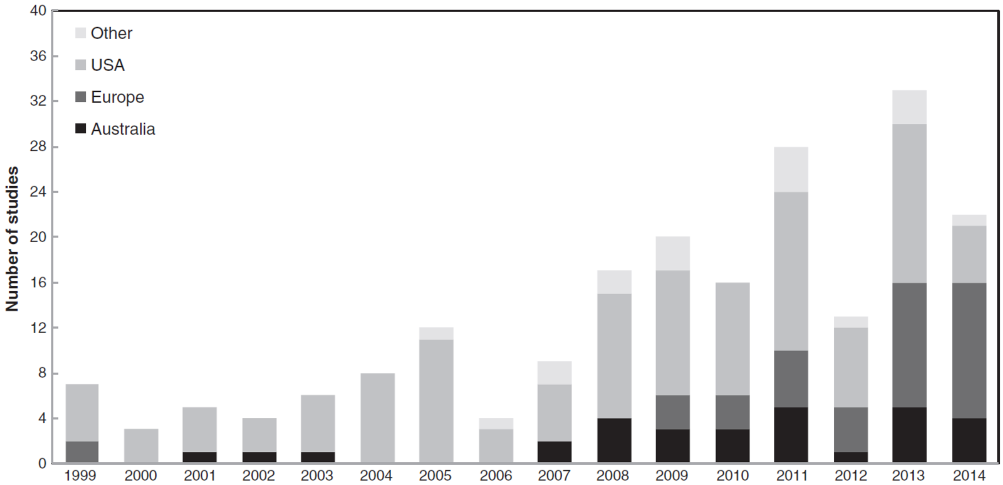

Figure 1: Number of studies published on biodiversity offsets between 1999-2014 per world region.

The research momentum seems to follow an increase in policy and societal attention to biodiversity offsetting in Europe. For instance, the EU Biodiversity Strategy for 2020, in connection to the Aichi 2020 Target 15 on ecosystem restoration, seeks to ensure no net loss of biodiversity and ecosystem services (EU, 2014). An European No Net Loss initiative has been initiated which includes the development of biodiversity offset schemes as one of the policy options. Currently compensation of unavoidable negative impacts on biodiversity is a legal requirement in Europe, through the Birds and Habitats Directives and the Environment Liability Directive, but only in the case of damages to the Natura 2000 network of protected areas. However, given the current rate of biodiversity loss in the EU, the No Net Loss initiative seeks to develop mechanisms beyond the current legal requirements. Another aspect of the discussion of biodiversity offsets in Europe relates to how offsetting could potentially raise extra funding for conservation (Klassert and Möckel, 2013). In the UK and France offsetting is currently being tested (Quétier et al., 2014; Regnery et al., 2013; DEFRA, 2013). Germany has a well-established system for offsetting and mitigating impacts that goes beyond protected species and protected areas. The German Impact Mitigation Regulations (IMR), based on the Federal Nature Conservation Act, aim to compensate for impacts in entire ecosystems and landscapes. However, there are no legal provisions in the IMR specifying how to assess the initial state of the area to be affected, the probably impacts resulting from the intervention or the appropriate methodology to determine compensation (Darbi and

Tausch, 2010). Recent reviews on biodiversity offsets have identified conceptual and practical issues hindering biodiversity offsets implementation (Table 1).

The conceptual issues more discussed in the literature were currency, location, and equivalence (Figure 2). The practical issues more frequently mentioned were compliance, transparency and monitoring. Some issues were recurrent through the period of time analysed in our survey, such as the conceptual issues of currency, location and ratios and the practical issue of monitoring. This may be because these issues, which are still under discussion, are at the core of the concept of biodiversity offsetting. By contrast, issues like longevity and reversibility emerged in the literature more recently. Longevity may have emerged later be-cause, as more biodiversity offset projects are implemented, the problem of funding these offsets through time becomes a concern (Bull et al, 2013; Habib et al., 2013; Hahn and Richards, 2013). The rise of studies addressing reversibility may be related to the recognition that biodiversity offsets have limitations in addressing irreversible biodiversity loss. According to the mitigation hierarchy perspective, biodiversity offsets are not an option to compensate for impacts on habitats with high irreplaceability (Piligrim et al., 2013). However, the mitigation hierarchy is not always effectively followed (Kiesecker et al., 2009; Clare et al., 2011). For example, a recent study reviewed national EIA processes and the mitigation hierarchy in Latin America. The study found that in the countries analysed, most national EIA laws or regulations have been enacted in the last decade. However, only in some of the countries regulations mention the complete mitigation hierarchy and in none of the countries regulations require adherence to it. Requirements for measures of impact avoidance were particularly overlooked (Villarroya et al., 2014). The majority of studies relate to freshwater environments (66%), in particular wetland ecosystems, followed by terrestrial environments (47%), while some recent studies start to explore the marine environment (1%). This dominance of freshwater studies is to be expected since the US Wetland Mitigation Program pioneered offsetting. We now explore the two most discussed conceptual issues in the biodiversity offsets literature, currency and location, in more detail.

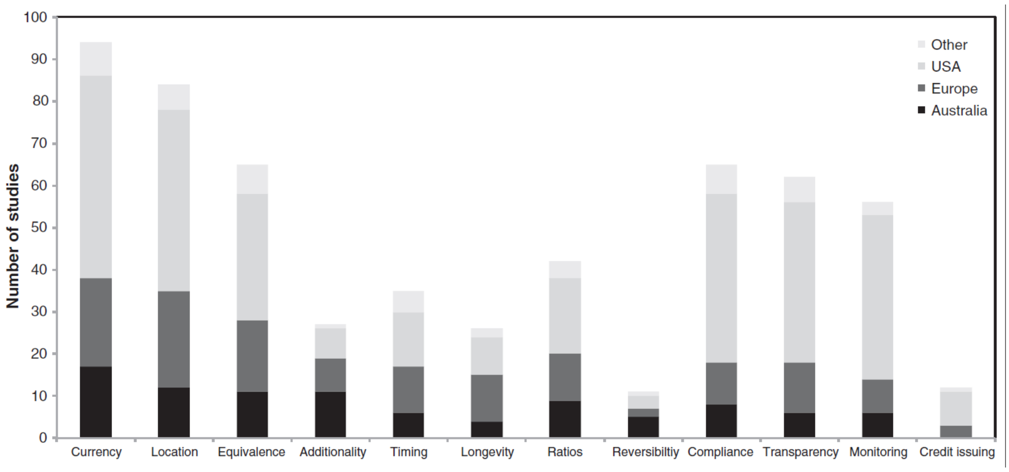

Figure 2: Number of studies on the different biodiversity offsets issues featured in the literature broken by world regions.

3.Currency: the choice of metric for biodiversity

The issue of choice of metric is complex and directly associated with the multidimensional nature of biodiversity (Pereira et al., 2012; Buckland, 2009; Mace, 2005; Studeny et al., 2011). In addition, it is controversial whether biodiversity values across different dimensions of bio-diversity can be converted to a common metric or exchanged between geographical locations (Bartosz et al., 2015). The choice of metric will influence how gains and losses are accounted for and therefore how equivalence and No Net Loss are met. The choice of metric will also influence the calculation of offset ratios to manage uncertainties and the choice of location for the offset actions. In the early offset projects, area alone was the currency used: the area impacted was offset by at least an equal area elsewhere (King and Price, 2004). However, as our understanding of ecosystem function grew, area by itself became no longer an adequate metric (Quétier and Lavorel, 2011; Parkes et al., 2003). Several methods have been developed to supplement area measurements in order to account for multiple biodiversity dimensions such as the condition, quality, ecological function and integrity of ecosystems (Bull et al, 2013; McKenney and Kiesecker, 2010; Gardner et al., 2013; Treweek et al., 2010). The use of compound metrics usually results in a more comprehensive measurement of biodiversity but adds complexity on comparisons across locations (Robertson, 2004). If an aggregated measure is used, the equivalence of the impacts and the restorations actions for each dimension can be difficult to assess. Up to now, biodiversity offsets have operated locally or regionally, often on a case-by-case basis. Therefore, each offset scheme has developed its own methodology, taking into account its particular context and compensation goals. This modus operandi makes it difficult to measure and compare the performance of the different projects in relation to each other, as well as to assess best practices (BBOP, 2013). A recent study by Bull et al. (2014) compared different methodologies and metrics used in biodiversity offset schemes, using gas extraction projects in Uzbekistan as a case study. They found that different methodologies resulted in different requirements to achieve no net loss. They argued that transferability of offsets across schemes or jurisdictions is limited. Equivalence between credits generated in different schemes could be assessed if standard methodologies were adopted (Bull et al, 2013; Alvarado-Quesada et al., 2014). However, due to the complex nature of biodiversity, standardization across the different schemes in operation, or under development, may effectively be possible only to a certain degree.

4.Location: the choice of place for offsets delivery

Offset site selection and how selected sites sit within the broader landscape is another important aspect of offset design (Kiesecker et al., 2009). The choice of site has important ecological implications and is intrinsically dependent on the choice of metric used. Biodiversity offsets can be delivered in the vicinity of the area impacted (McKenney and Kiesecker, 2010). The logic behind delivering offsets at close proximity to the lost habitat is that it increases the chances of contributing to the conservation and integrity of the same ecosystem as well as the needs of local people. When both proximity and social–

ecological equivalence are met, offsets are classified as 'in-kind' — for quality — and 'on-site' — for spatial location (Crowe and Ten Kate, 2010; Moilanen et al., 2009). On-site and in-kind offsets promote transparency of the offset delivery and render the demonstration of no net loss easier. However, the literature on systematic conservation planning suggests that, in certain circumstances greater environmental benefits result when offsets can be aligned with landscape or regional conservation goals, which may be 'out-of-kind' and 'off-site' (Gordon et al., 2011; Underwood, 2011; Kiesecker et al., 2009). Advantages of off-site offsets also include their potential to secure protection of non-statutory sites of local biodiversity importance, to incorporate landscape aspects of population dynamics of threatened species, or as a source of conservation funding for biodiversity conservation initiatives. A preference for 'on-site' delivery of offsets has been increasingly loosened by several schemes in favour of better alignment with conservation goals at broader scales (McKenney and Kiesecker, 2010; Habib et al., 2013). However, this trend in favour of 'off-site' and 'out- kind' type of offsets, is not always desirable and presents some philosophical challenges associated with the comparability of biodiversity values and the spatial distribution of impacts and benefits to local human communities.

5.Harmonizing metrics for biodiversity offsets: the EBV framework

The next decade will be crucial for biodiversity offsets and conservation. As more schemes emerge it is important to assure they deliver the promised biodiversity conservation benefits (Curran et al., 2014; Gordon et al., 2015). Our analysis suggests that two of the most pressing conceptual issues associated with implementation of biodiversity offsets are the choice of metric and location. Their choice, and especially the choice of metric will cascade down affecting all other offset challenges. Therefore, it is essential that the re-search community contribute to establish a sound theoretical framework on how to measure biodiversity offsets and where to locate them. Recently, Pereira et al. (2013) suggested that monitoring programs should be based on a set of harmonized Essential Biodiversity Variables (EBVs) organized into six classes: genetic composition, species populations, species traits, community composition, ecosystem function and ecosystem structure. An EBV is defined as a measurement required for study, reporting and management of biodiversity change, and should exhibit certain characteristics, namely, scalability, temporal sensitivity, feasibility and relevance (Pereira et al., 2013). Monitoring programs based on EBVs would use a minimum set of essential measurements that capture major dimensions of biodiversity change (Pereira et al., 2013). EBVs can enable the harmonization between metrics and methodologies behind biodiversity offsets, allowing for comparison of outcomes and performance of biodiversity offsets across locations. Given that biodiversity values are context dependent, EBVs need to be adapted locally to reflect how human communities use ecosystem services delivered by biodiversity, particularly cultural benefits. In order to assess the feasibility of the application of the EBVs framework to biodiversity offsets, we mapped the metrics used in the studies of offsets to EBVs classes (see Supplementary information). Our results show that the main EBV classes used in biodiversity offsetting schemes are species populations and ecosystem structure (Table 2). In the majority of studies, more than one EBV class was used in order to measure biodiversity losses and gains. This suggests that metrics in these classes are receiving more attention either because stakeholders feel they capture important aspects of biodiversity or because they allow for comparability of biodiversity values between impacts and conservation offsets. Currently, the Group on Earth Observation Biodiversity Observation Network (GEO BON) is leading the development of EBVs for biodiversity monitoring, and a list of candidates EBVs is already available (http://www.geobon. org). Such timing, together with the increasing interest on offsetting provides a unique opportunity for cooperation between the biodiversity offsets research community and the monitoring community that should not be missed. From this cooperation a set of EBVs tailored for biodiversity offsets could be established, and biodiversity offset locations could contribute towards a global network of biodiversity monitoring sites.

Table 2. Metrics used by biodiversity-offset studies, published between 1999 and 2014, mapped to classes of Essential Biodiversity Variables (EBVs).

Essential Biodiversity Variables (EBVs)	**Examples of metrics used in biodiversity offset projects**
Ecosystem structure (38 studies)	Habitat area, fragmentation
Ecosystem function (11 studies)	Net primary production; nitrogen content; soil pH
Species traits (7 studies)	Survival rate; emigration rate; dispersal distance
Species populations (38 studies)	Vegetation percent cover; number of trees per sizes/age class
Community composition (10 studies)	Species diversity

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CHAPTER III: Acting strategically to achieve target 11

1.Introduction

Protected areas are a key conservation tool (Dudley et al. 2014); a role recently underlined by Aichi target 11 of the biodiversity strategy for 2020 (Woodley et al. 2012) which calls for 17% of terrestrial surface area (including inland water) to be assigned to protected areas, by 2020. In the last century, there was a rapid expansion in the global coverage of protected areas (Dudley et al. 2014; Watson et al. 2014), but also in the scope of the protection granted by protected areas (McDonald & Boucher 2011; Mehnen et al. 2013). Despite conservation of biodiversity being the underlying and ultimate goal of protected area establishment (Dudley 2008), the creation of a protected area today can be justified on several grounds (Dudley et al. 2014). Examples include the preservation of iconic landscapes and seascapes, threatened species, natural processes and ecosystem functions in addition to social and economic aspects of human livelihood (Stolton & Dudley 2010). This expansion in the scope of protected areas arose out of necessity once these areas became more common worldwide in the second half of the twentieth century. As a consequence, people came closer in contact with these areas, often resulting in a conflict of interest between the goals of the protected area management and the needs of local people (Bennett & Dearden 2014; Salerno et al. 2015). In response, the management of protected areas was modified to integrate the needs of local communities for natural resources and economic wealth. These needs supplemented, rather than replaced, the original motivation for the creation of protected areas (Naughton-Treves et al. 2005). However, despite the need for widening the original scope of protected areas this has been criticized for compromising the effectiveness of these areas (Leverington et al. 2010; Geldmann et al. 2015).

Currently, Aichi target 11's goal of having at least 17% of the planet's terrestrial surface protected by 2020, appears to be within reach (Leadley et al. 2014). However, the other stated goal of Aichi target 11 to establish a well-connected network of protected areas that are effectively and equitably managed as well as ecologically representative, at both the species and the ecosystem level, appears very unlikely to be achieved (Saout et al. 2013). Target 11 not only calls for an increase in coverage of protected areas as an end in itself, but it also sets out a vision of how the network of protected areas should expand (Saout et al. 2013). Therefore, target 11 has two independent but complementary objectives: one very specific objective whose accomplishment can be easily demonstrated and a second objective that is more related to the quality of the protected area, and is therefore more difficult to evaluate.

The focus of this paper is to evaluate how effective existing protected areas have been in conserving biodiversity. What does it mean exactly to be protected? Aichi target 11 challenges the parties of the Convention on Biological Diversity (CBD) to increase their network of protected areas taking ecological representation, connectivity and effective management into account. Therefore, in the long term, a key question for protected area, management is what type of protected areas should be created i.e. how much human interference should be allowed inside protected areas. The answer to this question will shape the network of protected areas into the future.

Here we seek to provide recommendations on how biodiversity protection could be strategically improved given the existing protected area network. As case studies we compare the IUCN categories against land use inside protected areas in Brazil and in the European Union (28 member states), two regions that have already achieved, or are very close to achieving the target of 17% of their terrestrial surface area under protection (Table 1).

Table 1. Criteria influencing the choice of case studies.

Criteria	Brazil	EU (28 member states)
Economic status	Developing	Developed
Area (Km^2)	8,5 million Km^2	4,3 million Km^2
Population (Million inhabitants)	More than 508 M	More than 200 M
PA % terrestrial area surface	15,3 %	21,8 %

2. What exactly is protected in a "protected area"?

Both modelling and policy conservation analyses often assume that protected areas are set aside for nature conservation and are safeguarded from human presence. In reality, different levels of human influence are tolerated in officially designated protected areas. In 1994, the International Union for Conservation of Nature (IUCN) created six categories (I-VI) that aim to represent different levels of legislative and regulatory protection as well as differences in the nature and intensity of allowed land uses (Table 2). Ever since these classification standards were created by the IUCN and widely adopted by the member countries, the process of assigning a category has not been straightforward (Dudley 2008; Dudley et al. 2014; Shafer 2015). The important process of classifying national protected areas with respect to IUCN categories is a complex and controversial task in this context (Dudley 2008). Critics argue that there is a discrepancy between the IUCN designations and their stated goal, but also that IUCN designations often do not reflect the "on the ground" condition of protected areas (Leroux et al. 2010). This discrepancy may be partly due to the fact that many protected areas were created before the international categories were designated (Muñoz & Hausner 2013; Minin & Toivonen 2015). Another criticism is that the international categories focus on management goals rather than on quantitative conservation achievements (Leroux et al. 2010; Leverington et al. 2010).

In response to these criticisms, IUCN, in 2008, released a comprehensive guide explaining how to apply the categorisation of protected areas (Dudley 2008). This guide identifies a broad set of common goals across all the protected area categories with nature conservation being their common and ultimate goal. From a management perspective it is very important that different levels of human activities are allowed among the six categories. Among the six IUCN categories, Category I tolerates the lowest level of human influence with levels of human influence increasing sequentially to a maximum in category VI (Table 2).

Table 2. IUCN protected areas classification categories according to their main management objective. The darker the colour the more important is that criteria for management.

Management Objective	Ia	Ib	II	III	IV	V	VI
Scientific research							
Wilderness protection						-	
Preservation of spp and genetic diversity							
Maintenance of environmental services				-			
Protection of specific natural/cultural features	-	-					
Tourism and recreation	-						
Education	-	-					
Sustainable use of resources	-			-			
Maintenance of cultural/traditional attributes	-	-	-	-	-		

2. Methods

We aimed to explore the relationship between IUCN international categories and human dominated land uses, i.e. land uses where human presence cannot be discounted, such as in the case of land under agriculture or urban land use regimes (Table 3). With this goal in mind, we investigated how the prescribed management goals for each IUCN category were assigned and implemented, by measuring the relative proportions of naturally preserved land and "Human Dominated Land" (HDL) inside each protected area belonging to each IUCN category (I-VI) for the 28-member states of the European Union (EU28) and for Brazil. Hence, we integrate two geospatial datasets (one focusing on protected area coverage and one focus on land use) to investigate the relationship between international protected area management classification (i.e., IUCN categories) and degree of human impact on land use.

Table 3. Assumed Human Dominated Land Uses. Adapted from GlobCover land use classes.

Value	GlobCover Legend 2009	Our interpretation
11 & 14	Post-flooding or irrigated croplands and rainfed croplands	100 % cropland
20	Mosaic (50 – 70 %) and vegetation (20 – 50 %)	50 % Cropland
30	Mosaic vegetation (50 – 70 %) and cropland (20 – 50 %)	20 % Cropland
190	Artificial surfaces and associated areas	Urban

2.1. Datasets

2.1.1. Protected Areas

The World Database on Protected Areas (WDPA, release June 2015) was used because it is recognized to be the most comprehensive global dataset on protected areas and is frequently updated. The dataset contains information on protection status (e.g. Name of the protected area, Sub-national location, IUCN category, national designation, governance type, reported area, management plan) as well as spatial boundary. The administrative boundaries of Brazil and EU28 were used to select terrestrial protected areas.

Protected areas were divided into three broad classes: “strict protection”, “sustainable use” and “Not reported”. “Strict protection” and “sustainable use” broad categories were defined with respect to their stated management aims (Table 2). IUCN categories Ia, Ib and II, which represent strict nature reserves, wilderness areas and natural parks were considered as corresponding to cases of strict protection, whereas categories III-VI, which encompass national monuments, habitat/species management areas, protected landscapes/seascapes and managed resource protected area and hence correspond to cases of sustainable use. This grouping was intended to separate management strategies which favoured biodiversity conservation in a strict sense by highly restricting human intervention (Type I and II), from management strategies which permitted different levels of human presence and/or influence (Type III -VI), e.g. agriculture, forestry, hunting, mineral extraction. Notably, the assignment of an IUCN category to a protected area is the responsibility of national governments and is a voluntary process. The “Not reported” class corresponds to all areas not assigned to a IUCN category. For Brazil, land classified as “indigenous land” was excluded from the analysis because these areas have a specific status of their own, different from protected areas designated for biodiversity conservation. In any case, land classified, as “not reported” will very unlikely belong to a strict protection type of protected area (IUCN I or II), hence these areas, despite analysed separately, were treated as belonging to the “sustainable use” class (IUCN III – VI).

2.1.2. Land use

Land use was analysed by using the GlobCover dataset from 2009. This dataset was used because it offers global composites and land cover maps at a resolution of 300 m x 300 m (0.09 km^2). This dataset classifies land use into discrete categories based on remote sensing (Table 4). GlobCover discrete land use categories were grouped with respect to four different levels of human dominance (Table 3). A raster was created for each of the four discrete land use categories we determined. Each raster is binary, with 0 denoting (semi)natural habitat and 1 denoting human-dominated land.

Table 4. Classes of the GlobCover (from 2011. Bontemps et al. GlobCover 2009 products description and validation resport. UCLouvain & ESA team.

Value	GlobCover global legend
11	Post-flooding or irrigated croplands
14	Rainfed croplands
20	Mosaic Cropland (50-70%) / Vegetation (grassland, shrubland, forest) (20-50%)
30	Mosaic Vegetation (grassland, shrubland, forest) (50-70%) / Cropland (20-50%)
40	Closed to open (>15%) broadleaved evergreen and/or semi-deciduous forest (>5m)
50	Closed (>40%) broadleaved deciduous forest (>5m)
60	Open (15-40%) broadleaved deciduous forest (>5m)
70	Closed (>40%) needleleaved evergreen forest (>5m)
90	Open (15-40%) needleleaved deciduous or evergreen forest (>5m)
100	Closed to open (>15%) mixed broadleaved and needleleaved forest (>5m)
110	Mosaic Forest/Shrubland (50-70%) / Grassland (20-50%)
120	Mosaic Grassland (50-70%) / Forest/Shrubland (20-50%)
130	Closed to open (>15%) shrubland (<5m)
140	Closed to open (>15%) grassland
150	Sparse (>15%) vegetation (woody vegetation, shrubs, grassland)
160	Closed (>40%) broadleaved forest regularly flooded - Fresh water
170	Closed (>40%) broadleaved semi-deciduous and/or evergreen forest regularly flooded - Saline water
180	Closed to open (>15%) vegetation (grassland, shrubland, woody vegetation) on regularly flooded or waterlogged soil - Fresh, brackish or saline water
190	Artificial surfaces and associated areas (urban areas >50%)
200	Bare areas
210	Water bodies
220	Permanent snow and ice

2.1.3. Analysis and integration

WDPA sub-dataset & "Russian doll" procedure

Despite WDPA being the best available dataset of protected areas, the quality of this dataset is known to be imperfect and several issues must be accounted for. One such issue is the occurrence of overlapping polygons belonging to different IUCN categories. In such cases, the overlapping area of the polygon was assigned to the higher level of protection and subtracted this area from the lower level of protection (Jenkins & Joppa 2009; Joppa & Pfaff 2010; Geldmann et al. 2014). For example, if there was an overlap between two polygons of categories II and III, the overlapping area was assigned to the highest level of protection (category II in this case) and removed from the lower level of protection (category III in this case). When overlaps occurred between polygons in the “Not reported” class, these were merged into a single layer. Following this operation, the extent of each protected area was recalculated to correctly treat component areas of multipart features in the original WDPA (Leroux et al. 2010). We also excluded all protected areas smaller than 0.09 km^2, which is the minimal spatial resolution of the Globcover 2009 dataset.

2.2. Land Use and Human Dominance

The four discrete land use rasters created were overlaid into the protected area network free of overlapping polygons. For each protected area, the proportion of human dominated pixels was calculated by dividing the total sum of pixels that were scored as "1" by the total count of pixels within the protected area (sum/ count) (Figure 1). The proportion of (semi)natural land was calculated by simply subtracting the proportion of human dominated land from one.

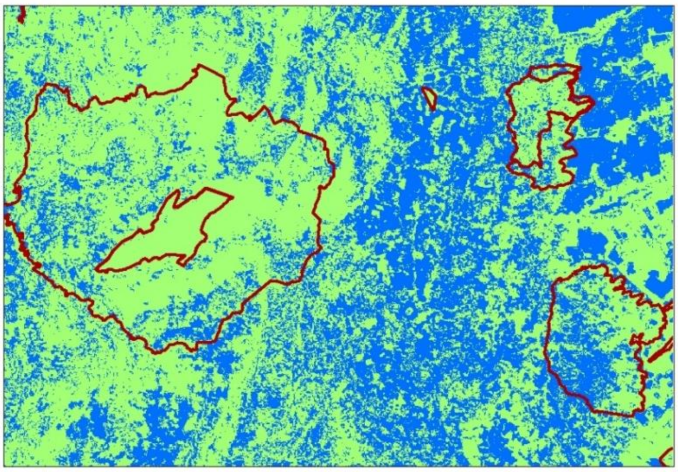

Figure 1. Proportion of “human dominated land” (HDL) inside a protected area. *Green:* (semi) natural land; *Blue:* human dominated land; *Red:* protected area limit. To calculate the proportion of “human dominated land”, we calculated for each protected area, the sum of the number of pixels falling to one of the land use categories of table 4 divided by the count of pixels inside a protected area boundary.

2.2.1. Analysis

The proportion of different land use categories inside protected area was measured in order to calculate the proportion of human dominated land and natural land inside the limits of each protected area and how each related to their IUCN category.

3. Results

3.1. Strict protection vs. Sustainable protection

We found that protected areas in the "sustainable use" class represent a much greater proportion of the studied area than strict protection type of protected areas (Figure 2) in both Brazil and the European Union.

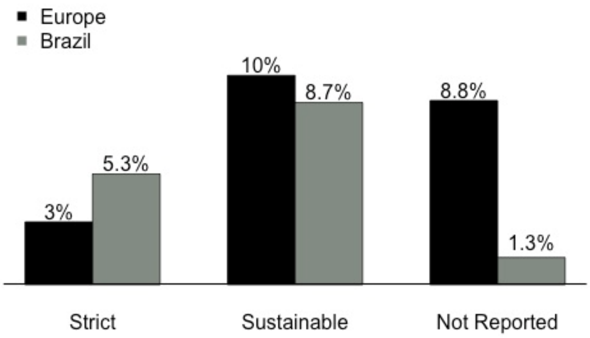

Figure 2: Percentage of the area of Brazil and Europe (28 member states) designated protected under: strict protection, sustainable use and not reported.

3.2. Human Dominated Land

We found that, among protected areas under strict protection there is little difference in the average proportion of human dominated land in the European Union and in Brazil (Figure 3). However, for the sustainable use class of protected areas the average proportion of HDL in the European Union is higher than in Brazil (Figure 4).

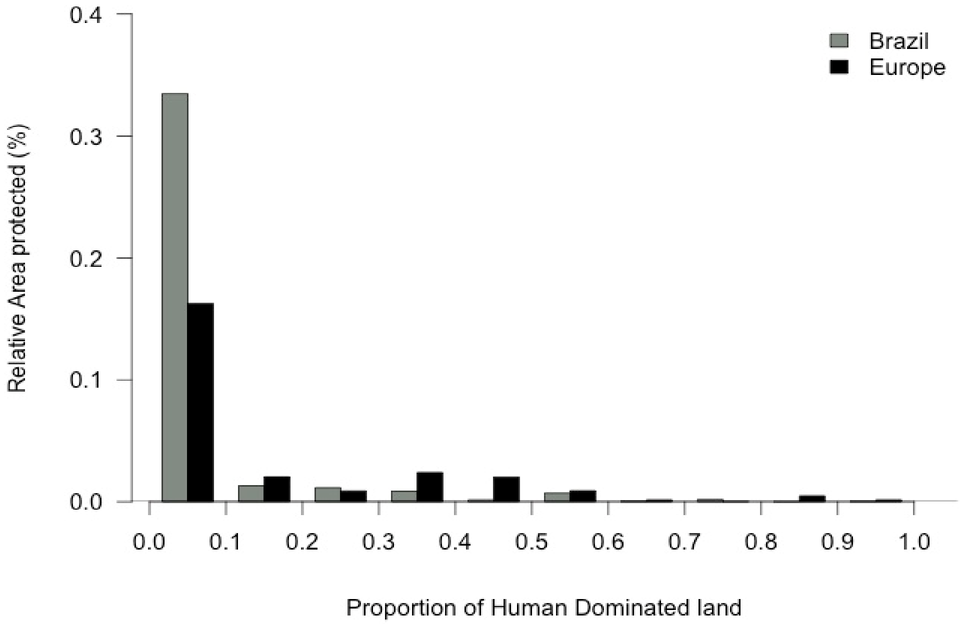

Figure 3. Proportion of "Human Dominated Land" normalized by relative area for Protected Areas under strict protection (IUCN I and II). This graph shows how much of the area designated protected from the total area of Brazil and EU (relative area), falls under what level of HDL (proportion of HDL).

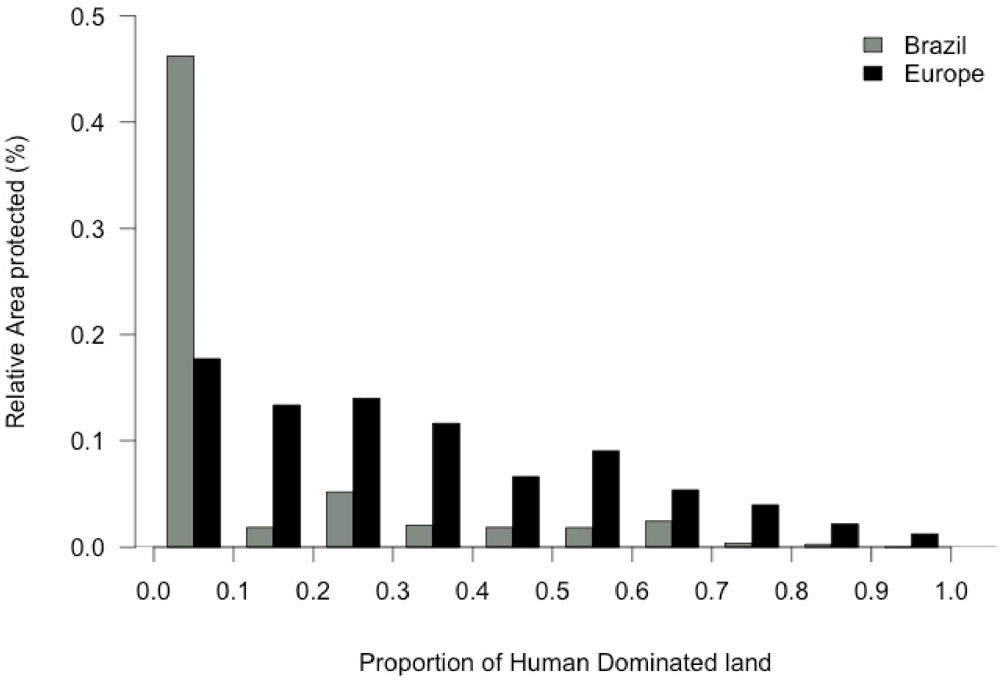

Figure 4. Proportion of Human Dominated Land normalized by relative area for Protected Areas under sustainable protection (IUCN III, IV, V, VI and Not Reported). This graph shows how much of the area designated protected from the total area of Brazil and EU (relative area), falls under what level of HDL (proportion of HDL).

4. Discussion

Europe and Brazil are both parties to the CBD and are currently well placed to achieve Aichi target 11 of having 17% of the terrestrial surface covered by protected areas by 2020. Both regions have already attained high coverage levels (Figure 2). Despite these grounds for optimism it should be noted that, in both cases, the greatest proportion of their network of protected areas is classified as "sustainable use" rather than being under strict protection (Figure 2). Protected areas under sustainable management represent a greater proportion of protected areas worldwide and are expected to continue increasing in the future (McDonald & Boucher 2011). From a pure political point of view, the creation of sustainable protected areas raises reasonably less controversy than the creation of strict protected areas since human presence and many human activities can be accommodated (Mehnen et al. 2013; McNeely 2015; Shafer 2015). Nevertheless, when compared the European Union has less “strict protection” class of protected areas than Brazil. Moreover, the proportion of human dominated land is higher for all categories of IUCN in the European Union than in Brazil. Europe's long history of human presence and high population density has resulted in a very fragmented landscape where natural areas are rarely found (Nolte et al. 2010). With the exception of the Scandinavian peninsula, protected areas are mostly small scattered areas (Nolte et al. 2010). Areas under strict protection represent a very small share of Europe’s surface. This finding confirmed our initial suspicions. A result that came as a surprise was the fact that the difference in the proportion of Human Dominated land for all IUCN categories for Brazil and the European Union is not as significant as initially expected (Figure 3 & 4). Nevertheless, greatest part of the protected areas designated fall under IUCN international system, highlighting the key role international classification system plays, even when there is additionally a more detailed protected area classification system.

This may however be due to a low sample size as well as by the difficulty of finding clear information regarding allowance of activities inside protected areas. One aspect worth stressing is the strong association between scientific research and protected areas under strict protection. This is the only human activity allowed and related uniquely to strict protected areas, being often conditional to authorisation. This fact brings to the fore the key role protected areas under strict protection play in supporting and promoting biodiversity conservation research (Gotmark 2013; Juliane Schultze 2014), biodiversity conservation (Dudley 2008; Joppa et al. 2016) and wilderness (Ceaușu et al. 2015). Protected areas under strict protection play a pivotal task delivering biodiversity conservation.

Currently, it appears that the 17% target will be met only through the expansion of sustainable use protected areas, which correspond to a very low level of biodiversity protection. Surprisingly, for Europe the IUCN “not reported” class was quite high. It is therefore vital to determine whether Europe's protected areas are effective in maintaining biodiversity and whether the management of these areas is appropriate. As a developed region, with well-defined governmental institutions, financial resources and access to better data and scientific capacity, as well as power to influence the policies of other countries, Europe can define best practice in this context by investing in areas under strict protection. Much of Europe’s protected areas are managed using traditional land-management practices (e.g.

grazing, burning, hunting), which involve some level of active habitat management and sustainable use of the land (Nolte et al. 2010). Hence, conservation efforts in Europe have greatly neglected stand-alone natural processes (Pereira et al. 2010). The Aichi target 11 presents the European Union with an opportunity to invest in creating protected areas that prioritize natural processes and that maintain biodiversity. On the other hand, for Brazil to meet Aichi target 11, within the time frame, a quick fix strategy may be to keep on creating protected areas under sustainable protection, even though a large proportion of its protected areas belong to the sustainable use class. However, given the shortage of time and since Brazil is already close to reaching the 17% target Brazil can expand on this type of protected area to ensure reaching Aichi target 11 by 2020.

Based on the case studies analysed in this study, we urge national governments to review their strategy to meet the Aichi target 11 and make two main recommendations. First, countries that are currently struggling to meet the 17% surface cover target, have little surface cover designated as protected, have limited resources, and have a high proportion of their populations dependent on nature and rich biodiversity should designate protected areas for sustainable use. Second, countries which already have a network of protected areas close to the 17% target, are economically strong, with a small fraction of their population dependent on nature and with little remaining biodiversity, have not only the opportunity but also the moral responsibility to invest in biodiversity conservation by placing protected areas under a regime of strict protection.

5. Conclusions

Protected areas are sometimes perceived as idyllic areas where nature is protected and conserved. In reality, the level of protection these areas afford in maintaining biodiversity is highly variable. Apart from those who directly work in the field of conservation biology, it is likely that this fact is not well understood by the general public. Recent decades have seen a rapid increase in the global extent of protected areas but despite this, biodiversity levels continue to decline. The increase in protected area coverage has mainly been achieved by creating areas of the sustainable use class, and therefore, at the cost of affording true protection to biodiversity. Indeed, our results confirmed this trend, with the European Union presenting an even higher proportion of protected areas under sustainable management than Brazil. Our results also show that overall protected areas appear to be modified by humans across all categories of IUCN classification for both Brazil and European Union.

We urge national governments to review their strategy to meet the Aichi target 11 and recommend countries to act strategically to meet the target until 2020. However, beyond 2020, we advise countries to re-evaluate their conservation strategy and plan for biodiversity conservation on the long term. We encourage countries to appraise the true contribution of their protected areas to biodiversity conservation and their role as a custodian of biodiversity and a signatory country to the CBD.

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CHAPTER IV: How SMART are the Aichi conservation targets?

1.Introduction

The current biodiversity crisis is unprecedented (Barnosky et al., 2011; Ceballos et al., 2017; Pereira et al., 2012). The magnitude of biodiversity change has worried scientists for several decades, whom have urged the international community to take action. Back in 2002, the parties to the Convention on Biological Diversity (CBD) agreed a Strategic Plan for 2002 – 2010. The aim of the Strategic plan and the so-called "2010 biodiversity target" was built with a vision to significantly reduce the loss of biodiversity by 2010. According to the CBD, biodiversity is defined as "the variety of life on Earth and the natural patterns it forms" (CBD, 2000) . The challenge of how to measure the progress towards the 2010 biodiversity target was on how to monitor biodiversity at global scale (Mace and Baillie, 2007; Pereira and Cooper, 2006; Walpole et al., 2009). With this task in mind and biodiversity in its essence being a complex concept, several international organizations joined efforts to create the Biodiversity Indicators Partnership (BIP). The BIP adopted a series of indicators which included measurements such as changes in populations of species, risk of extinction, area of habitat, etc (BIP, 2010). However, the 2010 the CBD goal was missed (Butchart et al., 2010; Mace et al., 2010). Relevant policies had been inadequately targeted, implemented and funded. Direct pressures, such as land use change, were reported to be constant or increasing while many state indicators exhibited negative trends (Adam, 2010; Butchart et al., 2010).

A new Strategic Plan to address the loss of global biodiversity, and currently in effect until 2020 was put forward. This time the Strategic Plan for 2011 – 2020 for was organized in five Strategic Goals grouping 20 bite-size targets, the Aichi conservation targets (Table 1) (CBD, UNEP, 2011).

Table 1. Aichi conservation targets as presented in Global Biodiversity Outlook 4 (CDB, 2013). Unless otherwise noted, each target has 2020 as the end date.

	AT No.	Description of target
A	1	By 2020 people **are aware of the values of biodiversity.**
		By 2020, people are **aware of the steps they can take to conserve & sustainably use biodiversity**.
	2	By 2020, biodiversity values are integrated into national and local **development poverty strategies**
		By 2020, biodiversity values are integrated into national and local **planning processes.**
		By 2020, biodiversity values are integrated into national and local **accounting**
		By 2020, biodiversity values are integrated into national and local **reporting systems**
	3	By 2020, **harmful incentives** to biodiversity, including subsidies **are eliminated**, phased out or reformed
		By 2020, **positive incentives** for conservation and sustainable use of biodiversity **are developed and applied**
	4	By 2020, stakeholders at all levels have taken steps to, or have **implemented plans for sustainable production & consumption**

		By 2020, ..and have **kept the impacts of use** of NR well **within safe ecological limits**.
B	**5**	By 2020, the **rate of loss of forests** is at least halved and where feasible brought close to zero
		By 2020, the **rate of loss of all natural habitats** is at least halved and where feasible brought close to zero
		By 2020, **degradation and fragmentation is significantly reduced**.
	6	By 2020, all fish & invertebrate stocks and aquatic plants are **managed and harvested sustainably, legally and applying ecosystem-based approaches,** so that overfishing is avoided
		By 2020, recovery plans and measures are in place for all depleted species
		By 2020, fisheries have no significant adverse impacts on **threatened species and vulnerable species**
		By 2020, the impacts of fisheries on stocks, species and ecosystems are **within safe ecological limits.**
	7	By 2020, areas **under agriculture** are managed sustainably, ensuring conservation of biodiversity,
		By 2020, areas **under aquaculture** are managed sustainably, ensuring conservation of biodiversity,
		By 2020, areas **under forestry** are managed sustainably, ensuring conservation of biodiversity.
	8	By 2020, **pollution** has been brought to levels that are not detrimental to ecosystem function and biodiversity,
		By 2020, **pollution from excess nutrients** has been brought to levels that are not detrimental to ecosystem function and biodiversity,
	9	By 2020, **invasive alien species (IAS)** are identified and prioritized
		By 2020, **pathways** are identified and prioritized
		By 2020, IAS priority species **are controlled or eradicated**
		By 2020, measures are in place to prevent the **introduction and establishment of IAS**.
	10	By 2015, **multiple anthropogenic pressures on coral reefs**, are minimized so as to maintain their integrity and functioning
		By 2015, **multiple anthropogenic pressures on vulnerable ecosystems impacted** by climate or ocean acidification are minimized so as to maintain their integrity and functioning
C	**11**	By 2020, **at least 17% of terrestrial and inland water are conserved**
		By 2020, **at least 10% of coastal and marine areas are conserved**
		By 2020, **areas of particular importance to biodiversity and ecosystem services are conserved**
		By 2020, conserved areas **are ecological representative**
		By 2020, conserved areas **are effectively and equitably managed**
		By 2020, conserved areas **are well-connected and integrated into the wider landscapes and seascapes**
	12	By 2020, **the extinction of known threatened species** has been prevented
		By 2020, **known threatened species conservation status**, particularly those in decline**, has been improved and sustained.**
	13	By 2020, the genetic diversity of **cultivated plants is maintained**
		By 2020, the genetic diversity of **farmland and domesticated animals is maintained**
		By 2020, the genetic diversity of **wild relatives is maintained**
		By 2020, the genetic diversity of **socio-economically as well as culturally valuable species** is maintained
		By 2020, **strategies have been developed and implemented** for minimizing genetic erosion and safeguarding genetic diversity.
	14	By 2020, **ecosystems** that provide essential services **are restored and safeguarded**
		By 2020, …**taking into account the needs of women indigenous & local communities** and the **poor and vulnerable**

D	**15**	By 2020, **ecosystem resilience** and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration
		By 2020, at least **15% of degraded ecosystems are restored**
	16	By 2015, the **Nagoya Protocol is in force**
		By 2015, the Nagoya Protocol **is operational and consistent with national legislation**
E	**17**	By 2015, **NBSAPs have been submitted to the Secretariat**
		By 2015, NBSAPs **are adopted**
		By 2015, NBSAPs **are implemented**
	18	By 2020, the traditional knowledge, innovations and practices of indigenous and local communities **are respected**
		By 2020, … **are fully integrated and reflected** in implementing of the Convention
		… **with full and effective participation of indigenous and local communities**
	19	By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends and the consequences of its loss **are improved**
		By 2020, … are widely shared and **transferred and applied.**
	20	By 2020, the **mobilization of financial resources** for effectively implementing the SPB 2011-2020 from all sources should be **increased substantially from current levels.**

The Aichi conservation targets were designed based on the SMART framework, a framework originally developed to guide private companies in designing targets for their businesses. Based on this framework, each target should be designed to be: Specific, Measurable, Ambitious, Realistic and Time-bound (Table 2) (Maxwell et al., 2015). The SMART framework has been applied beyond the business corporate world, such as in conservation ecology (Day and Tosey, 2011; Lawlor, 2012; MacLeod, 2012; Shahin and Mahbod, 2007). Slight variations in terms of what the acronym SMART stands for can be found in the literature. The adoption of SMART targets in the design of the new Strategic Plan for Biodiversity conservation reflects the broader trend and the increased importance that measurability has gained in biodiversity governance (Pereira et al., 2013; Turnhout et al., 2014), partly in response to the perception that past shortcomings to meet the global biodiversity targets were related to their lack of SMARt-ness (Maxwell et al., 2015).

Table 2: SMART framework as defined by Maxwell et al., 2015; Perrings et al., 2010)**.** However slight variations in terms of what the acronym SMART stands for can be found in the literature

SMART Framework
Specific: Clear, concise
Measurable: Measurable in a unit (dollars, volume, time, etc)
Ambitious: Balancing risk and reward, demand motivation
Realistic: At least 50% realistic
Time-bound: Bound to a deadline date
Other definitions
Achievable; Action-oriented: You can take action to make it happen
Reasonable, Relevant: Targets are feasible and possible. Related to set priorities

However, more than half-way through to 2020, the Global Biodiversity Outlook 4 showed that we are falling short in meeting the majority of the targets by 2020 (Butchart et al., 2016; Leadley et al., 2014; Secretariat of the Convention on Biological Diversity, 2010; Tittensor et al., 2014). The year of 2020 will bring a new strategic plan for biodiversity, but it is unclear, yet which form it will take. Therefore it is important to critically analyze what has and has not worked well in the past two decades in stopping biodiversity loss (Butchart et al., 2016; Mace et al., 2010; Tittensor et al., 2014).

The aim of this article is twofold: (1) to capture the perception of different biodiversity experts over the SMART-ness of the Aichi conservation targets design i.e. were the targets perceived to be designed smartly? (2) to evaluate and rank the importance attributed by the experts to the SMART criteria and another 3 proposed criteria for the future of global environmental target setting i.e. to what extent the selected criteria can have an influence on target achievement. Since all the Aichi conservation targets are time-bounded, to either 2015 or 2020, this criterion was not included in our survey. Instead, we asked the experts to classify the targets against the criterion "time-progressiveness" (Table 3). We also asked experts to evaluate and rank other three criteria for the future of global environmental target setting. Hence, overall experts evaluated the 20 Aichi conservation targets against seven criteria.

The three additional criteria, we ask the experts to evaluate their importance were: semantics, science, socio-economic aspects (Table 3) and they emerged from a thorough analysis of the semantics and formulation of the 20 Aichi conservation targets pertinence of these criteria for target achievability originate from an analysis of the current Aichi conservation targets against their progress status as reported in the Global Biodiversity Outlook 4 (GBO 4), a mid-term assessment of progress towards target achievement published in 2014 (Secretariat of the Convention on Biological Diversity, 2014).

2.Methods

We have conducted an online closed survey (see ***Annex II***), using the Delphi methodology, to evaluate the perception of biodiversity experts over the SMART-ness of the Aichi targets design. The online closed survey asked the experts to rate the importance as well of four additional criteria for effective target setting, proposed in this study, namely semantics, science, socio-economic aspects and being time-progressive (Table 3). Experts in our study are researchers who participated in the Global Biodiversity Outlook 4 (GBO 4) and/ or researchers who have to date been involved in studies on the progress being made towards meeting the Aichi targets by 2020. With this objective in mind, we sent the link to our online survey to 30 biodiversity experts. Our study involved two rounds of the same survey; each round lasting about an hour to answer. We asked the experts to rank each target from target 1 to target 20, many of which are sub-divided in at least two sub-targets (Table 1), against the SMART framework as well as four other criteria we proposed. Eight criteria were analysed in total. For each round and each sub-target, the experts were asked to rank each criterion from 1 to 5, with 1 being "completely agree" and 5 being "completely disagree". For example, for the criteria "measurable", for target 11: "*By 2020,* at least 17% of terrestrial and inland water *are conserved"*, experts were asked to select from 1-5 how much they agreed such a sentence enacted a measurable target. The only time, during both rounds, when experts could select more than one answer was for the socio-economic mechanism criterion, for which they could choose one or more of the options given: education, research, behavioural changes, legislative, economic incentives or other.

2.1 The eight criteria under evaluation

The SMART framework, originally developed to support private companies managing their businesses, sets out a list of principles, which aim to guide the process of target setting. SMART stands for: **s**pecific, **m**easurable, **a**ction-oriented, **r**ealistic and **t**ime-bound. An explanation and an example for each criterion was provided on the online questionnaire (see Table 3). Since all the Aichi targets are time-bounded, to either 2015 or 2020, we did not include this criterion on our survey. Instead, we asked the experts to classify the targets against "time-progressiveness" criterion, this is, whether the target was decomposed in progressive steps over time (Table 3). We also asked the experts to evaluate the Aichi targets against three other criteria, whose potential importance for target setting we wanted to assess. The three criteria were "socio-mechanisms", "science-constrained" and "semantics-dependent" (see Table 3). An explanation and example were also provided in the questionnaire online for each of these criteria (Table 3). The selection of the additional criteria aimed to complement aspects of the SMART criteria that we perceived to be important for target achievement. For example, some targets make reference to "safe ecological limits" is scientific knowledge today enough to precisely define what those limits in all situations are for the target to be formulated this way? Another example can be the reference to "degraded ecosystems" for which no universal definition exist and hence due a "semantics-dependent" aspect, the achievement of the target may be compromised from its design.

Table 3. Criteria definition against which the Aichi conservation targets were rated by biodiversity experts. The light grey shaded lines correspond to the SMART criteria, while the dark grey shaded lines, correspond to the four criteria we introduced for evaluation.

Criteria	Description	Example
Specific	The target is well-defined and its outcome is clear. Is the target specific?	+ I will lose fat tissue to reach the minimum recommended weight for my body type and age. - I will lose weight.
Measurable	The target, or progress, can be demonstrated by means of a metric. Is the target measurable?	+ I will lose 5 kg - I will lose weight.
Action-oriented	The actions needed to achieve the target are clear. Is the target action-oriented?	+ I will run 30 minutes three times per week, stop eating sweets and fast food and will weight myself on a Body-Mass Index calculator scale every two weeks. - I will become slimmer.
Realistic	The target is achievable given available resources and agreed timeframe. Is the target realistic?	+ I will lose 200gr per week and exercise 3 times a week. - I will lose 5 kg per week and exercise 4 hours a day.
Time-progressiveness	The target is designed in a bite-size manner, with a step-by-step progressive approach over time. Is the target time-progressive?	+ I want to lose 200gr each week for the first 4 months and then 100 gr per week for another 4 months. - I want to lose 3,5 kg in the next 8 months.
Socio-economic mechanism dependent	The target is design dependent on a specific socio-economic mechanism to be achieved, such as a new regulation or law, an economic incentive, deep societal behavioural changes. Is the target dependent on a socio-economic mechanism?	*Legislative:* A new law is approved demanding employers to offer exercise facilities to their workers. *Economic incentive:* A monthly incentive is paid to employees that bike to work. *Education:* Teenagers are offered health&nutrition classes as part of their curriculum. *Research:* Science provides evidence people should sleep at least 7 hours per night. *Behavioural changes:* People are choosing to eat meat once a week only.
Science-constrained	The target is constrained by gaps in scientific knowledge. Is the target science-constrained?	+ A healthy lifestyle can reduce the risk of cancer. - Eating two apples a day prevents cancer.
Semantics-dependent	The target uses terms for which there is no consensual definition. Is the target semantics-constrained?	I will stop to diet when I am beautiful.

2.2 The Delphi Methodology

The Delphi methodology was conceived in the USA, in the 1950s, as a systematic forecasting technique. However in the last 60 years, this methodology has gained ground within many disciplines as an efficient process to structure group communication and collectively reaching consensus on a complex issue (Hsu and Sandford, 2007; Mukherjee et al., 2015). Before addressing a complex issue, the experts involved determine the minimum level of consensus expected to be reached or the number of rounds to be carried out at which the process stops. (Hsu and Sandford, 2007; Mukherjee et al., 2015).

When compared to other decision-making group approaches, the main advantage the Delphi methodology offers is its capacity to ensure: i) anonymity; ii) iteration and iii) feedback along the process. The Delphi methodology success is related to the fact that it enables participants to safely state their position without being jeopardized as the participants identity is kept anonymous at all times (Kennedy, 2004; Powell, 2003). In ecology its application is recent and it still remains underused (Mukherjee et al., 2015).

When using Delphi, a panel of preselected experts is asked to respond individually, independently and confidentially to more than one round of questions (RQ1, RQ2, RQ3, etc). The questionnaire may be an open-end type of questionnaire (qualitative type of questions) or a "tick-box" type of questionnaire (quantitative) (Powell, 2003). Following the analysis of each round of answers, each member of the panel of experts is sent a summary of the collective positioning of the group, without revealing any identities, and with a reminder of his/her own answers. In the following round, which may or not be based on the same questionnaire as in the first round, each expert is given the opportunity to change his/ her answers, if they wish to. The process stops, once a pre-determined level of consensus has been reached or when a predetermined number of rounds has been carried out (Hsu and Sandford, 2007; Mukherjee et al., 2015).

3. Results

Round 1: Target 7 (manage within limits) was evaluated by the experts to be the SMARTest of the 20 targets (Table 4). In its design, the experts considered the following criteria to be: "specific", "measurable" and "realistic" (87.5%; 87.5% and 79.2% respectively). In second and third position, come target 14 and target 10 meeting two of the SMART criteria, "measurable" at 100% and "realistic" at 75%, and "measurable" at 87.5% and "action-oriented" at 75% respectively. Target 7 was assessed to be the only target, which meets the criterion "specific" (Table 4). Experts considered targets 8, 18, 7, 10, 19, 1 and 14 to comply respectively increasingly more satisfactory with the criterion "measurable". From all the 20 targets, in round 1, experts assessed targets 1, 10 and 5 to fulfill the criterion "action-oriented". Finally, for criterion "realistic" experts valued targets 6, 8, 14, 18, 7 and 4 respectively to increasingly satisfy the criterion. As far as the SMART framework is concerned, the criterion "measurable" was in round 1, according to the experts, occurred in the greatest number of targets (8 targets out of 20), while criterion “specific” was evaluated to occur only on target 7. Criterion “realistic” was evaluated to be present in 6 targets out of 20 and “action-oriented” in only 2 targets out of 20. Considering the additional set of criteria suggested in this study: “socio-economic mechanism”, “science-constrained”; “semantics-dependent” and “time-progressiveness”, for round 1, experts classified “socio-economic mechanism” sub-criterion “legislative” and “science constrained” (both for 12 targets out of 20) to play the most relevant role for target achievement, followed by criterion “semantics-dependent” (for 8 targets out of 20).

Round 2: Targets 10 (anthropogenic pressures on coral reefs) and 14 (restore ecosystems) were evaluated by the experts to be the SMARTest of the 20 Experts, fulfilling 4 SMAR-criteria. Experts weighted criterion: “socio-economic mechanism” sub-criterion “legislative”, “science-constrained” (both for 14 targets out of 20) and “semantics-dependent” (for 5 out of 20 targets) as the most relevant criteria to potentially influence target achievement. Overall, on round 2, experts evaluated the SMART criteria and the set of criteria suggested in this study to be present slightly stronger than in round 1 except for criterion “semantics-dependent” and “measurable”.

The criterion “time-progressive” was ranked high by the experts in both rounds. In general experts answered consistently between rounds, they did not change their position after they accessed the group results for round 1. Most of the changes between rounds concerned the following criterion: “action-orientated”, “measurability” and “socio-economic mechanisms” sub-criterion “behavioural-changes” and “economic incentives”. For the criterion “action-oriented”, experts changed their opinion from “yes to no” for targets 2 - 9 and from “no to yes” for targets 10 to 19. For” socio-economic mechanism” sub-criterion “behavioural-changes”, experts changed their opinion from “no to yes” for targets 1- 9 and for both ways: from “no to yes” for targets 3 - 6 and from “yes to no” for targets 17 - 20 for sub-criterion “economic incentives”. Finally, in relation to criterion “measurable” experts changed from “yes to no” for targets 1 – 4 (Table 4).

Table 4. Biodiversity experts rating of the analyzed criteria for each Aichi conservation targets for round 1 and 2.

Round	Criteria	Target No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Round 1	Socio-economic mechanism dependent	Education	100	0.0	18.8	56.3	16.7	37.5	62.5	25.0	9.4	31.3	6.3	56.3	50.0	43.8	25.0	0.0	0.0	33.3	37.5	12.5
		Research	12.5	21.9	18.8	68.8	12.5	62.5	50.0	56.3	75.0	50.0	37.5	62.5	65.0	31.3	62.5	0.0	0.0	25.0	81.3	12.5
		Behav.changes	43.8	0.0	6.3	62.5	29.2	37.5	37.5	25.0	3.1	56.3	14.6	18.8	25.0	50.0	12.5	0.0	8.3	41.7	12.5	37.5
		Legislative	0.0	100	100	68.8	87.5	78.1	87.5	87.5	56.3	87.5	68.8	75.0	60.0	75.0	75.0	87.5	79.2	54.2	18.8	75.0
		Eco.incentives	18.8	37.5	75.0	68.8	41.7	31.3	75.0	31.3	12.5	31.3	18.8	25.0	52.5	43.8	56.3	0.0	12.5	12.5	31.3	50.0
		Other	12.5	28.1	25.0	12.5	25.0	15.6	25.0	18.8	18.8	25.0	33.3	37.5	45.0	31.3	25.0	25.0	37.5	45.8	18.8	25.0
	Science - constrained		87.5	84.4	87.5	43.8	91.7	53.1	70.8	68.8	28.1	75.0	77.1	68.8	77.5	75.0	56.3	100	100	87.5	56.3	100
	Semantics - dependent		56.3	71.9	81.3	50.0	70.8	71.9	50.0	68.8	81.3	75.0	64.6	100	75.0	68.8	56.3	81.3	75.0	50.0	75.0	87.5
	Specific		56.3	21.9	6.3	56.3	25.0	31.3	87.5	31.3	25.0	68.8	39.6	0.0	35.0	68.8	37.5	6.3	16.7	58.3	56.3	62.5
	Measurable		93.8	62.5	62.5	87.5	16.7	59.4	87.5	75.0	53.1	87.5	35.4	12.5	50.0	100	56.3	12.5	33.3	79.2	87.5	25.0
	Action-oriented		75.0	25.0	25.0	56.3	79.2	62.5	62.5	68.8	34.4	75.0	54.2	56.3	60.0	68.8	56.3	25.0	25.0	54.2	50.0	50.0
	Realistic		37.5	37.5	43.8	81.3	58.3	75.0	79.2	75.0	50.0	56.3	52.1	50.0	70.0	75.0	50.0	25.0	66.7	75.0	43.8	25.0
	Time-progressive		93.8	93.8	93.8	93.8	95.8	96.9	100	100	93.8	100	91.7	87.5	87.5	87.5	87.5	87.5	75.0	87.5	81.3	75.0
	Mean		52.9	45.0	49.5	62.0	50.0	54.8	67.3	56.3	41.6	63.0	45.7	50.0	57.9	63.0	50.5	34.6	40.7	54.2	50.0	49.0
	SD		35.1	34.0	34.9	20.8	31.6	23.1	22.0	26.9	29.2	23.7	25.4	30.0	17.5	21.3	20.8	39.2	34.2	23.4	25.8	29.1
Round 2	Socio-economic mechanism dependent	Education	93.8	0.0	6.3	81.3	20.8	40.6	75.0	31.3	15.6	31.3	8.3	50.0	37.5	25.0	6.3	0.0	4.2	33.3	25.0	12.5
		Research	25.0	25.0	12.5	68.8	16.7	71.9	41.7	62.5	59.4	43.8	50.0	87.5	87.5	56.3	62.5	0.0	0.0	20.8	81.3	0.0
		Behav.changes	50.0	25.0	18.8	87.5	66.7	46.9	79.2	68.8	28.1	68.8	16.7	25.0	20.0	62.5	18.8	0.0	20.8	70.8	12.5	25.0
		Legislative	0.0	100	100	87.5	95.8	87.5	87.5	87.5	59.4	87.5	72.9	81.3	87.5	81.3	87.5	87.5	79.2	50.0	12.5	87.5
		Eco.incentives	12.5	50.0	93.8	75.0	87.5	40.6	75.0	31.3	18.8	12.5	18.8	25.0	42.5	43.8	56.3	0.0	4.2	12.5	18.8	37.5
		Other	6.3	21.9	12.5	18.8	12.5	18.8	25.0	12.5	18.8	25.0	35.4	43.8	35.0	25.0	31.3	25.0	37.5	16.7	12.5	12.5
	Science – constrained		87.5	87.5	81.3	50.0	83.3	65.6	79.2	62.5	43.8	100	83.3	87.5	87.5	81.3	62.5	87.5	87.5	83.3	62.5	87.5
	Semantics - dependent		56.3	75.0	68.8	25.0	66.7	59.4	50.0	43.8	75.0	62.5	58.3	87.5	72.5	62.5	62.5	81.3	87.5	58.3	68.8	75.0
	Specific		56.3	15.6	6.3	68.8	20.8	25.0	75.0	43.8	21.9	87.5	39.6	0.0	25.0	81.3	50.0	12.5	20.8	66.7	56.3	50.0
	Measurable		56.3	21.9	31.3	81.3	12.5	46.9	87.5	81.3	34.4	87.5	47.9	25.0	27.5	93.8	56.3	0.0	33.3	87.5	75.0	0.0
	Action-oriented		81.3	6.3	0.0	50.0	75.0	50.0	37.5	56.3	21.9	100	70.8	81.3	87.5	87.5	50.0	25.0	16.7	62.5	43.8	37.5
	Realistic		18.8	25.0	50.0	81.3	62.5	81.3	83.3	87.5	28.1	81.3	52.1	62.5	75.0	81.3	37.5	6.3	66.7	91.7	50.0	37.5
	Time-progressive		87.5	87.5	81.3	87.5	87.5	87.5	87.5	87.5	87.5	87.5	79.2	81.3	87.5	87.5	81.3	75.0	62.5	79.2	75.0	75.0
	Mean		48.6	41.6	43.3	66.3	54.5	55.5	67.9	58.2	39.4	67.3	48.7	56.7	59.4	66.8	51.0	30.8	40.1	56.4	45.7	41.3
	SD		33.2	34.2	37.2	23.5	32.6	22.4	21.5	24.5	23.6	29.8	24.4	30.5	28.1	23.4	22.9	37.3	32.6	27.6	26.4	31.6

4.Discussion

Eight out of the 30 experts invited to participate in the online questionnaire fully responded to the complete survey on both rounds. Despite the low level of participation, which is a limitation to our study, we believe important messages can still be derived from this study. According to the biodiversity experts that participated in our study, the Aichi conservation targets are not SMARTly designed, except for targets 10 and 14 which were perceived to fully reflect the SMART criteria (Table 4, Figure 1 and 2).

The 20 Aichi conservation targets for the purpose of this exercise were broken down in 57 separate elements (sub-targets), which demand different courses of action and effort to monitor and measure target achievement. Except for targets 10 and 14 experts classified one, or more than one of the SMART criteria to be present on the sub-targets individually, but not on the target as a whole. We believe that group feedback and/or previous-knowledge of the questionnaire, might have slightly influenced the evaluation in round 2 for targets 10 and 14, since during round 1, experts classified all the SMART criteria high (above 50%) but only two SMART criteria rated in the highest quartile (above 75%), while in round 2 the same targets rated in the highest quartile (above 75%) (Table 4).

As far as our suggested criteria is concerned, as potential determining criteria to be considered in the formulation of conservation targets in the future, the experts unanimously agreed that the criterion “time-progressive” is of key importance for meeting targets. Moreover, experts also classified the “socio-economic legislative” sub-criterion and the “science-constrained” criterion to play a determining role for the achievement of almost all Aichi conservation targets on both rounds. Regarding the other criteria suggested in this study, experts classified certain criterion high for particular sub-targets but not for the overall target.

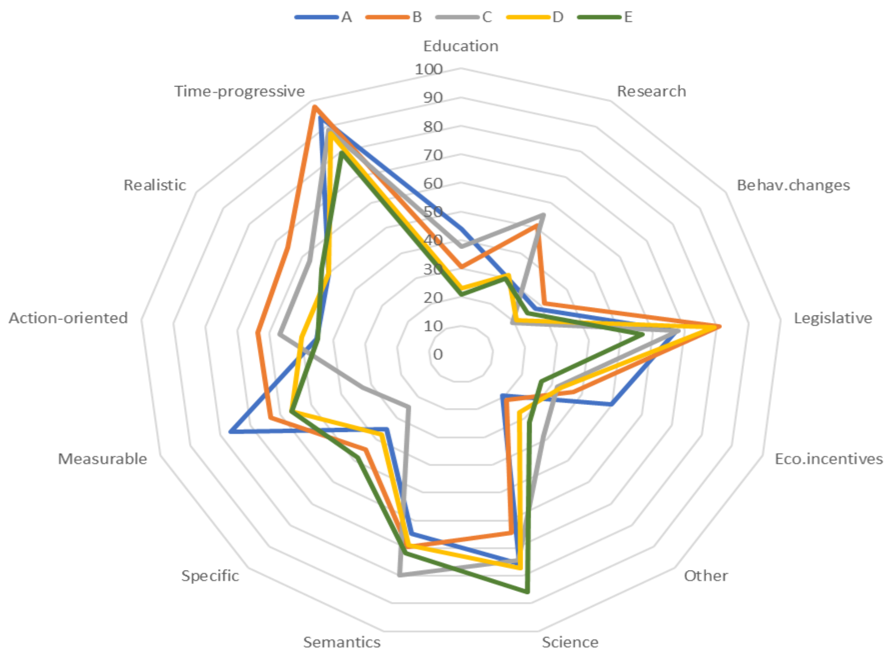

Figure 1: Biodiversity experts rating of the analyzed criteria according to the 5 strategic goals (A, B, C, D, E) for round 1. **A:** Address underlying causes of biodiversity loss by mainstreaming biodiversity across government and society; **B:** Reduce direct pressures on biodiversity and promote sustainable

use; **C:** Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity; **D:** Enhance the benefits to all from biodiversity and ecosystem services; **E:** Enhance implementation through participatory planning, knowledge management and capacity building.

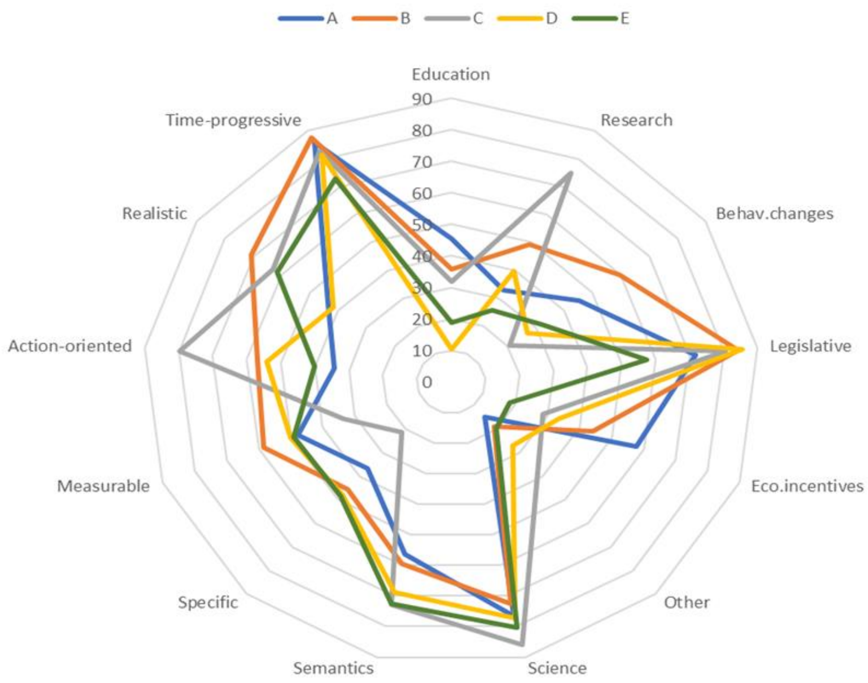

Figure 2: Biodiversity experts rating of the analyzed criteria according to the 5 strategic goals (A, B, C, D, E) for round 2. **A:** Address underlying causes of biodiversity loss by mainstreaming biodiversity across government and society; **B:** Reduce direct pressures on biodiversity and promote sustainable use; **C:** Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity; **D:** Enhance the benefits to all from biodiversity and ecosystem services; **E:** Enhance implementation through participatory planning, knowledge management and capacity building.

5.Conclusion

The Aichi conservation targets have been designed according to the SMART framework, however biodiversity experts feel they do not fully translate the SMART criteria the targets aspired to represent, except for targets 10 and 14. This suggests that as we go into the discussion of post-2020 targets, renovated efforts should be made to design those targets using criteria that fosters their effectiveness. Criteria suggested in this study such as sub-criterion “socio-economic legislative” and criterion “science-constrained” are considered by the experts to influence target achievement and hence, should be considered for biodiversity target setting for the following decade. The formulation of the next biodiversity targets will benefit from the lessons learned from the two previous decades. What have we learned? Future targets need to be short and objective. They need to be specific and measurable. They need to be long-term with intermediate bite-size actions required over time. Criteria suggested in this study such as sub-criterion “socio-economic legislative” and the “science-constrained” criterion can potentially influence target achievement.

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CHAPTER V: The status of implementation of the Nagoya Protocol in Central America

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1.A brief history of Access and Benefit Sharing (ABS) and the Nagoya Protocol

The Nagoya Protocol (NP) on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (hereafter, "the Nagoya Protocol") was adopted in 2010 after several years of intense negotiation (Medaglia, 2015; Mgbeoji, 2003). As of April 2020, there were 123 parties worldwide to the NP (CDB, Nagoya Protocol signatories). Yet the national implementation of its provisions remains limited, and successful cases showing how access and benefit sharing (ABS) works in practice are few.

The NP is a supplementary agreement to the 1992 Convention of Biological Diversity (CBD). The CBD has three, interrelated objectives: the conservation of biodiversity, the sustainable use of its components and the fair and equitable sharing of benefits derived from genetic resources. It is this third objective proved complex enough to require additional rules, which the NP now provides.

Historically, genetic resources were considered to be common heritage of mankind (Oberthür and Rosendal, 2014; Rhodes, 2016). However, as the social, ecological and economic value of biodiversity become clearer, the question of rights over its components, including genetic resources, was raised. More and more countries viewed as a problem that the benefits of genetic resources seemed to not reach biodiversity-rich countries, but rather accumulate in the countries with the technologies to tap into the genetic material and biochemical compounds of plants, animals, and microorganisms.

This imbalance heightened the debate on sovereignty rights over natural resources (Oberthür and Rosendal, 2014). It also resulted in the CBD recognizing that sovereign rights of countries over their natural resources included their genetic resources. Moreover, the CBD established the foundation for countries to regulate how genetic resources were accessed and used for research and development. Yet the principles established by the CBD, including prior informed consent and mutually agreed terms, were difficult to put in practice. The NP responds to the need to strengthen the ability of countries to put in practice access and benefit sharing principles, including by clarifying key concepts and establishing compliance measures. For example, an important advancement brought by the NP refers to the notion of "utilization of genetic resources". In the CBD, the definition of genetic resources referred to material from plants, animals and microbes which contained functional units of heredity. This led to conflicting interpretation on the type of activities that would be covered by rules on access and benefit sharing.

With the adoption of the NP, the “utilization of genetic resources” is defined to include research and development on both the genetic and the biochemical composition of genetic resources. This would include research and development on molecules and active ingredients, which is critical in sectors such as pharmaceuticals and cosmetics. Compliance measures in the NP mean that, for the first time, countries that are not necessarily rich in biodiversity, but have research and development taking place within their borders, must ensure that such research and development takes place in line with ABS requirements in the countries of origin (Article 17, NP).

The NP is legally binding, so state parties are required to elaborate their own national ABS system (Morgera et al., 2012). Nevertheless, the provisions of the NP, in line with the CBD, provide countries with significant flexibility in deciding the objectives, approaches and specific mechanisms in their ABS measures. This means countries must find a sometimes difficult balance between promoting research and development, respecting the rights of indigenous peoples and local communities, investing in conservation and sustainable use activities, among other policy objectives.

Obligations under the NP include establishing provisions on access (Articles 6 and 7), benefit sharing (Articles 5) and compliance (Articles 15, 15 and 17). Countries must designate a Competent National Authority (CNA) as the official body responsible for granting access in line with the national legislation as well as providing written evidence that access requirements were met, if needed. A National Focal Point (NFP) must also be defined. The NFP is responsible to provide information to applicants upon request and for all the communication with the Secretariat of the CBD.

Access requirements are based on Prior Informed Consent (PIC) and Mutually Agreed Terms (MAT). PIC is essentially the authorization to access genetic resources or associated traditional knowledge. Such authorization may be managed by government authorities or by other individuals or groups with rights over genetic resources and associated traditional knowledge. The NP introduces an important instrument regarding access, which is Biocultural Community Protocols. Through this instrument the NP recognizes indigenous and local communities’ rights over their resources and traditional knowledge associated. Biocultural Community Protocols are communities´ “presentation card” because they include information on values, priorities, and procedures for decision-making around their resources as well as their rights and responsibilities under customary, state, and international law. These protocols should be used as the basis for engaging with external actors.

A MAT agreement is a legal contract between the provider and the user of the resource in question, where the conditions of access and utilization of the resource(s) are clearly stated (e.g. restrictions of use, third party transfer, reporting requirements) as well as the benefits to be shared between both parties (monetary and/or non-monetary). Preferably the MAT should also determine what circumstances will trigger the necessity for re-negotiation of the terms of the contract, for example in the case of change of utilization of the resource granted access. Provider countries´ ABS system needs to determine when a MAT is needed and who needs to negotiate and receive potential benefits.

Regarding compliance, the NP offers three main instruments to support monitoring and enhance transparency, these are: the Access and Benefit Sharing Clearing House (ABS-CH), designated checkpoints and Internationally Recognized Certificate of Compliance (IRCC). Checkpoints are designated offices such as patent offices or equivalent, research funding agencies, etc to whom information must be submitted on the status of the utilization of the genetic resource according to provisions laid down on the provider country´s national ABS system. The appointed checkpoint office is responsible to keep the international ABS-CH information exchange platform informed. The ABS-CH is the protocol official portal, established by Article 14 of the Nagoya Protocol itself (https://absch.cbd.int/). It was created to be the main hub for exchanging information on access and benefit-sharing. States are required to make available to the ABS CH any information required by the Protocol, without compromising confidential information. Hence, the idea is that information is made available to anyone, in a transparent manner, about a country in relation to the Nagoya Protocol: has the country signed the NP, has it ratified it, has it designated a CNA, who is the NFP, has it issued any IRCC, etc. An IRCC is a permit, or equivalent, issued by the provider country to the user attesting internationally that access was granted and occurred in conformity with the provider country ABS national system. Just as a compliance system needs to be established, appropriate measures need to be in place to address non-compliance situations. Finally, as far as compliance is concerned, the burden mostly lies on user countries. When user countries have compliance measures in place it is very important to assure provider countries respect the user´s terms once the genetic resources leave the country of origin.

This paper analyzes whether and how NP obligations have been “translated” into ABS measures in SICA countries. Eight countries (Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama and the Dominican Republic) constitute the Central American Integration System (SICA). By comparing the status of implementation of the NP in the different countries in this region, we hope to show some of the challenges and opportunities that may be faced by countries around the world. A literature search and document analysis of legal documents, public strategies, policies and official documents related to the implementation of the NP and ABS mechanisms in each of the eight countries of the SICA region was carried out. When possible, the information collected was then explored/scrutinized via individual interviews with the NFP for the NP in order to understanding the values, beliefs and decision-making processes behind the advancements.

2.The Nagoya Protocol implementation, the SICA region as case study

2.1 Background on the SICA region

Central America falls in the so called “tropics”. That term, independent from definition and metrics, is identified by a particular climate belt around the earth. In the tropic’s biodiversity is known to thrive. Here the highest densities of species on the planet can be found, in part because of a great number of endemic species (Huettmann, 2015). Moreover, in the stretch of land that extends from Panama in the south to Guatemala’s border with Mexico in the north, the diversity of indigenous people, their cultures, traditions and ancient knowledge systems that are kept alive is astonishing (Carmack, 2017). There is extensive literature demonstrating the key role of indigenous peoples play worldwide as custodians of biodiversity and how today, when given appropriate support, they can be the best local allies for biodiversity conservation (Alcorn, 2010; Potvin et al., 2017; Sobrevila, 2008). Hence, for the countries of central America, in the light of the NP, the issues of access to GRs and/ or associated traditional knowledge and benefit sharing are important concerns (Ruiz, 2016).

The SICA came into operation in 1993 as a regional body with the mission to promote integration and set guidelines for the region's integration at a variety of different spheres: economic, social, cultural, political and ecological. Marking the end of turbulent times in the region, when many of the countries in Central America were coming out from years of civil war, the SICA initiative was welcomed by the United Nations as true commitment of the region towards a future of Peace, Freedom, Democracy and Development. Eight countries constitute the SICA, these are: Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama and the Dominican Republic (SICA, n.d.). The Central American Commission for the Environment and Development (CCAD) is the SICA highest authority on the environment and is made up of representatives of the environmental national authorities. The CCAD is the political body in the region with the mandate to provide guidance and support to each of its members on the implementation of the NP (SICA - CCAD, n.d.). All countries in SICA are parties to the CBD (CBD, Nagoya Protocol Signatories) and mention ABS in their public strategies and policies. However only four out of the eight SICA countries have ratified the NP: the Dominican Republic, Honduras, Guatemala and Panama (CDB, Nagoya Protocol signatories). From these four, only Panama and the Dominican Republic have an established and active ABS legal framework. On the other hand, Costa Rica has not ratified the NP but has an established ABS national framework (Table 2).

2.2. Achievements

The implementation of the NP in the eight countries of the SICA region has made different progress in recent years. Overall, in the region, there is a greater understanding and capacity built on ABS and the NP in governmental administrations, the private sector, and civil society since the Protocol entered into force. To help strengthen capacities in the region, the role of several development cooperation programmes have played a key role in preparing the region in relation to the NP implementation (Table 1).

Country	Year	Commissioned by	Name of the Programme	Implementing organization
SICA region	2014 - 2019	German Federal Ministry for Economic Cooperation and Development (BMZ)	Promotion of economic potentials of biodiversity in an equitable and sustainable way for the implementation of the Nagoya Protocol in Central America (access and benefit-sharing, ABS)	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Guatemala	2012	Global Environmental Facility (GEF) Trust Fund	Access to and Benefit Sharing and Protection of Traditional Knowledge to Promote Biodiversity Conservation and Sustainable Use	United Nations Environment Programme (UNEP)
Costa Rica	2013	Nagoya Protocol Implementation Fund	Promoting the Application of the Nagoya Protocol through the Development of Nature-based Products, Benefit-sharing and Biodiversity Conservation	United Nations Environment Programme (UNEP)
Panama	2011 - 2015	Nagoya Protocol Implementation Fund	Promoting the application of the Nagoya Protocol on Access to Genetic Resources and Benefit Sharing in Panama	United Nations Environment Programme (UNEP)

Table 1: Access and Benefit Sharing Projects that operated in the countries of the SICA region, promoted by the development cooperation between 2010 to 2017. Information collected from CBD website section on ABS financial support and GIZ website.

Four out of the eight countries of SICA have ratified the NP: the Dominican Republic, Honduras, Guatemala and Panama. In Panama and the Dominican Republic, specific ABS requirements exist. In Panama, Decree 25 (2009), on access and benefit sharing, regulates access and commercial and non-commercial use of genetic resources and/or associated traditional knowledge from Panama, ensuring a fair and equitable distribution of the benefits derived from a commercial use. This Decree has been under revision since 2017 to better tackle the challenges of access and use of genetic resources in Panama. Many other laws and regulations complement Decree 25 (2009) and are relevant for the access, use and benefit sharing of genetic resources in Panama (Table 2). The Dominican Republic adopted in 2017 an ABS Policy and Regulation (Table 2). Since that adoption, the relevant authorities can handle applications requesting access to GRs more efficiently. In Costa Rica, the environmental sector opposes ratification of the NP; however, for many years, the country has had its own national ABS System in place (Table 2). Furthermore, in 2016 Costa Rica strengthened its ABS national system and passed a Regulation on Sanctions for unauthorized access to GRs. The new Sanctions Regulation was announced, prior to being in force, to relevant parties by the CONAGEBIO, the appropriate CNA in Costa Rica. Several informative workshops on the Sanctions Regulation were held by CONAGEBIO. Later in 2018, Costa Rica again strengthened its national ABS system by adopting an incentive mechanism for the private sector commercially using national GRs. For those companies who comply with the national ABS legal system, CONAGEBIO has chosen to award their good practices by issuing an ABS signature which companies can use on the corresponding product. This is the first of its kind in Latin America and possibly a model worth exploring further. CONAGEBIO has no interest in complicating access and use of national GRs, but it is its responsibility to ensure legal requirements and procedures in place are being followed. In El Salvador, the MARN, the national CNA, is working on an ABS Policy and Regulation, but like Nicaragua, has not ratified the NP. However, both countries have ABS requirements via general environmental frameworks. Belize on the other hand, has not ratified the NP nor has ABS laws or regulations (Table 2).

Table 2: The Nagoya Protocol status and Access and Benefit Sharing existing systems in the countries of the SICA region. Adopted from UEBT (2018) ABS in Central America & the Dominican Republic Factsheet.

(Scope Na = native species; Ex = exotic species; Wd = wild species; Cul = cultivated species; GM = genetic material; BioCom = biochemical compounds)

(Activities triggering access requirements: Re = research; Bpr = bioprospecting; Scr = Sourcing (No R&D).

Country	Signed	Ratified	ABS requirements	Relevant laws and regulations	Scope	Activities triggering access requirements	Competent National Authority (CNA)
Belize	No	No	No	N/A	N/A	N/A	Belize Forest Department
Costa Rica	07/ 2011	No	Yes	Biodiversity Law No. 7788 (1998) Executive Decree 31,514-MINAE (2003) on access to genetic resources Executive Decree 33,697-MINAE (2007) on *ex-situ* access Executive Decree 39,341-MINAE (2016) on sanctions for unauthorized access	Na; Ex; Wd; Cul; GM; BioCom	Re; Bpr & Scr	Comisión Nacional para la Gestión de la Biodiversidad (CONAGEBIO)
Dominican Republic	09/ 2011	09/ 2014	Yes	Regulation on Access to genetic resources and traditional knowledge (January 2018) Biodiversity Law No.33 (2015)	Na; Ex; Wd; Cul;GM; BioCom	Re & Bpr	Ministerio de Ambiente y Recursos Naturales (MARN)
El Salvador	02/ 2012	No	Yes	Decree 844 (1994) establishing law for wildlife and conservation Decree 233 (1998) established general environment law Decree 17 (2000) regulating general environment law Decree 579 (2005) establishing law for protected areas	Na; Ex; Wd;GM; BioCom	Re; Bpr & Scr	Ministerio de Ambiente y Recursos Naturales (MARN)
Guatemala	05/ 2011	06/ 2014	Yes	Resolution No. ALC027 (2001) on rules for research authorizations	Na; Ex; Wd;GM	Re & Bpr	Consejo Nacional de Areas Protegidas (CONAP)
Honduras	02/ 2012	08/ 2013	No	N/A	N/A	Re & Bpr	Secretaria de Energia, Recursos Naturales, Ambiente y Minas (MiAmbiente+)
Nicaragua	No	No	Yes	Law 807 (2012) on conservation and sustainable use of biodiversity	Na; Ex; Wd; Cul;GM; BioCom	Re & Bpr	Ministerio del Ambiente y los Recursos Naturales (MARENA)
Panama	05/ 2011	12/ 2012	Yes	General Environmental Law No. 41 (1998) general provisions and guidance on ABS Law 8 (2015) modifying provisions of the general environment law Law No. 17 (2016) on protection of traditional knowledge used in indigenous medicine system Executive Decree No. 19 (2019) on access and benefit sharing for the processing of commercial and non-commercial research.	Na; Wd; Cul;GM; BioCom	Re & Bpr	Ministerio de Ambiente (MiAMBIENTE)

Most countries in the region, though, have taken measures to improve their administrative procedures regarding access to GRs, even without having adopted a national framework on ABS. Costa Rica, Panama, Guatemala and the Dominican Republic have improved their procedures and granted access permits under new conditions. In Guatemala, CONAP approved the National Policy on ABS and Biocultural Heritage; and, in Dominican Republic, ABS was included in the new National Biodiversity Law (Law 355-16); while Panama adopted Law No. 17, which establishes Prior Informed Consent (PIC), when traditional knowledge and indigenous groups are involved. In El Salvador new formats for requesting access to GRs were approved in 2018 and have been made available online. All these measures help to bring transparency and legal certainty in the process of accessing genetic resources to users.

Another important improvement in the region, at national level, has been the articulation between the CNA and other relevant bodies with a mandate related to GRs, such as for example the Ministry of Agriculture, which is usually responsible for the International Treaty on Plant Genetic Resources for Food and Agriculture or the Patent Office, etc. A concrete example of a successful collaboration is the one established in the Dominican Republic between the CNA and the National Office on Industrial Property (ONAPI according to its acronym in Spanish) in relation to intellectual property rights. The ONAPI has made legal adjustments to its structure, which have allowed it to become one of the main national check points. The office is now able to monitor all products that may result from an access to national GRs.

Institutional collaboration has also been established in many countries between the CNA and other national institutions which have been trained on ABS and assumed a multiplicator role, disseminating information on ABS with their own resources. To give a few examples; the Universidad de San Carlos in Guatemala; an NGO called the National Association for Nature Conservation (ANCON) in Panama; and the Museum of Natural History of El Salvador (MUHNES) in El Salvador. The involvement of other institutions is key in helping promote the NP at national level. For example, in El Salvador, MUHNES has a greater capacity to disseminate information and raise awareness on ABS than the CNA. Since 2017 MUHNES has had a permanent exhibition on ABS. In Panama, ANCON has actively been working to build inventories of genetic resources and promote their commercial use. In Guatemala, the University of San Carlos is one of the few national institutions, which can present a law proposal or changes to a law. The University has been working since 2016 with the designated CNA, the National Council for Protected Areas (CONAP for its acronym in Spanish) and some representatives of Indigenous Peoples, on a proposal for a framework Law on Biodiversity, which integrates ABS, and which is finally ready to be presented to the University Higher Council. The next step is a period for the socialization of the proposal with different sectors and administrative regions of the country before the University presents it to the Congress of Guatemala. This will be a lengthy process but given the poor credibility of the CNA and the Ministry of Environment, there is a higher chance that such proposal is adopted if presented via the University than by the CNA.

The focus of regulation in SICA countries has been primarily on “access” rather than on “utilization” of GRs. “Utilization” covers different activities from scientific research, bioprospection to industrial application and commercialization. Commercialization ultimately must result in benefit sharing. Commercial use of genetic resources and consequent benefit sharing is in its infancy in the region. However, both Costa Rica and the Dominican Republic have accumulated important experiences since the adoption of the NP, which can help other countries of the region to prepare for such negotiations.

A good example in Costa Rica is a benefit sharing agreement signed with Chanel, the international French perfume company. In 2016, the National Commission for Biodiversity Management (CONAGEBIO), the Costa Rica CNA, approved a Chanel request to commercially use the green coffee from Nicoya. The Blue Serum, the new face cream from Chanel, contains green coffee molecules from the Nicoya Peninsula in Costa Rica; and it is the properties of this coffee that makes the product special. The MAT agreement for benefit sharing was executed directly between Chanel and the local coffee producers. However, CONAGEBIO played a key role in supervising and mediating the negotiation. Today Chanel pays benefits directly to the producers of the green coffee in Guanacaste in the west of the country.

Similarly, in the Dominican Republic in 2017 Medolife, an American pharmaceutical company, was given permission to access the poison of the blue scorpio (*Rhopalurus princeps*), a species found in the Dominican Republic, for commercial use. The permission was given by the CNA assigned to implement the Nagoya Protocol, i.e. the Ministry for the Environment and Natural Resources (MARN for its acronym in Spanish). After many years of research, Medolife found that the poison of the blue scorpion is effective in the treatment of some types of cancer (Mikaelian et al., 2020) and wishes to use the poison on a natural complementary drug for the treatment of cancer. A Benefit- Sharing contract was signed between local providers of the blue scorpion poison in the province of Neyba and Medolife directly. As demanded by the Sectorial Law on Biodiversity (333-15), approved in 2017, the CNA mediated the process of negotiation. As part of the benefits negotiated in the MAT for commercial use, the company is obliged to support a local project to preserve biodiversity in the Neyba region. Part of the measures agreed is that the company will help set up a scorpion farm and will pay 5% of the profits that result from the sale of the cancer drug directly to a fund set up by the Dominican Republic government.

Overall, the higher the priority assigned to ABS in the political agenda of a country largely translates into how much progress that country has made to establish a national ABS system, independently from having ratified the NP or not. In the region, Costa Rica, the Dominican Republic and Panama are leading the way.

2.3 Challenges

Despite Guatemala having ratified the NP in 2016, there was an unconstitutionality in the process. This unconstitutionality that resulted in the NP ratification was later uncovered, helping to fuel suspicion around the Protocol. The current situation is hence very delicate. Despite internationally the ratification being in force, nationally little has been done to implement a national ABS system; and there has been little political will to settle the NP ratification situation. In El Salvador, ABS has never been perceived as a key theme in the political agenda. The genetic resources and biodiversity present in the territory are perceived to be of little value, so the interest in ABS is also low. This situation is similar in Belize, Honduras and Nicaragua where research and the use of resources is still incipient. In these countries the efforts have strongly been aimed towards building capacities of organizations and interinstitutional cooperation.

At the regional level ABS is still not a priority theme in the political agenda. Nevertheless, since 2016, with the support of the development cooperation regional programme (Table 2), a Regional Committee on ABS for Central America and the Dominican Republic (CR-ABS/CA-RD) was formed. The CR-ABS/CA-RD has ever since met twice a year to discuss common problems and exchange experiences, and in 2017 agreed on a common agenda of issues on which the countries want to work together. With the end of the development cooperation program the CR-ABS/CA-RD is lobbying with the CCAD so that ABS can be integrated into the agenda of the existing technical Committee on Seas and Biodiversity, an official body of the CCAD. While much progress has been made, there are still challenges, where countries have expressed the need for assistance. Some of these challenges are: a) encouraging the commercial use of genetic resources; b) working in a relevant way with Indigenous Peoples and traditional knowledge; and c) increased efficiency and collaboration between relevant organizations at national and regional level. Because each country goes at its own pace and has its own priorities, the issues and solutions found in one country may be of assistance as a reference for others. In this regard, it is very important to continue working on ABS and the NP with a regional approach. Countries share genetic resources and traditional knowledge and need to agree on common strategies and positioning regarding key challenges. New interventions should consider capacity building at the regional level to enhance the exchange of experiences and establish guidelines to assist member countries in furthering their own ABS development.

3.The Way forward

The question we proposed to answer in this paper: *What is the state of implementation of the NP, since its adoption in 2010, in Central American Integration System (SICA)?* As has been described, the circumstances in each country of the SICA region differ, which have resulted in different approaches taken on ABS and different progress made in recent years. Indeed, what is interesting about the SICA countries is that the region shows the range of challenges and opportunities presented by the NP. The Dominican Republic and Costa Rica are SICA countries with internationally-recognized approaches on ABS. In Costa Rica, applications for access can be done online, making the process easier and more transparent (CONAGEBIO, Access Permits). Both Costa Rica and Dominican Republic have negotiated benefit sharing agreements involving research and development with commercial purposes and international companies and organizations. In 2019 Panama took an important step to protect its genetic heritage passing on a reform to make its regulatory framework on ABS more efficient. Executive Decree No. 19 in Panama, published in March 2019, regulates access, control and use of biological and genetic resources in its territory for commercial and non-commercial purposes. The decree also regulates the conditions for access to traditional knowledge and practices of indigenous peoples and local communities as well as other measures related to the subject. Panama and the Dominican Republic became thus the first countries in the region to incorporate into their national regulations the legal framework that makes possible to implement and comply with the Nagoya Protocol. On the other hand, El Salvador, Guatemala and Nicaragua have not adopted specific ABS requirements and have little experience in negotiating ABS requirements with users. Belize and Honduras are still in the process of adapting their regulatory framework for ABS. A greater awareness of ABS can be observed in the region since the adoption of the NP. Nevertheless, it has not always proved straightforward to turn such awareness into a functioning legal framework. The NP remains highly controversial in the region. The amount of interest and priority placed on “access and benefit sharing” depends on each country’s political agenda. In many countries of the region, NP is still not perceived as a priority.

These findings show the importance of working on ABS and the NP under a regional approach. Being a relatively small region with many shared resources beyond political borders, the need to agree on common strategies and positioning as a block regarding key challenges is crucial to ensure equitable benefit sharing across the region. Regional approaches also harness the opportunity of sharing experiences among SICA countries in different levels of ABS implementation. New interventions should consider capacity building at the regional level to enhance such exchanges and establish common guidelines for countries to further their ABS implementation and sustainable development. No less importantly, experiences in the SICA countries can provide valuable lessons as the international community continues to assess the NP and its approaches and contributions to the sustainable development goals.

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CHAPTER VI - DISCUSSION AND CONCLUSIONS

After the 2010 Target for biodiversity was missed, a new Strategic Plan for Biodiversity, which included 20 conservation targets, the Aichi Targets (AT), were agreed and settled the roadmap for nations to safeguard biodiversity until 2020. Parties to the CDB agreed on the need to design biodiversity goals smartly. The SMART framework, commonly used in the business world, was hence adopted in order to support the design of robust conservation goals. The Aichi Targets were designed SMART i.e. specific, measurable, ambitious, realistic and time-bound (Maxwell et al, 2015). The 20 bite-size Aichi Targets were described to be more holistic and to have brought many positive improvements in relation to the CBD 2010 Biodiversity target, such as for example addressing the state of biodiversity, bringing into focus the agents of pressure and drivers of change on biodiversity and integrating the third objective of the CDB on access and benefit sharing – as translated in the Nagoya Protocol adopted in 2010, and integrating biodiversity issues across many sectors (Mace et al, 2013; Rees et al., 2018; OECD, 2019).

However, as the 2020 expiration date arrived it was unquestionable that most of the Aichi Targets had not been met and that yet again the internationally commitment towards biodiversity conservation fell short (OECD, 2019; IPBES, 2019). Studies analyzing and dissecting the progress towards the Aichi targets have been building up as early as 2014, when the first signs came up that we were not on track to meet the Strategic Plan for Biodiversity (Tittensor et al, 2014). Hence, during the 14th meeting of the CBD Conference of the Parties (COP 14) an Open-ended Intersessional Working Group on the Post 2020 Global Biodiversity Framework was established and given the responsibility of developing the post-2020 framework (CBD, COP 14 Decisions, Decision 14/34 https://www.cbd.int/doc/decisions/cop-14/cop-14-dec-34-en.pdf). Several studies criticize the AT for not delivering the promised SMARTness i.e. being ambiguous, not specific enough, not scalable or measurable and not enabling (Bridgewater, 2011; Wood, 2011; Butchart et al, 2016; O´Leary et al, 2016; Green et al, 2019). Whichever way the post-2020 biodiversity strategy may come to look like, the scientific community broadly recognizes that to reach the 2050 vision of "Living in Harmony with Nature" when "… biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits" (CBD) much more ambitious goals need to be agreed and implemented to bend the curve of biodiversity loss by 2030 (Mace et al., 2018). After two decades of failing to meet set targets, it is clear that "business as usual" is not an option anymore. The IPBES has urged, in its latest report, for transformative change to address the drivers of change (such as land conversion, overexploitation and climate change), such a step will demand shifts in our global financial and economic systems (IPBES, 2019).

A draft framework, the Zero Draft of the Post-2020 Global Biodiversity Framework (hereafter, "Zero Draft"), is available since January 2020 (CBD, 2020). The Zero Draft adopts the "theory of change" approach, a project planning and evaluation process which, maps the relationship between a long-term goal, such as the CBD 2050 vision of "Living in Harmony with Nature", and the intermediate and early changes that are required to bring it about. The draft takes into account "SMART targets, indicators, baselines, and monitoring frameworks, relating to the drivers of biodiversity loss, for achieving transformational change, within the scope of the CBD's three objectives" (CBD, 2020). With the goal of making the draft concise the set of goals and targets formulated use simple language and are limited in number. Each goal and target come with a preliminary monitoring framework draft that specifies which elements should be considered when implementing each goal or target, as well as a preliminary list of indicators that may be used to assess progress (CBD, 2020). This draft is under discussion and there are many opinions about the best way to move forward post-2020.

Erdelen (2020) brings *food for thought* by briefly presenting and discussing ten action-oriented proposals to bend the curve of biodiversity loss. Three from the ten are presented to be the fastest track initiatives: (1) the creation, as far as possible, of a worldwide protected area (PA) network; (2) a complete halt of deforestation and the restoration of forest ecosystems and (3) a massive reduction in/or the complete halt of environmental pollution.

Considering the first action-oriented proposal of Erdelen (2020) from the three fast track initiatives: extending the creation of PAs networks, is aligned with the long-term view that PAs are considered the building blocks of biodiversity conservation. Studies have shown that when well-managed, reserves are more effective in safeguarding biodiversity than any other land use approaches (Gray et al, 2016) however, on the ground many are just "paper parks" and an increase in area is not necessarily a synonym of increased protection of biodiversity (Barnes, 2015; Pringle, 2017; Kuempel et al, 2018).

Nevertheless, a growing movement of conservationists are arguing in favor of raising the bar to 30% of the global coverage of conservation areas until 2030 (O'Leary et al., 2016; Dinerstein et al, 2019; Locke et al., 2019). The Strategic Plan for Biodiversity 2010 – 2020 Aichi target 11 called *for "17% of terrestrial surface of the planet to be protected in some form and 10 % of the oceans by 2020"*. Currently, studies show that about 15% of the terrestrial surface and 7% of the marine ecosystems are under some form of protection (UNEPWCMC, 2020) and hence, the target has not been met.

The Biologist E.O. Wilson, in his book *Half Earth: Our Planet's Fight for Life* from 2016 first brought to the forelight of public attention the idea that in order to save the planet from mass extinction, including that of the human race, half of the surface of the planet should be saved for conservation. Slowly what looked an inspirational idea and far from reality has gained support among scientists (Dinerstein et al,2017; Dinerstein et al, 2019) as more data on the status and extent of the crisis of biodiversity is known. Specially worrying is the fact most species' populations and species' extinction risk continue to trend downwards (IPBES, 2019; Locke et al., 2019). Two proposals to make half of the Earth´s surface, terrestrial and marine, an interconnected global nature reserve are being developed by two organizations: Half of the Earth Project (HEP, https://www.half-earthproject.org/) (Wilson, 2016) and Nature Needs Half Coalition (NNH, https://natureneedshalf.org/) (Locke, 2013). The latter developed a concept of a Global Deal for Nature (GDN), which claims to be a time-bound, scientifically-based action plan to deliver the CBD 2050 vision, to conserve 50% of the 846 ecoregions of the Earth using remaining unused land for agriculture and settlements (Dinerstein et al, 2017; Dinerstein et al, 2019). Despite the above-mentioned proposals still being in early stages of being developed, many questions have been raised related to funding mechanisms, governance strategy and priority setting for conservation (Ellis and Mehrabi, 2019). Yet another aspect that raises a lot of questions is how the human-dominated half of the Earth will look like (Ellis and Mehrabi, 2019).

There are still many details and questions needing to be discussed and finalized before the new post-2020 Global Biodiversity Framework is agreed but there is also some elements which have found common ground. A growing number of studies show the need to link the biodiversity governance beyond the CBD, that is the new framework needs to allow for the contributions of non-state and private sector actors to be contribute and factored in (Karlsson-Vinkhuyzen et al, 2017; Patterberg et al., 2019; Smith et al, 2019; Erdelen, 2020). Additionally, it is ever more evident that two of the greatest environmental challenges of our time: biodiversity crisis and climate change are interconnected and can influence each other (Korn et al, 2019). Clearer links between both international agendas are needed to bring positive feedback. Finally, it is time to reflect whether it is time to make the post-2020 Biodiversity Framework legally binding. A review of International Environmental Agreements (IEAs) shows that legally binding EIAs that promote flexible decision-making processes perform better (Mitchell et al, 2020). Whichever path the post-2020 Biodiversity Framework takes on, a chance for achieving biodiversity targets will only be possible, definitely if “business as usual” scenario is completely abandoned and serious commitments at are made for biodiversity at political level. The recent Covid-19 pandemic has been an opportunity to rethink our value systems and remind us of our fragility. More scientists are highlighting the direct and underlying connections of this global pandemic with the increasing and accelerating disruptions and destruction humankind has been inflicting on the natural environment, time and time again attributing to financial growth a disproportioned weight in the value system governing our societies.

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ANNEXES

Annex I – Please see Excel file

Annex II - QUESTIONNAIRE: Assessing Aichi Targets Design

We would like to thank you for taking part in our study. The following pages will guide you through a set of 9 criteria against which we aim to evaluate the design of the Aichi targets of the biodiversity strategy for 2020. The questionnaire takes about 60 minutes to complete and an answer is always required.

For each criterion we provide you with: an explanation of the criteria, the question guiding our evaluation and an example of a target. We provide a good and a bad example of a target for each criterion.

Please note that your assessment should be based on the description of the target provided alone.

Thank you again for your contribution, your expert opinion matters to us!

PERSONAL DETAILS

Despite asking for your personal details, your answers will be kept confidential. We only ask you to provide your details, so we can send you a summary of your answers, after the first round of the questionnaire, giving you the option to change your answers if you so wish to.

Name:

Email:

1.CRITERIA: SPECIFIC

Description:

Target is well defined and its outcome is clear. Is the target SPECIFIC?

Example:

good: " I want to lose fat tissue to reach recommended health standards."
bad: " I want to lose weight."

2. CRITERIA: MEASURABLE

Description:

The achievement of the target, or the progress towards the target, can be demonstrated by means of a metric. Is the target MEASURABLE?

Example:

good: " good: "I want to lose 5 kg."
bad: "I want to lose weight."

3. CRITERIA: ACTION-ORIENTED

Description:

Actions needed to achieve the target are clear. Is the target ACTION-ORIENTED?

Example:

good: "I am going to run 30 minutes three times a week, will stop eating sweets and fat food and will weight myself on a Body-Mass Index (MBI) calculator scale every two weeks."
bad: "I will become slimmer."

4. CRITERIA: REALISTIC

Description:

Achievable within the resources and timeframe available. Is the target REALISTIC?

Example:

good: "I will lose 200 gr per week and exercise 3 times a week."
bad: "I will lose 5kg per week and exercise 4 hours every day."

5. CRITERIA: TIME PROGRESSIVE

Description:

The target was formulated as a bite-size goal, based on a long-term vision. Is the target TIME-PROGRESSIVE?

Example:

good: "I want to lose 200 gr each week during the first 4 months and 100 gr per week for the next 4 months."
bad: "I want to lose 3,5 Kg in the next 8 months."

6. CRITERIA: SOCIO-ECONOMIC MECHANISMS

Description:

The achievement of the target is facilitated via the approval of a new legislation or regulation, an economic incentive, by making more information available, by educating people, by advancing research, through deep societal behavioural changes, etc. What are the appropriate SOCIO-ECONOMIC MECHANISMS to reach the target?

Example:

Legislative: "A new law is approved demanding employers to offer exercise facilities to their workers."
Economic Incentive: "A monthly subsidy is paid to employers that bike to work."
Education: "Teenagers are offered health & nutrition classes as part of their curriculum."
Research: "Science provides evidence people should sleep between 7-8 hours to keep their focus."
Behavioural Changes: "People will only eat meat once a week."

7. CRITERIA: SCIENCE-CONSTRAINED

Description:

The achievement of the target is constrained by gaps in science knowledge. Is the achievement of the target limited by science?

Example:

good: "Healthy lifestyles can reduce the risk of cancer."
bad: "Eating two apples a day prevents cancer."

8. CRITERIA: SEMANTICS DEPENDENT

Description:

The target uses terms for which there is no consensual definition. Can the target not be reached only because of a SEMANTIC issue?

Example:

"I will stop my diet when I am beautiful."