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Mining CBD

Mineração do texto da Convenção sobre Diversidade Biológica

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DIREITO INTERNACIONAL E BIODIVERSIDADE

Sumário

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Abstract

The general objective of this study is to analyze the consideration of the themes of climate change and biodiversity, ecosystem approach, agricultural biodiversity and coastal and marine biodiversity in the Convention on Biological Diversity and to identify key events that have contributed to their recognition. The applied methodology relies on text mining and a terminological analysis, considering a textual corpus consisting in the Convention on Biological Diversity (1992) and in 364 decisions issued from the Conferences of the Parties (1994-2014). Our first specific objective is to analyze the evolution of the relative importance of these themes during the holding of the COPs. A second specific objective is to demonstrate through this study the contribution of text mining and its potential for further studies relying on large textual corpora. The main results are that these themes are addressed continuously throughout the holding of COPs and that the terminology enriched progressively with new notions and concepts sought by each theme. If climate change and the promotion of an integrative ecosystem approach have continuously be taken into account from 1992, agricultural diversity, and more recently the marine and coastal biodiversity are the most highlighted themes in the work of the COPs. As a consequence this study highlights the necessity to consider the interlinkages between biodiversity sectors, biodiversity appearing more and more clearly as a cross-cutting issue to be incorporated as such into various policies.

Keywords: Convention on biological diversity. Text mining. Climate change. Ecosystem approach. Agricultural biodiversity. Marine and coastal biodiversity**.**

Resumo

O objetivo geral deste artigo é analisar a consideração dos temas de mudança do clima e biodiversidade, abordagem ecossistêmica, biodiversidade agrícola e biodiversidade marinha e costeira na Convenção sobre Diversidade Biológica e identificar eventos-chave que contribuíram para o seu reconhecimento. A metodologia aplicada é de *text mining* e de análise terminológica, considerando corpo textual que consiste na Convenção sobre Diversidade Biológica e em 364 decisões das Conferências das Partes (1994-2014). O nosso primeiro objetivo específico é analisar a evolução da im-

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portância relativa destes temas durante a realização das COPs. O segundo objetivo é demonstrar a contribuição do *text mining* e o seu potencial para outras pesquisas com corpos textuais mais amplos. Os principais resultados foram que os temas selecionados foram tratados de forma recorrente durante as COPs e que a terminologia foi enriquecida progressivamente com novas noções e conceitos para cada tema. Se a mudança do clima e a promoção de uma abordagem ecossistêmica integrativa foram considerados de forma recorrente desde 1992, diversidade agrícola, e mais recentemente biodiversidade marinha e costeira são os temas postos em evidência nas COPs. Conseqüentemente, este estudo destaca a necessidade de se considerar os links entre os setores da biodiversidade, haja vista que ela aparece cada vez mais claramente como um tema transversal a ser incorporado nas diversas políticas.

Palavras-chave: Convenção sobre Diversidade Biológica. Mineração de texto. Mudança do clima. Abordagem ecossistêmica. Biodiversidade agrícola. Biodiversidade marinha e costeira.

1. Introduction

Data-mining gives a great opportunity to gain news insights from a wide range of data and information sources and to generate new knowledge from a variety of texts by bridging them in an innovative manner. In the context of biodiversity, data-mining can be used to measure biodiversity, to identify species, manage collections or standardize sampling protocols[1]. In fact, it is estimated that more than 80% of species are still undiscovered[2],[3]. Even though we know that biodiversity loss is a main driver of ecosystem change[4], the evaluation of biodiversity loss and the estimation of its rate remains a daunting challenge[5]. Therefore, many species become extinct before they are even discovered. Acknowledging the lack of taxonomists and the multiple challenges related to taxonomy[6] and considering the significant gap of knowledge regarding biodiversity, a group of researchers led by P. Hebert proposed to promote molecular identification of living organisms through DNA barcoding[7], using a short section of DNA from a standardized region of the genome for species identification and discovery.

It prompted the creation of the international Consortium for Barcode of Life (CBOL) which launched the International Barcode of Life Project (2010) with the aim to barcode 5 million specimens from 500,000 species within five years. The target has been reached. The CBOL relies on the Barcode of Life Data System (BOLD), online workbench and database that supports the assembly and use of DNA barcode data. Freely available to anyone with interests in DNA barcoding, it allows for searching all 1.3 million public records in BOLD using multiple search criteria (such as geography, taxonomy and depository). These barcoding initiatives, using huge amount of data, are in line with the main objectives of the International Convention on Biodiversity (1992) and notably with the Article 7 of the Convention about Identification and Monitoring which calls for the identification of the components of biodiversity and the maintaining and organization of data, derived from identification and monitoring activities[8].

Similarly, projects are built to provide more information and knowledge about biodiversity in its various dimensions through the utilization of complex sets of cross-cutting data. For instance, we can cite an on-going project called Mining of Biodiversity which intends to integrate novel text mining methods, visualization or crowdsourcing in order "*to transform the Biodiversity Heritage Library (BHL) into a next-generation social digital li-*

1 WALLS, Ramona L. et al. Semantics in support of biodiversity knowledge discovery: an introduction to the biological collections ontology and related ontologies. *Plus One*, v. 9, n. 3, p. 1-13, e89606, 2014.

2 MORA, Camilo et al. How many species are there on earth and in the ocean? *PLoS Biol*, v. 9, n. 8, 2011. e1001127. doi: 10.1371/journal.pbio.100112.

3 MAY, Robert. M. Why worry about how many species and their loss*? PLoS Biol,* v. 9, n. 8, 2011. e1001130. doi:10.1371/journal.pbio.1001130.

4 HOOPER, David U. et al. A global synthesis reveals biodiversity loss as a major driver of ecosystem change. *Nature,* v. 486, n. 7401, p. 105-108, 2012.

5 MENDENHALL, Chase. D. et al. Improving estimates of biodiversity loss. *Biological Conservation*, v. 151, p. 32–34, 2012.

6 KIM, Ke Chung; BYRNE, Loren B. Biodiversity loss and the taxonomic bottleneck: Emerging biodiversity science. *Ecological Research 21*, p. 794-810, 2006.

7 HEBERT, Paul D. N. et al. Biological identifications through DNA barcodes. Proceedings of the Royal Society B. *Biological Sciences*, v. 270 n. 1512, p. 313–321, 2003.

8 LAJAUNIE, Claire; MORAND, Serge. Barcoding, Biobanking, e-Banking: From Ecological to Ethical and Legal Aspects. Insights from the PathoDivSEA Project. In: MORAND, S. et al. (Ed.). *Socio-ecological dimensions of infectious diseases in Southeast Asia*. Singapore: Springer, 2015.

brary resource to facilitate the study and discussion (via social media integration) of legacy science documents on biodiversity by a worldwide community and to raise awareness of the changes in biodiversity over time in the general public"[9].

The present study is motived by the fact that many different themes regarding biodiversity are treated by the Convention of Biodiversity and the associated Conferences of the Parties (COPs) but there is a lack of studies and of methodology development that would allow showing and exploiting the huge quantity of knowledge generated by the work of the COPs, and its interconnections. Text-mining is providing a new perspective, without a priori considerations, that could help to scrutinize this knowledge[10]. Here, we propose an exploratory study focusing on a textual corpus resulting from the CBD and COP's decisions.

Our purpose is to consider four main themes, contained into the CBD, that are crucial to comprehend, in order to ensure the preservation of biodiversity. Text--mining will help us to analyze how the use of these themes has evolved from the adoption of the CBD in 1992. The use of text-mining methodology allows us considering raw data coming from the textual corpus prior to any legal analysis. Starting from data mining results, we describe and analyze the results without preconceived ideas on the evolution of terms and its interpretation. Thus, the legal interpretation came after the preliminary work of term extraction and resulted from the observation. We have chosen to present the four main themes we selected in a specific configuration (see Figure 1) showing how these themes interact within the CBD. We will first examine the very general theme of climate change and biodiversity and its interactions with the theme of the ecosystem biodiversity (and ecosystem approach) and then to illustrate the ecosystem biodiversity we will consider the theme of agricultural biodiversity, on the one hand, and the theme of marine and coastal biodiversity, on the other hand. Finally, the study of these various interactions will lead us to assess the knowledge coming from the agricultural biodiversity and marine and coastal biodiversity themes that could feed the awareness of the interlinkages between climate change and biodiversity (as illustrated by Figure 1).

FIGURE 1: A proposed hierarchy of major themes accounted in the CBD: the relations between climate change and biodiversity is encompassing the issue of biodiversity and ecosystems (including the ecosystem approach) that then specializes in agricultural biodiversity and marine and coastal biodiversity. The feedback (dashed arrows) of the components of agricultural, marine and coastal biodiversity to climate change that are the subject of numerous scientific studies, are calling for their inclusion in terms of norms and regulation via an increased inter-connection between concerned environmental regimes or regimes complexes.

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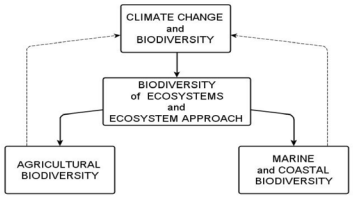


Fonte

The article is organized as follows. In a first place, we explain how we constituted the textual corpus, how we extracted the terms and thus we precise how we link those terms to the four main themes (Section 2). Then we make a quantitative assessment of the occurrence of terms related to the four themes as a function of time. We offer an interpretation of the observed progressive enrichment of thematic terminologies in relation to the work of scientific bodies of the CBD and of the COPs (Section 3). In section 4 we discuss about the biological diversity as a cross--cutting issue. We explain how the clearing-house mechanism and environmental impact assessment are continuously detailed and refined over time by the COPs. We then present the bridging role of the framework of the Strategic Plan for Biodiversity and the Aichi targets in the awareness of the importance of biodiversity for a sustainable development of the planet. The main conclusions of this work are presented in the final section.

9 <http://www.biodiversitylibrary.org/>. Access in: 29 Apr. 2016.

10 WAGH, Rupali S. Knowledge discovery from legal documents dataset using text mining techniques. *Intern. J. of Computer Applications,* v. 66 n. 23, p. 32-34, 2013.

2. Textual corpus and term extraction

The textual corpus that we analyse consists of the Convention on Biological Diversity (1992) and of the 364 decisions taken during the twelve COPs held from 1993 to 2014. These texts are available on the CBD website[11]. Using the free software TermoStat[12] we extract the complex nominal terms[13]. We get a list of over 12,500 complex terms. This list is manually revised a first time to remove the terms that come from spelling or typographical errors (from the source text), or from parsing errors when extracting terms (e. g. taking a verb for some component of a complex nominal terms). We also remove too general terms (like "*absolute certainty*", "*accompanying regulation*", "*enhanced cooperation*", etc.) or at the opposite context-dependent or very specific terms ("*open- ended workshop*", "*next ordinary meeting* "...). The filtered list includes 8,867 complex nominal terms or expressions. A second manual inspection is performed to identify in this filtered list terms related to each of the four themes. For that every author of this study separately established a list assigning terms for each topic (the same term can be assigned to several lists). Both lists were then compared: we estimate that in 90% of cases we set the same terms in the same thematic list. In case of dispute we argued our respective choices and easily taken a joint decision, no difference of opinion having persisted. Although the method is based on general knowledge of the authors, this high rate of similarity of classification decisions (taken independently) is remarkable as coming from two researchers from very different disciplines and different career paths.

Theoretically, we can consider these thematic lists of expressions in three different ways[14] : 1) In text mining, a theme built through the categorization of terms extracted from a corpus is a concept[15] which is used as soon as at least one of its composing terms is present in a text[16]; 2) In terms of the theory of concepts, the list of terms associated with a theme is an expression of how the theme is conceptualized in the corpus considered[17]. Thus a theme is likely to be treated differently depending on the Convention which seizes it: this difference may be a source of conflict between conventions when the same domain is regulated through different conceptions[18]; 3) from the point of view of the knowledge representation, a list of terms can be organized into hierarchical classes following generic ontological relationships (relationships such as "*is a*", "*is a part of*," for the most common ones[19]). Without using existing ontologies[20],[21],[22], we can consider the hierarchy of thematic terms as a kind of micro-ontology specific to the CBD (a kind of « very » lightweight ontology[23]). Text mining helps the clarification of ontologies, and is also likely to reveal other links between terms or concepts, sometimes transforming the hierarchical structure of the ontology in semantic network (e.g. a given term belonging to several classes), and highlighting semantic differences of interpretation or categorization[24].

11 <https://www.cbd.int/>. Access in: 29 Apr. 2016.

12 DROUIN, Patrick. Term extraction using non-technical corpora as a point of leverage. *Terminology*, v. 9, n. 1, p. 99-117, 2003.

13 Terms qualified as "complex" because consisting of several words, such as "biological diversity" (rather than the simple term "diversity"), "ecosystem approach" (rather than the simple terms "ecosystem" or "approach").

14 Provisionally, we use in this study only the first approach by text mining, keeping the other two (theoretical concepts and knowledge representation) for further study.

15 FELDMAN, Ronen; SANGER, James. Introduction to text mining. In: FELDMAN, Ronen; SANGER, James. *The text mining handbook:* advanced approaches in analyzing unstructured data. Cambridge: Cambridge University Press, 2007a. p. 1-18.

16 FELDMAN, Ronen; SANGER, James. Core text mining operation. In: FELDMAN, Ronen; SANGER, James. *The text mining handbook:* advanced approaches in analyzing unstructured data. Cambridge: Cambridge University Press, 2007b. p. 19-56.

17 HJØRLAND, Birger. Concept theory. *Journal Am. Soc. for Information Science and Technology*, v. 60, n. 8, p. 1519–1536, 2009.

18 See for example the treatment of issues related to forests and deforestation at the intersection of the regimes of Climate Change and Biodiversity in VAN ASSELT, 2012. This question is reminiscent of the lively debate between the ruralists and the environmentalists in Brazil about the reform of the Forest Code, and the need for fundamental principles (principles of sustainable development and the precautionary principle); cf. ARIFA, Bethânia Itagiba Aguiar. O Novo Código Florestal e a ECO-92. *Revista de Direito Internacional*, v. 9, n. 3, p. 171-180, 2012.

19 GRÜBER, Thomas Robert. Toward principles for the design of ontologies used for knowledge sharing. *International Journal of Human-Computer Studies*, v. 43, n. 5-6, p. 907–928, 1995.

20 E.g. for environmental ontology, PAFILIS, Evangelos et al. Environments and Eol: identification of environment ontology terms in text and the annotation of the Encyclopedia of Life. *Bioinformatics*, v. 31 n. 11, p. 1872–1874, 2015. doi: 10.1093/bioinformatics/btv045

21 ESTRELLA Project. *The European project for Standardized Transparent Representations in order to extend legal Accessibility* (Estrella, IST-2004-027655. Addtional in: <http://www.estrellaproject.org> Access in: 29 Apr. 2016.

22 SARTOR, Giovanni et al. (Ed.). *Approaches to legal ontologies*. Netherlands: Springer, 2011.

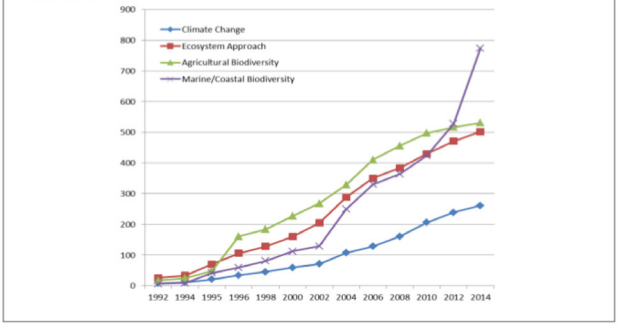
23 GUARINO, Nicola; MUSEN, Mark. Applied ontology: the next decade begins. *Applied Ontology*, v. 10, p. 1-4, 2015.

24 MAZZEGA, Pierre et al. A complex-system approach: legal knowledge, ontology, information and networks. In: SARTOR,

Finally, we get thematic lists with respectively 124 complex terms for Climate Change, 233 terms for Ecosystem Diversity (and the ecosystem approach), 270 terms for Agriculture and Biodiversity, and 494 terms for the Marine and Coastal Biodiversity. Of course though those terms are distinct from each other, they are not necessarily independent. Indeed in natural language, concepts are usually not semantically "independent" of each other. Various techniques are used to overcome this difficulty during the mining or comparison of texts. For example, Lafourcade uses conceptual vectors that he defines "*as the result of the expression of concept C itself as combined with the expression of a conceptual neighbourhood weighted by the hierarchical structure of the thesaurus*[25]." The classic (mathematical) vector space structure is then used to define measures including similarity[26],[27] between conceptual vectors (used in information retrieval) or distances[28] interpreted as an evaluation of the thematic proximity between the meaning of words or expressions.

Here we just need a quantitative assessment of the terminological uses. Some expressions are also simply linked together by a relationship of increasing specification (for example: *clearing house mechanism* > *clearing house mechanism national focal point*). However the number of terms used, the frequency of their use throughout the COPs and the progressive enrichment of the terminology are good indicators of the importance given to each theme, whatever the nature of the possible link between some of these terms. Figure 2 is precisely showing the cumulative number of term occurrences in the Convention on Biological Diversity (1992) and in the resolutions of the successive COPs. We see that each of the four themes is addressed in the Convention and in all COPs. Growth in the number of terms is dominated by the theme of agriculture and biodiversity, but is supplanted since 2012 (COP 11) with the theme of marine and coastal biodiversity. Climate change remains a leitmotif throughout all COPs, but as a background theme, without sudden terminological inflation.

FIGURE 2: Cumulative number of term occurrences in the Convention on Biological Diversity (1992) and in the decisions of successive COPs identified for each of the four investigated themes, in function of time (see text).



These preliminary observations deserve a more detailed analysis including sources of these developments.

3. Mining for climate change, ecosystem approach and biodiversity in the CBD

The interpretation of Figure 2 has shown a general increase of occurrences of terms regarding the four studied themes over time. We focus now on the new terms introduced by each COP for each of the four themes (Figure 3). We can notice that each theme appears since the adoption of the Convention on Biological Diversity (1992) with different variations of the number of new terms depending on the theme examined.

For the theme related to Climate change, the number of new terms is not very significant over time. Nevertheless, we can notice that in 2008 (COP9) and 2010 (COP10) events related to the CBD explained the number of new terms. For instance, in 2007, The International Day for Biological Diversity[29] was dedicated to "Climate Change and Biodiversity" which coincided with the International Polar Year and with UNEP'S World Environment Day theme of Climate Change. At that occasion, the message of the Executive Secretary of the CBD insisted on the fact that the relationship

Giovanni et al. (Ed.). *Approaches to legal ontologies*: theories, domains, methodologies. Springer: 2010. p. 117-132.

25 LAFOURCADE, Mathieu. *Lexique et analyse sémantique de textes*: structures, acquisitions, calculs, et jeux de mots. Document and Text Processing. Université Montpellier II - Sciences et Techniques du Languedoc. Mémoire d'Habilitation à Diriger les Recherches Spécialité: Informatique, 2011. <https://tel.archives-ouvertes.fr/tel-00649851>. Access in: 29 Apr. 2016.

26 FAIRON Cédrick ; HO Ngoc-Diep. *Quantité d'information échangée*: une nouvelle mesure de la similarité des mots, Journées internationales d'Analyse statistiques des Données Textuelles (JADT), Louvain-la-Neuve (Belgique). 2004.

27 LAFOURCADE Mathieu; JOUBERT Alain. Similitude entre les sens d'usage d'un terme dans un réseau lexical. *Traitement Automatique des Langues*, v. 50, n. 1, p. 177-200, 2009.

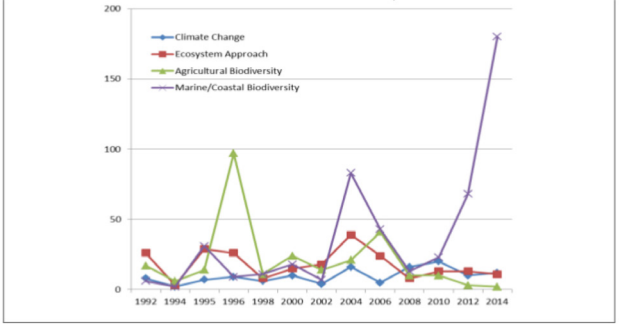
28 LAFOURCADE, Mathieu; PRINCE Violaine; SCHWAB Didier. Vecteurs conceptuels et structuration émergente de terminologies. *Traitement Automatiques des Langues*, v. 43, n. 1, p. 43-72, 2002.

29 The United Nations General Assembly, by its resolution 55/201 of 20 December 2000, proclaimed 22 May as The International Day for Biological Diversity, to increase understanding and awareness of biodiversity issues.

between biodiversity and climate change "*runs both ways. Climate change is an important driver of the loss of biodiversity. At the same time, the loss of biodiversity and the deterioration of natural habitats also contribute to climate change*"[30].

Thus the decision IX/16 of the COP9 in 2008 decided to integrate climate-change activities within the programmes of work of the Convention[31] and to create an Ad Hoc Technical Expert Group (AHTEG) on Biodiversity and Climate Change in order to provide biodiversity relevant information to the United Nations Framework Convention on Climate Change[32]. It has been followed by the decision X/33 of the COP10 in 2010 which invited the Parties to assess the impacts of climate change on biodiversity; to reduce the impacts of climate change on biodiversity and biodiversity-based livelihoods but also to reduce biodiversity impacts of climate change mitigation and adaptation measures. This decision notably calls for the implementation of ecosystem-based approaches for adaptation and mitigation.

FIGURE 3: For each of the themes, number of new terms introduced by each COPs' decisions (terms that have not been used by either the CBD or by any of the previous COPs). The most notable enhancements of thematic terminologies are primarily related to the work of CBD scientific groups or bodies or to international events related to the environment or sustainable development.



• **Regarding the theme of Ecosystem approach** (and biodiversity of ecosystems), it appears to be the most cited theme in the text of the CBD in 1992. The term "*ecosystem*" is indeed a central element of the definition of the Biological diversity given in the Article 2 of the Convention[33]. As stated by Maltby[34], considerable effort has been devoted since 1995 at clarifying the meaning of ecosystem approach and thus its *modus operandi*[35]. He thus noted the CBD process exemplifying key steps in development of an ecosystem approach under the CBD[36]. It confirms what we can see on Figure 3: in 1995 there is a first peak of new terms related to the ecosystem approach. In 1995, as mentioned by Maltby (2000), the First Meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) recommended in an explicit manner to develop a holistic approach for the conservation and sustainable use of biological diversity and as such the ecosystem approach[37] should be the primary framework of action to be taken under the Convention[38]. The recommendation has been integrated as such by the COP2 (1995) in the decision[39] II/8. In 1996, the second SBSTTA meeting considering developing guidelines for national reporting advocated for the use of the ecosystem approaches explaining the relative importance of new terms related

30 Message of the Executive Secretary of the CBD, A. Djoghlaf, 22 May 2007. https://www.cbd.int/doc/speech/2007/sp-2007-05-22-es-en.pdf. Cf. SECRETARIAT OF THE CONVENTION ON BIOLOGICAL DIVERSITY. *Biodiversity and climate change, international day for biological diversity*. Montreal: CBD, 2007.

31 CBD, COP9, decision IX/16 *Biodiversity and climate change*, 9 October 2008. Cf. also SECRETARIAT OF THE CONVENTION ON BIOLOGICAL DIVERSITY. *Interlinkages between biological diversity and climate change. Advice on the integration of biodiversity considerations into the implementation of the United Nations Framework Convention on Climate Change and its Kyoto Protocol*. Montreal: CBD, 2003. (Technical Series n. 10, 154 p., 2003). and SECRETARIAT OF THE CONVENTION ON BIOLOGICAL DIVERSITY. *Guidance for promoting synergy among activities addressing biological diversity, desertification, land degradation and climate change*. Montreal: CBD, 2006. (Technical Series n. 25, 43 p. 2006).

32 SECRETARIAT OF THE CONVENTION ON BIOLOGICAL DIVERSITY. *Connecting biodiversity and climate change mitigation and adaptation*: report of the second ad hoc technical expert group on biodiversity and climate change. Montreal, 2009. (Technical Series, n. 41).

33 CBD, Article 2, Use of terms, 1992.

34 MALTBY Edward. Ecosystem approach: From theory to practice, ecosystem service and sustainable watershed management in North China. In: INTERNATIONAL CONFERENCE, 2000, Beijing. *Proceedings*… Beijing, 2000. p. 23 25.

35 MALTBY Edward. Ecosystem approach: From theory to practice, ecosystem service and sustainable watershed management in North China. In: INTERNATIONAL CONFERENCE, 2000, Beijing. *Proceedings*… Beijing, 2000. p. 23 25.

36 Cf. MALTBY Edward. Ecosystem approach: From theory to practice, ecosystem service and sustainable watershed management in North China. In: INTERNATIONAL CONFERENCE, 2000, Beijing. *Proceedings*… Beijing, 2000. p. 23 25, Table 1 (Chronology of the CBD process and external fora exemplifying key steps in development of an ecosystem approach under the CBD).

37 On the ecosystem approach and human wellbeing, see LAJAUNIE, Claire; MAZZEGA, Pierre. One Health and biodiversity conventions – The emergence of health issues in biodiversity conventions. *IUCN Academy of Environmental Law Journal*. Available in: <http://www.iucnael.org/en/e-journal/>.

38 CBD, SBSTTA 1, Recommendation I/3 Alternative ways and means in which the Conference of the Parties could start the process of considering the components of biological diversity particularly those under threat and the identification of action which could be taken under the Convention, §1 and § 9, Paris 1995.

39 CBD, COP2, Decision II/8, Preliminary consideration of components of biological diversity particularly under threat and action which could be taken under the Convention, §1, Jakarta, Indonesia, 6 - 17 November 1995.

to this theme in COP3[40].

Then the main peak of new terms appears in 2004 when the COP7 adopted the decision VII/11 dedicated to ecosystem approach and detailing twelve principles regarding this approach and associated implementation guidelines[41]. Moreover, the COP7 focused on sector--specific approaches such as marine and coastal biodiversity, agricultural biodiversity or dry and sub-humid lands biodiversity[42], incorporating many elements of the ecosystem approach. Interestingly, even though COP9 (2008) adopted another decision on the ecosystem approach, it did not lead to the apparition of new terms, probably because many of them already came out in 2004. Nevertheless, we can underline that the decision mentioned that "*The Millennium Ecosystem Assessment findings and, in particular their articulation of the role of ecosystem goods and services to human well-being could be more widely taken into account in the application of the ecosystem approach*"[43].

• **The agricultural diversity theme** has also been the major theme of the COP3 in 1996: there are almost 100 new terms during this COP, which represent the highest peak for the considered period. The decision III/11 proposes a basis for action which states the importance of agricultural biodiversity as being "*of widespread and complex significance to society, encompassing socio--cultural, economic and environmental elements*"[44]. The basis for action details the impacts of biological diversity on agriculture and in turn, the impact of agriculture on biodiversity.

The decision established multi-year programme of activities on agricultural biological diversity in order to promote the positive effects and mitigate the negative impacts of agricultural practices on biological diversity in agro-ecosystems and their interface with other ecosystems; to promote the conservation and sustainable use of genetic resources and the fair and equitable sharing of benefits arising out of the utilization of genetic resources. In 2000, the decision V/5 reviews the first phase of the programme of work and adopt of a multi-year programme of work in line with the decision III/11. The decision calls for the contribution of farmers, indigenous and local communities to the conservation and sustainable use of agricultural biodiversity and the importance of agricultural biodiversity to their livelihoods. The programme applies the ecosystem approach[45].

We can notice another smaller peak of new terms in 2006 with an important decision VIII/23 of the COP8 on agricultural biodiversity insisting on the necessity to integrate biodiversity, food and nutrition considerations into national biodiversity strategies, on the one hand, and to identify research activities to address knowledge gaps on soil biodiversity and their implications for land use practices, on the other hand. The decision proposes two distinct frameworks: one cross-cutting initiative on biodiversity for food and nutrition and one for the implementation of the International Initiative for the Conservation and Sustainable Use of Soil Biodiversity, both building on the principles of the ecosystem approach.

Though one of the major themes[46] of the COP9 (2008) is Agricultural Biodiversity, the COP being held during the celebration of the International Day for Biological Diversity dedicated in 2008 to Biodiversity and Agriculture, there is not a large number of new terms regarding this theme. It can probably be explained by the fact that most of the terms appeared during the two previous peaks in 1996 and 2006. Nevertheless we can note that the decision X/1 is giving an in-depth review of the programme of work on agricultural biodiversity while the decision IX/2 focuses on agricultural biodiversity and the sustainable production and use of biofuels.

40 CBD, COP3, Decision III/10, Identification, monitoring and assessment, §9a, Buenos Aires, Argentina 4 - 15 November 1996. It instructs The SBSTTA to provide scientific advice and further guidance, through its thematic work on ecosystems.

41 CBD, COP7, Decision VII/11, Ecosystem approach, cf. Annex 1,Table 1:The 12 Principles of the ecosystem approach and their rationale and Annex 2 B, Integration of ecosystem approach into sectors and biomes corresponding to the thematic programmes of work of the Convention.

42 Linking de facto the Convention on Biological Diversity and the Convention to Combat Desertification (relating itself to climate change).

43 CBD, COP9, Decision IX/7 Ecosystem approach §g, 19 - 30 May 2008 - Bonn, Germany.

44 CBD, COP3, Decision III/11 Conservation and sustainable use of agricultural biological diversity, Annex 1 Basis for action. See also Annex 2 which gives an indicative list of thematic areas encompassed by agricultural biodiversity, 4 - 15 November 1996 - Buenos Aires, Argentina.

45 CBD, COP5, Decision V/5, Agricultural biological diversity: review of phase I of the programme of work and adoption of a multi-year work programme, Annex Programme of work on the agricultural biodiversity, §4,

46 As indicated by the CBD itself, see https://www.cbd.int/cop/. Access in: 29 Apr. 2016.

We can then remark a very slight increase of new terms again in 2010 during the COP10 which adopted the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets. The decision X/34 recognizes the importance of agro-ecosystems, in particular rice-paddy[47] and oasis systems, for the conservation and sustainable use of biodiversity, and insists on the need for further information on the nature of sustainable use of agricultural biodiversity and sustainable agriculture[48].

• The number of new terms regarding the **theme of marine and coastal biodiversity** has evolved in a distinctive way compared to the other themes studied. There is a first small peak in 1995 coinciding with the Ecosystem approach theme as Marine and coastal biodiversity was one of the major themes of the COP2. Indeed the COP2 adopted a decision II/10 in consideration for the "*serious threats to marine and coastal biological diversity caused by factors including physical alteration, destruction and degradation of habitats, pollution, invasion of alien species, and over-exploitation of living marine and coastal resources*". The decision followed the recommendation I/8 of the SBSTTA to endorse integrated marine and coastal area management as the most suitable framework for addressing human impacts on marine and coastal biological diversity and for promoting conservation and sustainable use of this biodiversity.

The year 2000 does not show a peak of new terms but as for agricultural biodiversity, the COP5 in the decision V/3 addresses the implementation of the programme of work on marine and coastal biological diversity focusing on coral reef, integrated marine and coastal area management, marine and coastal living resources and alien species. We must underline that a special attention is given to coral bleaching[49] with a specific call for joint actions among the Convention on Biological Diversity, the United Nations Framework Convention on Climate Change, and the Convention on Wetlands (Ramsar Convention) and, again, the use of the ecosystem approach.

In 2004, there is a peak of new terms regarding marine and coastal biodiversity (more than 70 new terms), with the decision to review the programme of work on marine and coastal biodiversity extending it for 6 years and complete it with new elements. It notably insists on the implementation of the programme at all levels (global, regional, national and local)[50]. As the COP8 took 3 decisions relating to marine and coastal biodiversity in its various expressions[51] (island biodiversity, conservation and sustainable use of deep seabed genetic resources beyond the limits of national jurisdiction and implementation of integrated marine and coastal area management), it maintains the number of new terms around 45 in 2006.

The number of terms increases again in 2012 as Marine biodiversity is the theme of the International Day for Biological Diversity. Moreover, the global context leads to an increased recognition of the strategic importance of the oceans and of their resources (living and non-living) in the game for a transformation of the global environmental governance[52]. The COP11 addresses the issue of marine and coastal biodiversity through various decisions regarding respectively: the review of the programme of work on island biodiversity; ecologically or biologically significant marine areas, sustainable fisheries and addressing adverse impacts of human activities; voluntary guidelines for environmental assessment, and marine spatial planning; or protected areas[53].

47 In accordance with a Resolution X.31 Enhancing biodiversity in rice paddies as wetland systems of the COP10 of the Ramsar Convention, Changwon, Republic of Korea, 28 October-4 November 2008. The resolution notes that rice is grown in at least 114 countries worldwide and that rice paddies (flooded and irrigated fields in which rice is grown) have provided large areas of open water for centuries and that they support a high level of rice associated biodiversity important (support important wetland biodiversity, such as reptiles, amphibians, fish, crustaceans, insects and molluscs, and play a significant role in the conservation of waterbird populations) for sustaining rice-paddy ecosystems.

48 It calls for the participation of the Food and Agriculture Organization of the United Nations and Bioversity International, and other relevant partners, including indigenous and local communities.

49 CBD, COP5, Decision V/3 Progress report on the implementation of the programme of work on marine and coastal biological diversity Annex priority areas for action on coral bleaching, Nairobi, 15-26 May 2000.

50 CBD, COP7, Decision VII/5, Marine and coastal biological diversity, Kuala Lumpur, 9-20 and 27 February 2004.

51 CBD, COP8, Decision VIII/1 Island biodiversity; Decision VIII/21 Marine and coastal biological diversity: conservation and sustainable use of deep seabed genetic resources beyond the limits of national jurisdiction; and Decision VIII/22 Marine and coastal biological diversity: enhancing the implementation of integrated marine and coastal area management, 20 - 31 March 2006 - Curitiba, Brazil.

52 With a focus on the positioning of Brazil in the governance of oceans, see BARROS-PLATIAU, Ana Flávia et al. Correndo para o mar no antropoceno: a complexidade da governança dos oceanos e a estratégia brasileira de gestão dos recursos marinhos. *Revista de Direito Internacional*, v. 12, n. 1, p. 150-168, 2015.

53 Respectively, CBD COP11, Decision XI/15 Review of the programme of work on island biodiversity; XI/17 Marine and coastal biodiversity: ecologically or biologically significant marine ar-

It is interesting to notice that the decision on protected areas insists on the need to achieve the marine component and other elements of Aichi Biodiversity Target 11[54] while the decision on sustainable fisheries and addressing adverse impacts of human activities refers to the Target 10: which states that "*By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning*".

During the COP12 held in October 2014, the number of new terms relating to marine and coastal biodiversity is the highest since 1992 (more than 180 new terms). The decision XII/23 in its title mentions explicitly the Target 10: "*Impacts on marine and coastal biodiversity of anthropogenic underwater noise and ocean acidification, priority actions to achieve Aichi Biodiversity Target 10 for coral reefs and closely associated ecosystems*"[55] for enhanced implementation toward achieving Aichi Biodiversity Target 10. The decision XII/22 on ecologically or biologically significant marine areas (EBSAs) also calls for the application of other area-based management measures in marine and coastal areas, with a view to contributing to national efforts to achieve the Aichi Biodiversity Targets.

Thus, in preparation for the COP13, a Technical Workshop on Monitoring of Marine and Coastal Biodiversity held on the margins of the 20th meeting of the SBSTTA in April 2016, intends to build synergies to develop appropriate types of research and monitoring approaches and sharing of information in order to achieve Aichi Biodiversity Targets in the marine and coastal area notably Target 6 on sustainable fisheries, Target 8 on pollution, Target 10 on coral reefs and other vulnerable ecosystems, Target 11 on protected areas and other effective area-based conservation measures and Target 12 on threatened species[56].

4. Discussion on biodiversity as a cross-cutting issue

In the section 3 we detailed the evolution of the number of new terms introduced by each COP for each of the four themes (Figure 3). Table 1 (see Appendix) summarizes the main decisions and major events that can be related to the progressive enrichment of the thematic terminologies. We have to underline since the adoption of the CBD, biodiversity has been considered as a cross-cutting issue and the first COP has shown the importance of cooperation with other biological diversity-related conventions, institutions and processes[57].

In order to illustrate that cross-cutting role of biodiversity in its various expressions, we now study the presence of two expressions common to all the four studied themes. Then we explain how the overarching nature of the framework of the Strategic Plan for Biodiversity has been decisive in revealing the interactions between the various aspects of biodiversity. First, two expressions are common to all the studied themes and we will explain further their pivotal role. It concerns "*clearing-house mechanism*" and "*environmental impact assessment*" and their variants.

The clearing-house mechanism (CHM) is a central feature of the CBD, established by the article 18.3 of the CBD to promote and facilitate technical and scientific cooperation, operating under the authority of the Conference of the Parties[58]. As it is constantly improved, each COP, from COP 1, has taken a decision re-

eas; XI/18 Marine and coastal biodiversity: sustainable fisheries and addressing adverse impacts of human activities, voluntary guidelines for environmental assessment, and marine spatial planning; XI/24 Protected areas, 8-19 October 2012, Hyderabad, India.

54 Aichi Strategic Goal C: To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity, Target 11 "By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes."
https://www.cbd.int/sp/targets/. Access in: 29 Apr. 2016.

55 CBD, COP12, Decision XII/23, Marine and coastal biodiversity: Impacts on marine and coastal biodiversity of anthropogenic underwater noise and ocean acidification, priority actions to achieve Aichi Biodiversity Target 10 for coral reefs and closely associated ecosystems, and marine spatial planning and training initiatives. Pyeongchang, Republic of Korea, 6-17 October 2014.

56 Statement of Mr Braulio f. de Souza Dias, CBD Executive Secretary, on the occasion of the Technical Workshop on Monitoring of Marine and Coastal Biodiversity, 24 April 2016, Montreal, Canada https//www.cbd.int/doc/speech/2016/sp-2016-04-24-marine-en.pdf [Access in: 29 April 2016].

57 Cf CBD, UNEP/CBD/COP/3/38, Annex: Statement of the Conference of the Parties to the convention on Biological Diversity to the special session of the United Natons General Assembly, §3-4, 4 – 15 November 1996 – Buenos Aires, Argentina.

58 Article 18 Technical and Scientific Cooperation, §3 and CBD COPI, Decision I/3 Clearing-House mechanism for technical and scientific cooperation, Nassau, Bahamas, 28 November - 9 December 1994.

garding the CHM. In regard with the Strategic Plan for Biodiversity 2011-2020, the decision X/15 had redefined the missions, goals and objectives of the CHM. It states that the CBD website constitutes the central CHM. A network of national CHM residing on high-quality national websites facilitate the implementation of the national biodiversity strategies and action plans and then various partner institutions collaborate and share knowledge through the CHM network. It implies that the information and knowledge gathered by the CHM are relating to all the various aspects of biodiversity and thus encompass the four themes studied.

Second, the impact assessment procedure to minimize adverse impacts on biodiversity is introduced by the article 14 of the CBD. It states for instance that the Parties should ensure that the environmental consequences of its programmes and policies that are likely to have significant adverse impacts on biological diversity are duly taken into account. The Impact Assessment (IA), Strategic Impact Assessment (SIA) or Environmental Impact Assessment (EIA), is further described in a decision IV/10 on measures for implementing the CBD[59]. It notably calls for exchange of information and sharing of experiences regarding national impact assessments and for reporting on the existing legislation.

The impact assessment appears along the COPs regarding various themes including the four studied themes and others such as inland water ecosystems, biodiversity and tourism or alien invasive species for instance. In 2002, the decision VI/7 proposed detailed guidelines for incorporating biodiversity-related issues into environmental impact-assessment legislation or processes and in strategic impact assessment in order to urge the Parties to implement these guidelines at the national level. Those guidelines have been completed in 2006 by voluntary guidelines on biodiversity-inclusive environmental impact assessment aiming at a better integration of biodiversity-related considerations into the EIA process. The EIA concerns intrinsically any theme relating to biodiversity.

The strategic plan for the conservation of biodiversity established strategic goals and objectives to achieve by 2010 "*a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth*." The four goals were very general regarding the role of the CBD, the capacity of the Parties to implement the Convention, the integration of biodiversity concerns into National biodiversity strategies and action plans or the better understanding of biodiversity and the CBD.

It appeared necessary to develop voluntary guidelines as a practical tool for Parties as they were reviewing their national biodiversity strategies and action plans (NBSAP) to improve the implementation of the CBD and its strategic plan. The decision VIII/8 proposed guidelines stated questions to decisions-makers to help them define the scope of the reviewed or new NBSAP. Among the questions, one is very interesting as it insists on the importance of transverse issues in the CBD: "*Does the most recent version of your biodiversity strategy and action plan address all of the major thematic areas and cross-cutting issues of the Convention relevant to your country and national priorities?*"[60]. The decision provides a list of the major thematic areas and cross-cutting issues. Among the thematic areas we find agricultural biodiversity and marine and coastal biodiversity. Ecosystem approach, impact assessments, climate change and biological diversity, indicators or education and public awareness are listed among the cross-cutting issues.

The Strategic Plan for Biodiversity 2011-2020 develops this thematic and cross-cutting approach. In fact, the rationale of Strategic Plan for Biodiversity 2011-2020 notice that the actions taken under the previous strategic plan have not been on a sufficient scale to address the pressures on biodiversity. It also underlines the insufficient integration of biodiversity issues into broader policies, strategies, programmes and actions, impeding the reduction of the underlying drivers of biodiversity loss. It states that biodiversity is essential for the achievement of the Millennium Development Goals[61], including poverty reduction as it contributes to local livelihood and economic development. It is fundamental for human well-being (food security, human health, or clean air and water).

The Strategic Plan has been conceived as an overarching framework on biodiversity, not only for the biodiversity-related conventions, but for the entire Uni-

59 CBD COP4, Decision IV/10 Measures for implementing the Convention on Biological Diversity, 4 - 15 May 1998 - Bratislava, Slovakia.

60 CBD, COP8, Decision VIII/8 Implementation of the Convention and its Strategic Plan, *Curitiba, Brazil* 20 - 31 March 2006.

61 CBD, COP10, Decision X/8 United Nations Decade on Biodiversity 2011-2020, Nagoya, Japan, 18–29 October 2010.

ted Nations system and other partners engaged in biodiversity management and policy development [62]. Thus the Strategic Goals and Aichi targets take into account the various aspects related to biodiversity. Indeed, for the definition of the indicator framework for the Strategic Plan 2011-2020, the SBSTTA[63] insisted on the need to promote further collaboration on biodiversity monitoring and indicators with the forestry, agriculture, fisheries and other sectors on the global, regional and national levels.

The COP12 in a review of progress in the implementation of the Strategic Plan for Biodiversity 2011-2020 insisted on the fact that actions should be undertaken in a coordinated way and that Aichi targets should not be addressed in isolation. Besides, the COP12 took decisions regarding very wide and transverse issues such as biodiversity and climate change and disaster risk reduction, ecosystem conservation and restoration or biodiversity and health[64]. The COP12 followed the recommendations of the SBSTTA which identified key scientific and technical needs for the implementation of the Strategic Plan. It notably called for social sciences to propose choices consistent with the Strategic Plan and to develop new approaches regarding better understanding of behavioural change, production and consumption patterns or policy development. It also insisted on the need to better integrate science and policymaking[65], through IPBES, to promote policy coherence[66] and evaluation, and to propose scenarios relevant to policy-makers[67]. Finally, the COP12 proposed to integrate the objectives of the Convention and the Strategic Plan for Biodiversity 2011-2020, and associated targets, into all relevant sustainable development goals (SDGs).

During the seventh Trondheim Conference on Biodiversity organized to prepare the COP12, it has been noted that, over time, the CBD COPs have considered cross-cutting issues relevant for "*fostering the objectives of the CBD and has helped to translate a number of scientific concepts into politically recognized guidance, such as the ecosystem approach*"[68]. It thus affirmed the biodiversity provides the critical foundation for sustainable development and human well-being[69].

5. Conclusion

While it appeared necessary to mobilize huge data sets in order to assess global biodiversity threats and take them into account in appropriate and coordinated policies, which questioned the quality of available data[70], little work was done on assessing and exploiting the texts generated over time by the CBD COPs and scientific bodies, materializing the main steps of the acknowledgement of the importance integrating biodiversity, in its various aspects, into policies whether they are global or local.

Stating that fact, we decided to study the occurrence of the different terms associated for themes that

62 UNEP, Sourcebook of opportunities for enhancing cooperation among the Biodiversity-related Conventions at national and regional levels, 2015, United Nations Environment Programme (UNEP), Nairobi, Kenya, p. 6.

63 CBD/SBSTTA Recommendation XV/1 Indicator framework for the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets, Montreal, 7-11 November 2011.

64 On health issues and the CBD, cf. LAJAUNIE, Claire; MAZZEGA, Pierre. One Health and biodiversity conventions – The emergence of health issues in biodiversity conventions. *IUCN Academy of Environmental Law Journal*. Available in: <http://www.iucnael.org/en/e-journal/>.

65 On the role of scientific knowledge and its evolution to nourish soft law, see SOUZA, Leonardo da Rocha de; LEISTER, Margareth A. A influência da soft law na formação do direito ambiental. *Revista de Direito Internacional*, v. 12, n. 2, p. 767-784, 2015.

66 For a discussion of factors binding international environmental commitments, national policies and domestic political pressures, see in particular BARROS-PLATIAU, Ana Flávia et al. A dissonância do quadro institucional brasileiro na Rio+20. o caso do clima e do código florestal. *Revista de Direito Internacional*, v. 9, n. 3, p. 159-170, 2012, for the Brazilian context (on climate change and biodiversity), LANTIS, Jeffrey S. *The life and death of international treaties*: Double-Edged diplomacy and the politics of ratification in comparative perspective. Oxford: Oxford University Press, 2009, for the case of the USA.

67 CBD, COP12, Decision XII/1 Mid-term review of progress in implementation of the Strategic Plan for Biodiversity 2011-2020 including the fourth edition of the Global Biodiversity Outlook, and actions to enhance implementation, Annex I Key scientific and technical needs related to the implementation of the Strategic Plan for Biodiversity 2011-2020, Pyeongchang, Republic of Korea, 6-17 October 2014.

68 Seventh Trondheim Conference on Biodiversity, *Ecology and Economy for a Sustainable Society*, Biodiversity in the post-2015 development agenda and Sustainable Development Goals (SDGs): Ecosystem goods and services for human wellbeing - Background paper, Trondheim, Norway, 27–31 May 2013, p. 17.

69 Seventh Trondheim Conference on Biodiversity, Biodiversity and Sustainable Development – the relevance of the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets for the post-2015 development agenda and the Sustainable Development Goals. Revised key-messages, June 2013, p.1.

70 JOPPA, L. N. et al. Filling in biodiversity threat gaps. Only 5% of global threat data sets meet a "gold standard". *Science*, v. 352, n. 6284, p. 416-418, Apr. 2016.

appeared crucial regarding biodiversity (see Figure 1), the number of terms per theme, the use of these terms over time and the apparition of new terms. It led us to explain the evolution of the consideration for those terms since 1992 and to show their multiple interconnections. It highlighted the necessity to take account of the interlinkages between biodiversity sectors, which has been advocated by a CBD technical series report of 2014 recommending that *"sectors recognise the opportunities that biodiversity provides, such as improved availability of fish and wood, improved soils for agricultural production systems and cost-effective nature-based solutions in water management. This is what mainstreaming policies need to achieve"*[71].

Biodiversity appeared more and more clearly as a cross-cutting issue to be incorporated as such into various policies. A retrospect of what has been achieved for the acknowledgement of the central role of biodiversity within the CBD seems an important phase for the appropriate design and monitoring of future policies. Indeed, a report from the United Nations recommends mobilizing data revolution, i.e. the Big Data movement, in favour of Sustainable Development, presenting data as "*the lifeblood of decision-making and the raw material for accountability*"[72].

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References

ARIFA, Bethânia Itagiba Aguiar. O Novo Código Florestal e a ECO-92. *Revista de Direito Internacional*, v. 9, n. 3, p. 171-180, 2012.

BARROS-PLATIAU, Ana Flávia et al. A dissonância do quadro institucional brasileiro na Rio+20. o caso do clima e do código florestal. *Revista de Direito Internacional*, v. 9, n. 3, p. 159-170, 2012.

BARROS-PLATIAU, Ana Flávia et al. Correndo para o mar no antropoceno: a complexidade da governança dos oceanos e a estratégia brasileira de gestão dos recursos marinhos. *Revista de Direito Internacional*, v. 12, n. 1, p. 150-168, 2015.

CONVENTION ON BIOLOGICAL DIVERSITY. *COP1, Decision I/3 Clearing-House mechanism for technical and scientific cooperation*. Nassau, 1994.

CONVENTION ON BIOLOGICAL DIVERSITY. *COP10, Decision X/8 United Nations Decade on Biodiversity 2011-2020*. Nagoya, 2010.

CONVENTION ON BIOLOGICAL DIVERSITY. *COP11, Decision XI/15 Review of the programme of work on island biodiversity*. XI/17 Marine and coastal biodiversity: ecologically or biologically significant marine areas. XI/18 Marine and coastal biodiversity: sustainable fisheries and addressing adverse impacts of human activities, voluntary guidelines for environmental assessment, and marine spatial planning. XI/24 Protected areas. Hyderabad, 2012.

CONVENTION ON BIOLOGICAL DIVERSITY. COP12, XII/*1 Mid-term review of progress in implementation of the strategic plan for biodiversity 2011-2020 including the fourth edition of the Global Biodiversity Outlook, and actions to enhance implementation.* Decision XII/23, Marine and coastal biodiversity: Impacts on marine and coastal biodiversity of anthropogenic underwater noise and ocean acidification, priority actions to achieve Aichi Biodiversity Target 10 for coral reefs and closely associated ecosystems, and marine spatial planning and training initiatives. Pyeongchang, 2014.

CONVENTION ON BIOLOGICAL DIVERSITY. *COP2, Decision II/8, Preliminary consideration of components of biological diversity particularly under threat and action which could be taken under the Convention*. Jakarta, 1995.

CONVENTION ON BIOLOGICAL DIVERSITY. *COP3, Decision III/10, identification, monitoring and assessment.* Decision III/11 conservation and sustainable use of agricultural biological diversity. Buenos Aires, 1996.

71 CBD Technical Series 79. How can sectors contribute to sustainable use and conservation of biodiversity. PBL Netherlands Environmental Assessment Agency. The Hague, 232 p. 2014.

72 United Nations Secretariat's Independent Expert Advisory Group, A World That Counts: Mobilising the Data Revolution for Sustainable Development, United Nations, 2015; http://bit.ly/Data4SustDev. Access in: 29 Apr. 2016.

p. 4-15.

CONVENTION ON BIOLOGICAL DIVERSITY. *COP4, Decision IV/10 Measures for implementing the Convention on Biological Diversity*. Bratislava, 1998. p. 4-15.

CONVENTION ON BIOLOGICAL DIVERSITY. *COP5, Decision V/3 Progress report on the implementation of the programme of work on marine and coastal biological diversity*. Decision V/5, Agricultural biological diversity: review of phase I of the programme of work and adoption of a multi-year work programme. Nairobi, 2000. p. 5-26.

CONVENTION ON BIOLOGICAL DIVERSITY. *COP7, Decision VII/5, marine and coastal biological diversity*. Decision VII/11, Ecosystem approach. Kuala Lumpur, 2004. p. 9-20.

CONVENTION ON BIOLOGICAL DIVERSITY. *COP8, Decision VIII/1 Island biodiversity. Decision VIII/8 Implementation of the Convention and its Strategic Plan*. Decision VIII/21 Marine and coastal biological diversity: conservation and sustainable use of deep seabed genetic resources beyond the limits of national jurisdiction. Decision VIII/22 Marine and coastal biological diversity: enhancing the implementation of integrated marine and coastal area management. Curitiba, 2006. p. 20-31.

CONVENTION ON BIOLOGICAL DIVERSITY. *COP9, Decision IX/7 Ecosystem approach. Decision IX/16, Biodiversity and climate change*. Bonn, 2008. p. 19-30.

CONVENTION ON BIOLOGICAL DIVERSITY. *How can sectors contribute to sustainable use and conservation of biodiversity*. PBL Netherlands Environmental Assessment Agency. The Hague, 2014. 232 p. (Technical Series 79).

CONVENTION ON BIOLOGICAL DIVERSITY. *SBSTTA 1, Recommendation I/3 Alternative ways and means in which the Conference of the Parties could start the process of considering the components of biological diversity particularly those under threat and the identification of action which could be taken under the Convention, §1 and § 9*. Paris, 1995.

CONVENTION ON BIOLOGICAL DIVERSITY. *SBSTTA 15, Recommendation XV/1 Indicator framework for the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets*. Montreal, 2011. p. 7-11.

CONVENTION ON BIOLOGICAL DIVERSITY. *UNEP/CBD/COP/3/38, Annex*: Statement of the Conference of the Parties to the Convention on Biological Diversity to the special session of the United Nations General Assembly. Buenos Aires, 1996. p. 4-15.

DROUIN, Patrick. Term extraction using non-technical corpora as a point of leverage. *Terminology*, v. 9, n. 1, p. 99-117, 2003.

ESTRELLA Project. *The European project for Standardized Transparent Representations in order to extend legal Accessibility* (Estrella, IST-2004-027655. Addtional in: <http://www.estrellaproject.org> Access in: 27 Apr. 2016.

FAIRON Cédrick ; HO Ngoc-Diep. *Quantité d'information échangée*: une nouvelle mesure de la similarité des mots, Journées internationales d'Analyse statistiques des Données Textuelles (JADT), Louvain-la-Neuve (Belgique). 2004.

FELDMAN, Ronen; SANGER, James. Core text mining operation. In: FELDMAN, Ronen; SANGER, James. *The text mining handbook:* advanced approaches in analyzing unstructured data. Cambridge: Cambridge University Press, 2007b. p. 19-56.

FELDMAN, Ronen; SANGER, James. Introduction to text mining. In: FELDMAN, Ronen; SANGER, James. T*he text mining handbook:* advanced approaches in analyzing unstructured data. Cambridge: Cambridge University Press, 2007a. p. 1-18.

GRÜBER, Thomas Robert. Toward principles for the design of ontologies used for knowledge sharing. *International Journal of Human-Computer Studies*, v. 43, n. 5-6, p. 907–928, 1995.

GUARINO, Nicola; MUSEN, Mark. Applied ontology: the next decade begins. *Applied Ontology*, v. 10, p. 1-4, 2015.

HEBERT, Paul D. N. et al. Biological identifications through DNA barcodes. Proceedings of the Royal Society B. *Biological Sciences*, v. 270 n. 1512, p. 313–321, 2003.

HJØRLAND, Birger. Concept theory. *Journal Am. Soc. for Information Science and Technology*, v. 60, n. 8, p. 1519–1536, 2009.

HOOPER, David U. et al. A global synthesis reveals biodiversity loss as a major driver of ecosystem change. *Nature,* v. 486, n. 7401, p. 105-108, 2012.

JOPPA, L. N. et al. Filling in biodiversity threat gaps. Only 5% of global threat data sets meet a "gold standard". *Science*, v. 352, n. 6284, p. 416-418, Apr. 2016.

KIM, Ke Chung; BYRNE, Loren B. Biodiversity loss

and the taxonomic bottleneck: Emerging biodiversity science. *Ecological Research 21*, p. 794-810, 2006.

LAFOURCADE Mathieu; JOUBERT Alain. Similitude entre les sens d'usage d'un terme dans un réseau lexical. *Traitement Automatique des Langues*, v. 50, n. 1, p. 177-200, 2009.

LAFOURCADE, Mathieu. *Lexique et analyse sémantique de textes*: structures, acquisitions, calculs, et jeux de mots. Document and Text Processing. Université Montpellier II - Sciences et Techniques du Languedoc. Mémoire d'Habilitation à Diriger les Recherches Spécialité: Informatique, 2011. <https://tel.archives-ouvertes.fr/tel-00649851>

LAFOURCADE, Mathieu; PRINCE Violaine; SCHWAB Didier. Vecteurs conceptuels et structuration émergente de terminologies. *Traitement Automatiques des Langues*, v. 43, n. 1, p. 43-72, 2002.

LAJAUNIE, Claire; MAZZEGA, Pierre. One Health and biodiversity conventions – The emergence of health issues in biodiversity conventions. *IUCN Academy of Environmental Law Journal*. Available in: <http://www.iucnael.org/en/e-journal/>.

LAJAUNIE, Claire; MORAND, Serge. Barcoding, Biobanking, e-Banking: From Ecological to Ethical and Legal Aspects. Insights from the PathoDivSEA Project. In: MORAND, S. et al. (Ed.). *Socio-ecological dimensions of infectious diseases in Southeast Asia*. Singapore: Springer, 2015.

LANTIS, Jeffrey S. *The life and death of international treaties*: Double-Edged diplomacy and the politics of ratification in comparative perspective. Oxford: Oxford University Press, 2009.

MALTBY Edward. Ecosystem approach: From theory to practice, ecosystem service and sustainable watershed management in North China. In: INTERNATIONAL CONFERENCE, 2000, Beijing. *Proceedings*… Beijing, 2000. p. 23 25.

MAY, Robert. M. Why worry about how many species and their loss*? PLoS Biol,* v. 9, n. 8, 2011. e1001130. doi:10.1371/journal.pbio.1001130.

MAZZEGA, Pierre et al. A complex-system approach: legal knowledge, ontology, information and networks. In: SARTOR, Giovanni et al. (Ed.). *Approaches to legal ontologies*: theories, domains, methodologies. Springer: 2010. p. 117-132.

MENDENHALL, Chase. D. et al. Improving estimates of biodiversity loss. *Biological Conservation*, v. 151, p. 32–34, 2012.

MORA, Camil et al. How many species are there on earth and in the ocean? *PLoS Biol*, v. 9, n. 8, 2011. e1001127. doi: 10.1371/journal.pbio.100112.

PAFILIS, Evangelos et al. Environments and Eol: identification of environment ontology terms in text and the annotation of the Encyclopedia of Life. *Bioinformatics*, v. 31 n. 11, p. 1872–1874, 2015. doi: 10.1093/bioinformatics/btv045

RAMSAR CONVENTION. *COP10, Resolution X.31 Enhancing biodiversity in rice paddies as wetland systems of the of the Ramsar Convention*. Changwon, 28 Oct. 4 Nov. 2008.

SARTOR, Giovanni et al. (Ed.). *Approaches to legal ontologies*. Netherlands: Springer, 2011.

SECRETARIAT OF THE CONVENTION ON BIOLOGICAL DIVERSITY. *Biodiversity and climate change, international day for biological diversity*. Montreal: CBD, 2007.

SECRETARIAT OF THE CONVENTION ON BIOLOGICAL DIVERSITY. *Connecting biodiversity and climate change mitigation and adaptation*: report of the second ad hoc technical expert group on biodiversity and climate change. Montreal. 2009. (Technical Series, n. 41, 126 p. 2009).

SECRETARIAT OF THE CONVENTION ON BIOLOGICAL DIVERSITY. *Guidance for promoting synergy among activities addressing biological diversity, desertification, land degradation and climate change*. Montreal: CBD, 2006. (Technical Series n. 25, 43 p., 2006.)

SECRETARIAT OF THE CONVENTION ON BIOLOGICAL DIVERSITY. *Interlinkages between biological diversity and climate change. Advice on the integration of biodiversity considerations into the implementation of the United Nations Framework Convention on Climate Change and its Kyoto Protocol*. Montreal: CBD, 2003. (Technical Series n. 10, 154 p., 2003.)

SOUZA, Leonardo da Rocha de; LEISTER, Margareth A. A influência da soft law na formação do direito ambiental. *Revista de Direito Internacional*, v. 12, n. 2, p. 767-784, 2015.

UNITED NATIONS ENVIRONMENT PROGRAMME. *Sourcebook of opportunities for enhancing coo-*

peration among the Biodiversity-related Conventions at national and regional levels, United Nations Environment Programme (UNEP), Nairobi, Kenya, 2015. 183 p.

UNITED NATIONS GENERAL ASSEMBLY. *Resolution 55/201 of 20 December 2000*.

UNITED NATIONS SECRETARIAT'S INDEPENDENT EXPERT ADVISORY GROUP, *A world that counts*: mobilising the data revolution for sustainable development, United Nations, 2015. Available in: <http://bit.ly/Data4SustDev>.

VAN ASSELT, Harro. Managing the fragmentation of international environmental law: forest at the intersection of the climate and biodiversity regimes.N.Y.U. J. *Int'l L. & Pol.*, v. 44, p. 1205-1278, 2012.

WAGH, Rupali S. Knowledge discovery from legal documents dataset using text mining techniques. *Intern. J. of Computer Applications,* v. 66 n. 23, p. 32-34, 2013.

WALLS, Ramona L. et al. Semantics in support of biodiversity knowledge discovery: an introduction to the biological collections ontology and related ontologies. *Plus One*, v. 9, n. 3, p. 1-13, e89606, 2014.

1. Appendix A

TABLE 1. Main decisions and major events explaining the terminology enrichment by theme over time (see Fig.3 and text). CC: Climate Change and biodiversity; EA: biodiversity of ecosystems and Ecosystem Approach; AB: Agricultural Biodiversity: MCB: Marine and Coastal Biodiversity.

COP	Dec.	Themes or Related Events
1995 COP02	II/8	EA: 1995: First Meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA, CBD)
	II/10	MCB: Ecosystem approach theme as Marine and coastal biodiversity; Follows recommendation I/8 of the SBSTTA
1996 COP03	III/10	EA: 1996: Second SBSTTA Meeting
	III/11	AB: On the conservation and sustainable use of agricultural biological diversity
2000 COP05	V/3	CC: Call for joint actions with UNFCCC and the Convention on Wetlands (Ramsar Convention)
		EA: Promotes the use of the ecosystem approach
		MCB: Implementation of the programme of work on marine and coastal biological diversity
	V/5	EA: Relies on the ecosystem approach
		AB: Adopt of a multi-year programme of work in line with the decision III/11
2002 COP06		AB: Proposal to establish an International Initiative for the Conservation and Sustainable Use of Soil Biodiversity
2004 COP07	VII/5	MCB: Reviews and extends the programme of work on marine and coastal biodiversity
	VII/11	EA: Decision on the ecosystem approach
2006 COP08	VIII/1	MCB: On island biodiversity
	VIII/21	MCB: On the conservation and sustainable use of deep seabed genetic resources beyond the limits of national jurisdiction
	VIII/23	EA: Necessity to integrate biodiversity, food and nutrition considerations into national biodiversity strategies; Proposes the" International Initiative for the Conservation and Sustainable Use of Soil Biodiversity" as a framework for action.
2008 COP09	X/1	AB: In-depth review of the programme of work on agricultural biodiversity
	IX/2	AB: Agricultural biodiversity and the sustainable production and use of biofuels
	IX/7	EA: Linkage with "Millennium Ecosystem Assessment findings"
	IX/16	CC: 2007, International Day for Biological Diversity "Climate Change and Biodiversity"; 2007: International Polar Year; 2007: UNEP'S World Environment Day " Climate Change"
2010 COP10		Adopts the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets.
	X/33	CC: Invites the Parties to assess the impacts of climate change on biodiversity (etc.
		EA: Calls for the implementation of ecosystem-based approaches for adaptation and mitigation
	X/34	AB: Recognizes the importance of agro-ecosystems. See Resolution X.31 Enhancing biodiversity in rice paddies as wetland systems of the COP10 of the Ramsar Convention
2012 COP11		MCB: 2012: International Day for Biological Diversity dedicated to Marine Biodiversity
	XI/15	MCB: Review of the programme of work on island biodiversity
	XI 17	MCB: Ecologically or biologically significant marine areas
	XI 18	MCB: Sustainable fisheries; Impacts of human activities; Guidelines for environmental assessment; Marine spatial planning. Aichi Biodiversity Target 10.
	XI/24	MCB: Protected areas. Insists on the need to achieve the marine component and other elements of Aichi Biodiversity Target 11.
2014 COP12	XII/22	MCB: On ecologically or biologically significant marine areas. Calls for national efforts to achieve the Aichi Biodiversity Targets
	XII/23	MCB: Linkage with Aichi Biodiversity Target 10

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