

## EVALUATING THE MITIGATION MEASURES TO BIODIVERSITY THREATS IN CROSS RIVER NATIONAL PARK, NIGERIA

Bukola Omotomilola ADETOLA<sup>1\*</sup>, Ebenezer Eyituyo OFUYA<sup>1</sup>

<sup>1</sup> Department of Ecotourism and Wildlife Management, School of Agriculture and Agricultural Technology, Federal University of Technology, P.M.B 704, Akure, Ondo State, Nigeria

---

### Abstract

*The extent to which the mitigation strategies in Cross River National Park (CRNP) Nigeria were able to curb anthropogenic activities was evaluated. Being one of Africa's oldest rainforests and biodiversity hotspot, various illegal activities are rampant in the two divisions of the park that without conservation measures, the forest resources would get to the state of being obliterated. Data were obtained through field observation, questionnaire administration to 125 park staff and review of record from the litigation unit. Descriptive and inferential statistics (percentages, weighted means and t-test) were used for data analysis. Findings show that spent cartridges, capolobia extraction, wire trap, gunshot, hunter and fishing camp were indicators of illegal activities within the park. Logging (39.2%), hunting (28.0%) and farming (12.8%) were the most common threats. Among the mitigation measures in use in CRNP, anti-poaching patrol was ranked as the most effective (WM = 32.80) while buffer zone designation ranked as the least (WM = 12.53). Although, effectiveness of mitigation measures between the park divisions (Oban and Okwangwo) were significantly different ( $t = -3.12, p < 0.05$ ), there are deficiencies in staff capacity to enforce protected area legislation and regulation. It is therefore crucial for protected areas in Nigeria to prioritise their strategies toward achieving significant conservation results.*

**Keywords:** Biodiversity; Mitigation strategies; Conservation; Poaching; Threats; Park; Anti-poaching

---

### Introduction

The variety of genes, species, and ecosystems that constitute life on earth and provides numerous essential services to society are referred to as biodiversity. These include material goods (for example, food, timber, medicines, and fibre), underpinning functions (flood control, climate regulation, and nutrient cycling), and nonmaterial benefits such as recreation [1, 2]. Therefore, the importance of biodiversity cannot be over emphasized as it plays great roles in the nation's economy and capacity for food production and critical to the maintenance of a healthy environment [3].

An assessment by Convention on Biological Diversity (CBD) concluded that without conservation measures, the world's current forest and cropland as a whole would be reduced and the attendant impact will be biodiversity loss and probably permanent extinction. There is good evidence that protected areas, planned as part of larger and connected conservation networks, offer practical, tangible solutions to the problem of species loss and adaptation to climate change [4]. Illegal harvesting of wildlife resources such as timber, fish and bushmeat

---

\* Corresponding author: boadetola@futa.edu.ng

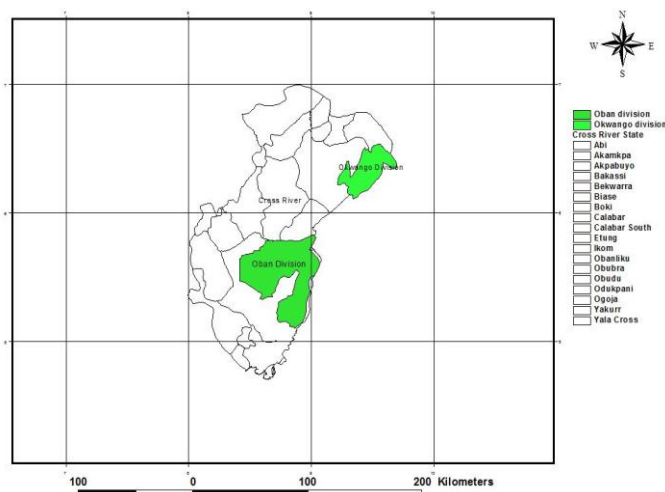
(hereafter, ‘poaching’) are some of the conservation challenges and threats facing many protected areas in Africa, and a better understanding of its nature would be useful to local conservation management [5].

Although wildlife laws exist as a global conservation tool for protection of species, most remain unenforced, due to limited human, financial and material resources required to monitor illegal activities and enforce existing laws [6]. The existence of wildlife acts in itself cannot deal with all known anthropogenic threats. Complementary actions are needed to back up legislation. *M.R.W. Rands et al* [7], therefore opined that before any suggestion about effective conservation of biodiversity in National Parks is implemented, the current scenario necessitates an understanding of the underlying factors for success and failure of the existing biodiversity threat mitigation approaches. As it becomes difficult to propose other strategies or to have a basis upon which new ones can be introduced if the reason for the persistence of biodiversity loss cannot be mitigated through the current strategies/approaches. This study therefore evaluates the effectiveness of mitigation strategies to biodiversity threats in Cross River National Park (CRNP), Nigeria.

**Materials and methods**

**Study Area**

The study was carried out in Cross River National Park (CRNP) located between latitude 5°05' and 6°29'N and longitude 8°15' and 9°30'E in Cross River State, Nigeria (Fig. 1). The Cross River National Park covers a total area of 4000km<sup>2</sup> and is segmented into two non-contiguous divisions; the Oban hills in the southern part covering 3000km<sup>2</sup> and the Okwangwo division in the northern part covering 1000km<sup>2</sup>. The Park ecosystem consists of primary moist tropical rainforests in the north and central parts, while the southern parts contain mangrove swamps on the coastal zones. The Cross River National Park has one of the oldest rainforests in Africa and has been identified as a biodiversity hot spot [8-11].



**Fig. 1.** Location of Okwangwo and Oban Divisions of CRNP, [12]

**Data collection**

Direct field observation, structured questionnaires and secondary data were used as instrument for data collection. Park surveillance was carried out for twelve days during the park routine anti-poaching patrol to identify biodiversity threats. The locations with indices of illegal activities were recorded with the aid of hand held Global Positioning System (GPS- 550

Magellan) unit. A total of 125 questionnaires were self-administered to 30% of the park protection staff. Cases of illegal activities from 1991-2015 were obtained from park administrative records.

**Data Analysis**

Descriptive (tables, charts, means) and inferential (t-test) statistics were used for data analysis. The geographic coordinates were used to produce maps of location of poaching indices. Responses of the respondents designed according to five Likert’s scale were converted (i.e. Very Effective - 5, Effective - 4, Unclear 3, less effective - 2 and not effective – 1), weighted (Equation 1),

$$\text{Weighted mean} = \sum_{i=1}^n \frac{w_i * x_i}{n}, \tag{1}$$

where: w = Weights (5 Likert’s scale), x = Number of responses to each weight of an item, n = Sum of all weights,

and then subjected to Gross Arithmetic Mean computation (Equation 2) in order to determine the level of effectiveness of the mitigation strategies,

$$\text{Gross Arithmetic Mean} = \sum_{i=1}^n \frac{w_i}{n}, \tag{2}$$

where: w = Sum of weighted means of all item Weights, n = Number of items.

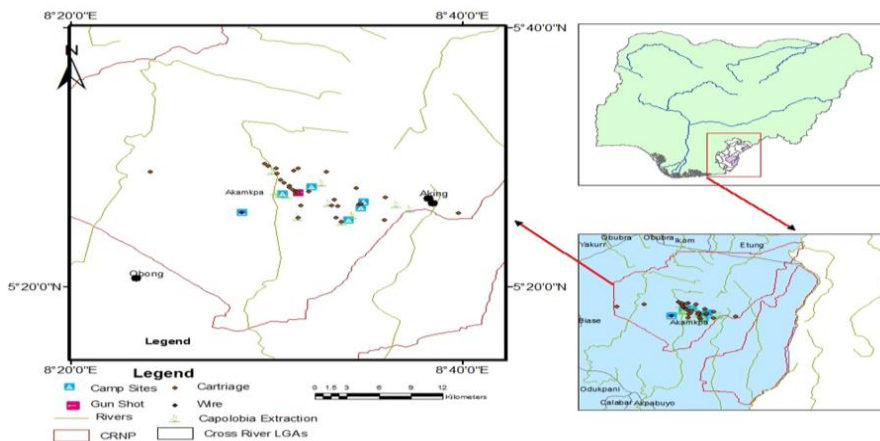
**Results and Discussion**

**Threat indicators in CRNP**

Threats to biodiversity were observed and identified in the park. Poaching indices include spent cartridges, hunters camp, wire traps, fishing camp, capolobia extraction, logging activities and arrest of two loggers (Table 1). The locations with threat indicators in Cross River National Park were presented in Figure 2.

**Table 1.** Indicators of Illegal Activities in CRNP

S/N	Illegal Activities	Frequency
1	Spent Cartridges	33
2	Hunters Camp	2
3	Fishing Camp	4
4	Capolobia Extraction	11
5	Gunshot	1
6	Logging	4
7	Wire Trap	1
8	Poachers Arrest	2



**Fig. 2.** Locations of Illegal Activities in CRNP

This findings is consistent with [8] who identified human encroachment, actual killing of wildlife as the main threats while habitat conversions and harassment are relatively less severe threats in Kenya protected areas.

**Staff Analysis of Poaching Activities in CRNP**

Majority of the staff respondents (80.9%) were male with tertiary education 53.7% while only 1.7% had primary school education and 61.8% have been on the job with CRNP for over 5 years (Table 2). This is an indication that the park staffs were literate and majority have had significant experience over the years they have been on the job. This highlights their level of experience and adequacy in providing relevant information about biodiversity threats and effective mitigation measures in use over the years. Staff analysis of poaching activities in CRNP show that logging (39.2%) was highest ranked threat, followed by hunting (28.0%), farming (12.8%), fishing (7.2%), Non-Timber Forest Product (NTFP) collection (4.8%), illegal entry (4.0%), grazing (2.4%) and mining (1.6%) was the least threat posed to the park (Table 3). This affirms that the park is susceptible to all of these threats, which support the assertion by [9] that persistent conflicts between park management and native inhabitants has always been over issues of encroachment, poaching, harvesting of non-timber forest products amongst others.

Since the designation of Cross River National Park in 1991 until 2015 several poachers' arrests were made [10] as indicated in Figure 3. Two hundred and twenty-two (222) cases of logging, hunting (204), NTPF Collection (170), Farming (34), Water Poisoning (31), and aiding and abetting was the least threat faced within the period (Table 4). This is consistent with [12, 13] in their studies which identified logging, hunting and farming as major threats in CRNP.

**Table 2.** Socio-Demographic Characteristics of Staff Respondents in CRNP

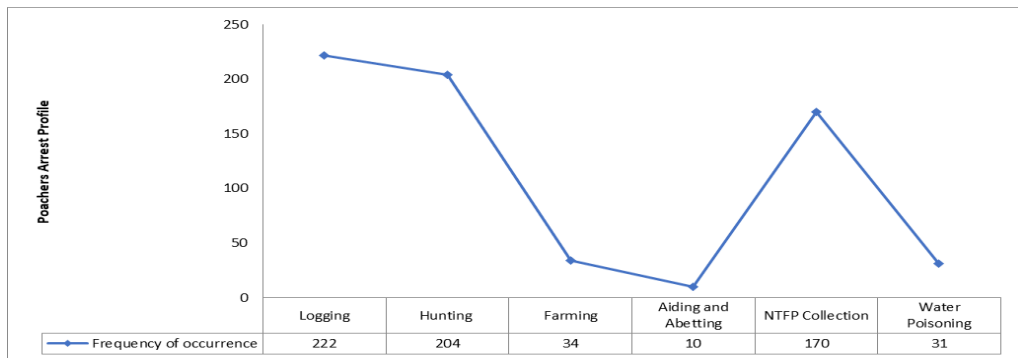
Variable	Frequency	Percentage (%)
<b>Gender</b>		
Male	93	80.9
Female	22	19.1
<b>Academic Qualification</b>		
Primary	2	1.7
SSCE/WAEC	52	44.4
NCE	6	5.1
OND	21	17.9
HND	26	22.2
Bachelor Degree	8	6.8
Master's Degree	2	1.7
<b>Number of Years in Service</b>		
0-5	31	36.8
6-10	55	50.4
11-15	7	8.5
16-20	3	2.9
Above 20	8	1.7

**Table 3.** Biodiversity Threats Identified by Park Staff in CRNP

Threats	Frequency	Percentages (%)
Illegal Entry	5	4.0
Hunting	35	28.0
Fishing	9	7.2
Logging	49	39.2
Mining	2	1.6
Grazing	3	2.4
NTFP Collection	6	4.8
Farming	16	12.8

**Table 4.** Analysis of Poaching Activities in CRNP between 1991-2015

Year	Logging	Hunting	Farming	Aiding and Abetting	NTPF Collection	Water Poisoning	Total
1991	-	-	-	-	-	-	-
1992	-	-	-	-	-	-	-
1993	-	-	-	-	-	-	-
1994	-	1	-	-	-	-	1
1995	-	1	-	-	-	-	1
1996	-	-	-	-	-	-	-
1997	10	3	-	-	3	-	13
1998	-	-	-	-	-	-	-
1999	-	1	-	-	-	-	1
2000	13	-	-	-	2	-	15
2001	7	-	-	-	-	-	7
2002	8	10	-	2	6	-	26
2003	6	6	1	-	28	-	41
2004	11	20	7	3	6	-	47
2005	39	18	-	-	6	-	63
2006	11	6	-	-	1	-	18
2007	14	10	-	-	4	-	28
2008	32	18	-	1	28	-	79
2009	7	12	-	1	6	10	36
2010	10	20	-	-	6	7	43
2011	23	14	18	3	16	1	75
2012	15	21	5	-	21	-	62
2013	6	17	3	-	28	3	57
2014	-	8	-	-	-	6	14
2015	10	18	-	-	9	4	41
Total	222	204	34	10	170	31	671



**Fig. 3.** Trend of Poaching Activities in Cross River National Park from inception (1991) to 2015

**Mitigation measures and its effectiveness**

Various mitigation measures are in use for curbing biodiversity threats in CRNP as revealed in Table 5. The most effective as opined by park staff was anti-poaching patrol with a Weighted Mean (WM) of 32.80, partnership with other conservation organizations (WM = 31.93), employment of community members in park service (WM = 31.87), arrest and penalties (WM = 28.00) were very effective strategies amongst others. However, provision of alternative livelihood (WM = 16.07), provision of basic amenities (WM = 14.27), and buffer zone designation (WM = 12.53) were less effective mitigation measures as their weighted mean were less than the Gross Arithmetic Mean (24.46). Anti-poaching patrol, which is an effective measure, is usually carried out by park protection staff and sometimes in partnership with Wildlife Conservation Society (WCS).

The WCS engaged the CRNP rangers in a routine patrol exercise to conserve wildlife resources in the park especially the primates (Gorilla’s, Chimpanzee’s and the Drills). The rangers are given special allowance to motivate them and the use of cyber tracker and now Spatial Monitoring and Reporting Tool (SMART), to encourage them to engage in the exercise. Also, trans-boundary park patrol is organised occasionally between CRNP and neighbouring Takamanda National Park (TNP) in Cameroun. This partnership was identified by the respondents as one of the effective means employed in CRNP to curb threats. Arrests of poachers was identified as an effective management tool for protecting biological resources in CRNP but has not been able to totally stop poaching activities in Nigeria’s National Parks [14]. Although the respondents also agreed that employment of community members to park service was one of the most effective ways to curb threats in the park, the host communities are consistently making new demands and sometimes make impossible demands. When these demands are not met, households use it as basis to encroach into the park.

Effectiveness of mitigation measures between the park divisions were significantly different ( $t = -3.12, p < 0.05$ ) (Table 6) as the mitigation measures were more effective in Oban division ( $15.25 \pm 1.60$ ) than Okwangwo division ( $9.24 \pm 1.08$ ). This could be attributed to the presence of the park’s head office that is situated in Oban division, as well as concentration of more human density in the surrounding and enclave villages of Okwangwo division, which is the smaller sector of the park. This aggravated the level of threats faced by this division as local people depend on park resources as a means of livelihood for their survival.

**Table 5.** Effectiveness of Biodiversity Threats Mitigation Measures in CRNP

Mitigation Measures	Very Effective	Effective	Unclear	Less Effective	Not Effective	Weighted Mean	Decision (GAM=24.46)	Rank
<b>Boundary Demarcation</b>	17 (14.8)	44 (38.3)	26 (22.6)	25 (21.7)	3 (2.6)	26.13	*	6 <sup>th</sup>
<b>Employment of community members to park service</b>	48 (41.4)	50 (43.1)	6 (5.2)	8 (6.9)	4 (3.4)	31.87	*	3 <sup>rd</sup>
<b>Anti-poaching patrol</b>	43 (37.1)	64 (55.2)	5 (4.3)	2 (1.7)	2 (1.7)	32.80	*	1 <sup>st</sup>
<b>Awareness campaign/conservation education programme</b>	18 (15.4)	44 (37.6)	23 (19.7)	31 (26.5)	1 (0.9)	26.53	*	5 <sup>th</sup>
<b>Arrest and penalties</b>	18 (15.4)	59 (50.4)	17 (14.5)	20 (17.1)	3 (2.6)	28.00	*	4 <sup>th</sup>
<b>Provision of alternative livelihood option to divert dependence on park resources</b>	2 (1.7)	12 (10.3)	16 (13.7)	48 (41.0)	39 (33.3)	16.07	ns	7 <sup>th</sup>
<b>Provision of basic amenities to communities</b>	1 (0.9)	7 (6.0)	11 (9.4)	50 (42.7)	48 (41.0)	14.27	ns	8 <sup>th</sup>
<b>Designation of buffer zone</b>	2 (1.7)	3 (2.6)	14 (12.0)	30 (25.6)	68 (58.1)	12.53	ns	9 <sup>th</sup>
<b>Partnership with other conservation organization in park protection</b>	48 (41.0)	50 (42.7)	5 (4.3)	10 (8.5)	4 (3.4)	31.93	*	2 <sup>nd</sup>

GAM denotes Gross Arithmetic Mean. Value greater than the GAM are accepted and vice versa.

\* signifies that effectiveness of mitigation measure is significant (Weighted mean > GAM) while ns signifies that the effectiveness of mitigation measure is not significant (Weighted mean < GAM)

Note: Values in bracket are percentage values

**Table 6.** Test of Significance in the Effectiveness of Mitigation Measures between the Park Divisions

Parameters/Sector	Values
Oban	15.25±1.60
Okwangwo	9.24±1.08
T value	-3.12
Sig	0.01*

**Constraints to Biodiversity Threat Mitigation Measures in CRNP**

The greatest constraints as perceived by staff (Table 7 and 8) were poor staff motivation with weighted mean (WM = 37.40) and inadequate funding (WM = 37.00). These constraints were buttressed with respondents who opined that the number of park protection staff, means of communication between field and office, and protection equipment were generally inadequate and that anti-poaching patrol is majorly carried out on foot (Fig. 4). However, this situation is not peculiar to CRNP alone as [15] stated that in KLNPN some essential facilities such as walkie-talkie for effective communication with protected area staff is lacking or inadequately supplied while rangers cover several kilometres on foot for patrol exercises and monitoring which limits the area they can cover. This is consistent with the findings of [16] which reported that in Ruaha National Park, Tanzania the area covered by patrols was relatively small compared to the total area of the park. This is due to the low number of rangers and sometimes logistical problems. It reported further that efficient transport and good road system would have increased the total area covered as transport is particularly important because the combined foot and vehicle patrols tend to cover larger areas and proved to be more effective in locating and arresting poachers. This is a valid assertion as it is an arduous task in CRNP to get suspects out of the park when arrests were made. There are instances where rangers are beaten up and suspects freed.

Furthermore, majority of the respondents indicated that there are deficiencies in staff capacity/resources to enforce protected area legislation and regulation (Table 9). This corroborates a study by [17] which reported that many National Parks in Africa had staff that faced serious shortfalls of skills and capacity to effectively perform.

**Table 7.** Constraints to Biodiversity Threat Mitigation Measures in CRNP

Constraints	SA	A	U	D	SD	WM	Decision (GAM=30.57)	Ranking
Inadequate funding	92 (78.6)	21 (17.9)	3 (2.6)	1 (0.9)	0 (0.0)	37.00	*	2 <sup>nd</sup>
Inadequate patrol equipment	73 (62.4)	40 (34.2)	2 (1.7)	2 (1.7)	0 (0.0)	35.67	*	3 <sup>rd</sup>
Inadequate communication gadgets	73 (62.9)	37 (31.9)	4 (3.4)	2 (1.7)	0 (0.0)	35.27	*	4 <sup>th</sup>
Inadequate staff	52 (45.2)	28 (24.3)	15 (13.0)	18 (15.7)	2 (1.7)	30.33	ns	5 <sup>th</sup>
Poor staff motivation (incentive/improved salary)	96 (82.1)	19 (16.2)	1 (0.9)	1 (0.9)	1 (0.9)	37.40	*	1 <sup>st</sup>
Weak support from neighbouring communities	34 (29.3)	38 (32.8)	20 (17.2)	22 (19.0)	2 (1.7)	28.52	ns	6 <sup>th</sup>
The provisions in the constitution are not sufficient to curb threats and protect wildlife/biodiversity	16 (13.9)	18 (15.7)	38 (33.0)	30 (26.1)	13 (11.3)	22.60	ns	9 <sup>th</sup>
Penalties are too lenient to discourage offenders from violating park rules	19 (16.2)	22 (18.8)	36 (30.8)	30 (25.6)	10 (8.5)	24.07	ns	8 <sup>th</sup>
The magistrate courts are too slow with prosecution of offenders	27 (23.3)	19 (16.4)	27 (23.3)	29 (25.0)	14 (12.1)	24.27	ns	7 <sup>th</sup>

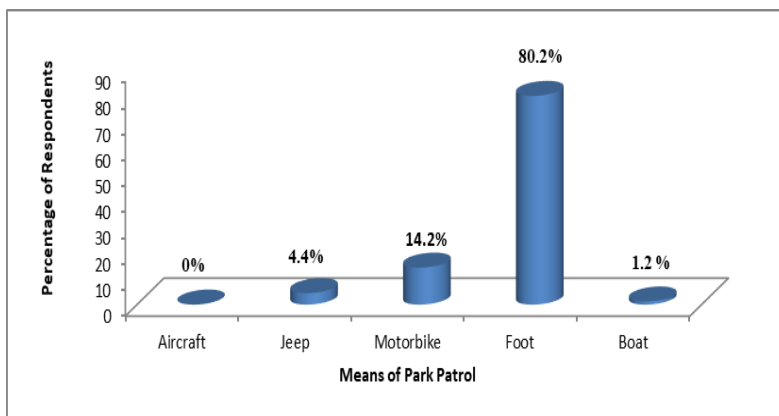
WM denotes Weighted Mean; GAM denotes Gross Arithmetic Mean. Value greater than the GAM are accepted and vice versa.

\* signifies a significant constraint to mitigation measures (Weighted mean > GAM) while ns signifies a non-significant constraint to mitigation measures (Weighted mean < GAM)

Note: Values in bracket are in percentage (%)

**Table 8.** Staff Rating of Park Protection Personnel and Equipment

Perception	Frequency	Percentages (%)
<b>Number of Park Protection Staff</b>		
Adequate	10	8.7
Inadequate	95	82.6
I don't Know	10	8.7
<b>Adequacy of Park Protection Equipment's</b>		
Adequate	11	9.6
Inadequate	100	87.7
I don't Know	3	2.6
<b>Adequacy of Means of Communication between Field and Office</b>		
Adequate	11	9.5
Inadequate	103	88.8
I don't know	2	1.7



**Fig. 4.** Means of park patrol in CRNP

**Table 9.** Rating of staff capacity to Enforce Protected Area Rules

S/N	Can Staff Enforce Protected Area Rules Well Enough?	Rating
1	The staff have no effective capacity/resources to enforce protected areas legislation and regulation	20.4%
2	There are major deficiencies in staff capacity/resources to enforce protected area legislation and regulation	33.3%
3	The staff have acceptable capacity/resources to enforce protected area legislation and regulations but some deficiencies remain	35.2%
4	The staff have excellent capacity/resources to enforce protected area legislation and regulations	11.1%

**Conclusion**

Evidence generated from this study revealed that CRNP has been facing numerous threats like logging, hunting, farming, NTFP collection amongst others. Although there were various threat mitigating strategies in place to combat biodiversity loss in the park, these have not been able to totally stop the poaching activities as deficiencies were observed that limit their effectiveness.

Anti-poaching patrol which was identified as one of the effective mitigation measures was not frequently carried out because of the inadequate logistics and equipment for the



exercise. Also, conservation education, provision of incentives, empowerment programmes were inadequately funded.

For effective conservation of biodiversity to be achieved in this national park, these challenges must be addressed, and prioritization of effective strategies will assist in achieving significant conservation results.

### Acknowledgements

The authors are grateful to the Management of the National Park Service for the approval granted to conduct this research in Cross River National Park, Nigeria. We also thank the Heads and members of the Support Zone Communities visited for their cooperation during the course of the study.

### References

- [1] \* \* \*, **Millennium Ecosystem Assessment, Condition and Trends Working Group, Ecosystems and Human Well-Being: Current State and Trends**, Island, Washington, DC, 2005.
- [2] O.E. Hapciuc, G. Romanescu, I. Minea, M. Iosub, A. Enea, I. Sandu, *Flood Susceptibility Analysis of the Cultural Heritage in the Sucevita Catchment (Romania)*, **International Journal of Conservation Science**, 7(2), 2016, pp. 501-510.
- [3] S.M. Idoga, M.O. Obasi, H.I. Usman, *A review of indigenous methods of soil conservation*, **A Proceeding of the National Conference on Indigenous Knowledge and Development**, 2004, p. 107.
- [4] L. Hannah, G.F. Migdley, D. Miller, *Climate change-integrated conservation strategies*, **Global Ecology and Biogeography**, 11, 2002, pp. 485-495.
- [5] K.A. Abernethy, L. Coad, G. Taylor, M.E. Lee, F. Maisels, *Extent and ecological consequences of hunting in Central African rainforests in the twenty-first century*, **Philosophical Transactions of the Royal Society, B-Biological Sciences**, 368(1625), 2013, Article Number: 20120303, DOI: 10.1098/rstb.2012.0303.
- [6] C.W. Kuuder, E. Bagson, I.O. Aalangdong, *Assessment of Visitor Satisfaction in Mole National Park, Ghana*, **African Journal of Hospitality, Tourism and Leisure**, 2(3), 2013, pp. 1-11.
- [7] M.R.W. Rands, W.M. Adams, L. Bennun, *Biodiversity conservation: challenges beyond 2010*, **Science**, 329, 2010, pp. 1298–130
- [8] \* \* \*, **Report on activities of Cross River National Park from 1991 to 2007**, presented to House of Representative Committee on Environment, *Nigeria National Park Service*. Cross River National Park, 2008, Retrieved 2010-11-05.
- [9] J.W. Kiringe, M.M. Okello, *Threats and their relative severity to wildlife Protected areas in Kenya*, **Applied Ecology and Environmental Research**, 5(2), 2007, pp. 49-62.
- [10] D. Campilan, **A Livelihood Systems Framework for Participatory Agricultural Research: The Case of UPWARD**, 2008, <http://www.idrc.ca/en>.
- [11] \* \* \*, **A Special Brief on Cross River National Park**, Nigeria National Park Service, CRNP, Nigeria, 2015.
- [12] B.O. Adetola, A.O. Adetoro, *Threats to biodiversity in Cross River National Park, Nigeria*. **International Journal of Conservation Science**, 5(4), 2014, pp. 547-552.
- [13] H.M. Ijeomah, D. Ogbara, *Challenges of Wildlife Management in Kainji Lake National Park, Nigeria*. **Nigerian Journal of Agriculture, Food and Environment**, 9(1), 2013, pp. 1-8.

- [14] A.J. Meduna, A.A. Ogunjinmi, S.A. Onadeko, *Biodiversity conservation problems and their implications on ecotourism in Kainji Lake National Park, Nigeria*, **Journal of Sustainable Development in Africa**, **10**(4), 2009, pp. 59-73.
- [15] H.M. Ijeomah, E. Eniang, S.K. Halidu, A.N. Onyejekwe, *Forms and Trends of Encroachments in Cross River National Park of Nigeria*, **International Journal of Biology**, **7**(3), 2015, pp. 103 – 114.
- [16] C.L. Nahanyo, *Assessment of anti poaching effort in Ruaha National Park, Tanzania*, **Ecological Monitoring and Research Monthly Report**. Sept 2002, Department of Zoology and Wildlife Conservation. University of Dar es Salaam, TanzaniaNgorongoro Conservation Area Authority (NCAA), Arusha, Tanzania, 2002.
- [17] N. Dudley, A. Belokurov, O. Borodin, L. Higgins-Zogib, M.L. Hockings, S. Stolton, **Are Protected Areas Working? An Analysis of Forest Protected Areas**, WWF International, Gland, Switzerland, 2004.
- 

*Received: April 9, 2020*

*Accepted: January 10, 2021*