

**ANALYSIS OF BIODIVERSITY IN THE RIVER CHANCAY- LAMBAYEQUE  
WATERSHED USING GEO CITY METHODOLOGY****Jorge G. Morales**<sup>1\*</sup>**Ambrocio T. Esteves**<sup>2\*</sup>**Freddy A. Manayay**<sup>3\*</sup>**Wilder E. Melgarejo**<sup>4\*</sup><sup>1\*</sup>University of San Martín de Porres northern subsidiary, Chiclayo, Perú. [jmoralesr1@usmp.pe](mailto:jmoralesr1@usmp.pe)<sup>2\*</sup>University César Vallejo, subsidiary, Lima, Perú. [diosteama774@hotmail.com](mailto:diosteama774@hotmail.com)<sup>3\*</sup>University of San Martín de Porres northern subsidiary, Chiclayo, Perú. [fmanayayl@usmp.pe](mailto:fmanayayl@usmp.pe)<sup>4\*</sup>University San Luis Gonzaga de Ica, [Ica-Peru.wi\\_melgar555@Hotmail.com](mailto:Ica-Peru.wi_melgar555@Hotmail.com)**ABSTRACT**

The purpose of this research is to analyze the biodiversity of the river Chancay watershed using the Geo cities methodology, in particular it introduces a different strategy to evaluate the biodiversity of a city by adapting the Geo cities methodology to a more extensive scope. The study found that floristic biodiversity in the River Chancay-Lambayeque watershed corresponds to a total of 113 species, comprised in 104 genera and 53 families. Of which 5 tree species, 2 shrubs and 1 herbaceous are threatened. Regarding wildlife, 37 species have been registered, of which 6 are threatened. The study shows that the GEO methodology for diagnosing threatened species in urban areas could be used in non-urban areas. By other hand, eight species of flora and six of threatened fauna were found in the Chancay - Lambayeque Valley.

**KEYWORDS:**

Biological diversity, Biodiversity, GEO methodology, threatened species, species categorization, inventory.

**INTRODUCTION**

The Convention on Biological Diversity (UN, 1992) states that biodiversity term includes the variability of living organisms from any source and that must be included the ecosystems, interspecific and intraspecific variability.

Peru is considered one of the 17 countries called megadiverse of the world (MINAM, 2018) and occupying the fourth place, this due to its extraordinary diversity (Kamiché, 2010); In addition to the 104 natural life zones in the world, Peru has 84 and 41 ecosystems (MINAM, 2019). Hence the importance of knowing all structurally related aspects at taxonomic, genetic and ecosystem levels.

The diversity of species can be expressed by means of an index that is independent of the amplitude of the sample on which it is determined (Margalef in Flos, 2005).

The Anthropogenic activities on ecosystems directly affect on the loss of biodiversity, lead to serious alterations and also to important extinctions of flora and fauna components. A study conducted in 2016 by the Division of Environmental Law and Environmental Agreements (DELCA) of the United Nations Environment Program (UNEP) mentions that the Latin American and Caribbean Region It presents a tendency to rise in all the main pressures on biodiversity and consequently a decrease in biodiversity, which also implies a relevant process of species extinction, endangering the life of the planet (UNEP, 2019).

The MINAM (2019) in its sixth national report on biodiversity "Biodiversity in Figures" indicates that the number of endangered wildlife species in Peru is 389, of which 64 species are in the Critical Hazard (CR) category, 122 Endangered (EN) and 203 Vulnerable (VU). The biodiversity threatened in flora is increasing the total number is 658 species distributed in 194 Critically Endangered (CR), 73 Endangered (EN) and 91 in Vulnerable (VU), very different from the list that was in force since 2014 which contains 55 species, 389 of them in the categories of Vulnerable, Endangered and Critically Endangered.

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The Economic Commission for Latin America and the Caribbean (ECLAC, 2017) provides a selection of biodiversity indicators to maintain the composition and diversity of species such as: Diversity and composition of species, species richness, rare species, endemic species, species richness in fish (lakes, rivers), epiphytic compositions, pollinator composition, composition and functional diversity, pollinator abundance, and decomposer abundance (fungi).

The National Biodiversity Institute (2015), institute attached to the Ministry of Environment of Ecuador, also proposes a series of national biodiversity indicators applying the GEO Methodology, which respond to the pressure-state-impact-response (PEIR) conceptual framework proposed by the OECD in 1993 and hosted by UNEP.

The International Union for the Conservation of Nature (IUCN) proposes various categories for endangered species. The categories for threatened species are the following: Critically Endangered (CR), Threatened (EN), Vulnerable (VU) (CEUICN, 2019).

In Peru, four urban environmental diagnoses have been carried out using the GEO City Methodology: GEO Lima and Callao (Arnold et al., 2005), GEO Arequipa (Encalada et al., 2005) and GEO Chiclayo. It should be said that the GEO indicators have not been used to assess threatened species. In the city of Chiclayo, the Urban Environment Outlook Report GEO Ciudad Chiclayo was presented (Vásquez; Rodríguez, E; Morales, J, 2008).

The scope of study is framed in the River Chancay-Lambayeque watershed. The watershed is located in the North of Peru and is comprised in two defined parts: the valley (coast) in the department of Lambayeque and the highlands in the department of Cajamarca. The main tributary is the Chancay River belonging to the Pacific slope, which is 170 km long. The area of the watershed is 5 555.49 km<sup>2</sup>.

In the present work the following problem arises: ¿Can the extinct or threatened species outside the urban field be measured with the GEO city Methodology?

### OBJECTIVES

The principal purpose of this investigation is to measure the percentage of threatened flora and fauna species, having as field of study the River Chancay- Lambayeque Watershed, using the GEO methodology proposal by the United Nations Program for de Environment (PNUMA) for evaluation and diagnosis of biodiversity in urban ecosystems.

### METHODOLOGY

The biodiversity analysis of the River Chancay-Lambayeque Watershed was carried out using the GEO city Methodology - Application Manual version 3 (UNEP, 2008). For the evaluation and diagnosis, the research work carried out in the different nationally and regionally recognized institutions such as the Regional Government of Lambayeque (2010), Regional Government of Lambayeque (2013), National Forest and Wildlife Service (2018) was systematized and researchers Arbulú et al. (2000).

To apply this methodology, all the species identified in the local academic literature and whose status is periodically evaluated were selected. It was systematized into families, genera and species. Subsequently, the percentage of threatened species was calculated for each class and compared the information with the number of corresponding species.

The indicators used are:

- a) Percentage of threatened plant species, total of all classes;
- b) Percentage of threatened species of each class of plants;
- c) Percentage of threatened vertebrate species, total of all classes;
- d) Percentage of vertebrate species of each threatened class.

The Sub-indicators a) and c) provide an overview of the situation of plants and animals, respectively.

Subindicators b) and d) show which is the most threatened class.

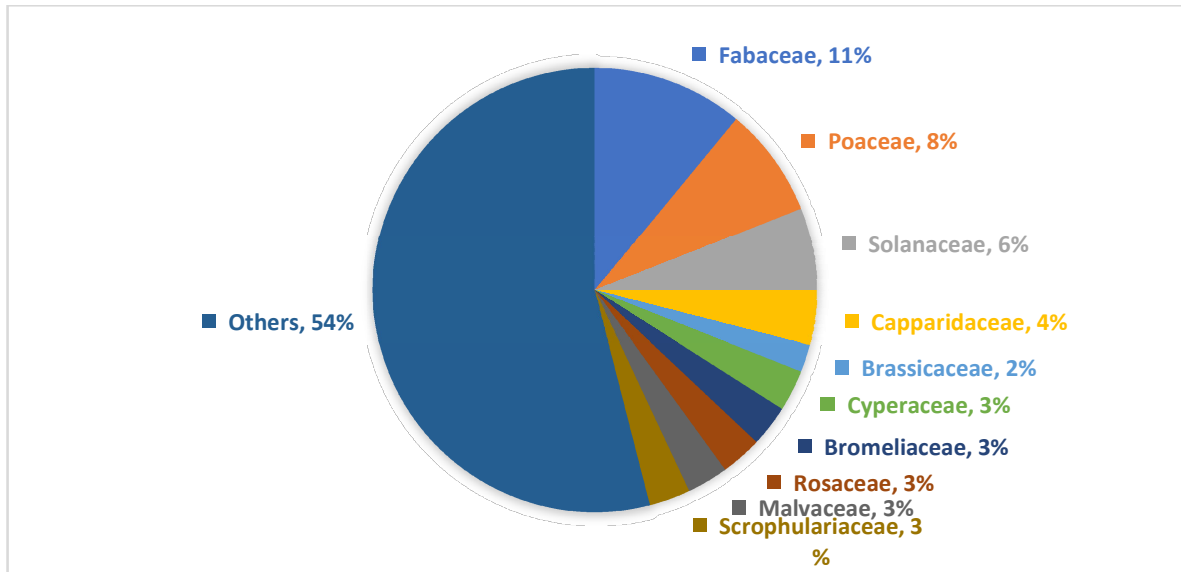
### RESULTS AND DISCUSSION

The Application Manual version 3 called Methodology for the preparation of the GEO Cities Reports in Chapter 3 referring to the state of the environment provides status indicators to evaluate extinct or threatened species / known species. This methodology has been applied in countries of Latin America and the Caribbean.

The results provide information on Floristic biodiversity at a taxonomic level in the River Chancay-Lambayeque watershed. The bibliographical references from which the data for the systematics were

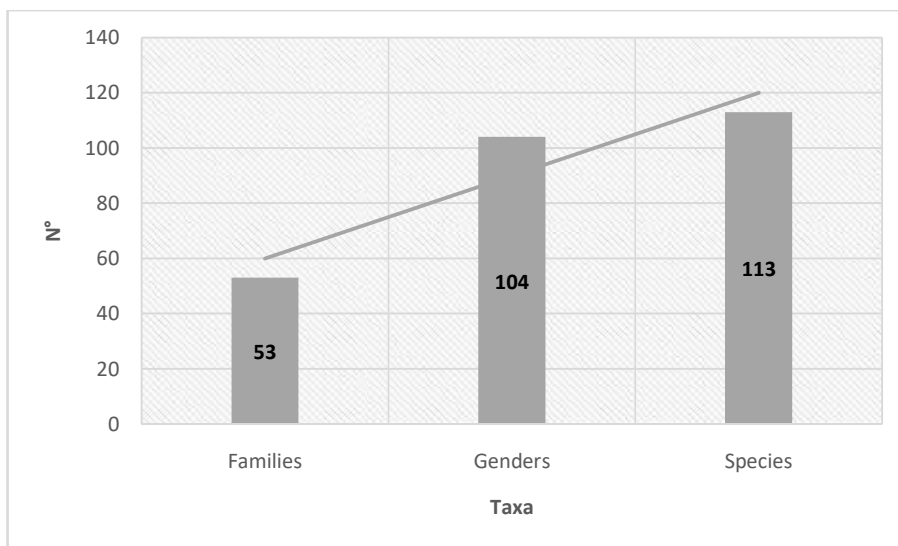
extracted were grouped into classes, orders, families and species. The data yielded a total of 113 species, making up the Fabaceae in the most important taxonomic group with 11%. These species are comprised in 104 genera and 53 families (Fig. 1, 2).

**Fig.1. Flora of the River Chancay-Lambayeque Watershed**



Own elaboration

**Fig. 2. Flora of the River Chancay-Lambayeque Watershed**



Own elaboration

### Endangered Species

Threatened species of flora in the River Chancay-Lambayeque watershed 5 tree species, 2 shrubs and 1 herbaceous (Table 1, 2).

**Table 1. Flora threatened in the River Chancay-Lambayeque Watershed**

<b>SPECIE</b>	<b>FAMILY</b>	<b>COMMON NAME</b>
<i>Loxopterigiumhuarango</i>	<i>Anacardiaceae</i>	<i>Hualtaco</i>
<i>Burseragraveolens</i>	<i>Burseraceae</i>	<i>Palo santo</i>
<i>Caesalpiniaaipai</i>	<i>Fabaceae</i>	<i>Charán</i>
<i>Prosopispallida</i>	<i>Fabaceae</i>	<i>Algarrobo</i>
<i>Acacia macrocantha</i>	<i>Fabaceae</i>	<i>Faique</i>
<i>Cordialutea</i>	<i>Boraginaceae</i>	<i>Overo</i>
<i>Capparisovalifolia</i>	<i>Capparidaceae</i>	<i>Vichayo</i>
<i>Proboscideaaltheifolia</i>	<i>Martyniaceae</i>	<i>Yuca de caballo</i>

Information source: Regional Government of Lambayeque (2010).

**Table 2. Number and percentage of threatened flora species of the River Chancay-Lambayeque Watershed**

<b>ESPECIES</b>	<b>NUMBER</b>	<b>(%)</b>
<i>Total Flora</i>	8	7.07
<i>Arboreal</i>	5	17.85
<i>Shrubby</i>	2	9.52
<i>Herbaceous</i>	1	4.34

Ownelaboration

In the *River Chancay-Lambayeque Watershed*, 37 species have been registered, of which 6 are threatened, according to categorization of endangered wildlife species (Table 3, 4,5).

**Table 3. Wildlife of the River Chancay-Lambayeque Watershed**

<b>CLASSES</b>	<b>SPECIES</b>		<b>FAMILIES</b>	
	<b>N°</b>	<b>%</b>	<b>N°</b>	<b>%</b>
Birds	12	32.43	6	21.43
Amphibians	1	2.70	1	13.57
Mammals	7	18.92	7	25.00
Reptiles	9	24.32	6	21.43
Fishes	8	21.62	8	28.57
<b>TOTAL</b>	<b>37</b>	<b>100.00</b>	<b>28</b>	<b>100.00</b>

Ownelaboration

Table 4: Threatened Species of Fauna in the River *Chancay-Lambayeque Watershed*

CLASSES	VULNERABLE	ALMOST THREATENED	IN DANGER	CRITICAL HAZARD
Birds	-	<i>Falco peregrinus</i>	-	<i>Penelope albipennis</i>
Reptiles	<i>Dicrodonheterolepis</i> <i>Bothrops pictus</i>	<i>Callopiestes flavipunciatus</i>	<i>Boa constrictor</i>	-

Ownelaboration

Table 5. Number and porcentaje of threatened Species of Fauna in the River *Chancay-Lambayeque Watershed*

SPECIES	NUMBER	%
Mammals	6	00.00
Birds	0	33.33
Reptiles	2	66.67
Amphibians	4	00.00
<b>TOTAL</b>	<b>6</b>	<b>100.00</b>

Ownelaboration

The results obtained using the records on the flora and fauna existing in the Chancay river watershed of Lambayeque serve as input to use them in the study to establish which are the threatened species (Fig. 1,2 and table 3). Tables 1 and 2 present the flora in categories of species, genera and families, which allow us to obtain the number and percentage of threatened species of the flora of the River Chancay-Lambayeque watershed. Herbaceous, shrub and tree species agree with the data provided by the Regional Government of Lambayeque (2010) and by Arbulú et al. (2000).

The Tables 3,4 and 5 show that there are 37 wildlife species in the river watershed, of which 6 are threatened having followed the categorization according to Supreme Decree of 2014 (El Peruano, 2014). In the red book of the threatened wildlife of Peru (SERFOR, 2018) the species *Dicrodonholmbergi* is consigned as a species of reptile categorized as vulnerable, being that the GRL mentions *Dicrodonheterolepis* "red-headed lizard". The list in Table 4 indicates threatened and categorized species according to the references published by the Regional Government of Lambayeque (GRL), by the National Forest and Wildlife Service<sup>9</sup> (SERFOR, 2018) and by the Ministry of Environment (MINAM, 2018).

### CONCLUSION

In the Chancay - Lambayeque Valley there are eight species of flora and six of threatened fauna. The GEO methodology to diagnose threatened species in urban areas could be used in non-urban areas.

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