



**LEA**

**LABORATORY OF APPLIED ECOLOGY**

<http://www.leabenin-fsauac.net>

# SCIENTIFIC ACTIVITIES REPORT

**2017**

# **LEA LABORATORY OF APPLIED ECOLOGY**

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Scientific Activities Report 2016

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**The Laboratory of Applied Ecology (LEA) is part of the**

Faculty of Agronomic Sciences (FSA) at the University of Abomey-Calavi (UAC-Benin).





***“The link between research and development can only be justified if the results of the various studies that follow are published, disseminated and used”***

**Brice Sinsin,**  
Former Rector of the University of Abomey Calavi, Director of the LEA

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# FOREWORD

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The Laboratory of Applied Ecology (LEA) at the Faculty of Agronomic Sciences (FSA), University of Abomey-Calavi (UAC) Benin was created in 1994 by Professor Brice Sinsin.

LEA is one of the advanced research institutions on natural resources management in Benin. The major research fields in which LEA is currently involved include (i) land use and land degradation, biodiversity and climate change, (ii) carbon stock measurement and monitoring of carbon sequestration, (iii) agriculture productivity and capacity building in organic agriculture, (iv) ethnobotany and new crops development, (v) management of agroforestry systems; (vi) ecological restoration of degraded land, (vii) conservation and sustainable management of wild palms, (viii) management of Non Timber Forests Products, (ix) management of protected areas (National Parks, hunting zones, community conservation areas), (x) Monitoring of wildlife, (xi) red list of threatened plants and wildlife, (xii) grassland ecology, (xiii) Land and watershed restoration.

Scientific research at LEA up to now has yielded more than 450 scientific publications in peer-reviewed international journals, books and proceedings of scientific conferences. Moreover, LEA has executed and has been involved in several projects (e.g. DADOBAT-UE; SUN-UE; BIOTA-West; LOEWE; UNDESERT-EU; Edulink-European Union; Global Climate Change Alliance; CORAF/WECARD) on sustainable management of natural resources and/or tree domestication in Africa.

Up to date, the major achievements of LEA are the following: (i) climate change, vulnerability assessment and natural/climatic risk management in the coastal area of Benin, (ii) conservation and management of more than 10 forest genetic resources in Benin (e.g: *Adansonia digitata*, *Blighia*

*sapida*, *Caesalpinia bonduc*, *Irvingia gabonensis*, *Pentadesma butyracea*, *Sclerocarya birrea*, *Tamarindus indica*, *Borassus aethiopum*, *Raphia sudanica*, *Dialium guineense*, etc.); (iii) management of more than 10 agroforestry systems involving medicinal plants in Northern Benin (e.g Community gardens of Papatia, Monts Kouffé, forest reserve, etc.) ; (iv) ecological restoration of more than 5 degraded areas (e.g. Lama forest reserve and Swampy forest of Lokoli in Southern Benin; semi deciduous forest of Bassila and Wari Maro in Northern Benin; etc.); (v) management of at least 5 protected areas in Benin (Biosphere Reserves of Pendjari and W in Northern Benin, Trois Rivières forests reserves, Goungoun and Sota forests in Northern Benin, Lama forest reserve in Southern Benin, etc.) ; (vi) Red list of threatened plants and wildlife in Benin (IUCN Red Book of Benin) ; (vii) remote sensing and mapping of vegetation (Swampy Forest of Lokoli, Dense Forest of Lama; Biosphere Reserves of Pendjari and W; etc.); (vii) atlas of biodiversity of Benin.

LEA works closely with many international and national partners (research institutions, NGOs, local communities and decision makers). LEA networks and working groups include:

- About 5 full Professors and 20 Associate Professors from many Departments (Regional Planning, Geography, Chemistry, Soil Science, Botany, Socio-economics, etc.) at the University of Abomey-Calavi ;
- International Scientific Groups such as AETFAT, IUCN (WCPA; SSC ; CWRSG), etc.;
- International Institutions involved in nature conservation and biodiversity management i.e. World Union for Nature Conservation (IUCN), Bioversity International, World Agroforestry Centre, Wildlife Management, West African Science Service Center for Climate and Land

Use (WASCAL), Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) etc.;

- Networks such as the South Saharan African Forest Genetic Program (SSAFOGP), Society for Ecological Restoration (SER-USA), RUFORUM, African Forest Forum (AFF), etc.

- NGOs and Universities (Belgium, Burkina-Faso, Cameroon, Canada, Côte d'Ivoire, Denmark, France, Ghana, Germany, Japan, Mali, Niger, Nigeria, The Netherlands, Senegal, Sierra Leone, Switzerland, Togo, UK, USA, Uganda, South Africa, Kenya, Mozambique, Namibia, etc.).

This report is the tenth edition following consecutive previous reports since 2007. It is intended for several audiences of researchers in Benin and abroad, partners, developers, donators and other professionals interested in the fields of applied ecology. It summarizes the research activities performed at the laboratory in 2017 and is organized into nine major sections. Section 1 presents the methodology used to gather information included in the report and shows how various indices have been calculated. Section 2 focuses on the types of research (individual, national teams, regional teams and international teams), types of publications (thesis, peer review articles, proceedings, technical reports, and newsletter), trends of publications for the last eighteen years (1998 – 2017) and the analysis of language of publications according to the types of publications at the laboratory. Section 3 provides a summary of conferences and seminars organized by the LEA in 2017 and those attended by researchers from LEA. Section 4 describes the research projects and research grants obtained at the laboratory in 2017 whereas section 5 shows details about active human resources at LEA as well as visitors who were in the laboratory in the framework of bilateral collaboration. Section 6 discusses the research activities performed at the laboratory in 2017 and shows the references used. The appendixes are presented in the section 7,

showing full details on references of the different types of publications, researches projects and grants as well as on conferences and visiting researchers in the laboratory. Finally, abstracts of publications in 2017 in peer review journals have been presented in the section 8 to allow easy searching and understanding of the full length papers.

## **DATA COLLECTION**



# 1 DATA COLLECTION

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The methodology used for this report was mainly based on the research activities performed by researchers and students of the laboratory of applied ecology (LEA) in 2016.

First, information related to dissertations (Postgraduate and undergraduate students), scientific articles (published, in press and under review) in peer-review journals and those published through proceedings, books of abstracts and technical reports were used. For each category of publication, the indices of specialization related to the scientific fields in which the works have been performed were assessed. Also, as far as the published papers in peer-review journals are concerned, two groups of papers were established: articles with Impact Factor and others (Web of Science of Thomson). Only publications addressing authors and/or co-authors in LEA were considered. Furthermore, collaborations and co-publications with scientists from African countries and others countries have been detailed throughout the report.

Trends of publications from 1998 to 2017 were assessed both for proceedings and published articles in peer review journals (with Impact Factor or others). The ratio French/English was computed for various types of publications including those in press.

For data processing, the following indices were calculated:

- Specialization Index of publications which is the ratio between the number of publications in a given field or discipline and the total number of publications when considering all disciplines;

- Impact Factor (IF) Index of Publication for a given field of publication which is the ratio between the number of publications having an Impact Factor and the total number of publications in peer review journals related to the considered field of publication;

- Weighted Impact Factor Index of a given field of publication which is the product of the Impact Factor Index of Publications and the arithmetic sum of impact factor indices as described in the web of science of Thomson;

- Index of co-publication at country vs. continental level which is the ratio between the number of co-publications at country vs. international level and the total number of co-publications in the laboratory;

- Estimated cost per publication which is the ratio between the estimated budget of LEA at a given year and the total publication at this year;

- Estimated cost per impact factor unit is the ratio between the estimated budget of LEA at a given year and the arithmetic sum of impact factor indices;

- Contribution of LEA to scientific publication at Faculty of Agronomic Sciences (FSA) and University of Abomey-Calavi (UAC) which is the ratio between the total publication at LEA and the total publication at FSA or UAC.

Information related to the conferences and seminars (organized by the laboratory and the ones to which the researchers from the laboratory have participated), research projects, grants, prices and awards are presented in the report.

To allow the assessment of the full references used to compute this report, a session named “appendixes” has been inserted at the end of the report as well as the abstracts of the published papers in the peer review journals.

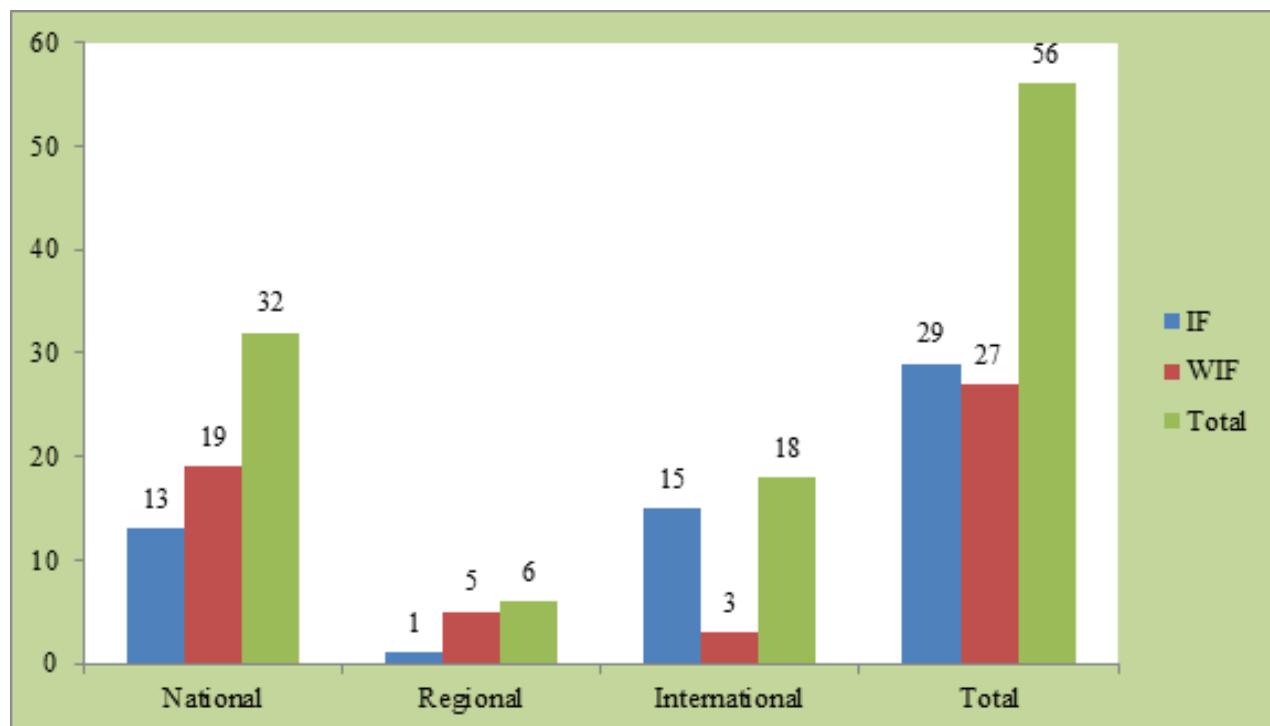
## **RESEARCHES AND PUBLICATIONS IN 2017**



## 2.1 PAPER PUBLISHED SCOPE AT LEA

The published articles of the research team at LEA in 2017 were mostly produced through national teams (57%). About 52% of the original research papers from LEA were published in international journals.

In most cases, these papers involved national and international partners (Figure 1).



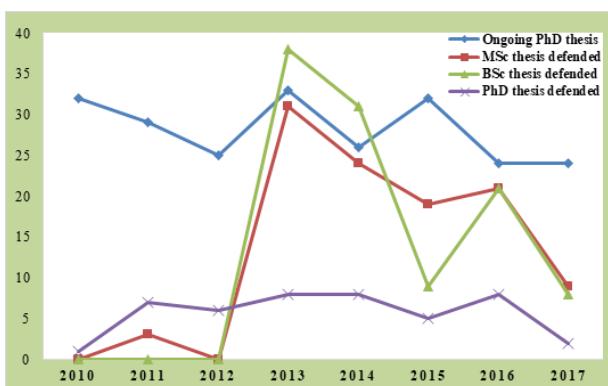
**Figure 1:** Scale context of research activities in LEA in the year 2017

Legend: IF = Impact Factor; WIF = Without Impact Factor

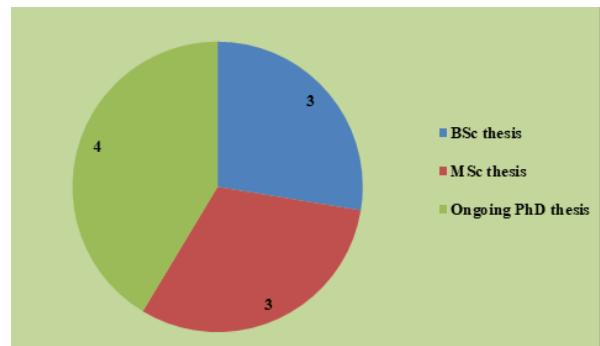
## 2.2 RESEARCH OUTPUTS AT LEA

### 2.2.1 Research students at LEA

The number of enrolled students in Master degrees in 2017 increased since 2007 due to the system LMD started at the University of Abomey-Calavi since 2007. The number of enrolled students in PhD degrees at LEA has increased globally from 2010 to 2017 (Figure 2). Two PhD students defended their PhD in 2017 at LEA. The professors in LEA (full and associate) were actively involved in promoting and supervising PhD and MSc theses (figure 3). One professor supervised at least 4 ongoing PhD and 3 MSc theses in 2017. The same trend is also observed between associate and assistant professors for the supervision of BSc thesis in 2017 (3 students per associate or assistant professor).



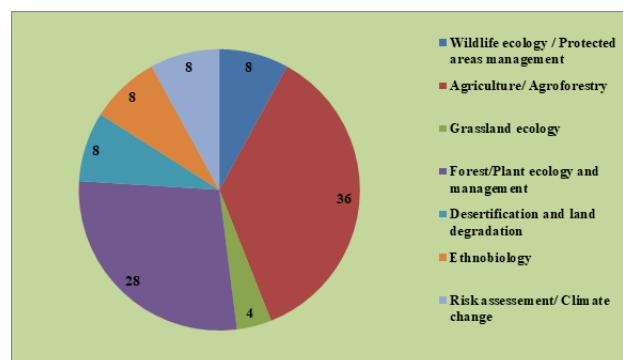
**Figure 2:** Trends of types of defended theses and ongoing PhD Theses from 2010 to 2017



**Figure 3:** Number of students supervised per professor at LEA in 2017

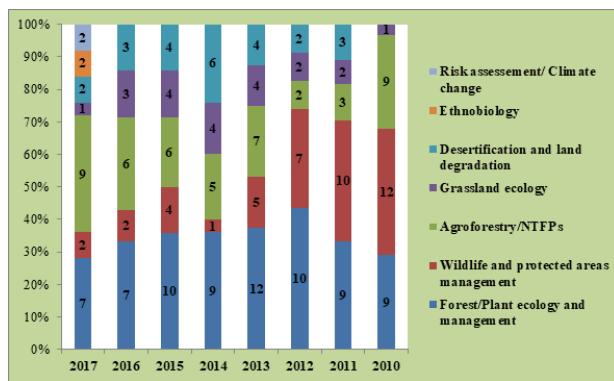
#### 2.2.1.1 Ongoing PhD theses at LEA in 2017

Seven main fields of research were covered by the PhD students at LEA in 2017 (Figure 4). Agriculture/ Agroforestry (36%) and Forest and Plant Ecology management(28%)are the most represented (Figure 4).



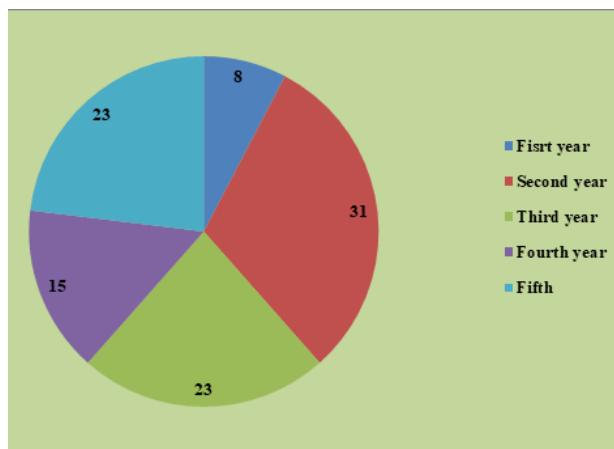
**Figure 4:** Spectrum of ongoing PhD thesis and related field of research in 2017

Figure 5 highlights that PhD research in LEA was mainly focused in the fields of: Forest and Plant ecology, Wildlife management, Agroforestry and NTFP (Figure 5). This is congruent with the laboratory's main research projects.



**Figure 5:** Trends of ongoing PhD thesis according to the fields of research from 2010 to 2017

A total of (62 %) of the students enrolled in PhD have already spent at least 3 years for their research activities while 38% are beginning (first and second year) their thesis at LEA in 2017 (Figure 6).



**Figure 6:** Typology of PhD students in LEA based on the number of years related to their research activities

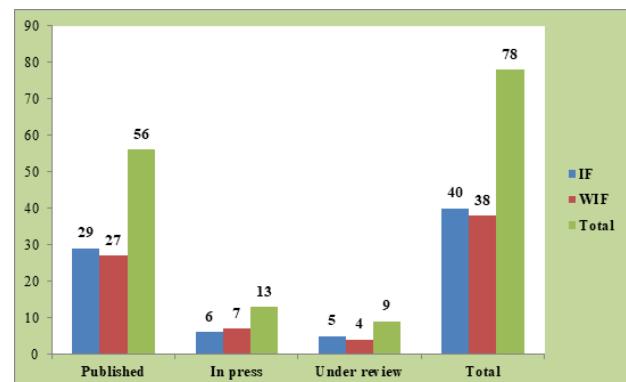
## 2.2.2 Scientific productions

A total of 78 scientific publications were produced by teams of LEA in peer-reviewed journals in 2017, 56 papers were already published; 13 in press and 9 under review. Moreover, 4 articles were published in proceedings, 12 abstracts were published in the books of abstracts and 9 technical report elaborated.

### 2.2.2.1 Publications in peer review journals

#### (i) Number, categories and impact factor indexes of publications

The published articles in 2017 are mostly in the peer review journals with IF (52 %) compared to the number of published papers in other peer reviews journals (48 %), (Figure 7). the number of articles under review (56% vs. 44%) follows the same trend. Full references (authors, journals, etc.) of the publications are provided in appendices 6, 7, 8, 9, 10 and 11.



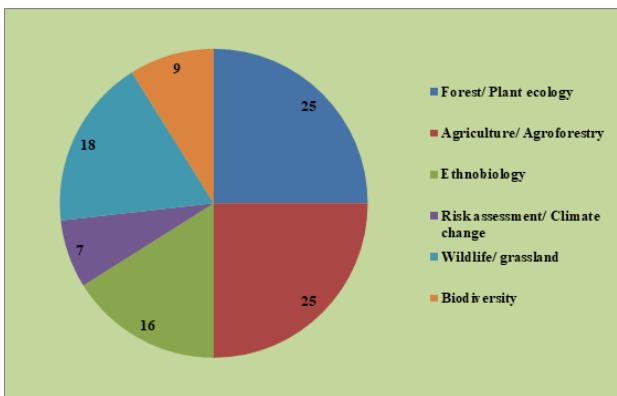
**Figure 7:** Spectrum of scientific productions of LEA in 2017

Legend: IF = Impact Factor; WIF = Without Impact Factor

### **(ii) Specialization Indexes of publications**

#### **a) Published articles**

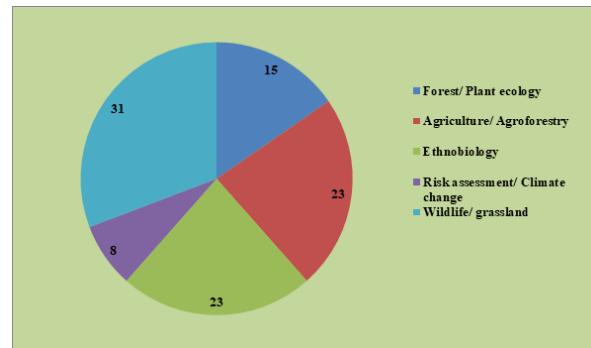
The published articles in 2017 cover various fields of research as the previous year including Forest and Plant ecology (14 papers), Agriculture and Agroforestry (14 papers), Wildlife and Grassland (10 papers), Ethnobiology (9 papers), Biodiversity (5 papers) and Risk assessment and Climate change (4 papers). Most articles were published in Forest and Plant ecology, Agriculture and Agroforestry, Wildlife and Grassland and Ethnobiology which are the main research's field of LEA.



**Figure 8:** Published articles according to the fields of research in 2017

#### **b) Articles in press**

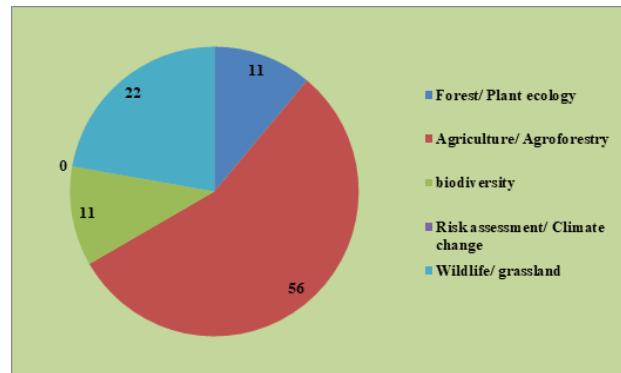
Wildlife/ grassland (4 manuscripts), Ethnobiology (3 manuscripts), Agriculture and Agroforestry (3 manuscripts) will provide more original research papers in the next year.



**Figure 9:** Articles in press according to the fields of research in 2017

#### **c) Articles under review**

Fields having more articles under review were Agriculture and Agroforestry (5 manuscripts), Wildlife and grassland (2 manuscripts), Forest/plant ecology (1 manuscript) and Biodiversity (1 manuscript). These fields have also contributed more in articles published and in press confirming these areas as the more scientifically productive within LEA.



**Figure 10:** Articles under review according to the fields of research in 2017

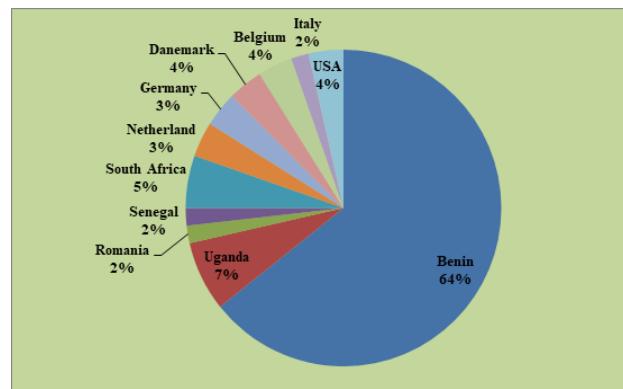
### **(iii) Weighted Impact Factor Index of publications**

Publications which have highly contributed to gain the Impact Factor of the laboratory in 2017 were related to Forest/Plant ecology, Wildlife/grassland and Agriculture/Agroforestry (table 1). Therefore, these fields of publication are the ones in which the recorded scientific publications in LEA had the highest Impact Factor in 2017.

### **(iv) Indices of co-publications in peer review journals**

#### **a) Country level**

LEA works with a wide partnership at local and international training and research institutions. Research teams within LEA used to publish their research papers in collaboration with national and international scientists (figure 11). At country level, most of the publications were written with researchers from Benin (36 publications out of 64).



**Figure 11:** Diversity in indices of the LEA co-publications in peer review journals at countries scale in 2017

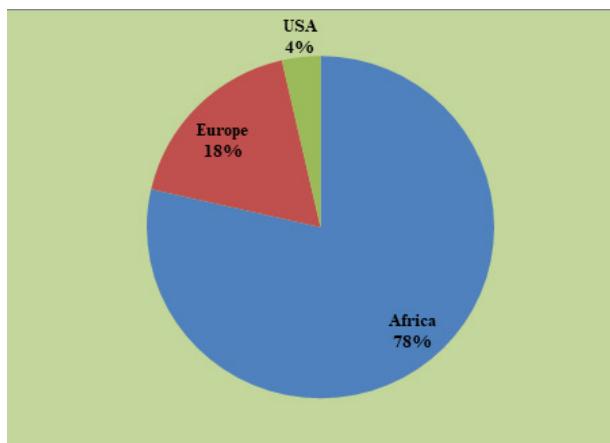
**Table 1:** Weighted Impact Factor Indices of publications according to the disciplines of specialization

Field of publication	Total number of publications related to the field in peer review journals	Total number of publications related to the field journals with impact factor	Weighted Impact Factor indices
<b>Agriculture/Agroforestry</b>	14	7	<b>5.346</b> (1.89, 1.903, 2.486, 0.22, 0.634, 2.265, 1.294)
<b>Ethnobiology</b>	9	4	<b>0.864</b> (0.283, 0.283, 0.27, 1.109)
<b>Forest/Plant ecology</b>	14	10	<b>9.211</b> (0.283, 1.308, 0.283, 0.875, 4.298, 1.951, 1.427, 0.774, 0.848, 0.848)
<b>Biodiversity</b>	5	2	<b>1.905</b> (0.69, 4.072)
<b>Risk assessment / Climate change</b>	4	1	<b>0.772</b> (3.089)
<b>Wildlife/Grassland</b>	10	5	<b>6.927</b> (2.8, 9.7, 0.88, 0.19, 0.283)

( ): The numbers in bracket are the Impact Factor (IF) recorded respectively for each article having an IF in a given field of publication ([www.thomsonreuters.com](http://www.thomsonreuters.com))

### b) Continental level

At continental scale, the most important articles were co-published with Africans (44 publications: mainly Beninese), European scientists (10 publications) and American (2 publication) scientists (Figure 12).

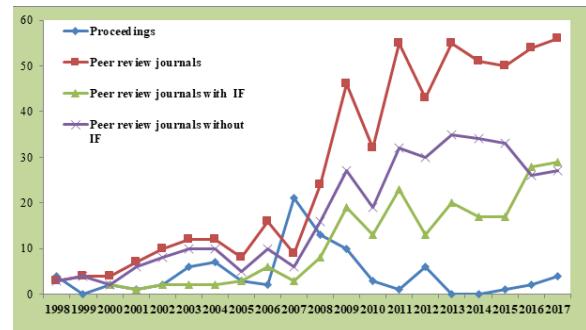


**Figure 12:** Diversity of nationalities of co-authors in peer review journals at continental level in 2017

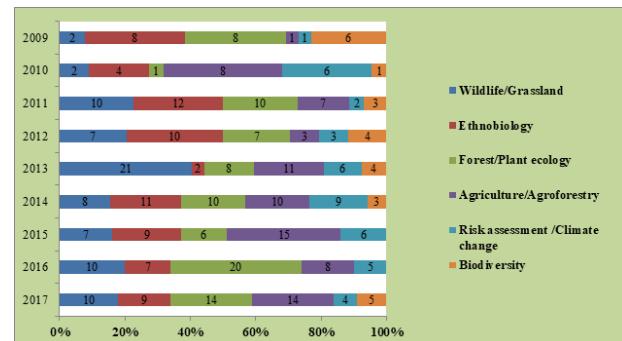
### 2.2.2.2 Trends of publications in peer review journals and proceedings from 1998 to 2016

Publications in peer review journals have globally increased from 1998 to 2017 with the highest peak in 2011, 2013, 2016 and 2017. Publishing in peer review journals with Impact Factor has started in the laboratory in 1994 with 1 to 3 publications per year till 2005. For a given year, the publications in peer review journals with Impact Factor were generally lower compared to the ones in other peer review journals except in 2016 and 2017 (Figures 13a).

Forest and Plant ecology, Wildlife and Grassland, Ethnobiology, Agriculture and Agroforestry are the research fields in which the most publications are obtained since 2010 at LEA (Figure 13b). This confirms these areas as the main research's field of LEA.



**Figure 13a:** Trends per types of publications from 1998 to 2017



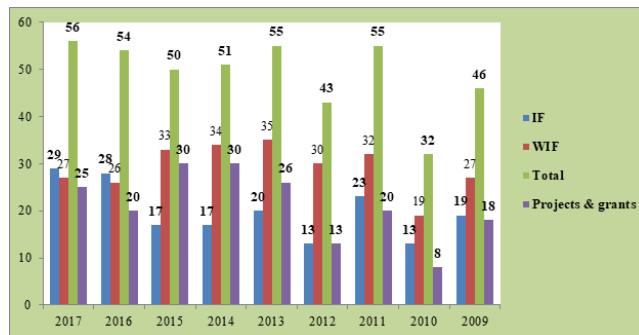
**Figure 13b:** Spectra of publications according to the fields of research from 2010 to 2017

### 2.2.2.3 Trends of research projects, research grants and publications in peer review journals from 2010 to 2016

The research projects and small grants have increased at LEA since 2010 (figure 14). The highest number of research projects and small grants is observed in 2014 and 2015 (30). The same trend is also observed with publications in peer review journals which globally increase since 2010. Thus while the number of projects has increased, the number of papers published also increased. Moreover, this trend is more observed with the number of papers published in impact factor journal.

Indeed, the number of published papers in impact factor journal varied from 13 papers with 8 research projects and small grants to 17-28 papers with 18-30 projects and small grants. With more research projects and small grants, researchers at LEA published more papers in peer review journals particularly in impact factor journals.

The budget per year at LEA from 2010 to 2017 vary from 125 000 Euro to 170 000 Euro. While the budget increased, the cost per publication decreased (table 2). In addition the total impact factor increased with lower cost of publication per impact factor unit. This is due to the increasing number of grantees PhD and MSc students involved in research projects and small grants who have more time for research and publishing. Thus with more funds, more publications are done at lower cost.



**Figure 14:** Relation between publications s output of projects and small grants from 2010 to 2017

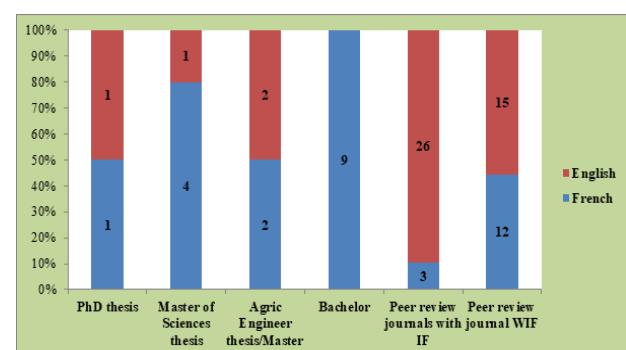
**Table 2:** Estimated cost per publication and per IF unit from 2010 to 2017

Year	Total Publication	Total IF unit	Estimated budget of LEA/year	Cost (Euro) / publication	Cost (Euro)/IF unit
<b>2017</b>	56	47.236	125000	2232	2646
<b>2016</b>	54	41.174	155000	2870	3765
<b>2015</b>	50	20.721	170000	3400	8205
<b>2014</b>	51	23.84	185000	3627	7760
<b>2013</b>	55	19.826	165 000	3000	8322
<b>2012</b>	43	11.6355	155 000	3605	13321
<b>2011</b>	55	27.0247	160 000	2909	5921
<b>2010</b>	32	12.628	125 000	3906	9899
<b>2009</b>	46	21.498	145 000	3152	6745

Mean budget of projects per year ≈ 100 000 Euro; Mean budget per grant per year ≈ 5000 Euro

#### 2.2.2.4 French/English ratio according to the types of publications

Articles in peer journals with and without impact factor were most written in English. While bachelor thesis were most written in French (Figure 15).

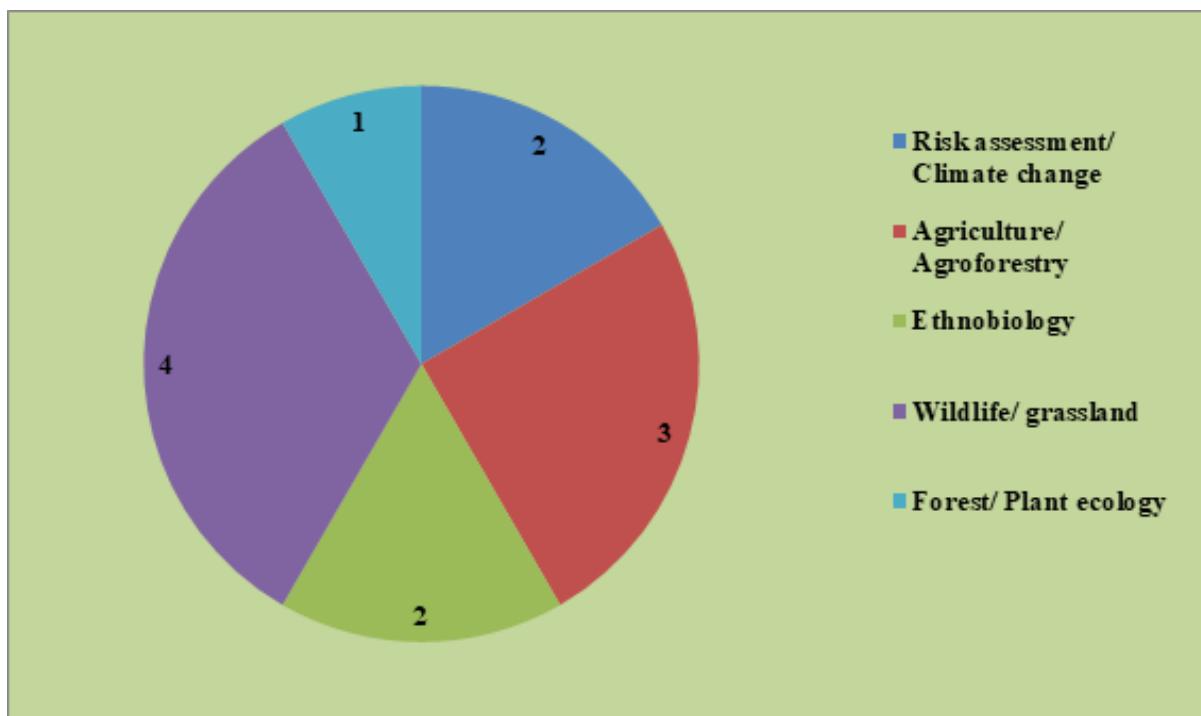


**Figure 15:** French/English ratio for various types of publications in LEA in 2017

### **2.2.2.5 Abstracts: number of publications and indexes of specialization**

A total of 12 abstracts were published in books of abstracts of scientific conferences in 2017.

These abstracts were linked to five disciplines (Risk assessment/Climate change, Agriculture/Agroforestry, Ethnobiology, Wildlife/grassland and Forest/Plant ecology). Wildlife/grassland and Agriculture/ Agroforestry have more abstract in 2017 (figure 16). Full references of these abstracts are provided in appendix 13.



**Figure 16:** Number of publications specialization in books of abstracts in 2017

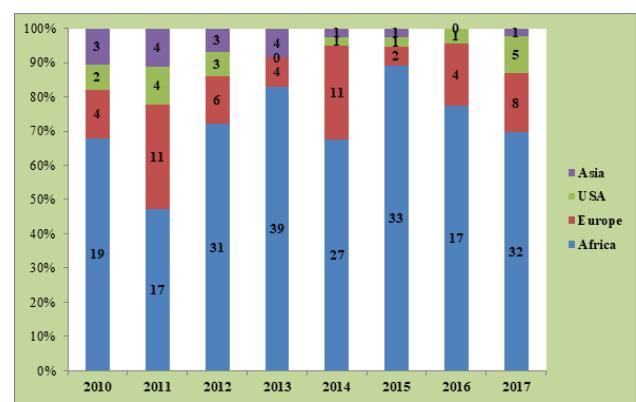
## **CONFERENCES AND SEMINARS FROM 2010 TO 2017**

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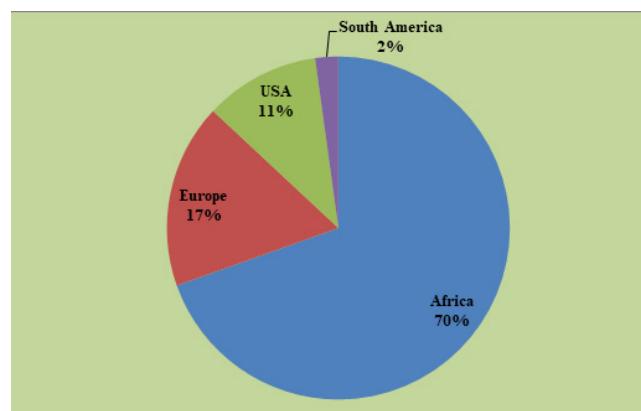


## 3 CONFERENCES AND SEMINARS FROM 2010 TO 2017

The participation of researchers at LEA to conferences and seminars has increased from 2010 to 2017 (figure 17) with the highest peak in 2013. The researchers at LEA have participated more to conferences and seminars in Africa than in the others continents. In 2017, researchers at LEA have participated to 47 conferences. About 70% of these conferences were held in Africa, 17% in Europe, and 11% in USA (Figure 18). Details related to these conferences/workshops are listed in appendix 15. Most of the conferences and seminars at which the researchers at LEA have participated were financially supported by organizers (table 3).



**Figure 17:** Trends of participation of LEA's researchers to international conferences from 2010 to 2017 inside Africa, in Europe, Asia and USA



**Figure 18:** Level of participation of LEA's researchers to international conferences in 2017

**Table 3:** Cost\* of participation to conferences and seminars from 2010 to 2017

Year	Africa	Europe	USA	Asia	Total	Financial support	Contribution of LEA/UAC
<b>2010</b>	19000	10000	5000	7500	41500	35165	6333
<b>2011</b>	17000	27500	10000	10000	64500	58833	5667
<b>2012</b>	31000	15000	7500	7500	61000	50667	10333
<b>2013</b>	39000	10000	0	10000	59000	46000	13000
<b>2014</b>	27000	27500	2500	2500	59500	50500	9000
<b>2015</b>	33000	5000	2500	2500	43000	32250	10750
<b>2016</b>	17000	10000	2500	0	29500	20114	9386
<b>2016</b>	32000	20000	12500	2500	67000	54000	13000

\*Cost per conference: Africa = 1000 Euro; International (Europe, USA, Asia) = 2500 Euro

The LEA has started internal seminars focusing on scientific information since 2012. A total of 5 communications were developed in 2017 during the seminars. These seminars mainly addressed themes related to “*De la psychologie à la biologie de conservation : application du modèle d'acceptation du danger à la conservation des îlots forestiers du Dahomey gap dans le contexte des épidémies de zoonoses émergentes*” developed by MSc Stanislas ZANVO, “*Evaluation des impacts écologiques et paysagers et des perceptions sociales des activités d'exploitation des carrières non sableuses en République du Bénin*” developed by MSc Akouavi Léa AÏTONDJI, “Le monde merveilleux des champignons” developed by Prof. Dr. Meike Piepenbring, Université de Francfort, Allemagne; “Ethnobotany and ecology of *Mimusops andongensis* Hiern and *Mimusops kummel* Bruce ex A. DC: implications for the species management and conservation in Benin (West Africa)” developed by MSc Gisèle SINASSON; and “A new call for a paradigm shift and theory driven ethnobotany” developed by Dr Orou G. Gaoué.

# **RESEARCH PROJECTS, RESEARCH GRANTS AND PRIZE AT THE LEA IN 2017**

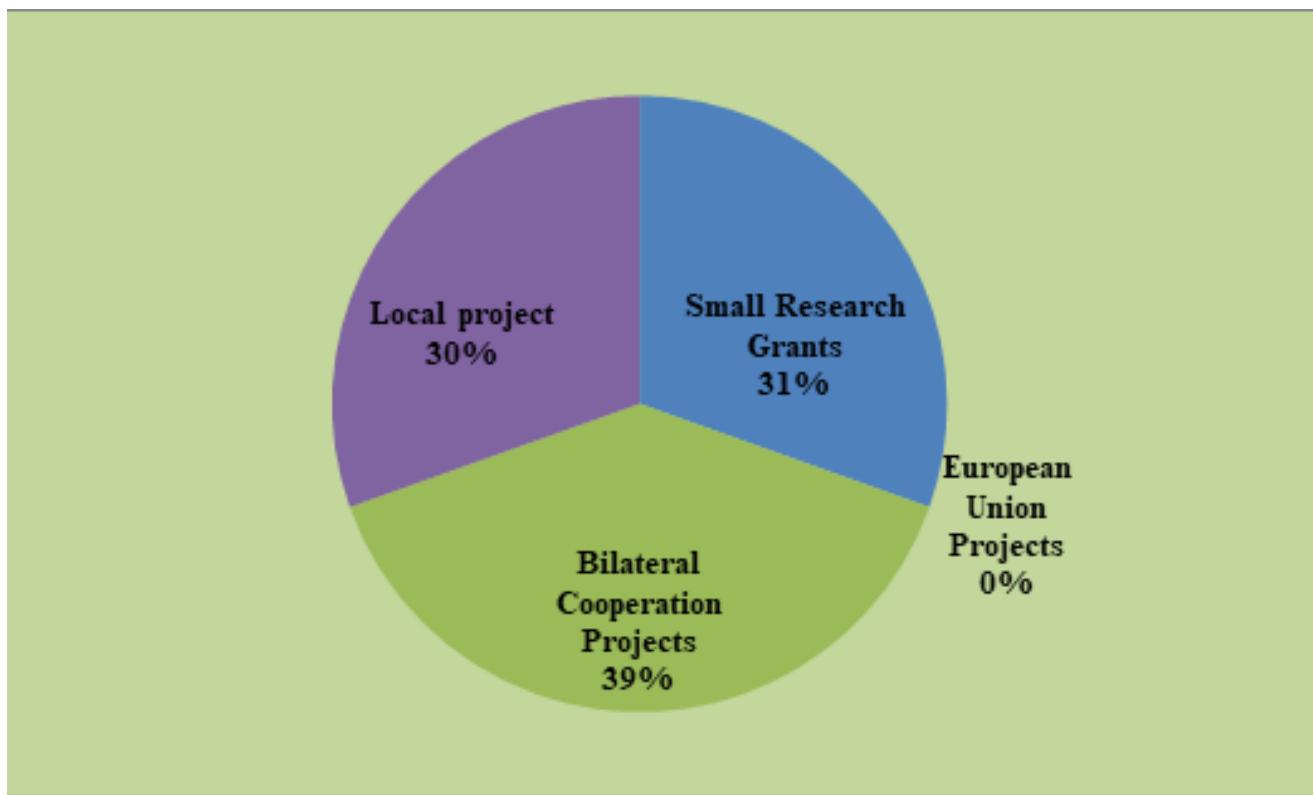
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## 4 RESEARCH PROJECTS, RESEARCH GRANTS AND PRIZE AT THE LEA IN 2017

The research activities undertaken by LEA were mainly funded by international foundations and institutions (Rufford Small Grants, International Fondation for Science, Species Protection Grant, The Kirkhouse Trust SCIO, NWO-Applied Research Fund and Georg Foster Research Fellowship: 31%), regional and international co-operation projects (Institut Royal des Sciences Naturelles de Belgique, ARES, IRD, AGROPOLIS FOUNDATION, FAO-Tchad, World Food Programme and RUFORUM: 39%) and local institution in Benin (FRNSIT and FAO-Benin: 30%) (Figure 19).

Most of the PhD as well as senior scientists at LEA are involved in these projects for their research activities. Details (objectives, beneficiaries, etc.) on these projects and grants are described in appendixes 16 and 17. Moreover, 02 international recognitions have been awarded to the researchers from LEA in 2017 (appendix 18).



**Figure 19:** Spectrum of research funding in 2017

# HUMAN RESOURCES AND VISITING RESEARCHERS IN THE LEA IN 2017

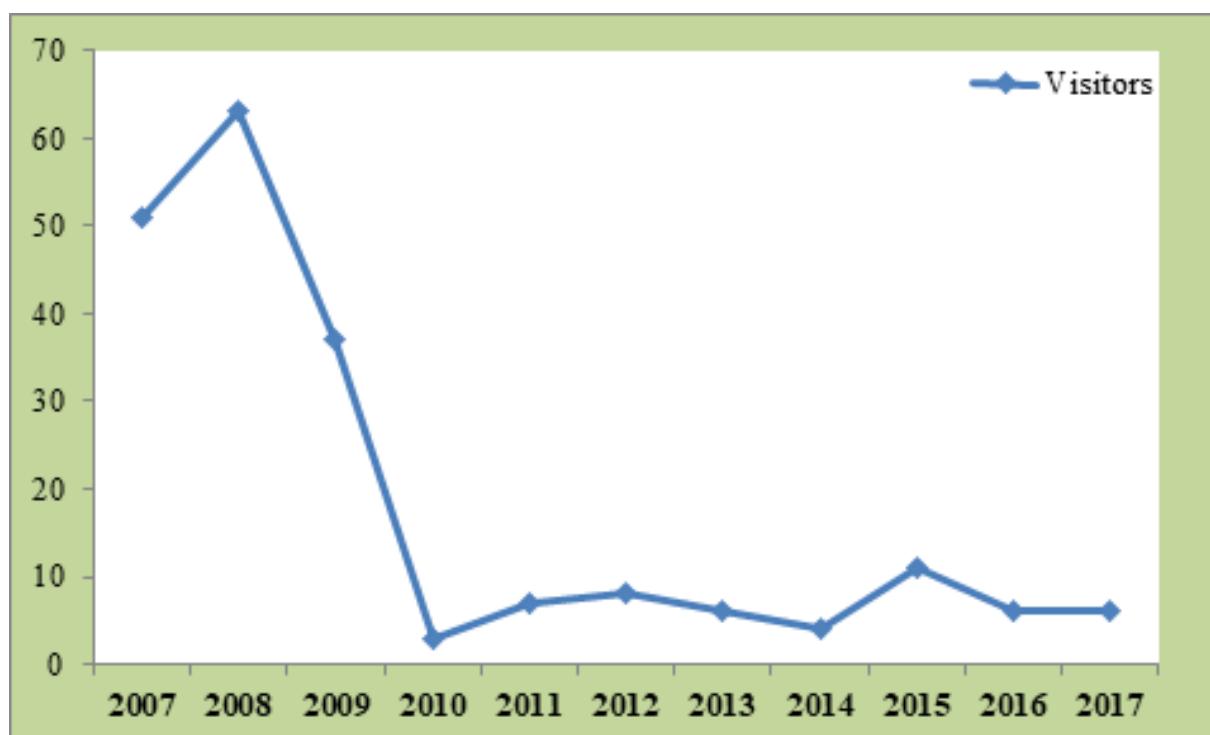
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## 5 HUMAN RESOURCES AND VISITING RESEARCHERS IN THE LEA IN 2017

Human resources in LEA during 2017 are about 30 main investigators and senior scientists, 24 PhD students, actively participating to research activities within the laboratory. Moreover, 5 technicians and 3 drivers are used on permanent basis for the fieldworks. Specifically, LEA houses 5 Full Professors (Professeur Titulaire Conseil Africain et Malgache pour l'Enseignement Supérieur CAMES), 20 associate Professors (Maître-Conférences/CAMES), several assistant Professors (Maître-Assistant/CAMES), assistant (PhD) and junior researchers (MSc and BSc students). Details about these human resources are shown on the web site of LEA ([www.leabenin-fsauac.net](http://www.leabenin-fsauac.net)).

Furthermore, in the course of the year 2017, LEA has welcomed 6 researchers as visitors vs. 69 in 2009, 63 in 2008 and 51 in 2007, (Figure 20). The visitors welcomed in the previous years (2007, 2008 and 2009) were mainly students through NGOs while since 2010 the visitors welcomed were Professors through collaboration or project.



**Figure 20:** Trends of visiting researchers welcomed at the LEA from 2007 to 2017

## **GENERAL DISCUSSION AND CONCLUSION**

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## 6 GENERAL DISCUSSION AND CONCLUSION

Various types of publications were produced by LEA's researchers in 2017 as it was the case in previous years. It is important to notice that the total number of published papers in peer review journal in 2017 is similar to the published papers in 2016, 2015, 2014 and 2013. The global trend of published papers in peer review journal in LEA had increased since 1998. This can be explained by the increase of researchers, research projects and grants holding a PhD, PhD students and MSc student since 2006. Indeed, with more projects and grants, more papers are published with lower cost per publication and impact factor unit. The number of published articles in journals with Impact Factor has considerably increased since 2008. This means that researchers are improving their publication skills and the quality of their investigation. Another driver for this is the change in the requirements before defending a PhD thesis at the Faculty of Agronomic Sciences which hosts LEA (having at least two published original research papers). In the other hand, requirements for upgrading academics grades within the CAMES system (Conseil Africain et Malgache pour l'Enseignement Supérieur) is another important driver for increasing high quality papers within LEA. As such, the scientific capacity of LEA research teams is increasing. Published articles in 2017 were mostly produced in team at African level (78 % mainly Beninese). Published article in peer journal with impact factor were mostly co-written with international colleagues while published articles in other peer journals were more likely written by teams at national level. A reason for that could be the requirements for writing in English for original papers to be submitted in most impact factor journals. Field research such as Forest and Plant ecology, Agriculture and Agroforestry, Wildlife and

Grassland Ethnobiology, Agriculture and Agroforestry will provide more original research papers.

Publications which have highly contributed to gain the Impact Factor of the laboratory in 2017 were related to Forest/Plant ecology, Wildlife/grassland and Agriculture/Agroforestry. These disciplines are then the most important in terms of scientific impact of LEA in 2017.

To date, almost no scientific works was done with the scientists from Latino America, Australia, Middle East China and even Northern Africa. This suggests the need of more and sustainable efforts for building cooperative research networks basically using interactive research topics and funds from these parts of the world. Moreover, since 2007, few scientific papers have been published with scientists at a regional level (West Africa). In 2017, 64% of the articles have been co-published within national team while 18% have been co-published with European and 4% with American scientists. As such, regional scientific collaborations should be developed in the future since Benin shares with its neighboring countries similar research problems which need regional solutions and then should be solved regionally through research activities involving laboratories in the region.

## 6 GENERAL DISCUSSION AND CONCLUSION

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Based on the findings from the present report, it is suggested that LEA:

- (1) helps for capacity building among its research teams in order to be able to publish more scientific papers in peer review journals having a high IF;
- (2) develop more research collaboration at regional level;
- (3) develop curricula in the fields of applied ecology for regional training purposes;
- (4) continue monitoring biodiversity at continental level;
- (6) develop conservation and domestication strategies for some edible and medicinal forest and savannah resources;
- (7) develop guidelines for fieldwork in applied ecology for para ecologists;
- (8) monitor threatened and endangered plants and animals species at regional level.

### References

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- <http://scientific.thomson.com/products/wos/>
- [www.leabenin-fsauac.net](http://www.leabenin-fsauac.net)
- [www.notesdecologie.bj.refer.org](http://www.notesdecologie.bj.refer.org)
- [www.fsa.bj.refer.org](http://www.fsa.bj.refer.org)
- Publications in LEA in 2017 (cf. appendices)
- Proceedings in LEA in 2017 (cf. appendices)
- Theses in LEA in 2017 (cf. appendices: PhD, MSc and agronomist degree).

Publication in UAC in 1998 – 2017.

## APPENDIXES

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## 7 APPENDIXES

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**Appendix 1:** Ongoing PhD thesis in LEA

N°	Student full name	Number of year since the start of the PhD	Research topics	Fields of Research
<b>1</b>	MENSAH Ezechiel	1st	Ecological and organic livestock breeding in Western Africa: overviews, norms and socio-economic determinants	Agriculture/Agroforestry
<b>2</b>	ADJAHOSSOU Christian	2nd year	Connaissance et conservation du genre Isoberlinia dans le Moyen-Bénin	Ethnobiology
<b>3</b>	AHOUANGAN Bidossessi S. Chiméi M.	2nd year	Strategies for adapting agropastoral systems to the climate spatio-temporal dynamics in the coastal zone of Benin.	Risk assessment/ Climate change
<b>4</b>	MOUSSA Hamadou	2nd year	Utilisation fourragère de <i>Pennisetum glaucum</i> comme stratégie d'adaptation aux changements climatiques en milieux sahéliens	Agriculture/Agroforestry
<b>5</b>	HOUNDONOUGBO Sènanmi Hermann Juliano	2nd year	Ecology, conservation and domestication of the African locust bean tree <i>Parkia biglobosa</i> (Jack.) R. Br. (Mimosaceae) in Benin, West Africa	Forest/Plant ecology and management
<b>6</b>	AGBAHOUNGBA Symphorien	3rd year	Genetic Study Of Cowpea Resistance To Flower Thrips ( <i>Megalurothrips Sjostedti Trybom</i> )	Agriculture/Agroforestry
<b>7</b>	HAMADOU Moussa	3rd year	Stratégies d'adaptations aux changements climatiques : Valorisation des potentialités fourragères d'écotypes de mil ( <i>Pennisetum. glaucum</i> (L) R. Br) cultivés au Niger pour l'élevage sédentarisé d'ovins de race locale.	Agriculture/Agroforestry
<b>8</b>	KOLIMEDJE Emilie Norberte	3rd year	Importance des champignons saprotrophes dans la décomposition de la litière au sein de la forêt dense semi décidue de Pahou (Bénin)	Grassland ecology
	Forest/Plant ecology and management	more than 5th year	Problématique de gestion et valorisation des eaux usées du Bénin en cultures maraîchères : cas de l'amarante dans la commune de Sème Kpodji.	Horticulture
<b>9</b>	ABDILAHY ALI Mohamed	4th year	Evaluation de l'efficacité thérapeutique des plantes dites anti-diabète de la république de Djibouti	Ethnobiology
<b>10</b>	TCHIBOZO Vital	4th year	Evaluation of zooeconomics performances of pigs and rabbits feed with different foodstuffs based on maize and corn bran varieties in Benin	Agriculture/Agroforestry
<b>11</b>	HEDJI Carine Christiane	5th year	Valorisation d'aliment à base de <i>Azolla Spp</i> , de feuilles de <i>Moringa oleifera</i> , de son de riz, se viscères de poisson et de poulet en production de porc et de poulet	Agriculture/Agroforestry

N°	Student full name	Number of year since the start of the PhD	Research topics	Fields of Research
<b>12</b>	TODAN Appolinaire	5th year	Implications des mutations agraires et sociodémographiques sur la gestion des ressources ligneuses sur le plateau adja au Bénin	Forest/Plant ecology and management
<b>13</b>	ADJASSE Martin	5th year	Les îlots de forêts sacrés et communautaires du centre Bénin : écosystèmes marginaux à protéger et conserver pour le maintien en équilibre de la diversité biologique	Agriculture/Agroforestry
<b>14</b>	AGBANI Onodjè Pierre	more than 5th year	Etat de conservation et viabilité des populations de quelques espèces ligneuses soudanaises menacées du Bénin.	Plant ecology and management
<b>15</b>	AGONYISSA Didier	more than 5th year	Species diversity variation in sudanian Isoberlinia doka and Isoberlinia tomentosa woodland in relation to plot sizes and landuse pressure in Benin.	Forest/Plant ecology and management
<b>16</b>	AZIZOU El-Hadj Issa	more than 5th year	Facteurs déterminants de cogestion pour la conservation des ressources naturelles de la réserve de biosphère transfrontalière du W/Bénin.	Wildlife /protected areas management
<b>17</b>	EDON Aderomou Tinuadé Solange	more than 5th year	Baobab regeneration in Benin	Forest/Plant ecology and management
<b>18</b>	HOUNDANTODE Justin	more than 5th year	Problématique de gestion et valorisation des eaux usées du Bénin en cultures maraîchères : cas de l'amarante dans la commune de Sème Kpodji.	Agriculture/ Agroforestry
<b>19</b>	KOMBIENOU Pocoum Damè	more than 5th year	Impacts des systèmes agricoles et de l'occupation des terres en zone montagneuse de la chaîne de l'Atacora au Nord-Ouest du Bénin Impacts des systèmes agricoles et de l'occupation des terres en zone montagneuse de la chaîne de l'Atacora au Nord-Ouest du Bénin	Agriculture/ Agroforestry
<b>20</b>	MALIKI Rafiou	more than 5th year	Evaluation de la durabilité écologique et socio-économique des systèmes de cultures sédentarisés à base d'igname : Développement des modèles bio-économiques.	Agriculture/ Agroforestry
<b>21</b>	OKOU Farris Aurlus Yissegnon	more than 5th year	The Atacora mountain under the drivers of land use and their impacts on species establishment	Desertification and land degradation
<b>22</b>	TOUDONOU A. S. Christian	more than 5th year	Utilisation and conservation of snakes: case study from ball python ( <i>Python regius</i> ) in Benin.	Wildlife /protected areas management
<b>23</b>	ZAKARI Soufouyane	more than 5th year	Vulnérabilité des parcours de transhumance aux changements climatiques dans le bassin versant de la Sota (Bénin)	Grassland ecology
<b>24</b>	AGBOMAHENAN Saturnin	more than 5th year	Erosion et Dynamique des états de surface dans la Basse vallée de l'Ouémé	Desertification and land degradation

**Appendix 2:** Completed bachelor degree in 2017

N°	Student full name	Research topics	Fields of Research
<b>1</b>	ATTEREY Jean Melchis F.	Analyse diagnostique des services de Africa Mobile Nature et impact des perceptions de la population riveraine de la réserve de biosphère du delta du Mono sur la conservation de l'hippopotame commun ( <i>Hippopotamus amphibius</i> )	
<b>2</b>	HOUNDJO Landry	Etude diagnostique d'un système d'élevage biologique de caprins en périphérie de Parakou : Cas de Wansirou et de Bakpérou (Nord-Bénin)	Agriculture/ Agroforestry
<b>3</b>	HOWATANNOU Fabrice	Etude diagnostique de l'élevage biologique de porc au Centre FON DO GNI de Bohicon (Centre-Bénin)	Agriculture/ Agroforestry
<b>4</b>	SEGNIBO Augustin	Etude diagnostique d'un système d'élevage biologique d'ovins en périphérie de Parakou : Cas de Wansirou et de Bakpérou (Nord-Bénin).	Agriculture/ Agroforestry
<b>5</b>	AYEDE Adeline	Etude diagnostique du cantonnement forestier de Bassila : Opportunité de traitement des douleurs musculaire avec des plantes médicinales	Ethnobiologie
<b>6</b>	GNIDOKPONOU Joel	Diagnostic du fonctionnement du secteur forestier de Kétou : Etude ethnobotanique des plantes anti-douleurs en application externe	Ethnobiologie
<b>7</b>	HOUEHOUN Hospice	Etude diagnostique de l'inspection forestière de Lokossa : Opportunités de traitement des douleurs musculaires avec des plantes médicinales	Ethnobiologie
<b>8</b>	ASSOGBADJO Sosthène	Valorisation des PFNL comme fertilisant biologique dans la culture hors sol cas du piment	Agriculture/ Agroforestry
<b>9</b>	ESSE Arnaud	Valorisation des PFNL comme fertilisant biologique dans la culture hors sol cas du piment	Agriculture/ Agroforestry

**Appendix 3:** Completed master or agronomist engineer degree in 2017

N°	<b>Student full name</b>	<b>Research topics</b>	<b>Fields of Research</b>
<b>1</b>	AGOSSOUKPE Abel	Wildlife in captivity in southern benin: legislation, health and conservation issues	Wildlife ecology / Protected areas management
<b>2</b>	SODJI Mathieu	Implications of mangrove ecosystems use in ruminants breeding for its sustainability in coastal area of Benin (West Africa)	Agriculture/ Agroforestry
<b>3</b>	FANDOHAN Bruno Florentin Sedjro	Caractérisation des systèmes d'élevage des petits ruminants à Monsou (Commune de Djidja, Centre-Bénin)	Agriculture/ Agroforestry
<b>4</b>	CLOUE Menestin Gbodjia Edossessi	Analyses des systèmes d'élevage des fermes agrobiologiques pour le développement de l'élevage biologique et écologique à Bohicon (Centre - Bénin)	Agriculture/ Agroforestry

**Appendix 4:** Completed Master of Sciences degree in 2017

N°	<b>Student full name</b>	<b>Research topics</b>	<b>Fields of Research</b>
<b>1</b>	EFIO Sylvain	Analyse des mesures de gestion des conflits homme-faune dans la Réserve de Biosphère de la Pendjari (RBP) au nord-Bénin	Wildlife ecology / Protected areas management
<b>2</b>	PADONOU Mikhail D.	Distribution of Trichechus senegalensis (Link 1785) and determinants in Southern Benin wetlands.	Wildlife ecology / Protected areas management
<b>3</b>	AGLISSI Janvier	Analyse spatio-temporelle d'habitat de la civette (Civettictis civetta) et des genettes (Genetta spp.) par caméra piège dans la Réserve de Biosphère de la Pendjari : Implications pour la conservation.	Wildlife ecology / Protected areas management
<b>4</b>	ADJE Bienvenu Chabi	Bio minéralisation et évaluation du potential minéral d'Ipomea involucrata pour la formulation de biofertilisants de type X-Y-Z	Agriculture/ Agroforestry
<b>5</b>	GANGBE Fadonougbo Noël	Dynamique spatio-temporelle et phytosociologique de la Réserve de Biosphère de la Pendjari	Risk assessment/ Climate change

**Appendix 5:** Completed Doctorate thesis in 2017

N°	<b>Student full name</b>	<b>Diploma (Doctor, PhD, etc..)</b>	<b>Research topics</b>	<b>Institution/Specialisation</b>
<b>1</b>	SINASSON SANNI Koupamba Gisele	PhD	Ethnobotany and ecology of Mimusops andongensis Hiern and Mimusops kummel Bruce ex A. DC: implications for the species management and conservation in Benin (West Africa)	Forest/Plant ecology and management
<b>2</b>	SEWADE Clément	PhD	Diversité, biomasse foliaire des ligneux fourrager et capacité de charge des terres de parcours des zones de transition Guinéo-Congolaise/ Soudanienne du Bénin	Wildlife ecology / Protected areas management

**Appendix 6:** Articles published in peer-review journal with Impact Factor (IF) in 2017

<b>Disciplines</b>	<b>N°</b>	<b>Authors' Names</b>	<b>Title of the article</b>	<b>Journals</b>	<b>Impact Factor</b>
<b>Wildlife/ grassland</b>	1	Bauer H., Henschel P., Packer C., SilleroZubiri C., Chardonnet B., Sogbohossou E.A., De longh H. H., Macdonald D. W.	Lion trophy hunting in West Africa: A response to Bouché et al.	Plos One 12 (3), 1-6. <a href="https://doi.org/10.1371/journal.pone.0173691">https://doi.org/10.1371/journal.pone.0173691</a> .	2.8
<b>Wildlife/ grassland</b>	2	Durant S.M., Mitchell N., Groom R., Pettorelli N., Ipavec A. .... Sogbohossou E.A., ... Wykstra M., Young-Overton K.	The global decline of cheetah <i>Acinonyx jubatus</i> and what it means for conservation	PNAS 114 (3): 528-533	9.7
<b>Agriculture/ Agroforestry</b>	3	Agoyi, E., Odong, T., Tumuhairwe, JB., Chigeza, G., Diers, B. and Tukamuhabwa, P.	Genotype by environment effects on promiscuous nodulation in soybean ( <i>Glycine max</i> L. Merrill).	Agriculture and Food Security 6:29. DOI 10.1186/s40066-017-0107-7	1.89
<b>Ethnobiology</b>	4	Assogba GA, Fandohan AB, Salako VK, Assogbadjo AE	Usages de <i>Bombax costatum</i> (Malvaceae) dans les terroirs riverains de la réserve de biosphère de la Pendjari, République du Bénin	Bois et Forêts des Tropiques 333(3):17-29	0.283
<b>Forest/ Plant ecology</b>	5	Akpoma JDT, Assogbadjo AE, Fandohan AB, Glèlè Kakaï R	Inventory and multicriteria approach to identify priority commercial timber species for conservation in Benin	Bois et Forêts des Tropiques 333(3): 5-16	0.283
<b>Ethnobiology</b>	6	Fandohan AB, Chadare FJ, Gouwakinnou NG, Tovissodé CF, Bonou A, Djonlonkou SFB, Houndelo LFH, Sinsin CLB, Assogbadjo AE	Usages traditionnels et valeur économique de <i>Synsepalum dulcificum</i> au Sud-Bénin.	Bois et Forêts des Tropiques 332(2): 17-30	0.283
<b>Forest/ Plant ecology</b>	7	Ahossou OD, Fandohan B, Stiers I, Schmidt M, Assogbadjo AE	Extraction of Timber and Non-Timber Products from the Swamp Forest of Lokoli (Benin): Use Patterns, Harvesting Impacts and Management Options	International Forestry Review 19(2):133-144	1.308
<b>Agriculture/ Agroforestry</b>	8	Gbedomon RC, Salako VK, Fandohan AB, Idohou AFR, Glèlè Kakaï R, Assogbadjo AE	Functional diversity of home gardens and their agrobiodiversity conservation benefits in Benin, West Africa	Journal of Ethnobiology and Ethnomedicine 13:66	1.903
<b>Biodiversity</b>	9	Gbeffe A. K., Houehanou T. D., Habiayremye M., Emeline S. P. Assede E. S. P., Yaoitcha A. S., Janssens de Bisthoven L. J., Sogbohossou E.A., Houinato M. and Sinsin B. A.	Effects of termite mounds on composition, functional types and traits of plant communities in Pendjari Biosphere Reserve (Benin, West Africa)	African Journal of Ecology	0.69

<b>Disciplines</b>	<b>N°</b>	<b>Authors' Names</b>	<b>Title of the article</b>	<b>Journals</b>	<b>Impact Factor</b>
<b>Wildlife/grassland</b>	10	Salako, K. V.; Houehanou, T. D.; Yessoufou, K.; Assogbadjo, A.E.; Akoègninou, A.; Glèlè Kakaï, R. L.	Patterns of elephant utilization of borassus aethiopum mart. and its stand structure in the pendjari national park, benin, west Africa	Tropical Ecology 58(2): 425–437	0.88
<b>Ethnobiology</b>	11	Ahoyo, C.C.; Houehanou, T.D.; Yaoitcha, A. S.; Prinz, K.; Assogbadjo, A. E.; Adjahossou, C.S.G.; Hellwig, F.; Houinato, M.R.B.	A quantitative ethnobotanical approach toward biodiversity conservation of useful woody species in Wari-Maro forest reserve (Benin, West Africa).	Environment, Development and Sustainability, doi:10.1007/s10668-017-9990-0	0.27
<b>Wildlife/grassland</b>	12	Sèwadé C, Azihou A F, Fandohan A B, Glèlè Kakai R L, Mensah G A and Houinato M R B	Leaf biomass modeling, carrying capacity and species-specific performance in aerial fodder production of three priority browse species Afzelia africana, Pterocarpus	Livestock Research for Rural Development http://www.lrrd.org/lrrd29/10/sewa29192.html	0.19
<b>Forest/ Plant ecology</b>	13	Adjahossou S. G. C., Gouwakinnou G. N., Houehanou D. T., Sode A. I., Yaoitcha A. S., Houinato M. R. B., Sinsin B., 2016.	Efficacité des aires protégées dans la conservation d'habitats favorables prioritaires de ligneux de valeur au Bénin.	Bois et Forêts des Tropiques, 328 (2) : 67-76.	0.283
<b>Ethnobiology</b>	14	Gisèle K. Sinasson Sanni, Charlie M. Shackleton, Achille E. Assogbadjo and Brice Sinsin	Local Knowledge on the Uses, Habitat and Change in Abundance of Multipurpose Mimusops Species in Benin	Economic Botany	1.109
<b>Forest/ Plant ecology</b>	15	Sinasson S., G.K., Shackleton, C.M., and Sinsin, B.	Reproductive phenology of two Mimusops species in relation to climate, tree diameter and canopy position in Benin (West Africa)	African Journal of Ecology	0.875
<b>Agriculture/ Agroforestry</b>	16	S. AGBAHOUNGBA, J. KARUNGI, T.L. ODONG, A. BADJI, K. SADIK and P.R. RUBAIHAYO	Stability and extent of resistance of cowpea lines to flower bud thrips in uganda	African Crop Science Journal	2.486
<b>Agriculture/ Agroforestry</b>	17	Agbahoungba Symphorien, Karungi Jeninah, Talwana Herbert, Badji Arfang, Kumi Frank, Mwila Natasha, Edema Richard, Gibson Paul and Rubaihayo Patrick	Additive Main Effects and Multiplicative Interactions Analysis of Yield Performances in Cowpea Genotypes under Ugandan Environments	International Journal of Advanced research	0.22

<b>Disciplines</b>	<b>N°</b>	<b>Authors' Names</b>	<b>Title of the article</b>	<b>Journals</b>	<b>Impact Factor</b>
<b>Forest/ Plant ecology</b>	18	Bucksch A., Atta-Boateng A., Azihou A. F., Battogtokh D., Baumgartner A., Binder B. M., Braybrook S. A., Chang C., Coneva V., DeWitt T. J., Fletcher A. G., Gehan M. A., Diaz -Martinez D. H., Hong L., Iyer-Pascuzzi A. S., Klein L. L., Leiboff S., Li M., Lynch J. P., Maizel A., Maloof J. N., Markelz R. J. C., Martinez C. C., Miller L. A., Mio W., Palubicki W., Poorter H., Pradal C., Price C. A., Puttonen E., Reese J. B., Rellán-Álvarez R., Spalding E. P., Sparks E. E., Topp C. N., Williams J. H., Chitwood D. H.	Morphological plant modeling: unleashing geometric and topological potential within the plant sciences	Frontiers in Plant Science, 8: 900.	4.298
<b>Forest/ Plant ecology</b>	19	Andronache I., Fensholt R., Ahammer H., Ciobotaru A-M., Pintilii R-D., Peptenatu D., Dr ghici C-C., Diaconu D. C., Radulovi M., Pulighe G., Azihou A. F., Toyi M. S. and Sinsin B.	Assessment of textural differentiations in forest resources in Romania using fractal analysis.	Forests, 8: 54.	1.951
<b>Wildlife/grassland</b>	20	Hounounougbo J. S. H., Salako V. K., Idohou R., Azihou F. A., Assogbadjo A. E. and Glèlè Kakaï R.,	Local perceptions of elephant-Borassus aethiopum Mart. (Arecaceae) interactions in the Pendjari National Park in Benin.	Bois et Forêts des Tropiques, 331: 7 – 17.	0.283
<b>Risk assessment/ Climate change</b>	21	Padonou, E.A., Lykke, A.M., Bachmann, Y., Idohou, R., Sinsin, B. 2017.	Mapping changes in land use/land cover and prediction of future extension of bowé in Benin, West Africa.	Land Use Policy 69: 85–92.	3.089
<b>Agriculture/ Agroforestry</b>	22	Padonou, E.A., Tovissodé, F.C., Idohou, R., Salako, V.K., Fantondji, L., Vihotogbé, R., Fandohan, B., Assogbadjo, A.E.	Pilot assessment of locally acknowledged morphotypes of <i>Irvingia gabonensis</i> (Aubry-Lecomte) Baill. in southwestern Benin (West Africa)	Fruits 72(5), 306–316.	0.634
<b>Forest/ Plant ecology</b>	23	Inoussa, M.M., Padonou, E.A., Lykke, A.M., Kakai, R.G., Bakasso, Y., Mahamane, A., Saadou, M.	Contrasting population structures of two keystone woodland species of W National Park, Niger	South African Journal of Botany, 112, 95-101	1.427

<b>Disciplines</b>	<b>N°</b>	<b>Authors' Names</b>	<b>Title of the article</b>	<b>Journals</b>	<b>Impact Factor</b>
<b>Forest/ Plant ecology</b>	24	Goussanou C.A., Guendehou S., Assogbadjo A.E., Sinsin B.	Application of site-specific biomass models to quantify spatial distribution of stocks and historical emissions from deforestation in a tropical forest ecosystem	Journal of Forestry Research 29:205-213. DOI 10.1007/s11676-017-0411-x	0.774
<b>Agriculture/ Agroforestry</b>	25	Gbedomon R.C., Salako V.K., Adomou A.C., Glèlè Kakaï R. & Assogbadjo A.E.	Plants in traditional home gardens: richness, composition, conservation and implications for native biodiversity in Benin.	Biodiversity and Conservation, DOI 10.1007/s10531-017-1407-8.	2.265
<b>Forest/ Plant ecology</b>	26	Assogbadjo A.E., Mensah S. & Glèlè Kakaï R.	The relative importance of climatic gradient versus human disturbance in determining population structure of <i>Afzelia africana</i> in West Africa.	Southern Forests 79(2): 125–132.	0.848
<b>Forest/ Plant ecology</b>	27	Gandji K., Salako V.K., Assogbadjo A.E., Orekan V.O.A., Glèlè Kakaï R. & Sinsin B.A.	Evaluation of the sustainability of participatory management of forest plantations: the case study of Wari-Maro Forest Reserve, Republic of Benin.	Southern Forests: 79(2): 133–142.	0.848
<b>Biodiversity</b>	28	Mensah S., Veldtman R., Assogbadjo A.E., Ham C., Glèlè Kakaï R. & Seifert T.	Ecosystem service importance and use vary with socio-environmental factors: A study from household-surveys in local communities of South Africa.	Ecosystem Services 23: 1-8.	4.072
<b>Agriculture/ Agroforestry</b>	29	Rodrigue Idohou . A. Townsend Peterson . Achille E. Assogbadjo . Romaric L. Vihotogbe .	Identification of potential areas for wild palm cultivation in the Republic of Benin through remote sensing and ecological niche modeling	Genetic Resources and Crop Evolution, 64(6), 1383-1393.	1.294

**Appendix 7:** Articles published in peer-review journal without IF in 2017

<b>Disciplines</b>	<b>N°</b>	<b>Authors' Names</b>	<b>Title of the article</b>	<b>Journals</b>
<b>Agriculture/ Agroforestry</b>	1	GUENDEHOU Ferdinand, DJOSSA AGOSSOU Bruno, TEKA Oscar et ASSOGBADJO Achille Ephrem	Propagation de zanthoxylum zanthoxyloides par bouturage au Bénin	Revue de Géographie du Bénin
<b>Forest/ Plant ecology</b>	2	Oscar Teka, Codjo Euloge Togbe, Rosos Djikpo, Romeo Chabi, Bruno Djossa	Effects of Urban Forestry on the Local Climate in Cotonou, Benin Republic	Agriculture, Forestry and Fisheries
<b>Risk assessment/ Climate change</b>	3	TEKA O., TOGBE E., DJIKPO R., DJOSSA B., OUMOROU M., SINSIN B.	Highlighting the mitigation effect of heat islands by urban forestry in Cotonou, republic of Bénin	J. Rech. Sci. Univ. Lomé (Togo)
<b>Agriculture/ Agroforestry</b>	4	Agoyi, E., Afutu, E., Chadare, F., Tumuhairwe, JB., Chigeza, G. and Tukamuhabwa, P.	Ureide essay to assess n2-fixation abilities of soybean genotypes under different bradyrhizobium strains.	Journal of Crop Sciences and Biotechnology 20 (2) : 65 -72 DOI No. 10.1007/s12892-016- 0132-0
<b>Ethnobiology</b>	5	Agoyi, E., Okou, F., Assogbadjo, A. and Sinsin, B.	Medicinal uses of <i>Moringa oleifera</i> in southern Benin (West Africa)	Acta Hortic. 1158. ISHS 2017. 3003-307 DOI 10.17660/ ActaHortic.2017.1158.34
<b>Forest/ Plant ecology</b>	6	Fandohan AB, Azihou AF, Assogbadjo AE, Fonton HN, van Damme P, Sinsin AB (2017).	Environment-driven spatial pattern of tamarind trees in riparian forests.	Environment for International Development 111 (1): 23-37
<b>Wildlife/ grassland</b>	7	A. I. H. DAOUDA, S. G. A. NAGO, S. DJEGO— DJOSSOU, A. HENNOU, J.-R. DA SILVA, O. OUMOROU, O. R. AYO, M. FASSINOU, A.-W. IDRISSOU, E-A. MIGAN, G.OFFIN, O. TAYEWO, G. A. MENSAH et B. A. SINSIN	Aires d'occurrence et ethnozoologie du daman des rochers ( <i>Procavia capensis</i> <i>kerstingii</i> ) dans la partie septentrionale du Bénin (Afrique de l'Ouest)	Bulletin de la Recherche Agronomique du Bénin (BRAB)
<b>Wildlife/ grassland</b>	8	Sogbohossou E.A., Aglissi J.	Diversity of Small Carnivores in Pendjari Biosphere Reserve, Benin	Journal of Entomology and Zoology Studies 5 (6)
<b>Biodiversity</b>	9	Sabi Lolo Ilou B., Sogbohossou E.A., Toko Imorou I., Houinato M.R.B., Sinsin B.	Diversité et importance socio- économique des services écosystémiques dans la Réserve de Biosphère de la Pendjari au nord-Bénin	[Journal de la Recherche Scientifique de l'Université de Lomé 19 (3)
<b>Wildlife/ grassland</b>	10	Sogbohossou E.A., Dansou P. E., Djagoun C.A.M.S.	Conflits hommes-hippopotames dans la Réserve Communautaire d'Adjamè au Bénin	Bulletin de la Recherche Agronomique au Bénin 82: 22-31
<b>Agriculture/ Agroforestry</b>	11	Ivan Bossima Koura, Serena Calabò, Luc Hippolyte Dossa, Nadia Musco, Monica Isabella Cutrignelli, Marcel Romuald Benjamin Houinato	Nutritional value of cereal and legume crop residues fed to ruminant in Republic of Benin	Journal of Nutritional Ecology and Food Research

<b>Disciplines</b>	<b>N°</b>	<b>Authors' Names</b>	<b>Title of the article</b>	<b>Journals</b>
<b>Ethnobiology</b>	12	ADJAHOSOU S. G. C., HOUEHANOU D. T., TOYI M., TINTE B., HOUINATO M., SINSIN B.	Degré de pression et perception endogène de multiplication et de conservation du genre Isoberlinia au Moyen-Bénin. (Afrique de l'Ouest)	Revue Science et Technique du Burkina
<b>Forest/ Plant ecology</b>	13	Adjahossou S. G. C., Gouwakinnou G. N., Houehanou D. T., Sode A. I., Yaoitcha A. S., Houinato M. R. B., Sinsin B.	Habitats favorables de conservation de Khaya senegalensis au Bénin	Fiche Technique, Institut National des Recherches Agricoles du Bénin, 2017
<b>Forest/ Plant ecology</b>	14	Adjahossou S. G. C., Gouwakinnou G. N., Houehanou D. T., Sode A. I., Yaoitcha A. S., Houinato M. R. B., Sinsin B	Habitats favorables de conservation de Afzelia africana au Bénin	Fiche Technique, Institut National des Recherches Agricoles du Bénin, 2017
<b>Risk assessment/ Climate change</b>	15	Bonou, A., Wünscher, T., Adégbidi, A. A., & Diaw, A.	Impact of Floods on Farmers' Livelihoods in the Semi-arid Zone of Benin	In: Saito O., Kranjac-Berisavljevic G., Takeuchi K., A. Gyasi E. (eds) Strategies for Building Resilience against Climate and Ecosystem Changes in Sub-Saharan Africa. Science for Sustainable Societies. Springer, Singapore
<b>Agriculture/ Agroforestry</b>	16	Moussa H., Soumana I., Chaïbou M., Souleymane O., Kindomihou V.	Potentialités fourragères du mil ( <i>Pennisetum glaucum</i> (L.) R. Br) : Revue de littérature	Journal of Animal & Plant Sciences, 2017 34(2): 5424-5447 <a href="http://www.m.elewa.org/JAPS">http://www.m.elewa.org/JAPS</a>
<b>Agriculture/ Agroforestry</b>	17	Zinsalo R., Akouehou G., Kindomihou V., Sinsin B.	Facies de végétation et caractérisation pastorale des agrosystèmes à <i>Elaeis guineensis</i> dans le périmètre Zè-Allada-Toffo au Sud-Bénin	Int. J. Biol. Chem. Sci. 11(3): 1135-1144 (2017)
<b>Agriculture/ Agroforestry</b>	18	Holou R.A.Y., Kindomihou M.V.	The Biofuel Crops in Global Warming Challenge: Carbon Capture by Corn, Sweet Sorghum and Switchgrass Biomass Grown for Biofuel Production in the USA.	Frontiers in Bioenergy and Biofuels 139-151. (2017). Prof. Eduardo Jacob-Lopes and Leila Queiroz Zepka (Ed.), InTech, DOI: 10.5772/65690. ISBN 978-953-51-2892-2, Print ISBN 978-953-51-2891-5.
<b>Agriculture/ Agroforestry</b>	19	Koura T.W., Dagbenonbakin G.D., Kindomihou V.M., Sinsin B.A.	Palm Oil Mill Solid Waste Generation and Uses in Rural Area in Benin Republic: Retrospection and Future Outlook	Solid Waste Management in Rural Areas 143-163 (2017). Dr. Florin-Constantin Mihai (ed.), InTech, DOI: 10.5772/66551. ISBN: 978-953-51-3486-2 Print ISBN: 978-953-51-3485-5
<b>Wildlife/ grassland</b>	20	Myrèle Aoudji; Mireille Toyi, Dan Céline, Marcel H and Brice S.	Effects of land-cover change on rangeland vegetation in W Biosphere Reserve, Benin Republic, West Africa	Journal of Research in Forestry, Wildlife & Environment
<b>Ethnobiology</b>	21	Akabassi, G.C., Padonou, E.A., Chadare F.J., Assogbadjo, A.E.	Importance ethnobotanique et valeur d'usage de <i>Picralima nitida</i> (stapf) au Sud-Bénin (Afrique de l'Ouest)	International Journal of Biological and Chemical Sciences 11(5): 1979-1993

<b>Disciplines</b>	<b>N°</b>	<b>Authors' Names</b>	<b>Title of the article</b>	<b>Journals</b>
<b>Ethnobiology</b>	22	Atanasso, J.A., Chadare, F.J., Padonou, E.A., Ahouansinkpo, E., Koura, K., Houehanou, T., Assogbadjo, A.E., Glele Kakai, R., Sinsin, B	Habitats and utilizations of Lippia multiflora Moldenke: local perception of four ethnic groups from Benin (West Africa)	Agronomie Africaine 29 (2): 111-120.
<b>Ethnobiology</b>	23	Savi M.K., Noumonvi R., Chadaré FJ, Daïnou K., Salako V.K., Idohou R., Assogbadjo A.E. & Glèlè Kakai R.	Synergy between traditional knowledge of use and tree population structure for sustainability of Cola nitida (Vent.) Schott. & Endl in Benin (West Africa).	Environment, Development and Sustainability DOI 10.1007/s10668-018-0091-5
<b>Biodiversity</b>	24	Dossou-Yovo H.O., Vodouhe F.G., Assogbadjo A. E. & Sinsin B.	Environmental education and ecotourism using termitaria research findings: A case study of Pendjari reserve, Benin.	Journal of Ecology and the Natural Environment 9(5): 71-76.
<b>Risk assessment /Climate change</b>	25	Georges DJOHY, Ange HONORAT EDJA, André Jonas DJENONTIN, Marcel HOUINATO	Vulnérabilité et dynamiques sociopolitiques d'adaptation des éleveurs transhumants aux perturbations climatiques au Nord du bénin	CERES Publishing
<b>Wildlife/ grassland</b>	26	ASSANI S. Alassan, ALKOIRET T. Ibrahim, HOUINATO Marcel	Transhumance and protected areas in West Africa: State of play and Management mechanisms review	The Saudi Journal of Life Sciences <a href="http://scholarsmepub.com/">http://scholarsmepub.com/</a>
<b>Biodiversity</b>	27	SABI LOLO ILOU B., TOKO IMOROU ISMAILA., SOGOHOSSOU ETOTEPE A., HOUINATO MARCEL., SINSIN BRICE	Diversité et importance socio-économique des services écosystémiques dans la réserve de biosphère de la pendjari au nord-bénin	European Journal of Scientific Research DOI: 10.19044/esj.2016.v13n2p400

**Appendix 8:** Articles in press in peer-review journal with IF in 2017

<b>Disciplines</b>	<b>N°</b>	<b>Authors' Names</b>	<b>Title of the article</b>	<b>Journals</b>	<b>Impact Factor</b>
<b>Wildlife/ grassland</b>	1	Sogbohossou E.A., Kassa B.D., Waltert M., Khorozyan I.	Spatio-temporal niche partitioning between the African lion ( <i>Panthera leo leo</i> ) and spotted hyena ( <i>Crocuta crocuta</i> ) in western African savannas	European Journal of Wildlife Research 64	1.264
<b>Agriculture/ Agroforestry</b>	2	Bonou, A. Wuenscher, T., Adegbidi, A., & Diaw, A.	Rice Yield Effects of the 2012 flood in Benin: Accounting for lack of a valid comparison group	Food Security.	2.271
<b>Agriculture/ Agroforestry</b>	3	S. Agbahoungba, J. Karungi, T.L. Odong, S. Kassim, A. Badji, F. Kumi, N. Mwila and P.R. Rubaihayo	Biochemical constituents influencing the resistance to flower bud thrips in cowpea [ <i>Vigna unguiculata</i> (L.) walp] germplasm	African Crop Science Journal	2.486
<b>Agriculture/ Agroforestry</b>	4	Symphorien Agbahoungba, Jeninah Karungi, Arfang Badji, Kassim Sadik, Paul Gibson, Richard Edema, Achille E. Assogbadjo and Patrick R. Rubaihayo	Inheritance of cowpea resistance to flower thrips in Uganda germplasm	Journal of Plant Breeding and Crop Science	4.0
<b>Forest/ Plant ecology</b>	5	Agbahoungba S., Assogbadjo A.E., Agoyi E.E. and Sinsin B.	Diversity and current spatial distribution of wild edible fruit tree species in the Lama Forest Reserve in Benin	International Journal of Fruit Sciences	0.32
<b>Forest/ Plant ecology</b>	6	Eméline Séssi Pélagie Assédé, Chabi Adégèmi Marc Sylvestre Djagoun, Fortuné Akomian Azihou, Yannick Senak-pon Caleb Gogan, Meryas Dègbémabou Kouton, Aristide Cossi Adomou, Coert Johannes Geldenhuys, Brice Augustin Sinsin	Efficiency of conservation areas to protect orchid species in Benin, West Africa	South African Journal Of Botany	1.244

**Appendix 9:** Articles in press in peer-review journal without IF in 2017

<b>Disciplines</b>	<b>N°</b>	<b>Authors' Names</b>	<b>Title of the article</b>	<b>Journals</b>
<b>Wildlife/ grassland</b>	1	S. DJEGO-DJOSSOU ; I. BATCHO; A.I.H. DAOUDA; G. A.MENSAH & B. A. SINSIN	Acquisition de données éco éthologiques sur le da-man des rochers, <i>Procapia capensis kerstingi</i> au Bénin (Afrique de l'ouest)	International Journal of Biological and Chemical Sciences
<b>Ethnobiology</b>	2	Sèwadé C., Lokonon E. B., Azihou A. F., Akouéhou S. G., Guy Apollinaire Mensah G. A., Glèlè Kakai L. R. & Houinato M.	Use diversity and farmer's preference of 48 local fodder trees: a comparative analysis of three socio-linguistic groups from the Guineo-Congolese / Su-danian transition zone of Benin.	Annales des Sciences Agronomiques. 22(1), 33-52 (sous presse)
<b>Ethnobiology</b>	3	Carlos C. AHOYO, Issifou MAMA SAMBO IMOROU, Thierry D. HOUEHANOU, Alain S. YAOITCHA, Marcel R. B. HOUINATO et Brice A. SINSIN	De l'éthnomédecine à l'ethnopharmacologie vété-rinaire et la conservation d'espèces ligneuses au Benin: Application raisonnée d'outils quantitatifs	Science et technique
<b>Wildlife/ grassland</b>	4	Efio S., Sogbohossou E. A., Magnon Z.Y., Houinato M.R.B., Habiyaremye M., Sinsin B.A., Tossou C.R.	Human-wildlife conflicts and mitigation measures in Pendjari Biosphere Reserve, northern Benin	Annales des Sciences Agronomiques 22 (1)
<b>Ethnobiology</b>	5	Eméline Sêssi Pélagie Assédé, Chabi Adéyémé Marc Sylvestre Djagoun, Akomian Fortuné Azihou, Meryas Dègbémabou Kouton, Yannick Senakpon Caleb Gogan, Coert Johannes Geldenhuys, Paxie Wanangwa Chirwa and Brice Augustin Sinsin	Folk perceptions and patterns of use of orchid species in Benin, West Africa	Flora et Vegetatio Sudano-Sambesica
<b>Wildlife/ grassland</b>	6	Chabi A. M. S. Djagoun, Hugues Ak-pona, Barthélémy Kassa, Nathan Gichohi, Philip Muruthi, Brice Sinsin	Elephant conservation in Benin National Parks: an assessment of human elephant conflict and building stakeholders' capacity	Pachyderm
<b>Risk assessment/ Climate change</b>	7	TOYI S. S. Mireille, EDA A. Flora, BA-RIMA S. Sabas; BAMBA Issouf; SIN-SIN Brice	Dynamique paysagère de la Forêt Classée de la Lama au sud du Bénin	Tropicultura

**Appendix 8:** Articles in press in peer-review journal with IF in 2016

<b>Disciplines</b>	<b>N°</b>	<b>Authors' Names</b>	<b>Title of the article</b>	<b>Journals</b>	<b>Impact Factor</b>
<b>Agriculture/ Agroforestry</b>	1	T. J. D. Akpona, H. A. Akpona, B. A. Djossa, M. K. Savi, K. Daïnou, B. Ayihouenou & R. Glèlè Kakaï	Impact of land use practices on traits and production of shea butter tree ( <i>Vitellaria paradoxa</i> C.F. Gaertn.) in Pendjari Biosphere Reserve in Benin	Agroforestry Systems DOI 10.1007/s10457-015-9847-1	1.22
<b>Ethnobiology</b>	2	Assogba GA, Fandohan AB, Salako VK, Assogbadjo AE	Utilisations de <i>Bombax costatum</i> (Malvaceae) dans les terroirs riverains de la Réserve de Biosphère de la Pendjari, République du Bénin	Bois et Forêts des Tropiques	0.192
<b>Landscape ecology/ land degradation &amp; restoration</b>	3	Goussanou C.A., Guendehou S., Assogbadjo A.E., Sinsin B.	Application of site-specific biomass models to quantify spatial distribution of biomass stocks and historical emissions from deforestation in a tropical forest ecosystem in West Africa	Journal of Forestry Research	0.6
<b>Ethnobiology</b>	4	Houndonougbo J., Idohou R., Salako V. K., Fortune A. A., and Glèlè Kakaï R.	Local perceptions of elephant- <i>Borassus aethiopum</i> (Arecaceae) interactions in the Pendjari National Park in Benin	Bois et Forêts des Tropiques	0.192
<b>Forest/ Plant ecology</b>	5	Alain K. Gbeffe1, Thierry D. Houehanou1, Muhashy Habiyaremye, Emeline S. P. Assede, Alain S. Yaoitcha1, Luc Janssens de Bisthoven, Etotépé A. Sogbohossou, Marcel Houinato and Brice A. Sinsin	Effects of termite mounds on composition, functional types and traits of plant communities in Pendjari Biosphere Reserve (Benin, West Africa)	African Journal of Ecology	0.87
<b>Forest/ Plant ecology</b>	6	Inoussa, M.M., Padonou, E.A., Glèlè Kakaï, R., Lykke, A.M., Bakasso, Y., Mahamane, A., Saadou, M.	Structural and ecological indicators of <i>Pterocarpus erinaceus</i> and <i>Anogeissus leiocarpa</i> in woodland in the W National Park of Niger, West Africa	South African Journal of Botanic	1.244
<b>Risk assessment/ Climate change</b>	7	A.E. Assogbadjo, S. Mensah, R. Glele Kakai	The relative importance of climatic gradient versus human disturbance in determining population structure of <i>Afzelia africana</i> in West Africa	Southern Forests	0.696
<b>Landscape ecology/ land degradation &amp; restoration</b>	8	K. Gandji, V. Salako, A.E. Assogbadjo, V.O.A. Orekan, R.L. Glele Kakai, B.A. Sinsin	Evaluation of the sustainability of participatory management of forest plantations: the case study of Wari-Marо Forest Reserve, Republic of Benin (West Africa)	Southern Forests	0.696
<b>Socioeconomy</b>	9	S. Mensah, R. Veldtman, A.E. Assogbadjo, C.Ham, R. Glele Kakai, T. Seifert	Ecosystem service importance and use vary with socio-environmental factors: A study from household-surveys in local communities of South Africa	Ecosystem services	4.307

**Appendix 9:** Articles in press in peer-review journal without IF in 2016

<b>Disciplines</b>	<b>N°</b>	<b>Authors' Names</b>	<b>Title of the article</b>	<b>Journals</b>
<b>Wildlife/ grassland</b>	1	Ivan Bossima Koura, Serena Calabò, Luc Hippolyte Dossa, Nadia Musco, Monica Isabella Cutrignelli, Marcel Romuald Benjamin Houinato	Nutritional value of cereal and legume crop residues fed to ruminant in Republic of Benin	Journal of Nutritional Ecology and Food Research
<b>Wildlife/ grassland</b>	2	Zinzalo R., Akouehou G., Kindomihou V., Sinsin B.	Facies de végétation et caractérisation pastorale des agrosystèmes à <i>Elaeis guineensis</i> dans le périmètre Zè-Allada-Toffo au Sud-Bénin	International Journal of Biological and Chemical Sciences
<b>Ethnobiology</b>	3	Donou M.T., Houéhanou T., Assogbadjo A.E., Glèlè Kakai R.L., Agbangla C.	Use of Raffias' species ( <i>Raphia spp.</i> ) and its impact on socioeconomic characteristics of harvesters in Benin (West Africa)	International Journal of Biomolecules and Biomedicine, 5 (1), 1-19
<b>Wildlife/ grassland</b>	4	Doha Y. G. AWOHOUEDJI, Séverin BABATOUNDE, Alex Gbêliho Zoffoun, Sylvie Hounzangbe-Adote, Marcel Houinato, Ibrahim Traoré Alkoiret & Guy-Appolinaire Mensah	In vivo digestibility of <i>Boerhavia diffusa</i> and <i>Khaya senegalensis</i> in West African Dwarf sheep in the Sudano-Guinean zone in Benin.	South African Journal of Animal Science

**Appendix 10:** Articles in press in peer-review journal without IF in 2017

Disciplines	N°	Authors' Names	Title of the article	Journals	Impact Factor
Forest/ Plant ecology	1	Slik JWF, Franklin J, Arroyo-Rodriguez, V et al., Fandohan AB, et al. (181 more authors)	Phylogenetic classification of the world's tropical forests	Proceedings of the National Academy of Sciences of the United States of America	9,7
Wildlife/ grassland	2	S. DJEGO- DJOSSOU1, E. WIAFE2, G.A. MENSAH 1,3 et B. SINSIN1	Comparative in Diet and feeding ecology Between Olive Colobus Monkey ( <i>Procolobus verus</i> ) groups Living in degraded Forest and Protected Forest (Benin)	Folia Primatologica	0.737
Wildlife/ grassland	3	Vanvanhossou S.U.F., Koura B.I., Dossa L.H.	Cattle entrustment practice and its implications for the management of local animal genetic resources in African pastoral systems: a case study from Benin, West Africa.	Journal of Rural Studies.	2.21
Agriculture/ Agroforestry	4	Agbahoungba Symphorien, Karungi Jeninah, Ongom Patrick, Badji Arfang, Sadiq Kassim, Gibson Paul, Edema Richard, Assogbadjo Achille E. and Rubaihayo Patrick R.	Quantitative trait loci (QTL) associated with resistance to flower thrips in cowpea genotype Tvu-123 x WC36	African Journal of Bio-technology	0.44
Biodiversity	5	Padonou, E.A., Akakpo, A.B., Ahlinvi, S., Schmidt, M., Lykke, A.M., Assogbadjo, A., Sinsin, B.	Termites can restore plant diversity and soil on bowé in West Africa	Land degradation and development	

**Appendix 11:** Articles under review in peer-review journal without IF in 2017

Disciplines	N°	Authors' Names	Title of the article	Journals
<b>Agriculture/ Agroforestry</b>	1	Agoyi, E., Afutu, E., Tumuhairwe, JB., Chigeza, G., As-sogbadjo, A. and Tukamuhabwa, P. Sinsin B.	A more complete definition for "promiscuous soybean".	Agricultural Research and Technology
<b>Agriculture/ Agroforestry</b>	2	Agoyi, E., Sodédji, A., Chadare, F., Tumuhairwe, JB., Assogbadjo, A. and Tukamuhabwa, P.	What do Ugandan Farmers know about nodulation in soybean?	African Journal of Rural development
<b>Agriculture/ Agroforestry</b>	3	Agoyi, E., Tumuhairwe, JB., Chigeza, G., Tukamuhabwa, P. and Diers, B.	GBS technique to identify and map QTLs associated with promiscuous nodulation in soybean.	
<b>Agriculture/ Agroforestry</b>	4	KOLIMEDJE Emilie Norberte	Production et décomposition de litière dans la forêt naturelle et dans une plantation au sein de la Forêt Dense Semi Décidue de Pahou (Bénin)	Annale des sciences agronomiques

**Appendix 12:** Publications in proceedings in 2017

<b>Field of research</b>	<b>N°</b>	<b>Authors' Names</b>	<b>Title of the article</b>	<b>Full References</b>
<b>Risk assessment/ Climate change</b>	1	Gnikplekpo E.L., Romaric., KOURA B. Ivan., DOSSA H. Luc., AHOUANGAN Chiméi., HOUINATO Marcel	Les systèmes d'élevage bovin face à la variabilité, climatique et aux activités anthropiques le long du littoral du Bénin: Stratégies d'adaptation et durabilité. Acte des résumés du IVe colloque international des Sciences cultures, et technologies de l'UAC Campus UAC 25 au 30 Septembre 2017, p 472	Gnikplekpo E.L.Romaric., KOURA B. Ivan., DOSSA H. Luc., AHOUANGAN Chiméi., HOUINATO Mar-cel Les systèmes d'élevage bovin face à la variabilité, climatique et aux activités anthropiques le long du littoral du Bénin: Stratégies d'adaptation et durabili-té. Acte des résumés du IVe colloque international des Sciences cultures, et technologies de l'UAC Campus UAC 25 au 30 Septembre 2017, p 472
<b>Agriculture/ Agroforestry</b>	2	Adjatin R.C.F., Gnikplekpo E.R., Ahouangan C., Koura B.I., Dossa H.L., Houinato M.R.B.	Caractérisation des élevages péri-urbains de bovins dans la commune de Grand-Popo. Acte des résumés du IVe colloque international des Sciences cultures, et technologies de l'UAC Campus UAC 25 au 30 Septembre 2017	Adjatin R.C.F., Gnikplekpo E.R., Ahouangan C., Koura B.I., Dossa H.L., Houinato M.R.B. Caractéri-sation des élevages péri-urbains de bovins dans la commune de Grand-Popo. Acte des résumés du IVe colloque international des Sciences cultures, et tech-nologies de l'UAC Campus UAC 25 au 30 Sep-tembre 2017
<b>Risk assessment/ Climate change</b>	3	AHOUANGAN B. S. C. MERIMEE, ANAGONOU G., TOYI M.; ADI M., HOUINA-TO R. B M., BOGAERT J.	Impact des activités anthropiques sur la dynamique des mangroves dans la commune de Ouidah (Sud du Bénin). Acte des résumés du colloque international CONFLITS, DYNA-MIQUES DES PAYSAGES ET SECURITE ALIMENTAIRE EN AFRIQUE SUBSAHARIENNE 10-12 mai 2017, Université Jean Lorougnon Guédé, Daloa (Côte d'Ivoire)	AHOUANGAN B. S. C. MERIMEE, ANAGONOU G., TOYI M.; ADI M., HOUINATO R. B M., BO-GAERT J. Impact des activités anthropiques sur la dynamique des mangroves dans la commune de Ouidah (Sud du Bénin). Acte des résumés du col-loque international CONFLITS, DYNAMIQUES DES PAYSAGES ET SECURITE ALIMENTAIRE EN AFRIQUE SUBSAHARIENNE 10-12 mai 2017, Université Jean Lorougnon Guédé, Daloa (Côte d'Ivoire)
<b>Agriculture/ Agroforestry</b>	4	F.J AKADIRI., C.M AHOUANGAN., P. LESSE., B.I KOURA., L.H. DOSSA., M. HOUINATO	Caractérisation des pâturages périurbains le long de la côte du sud-Bénin. Livre des résu-més du XXIVème Journée Scientifique de l'ABePa (Pastoralisme, biodiversité et sécurité alimentaire).	F.J AKADIRI., C.M AHOUANGAN., P. LESSE., B.I KOURA., L.H. DOSSA., M. HOUINATO Caractéri-sation des pâturages périurbains le long de la côte du sud-Bénin. Livre des résumés du XXIVème Journée Scientifique de l'ABePa (Pastoralisme, biodiversité et sécurité alimentaire).

**Appendix 13:** Abstracts in books of abstracts in 2017

<b>Field of research</b>	<b>N°</b>	<b>Authors' Name</b>	<b>Title</b>	<b>Full References</b>
<b>Agriculture/ Agroforestry</b>	1	Agoyi, E., E., Chigeza, G., Tumuhairwe, J., B., A. Assogbadjo, A., E., Tukamuhabwa, P., Diers, B. W.	The 'Promiscuous' soybean varieties for the future of Africa's soybean production	
<b>Risk assessment/ Climate change</b>	2	Fandohan AB	Vulnerability of rural communities to climate change in the Gambia: influence of methodological approaches on assessment outcomes	Forstliche Versuchs - und Forschungsanstalt (FVA) (eds.) 125th IUFRO Anniversary Congress - Book of Abstracts, 2017. FVA and IUFRO, Freiburg, Germany, pp: 126
<b>Agriculture/ Agroforestry</b>	3	Sèwadé C., Azihou A. F., Anagonou S. P. G., Sinsin B. & Houinato M., 2017.	Conflits liés à l'exploitation des ligneux fourragers dans les terres de parcours du Bénin : acteurs, causes et modes de gestion	Poster et communication orale présentés au 6ème Colloque des Sciences, Cultures et Technologies de l'UAC du 25 au 30 septembre 2017. Bénin Book of Abstract, 537.
<b>Agriculture/ Agroforestry</b>	4	Clément Sèwadé, Akomian Fortuné Azihou, Sétondji Polynice Gédéon Anagonou, Romain Lucas Glèle Kakaï, Gaston Sèhounkpindo Akouéhou, Brice Sinsin et Marcel Houinato 2017	Conflits d'usage des ligneux fourragers des terres de parcours de la zone de transition Guinéo-Congolaise/ Soudanienne du Bénin : Typologie, acteurs, causes et modes de gestion	Atelier Interdisciplinaire sur le Développement en Afrique Subsaharienne (Bamako - Mali), les 8 et 9 décembre 2017 « Sécurité et conflits en Afrique : Approches écono-miques et juridiques » p 2

<b>Field of research</b>	<b>N°</b>	<b>Authors' Name</b>	<b>Title</b>	<b>Full References</b>
<b>Wildlife/ grassland</b>	5	Sogbohossou E.A., Sinsin B., Kassa B.D.	Utilisation des caméras pièges pour le monitoring de la faune dans les aires protégées du Bénin : résultats et perspectives	In : VIème Colloque des Sciences, Cultures et Technologies de l'Université d'Abomey-Calavi, Abomey-Calavi, 25-30 septembre 2017 Livre des résumés – Page 542
<b>Wildlife/ grassland</b>	6	Efio, E.A., Sogbohossou E.A., Magnon Y.Z., Houinato M., Tossou C.R.	Les mesures de gestion des conflits homme-faune dans la Réserve de Biosphère de la Pendjari au nord-Bénin	In : VIème Colloque des Sciences, Cultures et Technologies de l'Université d'Abomey-Calavi, Abomey-Calavi, 25-30 septembre 2017 Livre des résumés – Page 542
<b>Wildlife/ grassland</b>	7	Sogbohossou E.A., Aglissi J.	Diversité des petits carnivores dans la Réserve de Biosphère de la Pendjari	In : VIème Colloque des Sciences, Cultures et Technologies de l'Université d'Abomey-Calavi, Abomey-Calavi, 25-30 septembre 2017 Livre des résumés – Page 543
<b>Wildlife/ grassland</b>	8	Chabi, D.; Sogbohossou, E.; Sinsin, B.	Effectiveness of protected area in conserving the highly hunting bush meat species in Southern Benin	In : IUFRO 125th Anniversary Congress, Freiburg, Germany, 18-22 septembre 2017 Abstract book Page 655
<b>Risk assessment/ Climate change</b>	9	Gnikplekpo E.L.R., Koura B.I., Dossa H.L., Ahouangan C., Houinato M.	Les systèmes d'élevage bovin face à la variabilité climatique et aux activités anthropiques le long du littoral du Bénin: stratégies d'adaptation et durabilité	6th Conference of sciences, cultures and technologies of the University of Abomey-Calavi (Colloque UAC 2017) – from 25 to 30 September 2017 at University of Abomey-Calavi, Abomey-Calavi, Benin, Book of Abstract, 472-472.

**Appendix 13:** Abstracts in books of abstracts in 2017

<b>Field of research</b>	<b>N°</b>	<b>Authors' Name</b>	<b>Title</b>	<b>Full References</b>
<b>Ethnobiology</b>	10	Assédé E. S. P., Djagoun S. Geldenhuys C., Sinsin, B.	Endogenous knowledges, use and folk perception on conservation status of orchids in Sudanian zone of Bénin	IUFRO 125th Anniversary Congress 2017, (125th Anniversary, Freiburg, Germany, 18-22 September) Interconnecting Forests, Science and People – Freiburg, Germany – Page 150: 722.
<b>Forest/ Plant ecology</b>	11	Eméline Séssi Pélagie Assédé, Chabi Adéyèmi Marc Sylvestre Djagoun, Akomian Fortuné Azihou, Meryas Dègbémabou Kouton, Yannick Senakpon Caleb Gogan, Coert Johannes Geldenhuys, Brice Augustin Sinsin	Effectiveness of conservation areas in protecting orchid species (Benin, West Africa)	Colloque des Sciences, Cultures et Technologies de l'UAC (VI ème , Abomey-Calavi, Bénin, 25-30 Septembre). Arts, Sciences et Technologie pour le Développement des Nations - Abomey-Calavi, Bénin – 39 : 726
<b>Ethnobiology</b>	12	Eméline Séssi Pélagie Assédé, Chabi Adéyèmi Marc Sylvestre Djagoun, Akomian Fortuné Azihou, Meryas Dègbémabou Kouton, Yannick Senakpon Caleb Gogan, Coert Johannes Geldenhuys, Brice Augustin Sinsin	Capitalizing Folk Perception On Orchids Uses And Conservation Status In West Africa	Colloque des Sciences, Cultures et Technologies de l'UAC (VI ème , Abomey-Calavi, Bénin, 25-30 Septembre). Arts, Sciences et Technologie pour le Développement des Nations - Abomey-Calavi, Bénin – 39 : 726

**Appendix 14:** Technical Reports and books in 2017

<b>Field of research</b>	<b>N°</b>	<b>Authors' Name</b>	<b>Title</b>	<b>References</b>
<b>Forest/ Plant ecology</b>	1	AGBANI P., AZIHOU F., DJAGOUP S., DJEGO- DJOSSOU S. et NOBIME G.2017	Rapport de prospection des sites de la Forêt marécageuse sur le fleuve Couffo et de la Forêt galerie de Okpa	AGBANI P., AZIHOU F., DJAGOUP S., DJEGO- DJOSSOU S. et NOBIME G.2017. Rapport de prospection des sites de la Forêt marécageuse sur le fleuve Couffo et de la Forêt galerie de Okpa
<b>Biodiversity</b>	2	Thierry D. Houenahou, Emeline S. P. Assede, François Muhashy Habiayaremye, Etotépé A. Sogbohossou, Méryas Kouton, Pierre Onodjè Agbani, Alain S. Yaoitcha, Alain K. Gbeffe et Marcel R. B. Houinato	marécageuse sur le fleuve Couffo et de la Forêt gale-rie de Okpa	
<b>Wildlife/ grassland</b>	3	Sogbohossou E.A., Padonou M., Sinsin B.	La réserve de Biosphère de la Pendjari (Benin)	Rapport
<b>Wildlife/ grassland</b>	4	Marker L., Cristescu B., Morrison T., Flyman M.V., Horgan J., Sogbohossou E.A., Bissett C., Van Der Merwe V., de Matos Machado I.B., Fabiano E., Van Der Meer E., Aschenborn O., Melzheimer J., Young K., Farhadinia M.S., Wykstra M., Chege M., Abdoulkarim S., Amir O.G., Sh Mohanun A., Paulos O.D., Nhabanga A.R., M'soka J.L.J., Belbachir F., Ashenafi Z.T., Nghikembua M.T .	Cheetah Rangewide Status and Distribution	In Marker L., Boast L., SchmidtKuentzel A; (eds). Cheetahs: Biology and Conservation. 1st Edition. Academic Press. Pp 31-53.

<b>Field of research</b>	<b>N°</b>	<b>Authors' Name</b>	<b>Title</b>	<b>References</b>
<b>Biodiversity</b>	5	AZIHOU A. F., DJAGOUN C. A. M. S., TOYI S. M., AGBANI P. MAHAMANE K. J-M., AMBOUTA A., AHAMIDE B. & SINSIN B.	Guide de conduite du stage intégré régional du master professionnel en gestion des ressources naturelles et de la biodiversité (RESBIO)	AZIHOU A. F., DJAGOUN C. A. M. S., TOYI S. M., AGBANI P. MAHAMANE K. J-M., AMBOUTA A., AHAMIDE B. & SINSIN B. 2017. Guide de conduite du stage intégré régional du master professionnel en gestion des ressources naturelles et de la biodiversité (RESBIO). FSA/UAC/RESBIO. 40 pages
<b>Biodiversity</b>	6	Padonou, E.A.	Rôles des termitières dans la conservation de la biodiversité et la restauration des sols sur les bowé au Bénin	Padonou, E.A. 2017. Rôles des termitières dans la conservation de la biodiversité et la restauration des sols sur les bowé au Bénin. Manuel Pratique, The Rufford Fondation. 12pages
<b>Biodiversity</b>	7	Achille E. ASSOGBADJO, Elie PADONOU	Stratégie et du plan d'actions de gestion durable des écosystèmes de mangroves des sites RAMSAR 1017 et 1018 du Sud Bénin (Projet TCP/BEN/3502)	Stratégie et du plan d'actions de gestion durable des écosystèmes de mangroves des sites RAMSAR 1017 et 1018 du Sud Bénin (Projet TCP/BEN/3502)
<b>Biodiversity</b>	8	Achille E. ASSOGBADJO Brice TENTE Toussaint O. LOUGBEGNON Simon AHOUANSOU Etotépé A. SOGBOHOSSOU Elie PADONOU Pierre AGBANI Brice SINSIN	Inventaire floristique et faunique des écosystèmes de mangroves et des zones humides côtières du Bénin	Inventaire floristique et faunique des éco-systèmes de mangroves et des zones hu-mides côtières du Bénin (Projet TCP/BEN/3502)
<b>Biodiversity</b>	9	Zannou Affio, Padonou Elie Antoine	Etude des besoins en bois des populations dans les zones de mangroves des sites Ramsar 1017 et 1018	Etude des besoin en bois des populations dans les zones de mangroves des sites Ramsar 1017 et 1018 (Projet TCP/BEN/3502)

**Appendix 15:** Participation at workshops/conferences in 2017

N°	Title and period	Type of presentation (oral, poster, ..)	Name of the participants from LEA	Cost
<b>1</b>	Beekeeping and bee pollination services in pesticide application context in Bénin: implication for conservation; 11-15/09/2017	Oral presentation	Bruno Agossou DJOSSA, Oscar TEKA	
<b>2</b>	3rd to 6th December 2017: 3rd International Conference on Global Food Security. Cape Town, South Africa	Poster	Dr. Eric AGOYI	
<b>3</b>	20th October 2017: Visit the DuPont Pioneer Research and Seed Production Facilities in Iowa State, USA		Dr. Eric AGOYI	
<b>4</b>	19th October 2017: World Food Prize Laureate Award Ceremony, Iowa State Capitol, USA	N.A.	Dr. Eric AGOYI	
<b>5</b>	18th to 20th October 2017: Participation in the Borlaug Dialogue. Downtown Des Moines Marriott, Iowa State, USA	N.A.	Dr. Eric AGOYI	
<b>6</b>	17th October 2017: Participation in the DuPont Seed Security for Food Security Forum. Downtown Des Moines Marriott Hotel, Io-wa State, USA	N.A.	Dr. Eric AGOYI	
<b>7</b>	16th October 2017 : Participation in the Eleventh Annual Iowa Hunger Summit : UNITED in Fighting Hunger. Downtown Des Moines Marriott Hotel, Iowa State, USA	N.A.	Dr. Eric AGOYI	
<b>8</b>	IUFRO 125th Anniversary Congress 2017), Freiburg, Allemagne, du 17 au 22 Septembre 2017.	Oral	Fandohan AB	3000 Euros
<b>9</b>	7th Forest Science Symposium, Pietermaritzburg, Afrique du Sud, du 18 au 20 Juillet 2017	-	Fandohan AB	3000 Euros
<b>10</b>	Congrès inaugural de la Société Africaine de Primatologie (SAP),	Poster	NOBIME Georges ZOFFOUN Ghislain TCHABI OTA Raimi	
<b>11</b>	European Conference of Tropical Ecology, "(re)connecting tropical biodiversity in space and time", February 06-10, 2017, Vrije Universiteit Brussels, Belgium	Poster	Thierry Houehanou	
<b>12</b>	6ème Colloque des Sciences, Cultures et Technologies de l'Université d'Abomey-Calavi sur les « Arts, Sciences et Technologies pour le Développement Socio-économiques des Nations », 25 au 30 septembre 2017, Abomey-Calavi, Bénin.	Oral	ADJATIN Coralie	
<b>13</b>	6ème Colloque des Sciences, Cultures et Technologies de l'Université d'Abomey-Calavi sur les « Arts, Sciences et Technologies pour le Développement Socio-économiques des Nations », 25 au 30 septembre 2017, Abomey-Calavi, Bénin	Oral	GNIKPLEKPO Romaric	

N°	Title and period	Type of presentation (oral, poster, ..)	Name of the participants from LEA	Cost
<b>14</b>	Colloque international CONFLITS, DYNAMIQUES DES PAY-SAGES ET SECURITE ALIMENTAIRE EN AFRIQUE SUBSA-HARIENNE 10-12 mai 2017	Poster	AHOUANGAN Chiméï	
<b>15</b>	XXIVème Journée Scientifique de l'ABePa (Pastoralisme, biodi-versité et sécurité alimentaire).	Oral	AKADIRI Farid	
<b>16</b>	Symposium International sur la Science et la Technologie (SIST), Ouagadougou (Burkina-Faso), du 04 au 08 décembre 2017	Oral	ADJAHOSSOU Christian	
<b>17</b>	ABEPA, novembre 2017	Oral	ADJAHOSSOU Christian	
<b>18</b>	Colloque international sur la « Sécurité alimentaire et Adaptation des systèmes de production aux changements climatiques », 15 au 17 Novembre 2017 Campus Universitaire de Parakou, Para-kou, Bénin	Oral	ADJAHOSSOU Christian	
<b>19</b>	IUFRO 125th ANNIVERSARY Congress 2017. From 18/10/2017 to 22/10/2017, Freiburg, Germany	oral	Djagoun Chabi A.M.S.	4000 EUR
<b>20</b>	1st International Conference of TWAS Young Scientist Network. From 22/08/2017 to 24/08/2017, Rio de Janeiro, Brazil	oral	Djagoun Chabi A.M.S.	5000 USD
<b>21</b>	Conference on Climate, Ecosystems and Livelihoods for Africa, Sep 4-5th, Nairobi, Kenya	Attendance only	Djagoun Chabi A.M.S.	4000 USD
<b>22</b>	IUFRO 125th Anniversary Congress, 125th Anniversary, Freiburg, Germany, 18-22 September	Oral	Chabi Adéyèmi Sylvestre Djogoun, Gille Nago	
<b>23</b>	Colloque des Sciences, Cultures et Technologies de l'UAC (VI ème , Abomey-Calavi, Bénin, 25-30 Septembre)	Oral		
<b>24</b>	25 – 29 Septembre 2017: Colloque UAC 2017	Oral	Avakoudjo Julien	
<b>25</b>	24-28 October 2017, UAS, Bengaluru, India; the 7 Interna-tional Conferences on. Silicon in Agriculture.	Oral & Poster	Kindomihou Valentin	
<b>26</b>	11 Mars – 29 Avril 2017 (UAC/Calavi/Bénin); Formation pilote sur l'agriculture écologique et biologique	Oral	Kindomihou Valentin	
<b>27</b>	27-28 decembre 2017 à l'Hôtel Paquita de Bohicon (Bénin): Ate-lier de restitution de la 4ème Conférence Ouest Africaine sur l'Agriculture Biologique et Ecologique et de présentation des acti-vités du projet	Participant	Kindomihou Valentin	
<b>28</b>	7 Août 2017 à l'hôtel KTA-Cotonou (Bénin): Atelier de Validation du Rapport d'évaluation du document de stratégie de communi-cation du pilier information et communication de l'initiative EOA	Participant	Kindomihou Valentin	
<b>29</b>	Conflits, dynamiques des paysages et sécurité alimentaire en Afrique subsaharienne	Oral	Mireille TOYI; Chiméï AHOUANGAN	

N°	Title and period	Type of presentation (oral, poster, ..)	Name of the participants from LEA	Cost
<b>30</b>	AgriFoSe2030 - Agriculture for Food Security, course on Multi-functional landscapes for food security, 23.01 to 26.01.2017, Nairobi Kenya	Attendancy	Padonou Elie	
<b>31</b>	Appréhender l'espace public: apports des outils et méthodes de description spatiale du 18 au 21 septembre à l'Ecole du Patri-moine Africain à Porto-Novo (Bénin) organisées par la Faculté d'Architecture La Cambre-Horta de L'Université Libre de Bruxelles dans le cadre du projet de recherche (PDR-FNRS) « Es-paces publics dans les villes d'origine pré-coloniale dans le Sud-Bénin ».	Oral	Padonou Elie	
<b>32</b>	Training workshop for scientific relevance in African Agricultural Universities. Morogoro (Tanzania), 14-16 September 2017	Attendancy	Achille Assogbadjo	
<b>33</b>	Participation at the Food & Business ARF & GCP research – poli-cy dialogue conference. Then Hague, The Netherlands, 30 November & 1st December 2017	Attendancy	Achille Assogbadjo	
<b>34</b>	Participation in the “Intra-Africa Academic Mobility Scheme – Call 2018 proposal preparation” workshop, Lilongwe, Malawi, 21-25 October 2017	Attendancy	Achille Assogbadjo	
<b>35</b>	Participation in the VIème Colloque de l'UAC des Sciences, Cul-tures et Technologies sur le thème : Arts, Sciences et Technologies pour le Développement Socio-économique des Nations. Abomey-Calavi, Benin, September 25 - 30, 2017	Attendancy	Achille Assogbadjo	
<b>36</b>	Participation in the workshop on “Capacity Building for Scientific Relevance in African Agricultural Universities. Morogoro, Tanzania, September 14 – 16, 2017	Attendancy	Achille Assogbadjo	
<b>37</b>	Participation in INTRA-ACP Academic Mobility Project Meeting. Entebbe, Uganda, 13 – 16 August 2017	Attendancy	Achille Assogbadjo	
<b>38</b>	Participation in PBES third authors meeting for AfRA experts. Addis Ababa, Ethiopia, 7–11 August 2017	Attendancy	Achille Assogbadjo	
<b>39</b>	Participation in the Regional Workshop on Sharing of Knowledge and Experiences on SFM and Climate Change in African Forestry. Entebbe, Uganda, 22 - 26 May 2017.	Attendancy	Achille Assogbadjo	
<b>40</b>	Participation in Staff Exchange and Mid-Term Review of Ruforum’s Strategic Business Plan (2015-2020). Kampala, Uganda, 21-22 April 2017	Attendancy	Achille Assogbadjo	
<b>41</b>	Participation at the « atelier de formation pour l'Afrique franco-phone visant à créer une capacité en conseil scientifique aux gouvernements » Dakar, Senegal, 5-7 March 2017	Attendancy	Achille Assogbadjo	

N°	Title and period	Type of presentation (oral, poster, ..)	Name of the participants from LEA	Cost
<b>42</b>	Participation in the Summary for Policymakers (SPM) capacity development writing workshop for the ongoing IPBES regional and thematic assessments. Oslo, Norway, 27 February - 2 March 2017	Attendancy	Achille Assogbadjo	
<b>43</b>	Participation in IPBES Capacity Building Writing Workshop for AfRA experts. Golden Gate Highlands National Park, South Africa, 12 – 18 February 2017.	Attendancy	Achille Assogbadjo	
<b>44</b>	Participation to Tought for Food selected projects kickoff meeting. Montpellier/ France, 27 January to 05 February 2017.	Attendancy	Achille Assogbadjo	

**Appendix 16:** Research projects of LEA in which you have been involved in 2017

N°	Title of the project	Sources of Funding	Objectives of the project	Status (ongoing or ended)	Estimated fund
<b>1</b>	Biologie de la conservation et ethnopharmacologie des ligneux médicinaux de la pharmacopée béninoise (BIOCEL).	Financement FRNS-IT/BENIN	(i) Evaluer la diversité et la disponibilité des principales espèces ligneuses médicinales employées pour le traitement des maladies humaines et animales les plus récurrentes ; (ii) Déterminer les aires prioritaires de conservation des principales espèces ligneuses médicinales; (iii) Evaluer in vivo les propriétés médicinales des principales espèces ligneuses utilisées pour le traitement des pathologies animales la plus récurrente.	Ongoing	
<b>2</b>	Projet de partenariat entre le LEA et l'IRSNB: Investigating bush fire, habitats and ecosystems services for strengthening local conservation in Pendjari Biosphere Reserve.	Institut Royal des Sciences Naturelles de la Belgique (IRSNB).	1. Renforcer les capacités de l'université d'Abomey-Calavi à répondre aux préoccupations de la DPNP, et des AVIGREFs sur la gestion des feux et leurs impacts sur les habitats et la faune dans la Réserve de Biosphère de la Pendjari, tout en valorisant l'expertise de l'IRSNB. 2. Informer et sensibiliser les acteurs et les bénéficiaires des services inhérents au parc (entre autres CE-NAGREF et AVIGREFs) sur les valeurs de ces services écosystémiques. 3. Contribuer au réseau CHM national pour renforcer la coopération scientifique et technique	Ongoing	
<b>3</b>	Amélioration des systèmes	ARES		Ongoing	500,000 euros
<b>4</b>	traditionnels d'élevage de petits ruminants (ovins et caprins) dans un contexte de mutation	FNRSIT		ongoing	30,000,000 F CFA
<b>5</b>	Supporting anti-poaching efforts together with human-elephant conflict in Pendjari and wider W Park.	Species Protection Grant	- Enhance effectiveness of rangers in monitoring the reserve and managing threats - Empower local communities to protect their crops from elephant damage	Ongoing	USD 50,000
<b>6</b>	Participatory Selection of cowpea varieties resistant to aphid and striga in Benin	The Kirkhouse Trust SCIO	Overall objective This project aims to improve livelihoods of smallholder farmers through selection of improved cowpea varieties in Benin. Specific objectives Specifically, the project aims to: 1- identify introduced lines of cowpea with resistance to aphid and striga under artificial inoculation conditions in Benin. 2- determine the adaptability and stability of selected cowpea lines for yield and resistance to aphids and striga under different agro-ecological zones in Benin	Ongoing	13.539.900 FCFA

N°	Title of the project	Sources of Funding	Objectives of the project	Status (ongoing or ended)	Estimated fund
<b>7</b>	Renforcement des capacités des acteurs de la conservation pour une mise en pratique des acquis de la recherche scientifique dans la Réserve de Biosphère de la Pendjari (RBP)	Institut Royal des Sciences Naturelles de Belgique	Améliorer l'état des connaissances et l'utilisation des acteurs de la conservation par les acquis de la recherche.	ongoing	
<b>8</b>	Dynamiques paysagères en période de crises politico-militaires en Côte d'Ivoire : influences sur la gestion et la disponibilité des terres agricoles et la sécurité alimentaire.	IRD	Développer des connaissances sur les conséquences des crises politico-militaires des années 2000 en Côte d'Ivoire sur les dynamiques des paysages naturels et la disponibilité des terres pour l'agriculture de subsistance avec comme pays témoins, le Bénin et le Burkina-Faso	Ended by May 2017.	8.000.000 FCFA
<b>9</b>	Effets combinés des activités anthropiques et de la variabilité climatique sur les ressources naturelles et systèmes d'élevage du cordon littoral du bénin (Afrique de l'ouest)	FNRSIT/Bénin	Étudier la dynamique spatio-temporelle des paysages marqués par les activités anthropiques (système d'élevage bovin, agriculture périurbaine, pêche et urbanisation) et la variabilité climatique ainsi que leur impact sur la structure du paysage et les pratiques agro forestières sur les communes côtières du Bénin	Ongoing	30.000.000 FCFA
<b>10</b>	Quantification of the wood need of the local population living around mangrove ecosystems in RAMSAR site 1017 and 1018, South Benin.	FAO-Benin	Quantification of the wood need of the local population living around mangrove ecosystems in RAMSAR site 1017 and 1018, South Benin.	Ended	
<b>11</b>	Inventory of biodiversity of mangrove ecosystems in RAMSAR site 1017, South Benin	FAO-Benin	inventory of biodiversity of man-grove ecosystems in RAMSAR site 1017, South Benin		10 000 000 FCFA
<b>12</b>	Elaboration of the strategy and sustainable management plan of mangrove ecosystems in RAMSAR site 1017 and 1018 of South Benin.	FAO-Benin	Elaboration of the strategy and sustainable management plan of man-grove ecosystems in RAMSAR site 1017 and 1018 of South Benin.		20 000 000

N°	Title of the project	Sources of Funding	Objectives of the project	Status (ongoing or ended)	Estimated fund
<b>13</b>	Enhancing nutritious food availability through promotion of native edible tree/shrub species in Sub-Saharan Africa (TREEFOOD) (Benin-Niger-Burkina Faso-Mali-Danemark-Belgium)	AGROPOLIS FOUNDATION	Enhancing nutritious food availability through promotion of native edible tree/shrub species in Sub-Saharan Africa	Ongoing	
<b>14</b>	Enhancing kersting's groundnut ( <i>Macrotyloma geocarpum</i> ) production and marketability in Benin (Projet Doyiwé)	NWO-Applied Research Fund	Enhancing kersting's groundnut ( <i>Macrotyloma geocarpum</i> ) production and marketability in Benin	Ongoing	
<b>15</b>	Utilisation des parents sauvages des plantes cultivées pour améliorer l'adaptation des systèmes de cultures au stress biotique et abiotique dans le contexte des changements climatiques.	FNRSIT	Utilisation des parents sauvages des plantes cultivées pour améliorer l'adaptation des systèmes de cultures au stress biotique et abiotique dans le contexte des changements climatiques.	Ongoing	
<b>16</b>	Graduate Research Grant. Promoting environmentally friendly practices for sustainable baobab leaves production for food and nutritional security in smallholders farming systems in Benin (West-Africa)	RUFORUM	Promoting environmentally friendly practices for sustainable baobab leaves production for food and nutritional security in smallholders farming systems in Benin (West-Africa)	Ongoing	
<b>17</b>	Tchad National Strategy for the sustainable use and valorization of Non timber Forest Products.	FAO-Tchad	Tchad National Strategy for the sustainable use and valorization of Non timber Forest Products	Ongoing	
<b>18</b>	Zero Hunger Assessment for Benin	World Food Programme	Zero Hunger Assessment for Benin	Ongoing	

**Appendix 17:** Research Grants in 201

<b>N°</b>	<b>Title of Grant</b>	<b>Beneficiaries</b>	<b>Status (ongoing or ended)</b>	<b>Estimated fund</b>
<b>1</b>	Enhancing Kersting's groundnut ( <i>Macrotyloma geocarpum</i> ) production and marketability in Benin (Projet Doyiwé)	Consortium : SOJAGNON-NGO, UAC/FSA, WUR/ MCB, BAIH-Sarl, RE-DAD	Ongoing	300000 euros
<b>2</b>	Georg Forster Research Fellowship (HERMES) for Postdoctoral Researchers: Improving the efficiency of conservation and management strategies of the threatened tree species, <i>Afzelia africana</i> Sm. using morphological and molecular tools on its West African populations	Thierry Houehanou	ongoing	
<b>3</b>	Rufford Small Grant: Towards botanic garden setting through community-based knowledge for forest genetic resources conservation and training students in Sudanian zone of Benin	Thierry Houehanou	Ended	
<b>4</b>	Ecology of Regeneration and Restoration of Natural Habitats of <i>Garcinia kola</i> and <i>Cola nitida</i> in Benin: Rural Community based Approach [Rufford 2nd Grant]	Merveille Koissi Savi	En cours	5000 GBP
<b>5</b>	IFS Individual Research Grant	Koura B. Ivan	Ongoing	12,000 dollars USD

**Appendix 18:** Prizes and nomination in 2017

<b>N°</b>	<b>Title of prize / nomination</b>	<b>Nominee</b>	<b>Estimated fund</b>
<b>1</b>	Nominate in African Academy of Sciences (AAS) Affiliate	Padonou Elie	
<b>2</b>	Nominated by Science in Africa among the top scientists for their outstanding contributions as African research-ers in 2017	Achille Assogbadjo	

**Appendix 19:** Visitors received in 2016

<b>N°</b>	<b>Full names of visitors</b>	<b>Provenance</b>	<b>Responsibles in LEA</b>	<b>Topics</b>
1	Jean-Paul LEDANT	Belgique	HOUINATO Marcel	Projet PRD-ARES
2	Dominique DEMBLON	Belgique	HOUINATO Marcel	Projet PRD-ARES
3	Claire AVRIL	Belgique	HOUINATO Marcel	Projet PRD-ARES
4	Christian PLOWMAN	ZSL, England / Africa	SOGBOHOSSOU E.A	Nature and Extent of Wildlife Crime
5	Murray STOKOE	South Africa	SOGBOHOSSOU E.A	Wildlife Capture Methods
6	Bianca Gasparrini	Italy	Prof HOUINATO	Animal biotechnology and reproduction

## **ABSTRACTS OF PUBLICATIONS**

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## 8.1 ARTICLES PUBLISHED IN PEER-REVIEW JOURNAL WITH IMPACT FACTOR (IF) IN 2017

### Genotype by environment effects on promiscuous nodulation in soybean (*Glycine max L. Merrill*) [Published in Agriculture and Food Security]

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Received: February 14, 2017 / Revised: April 21, 2017 / Accepted: April 29, 2017

#### ABSTRACT

**Background:** Understanding factors influencing the expression of a trait is key in designing a breeding program. Genotype by environment interaction has great influence on most quantitative traits. Promiscuous nodulation is a trait of importance for soybean production in Africa, because of the soil bacteria *Bradyrhizobium japonicum* not being indigenous in most African soils. Most soybean cultivars require *B. japonicum* for nodulation leading to the need for seed inoculation before sowing soybean in Africa. Few cultivars have capability to nodulate with *Bradyrhizobia* spp. that are different from *B. japonicum* and native in African soils. Such cultivars are termed "promiscuous cultivars." Field experiments were conducted in six locations in Uganda for two seasons, to investigate the extent of environmental influences on the nodulation ability of promiscuous soybean genotypes. **Results:** Additive main effect and multiplicative interaction effects showed highly significant environment and genotype by environment (GxE) interaction effects on all nodulation traits. GxE interaction contributed more to the total variation than genotypes. The genotypes Kabanyolo I and WonderSoya were the most stable for nodules' dry weight (NDW), which is the nodulation trait the most correlated with grain yield. Genotype UG5 was the most stable for nodules' number (NN), and Nam II for nodules' effectiveness (NE). The genotype NamSoy 4M had the highest performance for NN, NFW, and NDW, but was less stable. WonderSoya had the highest NE. Genotype and genotype by environment analysis grouped environments into mega-environments (MEs), and four MEs were observed for NDW, with NamSoy 4M the winning genotype in the largest ME, and Kasese B the ideal environment for that nodulation trait. **Conclusion:** This study provides information that can guide breeding strategies. The low genetic effect that led to high environmental and GxE interaction effects raised the need for multi-environments testing before cultivar selection and recommendation. The study revealed genotypes that are stable and others that are high performing for nodulation traits, and which can be used as parental lines in breeding programs.

**Keywords:** *Bradyrhizobium* sp. USDA 3456, GxE, Nodulation, Promiscuous Soybean

### Local perceptions of interactions between elephants and *Borassus aethiopum* Mart. (Arecaceae) in the Pendjari National Park in Benin

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#### ABSTRACT

Elephants are reported to have a dramatic impact on woody vegetation in protected areas. Careful control of elephant and wood species populations is therefore crucial to successful biodiversity management in such ecosystems. The perceptions of local people and protected areas managers could very usefully supplement classic ecological surveys and monitoring to achieve this goal. This study assessed the perceptions of managers and local people regarding the causes, damage, consequences and management options of elephant pressure on the declining dioecious palm *Borassus aethiopum*. The study was conducted in the Pendjari National Park, which is part of the W-Arly-Pendjari transboundary complex of reserves in West Africa. Semi-structured interviews were conducted with 53 respondents belonging to three socio-professional categories: administrators, ecoguards and local professional hunters. Relative frequency of citation and the Pearson correlation were used to assess the consensus and concordance of their perceptions, respectively. The respondents reported a steep increase in the number of elephants in the Pendjari National Park, which they attributed to significant elephant migration from

transboundary parks where poaching pressure was perceived as high. This has resulted in high pressure on tree species including *B. aethiopum*. Despite differences in professional outlook, consensual and concordant opinions were noted among administrators, ecoguards and local professional hunters on the relationship between *B. aethiopum* and elephants. A regional approach aiming to protect the elephant population (low poaching) in the W-Arly-Pendjari complex and other neighbouring reserves was suggested in order to limit elephant migration.

Keywords: African fan palm, elephant, pressure, reserve managers, savannah, West Africa.

### **Usages de *Bombax costatum* (Malvaceae) dans les terroirs riverains de la réserve de biosphère de la Pendjari, République du Bénin**

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#### Résumé

La capitalisation des savoirs endogènes sur les plantes autochtones et leur valorisation pourraient efficacement contribuer à l'atteinte des objectifs du millénaire pour le développement qui visent, entre autres, à éliminer la pauvreté, la faim et à assurer la sécurité alimentaire dans le monde. *Bombax costatum* (faux kapokier) est une espèce des zones soudanaises peu étudiée et sous-utilisée. Cette étude a évalué les connaissances traditionnelles sur les usages de *B. costatum* en relation avec les facteurs sociodémographiques (âge et sexe) et le groupe socioculturel. À cet effet, 118 entretiens individuels semi-structurés ont été réalisés dans les terroirs riverains de la réserve de biosphère de la Pendjari au Bénin. La fréquence relative de citation, la valeur d'usage rapportée et l'indice d'importance culturelle ont été utilisés pour quantifier les usages et l'importance de l'espèce. Au total, 46 usages ont été recensés et classés en huit catégories d'usages dont les plus citées et ayant les valeurs d'importance culturelle les plus élevées sont les usages alimentaires et médicinaux. Le calice est la partie de plante la plus sollicitée pour les usages alimentaires ; il est de surcroît localement commercialisé. Les usages médicinaux impliquent plusieurs organes/parties (calice, feuille, écorce, graine et racine). Les connaissances sur les usages de *B. costatum* variaient significativement entre groupes socioculturels mais pas entre sexe et catégorie d'âges. En effet, les groupes socioculturels Berbas et Gourmantchés contrairement aux Waamas, Natimbas et Peulhs possédaient plus de connaissances sur les usages de *B. costatum* et avaient une préférence pour les usages alimentaires. La promotion des usages alimentaires de *B. costatum* peut être envisagée et ainsi servir de point de départ pour sa plus large valorisation. Les études futures devraient toutefois explorer d'autres régions d'occurrence de l'espèce et mettre l'accent sur la valeur nutritionnelle, les revenus générés par la plante, de même que sa propagation en vue de sa valorisation.

### **Inventory and multicriteria approach to identify priority commercial timber species for conservation in Benin**

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#### Résumé

Diverses essences forestières dont certaines sont menacées, sont exploitées pour leur bois, légalement ou non. Cependant, il serait peu réaliste d'envisager des actions de conservation pour toutes les espèces concernées. Il est donc nécessaire d'élaborer un système de priorisation afin de définir les essences prioritaires pour la conservation. La présente étude propose une approche multicritère de priorisation des essences sujettes à l'exploitation forestières au Bénin. Pour ce faire, un inventaire des essences exploitées au Bénin a été réalisé et les essences prioritaires pour lesquelles des actions urgentes de conservation et de restauration sont nécessaires ont été identifiées. Des recherches bibliographiques complétées par des entretiens avec différentes parties prenantes ont été menées afin de recueillir les données requises pour dresser une liste exhaustive des essences prioritaires. Dix critères et quatre méthodes de priorisation ont été utilisés. Au total, vingt-quatre (24) espèces végétales ont été identifiées, appartenant à neuf (9) familles : Fabaceae (25 %), Malvaceae (20,83 %), Meliaceae (16,67 %), Combretaceae (8,33 %), Moraceae (8,33 %), Verbenaceae (8,70 %), Ebenaceae (4,17 %), Rutaceae (4,17 %) et Myrtaceae (4,17 %). Le recoupage des résultats d'hierarchisation des espèces selon chacune

des méthodes, a permis de retenir 10 essences prioritaires. Notamment, *Khaya senegalensis*, *K. grandifoliola*, *Afzelia africana*, *Milicia excelsa*, *Pterocarpus erinaceus*, *Isoberlinia tomentosa*, *Antiaris toxicaria*, *Anogeissus leiocarpa*, *Pseudocedrela kotschy*, *Isoberlinia doka*. Compte tenu des fortes pressions d'exploitation exercées sur les 10 essences prioritaires ainsi retenues, des mesures de conservation et de restauration sont préconisées.

### Extraction of Timber and Non-Timber Products from the Swamp Forest of Lokoli (Benin): Use Patterns, Harvesting Impacts and Management Options

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#### Résumé

The study of anthropogenic impacts on tropical forests is vital in the design and development of sustainable extraction systems for both timber and non-timber products. However, distinguishing non-timber forest products (NTFPs) harvesting impacts from timber extraction consequences on the vegetation could be difficult, since tropical forest species often have a multipurpose status. This study explores the purposes and characteristics of timber and non-timber products usage in the Swamp Forest of Lokoli (in the south of Benin Republic) and assesses extraction impacts on the forest dynamics. We used structural parameters analysis and ecological indices to explain the vegetation structure and the species responses to anthropogenic pressures. The results suggest that the forest is being devastated by extraction activities of the local people including both timber collection and non-timber harvesting. Finally, this paper suggests that management policies balancing socio-economic and conservation priorities, through introduction of alternative economic activities, strengthening of the local agriculture and a participatory management plan are the best options for the long term preservation of this forest.

### Usages traditionnels et valeur économique de *Synsepalum dulcificum* au Sud-Bénin

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#### Résumé

La dépendance des populations locales africaines vis-à-vis des ressources prélevées en milieu naturel est avérée, et peut représenter une menace pour la survie des espèces prélevées. La gestion rationnelle des populations de ces espèces nécessite une bonne compréhension de leur importance pour ces communautés. *Synsepalum dulcificum* (Schumach. & Thonn. Daniell) est un arbuste originaire de l'Afrique de l'Ouest, inscrit sur la liste des espèces vulnérables de l'IUCN. Au Bénin, son importance pour les populations locales reste peu documentée. Le présent article avait alors pour objectif d'évaluer les connaissances endogènes, la valeur d'usage et l'importance économique de l'espèce pour les populations locales. Des enquêtes ethnobotaniques et économiques ont été conduites auprès de 606 personnes réparties dans 13 groupes socioculturels du Sud-Bénin. Des paramètres ethnobotaniques (fréquence de citation, valeur d'usage ethnobotanique) et économique (revenu moyen réalisé) ont été calculés, et leur significativité éprouvée par l'ajustement de modèles linéaires généralisés et le test de Kruskal et Wallis. Les résultats ont montré que *S. dulcificum* est bien connu des populations locales du Sud Bénin (100 % des enquêtés), qui le cultivent notamment dans les jardins de case. Toutes les parties de la plante sont utilisées à des fins médicinales, alimentaires et spirituelles. Les connaissances et la valeur d'usage

de la plante varient entre les groupes socioculturels du Sud-Bénin, avec un gradient décroissant Est-Ouest. Les connaissances et la valeur d'usage varient en fonction du sexe, l'âge et le domaine d'activité, les connaissances étant concentrées au niveau des hommes, des adultes et personnes âgées, et des praticiens de la médecine traditionnelle. L'évaluation économique a révélé un circuit de commercialisation relativement court. Le faible revenu moyen réalisé sur la vente des fruits (environ 28 Dollars US par an et par commerçant) illustre la faible valeur économique de l'espèce qui constitue une ressource de subsistance en déclin. La conservation et la valorisation optimale de l'espèce nécessiteront des investigations sur les plans nutritionnel, phytochimique et pharmaceutique, phénologique, morphologique et génétique, le développement d'une sylviculture, l'intégration de la plante dans les politiques formelles de conservation, et enfin le développement d'une chaîne de valeurs à travers la mise en place d'une véritable filière.

### Functional diversity of home gardens and their agrobiodiversity conservation benefits in Benin, West Africa

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#### Résumé

Comprendre la diversité fonctionnelle des jardins de case et leurs déterminants socio-écologiques est essentiel pour intégrer ces pratiques agroforestières dans les stratégies de conservation de l'agrobiodiversité. Cet article analyse la diversité fonctionnelle des jardins de case, identifie les facteurs socio-écologiques des fonctions qui leur sont assignées et évalue les avantages de la biodiversité agricole pour ces jardins. En utilisant des données sur les espèces présentes dans le jardin de case (JC) et les fonctions attribuées à chaque espèce par les jardiniers, l'étude a combiné des analyses canoniques et discriminantes pour explorer la diversité fonctionnelle de 360 JC au Bénin. Des modèles logistiques multinomiaux et des tests du chi carré ont été utilisés pour analyser l'effet des caractéristiques sociodémographiques des jardiniers (âge, sexe et niveau d'éducation), des zones agro-écologiques (humides, subhumides et semi-arides), et régime de gestion (gestionnaires uniques et multiples) sur la possession d'un type fonctionnel de JC. Des modèles linéaires généralisés ont également été utilisés pour évaluer l'effet des fonctions des jardins et le facteur déterminant sur leur potentiel à conservation l'agrobiodiversité. Sept groupes fonctionnels de JC, dont quatre avec des fonctions spécifiques (alimentaires, médicinales, ou à la fois alimentaires et médicinales) et trois avec des fonctions multiples (plus de deux fonctions principales), ont été observés. Les femmes possédaient la plupart des jardins avec pour fonction principale la production de plantes alimentaires, alors que les hommes possédaient en général des jardins principalement à des fins de production de plantes médicinales. Nos résultats suggèrent également que les jardins multifonctionnels présentaient une plus grande diversité d'espèces végétales. Plus précisément, les plantes cultivées et les plantes sauvages apparentées à des plantes cultivées se trouvaient principalement dans les jardins familiaux à fonction alimentaire, tandis que les espèces végétales sauvages se retrouvaient principalement dans les jardins à fonction principalement médicinale. En dépit de la grande diversité végétale observée dans les jardins de case, nos résultats n'ont révélé aucune garantie de maintien à long terme des espèces concernées dans ces jardins.

### A quantitative ethnobotanical approach toward biodiversity conservation of useful woody species in Wari-Maro forest reserve (Benin, West Africa)

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#### Abstract

Quantitative ethnobotany researches can contribute much to guide biodiversity conservation, especially in developing countries. Our study presents a step-by-step approach to identify priority species for local conservation of useful woody species. The presented approach includes (1) an investigation of the popularity and versatility of woody species in the local people, (2) an estimation of the ecological availability of useful tree species in the forest and (3) identification of local priority species for conservation. We focused the study on the

Wari-Maro forest reserve in the Sudanian zone of Benin as an example to implement such approach and identify useful priority species for sustainable conservation and management strategies development. Ethnobotanical surveys were conducted with people in surrounding villages of the forest composed by different sociocultural groups. Floristic vegetation surveys were performed within the forest to assess the local ecological availability of used woody species. A principal component analysis was performed to analyze the versatility, the popularity and the ecological availability of species. Spearman's correlation test was used to assess relation between variables. In total, 79 woody species were reported for seven main types of uses: technology, construction, medicinal, veterinary, food, forage and energy. Among them, 35 were most popular and versatile, and 3 were characterized as priorities for conservation especially regarding their less availability and more versatility. We discussed the used approach by the underlining importance of integrating wood uses or multiples uses in conservation priorities setting and conservation decision-making of useful woody tree species.

Keywords : Versatility \_ Ecological availability \_ Quantitative ethnobotany \_ Conservation priorities

### Patterns of elephant utilization of *Borassus aethiopum* Mart. and its stand structure in the Pendjari National Park, Benin, West Africa

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#### Résumé

#### Abstract

Understanding interactions of elephants with threatened plant species is crucial to guide conservation decisions in protected areas (PAs). This study focused on the dioecious palm *Borassus aethiopum* Mart. in the Pendjari National Park (PNP). The aim was to assess elephant damages to the palm, and compare the stand structure (adult sex-ratio, density, height, diameter, and survival of regenerations) of the palm in stands of high versus low elephant pressure (EP). Data were collected in 60 square-plots of 0.25 ha each in five stands of *B. aethiopum*. Analysis of variance and generalized linear models were used for statistical analyses. Adult uprooting ( $57.80 \pm 3.32\%$ ) and sapling grazing ( $79.87 \pm 1.02\%$ ) were the most commonly occurring damage. High EP significantly (ANOVAs,  $P < 0.05$ ) reduced adult densities (from  $107.60 \pm 4.50$  individuals' ha $^{-1}$  to  $33.50 \pm 1.73$  individuals ha $^{-1}$ ). However, high EP promoted seedling transition to sapling (from  $0.10 \pm 0.02$  to  $0.20 \pm 0.02$ ), but prevent transition of sapling to juvenile (from  $0.12 \pm 0.03$  to  $0.01 \pm 0.00$ ). For the adult sex-ratio, no significant variation (Nested GLM with binomial error,  $P = 0.82$ ) between EPs and no significant departure from 50:50 (Exact binomial tests,  $P > 0.05$ ) were observed, suggesting that adult uprooting is not sex-specific. We conclude that high EP limits functional diversity of the *B. aethiopum* in savannah ecosystems, and may cause decline of the palm species. Management actions should improve the survival of sapling palms by the use of barbed wire to protect several patches of saplings from EP. In addition, because the PNP belongs to a regional network of PAs, a regional management plan of elephant populations would yields better outcome.

Key words: *Borassus aethiopum*, herbivory, *Loxodonta africana*, stand structure

**Leaf biomass modeling, carrying capacity and species-specific performance in aerial fodder production of three priority browse species *Afzelia africana*, *Pterocarpus erinaceus* and *Daniellia oliveri* in Benin**

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#### ABSTRACT

Browse plants play an important role in feeding ruminants especially in dry seasons when herbaceous forage is unavailable. This paper aim at developing models for leaf biomass estimating for their rapid evaluation and the planning of the rational use conditions. For each of the three main browse species, 25 trees were sampled. Dendrometric measurements such as girth at breast height, total height, stem height, crown diameter and crown height were performed on each tree before harvesting the entire leaf biomass which is then weighed. A sample of 200 g of leaves was taken per tree to estimate the dry matter. Kruskal-Wallis test was performed to compare plant traits among the three species. Relationship between plant traits and aerial fodder biomass was examined using a stepwise multiple regression. Carrying capacity was determined for the dry season in the study area. Aerial fodder production varied among species. The best models that estimated leaf biomass production of *Afzelia africana* and *Pterocarpus erinaceus* were obtained with diameter at breast height, a plant trait not directly affected by pruning as predictor. For *Daniellia oliveri* the best model uses the crown height as estimator parameter. Globally, the carrying capacity of each species is about 0.05 to 0.09 TLU/ha/year for *Afzelia africana*; 0.03 to 0.08 TLU/ha/year for *Pterocarpus erinaceus* and 0.04 to 0.79 TLU/ha/year for *Daniellia oliveri* in the dry season. The number of animal that can sustainably be fed in the study area was 38497. The introduction of these fodder tree species in afforestation/reforestation activities can improve the availability of leaf biomass to feed animals.

Keywords: carrying capacity, fodder, models, pastoralism, production

**A quantitative ethnobotanical approach toward biodiversity conservation of useful woody species in Wari-Maro forest reserve (Benin, West Africa)**

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#### Significance

Here, we compile and present the most comprehensive data available on cheetah distribution and status. Our analysis shows dramatic declines of cheetah across its distributional range. Most cheetah occur outside protected areas, where they are exposed to multiple threats, but there is little information on population status. Simulation modeling shows that, where cheetah population growth rates are suppressed outside protected areas, extinction risk increases markedly. This result can be generalized to other “protection-reliant” species, and a decision tree is provided to improve their extinction risk estimation. Ultimately, the persistence of protection-reliant species depends on their survival outside and inside protected areas and requires a holistic approach to conservation that engages rather than alienates local communities.

## Local Knowledge on the Uses, Habitat and Change in Abundance of Multipurpose *Mimusops* Species in Benin

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### ABSTRACT

Multipurpose NTFP species typically experience higher harvest demand because of their multiple uses, which, when combined with unsustainable land use practices may threaten population viability. We assessed local knowledge on the uses, habitat and population status of *Mimusops andongensis* and *Mimusops kummel*, both multipurpose NTFP species in Benin, to promote their valorization and conservation, and thus sustain local knowledge on their uses for domestication issues. One hundred households were randomly selected for structured interviews for *M. andongensis* and 500 for *M. Kummel*. The relationship between age, sex and ethnic groups and the species uses was assessed using comparison and correspondence analyses. Nearly all organs of the species were used. Both species were mainly exploited for medicinal purposes but also in construction and as firewood. We found similarities in some uses of the species organs, although the species occur in different ecological zones and are used by different ethnic groups. This result should be considered for the valorization of the species. Most informants reported that populations of *M. andongensis* were decreasing, although some felt that they were increasing, whereas less than one-third said that *M. kummel* was decreasing. There were strong relationships between gender, age and ethnic affiliation of the users and the exploited organs of both species. Potential uses exist based on both the past and current uses of the species and in comparison to other countries where they are exploited. Local ethno-ecological knowledge and practices will help to valorize and conserve the species. However, further research on the species seeds germination and propagation ability are also necessary.

Key words: Non-Timber Forest Products, local knowledge, ethnobotany, ethnoecology, medicinal plants, *Mimusops andongensis*, *Mimusops kummel*.

## Reproductive phenology of two *Mimusops* species in relation to climate, tree diameter and canopy position in Benin (West Africa)

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### Abstract

Assessing species phenology adds useful understanding about their autecology, for management strategies. We monitored the reproductive phenology of *Mimusops andongensis* and *Mimusops kummel* during 12 months and the relationship with climate, tree diameter and canopy position across climatic zones in Benin. Flowering was evident from the dry season to the beginning of the rainy season, but peaked in the dry season. Fruiting occurred in the rainy season and peaked during the wettest period, for both species. Flowering was positively correlated with temperature. Conversely, fruiting was negatively correlated with temperature and positively with rainfall, in the Guineo-Sudanian zone. For *M. andongensis*, both flowering and fruiting prevalence was positively linked to diameter, while only flowering was significantly related to canopy position. For *M. kummel*, the relationship with diameter was significant for flowering prevalence only and in the Guineo-Sudanian zone. Our results suggest that *Mimusops* species phenology is mainly restricted by phylogenetic membership. Flowering and fruiting of both species are influenced by climate and climate change might shift their patterns and affect the species population and, other organisms and services related to them. Long-term investigations, considering flower and fruit abortion, will help to better understand the species phenology and perhaps predict demographic dynamics.

Key words: Flowering, Fruiting, Tree sizes, Climatic conditions, *Mimusops andongensis*, *Mimusops kummel*

## STABILITY AND EXTENT OF RESISTANCE OF COWPEA LINES TO FLOWER BUD THRIPS IN UGANDA

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### ABSTRACT

Cowpea (*Vigna unguiculata* (L.) Walp.) is a legume attacked by several field insect pests, with flower thrips (*Megalurothrips sjostedti* Trybom) being the most damaging. It causes 20 to 100% yield losses. Cowpea constitutes an important source of protein for resource poor households in Africa. The objective of this study was to identify cowpea lines that are resistant to flower thrips as a step in developing sustainable thrips management strategies. Seventy two cowpea cultivars were screened in three locations and two rainy seasons in Uganda, for thrips damage and yield components. Up to 11 cultivars (IT2841\*Brown (1.50), MU20B (1.58), EBELAT\*NE39 (1.61), WC17 (1.63), WC29 (1.65), MU24C (1.65), WC5 (1.66), NE46 (1.67), WC30 (1.68), NE67 (1.69), and NE51 (1.71)) were the most resistant and stable across locations. However, thrips damage was negatively correlated with the number of days to flowering ( $r = -0.32$ ), indicating that the resistance in the cultivars was explained by the flower thrips infestation escape due to later flowering. Cultivar MU9 was high yielding (813.87 kg ha<sup>-1</sup>) and the most adapted genotype to all the locations; while cultivars WC26, NE48, and NE5 were the most adapted to Arua and Serere, and WC48A was the most adapted to Makerere University Agricultural Research Institute, Kabanyolo (MUARIK).

There is potential of finding resistance sources in the cultivars tested.

**Key Words:** GGE biplot, *Megalurothrips sjostedti*, *Vigna unguiculata*

## ADDITIVE MAIN EFFECTS AND MULTIPLICATIVE INTERACTIONS ANALYSIS OF YIELD PERFORMANCES IN COWPEA GENOTYPES UNDER UGANDAN ENVIRONMENTS.

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### ABSTRACT

Yield in legumes is the result of many plant processes, which are usually expressed in yield and have been shown to be affected by management, genotype and environment. The objectives of this study were to assess the extent of genotype x environment interaction and to select the stable cowpea genotypes in Ugandan environments over seasons. Seventy-two cowpea genotypes were evaluated for yield in three locations and two seasons in Uganda. The yield data were subjected to analysis of variance and additive main effects and multiplicative interactions (AMMI) analysis. The results showed a highly significant ( $P<0.001$ ) genotype by location and by year (season) interaction effects for grain yield, with 69.16% of the total variation attributable to environmental effects, 5.36% to genotypic effects and 12.74% to G x E interactions effects. Genotype MU9 had the highest yield (854.68 kg ha<sup>-1</sup>) but was only adapted to specific environments (Arua 2015B and 2016A). Hence, genotypes WC 30, NE 45, NE 31, NE 51 which were equally high yielding, stable and adapted to the tested environments, and should be recommended for genetic improvement of cowpea germplasm in Uganda.

**Key words:** Adaptability, AMMI, stability, GxE interaction, *Vigna unguiculata*

## Morphological Plant Modeling: Unleashing Geometric and Topological Potential within the Plant Sciences

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### ABSTRACT

The geometries and topologies of leaves, flowers, roots, shoots, and their arrangements have fascinated plant biologists and mathematicians alike. As such, plant morphology is inherently mathematical in that it describes plant form and architecture with geometrical and topological techniques. Gaining an understanding of how to modify plant morphology, through molecular biology and breeding, aided by a mathematical perspective, is critical to improving agriculture, and the monitoring of ecosystems is vital to modeling a future with fewer natural resources. In this white paper, we begin with an overview in quantifying the form of plants and mathematical models of patterning in plants. We then explore the fundamental challenges that remain unanswered concerning

plant morphology, from the barriers preventing the prediction of phenotype from genotype to modeling the movement of leaves in air streams. We end with a discussion concerning the education of plant morphology synthesizing biological and mathematical approaches and ways to facilitate research advances through outreach, cross-disciplinary training, and open science. Unleashing the potential of geometric and topological approaches in the plant sciences promises to transform our understanding of both plants and mathematics.

Keywords: plant biology, plant science, morphology, mathematics, topology, modeling

### Assessment of Textural Differentiations in Forest Resources in Romania Using Fractal Analysis

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#### ABSTRACT

Deforestation and forest degradation have several negative effects on the environment including a loss of species habitats, disturbance of the water cycle and reduced ability to retain CO<sub>2</sub>, with consequences for global warming. We investigated the evolution of forest resources from development regions in Romania affected by both deforestation and reforestation using a non-Euclidean method based on fractal analysis. We calculated four fractal dimensions of forest areas: the fractal box-counting dimension of the forest areas, the fractal box-counting dimension of the dilated forest areas, the fractal dilation dimension and the box-counting dimension of the border of the dilated forest areas. Fractal analysis revealed morpho-structural and textural differentiations of forested, deforested and reforested areas in development regions with dominant mountain relief and high hills (more forested and compact organization) in comparison to the development regions dominated by plains or low hills (less forested, more fragmented with small and isolated clusters). Our analysis used the fractal analysis that has the advantage of analyzing the entire image, rather than studying local information, thereby enabling quantification of the uniformity, fragmentation, heterogeneity and homogeneity of forests.

Keywords: fractal analysis; forest resources; forest management; box-counting method; deforestation

**Pilot assessment of locally acknowledged morphotypes of *Irvingia gabonensis* (Aubry-Lecomte) Baill. in southwestern Benin (West Africa)**

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### Summary

**Introduction –** This study was set up to assess the local perception on morphological differentiation within sweet African bush mango tree (*Irvingia gabonensis*) in southwestern Benin. Materials and methods – Locally acknowledged morphotypes (LAM) and local differentiation criteria were determined, using group discussions with 60 farmers. A total of 120 trees distributed between the fixed LAM were randomly sampled with farmers' aid. The trees were morphologically characterized based on their leaves (length and width), fruit (length, diameter and mass), seeds (length, diameter and mass), kernels (mass) and fruit flesh (mass and depth). The owners of the 120 trees were questioned for their LAM preference, number of owned LAM trees, propagation methods, and taboos. Data were analyzed through a multivariate analysis of variance (MANOVA). Results and discussion – Three LAM were differentiated: (1) a pasty morphotype named 'woto', (2) an aqueous morphotype named 'shito', and (3) an intermediate morphotype. The MANOVA revealed that contrary to farmers' perceptions, the accurate prediction of LAM on the field was hard ( $P > 0.05$ ). However, canonical discriminant analysis indicated an overall significant morphological difference between the three LAM ( $P < 0.001$ ). Although farmers preferred pasty and intermediate LAM, the aqueous LAM was most abundantly found on farms. Twelve taboos and their potential negative impacts were unanimously recognized in the context of *I. gabonensis* management. Most farmers admitted to have already broken these taboos, particularly the taboo prohibiting plantation of the species.

**Conclusion –** This study highlights an ongoing but stagnating local domestication process for this species. A progressive breaking of non-profitable taboos appears to be a gate for a guided selection process.

**Keywords** Benin, African bush mango tree, *Irvingia gabonensis*, agroforestry system, plant domestication, local perception

**Contrasting population structures of two keystone woodland species of W National Park, Niger**

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*South African Journal of Botany* 112 (2017) 95–101

### Abstract

This study aims to assess population structure and ecological indicators of woodland vegetation dominated by *Pterocarpus erinaceus* and *Anogeissus leiocarpa* as a basis for sustainable management and conservation strategies. We sampled 34 plots each measuring 30 m × 30 m in W National Park in Niger and analyzed structural parameters (tree density, basal area, Lorey's mean height and size class distribution) and ecological indicators (species richness, Shannon diversity index, Pielou evenness index and Importance Value Index) of woodland in general and for the two key species. Mean tree density was 752.6 stems/ha and basal area was 24.5 m<sup>2</sup>/ha in woodlands including 145.4 stems/ha and 14.1 m<sup>2</sup>/ha for *A. leiocarpa* and 3.3 stems/ha and 0.7 m<sup>2</sup>/ha for *P. erinaceus*. The woodland was composed of 59 tree species belonging to 34 genera and 17 families. *A. leiocarpa* had the highest IVI value (0.93), whereas *P. erinaceus* was among the species with the lowest IVI value (0.03). The mean diameter of both species was higher (24 cm and 47 cm for *A. leiocarpa* and *P. erinaceus* respectively) than the mean diameter in woodlands (16 cm). A "reverse J" shape distribution was found for woodland in general and for *A. leiocarpa*, but *P. erinaceus* showed a left dissymmetric distribution. Findings of this study showed that urgent actions are needed for sustainable management and conservation of some key species especially *P. erinaceus*.

**Keywords:** Forest inventory, Regeneration, Size class distribution, Woody vegetation

**Mapping changes in land use/land cover and prediction of future extension  
of bowé in Benin, West Africa**

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*Land Use Policy 69 (2017) 85–92*

Desertification and land degradation are worldwide problems affecting soil, vegetation and the livelihoods of rural populations. Bowal (plural bowé) is a particular form of degraded land that occurs in tropical regions and leads to the exposure of ferricretes, which are unsuitable for farming. Bowé are more common on farmland and degraded savanna. Changes in land use/land cover were used to map a region of 6.7 million ha in northern Benin, West Africa in 1975, 1990 and 2010. The changes observed during these periods (1975–1990, 1990–2010 and 1975–2010) were used to predict the occurrence of bowé in the period up to 2050 using Markovian chain analysis. The results showed a considerable change in land use/land cover during the three periods. The types of land on which bowé occur (farmland and degraded savanna) increased in northern Benin by 5.4% per year during the period 1975–1990 and 9.5% per year during the periods 1990–2010, while the natural vegetation (forest, woodland and tree savanna) decreased by the same amount. The future scenarios also predicted the same trend. In the period 1975–1990, 1.28 million ha (26%) of natural vegetation was converted to degraded savanna and farmland while 2.23 million ha (53%) of natural vegetation was converted to degraded savanna and farmland in the period 1990–2010. Based on the dynamics recorded during the period 1975–1990 and 1990–2010 respectively, a total of 1.28 million ha (26% of the natural vegetation that was present in 1975) and 1.29 million ha (31% of the natural vegetation that was present in 1990) will be converted to farmland and degraded savanna in the study area by 2050. Thus bowalization will persist and increase in the period up to 2050. The natural vegetation could disappear if protection and restoration measures are not taken. It is thus important to take measures to stop the degradation and to implement programs to restore soils on bowé based on the soil and water conservation techniques used on highly degraded West African soils, such as zai pit and stone rows with grass strips. Some native plants species adapted to bowalization and resistant to climate change in northern Benin (e.g. Asparagus africanus, Andropogon pseudapricus and Combretum nigricans) should be used in association with soil and water conservation techniques on bowé.

Keywords: Land use/land cover change, Natural vegetation, Bowé, Ferricretes, West Africa

**Identification of potential areas for wild palm cultivation in the Republic of Benin  
through remote sensing and ecological niche modeling**

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Elie Padonou . Romain Gle le`Kakai*

**Abstract**

Wild palms contribute significantly to food security and local economy in tropical areas, and particularly in sub-Saharan Africa. In light of this importance, eight palm species were explored [Borassus aethiopum (L.) Mart, Eremospatha macrocarpa (G. Mann et H. Wendl.) H. Wendl., Laccosperma opacum (G. Mann et H. Wendl.) Drude, Hyphaene thebaica (L.) Mart, Phoenix reclinata Jacq., Raphia hookeri G. Mann et H. Wendl., R. sudanica A. Chev., and R. vinifera P. Beauv.] as targets for conservation, domestication, and cultivation in Benin. Cultivation potential was evaluated in a coarse-resolution, firstpass effort using ecological niche models to relate known occurrences of each species to vegetation indices (VEG), gross primary productivity (GPP), and soil characteristics (SOIL), and model outputs were related to human distribution and land-use patterns. Results showed that wild palms responded differentially to different suites of environmental factors: some species showed best model performance with VEG ? GPP ? SOIL, others with GPP ? SOIL or VEG ? GPP, or with a single factor. Two species had broad potential distributions across the country; others had potential areas in the north (2 species) or the south (4 species). Raphia hookeri and R. vinifera showed greatest overlap in terms of ecology and distribution, whereas L. opacum and R. sudanica had the lowest similarity. These models constitute initial steps toward a sustainable scheme for planning exploration of the possibility of cultivation of these species.

Keywords Cultivation \_ MODIS \_ West Africa \_ Wild palms

## 8.2 ARTICLES PUBLISHED IN PEER-REVIEW JOURNAL WITHOUT IF IN 2017

### PROPAGATION DE ZANTHOXYLUM ZANTHOXYLOIDES PAR BOUTURAGE AU BENIN

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#### ABSTRACT

The purpose of this study was to contribute to mitigating heat islands by assessing the characteristics and effects of the alignment plantation on the local climate in Cotonou. The methodology was based on a systematic inventory of all trees on the Avenue Proche. For each individual having diameter at breast height (dbh)  $\geq 10\text{cm}$ , species was recorded as well as total tree height, the number of twisted trees or threatening branches; the diameter of the crown projection of each tree on the ground when the sun was at the zenith. The other individuals with dbh  $\leq 10\text{cm}$  were recorded to determine the turnover rate of individuals on the Avenue.

Air temperature and relative humidity were recorded at nine (09) points including three (03) located in the alignment plantation and six (06) on the roadway. Temperature and relative humidity were recorded every hour from 7am to 6pm. Results indicated a low diversity of alignment plantations on the Avenue Proche. Linear density was 8.3 trees / 100 m, mean diameter and height of individuals were respectively estimated at 47.53  $\pm 14.42\text{cm}$  and 11.92 cm. The estimated road shade index was 39.96% while the potential drop hazard index was 22.22%. Overall, temperature was lower inside the plantation than that recorded on the pavements ( $p < 0.05$ ). Relative humidity was higher in the alignment plantation than on the pavements ( $p < 0.05$ ). Based on those results, it can be conclude that alignment plantation refreshes the local climate by decreasing the air temperature and increasing its relative humidity. Urban forestry represents an effective approach to mitigate the effects of heat islands.

Keywords: Heat island, urban forestry, temperature, relative humidity, Proche avenue, Cotonou.

### Effects of Urban Forestry on the Local Climate in Cotonou, Benin Republic

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#### Abstract

The effect of urban green on meteorological parameters such as temperature and relative humidity was assessed on one major city street in Cotonou called "Boulevard de Missèbo-Zongo" (BMZ). Tree inventory and

field measurement of meteorological parameters were performed on the roadside and central median of the BMZ. Dendrometric data collected were the number of tree species, the number of tree individuals per species, the diameter of trees at breast height, the tree heights, the tree crown shape, shade form on the ground when the sun is at Zenith; while the meteorological data were the airtemperature and the relative humidity inside and outside of urban green at 1.5, 2 and 3 meters height measured from 7am to 6pm at one hour interval. Data were analyzed using Mixed Generalized Linear Model under R 3.3.1 software. Results showed that street alignment trees were poorly diversified and dominated by *Khaya senegalensis*. This species appeared to be highly pruned and threatened because of its numerous medicinal virtues. Moreover it was found that air temperature and relative humidity were influenced by the time and the place of measurement. The coolness effect of urban green was evidenced by the decrease in temperature under alignment trees compared with that recorded on roadside free of trees. These results suggested that urban green could be adopted as adaptation strategy to address the issue of global warming in the city.

Keywords: Alignment Plantation, Dendrometric Characterization, Meteorological Parameter, Tree Diversity

### HIGHLIGHTING THE MITIGATION EFFECT OF HEAT ISLANDS BY URBAN FORESTRY IN COTONOU, REPUBLIC OF BENIN

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### ABSTRACT

The purpose of this study was to contribute to mitigating heat islands by assessing the characteristics and effects of the alignment plantation on the local climate in Cotonou. The methodology was based on a systematic inventory of all trees on the Avenue Proche. For each individual having diameter at breast height (dbh)  $\geq$  10cm, species was recorded as well as total tree height, the number of twisted trees or threatening branches; the diameter of the crown projection of each tree on the ground when the sun was at the zenith. The other individuals with dbh  $\leq$  10cm were recorded to determine the turnover rate of individuals on the Avenue. Air temperature and relative humidity were recorded at nine (09) points including three (03) located in the alignment plantation and six (06) on the roadway. Temperature and relative humidity were recorded every hour from 7am to 6pm. Results indicated a low diversity of alignment plantations on the Avenue Proche. Linear density was 8.3 trees / 100 m, mean diameter and height of individuals were respectively estimated at  $47.53 \pm 14.42$  cm and 11.92 cm. The estimated road shade index was 39.96% while the potential drop hazard index was 22.22%. Overall, temperature was lower inside the plantation than that recorded on the pavements ( $p < 0.05$ ). Relative humidity was higher in the alignment plantation than on the pavements ( $p < 0.05$ ). Based on those results, it can be conclude that alignment plantation refreshes the local climate by decreasing the air temperature and increasing its relative humidity. Urban forestry represents an effective approach to mitigate the effects of heat islands.

Keywords: Heat island, urban forestry, temperature, relative humidity, Proche avenue, Cotonou.

**Ureide Essay to Assess N2-fixation Abilities of Soybean (*Glycine Max*) Genotypes under Different Bradyrhizobium Strains (Published in Journal of Crop Science and Biotechnology)**

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*Received: February 14, 2017 / Revised: April 21, 2017 / Accepted: April 29, 2017*

**ABSTRACT**

The high protein content of soybean (*Glycine max*) seeds results in high nitrogen demand, causing a huge nitrogen uptake during plant growth. As a legume crop, soybean can fix atmospheric N through symbiotic associations with Bradyrhizobia and perform well in African nitrogen poor soils. This study aimed at establishing the ability of promiscuous soybean genotypes to fix nitrogen and devise the relationship between nodule scores and amount of nitrogen fixed. Twelve soybean genotypes were inoculated with *Bradyrhizobium japonicum* Strain USDA 110 (specific) and *Bradyrhizobium* sp. Strain USDA 3456 (native) and raised in pots in a greenhouse. At the R3.5 growth stage, nodules were scored and xylem sap was extracted, which xylem sap was used to carry out ureide, amino-N, and nitrates assays. The relative abundance of ureide was used to devise the proportion of nitrogen fixed by each genotype. The proportion of nitrogen derived from atmospheric N2 (Ndfa) ranged from 47.9 to 78.8% under USDA 3456 and from 36.7 to 78.7% under USDA 110. A strong correlation was found between nodule scores, especially nodules' effectiveness, and Ndfa. The genotypes Wondersoya (78.8%), Maksoy 2N (78.4%), Namsoy 3 (78.3%), and Maksoy 3N (75.7%) had high nitrogen-fixing ability in response to USDA 3456. Promiscuous soybean genotypes can fix nitrogen equally under both native and specific *Bradyrhizobium* types. Nodules' effectiveness can be a good predictor of biological nitrogen fixation. This study highlighted that crop improvement to boost soybean production in Africa should target promiscuous varieties for better yield with less inputs.

Key words: Promiscuous soybean, *Bradyrhizobium* sp. Strain USDA 3456, *Glycine max* (L. Merr.), ureide, nitrates.

**Medicinal uses of *Moringa oleifera* in southern Benin (West Africa) [Published in Acta Horticulturae]**

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**ABSTRACT**

*Moringa oleifera* is a non-tree forest product (NTFP) known for its nutritional and medicinal virtues. The present study investigated the medicinal uses of various parts of *Moringa oleifera* in southern Benin. An ethnobotanical survey was carried out across the four phyto-districts of southern Benin (Plateau, Coast, Ouémé and Pobè) with a sample of 439 informants (201 women and 238 men) belonging to Fon, Waci, Xwla, Sahoué, Djerma, Kotafon, Aïzo, Goun, Yoruba socio-cultural groups. The informants include traditional medicine practitioners, householder, housewives, old men and women, adults, and the young. Various parts of *Moringa oleifera* are used to obtain traditional medicines to cure diseases. The study revealed up to 46 complete recipes traditionally made to heal 34 common diseases. These include venereal diseases, cardiovascular diseases, infectious diseases, tropical diseases, inflammatory complaints, oto-rhino-laryngologocal complaints, skin infections, digestive diseases, infertility disorders, etc. The mode of administration as well as the dosage of each medicine were recorded. It was found that among the plant parts used for this purpose, the leaf was the most used, followed by the roots, bark, seeds and pods. The consensual value of use types was estimated to prove the relative efficiency of each medicine. Moreover, the seeds were also found to be used to carry out rites for blessings and attracting customers and a sexual partner. The study showed that *M. oleifera* plays an important role in traditional medicine in the rural areas of South Benin, hence this study constitutes sound arguments for its production at large scale in agroforestry systems in Benin. The information collected is useful and can nurture more in-depth research on the part of modern medicine for better use of this species.

Keywords: Ouémé, non-tree forest products, agroforestry, traditional medicines

## Environment-driven spatial pattern of tamarind trees in riparian forests

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### Résumé

La domestication des espèces agroforestières autochtones reçoit de plus en plus d'intérêt comme une option sérieuse pour une agriculture durable. La mise en œuvre d'une telle option nécessite des informations dont les écartements optimums à respecter lors de la mise en place des plantations et l'effet de l'environnement sur l'espace vitale nécessaire aux arbres. Ces informations peuvent être obtenues en caractérisant l'espacement naturel des arbres d'une espèce agroforestière donnée en fonction des conditions environnementales. Dans cet article, la fonction corrélation des paires a été utilisée pour caractériser la répartition spatiale des individus de tamariniers (*Tamarindus indica*) et sa variation sous différentes conditions environnementales en galerie forestière : niveau du couvert végétal et seuil de dégradation du sol. Les graines de tamarinier étant disséminées par zoothorie et barochorie, il a été supposé qu'il y a une distribution agrégative au sein et entre les individus des différentes classes d'âge. Les résultats ont suggéré une faible variation de la structure spatiale et de la densité des individus de tamarinier en fonction des conditions environnementales considérées. Cependant, les individus juvéniles ont montré une répartition agrégative autour des adultes sous un faible couvert végétal et / ou une forte dégradation du sol, mais une distribution répulsive vis-à-vis des adultes sous canopée dense. Ces résultats pourraient être dus à l'effet allélopathique des adultes sur les juvéniles ou à une intolérance de ces derniers à l'ombrage. De même, la dégradation des sols pourrait avoir favorisé une agrégation des juvéniles autour des adultes par drageonnage. Cette étude a également mis en évidence la persistance du tamarinier sur des terres dégradées. Il pourrait donc être utilisé dans les programmes de restauration écologique. A cet effet les résultats du présent travail suggèrent des plantations de juvéniles dans des blocs de 40 m de rayon avec grille d'espacement de 10 m x 10 m entre plants, éloigné d'au moins 30 m des individus matures.

## Aires d'occurrence et ethnozoologie du daman des rochers (*Procavia capensis kerstingii*) dans la partie septentrionale du Bénin (Afrique de l'Ouest)

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### Résumé

Les damans font partie des petits mammifères les moins étudiés et les plus problématiques quant à la qualité et l'envergure de leurs connaissances actuelles. Pourtant, ils sont bien connus des populations locales et subissent beaucoup de pressions du fait des usages et des réductions de leur habitat. Cette situation inquiète les conservateurs pour l'impact sur leur conservation. Au Bénin, le daman des arbres (*Dendrohyrax dorsalis* ssp) et le daman des rochers (*Procavia capensis kerstingii*) sont les deux espèces de damans qui existent et sont réparties sur tout le territoire. Alors que peu d'informations existaient sur la distribution des deux espèces

et leur envergure, le gap a été comblé récemment pour l'une d'elles, le daman des arbres. Ainsi, l'étude a été réalisée afin de mieux apprécier la situation pour une meilleure conservation de la seconde espèce, le daman des rochers. Le milieu d'étude a couvert toute la partie septentrionale du Bénin, le milieu de vie par excellence pour l'espèce. A travers des mega transects et des enquêtes ethno-zoologiques auprès des populations cibles, une cartographie de situation et de couverture d'espace a été réalisée pour l'espèce. Ces données confirment la présence du daman des rochers au nord du Bénin et doivent être assez utiles dans la prise de mesures pour leur conservation.

Mots-clés : Damans, Cartographie, Mégatranssect, enquêtes ethnozoologiques, Nord-Bénin.

### Vulnérabilité et dynamiques sociopolitiques d'adaptation des éleveurs transhumants aux perturbations climatiques au Nord du Bénin

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#### Résumé

La transhumance, dans un environnement en mutation, est devenue un motif de préoccupation internationale. En effet, les facteurs climatiques s'ajoutent aux facteurs anthropiques pour accentuer ces dernières décennies la dégradation des parcours pastoraux. Les aires protégées et les écosystèmes contigus qui représentent des espaces convoités par les éleveurs et bien d'autres modes d'existence, sont sous la réglementation publique et se présentent comme des espaces conflictuels pour divers groupes interprofessionnels. L'étude socioanthropologique réalisée dans le Nord du Bénin, nous a permis d'analyser les mécanismes sociopolitiques de maintien de la transhumance. Dans le cadre de stratégies individuelles basées sur les réseaux sociaux, les éleveurs sont engagés dans des formes diversifiées de pastoralisme allant du pastoralisme d'opportunisme au pastoralisme sur tutorat en passant par le pastoralisme social et le pastoralisme clientéliste. Il se dégage de cette étude que l'élevage transhumant résiste aux chocs en s'ajustant aux réalités nouvelles tout en sécurisant l'éleveur.

Mots clés Transhumance • Risque climatique • Dynamiques sociopolitiques • Bénin

## Transhumance and protected areas in West Africa: State of play and Management mechanisms review

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### Abstract

Protected areas are increasingly frequented by transhumant cattle herds. This phenomenon has grown in recent decades in West Africa. In order to make a state of play of the use of areas protected by cattle herds, through its history, the causes of their presence and the consequences on natural resources and propose mechanisms for managing transhumance in protected areas, a bibliographical review of scientific work carried out in this direction has been made. It shows that the search for pastoral resources during the drought has been the basis for the entry of transhumant herders into these protected areas. From an ecological point of view, the debate is between those who claim that livestock is in direct competition with wildlife for access to forage resources and those suggesting that livestock and wildlife interact through a complex combination of competition / facilitation depending on the season and abundance of resources. The mode of management of transhumance in West African forests depends on the category of protected areas. Some protected areas have opted for strict management and others for concerted management. This is the case for Park W, which, through the regional project (ECOPAS) has developed a common strategy for the management of transhumance in this protected area. Despite these various proposals, the protected areas of West Africa continue to suffer pastoral pressure. It is then necessary to propose a sustainable management mode which will make it possible to make judicious use of the pastoral resources of these protected areas without compromising their biodiversity.

**Keywords:** Forestry; natural resources; Pastoral mobility; protected area-livestock interaction; sustainable management

## Synergy between traditional knowledge of use and tree population structure for sustainability of *Cola nitida* (Vent.) Schott. & Endl in Benin (West Africa).

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### ABSTRACT

*Cola nitida* is a West African tree, commonly used for pharmaceutical purposes. In Benin, the species is used for many purposes ranging from traditional rituals to domestic consumption. Nowadays, the species, as well as its offspring, are hardly encountered. So far, research on the species focused on a single domain such as ethnobotany and phytochemistry. The current paper used a holistic approach to explain the species scarcity in the natural habitats using (1) the rural knowledge pattern on *C. nitida* and (2) the tree population structure. Semi-structured interviews ( $n=170$  respondents) were conducted and combined with ecological inventory ( $n=38$  plots) in the phyto-geographical districts of Coast and Pobè in southern Benin. The indices of diversity, equitability, and consensus quantified the range, the evenness, the relative reliability of rural communities' knowledge. Moreover, the plant part index gave the most used part of the tree. The knowledge on the species was unevenly distributed according to the gender while the cofactor age did not have a statistically significant effect ( $P = 0.902$ ) on the pattern. In addition, seeds represented the most used plant part ( $PPI=0.59$ ). *C. nitida* tree demographic structure showed a low density of seedling and sapling ( $1.05\pm0.47$  trees.ha $^{-1}$ ). Diameter size fitted with a 2-parameter Weibull distribution indicated a threat of species extinction. The multiple uses of *C. nitida* seeds do not allow natural regeneration of the species. The domestication of *C. nitida* tree and the establishment of *Cola* garden/orchard in the surveyed districts is suggested for sustainable use of the species.

**Key words:** Benin; *Cola nitida*; Quantitative ethnobotany; tree demographic structure; wild edible plant

## Diversity of small carnivores in Pendjari biosphere reserve, Benin

*small carnivores in Pendjari biosphere reserve, Benin*

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*Journal of Entomology and Zoology Studies 2017; 5(6): 1429-1433*

### ABSTRACT

Small carnivores, important members of ecosystems are poorly studied in Africa. In order to fill this gap, we camera trapped 103 sites in Pendjari Biosphere Reserve, West Africa. The specific objectives were to assess the species richness in the small carnivore guild and whether the land use system affect this diversity. For a total trapping effort of 3607 days between November 2014 and April 2015, we got 543 independent captures of at least ten species. The trapping success of small carnivores was 15 pictures/100 days in the reserve. Small carnivores were found in 68% of the sites. Jackal and genet were the most abundant distributed species in the park while mongooses and genets were more common in hunting zones. Hunting zones being more prone to human disturbance, our results suggested that Felidae were more vulnerable to anthropogenic activities than other carnivores. These species and jackal could be used as indicator species in Pendjari ecosystem. Conservation efforts should be improved, especially in hunting zones, to guaranty the survival of small carnivores in this ecosystem.

Keywords: Small mammals, species richness, camera trapping, West Africa

## Diversité et importance socio-économique des services écosystémiques dans la Réserve de Biosphère de la Pendjari au nord-Bénin

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J. Rech. Sci. Univ. Lomé (Togo), 2017, 19(3): 15-28*

### RESUME

Les écosystèmes et les aires protégées en particulier fournissent d'importants services aux communautés locales, services qui représentent des motivations pour la conservation des ressources naturelles. La présente recherche a été conduite dans la Réserve de Biosphère de la Pendjari au Nord-Bénin dans le but d'identifier les services écosystémiques et leurs contributions aux revenus des ménages riverains de la réserve. La collecte des données, basée sur des questionnaires et des guides d'entretien, s'est effectuée par l'observation directe, les entretiens semi-structurés, les focus group et la méthode active de recherche participative. L'importance des services écosystémiques a été déterminée à partir des taux de réponse et les valeurs d'importance et consensuelle. L'accent a été mis sur les services d'approvisionnement et culturels. Au total, 60 services écosystémiques répartis en 50 services d'approvisionnement, neuf services culturels et un service de régulation ont été répertoriés par les populations enquêtées. Les produits les plus exploités sont les légumesfeuilles, la paille, le bois de chauffe, les plantes médicinales, la noix de karité et les cordes. Certains services sont exclusivement destinés aux hommes du fait de leur éloignement des terroirs villageois. Chaque ménage tire en moyenne  $84\ 897 \pm 191\ 430$  XOF des services écosystémiques et  $169\ 000 \pm 182\ 984$  XOF des spéculations agricoles. Les résultats de cette étude doivent être utilisés pour sensibiliser les populations sur l'importance de la réserve et des actions doivent être menées pour garantir la durabilité des services écosystémiques surtout ceux d'approvisionnement pour le mieux-être des communautés locales et des ressources naturelles.

Mots clés : services d'approvisionnement, contribution, revenus des ménages, aire protégée, Afrique de l'Ouest

## Nutritional Value of Cereal and Legume Crop Residues Fed to Ruminant in Republic of Benin

*Benin*

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Journal of Nutritional Ecology and Food Research (In press)*

### Abstract

In sub-Saharan Africa, farmers use crop residues as livestock feeding strategy in small-scale-farms during the dry season. Due to the ignorance of the nutritional potential of the residues, the amounts of residues used are low and the operation remains rudimentary. The nutritive value of crop residues (cereal and legume) commonly used in ruminant feeding in Benin was determined to provide recommendation for their enhanced. The samples, collected in two agro-ecological regions areas of the country, were screened for their chemical composition and energy content, as well as for their in vitro fermentation characteristics (i.e., gas and volatile fatty acid production, organic matter degradability). Compared to legume residues, cereal residues showed lower energy (5.86 vs. 10.89 MJ/kg DM) and crude protein (4.16 vs. 11.77% DM) level and higher cell wall content (NDF: 84.98 vs. 56.12% DM), respectively. For both cereal and legume residues, the in vitro fermentation parameters were highly ( $P < 0.01$ ) influenced by the residue type, while the study area significantly affected mainly cereal residues. Organic matter degradability ranged between 55.4 and 57.5% in cereal whereas between 53.2 and 89.6% in legume. The in vitro method utilized was helpful to evaluate the nutritive value and describe the fermentation kinetics of crop residues studied.

Keywords: Degradability, Fermentation Kinetics, In Vitro Gas Production, Volatile Fatty Acids.

Keywords: Forestry; natural resources; Pastoral mobility; protected area-livestock interaction; sustainable management

## Impact of Floods on Farmers' Livelihoods in the Semi-arid Zone of Benin

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### Abstract

Fluvial flooding is a common and devastating natural disaster that causes significant economic and social damage. Since 2007, Benin has experienced frequent floods. In the semiarid zone of Benin, the last flood occurred in August 2012, and many farmers lost most of their crops. However, no study was conducted to show the effects of recent flooding on the livelihoods of farmers. To fill this gap in knowledge, a survey was conducted in Benin, a small country located in the south of the Sahel. Two municipalities, Malanville and Karimama, were chosen because of their locations at the downstream of the Benin part of the Niger basin and the harsh effects experienced by the farmers during the flooding in 2012. Within these municipalities, we focused on the villages near the four rivers of the basin. Within the 19 villages targeted, the sampling rate was 14.67%, and the sample size was 228 farmers. The econometric framework adopted was the Rubin causal model with simple linear regression using ordinary least squares. The results show that the 2012 flood had significant impacts. An increase of 1% in flooding duration was found to correspond to a loss in agricultural income of approximately 0.40%. When a farmer stated that the severity of flooding in 2012 was major, his household agricultural income was reduced by approximately 1.44% compared to a farmer who stated that the flooding was minor. An increase of 1% in the cultivated area that was flooded corresponded to a loss in agricultural income of approximately 0.27%. The introduction of water-resistant species to withstand the effects of flooding should be encouraged in the study area. Future researches will focus on the estimation of flood insurance premiums, the design of the insurance, and the implementation of the insurance.

Keywords: Flooding, Semiarid zone, Livelihoods, Agriculture, Ordinary least squares, Off-farm income, Benin

**Palm Oil Mill Solid Waste Generation and Uses in Rural Area in Benin Republic:  
Retrospection and Future Outlook**

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*Solid Waste Management in Rural Area pp: 143-163. <http://dx.doi.org/10.5772/intechopen.70033>*

**Abstract**

Palm oil is one of the major oil crops in the world, producing important vegetable oils in the world oil and fats market. Its production generates solid wastes whose sustainable management is crucial for the oil chain development in oil palm producing countries. Benin Republic is a small oil palm producing country where oil palm plays social, cultural, and economic roles for farmers. This chapter analyzes the linkage between improvement of palm oil process extraction and palm oil mill solid waste (POMSW) management for sustainable palm oil production. Composed mainly of fibers, the two kinds of POMSW are empty fruit bunches (EFBs) and press mesocarp fibers (PMFs), which are rich in units' fertilizers and are renewable energy. POMSW in Benin Republic is used in agriculture, in cosmetic, or as energy. The upgrade of traditional mills generates POMSW use as a boiler fuel to reducing wood necessity and increasing farm profit. As this use is not sustainable, research must be made to generate electricity with POMSW and its use for crop fertilization, to ensure environment protection, enhance contribution to food security, restore degraded soils, and increase earnings of producers of rural areas.

**Keywords:** POMSW, improvement of palm oil process extraction, electricity, fertilization, rural area

**The Biofuel Crops in Global Warming Challenge: Carbon Capture by Corn, Sweet Sorghum and Switchgrass Biomass Grown for Biofuel Production in the USA**

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*Frontiers in Bioenergy and Biofuels (2017): Prof. Eduardo Jacob-Lopes (Ed.), InTech, DOI: 10.5772/65690.*

**Abstract**

This research evaluates potential carbon capture of sweet sorghum, switchgrass, and corn grown in Portageville, Missouri, from 2007 to 2009. Our results showed that corn grain C content averaged 43%, whereas C grain captured was 1.3–4.7 Mg Cha<sup>-1</sup> depending on year and N rate. N fertilization significantly increased C capture, but not C content of grain. C capture by switchgrass depended on cultivars and harvest date. Switchgrass cv. Alamo biomass contained 46% C compared to 44% C for Blackwell's. Alamo maximum C capture depended on year, being 9.8 Mg Cha<sup>-1</sup> in 2008 and 13.4 Mg Cha<sup>-1</sup> in 2009. C is equivalent to 32.3–49.6 Mg CO<sub>2</sub> ha<sup>-1</sup>, while Blackwell captured 3.7–4.4 Mg Cha<sup>-1</sup>. C in sweet sorghum biomass ranged from 42 to 45%, whereas total C capture ranged from 3.2 to 13.8 Mg ha<sup>-1</sup> according to year, soil, and N rate. The highest C capture appeared in loam. Sweet sorghum aboveground biomass showed 82% C captured in the stalk. When converted into CO<sub>2</sub>, C captured by sweet sorghum was equivalent to 12–51 Mg CO<sub>2</sub> ha<sup>-1</sup>. In addition to their biofuel potential, corn, switchgrass, and sweet sorghum can substantially contribute to environmental cleaning by capturing a significant amount of CO<sub>2</sub>.

**Keywords:** carbon, corn, sweet sorghum, switchgrass, global warming, CO<sub>2</sub>

## Importance ethnobotanique et valeur d'usage de *Picralima nitida* (stapf) au Sud-Bénin (Afrique de l'Ouest)

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### RESUME

Beaucoup de connaissances se perdent en Afrique faute de transmission, ce qui ne favorise pas la conservation des ressources par les populations locales. Il urge donc d'évaluer les connaissances des populations sur l'importance des ressources en vue d'élaborer des stratégies de conservation et de gestion durable. Le but de la présente étude est de documenter les connaissances des populations locales sur la valeur d'usage de *Picralima nitida* au Sud-Bénin. Pour y parvenir, 240 enquêtés, choisis de façon aléatoire dans 4 groupes socio-culturels au Sud-Bénin à savoir Fon, Goun, Nago et Aïzo ont été interviewés. Les enquêtés étaient soumis à un entretien dans la langue locale. Des paramètres ethnobotaniques ont été calculés. L'analyse en composante principale a été effectuée à partir d'une matrice conçue. Les résultats ont révélé que les populations locales des 4 groupes socio-culturels utilisent les différentes parties de *P. nitida* pour 21 traitements. *P. nitida* est assez important pour les populations locales. Les graines sont les organes les plus utilisés suivies des racines, feuilles et écorce. Le groupe socio-culturel Goun a une meilleure connaissance des usages de l'espèce comparé aux Nago, Fon, et Aïzo. Existence de mauvaise transmission horizontale et verticale des connaissances endogènes disponibles sur l'espèce.

Mots clés : Connaissances endogènes, usage, *Picralima nitida*, groupe socio-culturel.

## HABITATS AND UTILIZATIONS OF *Lippia multiflora* MOLDENKE : LOCAL PERCEPTION OF FOUR ETHNIC GROUPS FROM BENIN (WEST AFRICA)

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### ABSTRACT

The purpose of this study is to assess the local knowledge on the habitats and uses of *Lippia multiflora* in Benin. A total of 180 households distributed in four ethnic groups in the Sudano-Guinean (Mahi, Bariba and Peulh) and the Sudanian zones (Boo and Peulh) in Benin were surveyed. The perception of the local population on the habitats and use of the species was assessed. Pearson Chi-square Test was used to test the independency of the use of the species according to the ethnic groups. Correspondence Analysis was used to assess the relationship between the organs used and the ethnic groups. Results revealed that *L. multiflora* was mentioned abundant in fallow and savanna. The use value of the species was 0.65 for food, 0.50 for medicine versus 0.03 for handicraft. Mahi ethnic group used mainly the leaves of the plant species for health care, while Boo and Peulh used mainly the inflorescences as food (sauce, soup and tea). Bariba ethnic group used the stems for handicraft. Diseases treated by the species were stomach ache, fever, malaria, toothache, high blood pressure, wound, physical weakness of baby, itch, reduced lactation activity after birth and diverse attacks. Valorization programs can then be based on those utilizations according to ethnic groups in Benin.

Key words : *Lippia multiflora*, local knowledge, food and medicinal uses, biogeographic zones in Benin, ethnic groups.

## 8.3 ARTICLES IN PRESS IN PEER-REVIEW JOURNAL WITH IF IN 2017

### Inheritance of cowpea resistance to flower thrips in Uganda germplasm

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#### Abstract

Flower thrips [Megalurothrips sjostedti (Trybom)] is the most damaging insect pest on cowpea. However, information regarding the nature of gene action governing the inheritance of resistance to thrips is not available for cowpea genotypes in Uganda. This study was carried out to determine the inheritance pattern of cowpea resistance to flower thrips. Five resistant cowpea genotypes and three susceptible genotypes were crossed in full diallel mating design. F2 progenies were evaluated along with the parents in alpha lattice design with two replications under natural thrips infestation at Kabanyolo, Arua and Serere in Uganda. Combining ability analysis was performed using method one and model one of diallel analysis. The results showed that the environmental effects were highly significant ( $P<0.001$ ). Additive, dominance and epistasis effects had major contributions. The broad sense heritability varied from 18 to 42% for thrips damage scores and from 0 to 6% for thrips counts. The estimates of narrow sense heritability were low for thrips damage score (2 to 18%) and thrips counts (0 to 9%). Genotypes TVU-1471 and TVU-1509 were identified as good transmitters of resistance to flower thrips. Crosses TVU-1509 x NE5, TVU-473 x Sanzi, TVU-123 x Sanzi, TVU-123 x TVU-473, and TVU-473 x TVU-1509 presented significant ( $P<0.05$ ) and negative SCA effects for thrips damage scores and thrips counts and would be the most useful in breeding as some of their progenies would have high resistance to flower thrips. This study provides the basis of an efficient breeding program of cowpea for flower thrips resistance.

Key words: Damage score, gene action, Megalurothrips sjostedti, Vigna unguiculata

### BIOCHEMICAL CONSTITUENTS INFLUENCING THE RESISTANCE TO FLOWER BUD THRIPS IN COWPEA [VIGNA UNGUICULATA (L.) WALP] GERMPLASM

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#### ABSTRACT

The flower bud thrips, Megalurothrips sjostedti, is a major pest of cowpea that can cause yield losses of up to 100%. The use of cowpea cultivars resistant to thrips is among the most promising control measures. Six cultivars were evaluated in 2016 in Uganda for resistance to thrips under field conditions and analyzed for total carbon, total reducing sugar, total protein, soluble amino acid, total phenol, flavonoids, antioxidant activity and tannin contents. Data were subjected to analysis of variance, correlation and multiple linear regression analyses. The results showed that the genotypes responded differently to thrips damage and thrips counts in flowers and they presented different concentrations in total reducing sugar, soluble amino acid, antioxidant activity and tannin in

the plants parts. Cultivar Tvu-1509 suffered the least thrips damage (1.03) while WC36 was severely damaged by thrips (6.95). A significant negative correlation was observed between thrips damage scores and total carbon concentration ( $r=-0.54$ ) indicating that total carbon plays a significant role against thrips damage in cowpea. Increase in the concentration of flavonoids, total reducing sugar, total carbon in the plants contributed to the reduction of thrips damage (coefficient of regression = -1.47; -0.61 and -0.48, respectively) while the increase in the concentration of the soluble amino acid contributed to the increase of thrips damage (coefficient of regression = 2.10), suggesting that these biochemical conferred the resistance of cowpea to flower thrips damage. These biochemical compounds could be promising candidates to bolster cowpea cultivars' resistance.

Keywords: Cowpea, flavonoids, Megalurothrips sjostedti, reducing sugar, total carbon, soluble amino acid.

### DIVERSITY AND CURRENT SPATIAL DISTRIBUTION OF WILD EDIBLE FRUIT TREES SPECIES IN THE LAMA FOREST RESERVE IN BENIN

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#### ABSTRACT

Wild edible fruits trees (WEFT) species constitute an important source of nutrients but nowadays, these resources are concentrated in the protected areas. This study aimed to evaluate the diversity and distribution pattern of WEFT species in the Lama Forest Reserve in Benin, to provide basics for designing appropriate conservation strategies. An inventory of WEFT species was carried out in 53 square plots demarcated in the four vegetation types of the reserve. Shannon (H), Pielou (E), Green (GI) indices, and the actual distribution maps of the species were generated. The results revealed ten WEFT species with the dense forests and young fallow having 9 species; while the old fallow had 7 species. The diversity indices showed that the reserve had low floristic diversity ( $H=2.41$  and  $E=0.73$ ) in WEFT species. *Dialium guineense*, *Ficus capensis*, *Mimusops andongensis*, and *Pancovia bijuga*, in the young fallow, *Lecaniodiscus cupanioides*, and *Psidium guajava* in the degraded dense forest and *L. cupanioides*, and *P. bijuga* in old fallow exhibited an aggregative distribution ( $GI \geq 1$ ), suggesting that more effort need to be put on their conservation in these vegetation types. The maps generated in this study can later be used as reference to carry out gap analyses.

Keywords: Distribution, floristic diversity, gap analysis, Lama Forest Reserve, WEFT species

## 8.4 ARTICLES IN PRESS IN PEER-REVIEW JOURNAL WITHOUT IF IN 2017

### Acquisition de données éco éthologiques sur le daman des rochers, *Procavia capensis kerstingi* dans la commune de Dassa au Bénin

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#### RESUME

La présente étude a été réalisée dans le souci de contribuer à l'acquisition de données éco éthologiques de base à une meilleure connaissance et à la conservation du daman des rochers au Bénin. Elle fait suite à une étude réalisée sur l'espèce dans la partie septentrionale du pays. Pour y parvenir, des enquêtes ethnozoologiques ont été réalisées d'avril à juin 2016 à l'endroit des chasseurs de 7 villages de la commune administrative de Dassa (zone de transition soudano-guinéenne). Outre les enquêtes, des prospections dans les habitats de daman des rochers, ont permis d'identifier les facteurs des habitats déterminants la présence de ces petits mammifères et les caractéristiques des sites dortoirs. Les résultats indiquent que les populations riveraines de Dassa ont une bonne connaissance de l'animal. En dehors des rochers, les habitats de l'animal sont caractérisés par l'existence de refuges entre les rochers, la présence de *Ficus glumosa* et de *Panicum maximum* aux environs des dortoirs et servant d'alimentation. Le daman des rochers est abondant dans la zone d'étude mais déjà une forte pression est exercée sur les habitats alors que l'animal présente des usages non seulement alimentaire, mais aussi médicinal, commercial et culturel pour les populations riveraines. Au regard de l'importance socio-économique du daman des rochers, les populations riveraines ont manifesté, le désir de a domestication.

Cette étude d'investigation permet d'orienter les travaux ultérieurs sur les damans des rochers et implique des questions de recherche liées aux habitats, à l'écologie alimentaire, au répertoire et contextes sociaux des cris et à la reproduction pour des essais de domestication de l'animal. Aussi, la forte pression de chasse exercée sur l'espèce liée au manque de mesures de protection endogène dans les zones prospectées mérite qu'une attention particulière soit accordée à cette espèce.

Mots-clés : *Procavia capensis*, enquêtes ethnozoologiques, habitats, Bénin.

### Human-wildlife conflicts and mitigation measures in Pendjari Biosphere Reserve, northern Benin

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#### ABSTRACT

Human-wildlife conflicts are any interactions between human and wildlife with a negative impact for both parties. Understanding these conflicts is necessary to guaranty a better coexistence between human and wildlife and an improvement of wildlife conservation. The current research aims at assessing humanwildlife conflicts and analyzing the management measures developed by local communities around Pendjari Biosphere Reserve in Benin. Data were collected in January and February 2017 through a questionnaire survey of 245 respondents from different socio-professional background. Three main types of conflicts were observed around the Reserve: crop raiding, livestock predation and destruction of fishing materials. The most destroyed crops were maize (15 %), cotton (15 %) and millet (14 %), and sorghum (29 %) and baboon was the most important crop raiding species (61 % of depredation cases). Regarding livestock, pig (25 %) and sheep/goat (23.1 %) were the most

attacked animals while hyena was the most important predator reported (40.6 % of attacks). Fishing nets and hoop nets were destroyed by crocodile (72.2 %) and hippopotamus (27.8 %). To reduce these damages, farmers used several measures such as guarding (82%), scarecrows (64.5 %), and fires on the outskirts of the fields (67.3 %). Herders mostly used livestock' guarding (12.7 %) and fires or torchlight lit in the enclosures during the night (8.6 %). These measures were not efficient to prevent or avoid the damages but they did reduce them. They must be reinforced to reduce the impact of the damages on the agricultural production, the main source of income of local communities.

Key words : human-wildlife coexistence, damage, predation, conflicts mitigation, West Africa.

### Folk perceptions and patterns of use of orchid species in Benin, West Africa

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#### ABSTRACT

In Benin, people have a rich ethnobotanical knowledge of plant species, reflecting the cultural and ecological diversity of their environment. Several studies were focused on the question of how valuable are plant species for local communities. However, there has been very little research interest in the orchid species in spite of the importance of orchids in the livelihood of the local people. This study examined the use and differences in knowledge of local people of orchids in the Sudanian zone of Benin. An ethnobotanical study was conducted amongst the four main socio-economic and ethnic groups from six villages around the Pendjari Biosphere Reserve in Benin. One hundred and sixty people participated in this study. Data were gathered using semi-structured individual interviews and analysed using quantitative ethnobotanical methods. 29 different types of use were recorded and can be grouped into four main use categories: medicinal, veterinary, spiritual and food. There were differences in orchid utilization among the ethnic groups, gender and age. The knowledge of orchid uses was significantly affected by the ethnic group and the age of the respondent. Unlike young educated generations, most adults and elders, especially women, had a more comprehensive knowledge of orchid uses. *Calyptrochilum christianum*, the most used orchid, was mentioned in more than 50% of the types of orchid use. The Gourmantché and Waama tribe had more knowledge on orchid use whereas the Berba tribe had less knowledge. Three orchid species (*Habenaria cirrhata*, *Eulophia horsfallii* and *Nervilia bicarinata*) were reported as food. Orchids had low use value ranging from 0.01 (*Eulophia spp*) to 0.2 (*C. christianum*). The controlled access to the biosphere reserve and rural exodus can explain the lack of indigenous knowledge transfer of orchid use and value from elders to the young generation.

Key words: orchid, use value, traditional ecological knowledge, conservation

## Elephant conservation in Benin National Parks: an assessment of human elephant conflict and building stakeholders' capacity

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### Abstract

This field note has been adapted from the report of the project on elephant related conservation work in the larger WAP landscape was implemented with the support of the African Wildlife Foundation in 2015. Some activities were conducted to gain more knowledge about the elephant conservation in Benin's National Parks. Detailed data on human-elephant conflict were collected through participatory field work with the local communities and Park administration. We found fidelity in the traditional knowledge and the scientific data as the kernel density map generated from the elephant bio-monitoring data overlap perfectly with the elephant concentration zones and the zone identified by the local communities as high conflict zones. Elephants depopulation from poaching is high and thus a major concern for biodiversity conservation. Elephant conservation stakeholders as well as local community members warn that patrol efficiency is limited and the fragile link between population and Park will be broken. The study enabled decision makers to determine priority areas where elephant populations are more liable to become vulnerable as a result of HEC, especially as elephants migrate between protected areas and the WAP (W-Arly-Pendjari) complex. Some strategies for sustainable elephant conservation were proposed.

Keywords: conflict, elephants, farmers, crop damage, mitigation technic

## Dynamique paysagère de la Forêt Classée de la Lama au sud du Bénin

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### Résumé

La Forêt Classée de la Lama (Sud-Bénin) a subi de profonds changements suite aux efforts de restauration et de conservation qu'il est nécessaire de quantifier à partir des techniques d'écologie du paysage et de la phytosociologie. Pour y parvenir, deux images satellites Landsat ETM+ de 2000 et Landsat OLI TIRS de 2015 ont été traitées afin de cartographier le couvert végétal et d'évaluer la dynamique paysagère à travers la matrice de transition et le modèle du «decision tree algorithm». Les inventaires phytosociologiques ont été réalisés afin d'évaluer l'état de conservation de la Forêt Classée à partir de 80 relevés sur transect de 50 m de long et de 10 m de large. Il ressort des analyses que les forêts en 2015 couvrent 27,85 % de la zone d'étude contre 8,02 % en 2000 au détriment des classes anthropiques suite aux efforts d'aménagement. L'agrégation, la création et la suppression sont les principaux processus de transformation dans le paysage. Sur le plan floristique, deux groupements végétaux ont été discriminés à partir de 192 espèces. Tous ces groupements sont spécifiquement diversifiés avec la prédominance des espèces de l'élément base Guinéo-Congolais confirmant un état de protection acceptable des espèces de la forêt.

Mots clés : paysage, dynamique, indices structuraux, restauration, Forêt de la Lama, Sud-Bénin.

## 8.5 ARTICLES UNDER REVIEW IN PEER-REVIEW JOURNAL WITH IF IN 2017

### Phylogenetic classification of the world's tropical forests

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#### Abstract

Knowledge about the biogeographic affinities of the world's tropical forests helps to better understand regional differences in forest structure, diversity, composition and dynamics. Such understanding will enable anticipation of region specific responses to global environmental change. Modern phylogenies, in combination with broad coverage of species inventory data, now allow for global biogeographic analyses that take species evolutionary distance into account. Here we present the first classification of the world's tropical forests based on their phylogenetic similarity. We identify five principal floristic regions and their floristic relationships: (1) Indo-Pacific, (2) Subtropical, (3) African, (4) American, and (5) Dry forests. Our results do not support the traditional Neo- versus Palaeo-tropical forest division, but instead separate the combined American and African forests from their Indo-Pacific counterparts. We also find indications for the existence of a global dry forest region, with representatives in America, Africa, Madagascar and India. Additionally, a northern hemisphere Subtropical forest region was identified with representatives in Asia and America, providing support for a link between Asian and American northern hemisphere forests.

### Comparative in Diet and feeding ecology Between Olive Colobus Monkey (*Procolobus verus*) groups Living in degraded Forest and Protected Forest (Benin)

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#### Abstract

To relate differences in diet and feeding ecology to differences in vegetation strucutre and composition, olive colobus's feeding behavior was assessed in southern Benin (West Africa).The data was collected for 8 months on four unhabituated groups of olive colobus : two groups living in protected forest (Classified Forest of the Lama) and two in degraded forest (patches forests of Domè).The sampling procedure, ad libitum was used to determine the diet and feeding ecology of this monkey in two both forest .

The results showed firstly that olive colobus feeds diversity, ranged in 25 food species (37% of species occurred in this forest) whereas, diet concerned 37 parts in degraded forest against 32 food species (15% of the species occurred) for 42 parts in protected forest. Specific richness in both forests is 47 species when we combined diets for both two groups and Sorenson similary index is 18% in value (Albizia zygia, Cleistopholis patens, Cynometra megalophylla, Leucaniodiscus cupanioides, Pauridiantha hirtella, Psychotria apple-brandy, Pterocarpus santalinoides, Spondianthus preussii, Terminalia avicennioides, Xylopia parviflora are commonly occurred in both forest types). Afterwards, leaves were the most important food (61%) in protected forest than in degraded (58%) but fruits (28%) were the least important in protected forest than degraded (40%). However, this study must be continue particularly in Classified forest of Lama, in order to provide the exhaustive list of food species and diet of olive colobus.

Key-words : *Procolobus verus, feeding, ab libitum, protected forest, degraded forest, diet*

**MICROSATELITES MARKERS ASSOCIATED WITH RESISTANCE TO FLOWER THIRPS  
IN COWPEA GENOTYPE TVU-123 X WC36**

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**ABSTRACT**

Breeding for resistance to flower thrips in cowpea has been hindered by the quantitative nature of resistance. The objective of this study was to use molecular markers to identify genetic loci associated with the expression of resistance to flower thrips. F2 lines were generated from a cross between a resistant TVU-123 and a susceptible WC36 lines. The F2s plants were evaluated for thrips damage scores, thrips counts, and pods number per plant under artificial infestation. Sixty-six microsatellites markers were screened between the two parental lines and the polymorphic markers were used to genotype 100 F2s population. Single marker analysis methods were used to evaluate the association between the markers and traits. The results showed that there was a transgressive segregation among the F2s for resistance to flower thrips. A significant and negative ( $R^2=0.21$ ) relationship was observed between thrips damage scores and pods number per plant. Seven SSR markers showed polymorphism among the 66 markers. Two markers (CP37/38 and CP215/216) were significantly ( $P<0.01$ ) associated with thrips damage scores and thrips counts. The two markers explained 7 and 11.2% of the total variation in thrips damage scores and thrips counts, respectively. The QTLs detected have mainly additive gene effects and could be applied in breeding. A more detailed study using more markers on these loci should provide better understanding of this complex trait.

Key words: Cowpea, flower thrips, microsatellites markers, resistance, single marker analysis

## 8.6 ARTICLES UNDER REVIEW IN PEER-REVIEW JOURNAL WITHOUT IF IN 2017

### A MORE COMPLETE DEFINITION FOR “PROMISCUOUS SOYBEAN” RUNNING TITLE : DEFINING ‘PROMISCUOUS’ SOYBEAN

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#### RESUME

La présente étude a été réalisée dans le souci d'ABSTRACT

Following a series of research on promiscuous nodulation, it came out that it is incomplete to define ‘promiscuous soybean’ as soybean cultivars with the sole ability to form nodules freely with indigenous Bradyrhizobium strains without requiring the specific type, *Bradyrhizobium japonicum*. This paper proposes a more complete definition which caters for both nodulation and biological nitrogen fixation ability.

Key words : promiscuous soybean, nodulation, biological nitrogen, fixation, *Bradyrhizobium*

### WHAT DO UGANDAN FARMERS KNOW ABOUT NODULATION IN SOYBEAN?

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#### ABSTRACT

Farmers' awareness and perceptions play key roles in agricultural technologies adoption. In this study we investigated the perceptions of Ugandan farmers on nodulation in soybean. Information were gathered using a stratified random sampling approach in major soybean growing areas in Uganda, namely Kasese, Luwero, Kamwenge, and Jinja. Data were analysed using descriptive statistics combined with a correspondence factorial analysis performed in Minitab 14th edition. Results showed that the majority of soybean farmers were aware of nodulation (87.5%) and can differentiate root nodules from root knots (56.25%). Most farmers (73.44%) reported nodules as important for soybean, being sources of nutrients, nitrogen, fast growth, and high yield. Factorial analysis showed that farmers in Kamwenge, large scale soybean farmers and farmers with high education level perceived nodules as nutrients absorption structures. Junior, small scale soybean farmers, and farmers with secondary education level always observed nodules in their fields. Farmers in Jinja and female farmers perceived nodules as source of nitrogen and distinguished root-knots as swelling on root systems. Farmers in Kasese and farmers with primary education level identified nodules as sources of nutrients and perceived root-knots as structures that damage soybean plants. Farmers in Luwero, medium scale farmers and soybean processors were not really aware of nodulation in soybean. This is the first study reporting farmers' perceptions on nodulation in soybean and information gathered herein would help in participatory breeding to foster development and adoption of promiscuous soybean varieties in Uganda.

**Production et décomposition de litière dans la forêt naturelle et dans une plantation au sein de la Forêt Dense Semi Décidue de Pahou (Bénin)**

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**Résumé**

La quantité, la dynamique de chute et la décomposition de la litière ont été étudiées au sein de la FDSD de Pahou/Bénin (Afrique de l'Ouest). La production de litière est mesurée grâce à des trappes de 1m<sup>2</sup> disposées dans la forêt alors que le taux de décomposition est évalué par la technique de litterbag. A titre comparatif, ces mesures ont été prises aussi bien dans la forêt naturelle que dans une plantation d'*Acacia auriculiformis*. Les résultats ont montré que la litière de la forêt naturelle renferme plus de feuilles (70 à 97%) et celle de la plantation , des feuilles (phyllodes) et des organes reproducteurs respectivement 50% et 46%. Les chutes maximales sont enregistrées en décembre pour la forêt naturelle (1,47 t/ha) et en janvier dans la plantation (3,15t/ha) et celles minimales dans les mois d'avril à octobre. La chute totale annuelle est de 16,23t/ha dans la plantation mais de 12,22t/ha dans la forêt naturelle. D'une manière générale, la décomposition de la litière est plus rapide en saison humide qu'en saison sèche au sein des deux forêts. Toutefois le taux de décomposition de la forêt naturelle ( $k=0,67$ ) est plus élevé que celui de la plantation ( $k=0,63$ ).

Mots clés : chute de litière, décomposition de litière, forêt naturelle, coefficient de décomposition.

**In vivo digestibility of Boerhavia diffusa and Khaya senegalensis in West African Dwarf sheep in the Sudano-Guinean zone in Benin.**

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**ABSTRACT**

Nutritional values of two anthelmintic forage species namely *Boerhavia diffusa* and *Khaya senegalensis* were determined by in vivo digestibility tests. The study was performed on 12 non-castrated rams sheep with an average weight of  $23 \pm 0.6$  kg vaccinated, dewormed, divided into two homogeneous groups of six subjects for each plant and housed individually. The experiment lasted 25 days divided into two phases: adaptation and data gathering which is about food, refusals and faeces samples weighing. Chemical analyzes and bromatology of all samples collected were made. The forages' net energy was calculated from the organic matter constituents' digestibility according to the INRA system. Phytochemical screening of leaves of *B. diffusa* and *K. senegalensis* shows the presence of secondary metabolites. On the other hand, galenic tannins's level is much higher in *K. senegalensis* than in *B. diffusa*. That negatively affects its water's level, its intake, its nitrogen's, fat's, and energy's digestibility coefficient cross-check to *B. diffusa* ( $p < 0.1$ ). Indeed, *B. diffusa*'s net energy level for growth and feeder were higher than *K. senegalensis*'s ( $p < 0.1$ ). *B. diffusa*'s leaves had a better nutritional value than *K. senegalensis*'s and could improve ovines's growth by appropriate supplementation.

Key words: Anthelmintic plants; Forage; Nutritional value, Phytochemical screening.

## DIVERSITE ET IMPORTANCE SOCIO-ECONOMIQUE DES SERVICES ECOSYSTEMIQUES DANS LA RESERVE DE BIOSPHERE DE LA PENDJARI AU NORD-BENIN

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### Abstract

Les écosystèmes et les aires protégées en particulier fournissent d'importants services aux communautés locales, services qui représentent des motivations pour la conservation des ressources naturelles. La présente recherche a été conduite dans la Réserve de Biosphère de la Pendjari au Nord-Bénin dans le but d'identifier les services écosystémiques et leurs contributions aux revenus des ménages riverains de la réserve. La collecte des données, basée sur des questionnaires et des guides d'entretien, s'est effectuée par l'observation directe, les entretiens semi-structurés, les focus group et la méthode active de recherche participative. L'importance des services écosystémiques a été déterminée à partir des taux de réponse et les valeurs d'importance et consensuelle. L'accent a été mis sur les services d'approvisionnement et culturels. Au total, 60 services écosystémiques répartis en 50 services d'approvisionnement, neuf services culturels et un service de régulation ont été répertoriés par les populations enquêtées. Les produits les plus exploités sont les légumes-feuilles, la paille, le bois de chauffe, les plantes médicinales, la noix de karité et les cordes. Certains services sont exclusivement destinés aux hommes du fait de leur éloignement des terroirs villageois. Chaque ménage tire en moyenne  $84\ 897 \pm 191\ 430$  XOF des services écosystémiques et  $169\ 000 \pm 182\ 984$  XOF des spéculations agricoles. Les résultats de cette étude doivent être utilisés pour sensibiliser les populations sur l'importance de la réserve et des actions doivent être menées pour garantir la durabilité des services écosystémiques surtout ceux d'approvisionnement pour le mieux-être des communautés locales et des ressources naturelles.

## Conflits hommes-hippopotames dans la Réserve Communautaire d'Adjamè au sud-ouest du Bénin

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*Bulletin de la Recherche Agronomique du Bénin (BRAB) Numéro 82 – Décembre 2017 BRAB en ligne (on line) sur le site web <http://www.slire.net> ISSN sur papier (on hard copy) : 1025-2355 et ISSN en ligne (on line) : 1840-7099*

### RESUME

L'hippopotame commun fait partie des espèces les plus impliquées dans les conflits avec les hommes en Afrique. La conservation de l'espèce doit intégrer une meilleure gestion de ces conflits. Afin de mieux comprendre les conflits hommes-hippopotames dans la Réserve Communautaire d'Adjamè au sud-est du Bénin, une recherche a été menée dans les villages riverains à cette réserve. Au total 125 personnes ont été interrogées sur la base d'un guide d'entretien. La statistique descriptive a été utilisée pour présenter les résultats. Les résultats ont montré que les conflits se résumaient à la destruction des champs et des engins de pêche par les hippopotames. Le maïs et le manioc étaient les principales cultures détruites et les ménages ont perdu la saison d'étude en moyenne 140.000 XOF par les conflits. Les dommages étaient très importants plus proche de la réserve. Les conflits devaient être en augmentation. Les populations utilisaient plusieurs méthodes dont les épouvantails, le feu et le bruit, mais ces méthodes étaient peu efficaces contre les incursions des hippopotames dans les champs. Heureusement les conflits ne conduisaient plus à des pertes en vies humaines. Bien que les abattages de revanche des hippopotames ne soient pas fréquents dans la zone, il importe de faire un meilleur suivi des conflits, de leurs conséquences ainsi que des populations d'hippopotames. Cela doit permettre de trouver des solutions durables aux conflits pour le mieux-être des communautés locales et des hippopotames.

Mots clés : Réserve de Biosphère du Delta du Mono, Hippopotamus amphibius, champs, réduction des conflits. Human-hippopotamus conflicts in Adjamè community reserve in south-eastern Benin

**Facies of vegetation and pastoral characterization of agrosystems dominated by oil palm tree (*Elaeis guinensis*) in Zè Allada and Toffo' perimeter in South of Benin**

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*Int. J. Biol. Chem. Sci. 11(3): 1135-1144, June 2017*

*DOI : <https://dx.doi.org/10.4314/ijbcs.v11i3.17>*

**ABSTRACT**

The natural resource assessment, particularly grassland assessment, is one of the most preoccupations of present day. This study has been carried out in Zè, Allada, and Toffo townships agrosystems in Atlantique' department, South of Benin. The main objective was to contribute to the assessment of fodder' agrosystems importance in those townships. Specifically, it concerned Zè-Toffo and Allada's perimeter mapping; identifying of grazing value of vegetal species; estimating grazing value. To reach these objectives, the three townships were first zoned in two areas, this area was mapped and surveys have been realized close to shepherds to make a list of consumed species. The study result reveals that land owners are essentially men (83.3%) and women (16.7%) from 55 age average. Legacy is the principal access to land (46% of household survey). 171 vegetal species distributed on 63 botanic families was inventoried. Euphorbiaceae are the most dominant and diversified family (16 species) followed by Fabaceae and Poaceae (12 species).*P. maximum* is the dominant specie of the studying area. Its Touch Specific Contribution average and grazing pasture average are respectively estimated to 77.03% et 43.13%. © 2016 International Formulae Group. All rights reserved.

Keywords: Facies of vegetation, specific indices of quality, grazing value.

**The Potential of Millet fodder (*Pennisetum glaucum* (L.) R. Br): A review**

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*Journal of Animal & Plant Sciences, 2017. 34(2): 5424-5447*

*<http://www.m.elewa.org/JAPS; ISSN 2071-7024>*

**ABSTRACT**

In this context of forage deficit, which has become structural in the Sahelian lands, due to climate change and demographic pressure, millet is increasingly exploited as a forage plant or at least a double-purpose plant (grain and forage) in the concern to ensure the food security of livestock. In Niger, millet is found to be characteristic of the most dominant cropping systems. Adapted to difficult edaphic and climatic conditions, it may well compensate for climate-induced fodder deficits in the context. However, although research on millet has been the subject of an abundant production of research articles for several decades, it is easy to see that few studies have addressed topics on the potential forage of millet in the scientific literature. This work, based on an extensive literature review, aims to provide an overview of the major research topics on millet on the one hand and to document millet's forage performance on the other. Current research themes on millet revolve around areas such as: conservation of the diversity of genetic resources, research of resistant (or tolerant) varieties to drought, the study of genes encoding adaptation to climate change (PHYC gene discovery), cytoplasmic male sterility, use of dwarfism genes and apomixis to fix hybrid vigor. This bibliographic synthesis provides a broad view of the research carried out in the world scientific sphere and makes it possible to better guide future research in the field of millet production for fodder purposes.

Key words: climate change, fodder, millet, Sahel

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### Abstract

Les écosystèmes et les aires protégées en particulier fournissent d'importants services aux communautés locales, services qui représentent des motivations pour la conservation des ressources naturelles. La présente recherche a été conduite dans la Réserve de Biosphère de la Pendjari au Nord-Bénin dans le but d'identifier les services écosystémiques et leurs contributions aux revenus des ménages riverains de la réserve. La collecte des données, basée sur des questionnaires et des guides d'entretien, s'est effectuée par l'observation directe, les entretiens semi-structurés, les focus group et la méthode active de recherche participative. L'importance des services écosystémiques a été déterminée à partir des taux de réponse et les valeurs d'importance et consensuelle. L'accent a été mis sur les services d'approvisionnement et culturels. Au total, 60 services écosystémiques répartis en 50 services d'approvisionnement, neuf services culturels et un service de régulation ont été répertoriés par les populations enquêtées. Les produits les plus exploités sont les légumes-feuilles, la paille, le bois de chauffe, les plantes médicinales, la noix de karité et les cordes. Certains services sont exclusivement destinés aux hommes du fait de leur éloignement des terroirs villageois. Chaque ménage tire en moyenne  $84\ 897 \pm 191\ 430$  XOF des services écosystémiques et  $169\ 000 \pm 182\ 984$  XOF des spéculations agricoles. Les résultats de cette étude doivent être utilisés pour sensibiliser les populations sur l'importance de la réserve et des actions doivent être menées pour garantir la durabilité des services écosystémiques surtout ceux d'approvisionnement pour le mieux-être des communautés locales et des ressources naturelles.

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Mots clés : Réserve de Biosphère du Delta du Mono, Hippopotamus amphibius, champs, réduction des conflits. Human-hippopotamus conflicts in Adjamè community reserve in south-eastern Benin

## 8.7 COMPLETED DOCTORATE THESIS IN 2017

**Ethnobotany and ecology of *Mimusops andongensis* Hiern and *Mimusops kummel* Bruce ex A. DC: implications for the species management and conservation in Benin (West Africa)**

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### ABSTRACT

Non-Timber Forest Products (NTFPs) are very important resources as they help local people to meet their basic needs in terms of health, food, energy, shelter and cash income through trade, especially during times of hardship where they provide a form of natural insurance to multitude of households. However, due to multiple pressures faced by forest species, their conservation remains a substantial challenge worldwide and understanding NTFP species uses and the general autecology of the remaining populations is highly relevant. The present study provides basic information for the knowledge, valorisation and conservation of *Mimusops andongensis* and *Mimusops kummel* in Benin. It aimed to: (i) assess the distribution and morphological differentiation of the species; (ii) assess the ecological factors underlying their distribution and potential impact of climate change on suitable habitats; (iii) identify both species' exploited parts and uses, and local knowledge on their occurrence habitats and threats faced; (iv) analyze the synergistic impact of multiple pressures on population of *M. andongensis*; (v) characterize the population structure and morphology of both species, in the context of ecological stresses and anthropogenic pressures; and (vi) characterize the phenology of both species in relation to abiotic and biotic drivers.

Chapter 2 focused on the distribution and morphological differentiation of *Mimusops* species, using morphological traits. The structure of the flowers was analysed to confirm *Mimusops* genus and the length of flower pedicel was used to separate the species. Also, the species were characterized by length and width of leaves as well as length of blade and petiole. Although mean values of leaf characteristics seemed higher for *M. kummel* than *M. andongensis*, the measures overlapped. Contrary to literature, *M. andongensis* is present in the Guineo-Congolian zone of Benin while *M. kummel* occurs in the Guineo-Sudanian transition and Sudanian zones, with no overlap in their distribution.

In chapter 3, we assessed ecological factors underlying the distribution of *Mimusops* species, and potential impact of climate change on suitable habitats, using Principal Components Analysis and niche modelling in MaxEnt. Gap analysis was also applied to highlight the effectiveness of protected areas (PAs) network in preserving the two species populations. *M. andongensis* mainly occurs on soils with high soil clay, silt, organic carbon and cationic exchange capacity, and *M. kummel* on soils with high sand content. However, both species preferred soil conditions which allow prolonged high water holding capacity. *M. andongensis* occurrence is positively linked to mean annual temperature, while *M. kummel* occurrence is influenced by seasonality of precipitation and precipitation of the wettest period. Predictions showed affinity of suitable areas with water lines, for both species. Suitable areas are mainly limited to the humid zone for *M. andongensis*, while they are mostly located in the sub-humid zone and absent from the driest part of the semi-arid zone for *M. kummel*. Also, very suitable areas covered by PA (only Lama Forest reserve) for *M. andongensis* will decrease in the future, while for *M. kummel* they will be stable.

Chapter 4 identified the exploited parts and uses of both species, and local knowledge on their occurrence habitats and threats faced. For that, we conducted a structured household survey using questionnaires. Nearly all organs of the species were used with the most widely used being the wood, young stems, bark and leaves. Both species were mainly exploited for medicinal purposes but also in construction and as firewood. We found similarities in some uses of the species organs, although the species are used by different ethnic groups in different ecological zones. There were strong relationships between gender, age and ethnic affiliation of users and the exploited organs of both species. For most informants, population of *M. andongensis* was decreasing, although some felt it is increasing, whereas for less than one-third *M. kummel* was decreasing. Factors responsible for this decrease are conversion of forest for agriculture, exploitation of the species, limited regeneration and bushfires. In chapter 5, we assessed the impact of forest degradation and invasion by *Chromoleana odorata* on the population of *M. andongensis* in Lama Forest reserve in Benin. We analyzed density of adult and mature trees, regeneration, and size class distribution across three degradation levels, in relation with *C. odorata* cover. Densities of adult trees and regeneration decreased with increasing degradation. There were fewer *M. andongensis* recruits with increasing *C. odorata* cover. Smaller dbh trees predominated in non-degraded and moderately degraded sites while in degraded sites, their density was less than 2 trees/ha. Larger trees were also rare in degraded sites. The low density of both mature trees and seedlings in degraded sites may undermine the long-term viability of *M. andongensis*, despite the existing protection against NTFP harvesting and other anthropogenic pressures. Chapter 6 characterized the density, population stability and leaf morphology of both species, in the context

of ecological stresses and anthropogenic pressures. Density of trees  $\geq 5$  cm and regeneration were higher for *M. andongensis* (in the more protected forest) than *M. kummel* (in forests with access to people). We observed significant relationships between regeneration density and soil properties for *M. andongensis* but not for *M. kummel*. Correlations between tree morphology and soil characteristics were weak, for both species. The population was stable in the more protected forest relative to the other forests. *Mimusops* trees with dbh 5-15 cm represented more than 30 % in most forests. *M. kummel* trees flower when quite small ( $\geq 6$  cm dbh), suggesting that there is sufficient reproductive trees and as a long-lived species, its populations could be maintained with low/episodic recruitment. However, many forests lack regeneration and climate change could threaten those populations by causing death of big trees.

Chapter 7 focused on the phenology of both species and relationships with climate and tree dbh and canopy position, using correlations. We sampled trees in six dbh classes and noted their canopy position. Flowering started from the dry season through to the beginning of the rainy season, but peaked in the dry season. Fruiting occurred in the rainy season and peaked during the more humid period, for both species. Flowering was positively correlated with temperature. Conversely, fruiting was negatively correlated with temperature and positively with rainfall, but only in the Guineo-Sudanian zone. For *M. andongensis*, both flowering and fruiting prevalence was positively linked to tree dbh, while only flowering was significantly related to canopy position. The relationship with tree dbh was significant for flowering prevalence only and in the Guineo-Sudanian zone, for *M. kummel*. Results suggested phylogenetic membership as important factor restricting *Mimusops* species phenology. The phenology of both species is influenced by climate, and climate change might shift its pattern and affect the species population, and other organisms and services related to them.

*M. andongensis* and *M. kummel* are two interesting endogenous plant species that have potential for commercial uses (preparation of tea, juice or local beverage, jams and jellies) to contribute to improvement of local peoples livelihoods. We suggested the valorisation of the species could incite, under the right circumstances, effective actions for their sustainable use, thus their preservation. However, because the species are under multiple stresses, their long-term viability and preservation might not be guaranteed even in protected areas. Fortunately, predictions under future climates showed an increase in the extent and the level of suitability of favourable habitats for both species. This could be profitable for the species reintroduction and help in sustaining their uses, only if their sylviculture is well known and planting proved successful. For the species valorisation and sustainable use, further long-term investigations are required on the species population growth, dynamics and viability (population structural and reproductive patterns in relation with the different pressures, availability and germination of seeds). Human-assisted natural regeneration and introduction of seedlings and propagation ability of the species should also be considered.

**Keywords:** Benin, ecological niche modelling, ethnobotany, gap analysis, multiple pressures, NTFP species, population structure, taxonomic differentiation.

## 8.8 ABSTRACT OF CONFERENCE/SEMINAR IN LEA

### De la psychologie à la biologie de conservation : application du modèle d'acceptation du danger à la conservation des îlots forestiers du Dahomey gap dans le contexte des épidémies de zoonoses émergentes

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#### *ABSTRACT*

*L'explosion récente des épidémies de zoonoses émergentes telles que la fièvre à virus Ebola et la fièvre Lassa amène les populations à considérer les reliques de forêt dense humide du Dahomey gap, habitats des vecteurs de ces maladies (primates, rongeurs, chauves-souris), comme une source de danger. Ainsi, il importe de comprendre comment les populations riveraines des îlots de forêts du Dahomey gap modifieront leur engagement à vivre en harmonie avec la nature et de développer un modèle psychologique d'acceptation des communautés à conserver les habitats malgré les risques d'épidémie. La théorie psychologique sur le risque stipule que l'acceptation du danger par un individu dépend de cinq facteurs : le risque perçu, le bénéfice anticipé, la confiance sociale, la similarité des valeurs et la maîtrise de soi. Le risque perçu est une évaluation intuitive de la menace que représenterait une forêt, reflétant le degré auquel l'individu pense être exposé à un danger. Le bénéfice anticipé représente les services tirés de la forêt. La confiance sociale est conceptualisée comme la volonté d'un individu de compter sur ceux qui ont la responsabilité de prendre des décisions et de mener des actions en matière de santé publique et de sécurité. La similarité des valeurs représente le degré auquel un individu perçoit les Services Forestiers et les Structures Sanitaires comme partageant ses propres valeurs. La maîtrise de soi est le degré auquel un individu pense avoir le contrôle de sa vie. En s'appuyant sur ce cadre théorique conçu par les psychologues, un projet de recherche a été rédigé pour collecter les données autour de 4 forêts classées et réserves botaniques (Lama, Niaouli, Pahou, Pobè) ainsi que 4 forêts communautaires (Lokoli, Ewè, Tèdozoun, Soligbozoun) localisées aussi bien en milieu urbain qu'en milieu rural. L'enquête individuelle à réaliser sur une taille d'échantillon de 600 ménages est basée sur un questionnaire s'articulant autour des cinq facteurs déterminant l'acceptation du danger. Les données seront analysées afin de ressortir les variables influençant significativement l'acceptation du danger en fonction du statut juridique des forêts (forêts classées/ réserves botaniques vs. forêts communautaires) et du niveau d'urbanisation (zone rurale vs. zone urbaine). Les implications pour la conservation de la diversité biologique des forêts ainsi que la stratégie nationale de gestion des épidémies de zoonoses émergentes seront précisées et présentées aux autorités compétentes.*

*Mots clés : Bénin, conservation, épidémie, fièvre à virus Ebola, forêt, psychologie*

### Le monde merveilleux des champignons

*Prof. Dr. Meike Piepenbring, Université de Francfort, Allemagne*

#### *ABSTRACT*

*La diversité des champignons est estimée entre 1.5 à 5.1 millions d'espèces dans le monde entier. De cette diversité, environ 130.000 espèces sont connues, décrites et documentées, laissant une grande majorité des espèces méconnues du monde scientifique. On estime que la grande majorité des taxa non connus résident sous les tropiques. Les champignons présentent une variabilité remarquable de forme, couleur, odeur, mode de vie et de stratégie de survie. Ils présentent aussi une diversité fonctionnelle impressionnante, comprenant entre autre leur rôle crucial dans les écosystèmes en tant que symbiotes, saprotrophes et parasites, de même que leur importance alimentaire, agricole, et les applications potentielles en industrie alimentaire et pharmaceutique du fait de leur pouvoir enzymatique et de synthèse de composés bioactifs. De l'autre côté, les champignons peuvent être néfastes en causant des maladies et détruire des aliments. À travers cette présentation, nous invitons les auditeurs à explorer avec nous la diversité biologique et fonctionnelle des champignons avec un accent particulier sur les espèces tropicales. Des exemples sélectionnés à partir de notre propre expérience de terrain sous les tropiques permettront d'illustrer les différentes interactions entre les champignons et les autres éléments de la biodiversité, et de mettre en évidence le rôle écologique des champignons au sein des écosystèmes tropicaux. Un accent sera aussi mis sur la formation des compétences mycologiques et le transfert de compétence nord-Sud, nécessaire pour assurer une documentation rapide de cette richesse ignorée mais menacée de disparition.*

## Evaluation des impacts écologiques et paysagers et des perceptions sociales des activités d'exploitation des carrières non sableuses en République du Bénin

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### ABSTRACT

L'exploitation des carrières est une forme d'utilisation des terres qui entraîne des effets non négligeables sur l'environnement, notamment le paysage, la végétation et les populations locales. Très peu d'études se sont intéressées aux impacts de cette forme d'utilisation des terres en République du Bénin. L'objectif général a été d'évaluer les impacts écologiques sur le paysage et les perceptions sociales des activités d'exploitation des carrières non sableuses du Bénin. Les objectifs spécifiques fixés étaient (1) de déterminer les communautés végétales des carrières non sableuses du Bénin et leurs caractéristiques floristiques et écologiques, (2) d'identifier les facteurs déterminant la mise en place des groupements végétaux après les activités d'extraction des carrières, (3) d'analyser les perceptions sociales des activités d'exploitation des carrières non sableuses et (4) d'analyser la composition et la configuration des paysages de carrières. La diversité et le nombre de carrières non sableuses ont été identifiés grâce aux informations recueillies à la Direction Générale des Mines (DGM), auprès des responsables communaux et des exploitants de carrières. Des relevés phytosociologiques ont été réalisés dans des placeaux carrés de 400 m<sup>2</sup> dans des formations post carrière et celles adjacentes (savanes et jachères) sur les mêmes matériaux. L'analyse de ces relevés a révélé une flore constituée de 457 espèces réparties dans 82 familles dont les plus représentées sont les Leguminosae. Les carrières en abritent 348 dont 2,01% sont classées dans la Liste Rouge des espèces végétales menacées de disparition au Bénin. Une classification hiérarchique ascendante des relevés a été exécutée dans le logiciel PCORD 5 avec une matrice de 57 relevés et 346 espèces des formations végétales témoins et une matrice de 68 relevés et 348 espèces des formations végétales post carrière. La classification a abouti à une discrimination de six et trois groupements végétaux respectivement dans les carrières et les témoins. La discrimination des groupements a été faite suivant la zone biogéographique et la nature du matériau extrait dans les carrières et suivant un gradient latitudinal dans les témoins. Tous les groupements végétaux sont diversifiés et caractérisés par une prédominance de Phanérophytes et de Thérophytes. Dans les carrières, les Thérophytes, les espèces à large distribution géographique et les espèces rudérales et ségétales sont les plus représentées. Une régression binomiale négative exécutée dans le logiciel R a révélé que l'établissement des groupements végétaux après les activités d'extraction est fonction de la profondeur d'extraction et de l'âge d'abandon. De même, l'utilisation de la terre arable comme amendement sur les sites après l'extraction du calcaire a influé sur la discrimination et les caractéristiques phytosociologiques des groupements végétaux post carrière. Aussi, des enquêtes menées auprès des communautés vivant près des sites d'extraction de carrières ont permis de faire ressortir les retombées relatives à ces activités. Les résultats ont révélé que les populations locales ont une perception négative des activités d'extraction. Cependant, des régressions logistiques ordinaires réalisées dans R, ont révélé que leurs points de vue ont été influencés significativement ( $p < 0,05$ ) par leur profession, leur statut matrimonial, leur ethnie, leur âge et leur niveau d'éducation. Enfin, grâce aux logiciels ENVI 5.0 et ArcGIS 10.0, une analyse de la structure spatiale de deux paysages de carrières a été faite au moyen de deux images QuickBird acquises dans des zones de carrières de quartzite et de gravier. Les carrières ont occupé de faibles proportions, respectivement 0,2% et 3,7% des paysages de carrières de quartzite et de gravier. Au regard des impacts liés aux activités d'extraction, la nécessité de procéder à un décapage sélectif, au stockage de la terre végétale et son utilisation dans l'aménagement des sites extraits s'impose afin de rétablir les caractéristiques physico-chimiques des sols et favoriser le retour de la végétation. De même, le remblayage et le nivellement des sites extraits sont des mesures destinées au rétablissement de la topographie originale. L'arrosage régulier des pistes et l'installation d'une ceinture verte autour des carrières sont des mesures d'atténuation des effets de pollution dus à la poussière.

**Mots clés :** Carrières, impacts, phytodiversité, perceptions des populations, structure spatiale, Bénin.

**Mots clés :** Bénin, conservation, épidémie, fièvre à virus Ebola, forêt, psychologie

**Ethnobotany and ecology of *Mimusops andongensis* Hiern and *Mimusops kummel* Bruce ex A. DC: implications for the species management and conservation in Benin (West Africa)**

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**ABSTRACT**

Non-Timber Forest Products (NTFPs) are very important resources as they help local people to meet their basic needs in terms of health, food, energy, shelter and cash income through trade, especially during times of hardship where they provide a form of natural insurance to multitude of households. However, due to multiple pressures faced by forest species, their conservation remains a substantial challenge worldwide and understanding NTFP species uses and the general autecology of the remaining populations is highly relevant. The present study provides basic information for the knowledge, valorisation and conservation of *Mimusops andongensis* and *Mimusops kummel* in Benin. It aimed to: (i) assess the distribution and morphological differentiation of the species; (ii) assess the ecological factors underlying their distribution and potential impact of climate change on suitable habitats; (iii) identify both species' exploited parts and uses, and local knowledge on their occurrence habitats and threats faced; (iv) analyze the synergistic impact of multiple pressures on population of *M. andongensis*; (v) characterize the population structure and morphology of both species, in the context of ecological stresses and anthropogenic pressures; and (vi) characterize the phenology of both species in relation to abiotic and biotic drivers.

Chapter 2 focused on the distribution and morphological differentiation of *Mimusops* species, using morphological traits. The structure of the flowers was analysed to confirm *Mimusops* genus and the length of flower pedicel was used to separate the species. Also, the species were characterized by length and width of leaves as well as length of blade and petiole. Although mean values of leaf characteristics seemed higher for *M. kummel* than *M. andongensis*, the measures overlapped. Contrary to literature, *M. andongensis* is present in the Guineo-Congolian zone of Benin while *M. kummel* occurs in the Guineo-Sudanian transition and Sudanian zones, with no overlap in their distribution.

In chapter 3, we assessed ecological factors underlying the distribution of *Mimusops* species, and potential impact of climate change on suitable habitats, using Principal Components Analysis and niche modelling in MaxEnt. Gap analysis was also applied to highlight the effectiveness of protected areas (PAs) network in preserving the two species populations. *M. andongensis* mainly occurs on soils with high soil clay, silt, organic carbon and cationic exchange capacity, and *M. kummel* on soils with high sand content. However, both species preferred soil conditions which allow prolonged high water holding capacity. *M. andongensis* occurrence is positively linked to mean annual temperature, while *M. kummel* occurrence is influenced by seasonality of precipitation and precipitation of the wettest period. Predictions showed affinity of suitable areas with water lines, for both species. Suitable areas are mainly limited to the humid zone for *M. andongensis*, while they are mostly located in the sub-humid zone and absent from the driest part of the semi-arid zone for *M. kummel*. Also, very suitable areas covered by PA (only Lama Forest reserve) for *M. andongensis* will decrease in the future, while for *M. kummel* they will be stable.

Chapter 4 identified the exploited parts and uses of both species, and local knowledge on their occurrence habitats and threats faced. For that, we conducted a structured household survey using questionnaires. Nearly all organs of the species were used with the most widely used being the wood, young stems, bark and leaves. Both species were mainly exploited for medicinal purposes but also in construction and as firewood. We found similarities in some uses of the species organs, although the species are used by different ethnic groups in different ecological zones. There were strong relationships between gender, age and ethnic affiliation of users and the exploited organs of both species. For most informants, population of *M. andongensis* was decreasing, although some felt it is increasing, whereas for less than one-third *M. kummel* was decreasing. Factors responsible for this decrease are conversion of forest for agriculture, exploitation of the species, limited regeneration and bushfires. In chapter 5, we assessed the impact of forest degradation and invasion by *Chromoleana odorata* on the population of *M. andongensis* in Lama Forest reserve in Benin. We analyzed density of adult and mature trees, regeneration, and size class distribution across three degradation levels, in relation with *C. odorata* cover. Densities of adult trees and regeneration decreased with increasing degradation. There were fewer *M. andongensis* recruits with increasing *C. odorata* cover. Smaller dbh trees predominated in non-degraded and moderately degraded sites while in degraded sites, their density was less than 2 trees/ha. Larger trees were also rare in degraded sites. The low density of both mature trees and seedlings in degraded sites may undermine the long-term viability of *M. andongensis*, despite the existing protection against NTFP harvesting and other anthropogenic pressures. Chapter 6 characterized the density, population stability and leaf morphology of both species, in the context

of ecological stresses and anthropogenic pressures. Density of trees  $\geq 5$  cm and regeneration were higher for *M. andongensis* (in the more protected forest) than *M. kummel* (in forests with access to people). We observed significant relationships between regeneration density and soil properties for *M. andongensis* but not for *M. kummel*. Correlations between tree morphology and soil characteristics were weak, for both species. The population was stable in the more protected forest relative to the other forests. *Mimusops* trees with dbh 5-15 cm represented more than 30 % in most forests. *M. kummel* trees flower when quite small ( $\geq 6$  cm dbh), suggesting that there is sufficient reproductive trees and as a long-lived species, its populations could be maintained with low/episodic recruitment. However, many forests lack regeneration and climate change could threaten those populations by causing death of big trees.

Chapter 7 focused on the phenology of both species and relationships with climate and tree dbh and canopy position, using correlations. We sampled trees in six dbh classes and noted their canopy position. Flowering started from the dry season through to the beginning of the rainy season, but peaked in the dry season. Fruiting occurred in the rainy season and peaked during the more humid period, for both species. Flowering was positively correlated with temperature. Conversely, fruiting was negatively correlated with temperature and positively with rainfall, but only in the Guineo-Sudanian zone. For *M. andongensis*, both flowering and fruiting prevalence was positively linked to tree dbh, while only flowering was significantly related to canopy position. The relationship with tree dbh was significant for flowering prevalence only and in the Guineo-Sudanian zone, for *M. kummel*. Results suggested phylogenetic membership as important factor restricting *Mimusops* species phenology. The phenology of both species is influenced by climate, and climate change might shift its pattern and affect the species population, and other organisms and services related to them.

*M. andongensis* and *M. kummel* are two interesting endogenous plant species that have potential for commercial uses (preparation of tea, juice or local beverage, jams and jellies) to contribute to improvement of local peoples livelihoods. We suggested the valorisation of the species could incite, under the right circumstances, effective actions for their sustainable use, thus their preservation. However, because the species are under multiple stresses, their long-term viability and preservation might not be guaranteed even in protected areas. Fortunately, predictions under future climates showed an increase in the extent and the level of suitability of favourable habitats for both species. This could be profitable for the species reintroduction and help in sustaining their uses, only if their sylviculture is well known and planting proved successful. For the species valorisation and sustainable use, further long-term investigations are required on the species population growth, dynamics and viability (population structural and reproductive patterns in relation with the different pressures, availability and germination of seeds). Human-assisted natural regeneration and introduction of seedlings and propagation ability of the species should also be considered.

**Keywords:** Benin, ecological niche modelling, ethnobotany, gap analysis, multiple pressures, NTFP species, population structure, taxonomic differentiation.

## A new call for a paradigm shift and theory driven ethnobotany

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### ABSTRACT

Ethnobotany, the science of survival, has evolved from a discipline that largely documented the diversity of plant use by local people to one focused on understanding how and why people select plants for a wide range of uses. This progress has been in response to a repeated call for theory-inspired and hypothesis-driven research to improve the rigor of the discipline. Despite improvements, recent ethnobotanical research has over-emphasized the use of quantitative ethnobotany indices and statistical methods borrowed from ecology, yet underemphasized the development and integration of a strong theoretical foundation. To advance the field of ethnobotany as a hypothesis-driven, theoretically-inspired discipline, it is critical for emerging ethnobotanists to be exposed to ethnobotanical theories in a systematic way. I developed over four years an advanced undergraduate course on theory and methods in ethnobotany that attracted the interest of students. This course taught students how to critically read published papers, identify major scholarly trends and theories in the discipline, and use it as a starting point for their hypotheses. Such effort led to published papers in peer reviewed journals by student participants, suggesting that a large-scale implementation of this instructional approach can yield tangible results. For this effort to expand beyond this case study, I postulate that providing a clear synthesis of existing theoretical lines of research on people-plant interactions will focus future ethnobotanical research toward delineating the theoretical bases for plant selection and use by people. To achieve this, with doctoral students in my lab, we reviewed seventeen major theories and hypotheses in ethnobotany that can be used as a starting point for developing research questions that contribute to advancing our understanding of people-plant interactions. For each theory or major hypothesis, we identified its primary predictions and testable hypotheses and then discuss the degree to which these predictions or hypotheses have been tested. Developing research projects to test these predictions will make significant contributions to the field of ethnobotany and create the critical mass of primary literature necessary to develop meta-analyses and to advance new theories in ethnobotany.

**Keywords:** hypothesis-driven research; medicinal plant selection; optimal defense theory; utilitarian redundancy model; taboo as luxury; theory in ethnobotany.



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