HABITAT AND THREATS TO THE ARBOREAL PANGOLIN POPULATION (*PHATAGINUS TRICUSPIS*) IN THE MONT KOUFFÉ PROTECTED FOREST (BENIN)

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ABSTRACT

In Benin, due to habitat disturbance due to strong anthropogenic pressure, some pholidote species have become vulnerable or even threatened, as is the case with tree pangolins. Thus, the problem of wildlife conservation, especially that of pholidotes, becomes worrying. The overall objective of the study is to determine the preferred habitats and threats to the tree pangolin population in the Monts Kouffé protected forest.

The method used to collect biogeographical data is based on surveys followed by forest surveys and interviews with the local population. Thus, clues of the presence of *Phataginus tricuspis* (smell of the animal, tree cavities, claws of the animal against trees in savannah, open forest, dense dry forest and gallery forest in the hunting areas of Manigri Ikanni, Manigri Oké, and Agbassa) were sought and this through excavations in the savannahs. The Menly Alpha Habitat Preference Index was calculated to determine the habitat preference of the tree pangolin and the frequency of threat observations on this animal population. The species frequents open forests, gallery forests, dense-dry forests, wooded savannahs, shrub savannahs. But nevertheless, it has a strong preference for dense dry forests with the Menly alpha index equal to 0.8. The decline of the species' populations is facilitated by several factors that constitute direct or indirect threats affecting the distribution of the species. These threats are: deforestation (49.05%), illegal hunting (22.64%), human occupations (13.20%), transhumance (7.54%) and wildland fires (7.54%).

Keywords: Mammal, threat, pangolin, Mont Kouffé, Bassila

1. INTRODUCTION

Wildlife is a heritage to be passed on to future generations (Fichant, 2011). It is one of the most valuable, exploited and threatened resources (Boulweydou, 2008).

Indeed, most studies conducted on fauna in Benin are of a general nature, integrating several orders of mammals (case of counts and monitoring), or address the study of a few specific orders according to their importance, their usefulness or according to the urgency of conservation according to IUCN criteria. The focus is generally on large fauna (Di Silvestre, 2004; Sogbohossou, 2006), which considerably reduces knowledge about the small, which, as a result, is not specifically integrated into management plans (Mouzoun, 2014).

The pangolin belongs to the order of pholidotes. They form an order of mammals that includes several families, only one of which is not extinct but is decimated, that of the pangolins (IFAW, 2017). The pangolin is a species fully protected by Law No. 2002-16 of 18 October 2004 on the fauna regime in the Republic of Benin. Since 2017, the pangolin has become the most poached mammal in the world (IFAW, 2017). Thirty-one thousand (31,000) kg of pangolin scale have been seized worldwide according to the International Fund for Animal Welfare (IFAW, 2017).

All african pangolin species are threatened by hunting for local markets (Waterman *et al.* 2014a, b, c; Pietersen *et al.*, 2014).

Three species of pangolins are present in West Africa where it is estimated that 80% of the original forest has been converted to an agricultural mosaic, representing an estimated loss of 10 million hectares of forest in the twentieth century (Norris *et al.*, 2015).

Little is known about the ecology or behavior of pangolin species. However, based on the available data, pangolins are very vulnerable to overexploitation due to their low reproductive rate (1 pup per year, and 2 pups on rare occasions). Manis temminckii is the best studied of all African species, yet little is known about the biology of this species in the wild (Pietersen *et al.* 2014b).

Africa has one of the highest rates of primary forest loss in the world (FAO 2010), and deforestation is considered an additional factor in the decline of pangolin populations especially in the western and central parts of the continent.

The Nigerian Management Authority noted that pangolins have almost completely disappeared from the habitat of the savannah and other northern parts of Nigeria (E. Ehi-Ebewele, Deputy Director, Federal Dept. of Forestry, Nigeria, pers. comm. February 2016).

According to Gorgen *et al.*, 1996, poaching, extensive agriculture, extensive and uncontrolled urbanization of certain regions, forestry and mining cause the scarcity of wildlife that was once one of the most important sources of protein for people in sub-Saharan Africa.

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In the Classified Forest of Monts Kouffé (FCMK), *Phataginus tricuspis* went from 8 individuals on an area of 28,000 ha (Maniri Ikanni hunting area) in 2016 to 5 individuals on an area of 75,000 ha (Manigri Oké, Manigri Ikanni and Agbassa hunting area) in 2018 (Dotché, 2018). This reduction in the number of *Phataginus tricuspis* is due to habitat loss, uncontrolled grazing and poaching. In this area, wildlife conservation is less important (PAMF, 2006). Hunting is not controlled. The most vulnerable and useful animals are the most exposed to poaching (Dotché, 2016).

The FCMK, a densely forested area, was rich in mammals (Sayer *et al.* 1984). But in the face of the economic crisis, the exploitation and marketing of wood is a very fruitful alternative for the local population. Thus, despite the existence of a management plan, the FCMK is subject to strong pressures from slash-and-burn agriculture, uncontrolled logging, uncontrolled grazing and poaching. These anthropogenic activities have negative effects on flora and fauna.

Hence the present study focuses on "the habitat of the arboreal pangolin and the threats to the species in the classified forest of Monts-Kouffé".

1.1 Geographical location of the FCMK

The FCMK lies between the parallels 8° 30` 11.4`` and 8° 51` 39; 47.4`` north latitude and the meridians 1° 38` 09.3`` and 2° 16` 23.3`` east longitude. It is bounded to the north by the classified forest of Wari-Maro and the Odola River, to the east by the Ouémé River, to the west and south by the Adjiro River. Figure 1 shows its location.
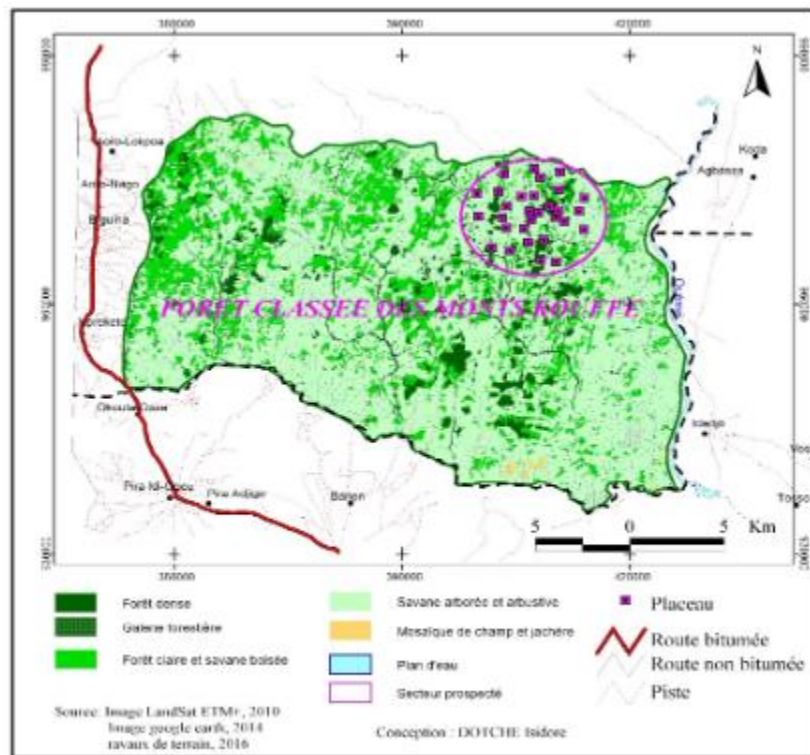
Figure 1: Location of the classified forest of the Kouffé Mountains

1.2 Biophysical and human aspects of the study environment

The climate of the environment is Sudano-Guinean, characterized by two main seasons: a rainy season Precipitation, evapotranspiration and temperature are elements of the climate that influence the fauna of this classified forest.

In the classified forest of the Monts Kouffé, three types of soil are distinguished: sandy or sandy-loamy ferruginous soils with gravel load with a very modest forest potential (55%); red-brown or rust-brown ferralitics with low or medium quench thirst with gravel load, clayey at depth (25%); hydromorphic soils with low humiferous Gley or pseudogley, with marked horizontal differentiation, at useful depth sometimes limited by a lateritic shell (20%). These soils have very diverse textures. Their forest potential is generally considered good (PRRF, 2001).

2. METHODOLOGICAL APPROACH

The methodological approach is necessary in order to better guide the investigations. It presents the data used, the methodological approaches adopted including the main stages of data

collection (documentation, field surveys), their processing, and the analysis of the results. The data used are demographic, biogeographical, cartographic, satellite and ethnozoologiques.

Several materials contributed to the collection of data, the interview guide, the questionnaire, as well as tools such as GPS, penta-decameter.

2.1 Habitat Determination Methodology in the FCMK

In order to study the habitat of the species in the FCMK, forest surveys have identified its presence in the different plant formations (dense-dry forest, open forest and wooded savannah, wooded savannah, shrub savannah, degraded forest of the FCMK).

The study of the relationships between the presence of the tree pangolin and its habitat was carried out using the stations (plots) installed. Fifty-five (55) sites (plots) were used in the analysis with fairly global descriptive variables.

2.2 Determination of the distribution area of pangolin in the FCMK.

The surveys were made between 10 p.m. and 5 a.m. The following data were collected the dendrometric measurements (dbh and height of woody trees in the plot) were collected: species footprints, soil types, altitude, types of plant formations where these indices were found. These different data were systematically georeferenced by means of a GPS (Gobal Positioning System). The identification of the prints was done with the support of the guides.

✓ **Vegetation sampling**

The FCMK has an area of 2010 km² or 273,000 ha. It is subdivided into 11 hunting areas. The work was carried out in the hunting areas on the Bassila side. Fifty-five (55) plots spread over the hunting areas of the reserve on the Bassila side. These are the hunting areas of Manigri Oké (25,000 ha), the hunting area of Manigri Ikani (28,436 ha), the hunting area of Agbassa-Olougbé (14,150 ha).

The collection of information was carried out within a plot of 30 m radius (2826 m2), the diameter at chest height (dbh) of the trees, the height of the trees was noted. Contact with the species as well as evidence of presence were noted. The distance from the point of the presence index to the nearest watercourse was noted. At the scale of the plot, the closure of the vegetation cover as well as the ecological type were visually assessed. The presence of particular abiotic characteristics is also specified (passage of a watercourse, wetland).

❖ **Real-world investigation methods:**

Due to the nocturnal and discreet habits of the animal and their limited period of activity, it is more effective to locate pangolin populations using presence cues such as: two-cavity trees, claws of the animal on trees, the smell of pangolin in termite mounds and in the hollows of trees as well as direct observation of the pangolin. Scales charred by wildland fires have also been observed in the reserve.

❖ **Identification of habitat types frequented by the species in the FCMK**

The preferred habitats of the species are defined by calculating the percentage of observation of presence indices according to the different habitat types such as savannahs (shrubs, trees), gallery forests, open forests and dense-dry forests using the full data (GPS coordinates). The data are processed for the purpose of determining the frequency of occurrence and the preference index.

Frequency of occurrence of a species (Damnergie, 2008)

It is the ratio expressed as a percentage of the number of samples in which this species is recorded to the total number of samples taken (Damerdji 2008).

Its expression is as follows:

$$F = Pa /P * 100$$

3. Results

3.1 Habitat of *Phataginus tricuspis* in the of Monts Kouffé protected forest

3.1.1 Types of habitats frequented

The distribution of observations by habitat type showed the presence of *Phataginus tricuspis* by direct and indirect contact in wooded savannas (26.41%), shrub savannas (49.05%), open forests (11.32%) forest galleries (05%) and degraded dry dense forests (3.77%). Figure 5 shows the proportions of plant formations frequented by the species.
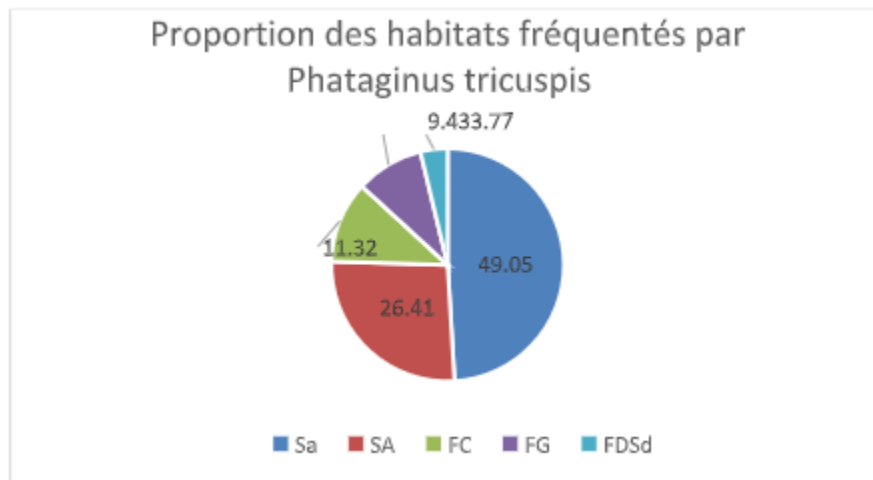
Figure 5: Proportion of habitats frequented by *Phataginus tricuspis* in the FCMK

Source: Field survey, April, 2018

This figure shows that *Phataginus tricuspis* frequents forest formations (gal e forests, open forests and dense-dry degraded forest) and savannah formations (shrub savannas and wooded savannahs).

The calculation of Manly's alpha indices makes it possible to know the preferential habitats.

Preferred habitat

The calculation of Manly alpha indices for habitat selection for the five habitat types present in the reserve, wooded savannah, shrub savannah, forest gallery, degraded dense dry forest and open forest, was done. Table VIII presents the alpha value indices of Manly for each habitat. In this table the comparison of αi is made with respect to m = 5 is the number of habitats available. So, 1 / m = 0.2.

Table VIII: Manly alpha index value for different habitat types

Habitat types	Manly Alpha Value Indices	Habitat used (Preferred/avoided)
Wooded savannah	$\alpha SA = 0.01 < 1/m$	Evity
Savannah shrubs	$\alpha Sa = 0.017 < 1/.m$	Evity
Open forest	$\alpha FC = 0,06 < 1/m$	Evity
Degraded dense dry forest	$\alpha FDSd = 0,8 > 1/m$	Favourite
Galerie forest	$\alpha FG = 0.16 < 1/m$	Evity

Analysis in Table VIII shows that the MKFC contains habitats that support Phataginus triscuspis. While considering Menly's alpha values, wooded savannahs, shrub savannahs, open forests, gallery forests are habitats avoided by Phataginus triscuspis. Only dense dry forests are preferred. This is explained by the fact that the SDF being almost in the middle of the prospected areas is more spared from activities around the reserve. Especially since 2/5 of the individuals of the animal were captured in the SDF. The Menly value of the habitat of galeries forests is equal to 0.16 close to 0.2. The species likes to live along streams; transhumant Puhl scamps have been observed near the Idjisin, Odo-Agan and Djoffo rivers. This state of affairs disturbs the tranquility of the fauna especially pangolins which have a very high degree of stress when they feel the presence of a foreign individual especially man.

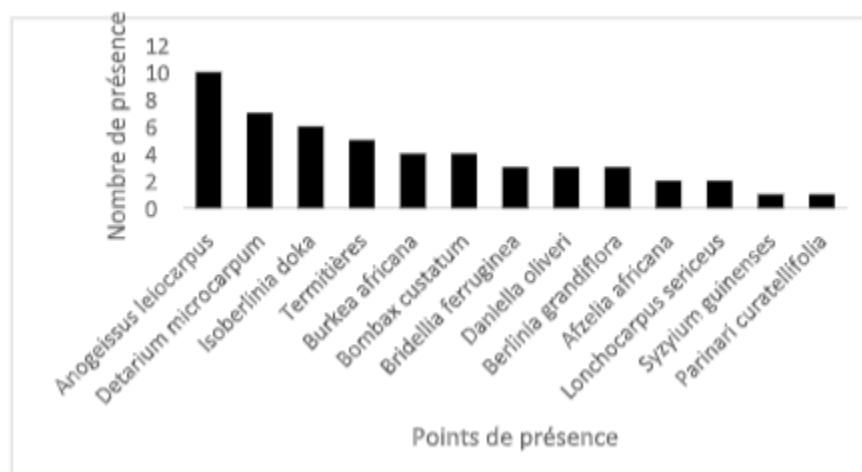Figure 6 shows the trees used by pangolins

Figure 6: Tree species with pangolins From the exploitation of this graph, it appears that *Anogeissus leiocarpa, Detarium microcarpium, Isoberlinia doka, Burkea africana* are the tree species most used by the animal species.

Different forms of pressure on the species in the FCMK

The decline in populations of *Phataginus tricuspis* is facilitated by several factors that constitute direct or indirect threats affecting the distribution of the species. These threats are: deforestation (49.05%), illegal hunting (22.64%), human occupations (13.20%), transhumance (7.54%) and wildland fires (7.54%). Figure19 shows the frequency of these threats to animals in the study area.
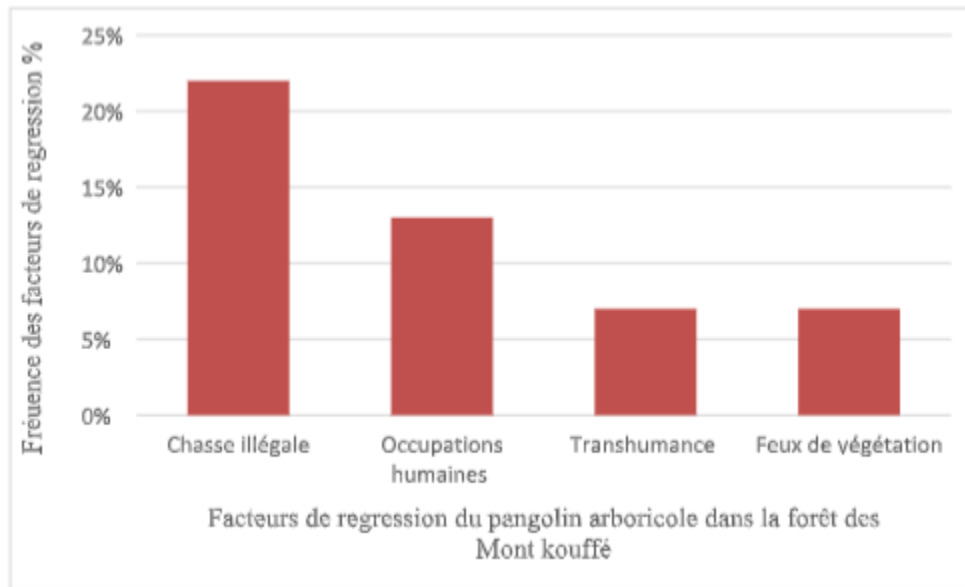
Figure 4: Frequencies of regression factors of *Phataginus tricuspis*.

Overall, deforestation isidentified in the FCMK as the main source of the decline in the population of *Phataginus tricuspis* (49.05%). Then come illegal hunting (22.64%), human occupations (13.20%). They are followed by transhumance (7.54%) and wildland fires (7.54%).

The following photos illustrate the threats to the population of the species in the classified forest of Monts Kouffé.

***Daniellia oliveri* cut in the FCMK**

Source: Dotted shot, 2018

Traffic of Phataginus .tricuspis in the FCMK

Photo: Human occupation around the FCMK

Photo: Wildland fires in the study area

Plate 1: Threats to the population of *Phataginus tricuspis* in the classified forest of Monts Kouffé.

Source: Dotted shot, 2018

Photo (a) shows deforestation in the FCMK, photo (b) shows illegal hunting, photo (c) shows settlements in Koumassi, a hamlet located 2 km from the Manigri Oké hunting area, photo (d) shows wildfires in the study area.

CONCLUSION

The pangolin frequents open forests, gallery forests, dense-dry forests, wooded savannahs, shrub savannahs. Although the species frequents forest formations and savannah formations, it avoids wooded savannahs, shrub savannahs, open forests, gallery forests but nevertheless prefers dense dry degraded forests. It selects several types of trees, the most preferred of which are *Anogeissus leiocarpa, Detarium microcarpum, Isoberlinia doka.*

Urgent action is needed to conserve the pangolin sustainably in its habitat.

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BIBLIOGRAPHY

[1]   Amroun, M. 2005. Food competition between jackal Canis aureus and Genette (Genetta genetta) in two sites in Kabylia: foreseeable consequences of changes in environments. State Doctoral Thesis, UMMTO, 96 p.

[2]   Ayégnon, D. T. D. 2004. The feeding ecology of some large herbivores of the NWP and their role in the dissemination of herbaceous plants. 118p.

[3]   Ba, K. 2002. Systematics, ecology and population dynamics of small rodents potentially reservoirs or hosts of viruses in Senegal. Mémoire de l'Ecole Pratique des Hautes Etudes, Sciences de la Vie et de la Terre, 132 p.

[4]   Basille, M., Calenge, C., Ma rboutin, E., Andersen, R. and Gaillard, J-M 2007. Characterization of the habitat from presence data: the case of the lynx in the Vosges. ONCFS - Scientific Report, 5 p.

[5]   Behanzin, R. 2006. Identification of management and conservation parameters for common hippos (Hippopotamus amphibius) in the Mono River Valley. Thesis of Ing. Agr., FSA/UAC, 131 pp.

[6]   Belem, B., Smith, O. C., Bellefontaine, R., Guinko, S., Lykke, A. M. and Boussim, J.I. 2008. Identification of trees outside forests preferred by the populations of Sanmatenga (Burkina Faso). Woods and forests of the tropics, n°298 (4) 53-63.

[7]   Bellakhdar, J. 1997. Traditional Moroccan pharmacopoeia. Ibis Press, Paris. 764 pp. Benhamou, S. 1998. The home range of land mammals. Journal of Ecology 53:309-330.

[8]   Burel, F. and Baudry, J. 1999. Landscape ecology: concepts, methods and applications. Ed TEC & amp; DOC, ISBN: 2-7430-0305-7, 359 p.

[9]   Burt, V. H. 1943. Territoriality and home range as applied to mammals. Journal of Mammalogy 24:346-352.

[10]   CENAGREF, 2002. Terrestrial enumeration of fauna in the W National Park complex of Benin. Ecological monitoring service. APRM/ECOPAS, Kandi, Benin.

[11]   CITES, 2003. The CITES World. Official Bulletin of the Parties, No. 11, 16 p.

[12]   Clap, F. and Moral, V. 2010. Biodiversity and Communities: Overview of the involvement of local authorities for the preservation of biodiversity in metropolitan France. Paris, France: French IUCN Committee, 97 p.

[13]   CNEDD, 2003: Document d'information et de sensibilisation sur la convention Diversité Biologique, 24 p.

[14]   Codjia, J.T.C. 1996. Ecological distribution and dynamics of populations of cricetomas (Cricetomys gambianus and Cricetomys emini) and aulacode (Thryonomys swinderianus) in the natural environments of Benin. Doctoral Thesis in Zoological Sciences, UL-Belgium, 210 p.

[15]   Codjia, J.T.C. and Assogbadjo, A.E., 2004. Mammalian wildlife and feeding of the holli and fon populations of the classified forest of the Lama (South Benin). Cahiers Agricultures. Vol.13(4): 341-347. http://www.jle.com, accessed 04/09/2012 at 12:30.

[16]   Cuzin, F. 2003. The Great Mammals of Southern Morocco (High Atlas, Anti-Atlas and Sahara): Distribution, Ecology and Conservation. PhD thesis, Laboratory of Biogeography and Ecology of the vertebrae, Ecole Pratique des Hautes Etudes, University of Montpellier II, 345 p.

[17]   Damerdji, A. 2008: Contribution to the ecological study of the malacofauna of the southern zone of the Tlemcen region (Algeria). Africa Science 04(1):138-153

[18]   De Visser, J. Mensah, G.A., Codjia, J.T.C. and Bokono-Ganta, A.H. 2001. Preliminary Guide to Recognition of Benin Rodents. Benin, Cotonou, 252 p.

[19]   Delassus, L., Magnanon, S. and Bougault, C. 2009. Proposal for the structure of a & quot; Housing Pole & quot; for the Lower Normandy, Brittany and Pays de Loire regions. Report of the National Botanical Conservatory of Brest, 28 p.

[20]   Desrochers, M., Provencher, L. and Dubois, J.-M.M. 2002. Relationship between natural habitat characteristics and the distribution of grizzly bears (Ursus arctos) in

[21]   Di Silvestre, I. 2004. Distribution and abundance of large carnivores in the hunting areas of the W Regional Park. Final report of the mission for the ECOPAS Programme, Benin, 46 p.

[22] Dossou, M.E. 2010. Floristic study, ethnobotany and management proposal of the swamp forest of Agonvè and related areas (municipality of Zangnanado). Master's thesis, FLASH/UAC, 54 p.

[23] ECOPAS, 2004: Wildlife Enumeration. Interim Report, 16 pp.

[24] Fresquet, B.M. 2008. North African crested porcupine. 2 p. www.rongeurs.net (accessed 23/10/2012 at 18:45).

[25] Gaudin, S. 1997. Some elements of ecology useful to the forester. Course manual, BTSA/Forest Management. Module D41, CFPPA/CFAA de Châteaufarine, 88 p.

[26] Gomez-Beloz, A. 2002. Plant use knowledge of the Winiki-na Warao: the case for questionnaires in ethnobotany. Economic Botany 56:231-241.

[27] Grzimek, B. 1990. Grzimek's Encyclopedia of Mammals. McGraw-Hill, New York.

[28] Hanski, I., Saccheri, I., Camara, M. et Kuussaari, M. 1998. Allee effect and population dynamics in the Glanville fritillary butterfly. Oikos 82: 384-392.

[29] Harris, L.D. et Kangas, P. 1988. Reconsideration of the habitat concept. Trans. North. Amer. Wildl. Nat. Resources. Conf. 53: 137-144

[30] Hirzel, A.H., Hausser, J., Chessel, D. et Perrin, N. 2002. Ecological-Niche Factor Analysis: How to compute habitat-sui

[31] Hirzel, A.H., Hausser, J., Chessel, D. et Perrin, N. 2002. Ecological-Niche Factor Analysis: How to compute habitat-suitability maps without absence data? Ecology 83: 2027-2036.

[32] Houessou, L. G. 2013. Assessing land use impact and indicators for sustainable conservation of W Biosphere Reserve and its bordering areas in Benin. Thèse de doctorat PhD, Université d'Abomey-Calavi, FSA, 287 p.

[33] Hutchinson, G. E. 1957. Concluding remarks. Cold Spring Harbour Symposium on Quantitative Biology 22: 415-427.

[34] Ichaou, A. 2004. The characterization of lowland and sandy plain forest formations. 91 pp.

[35] INSAE, 2003. Third General Population and Housing Census, RGPH3, 2002, Cotonou.

[36] INSAE, 2013. Fourth General Population and Housing Census. RGPH4, unpublished data, 7 p.

[37] Kassa, D. K. 2008. Ecology, ethology, land use and population dynamics of Waterbuck (Kobus ellipsiprimnus defassa) in the Pendjari Biosphere Reserve, Benin. Doctoral thesis, FSA/UAC. 174 p.

[38] Kraussman, P.R. 1999. Some basic principles of habitat use, Moscow, Idaho, USA.

[39] Lamarque, F. 2004. Large mammals of the WAP complex. Louis Jean Gap, Cedex (France), ISBN: 2-87614-586-3.

[40]   Lemarchand, C. 2007. Study of the habitat of the European otter (Lutra lutra) in the Auvergne region (France): relationship between diet and the dynamics of essential compounds of toxic elements. Doctoral thesis, Univ. Blaise Pascal, Clermont-Ferrand, 225 p.

[41]   Loreau, M., Naeem, S., Inchausti, P., Bengtsson, J., Grime, J.P., Hector, A., Hooper, D.U., Huston, M.A., Raffaelli, D., Schmid, B., Tilman, D. et Wardle, D.A. 2001. Biodiversity and Ecosystem Functioning: Current Knowledge and Future Challenges. Science, 294: 804-808 (www.sciencemag.org).

[42]   Marzluff, J.M., Knick, S.T. et Millspaugh, J.J. 2001. Hightech behavioral ecology: modeling the distribution of animal activities to better understand wildlife space use and resource selection. Academic Press, San Diego, California, USA, pp. 310–326.

[43]   MEHU, 2002. National strategy and action plan for the conservation of biological diversity. Project BEN/97/G 31, Cotonou, Benin, 144 pp.

[44]   Mensah, G. A., Assogbadjo, A.E., Ekué M.R.M., Achigan, E.G.D. and Bokonon-Ganta, A.H. 2002. Cultural role of rodents. Proceedings of the seminar-workshop on mammalogy and biodiversity Abomey-Calavi/Benin, 30/10 -18/11/2002, pp: 53-55.

[45]   Mitchell, S.C. 2005. How useful is the concept of habitat? a critique. Oikos 110: 643-638. Mohamed, W.F. 2011. The crested porcupine, Hystrix cristata (Linnaeus, 1758) in Misurata, Libya. Journal of Ecology and the Environment, vol. 3(7), pp. 228-231.

[46]   Monteil, V. 1951. Contribution to the study of the fauna of Western Sahara. Institut & quot; Hautes Etudes Marocaines & quot;, Notes et Documents, n°9. Paris. 169 pp.

[47]   Morrison, M.L., Marcot, B.G. et Mannan, R.W. 2006. Wildlife-habitat relationships: concepts and application. Island Press. In Dénis, 2012.

[48]   Neu, C., Byers, C.R. et Peek, J.M. 1974. A technique for analysis of utilization availability data. J. Wildl. Manage, 38: 541-545.

[49]   Neuenschwander, P. Sinsin, B. and Goergen, G. (eds). 2011. Nature Protection in West Africa: A Red List for Benin. International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.365 p.

[50]   Odum, E.P. 1971. Fundamentals of ecology (3rded.). Philadelphia: W.B. Saunders Company. In Desrochers *et al.*, 2004.

[51]   Sansregret, H. and Blachette, P. 2003. Development of a habitat quality index for the brown woodcreeper (Certhia americana), René-Levasseur Island, Quebec. The Canadian Naturalist, vol.127 (1): 32-37

[52]   Sogbohossou, E.A. 2006. Conservation of large carnivores in West Africa: Population perception and trade in by-products. WCS Small Grant for Africa Technical Report. Calavi, Benin, 31 p.

[53]   Tchibozo, S. and Motte-Florac, E. 2004. Medical animals from Benin: old drugs that are still current. Association of Friends of the Pharmacy Museum Liaison Newsletter, 29: 40-47

[54]   Tohmé, H. and Tohmé, G. 1981. Some anatomical data on the porcupine Hystrix indica, Kerr, 1792 (Rodentia). Mammalia, 45: 363-371.

[55]   IUCN, 2000. Analyses of proposed amendments to the CITES Appendices, transfer of Geochelone sulcata from Appendix II to Appendix I, pp 140-148.

[56]   UICN, 2010. Red List. http://www.UICNredlist.org/ Vanclay, J.K. 1994. Modelling forest growth and yield, applications to mixed tropical forests. CAB international, 312 p.

[57]   Warigui, S.B. 2011. Study of ecological parameters and ethno-zoological considerations of Orycteropus afer in the W. National Park. Bachelor's thesis, Catholic University of West Africa (Cotonou section), 95 p.

[58]   Williams, J.A., Su, H.S., Bernard, A., Field, J. et Sehgal, A. 2001. A circadian outpout in Drosophilia mediated by Neurofibromatosis-1 and Ras/MAPK. Science 293 (5538):

[59]   Aruna. O., (2012): Mapping and predictive modelling of spatio-temporal changes in vegetation in the commune of Djidja in Benin: implication for spatial planning. Single Doctoral Thesis, EDP/FLASH/UAC, 246p.

[60]   Biaou S., (2015): Mapping of spatio-temporary changes in land use in the classified forest of Bassila. Master's thesis DGAT/FLASH/ UAC, Benin, 155 p

[61]   CENATEL., (2002): Final report on the georeferenced database of agricultural land use in Benin. study report 20p

[62]   Chabi W., (2015): Forms of use of mammalian fauna of the sacred forest of Dorison in the commune of N'dali. Master's thesis, DGAT /FLASH / UAC, Benin, 87 p.

[63]   Chabi ota R., (2015): Analysis of distribution and distribution factors of Colobus vellerosus in the forest complex Mont Kouffé, wari maro and Pénéssoulou .mémoire de maîtrise, DGAT/FLASH/UAC, Benin, 85 p

[64]   Damanadji. B., (2009): Biodiversity of the avifauna of the botanical and zoological garden of the University of Abomey-Calavi. In Climate and Development No. 0 3, pp 45-54.

[65]   Dajoz R., (1985) Précis d'écologie. Bordas, Paris, France 504 p.

[66]   De Sousa S., (1998): Flore du Bénin, UNB/Bénin, 424 p.

[67]   De Souza S.2006 Nom des plantes dans les langues nationales Bénin, 423 p.

[68]   De Visser J., Mensah G. A., Codjia J. T. C. and Bokonon-Ganta A. H., (2001): Guide préliminaire de reconnaissance des rongeurs du Bénin, ISBN, 252 p.

[69]   Djodjouwin L., (2001): Study on ecotourism facilities and pastoral management on the terroirs and classified forest of Monts Kouffé and Wari-Maro. Submission of DESS, UAC/FSA. Benin, 102 p

[70]   Gbègbo M., (2014): Impact of fragmentation of islands in the dense forest of the FCMK and its periphery on biological diversity. Master's thesis DGAT/FLASH/UAC 89 p.

[71]   Georges P., (1994): Dictionnaire de géographie. University Press of France, 450 p.

[72]   Goergen G., Sinsin B. & Neuenschwander P. (eds). (2011): Nature protection in West Africa: a red list for Benin. Nature conservation in West Africa: Red list for Benin. International Institute of Tropical i((() Agriculture, Ibadan, Nigeria. 365 pp.

[73]   Heymans C. J., (1986): a short guide to the mammals of North Benin. Abomey-Calavi, FSA/UAC, 38 p.

[74]   Heymans J-C. & Petit M., (1985): Study and management of the classified forest of Monts Kouffé (Republic of Benin). Preliminary note. Tropicultura, 3 (3): pp88-92

[75]   Heymans C. & Petit J. M., (1985): Study and management of the classified forest of Monts Kouffé (RB). Tropicultura 33; 88-92 pp.

[76]   INSAE-RGPH3., (2003): Synthesis of analyses. Benin, 42p

[77]   Larousse., (1999) : Dictionnaire de français, 455 p.

[78]   Lougbégnon, O. T., (2007): Inventory of forest birds in southern Benin. Unpublished data. 29 pp.

[79]   Le Guyader H., (2008): Biodiversity: a fuzzy concept or a scientific reality. Mail de l'environnement de l'INRA, 26p.

[80]   Nobimè G., (2012): Ecological and ethological factors determining the conservation of the Red-bellied Zinkaka Monkey (Cercopithecus erythrogaster erythrogaster) in habitats in southern Benin. Doctoral degree, University of Abomey-Calavi 107 p.

[81]   Odjoubéré J., (2010): Surge of carbonization in Okouta-Ossé, a village peripheral to the classified forest of Monts Kouffé: Problems and prospects for sustainable management of plant resources. Mémoire de DEA, FLASH/UAC., 125 p.

[82]   Odjoubéré J. (2014): Pressure on plant species of the series of protection of the classified forest of Monts Kouffé in Benin Single doctoral thesis, DGAT/FLASH/UAC, Benin, 175 p.

[83]   Ozenda P. (1982) Plants in the Biosphere. Do in, Paris, France 431p.

[84]   PAMF., (2002): Simple management plan for the classified forest of Monts Kouffé. Cotonou, Benin. 63p.

[85]   PAMF., (2006) : Plan d'aménagement des massifs forestiers des Monts Kouffé et de Wari-Maro, Bénin 88p. (Plan d'Aménagement Participative des Monts Kouffé), 267 p.

[86]   PAP MK (Plan d' Aménagement Participative des Monts Kouffé), 2007: Participatory Management Plan for the complexes of the Wari – Maro classified forests and the Kouffé Mountains. Volume A, 267 p.

[87]   PRRF., (2001) participatory management plan for the classified forest of Bassila in collaboration with PRRF Bassila /GTZ 76 p.

[88]   Tente O., (2015): Current dynamics and evolution process of ecosystems in the Djigbé forest in the commune of Zè. Master's thesis, DGAT/FLASH/UAC, Benin, 62 p.

[89]   Toko M. I., (2005): Effect of border of village terroirs on protected areas following land use dynamics: case of the classified forest of Monts Kouffé in Benin. Memory of DEA/GEN/EDP/FLASH/UAC. Benin. 75 pp.

[90]   Toko I. (2008): Study of the spatial variation of herbaceous biomass, phenology and vegetation structure along toposequences of the upper ouémé river basin in Benin (Thesis), UAC, Benin, 241 p.

[91]   Heath, M.E. and Coulson, I.M. (1997) Home range size and distribution in a wild population of Cape pangolins, Manis temminckii, in north-west Zimbabwe; African Journal of Ecology; 35:94-109.

[92]   Ingram, D.J., Coad, L., Scharlemann, J.P. W. (2016) Hunting and sale of Pangolins across Sub- Saharan Africa: a preliminary analysis. Working Paper. OFFTAKE Project. Available from:http://sro.sussex.ac.uk/59416/1/OFFTAKE%202016%20Hunting%20and%20sale%20of%20pango lins%20across%20Sub-Saharan%20Africa_FINAL.pdf

[93]   Pietersen, D.W., McKechnie, A.E., Jansen, R. (2014a) Home range, habitat selection and activity patterns of an arid-zone population of Temminck's ground pangolins, Smutsia temminckii, African Zoology, 49(2):265-276.

[94]   Pietersen, D.W., McKechnie, A.E., Jansen, R. (2014b) A review of the anthropogenic threats faced by Temminck's ground pangolin Smutsia temminckii, in southern Africa, Southern African Journal of Wildlife Research, 44(2):167-178.

[95]   Soewu, D.A. and Ayodele, I.A. (2009) Utilisation of Pangolin (Manis spp.) in traditional Yorubic medicine in Ijebu province, Ogun State, Nigeria, Journal of Ethnobiology and Ethnomedicine; 5:39 doi:10.1186/1746-4269-5-39

[96]   Waterman, C., Pietersen, D., Soewu, D., Hywood, L. and Rankin, P. (2014a). Phataginus tetradactyla. The IUCN Red List of Threatened Species 2014: e.T12766A45222929.http://dx.doi.org/10.2305/IUCN. UK.2014 2.RLTS. T12766A45222929.en. Downloaded on 21 December 2015.

[97]   Waterman, C., Pietersen, D., Soewu, D., Hywood, L. and Rankin, P. (2014b). *Phataginus tricuspis*. The IUCN Red List of Threatened Species 2014: e.T12767A45223135.http://dx.doi.org/10.2305/IUCN. UK.2014 2.RLTS. T12767A45223135.en. Downloaded on 21 December 2015.

[98]   Waterman, C., Pietersen, D., Hywood, L., Rankin, P. and Soewu, D.(2014c). Smutsia gigantea. The IUCN Red List of Threatened Species 2014:e.T12762A45222061.http://dx.doi.org/10.2305/IUCN. UK. 2014 2. RLTS.T12762A45222061.en. Downloaded on 21 December 2015.