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Assessing the Sustainability of *Thryonomys swinderianus* Hunting in Ogoni Land

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: *Thryonomys swinderianus* is a renewable natural resource and is a major mammal that constitute what is termed bushmeat in Ogoni land. Between July 2017 and June 2018, 10320Kg of *Thryonomys swinderianus* meat or 2580 animals were obtained from the wild by hunting. The number of animals removed compared to its population as at June 2017 prompted this study.
Aim: The aim of the study is to ascertain the sustainability of this level of harvest in Ogoni land.
Methods: The Robinson and Redford model of 1991 was used to assess the sustainability of this harvest in this study. The maximum possible production of *Thryonomys swinderianus* from July 2017 to June 2018 was 3.5/Km^2 and the proportion of this production to be harvested sustainably is 2.1/Km^2 or 8.4Kg/Km^2. The actual harvest within this period was 2.58/Km^2 or 10.32Kg/Km^2.
Results: The actual harvest of 2.58/Km^2 is greater than the maximum sustainable yield of 2.1/Km^2 and as such, the harvest of 2.58 *Thryonomys swinderianus* per square kilometer per year is not sustainable in Ogoni land.
Conclusion: The unsustainable harvest of *Thryonomys swinderianus* should as a matter of urgent concern be monitored and regulated. Continuation of this rate of removal will diminish the renewal rate and lead to the extinction of *Thryonomys swinderianus* in the near future.

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Keywords: Thryonomys swinderianus; maximum production; actual harvest; sustainable yield; Ogoni land.

1. INTRODUCTION

Wild mammals are an integral component of the ecosystem that contribute to ecosystem functions which provide unquantifiable goods and services necessary for mankind's survival [1]. The use of wildlife by humans fall into several categories: consumption, trophy, sports, income, tourism, scientific study, conflict resolution or vengeance. Mammals from the wild have for long been associated with human food chain and a food source in most parts of the world [2,3]. They are considered the exclusive of food, fiber, fuel and medicine for the first 99% of human history and till date still contribute significantly to the welfare of society [1]. Wildlife make an important contribution to rural economics by generating jobs, income and profit from food and sporting enterprises coupled with pleasure experience from viewing and learning [4]. According to Wilson et al. [3], the hunting of wild mammals primarily for sports is a multibillion dollar enterprise. Although humans have gained economic value from wild mammals through nutrition, trade and tourism, they can also have detrimental effect on human food chain through competition, predation and disease transmission [2,1].

The use of any non-domesticated terrestrial mammal, bird, reptile and amphibian for food by humans is bushmeat consumption [5]. *Thryonomys swinderianus* is a major mammal that constitute what is termed " bushmeat" in Ogoni land. *Thryonomys swinderianus* is hunted and exploited as an important source of animal protein and food throughout their range [6,7]. It is one of the most preferred meat in Africa and can be more expensive than lamb, chicken, beef or pork partly due to it's protein nature superseding chicken, rabbit and guinea pig and lower fat than pork, beef and lamb [8,7]. It is a steady and prominent source of alternative dietary animal protein in many rural areas of Nigeria and other West African countries [9]. In one African market alone, about 200,000 kilograms of *Thryonomys swinderianus* meat worth $220,000 US dollars was sold in a given year [10]. It contributes to both local and export earnings as 73 tons of *Thryonomys swinderianus* can be sold in a year at the local market [8, 6].

Animal distribution and human activities are interrelated in socio-ecological systems but most human-mammal interactions are detrimental to wild mammals [11, 1]. Terrestrial mammals are experiencing a massive collapse in their population and geographical ranges around the world [12], humanity wiping out as much 60% of mammals, birds, fishes and reptiles since 1970 [13]. According to Pariona 2018, the major causes of wildlife population decline include exploitation 37%, habitat degradation/change 31.4%, habitat loss 13.4%, climate change 7.1%, invasive species/genes 5.1%, pollution 4% and disease 2%. Hunting either for food and medicinal products is by far the greatest immediate threat to the survival of most endangered vertebrates, driving global crisis whereby 301 terrestrial mammalian species are threatened with extinction [14, 12].

Hunting, which is an important component of native subsistence strategies, is a major driver of biodiversity loss currently influencing the extinction of numerous species [15,16,17]. On the average, hunting leads to 83% reduction in mammalian populations within 25 miles of hunter access points [18]. Harvest of wildlife for human consumption is a major threat to global biodiversity and to the livelihoods that depends on it for food and incomes [19]. According to Lindsey *et al*., 2013, the key drivers of wildlife loss include 1. increase demand for bushmeat 2. lack of clear rights regarding lands & wildlife 3. inadequate legal protection for wildlife, inadequate enforcement and penal systems 4. poverty and food insecurity as well as 5. political instability. In Africa, overhunting of wildlife for food is however an intractable issue [20].

Although wildlife is said to be a renewable resource whose regenerative capacity allows for some level of harvest, it is sustainable when harvest does not exceed production [19]. In Ogoni land, all consumed *Thryonomys swinderianus* is gotten from the wild since there is no place where this animal is reared save at Kenule Beeson Saro-Wiwa polytechnic for studies. According to National Research Council 1991, more than 15,000 *Thryonomys swinderianus* can be sold at local markets in a given year. In 2016, African Union Interafrican Bureau of Animal Research said that 80 million *Thryonomys swinderianus* are harvested annually in West African. Ogoni land is in West African and the concern is whether the amount of *Thryonomys swinderianus* harvested is

sustainable. This concern about sustainability of harvest has prompted this research. This research seek to ascertain if the quantity of animals harvested from the wild is naturally renewable to sustain the harvest rate continually.

2. METHODS

2.1 Study Area

Ogoni land is located in the southeastern part of the lower Niger Delta within the coastal and rainforest belt [21,22,23]. It covers an area of 1000 – 1050 square kilometers and lie between longitude 7°2'00"E and 7°18'30"E and latitude 4°18'30"N and 4°31'00"N [24,22]. Like the rest of the regions in the Niger Delta, Ogoni land experience two seasons; rainy and dry season; rain distribution ranging from 2000 – 3000 mm per annum with an average temperature of 27°C to 35°C [25,26]. The vegetation of Ogoni land is characterized by mangrove swamp forest and rich rainforest [21,22]. Ogoni land is administratively divided into four Local Government Areas (LGAs); Khana, Gokana, Tai and Eleme (Fig. 1).

There is no special hunting season in Ogoni land (Fig. 2 shows hunted animal), hunting is done year round by hunters. In Ogoni land, there is also no place where *Thryonomys swinderianus* is commercially reared.

2.2 Model

The Robinson and Redford model [27] was employed in this study. The model first calculates maximum production (no. of animals/Km²). The formula for calculating maximum production (Pmax) is

$$P_{max} = (0.6D \times \lambda_{max}) - 0.6D \quad (1)$$

Where P_{max} is maximum production; D is predicted density or site specific density and λmax is maximum finite rate of increase.

Equation 1 is also represented as

$P_{max} = (0.6K \times \lambda_{max}) - 0.6K$ or
$P_{max} = (\lambda_{max} - 1)0.6K$

Where K is density at carrying capacity.

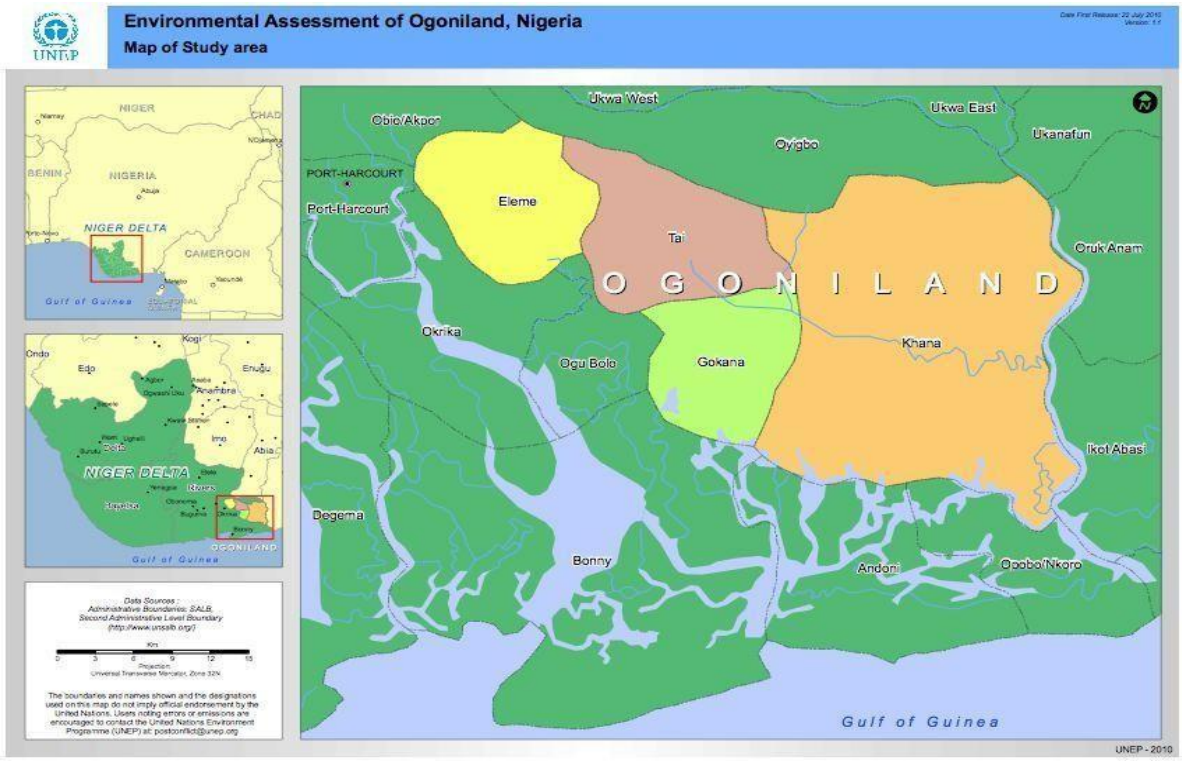

Fig. 1. Ogoni Land Showing LGAs. (prospering.weebly.com; retrieved 13/10/2020)

Fig. 2. Hunted *Thryonomys* swinderianus in Ogoni Land

The model also calculated potential harvest (maximum sustainable yield) (no. of animals/Km²). To calculate maximum sustainable yield, effective rate of population growth (λ_{RR}) is first calculated using equation two

$$\lambda_{RR} = 1 + (\lambda_{max} - 1)FRR \quad (2)$$

Where λ_{RR} is Effective rate of population growth; FRR is mortality factor and is 0.2 for long-lived species, 0.4 for short-lived species and 0.6 for very short-lived species.

The effective rate of population growth (λ_{RR}) is then used to calculate maximum sustainable yield (PRR) using equation three

$$P_{RR} = (\lambda_{RR} - 1)0.6K \quad (3)$$

Each of the outcomes of the several calculations can be expressed in life weights by multiplying the outcome with the weight of the animal in kilograms [27].

The Robinson and Redford model [27] provide a first assessment of hunting impact on wildlife population; suggest estimating sustainability of a harvest by calculating maximum possible production and its yield and then comparing this to the actual harvest [27], (Robinson, 1999). The model evaluates whether an actual harvest is not sustainable (Robinson, 1999). Any harvest greater than the potential sustainable harvest is almost certainly not sustainable [28].

The Robinson and Redford model [27] has several assumptions: i. R_{max} is achieved at 0.6K; ii. R_{max} can be achieved in game population; iii. Hunted populations can be managed so that they remain at or near 0.6K; iv. That the proportion of production that can go into yield is 60% for very short-lived species, 40% of short-lived species and 20% for long-lived species [27, 28]. These assumptions are however not conservative [28]. The Robinson and Redford model [27] has since been greeted with certain criticisms. These include: the model did not consider survival rates but mortality factors that highly simplifies survival rates, it assumes that no mortality of juveniles and adults occur up to the age of last parturition and uses Rmax instead of the actual population growth all of which lead to the overestimation of production [29,30].

Despite the shortcomings of the model, it is the most used model in similar sustainability studies. It is a simple model to be used in the absence of detailed information concerning a population to provide estimates of sustainability. Irrespective of the model used, a one time determination of sustainability does not allow the conclusion that harvest will continue to be sustainable [28].

2.3 Data

The following data i. number of *Thryonomys swinderianus* caught from July 2017 to June 2018 (Fig. 3) and ii. The population of *Thryonomys swinderianus* before July 2017 (that is June 2017) was gotten from Opuogulaya et al. [31].

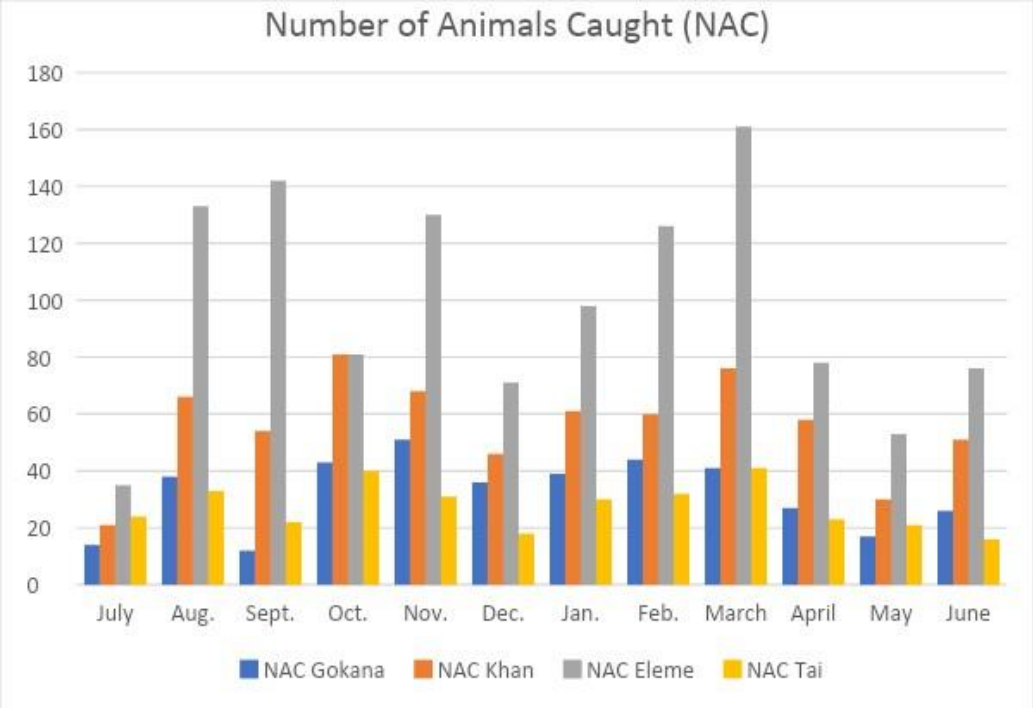

Fig. 3. Number of *Thryonomys swinderianus* caught in Ogoni Land

The total number of *Thryonomys swinderianus* caught from July 2017 to 2018 was 2580.

The population of *Thryonomys swinderianus* as at June 2017 was 6020.

2.4 Analysis

Ogoni land covers an area of approximately 1000 square Kilometers.

The number of animals caught from July 2017 to June 2018 was 2580.

Average lifespan of *Thryonomys swinderianus* is 4 years [10,32] so its FRR is 0.6.

Weight of *Thryonomys swinderianus* is between 2Kg and 7Kg, males weighing more than females [33,32].

Average weight taken in this study is 4Kg.

Intrinsic rate of natural increase of *Thryonomys swinderianus* is 0.68 [34]; its maximum finite rate of increase is 1.97.

Total meat of *Thryonomys swinderianus* obtained from the wild from July 2017 to June 2018 was 10320 Kg.

Observed population density of *Thryonomys swinderianus* as at June 2017 = 6020 ÷ 1000 = 6.02/Km².

Number of animals harvested = 2580 ÷ 1000 = 2.58/Km² or 10.32Kg/Km² in biomass.

Maximum production of *Thryonomys swinderianus* (for which observed density is used in this study like Fa et al. [35]:

$$P_{max} = (1.97 - 1)0.6 \times 6.02 = 3.5/Km^2.$$

Effective rate of population growth λ_{RR}:

$$\lambda_{RR} = 1 + (1.97 - 1) \times 0.6 = 1.582.$$

Maximum sustainable yield

$$P_{RR} = (1.582 - 1)0.6 \times 6.02 = 2.1/Km^2 \text{ or } 8.4Kg/Km^2.$$

3. RESULTS

In the 1000 square kilometers Ogoni land, 2580 *Thryonomys swinderianus* was removed from the wild from July 2017 to June 2018 the biomass of which is 10320Kg. The observed population density of *Thryonomys swinderianus* as at June 2017 was 6.02/Km². The maximum possible production of *Thryonomys swinderianus* from

July 2017 to June 2018 was 3.5/Km² of which 2.1/Km² or 8.4Kg/Km² is the maximum sustainable yield. The actual harvest of *Thryonomys swinderianus* is 2.58/Km² or 10.32Kg/Km². According to Robinson and Redford model [27], an actual harvest is not sustainable when it exceed the maximum sustainable yield.

4. DISCUSSION

Wildlife is a renewable resource whose regenerative capacity allows for some level of harvest. Removal is however sustainable when harvest does not exceed production according to Weinbaum et al. [19]. If harvest takes away all production and this continues, the population naturally will continue to experience decline and probably go into local extinction. For a population to continue, only a proportion of the production should be harvested. If the proportion of the production to be harvested is exceeded, the population is not likely to be viable.

A total of 10320Kg of *Thryonomys swinderianus* biomass was obtained from the wild between July 2017 and June 2018 in Ogoni *land. Thryonomys swinderianus* is primarily used for consumption and studies at KenuleBeeson Saro-Wiwa polytechnic. Without apportioning percentages of use, consumption of *Thryonomys swinderianus* is the dominant form of use in Ogoni land. The understudied species are obtained from the wild through hunting. Although hunting is an important component of native strategies, it leads to 83% reduction in mammalian population within 25 miles of hunter access point and is the greatest immediate threat to the survival of most vertebrates according to Alvard et al. [15]; Milner-Gulland and Bennett, [16]; Harrison et al. [14] Ripple et al. [12] Benitez-Lopez et al. [36] and Worland, [18]. For most hunters in Ogoni land, hunting is their livelihood and will hunt with near constant enthusiasm since their needs are always before and motivating them. Ogoni hunters are responsible for the harvest of *Thryonomys swinderianus* and the consequences associated with these actionns.

The maximum production of *Thryonomys swinderianus* in the 1000Km² of Ogoni land with a density of 6.02/Km² is 3.5/Km² of which the maximum yield that will make the harvest sustainable is 2.1/Km² or 8.4Kg/Km². The actual harvest of *Thryonomys swinderianus* within this period is 2.58/Km² or 10.32Kg/Km². Actual harvest is more than the maximum sustainable yield:

2.58 > 2.1 or 10.32Kg/Km² > 8.4Kg/Km². According to Robinson and Bodmer [27], any harvest greater than the potential sustainable harvest is almost certainly not sustainable. The harvest of *Thryonomys swinderianus*, where 2.58 animals or 10.32Kg of its biomass is harvested per kilometer is not sustainable.

According to NRC [8], Addo [6] and AUIBAR [7], *Thryonomys swinderianus* is hunted and exploited in their range; 150000 can be sold on local markets a year with an estimated 80 million animals harvested annually in West African: the findings of the study finds a comfortable placement in these statements. If overestimation of production by the Robinson and Redford model is held strong, then the population status of *Thryonomys swinderianus* and the impact of hunting on it's population is more dare than what is presented here: IUCN should urgently revisit it's categorization of *Thryonomys swinderianus* in Ogoni land.

5. CONCLUSION

The observed population density of *Thryonomys swinderianus* in a 1000 square kilometers Ogoni land as at June 2017 was 6.02/Km²; the population being 6020. From this population, 2580 was taken between July 2017 and June 2018. All these animals were removed from the wild by hunting. Hunting is an important means of survival for most hunters in Ogoni land and whereas hunting can not be stopped, measures need to be put in place to check it's implications on biodiversity other ecological processes.

The calculated harvest of *Thryonomys swinderianus* from July 2017 to June 2018 is 2.58/Km² or 10.32Kg/Km² translating into 10320Kg of biomass within the period. The maximum possible production of *Thryonomys swinderianus* is 3.5/Km² and the proportion of the production to be harvested sustainably is 2.1/Km² or 8.4Kg/Km². The actual harvest of 2.58/Km² is found to be greater than the maximum sustainable yield of 2.1/Km² as such, the harvest of 2.58 animals per square kilometer per year in Ogoni land is not sustainable.

All that use *Thryonomys swinderianus* in Ogoni land should be concerned about how quickly this "renewable natural resource" is being removed for use; if this removal rate is not checked, the rate of removal will exhaust the rate of renewal

and there may be no more *Thryonomys swinderianus* for use in the near future.

Locals should encourage themselves into rearing this 'their dear animal' so as to continue it's availability at home and preserve those in the wild. Since there are no regulations on wildlife hunting, hunters associations in Ogoni land should place a barn on the catch of *Thryonomys swinderianus* less than 3.5Kg. Authorities of the local government should encourage the rearing of this animal by providing subsidies and lucrative incentives for those that go into rearing.

CONSENT

It is not applicable.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Boesch L, Mundry R, Kuehl H, Berger R. Wild Mammals as Economic Goods and Implications for their Conservation. Ecology and Society. 2017;22(4):36-45.
2. White PCL, Lowe P. Wild mammals and the human food chain. Mammal Review. 2008;38(1-2):117-122.
3. Wilson DE, Jones JK, Armstrong DM. Mammal. Encyclopedia Britannica; 2016. Accessed September 15, 2020. Available:https://www.britannica.com/animal/mammal
4. Macmillan DC, Phillip S. Consumptive and Non-consumptive Values of Wild Mammals in Britain. Mammal Review. 2008;38(1-2):189-204.
5. Vliet N, Nasi R. Why Do Models Fail to assess properly the sustainability of duiker (*Cephalophus spp*.) Hunting In Central Africa? Oryx. 2008;42:392–399.
6. Addo PA. Detection of Mating, Pregnancy and imminent parturition in the grasscutter (*Thryonomys swinderianus*). Livestock Resources and Rural Development. 2002;14:8-13.
7. African Union Interafrican Bureau for Animal Resources (AU-IBAR). Grasscutter: *Thryonomys swinde*rianus; 2016. Accessed August 18 2020. Available:http://www.au-ibar.org/2012-10-01-13-08-42/features/421-series/know-your-a nimals/1045-grasscutter-thryonomys-swinderianus
8. National Research Council. Microlivestock: Little Known Small Animals with a Promising Economic Future. Washington DC: The National Academic Press Pg. 1991;147-155.
9. Ogunsanmi AO, Ozegbe PC, Ogunjobi D, Taiwo VO, Adu JO. Haematology, plasma Biochemistry and Whole Blood Minerals of The Captive Adult African Grasscutter (*Thryonomys Swinderianus*, Temminck). Tropical Veterinarian. 2002;20:27-35.
10. Gochis E. Thryonomys swinderianus, Animal Diversity Web; 2002. Accessed September 4 2020. Available:http://animaldiversity.org
11. Happold DCD. The interactions between humans and mammals in Africa in relation to conservation: A Review. Biodiversity and Conservation. 1995;4(4):395-414.
12. Ripple WJ, Abernethy K, Betts MG, Guillaume C, Dirzo R, Galetti M, et al. Bushmeat hunting and extinction risk to the world's mammals. Royal Society Open Science. 2016;160498.
13. Carrington D. Humanity Wiping Out as Much as 60% of Mammals,Birds, Fishes and Reptiles Since 1970. The Guardian; 2018. Accessed August 18 2020. Available:https://www.theguardian.com/environment/2018/oct/30/humanity-wiped-out-a nimals-since-1970-major-report-finds
14. Harrison RD, Sreekar R, Brodie JF, Brook S, Luskin M, O'Kelly H, et al. Impacts of hunting on tropical forests in Southeast Asia. Conservation Biology. 2016;30(5):972-981.
15. Alvard MS, Robinson JG, Redford KH, Kaplan H. The Sustainability of subsistence hunting in the neotropics. Conservation Biology. 1997;11:977–982.
16. Milner-Gulland EJ, Bennett EL. Wild Meat: The bigger picture. Trends in Ecology & Evolution. 2003;18:351–357.
17. López A, Alkemade R, Schipper AM, Ingram DJ, Verweij PA, Eikelboom JAJ, Huijbregts MAJ. The Impact of Hunting on Tropical Mammal and Bird Populations. Science. 2017;356(6334):180-183.

18. Worland J. Research shows just how much hunting reduces animal populations. Time; 2017.
Accessed September 4, 2020.
Available:http://time.com/4736526/hunting-reduces-animal-populations/
19. Weinbaum KZ, Brashares JS, Golden CD, Wayne M, Getz WM. Searching for sustainability: Are assessments of wildlife harvests behind time? Ecology Letters. 2013;16(1):99–111.
20. Wilkie DS, Wieland M, Boulet H, Le Bel S, van Vliet N, Cornelis D, et al. Eating and Conserving Bushmeat in Africa. African Journal of Ecology. 2016;54(4): 402-414.
21. Amanyie V. The Agony of the Ogoni in the Niger Delta: A Case Study. Horizon Concept. 2001;19-37.
22. Okon IE, Ogba CO. The impact of crude oil exploitation on soil in some parts of Ogoni Region, Rivers State Southern Nigeria. Open Access Library Journal. 2018;5: e4297.
Available:https://doi.org/10.4236/oalib.1104297
23. Unrepresented Nation and Peoples Organization. Ogoni Land; 2017.
Accessed March 11, 2019.
Available:unpo.org/member/7901
24. United Nations Environmental Program. About Ogoni Land; 2016.
Accessed September 12 2020.
Available:www.unep.org/disasterandconflicts/where-we-work/Nigeria/what-we-do/about -ogoniland
25. Peter KD, Ayolagha GA. Effect of remediation on growth parameters, grain and dry matter yield of soybean (*Glycine max*) in Crude Oil Polluted Soils in Ogoni Land, South Eastern Nigeria. Asian Journal of Crop Science. 2012;14:113-121.
26. Tanee FBG, Albert E. Reconnaissance assessment of long-term effects of crude oil spill on soil chemical properties and plant composition at Kwawa, Ogoni Nigeria. Journal of Environmental Science and Technology. 2015;8:320-329.
27. Robinson JG, Redford KH. Sustainable harvest of neotropical forest mammals. University Of Chicago Press; Chicago. 1991;415–429.
28. Robinson JG, Bodmer RE. Towards wildlife management in tropical forests. Journal of Wildlife Management. 1994;63:1–13.
29. Slade NA, Gomulkiewicz R, Alexander HM. Alternatives to robinson and redford's method of assessing overharvest from incomplete demographic data. Conservation Biology. 1998;12:148–155.
30. Milner-Gulland EJ, Akçakaya HR. Sustainability Indices for Exploited Populations. Trends in Ecology & Evolution. 2001;16(12):686-692.
31. Opuogulaya R, Ekiyor TH, Aisuene F. Ecology of *Thryonomys swinderianus* in Ogoni Land. International Journal of Scientific and Technological Research. 2019;5(4):90-97.
32. Opara MN. The Grasscutter 1: A livestock of tomorrow. Research Journal of Forestry. 2010;4(3):119-135.
33. Agriculture Nigeria. Grasscutter; 2014.
Accessed August 19, 2020.
Available:www.agriculturenigeria.com/farming-production/livestock/grasscutter
34. Davies G, Brown D. Bushmeat and livelihood: wildlife management and poverty reduction. John Wiley & Sons. 2008;294-296.
35. Fa JB, Javier Juste J, Del Val JP, Castroviejot J. Impact of Market Hunting on Mammal Species in Equatorial Guinea. Conservation Biology. 1995;9(5):1105-1115.
36. Benítez-López A, Alkemade R, Schipper AM, Ingram DJ, Verweij PA, Eikelboom JAJ, Huijbregts MAJ. The impact of hunting on tropical mammal and bird populations. Science. 2017;356(6334): 180-183.

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