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Perceived effects of elephant presence and climate change on ecosystem services in the Pendjari Biosphere Reserve, West Africa

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1. Background and Justification



(1/3)

Extinction, Substitution, and Ecosystem Services

Author(s): Paul R. Ehrlich and Harold A. Mooney

Source: *BioScience*, Vol. 33, No. 4 (Apr., 1983), pp. 248-254

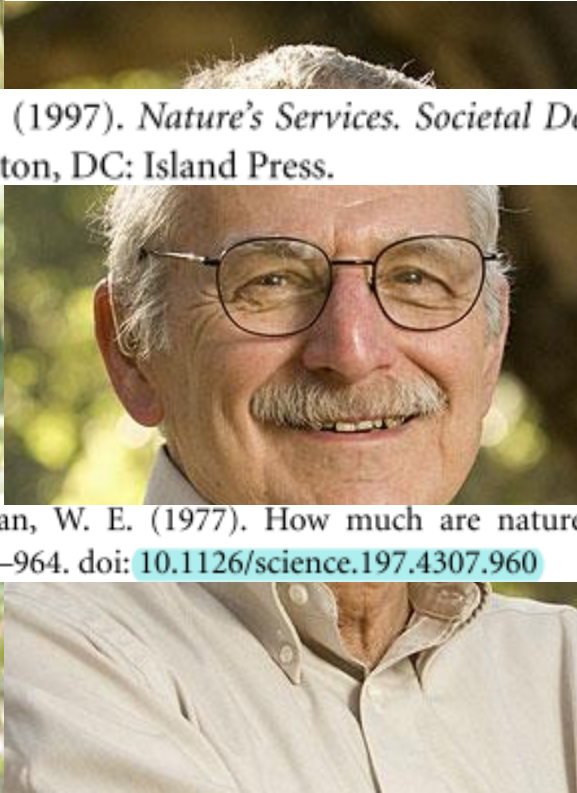
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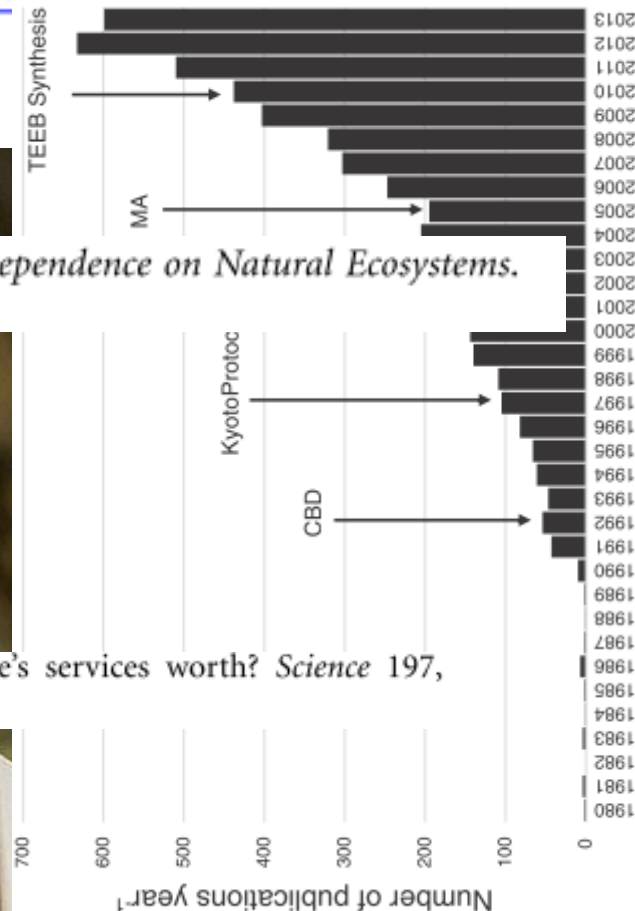
Ehrlich & Mooney [4] first coined the term 'ecosystem services' to raise awareness that anthropogenic activity was increasingly degrading habitats and subsequently resulting in the degradation of the functions and services provided by such ecosystems [4]. Since then, there has been growing attention and research on ecosystem services from various analytical angles (see Figure 1).



Daily, G. C. (1997). *Nature's Services. Societal Dependence on Natural Ecosystems*. Washington, DC: Island Press.



Westman, W. E. (1977). How much are nature's services worth? *Science* 197, 960-964. doi: [10.1126/science.197.4307.960](https://doi.org/10.1126/science.197.4307.960)



1. Background and Justification



(2/3)

Protected areas hotspots ecosystem services (Chape et al., 2005; Palomo et al., 2014) **which, strongly** contribute to human wellbeing and economic development of nations (MEA, 2005; TEEB, 2010; Schägner et al., 2013)



But ES diversity miss
in management plans
(Jacobs et al., 2015)



1. Background and Justification



(3/3)

Mammals' herbivory and climate change **are** threatened **trees** dynamics and ecosystem services delivery in natural stands (Field, 1971; Bellard et al., 2012 etc.)



However, little studies have documented such effects on ES potential and supply



Increase T (°C) and long dry seasons →



2. Objectives

(1/1)

GO: The aim of this study is to understand the drivers of ecosystem services sustainability in Pendjari Biosphere Reserve in Benin



SO1: analyze the importance of ecosystem services in Pendjari Biosphere Reserve



SO2 : analyze the perception of Reserve managers and local people on the impacts of elephants and climate change on ecosystem services in the Pendjari Biosphere Reserve



SO3 : assess the economical importance of threatened ecosystems services and related losses due to elephants' damages

3. Research questions

(1/1)

RQ1: What are the important ecosystem services of the Biosphere Reserve for local and international communities ?

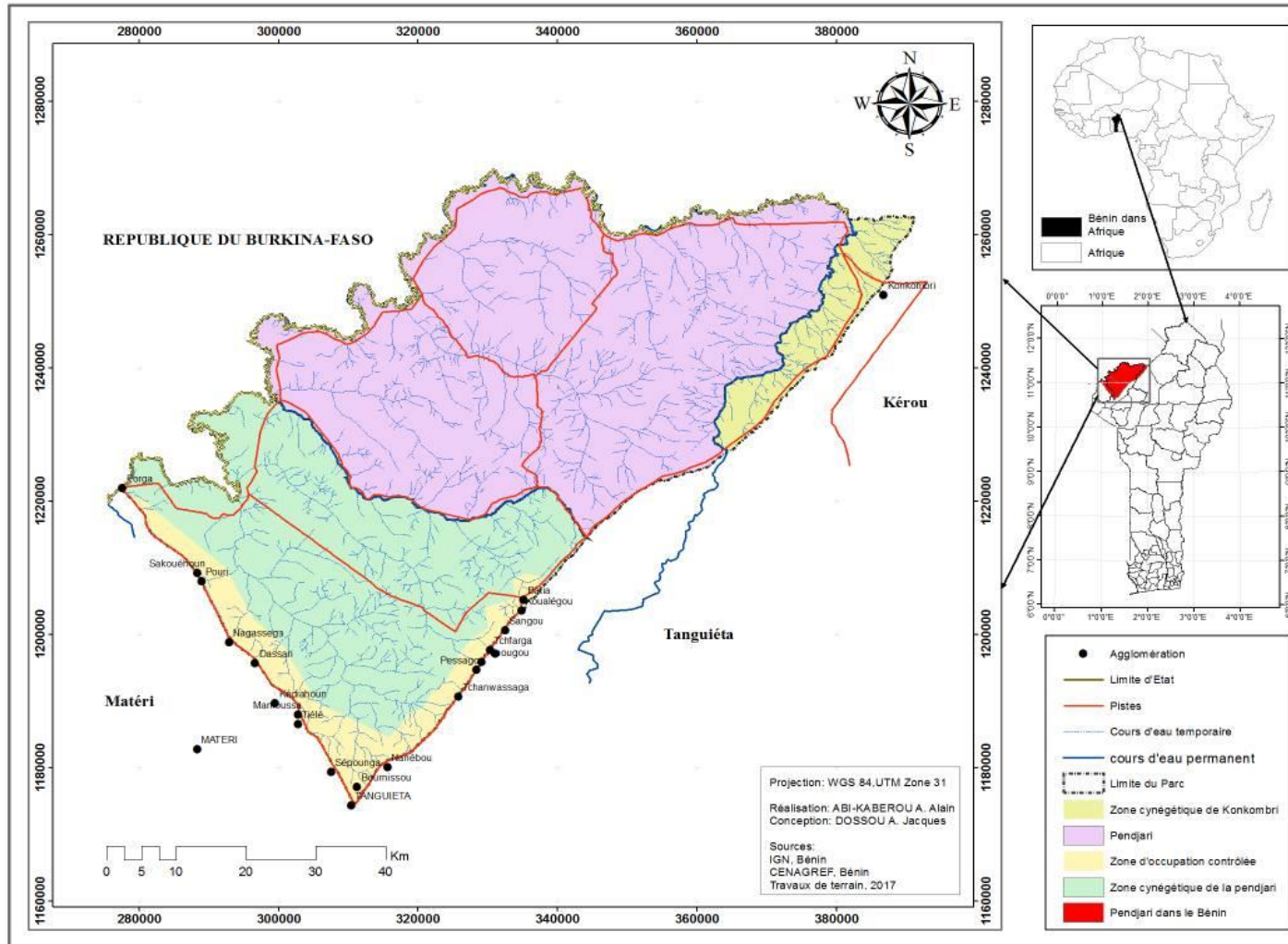
RQ2: Does the Biosphere Reserve preserve ecosystem functions and services face to the increase of elephants' populations and climate change effects?

RQ3: Which type of ecosystem services does it preserve?

RQ4: What are the economic costs of elephants' damages for the local communities?

3. Study area

(1/1)



Sudanian zone:
mosaic of
savannas
formations
interspersed
with forest
formations

Rainfall 900-
1000 mm
T (°C) 27-28

Population 188633 inhabitants (district of Matéri and Tanguiéta)(RGPH4, 2015).
Ethnic groups: Berba, Gourmantché and Waama with few people from Peulh or Fulani, Dendi, and Bariba ethnic groups

3. Methodology

(1/3)

3.1. Sampling design and data collection

Given that ecosystem service research should be “user-inspired” and “user-useful” (Cowling et al., 2008, Palmo et al., 2013), the semi-structured interview is used



112
interviewees

3. Methodology

3.1. Sampling design and data collection

- ❖ Important ecosystems services and related benefits
- ❖ Effects of elephants' damages and of climate change on such ecosystem services
- ❖ Economic cost of elephants' damages in the area of controlled occupation

3. Methodology

3.2. Statistical analysis

$$I_{imp_{ESc}} = \frac{\sum_{ESi=1}^n \text{mean score } ESi}{n}$$

Index of importance



Kruskall Wallis test

$$IPI_{imp_{ESc}} = \sum_{ES=1}^n \frac{\text{Impact score } ESi}{n}$$

Index of potential impact



Kruskall Wallis and Mann whiteny tests

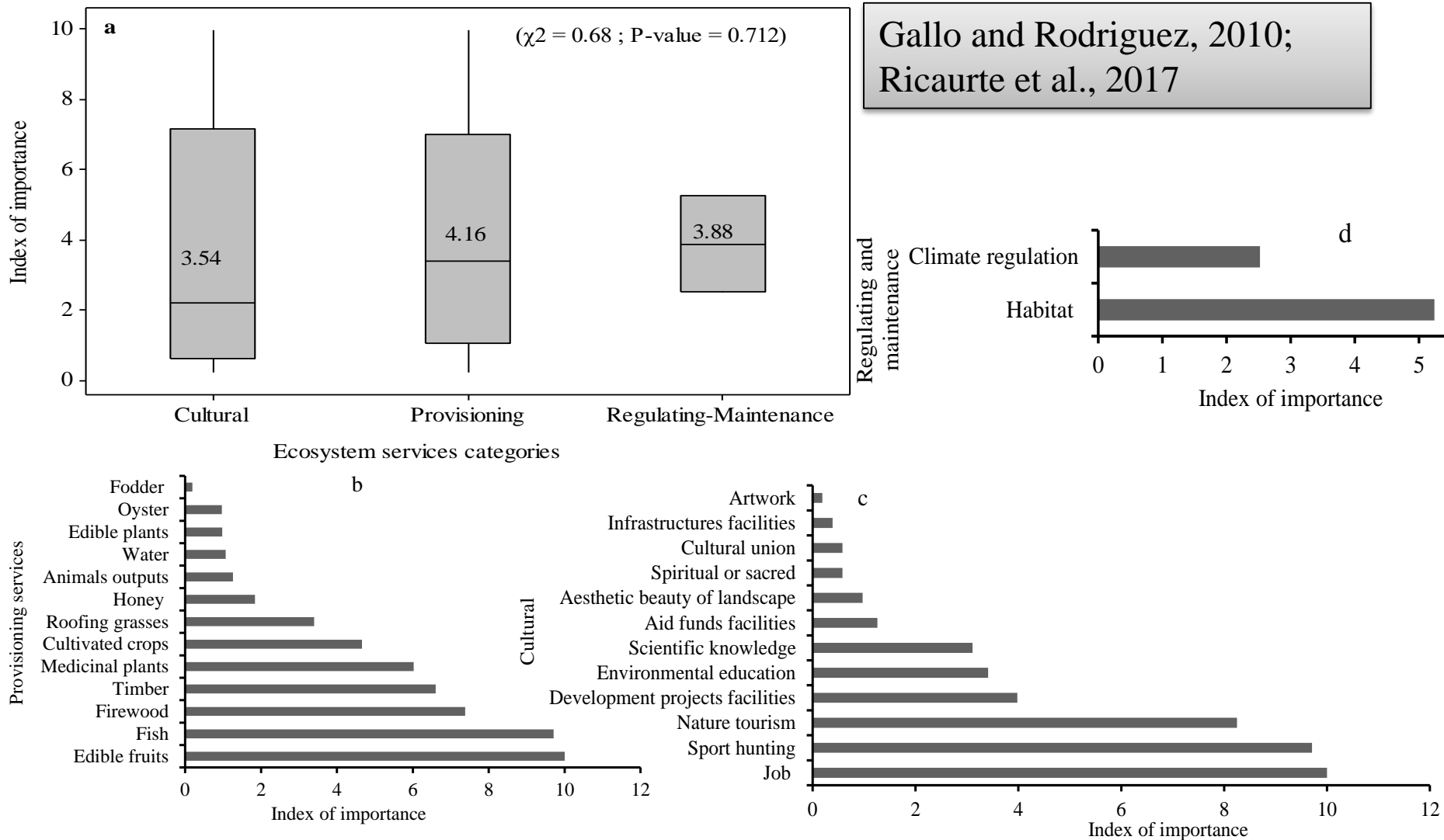
Annual area of farm damaged per crop, the corresponding annual yield and income were compute



ANOVA

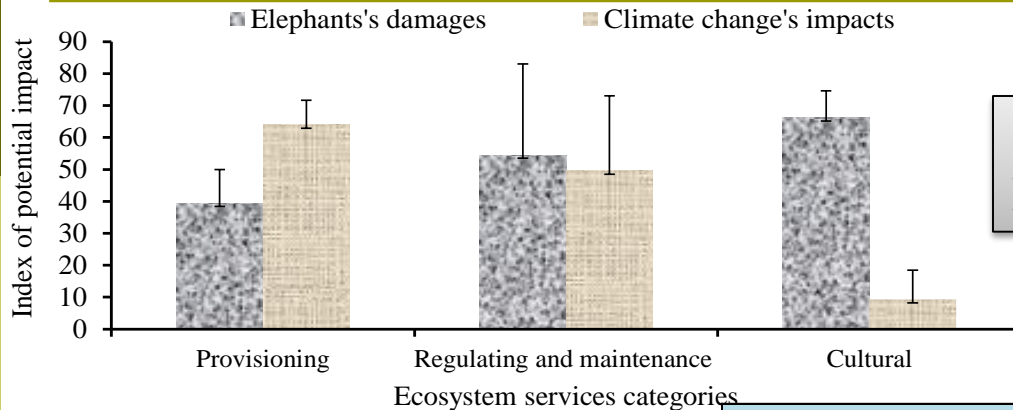
4. Results, discussion and conclusion

4.1. Importance of Ecosystem services



4. Results, discussion and conclusion

4.1. Impact of elephants and climate change on ecosystem services in Pendjari Biosphere Reserve



(Lindsey et al., 2007; DiMinin et al., 2013; Naidoo et al., 2016).

Ecosystem services	Elephants' damages	Regulating and maintenance				
Provisioning		Habitat		-	-	↔
Edible fruits	-	Climate regulation		-	-	↓ ↓
Fish	-	Cultural				
Medicinal plants	-	Nature tourism	↓ ↓	+	-	↑↑
Cultivated crops	-	Development projects facilities	↔	*	*	↑↑
Firewood	+	Sport hunting	↔	*	-	↑↑
Timber	-	Environmental education	↔	+	-	↑↑
Honey	-	Aid funds facilities	↓ ↓	*	*	↑↑
Water	*	Scientific knowledge	↔	+	+	↑↑
Roofing grasses	+	Aesthetic beauty of landscape	↔	-	-	↑↑
Animals outputs	*	Spiritual or sacred	↔	+	-	↑↑
Fodder	+	Cultural union	↓ ↓	+	*	↑↑
Edible plants	-	Artwork	↔	+	*	↑↑
Oyster	*	Job -	↔	*	*	↑↑
		Infrastructures facilities	↔	*	*	↑↑

4. Results, discussion and conclusion

4.1. Impact of elephants and climate change on ecosystem services in Pendjari Biosphere Reserve

Table. Annual losses of crops per household due elephants' damages

Crops	Cultivated area (ha / yr)		Yield (kg / ha / yr)		loss (\$)	
	mean	cv (%)	mean	cv (%)	mean	cv (%)
Cotton	1.60 ^{ab}	68.64	1000 ^{bc}	68.643	463.75	85.36
Yam	1.16 ^{ab}	184.78	1600 ^{ab}	184.775	174.80	61.39
Shea	2.00 ^a	0.00	491.66 ^d	22.93	279.44	22.42
Corn	1.57 ^{ab}	119.66	1587.75 ^{ab}	119.65	354.00	127.58
Rice	0.25 ^b	58.77	1866.66 ^a	32.73	175.39	22.93
Sorghum	1.54 ^{ab}	104.84	705.71 ^c	63.51	586.05	116.43
Probability	0.039	-	0.000	-	0.144	-

4. Results, discussion and conclusion

4.1. Impact of elephants and climate change on ecosystem services in Pendjari Biosphere Reserve

- (i) Assessing the climate change and elephants' disturbances effects on the ESs hotspots of the Biosphere Reserve

- (ii) Assessing the conservation status of the wild edible trees species of the Biosphere Reserve

- (i) Assessing the nature of the relationships between ESs

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