Biodiversity Toolbox for Continental Wetlands

PROCLIMA®

VERSION 1.0 | October 27, 2021

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We recognize the role and technical support of the Cataruben Foundation in the construction of this methodology, as a tool for the conservation and restoration of the Continental Wetlands in the Orinoquia region.

PROCLIMA. 2021. Biodiversity Toolbox for Continental Wetlands. Version 1.0. October 27, 2021. 11 p. Bogota, Colombia. http://www.proclima.net.co.

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1 Introduction

Continental Wetlands are recognized as strategic carbon storage ecosystems and have great biodiversity, represented by a high number of species whose populations have decreased since 1970 (Ramsar, 2018[1]). The loss of Continental Wetlands [2] (hereinafter wetlands) is due to different causes and agents that generate changes in land usage, usually related to pressures on biodiversity. Therefore, GHG emission reduction or removal projects whose activities prevent land usage change must demonstrate a positive impact on the biodiversity associated with wetlands.

The positive impact can be reflected in the preservation and improvement of ecological characteristics[3] of wetlands as strategic ecosystems for the conservation of biodiversity and the provision of ecosystem services. Based on this, project managers must develop an assessment of the biological component of wetlands, in which the biodiversity baseline is established, and the presence of High Conservation Values (HCVs) and pressures on biodiversity are determined. Similarly, project managers must design a monitoring plan in order to monitor the status and change trends in biodiversity throughout the project.

This document is a toolbox that will serve as a guide for project managers in the design and implementation of the biological component assessment and the biodiversity monitoring plan. The tools proposed in this document correspond to open access platforms, databases, guides, manuals and procedures, developed by government entities, international NGOs, among other organizations. The consultation and use of the tools presented below contributes to satisfying the requirements to demonstrate the positive impact of the project on biodiversity.

[1] Ramsar Convention on Wetlands. (2018). A Global Outlook on Wetlands: State of the World's Wetlands and Their Services to People. Gland (Switzerland). Ramsar Convention Secretariat.

[2] Continental Wetlands (natural tropical) are all wetlands that are not coastal, nor have they been created by man. They commonly occur in floodplains along rivers and streams, in isolated depressions surrounded by dry land, lake and pond margins, and in other low-lying areas where groundwater intercepts the soil surface or where rainfall sufficiently saturates the soil. Geographically located in the tropical zone of the planet (20º N - 20º S).

[3] Ecological characteristics: Combination of the components, processes and benefits / services of the ecosystem that characterize the wetland at a given moment (Ramsar, 2018).

2 Biodiversity Associated to Continental Wetlands.

According to the Convention on Biological Diversity (CBD, 1992), biodiversity or biological diversity is understood as "the variability of living organisms from any source, including, among others, terrestrial and marine ecosystems and other aquatic ecosystems and the ecological complexes of which they are part of; it covers the diversity within each species, between species and of ecosystems "[4]. The biodiversity associated with wetlands is in danger, because it is highly dependent on the permanence of these ecosystems (compared to the purely terrestrial diversity). In addition, in recent years it has been shown that the extension of natural continental wetlands is decreasing while that of artificial wetlands has increased. (Ramsar, 2018)[5].

Due to their biodiversity, wetlands have the capacity to provide a wide range of ecosystem services, among which water and climate regulation stand out. However, the unsustainable use of natural resources, the loss and degradation of habitat, climate change, among other pressures, alter the ecological characteristics of wetlands, which results in the loss of biodiversity, ecosystem services provision, and even the loss of wetland.

3 Biological Component Assessment in Continental Wetlands

The first step that project managers must develop is a biological component assessment, identifying from the beginning of the project the ecological characteristics of the wetland that influence biodiversity. This evaluation includes two substeps: i. establishment of a biodiversity baseline and ii. identification of pressures on biodiversity. The result of this step should be sufficient for designing project activities and the biodiversity monitoring plan.

3.1 Biodiversity baseline

The biodiversity baseline must contain specific information on the ecological characteristics of the wetland, including physical aspects such as climate, geomorphology and hydrography. These aspects characterize and even delimit the different types of natural ecosystems and therefore determine the presence of certain species in the project area. The types of natural ecosystems other than wetlands must also be identified as they maintain biological interactions and are important both for the sustenance of the wetland and for biodiversity.

3.1.1 Characterization of fauna and flora associated with Continental Wetlands

As mentioned before, the baseline must contain the description of the ecological characteristics of the wetland, it must also include the characterization of the fauna and flora, based on the identification of the main taxonomic groups associated with the wetlands. For this, a large number of resources exist at a global and local scale, in different information systems (literature, metadata, cartography, among others), that can help carry out this characterization.

Biological information from secondary sources may be sufficient for the establishment of the baseline, only if the available information on the ecological characteristics of the project area is accurate and complete. However, the project manager may consider it necessary to collect primary information from inventories and records made through field work. The decision to carry out a primary information survey must be made taking into account aspects such as

[4] https://www.cbd.int/doc/legal/cbd-es.pdf

[5] https://www.ramsar.org/sites/default/files/documents/library/gwo_s.pdf

biological information gaps, availability of resources (financial, trained personnel, equipment and materials), accessibility to the project area, among other aspects that may become limiting for the execution of a biological characterization.

3.1.2 HCVs identification.

Another aspect that project managers must carry out is to assess whether there are project areas that can be considered as HCVs, that is, areas that have exceptionally significant or critically important biological, ecological, social or cultural value. (Brown, Dudley, Lindhe, Muhtaman, Stewart & Synnott, 2013[6]). This assessment must be integrated into the baseline justifying the presence or absence of HCVs, since it allows recognizing priorities for the conservation efforts implemented in the project activities and in the monitoring plan.

Table 1 lists tools that provide further guidance for the establishment of the biodiversity baseline. These tools contain a vast amount of information generated by national and international entities, which can be filtered by country, province, locality, ecosystem, taxonomic groups, according to need. In this way, the project managers have multiple information alternatives to carry out the establishment of the baseline, essential for the collection of secondary information or as guidance for the collection of primary information.

Table 1. Tools and resources for establishing a biodiversity baseline.

Source/Organization	**Tools and resources**
a. Characterization of vegetation and fauna groups	
i. Project area description	
Agustin Codazzi geographic institute (IGAC for its spanish acronym)	Colombia on maps, where you can find the following cartography: - Institute of Hydrology, Meteorology and Environmental Studies - IDEAM: Annual Precipitation for the year. - IDEAM: Caldas-Lang climate classification. - Natural National Parks - PNN: Natural National Park. - PNN: National conservation priorities CONPES 3680 - PNN: Limits of Protected Areas. - PNN: Natural Reserves of Civil Society 2016. - Alexander von Humboldt Biological Resources Research Institute - IvAH: Important Areas for Bird Conservation. www.colombiaenmapas.gov.co/#
Colombian Environmental Information System - SIAC.	Geographic viewer and database with the following maps: - Ministry of Environment and Sustainable Development - MADS: Aquatic ecosystems 2015. - IvAH: General ecosystems of Colombia - IvAH: Priority areas for biodiversity conservation. - IDEAM: Map of continental, marine and coastal ecosystems of Colombia 2017. Version 2.1 sig.anla.gov.co:8083/ www.siac.gov.co/catalogo-de-mapas
World Wildlife Fund. - WWF	Terrestrial Ecoregions of the World www.worldwildlife.org/publications/terrestrial-ecoregions-of-the-world
	Freshwater ecoregions of the world: A new map of biogeographic units for freshwater biodiversity conservation. www.worldwildlife.org/pages/freshwater-ecoregions-of-the-world--2

[6] Brown, E., N. Dudley, A. Lindhe, D.R. Muhtaman, C. Stewart, y T. Synnott (eds.). (2013) (September). Generic guide for the identification of High Conservation Values. HCV Resource Network (HCVRN).

Freshwater Ecoregion of the World - FEOW.	Freshwater Ecoregion of the World. www.feow.org/
ii. Description of flora and fauna associated with Continental Wetlands	
IvAH	Application of bioecological criteria for the identification, characterization and establishment of functional limits in wetlands of the flooded savannas of the Orinoquia. http://repository.humboldt.org.co/handle/20.500.11761/9301
	Principles and criteria for the delimitation of continental wetlands: a tool to strengthen resilience and adaptation to climate change in Colombia. http://repository.humboldt.org.co/handle/20.500.11761/31444
	Inland wetlands of Colombia: identification, characterization and establishment of limits according to biological and ecological criteria. http://repository.humboldt.org.co/handle/20.500.11761/9280
	Methods for the development of biodiversity inventories manual. http://repository.humboldt.org.co/bitstream/handle/20.500.11761/31419/63.pdf?sequence=1
	Methodological description for biological evaluation in wetland complexes. http://repository.humboldt.org.co/handle/20.500.11761/9591
Junk, Piedade, Lourival, Wittmann, Kandus, Lacerda & Agostinho (2014).	Brazilian Wetlands: Classification. **https://doi.org/10.1002/aqc.2386**
Ricaurte, Patiño, Zambrano, Arias, Acevedo, Aponte & Junk (2019).	A classification system for Colombian wetlands: an essential step forward in open environmental policy-making. https://link.springer.com/article/10.1007/s13157-019-01149-8
Inter -American Development Bank - IDB Convention on biological diversity - CDB	Good practices for collecting biodiversity baseline data. https://publications.iadb.org/publications/spanish/document/Buenas-pr%C3%A1cticas-para-la-recopilaci%C3%B3n-de-datos-de-l%C3%ADnea-base-de-biodiversidad.pdf
	Status and trends of biodiversity of inland water ecosystems. https://www.cbd.int/doc/publications/cbd-ts-11.pdf
Ramsar Convention.	Guidelines for Rapid Ecological Assessment of Coastal, Marine and Inland Water Biodiversity. www.ramsar.org/sites/default/files/documents/library/lib_rtr01_s.pdf
International Union for Nature Conservation (IUCN).	The IUCN Red List of Threatened Species www.iucnredlist.org/
Global Biodiversity Information Facility - GBIF	Free and open access to biodiversity data www.gbif.org/
Convention on International Trade of in Endangered Species of Wild Fauna and Flora - CITES	CITES Species cites.org/esp/disc/species.php
Map of Life	Database that includes information on the range and distribution patterns of species among others. https://mol.org/
Conservation	Biodiversity hotspots. Targeted investment in nature's most important places www.conservation.org/priorities/biodiversity-hotspots
Bird Life International	Data zone datazone.birdlife.org/home
Trópicos	The Tropicos database www.tropicos.org/home

b. Identificación de AVCs	
High Conservation Value - HCV. Resource Network.	Generic guide for the identification of High Conservation Values. hcvnetwork.org/library/guia-generica-para-la-identificacion-de-altos-valores-de-conservacion/
IUCN Biodiversity A-Z, UN Environment Programme World Conservation Monitoring Centre - UN WCMC.	The IUCN Red List of Threatened Species www.iucnredlist.org/
	Guidelines for Appropriate Uses of IUCN Red List Data (Version 3.0). www.iucnredlist.org/resources/guidelines-for-appropriate-uses-of-red-list-data
	Ecosystems red list. iucnrle.org/
Biodiversity A-Z, UN Environment Programme World Conservation Monitoring Centre - UN WCMC.	Areas of biodiversity importance www.biodiversitya-z.org/themes/areas?s=home-icons
Benayas, J. M. R., & de la Montaña, E. (2003).	Identifying areas of high-value vertebrate diversity for strengthening conservation. https://www.sciencedirect.com/science/article/abs/pii/S0006320703000648
ProForest (*s.f*)	Good practice guidelines for High Conservation Value assessments. A practical guide for practitioners and auditors. https://www.proforest.net/fileadmin/uploads/proforest/Documents/Publications/hcv-20good-20practice_final.pdf

3.2 Pressures on Biodiversity Identification

The loss of biodiversity reflected in the decline of populations and the growing list of threatened species is mainly due to the persistence and intensification of five (5) pressures identified at the international level (CBD, 2010). These correspond to:

a. Loss and degradation of habitats
b. Climate change
c. Contamination and nutrient pollution
d. Overexploitation and unsustainable usage
e. Invasive alien species

Proper identification of these pressures and the description of their effect on wetlands and associated flora and fauna populations is essential for the design and implementation of project activities that prevent or reduce the loss of biodiversity. Similarly, it is essential to determine whether these pressures also threaten the permanence of the HCVs present in the project area and to determine management and mitigation measures. Table 2 lists some resources that allow us to show and describe the effect of pressures on biodiversity.

Table 2. Tools and resources for identifying pressures on biodiversity

Source/Organization	Tools and resources
CBD	Voluntary guidelines for the design and effective implementation of ecosystem-based approaches climate change adaptation and disaster risk reduction and supplementary information. www.cbd.int/doc/publications/cbd-ts-93-en.pdf
	The Application of Classical Biological Control for the Management of Established Invasive Alien Species Causing Environmental Impacts. www.cbd.int/doc/publications/cbd-ts-91-en.pdf
	Sustainable Use of Biodiversity https://www.cbd.int/undb/media/factsheets/undb-factsheet-sustainable-en.pdf
Invasive Species Specialist Group - ISSG	Global invasive species database. www.iucngisd.org/gisd/
IUCN	The Classification Schemes for Threats and Conservation Actions Needed. www.iucnredlist.org/resources/classification-schemes
The Conservation Measures Partnership - CMP	Open Standards for the Practice of Conservation. www.cbd.int/doc/pa/tools/Open%20standards%20for%20the%20practice%20of%20conservation.pdf
Evans, M. J., & Malcom, J. W. (2020).	Evans, M. J., & Malcom, J. W. (2020). Supporting habitat conservation with automated change detection in Google Earth Engine. https://conbio.onlinelibrary.wiley.com/doi/abs/10.1111/cobi.13680
Xi, Y., Peng, S., Ciais, P. & Chen, Y. (2021).	Future impacts of climate change on inland Ramsar wetlands. https://www.nature.com/articles/s41558-020-00942-2
Bassem (2020).	Water pollution and aquatic biodiversity. 10.15406/bij.2020.04.00159
Convención de Ramsar	An Integrated Framework and guidelines for avoiding, mitigating and compensating for wetland losses. www.ramsar.org/sites/default/files/documents/pdf/guide/guide-losses-e.pdf
	Peatlands, climate change mitigation and biodiversity conservation. www.ramsar.org/es/document/peatlands-climate-change-mitigation-and-biodiversity-conservation
	Wise use of wetlands. www.ramsar.org/sites/default/files/documents/library/hbk4-01.pdf
International Institute for Sustainable Development - IISD	The Sustainable Use of Natural Resources: The Governance Challenge www.iisd.org/articles/sustainable-use-natural-resources-governance-challenge

4 Biodiversity monitoring plan

Biodiversity monitoring corresponds to the medium and long-term monitoring of the status and change trends in biodiversity associated with wetlands. The success or effectiveness of monitoring depends mainly on an adequate choice of indicators understood as variables or attributes to be measured. The choice of these indicators must respond to the objectives set for the conservation of biodiversity according to the results of the baseline, and the scope of the project. Similarly, the monitoring plan can help demonstrate that the project generates benefits for biodiversity conservation, for which the plan must be aligned with one of the special categories related to co-benefits [7].

[7] Special Categories, related to co-benefits, i. Orchid, ii. Wax palm and iii. Andean Condor, found in: https://proclima.net.co/wp-

Since a monitoring plan is made up of several steps, the choice of information gathering methods that adequately respond to the monitoring of indicators and the fulfillment of biodiversity objectives can become complex. In order to guide project managers in the process of designing and implementing a biodiversity monitoring plan, Table 3 presents some useful tools and resources.

Table 3. Tools and resources for biodiversity monitoring.

Source/Organization	Tools or resources
CBD	Biodiversity Indicators & The 2010 Biodiversity Target: Outputs, experiences and lessons learnt from the 2010 Biodiversity Indicators Partnership www.cbd.int/doc/publications/cbd-ts-53-en.pdf
	Sourcebook on Remote Sensing and Biodiversity Indicators Prepared by the NASA-NGO Biodiversity Working Group and UNEP-WCMC to support implementation of the Convention on Biological Diversity www.cbd.int/doc/publications/cbd-ts-32.pdf
Nature Briefing	Set a global target for ecosystems https://media.nature.com/original/magazine-assets/d41586-020-00446-1/d41586-020-00446-1.pdf
Colombian Ministry of the Environment (2002)	National Policy for Inland Wetlands of Colombia. Strategies for its conservation and sustainable use. www.minambiente.gov.co/images/BosquesBiodiversidadyServiciosEcosistemicos/pdf/Normativa/oliticas/polit_nal_humedales_int_colombia.pdf
Puerta-Piñero C., Gullison R.E., Condit R.S. (2014)	Methodologies for the Monitoring System of Biological Diversity of Panama http://dx.doi.org/10.5479/si.ctfs.0001.
Barbour, M. T., J. Gerritsen, B. D. Snyder, and J. B. Stribling. (1999)	Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish. www3.epa.gov/region1/npdes/merrimackstation/pdfs/ar/AR-1164.pdf
Jacobs, J. F and W. R. Heyer. (1994)	Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians.
IAvH (2017)	Conceptual framework for the monitoring of biodiversity in Colombia. http://repository.humboldt.org.co/bitstream/handle/20.500.11761/32946/BEP2001Marco.pdf?sequence=1&isAllowed=y
Ramsar Convention Secretariat, (2010).	Inventory, assessment and monitoring: Integrated Framework for wetland inventory, assessment and monitoring. www.ramsar.org/sites/default/files/documents/pdf/lib/hbk4-13sp.pdf
	The use of low-cost GIS data and programs for wetland inventory, assessment and monitoring. Ramsar Technical Report No. 2 www.ramsar.org/sites/default/files/documents/library/lib_rtr02_s.pdf
INECC	Techniques for assessing and monitoring the state of wetlands and other aquatic ecosystems www2.inecc.gob.mx/publicaciones2/libros/533/tecnicas.pdf
ARAUCO	Protocol for the Identification, Management and Monitoring of High Conservation Values. www.arauco.cl/chile/wp-content/uploads/sites/14/2017/09/EG14.5-Identificacio%CC%81n-Manejo-y-monitoreo-de-altos-valores-09.2017.pdf
Forest Stewardship Council	Guidelines for Identification, Management and Monitoring of High Conservation Values of FSC Chile. https://cl.fsc.org/preview.pautas-para-identificacin-manejo-y-monitoreo-avc-de-fsc-chile-2016.a-235.pdf

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