

Philippine Native Plants Conservation Society, Inc.



# 4<sup>th</sup> INTERNATIONAL SYMPOSIUM

Native Plants: Resiliency and Conservation  
in a Changing Environment

Southern Luzon State University  
Lucban, Quezon

November 24-25, 2017

*Program*

in partnership with





# Forest Foundation Philippines

Let's grow together.

## **About the Forest Foundation Philippines**

Established in 2002 under two bilateral agreements between the governments of the United States of America and the Philippines, the Forest Foundation Philippines (formerly known as Philippine Tropical Forest Conservation Foundation) is a non-profit organization that provides grants to organizations that empower the people to protect the forests.

Since its inception, the Forest Foundation Philippines has supported over 450 projects which has improved the management of 1.5M hectares of forest lands, restored approximately 4,200 hectares of forests through the re-introduction of appropriate native species, established over 40 community-conserved areas, and built over 60 community enterprises.

Today, the Forest Foundation Philippines' work continues as the forests still face threats. Guided by the Forest Foundation Philippines Program Plan 2017-2021, the Foundation has allocated around Php 480M to protect the country's most critical forest landscapes: Sierra Madre, Palawan, Samar and Leyte, and Bukidnon and Misamis Oriental.

**The Philippine Native Plants Conservation Society Inc.**

in partnership with the

**Southern Luzon State University**

present its

4<sup>th</sup> International Symposium

***Native Plants: Resiliency and Conservation  
in a Changing Environment***

23-25 November 2017

Southern Luzon State University

Lucban, Quezon





# TABLE OF CONTENTS

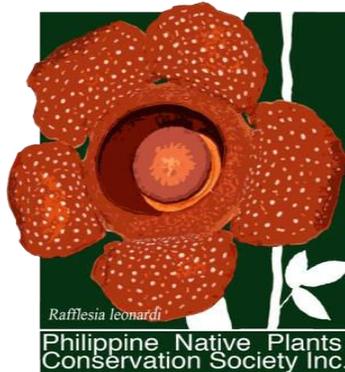
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<b>Title</b>	<b>Page</b>
Welcome message from Carmen Felicisima R. Odulio.....	4
Welcome message from Milo O. Placino.....	6
Message from Theresa Mundita S. Li.....	7
Message from Gov. David C. Suarez.....	9
About Philippine Native Plants Conservation Society Inc. ....	11
Board Members and Symposium Committee 2017.....	12
Symposium Program.....	13
Parallel Session Schedule.....	16
Abstracts of Plenary Talks.....	19
Abstracts of Oral Presentations.....	23
Abstracts of Poster Presentations.....	56
Workshop.....	81
Symposium Sponsors.....	85

# WELCOME ADDRESS

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## PHILIPPINE NATIVE PLANTS CONSERVATION SOCIETY, INC.



Welcome to the Fourth International Symposium of the Philippine Native Plants Conservation Society, Inc. with the theme *“Native Plants: Resiliency and Conservation in a Changing Environment”*.

The Philippines is one of the countries most vulnerable to climate change. Recent natural phenomena, most significantly super typhoon Yolanda, underscore this fact. Our geography and human activities through the years such as logging, mining, kaingin, disregard for protected areas and lack of political will to implement environmental laws are factors that heighten the negative impact of changes in weather patterns that we have observed in recent years.

While we cannot change our geography, we can possibly mitigate some of the effects of human activities through the years, primarily those involving one of our greatest natural assets - our native plants.

With this in mind, the Philippine Native Plants Conservation Society, Inc. continues its mission of generating knowledge and sharing in the conservation of Philippine native plants and their habitats towards sustainable development with this year’s International Symposium. Presentations – plenary, oral and poster – highlight ethnobotanical studies; biodiversity in specific areas from mountains, starting with this region’s own Mount Banahaw, to mangroves and beach forests; and impact of current human activities such as road widening and use of invasive alien species. Other activities include a nursery tour, a workshop on spatial modeling, and a tour of the Mount Banahaw Botanic Garden.

We would like to thank the Southern Luzon State University, our co-convenor for this symposium; our major sponsors: Protect Wildlife, Forest Foundation Philippines, DENR-Biodiversity Management Bureau, Center for Conservation Innovation Ph, and Primer Group of Companies; and the government of Quezon Province. We also thank all of our benefactors, minor sponsors, incoming and outgoing Board of Trustees, members, guests, participants and volunteers.

On a personal note, we take this opportunity to give tribute to Dr. Antonio C. Manila, who served as President of PNPCSI from 2013 until he passed away a few months ago. This symposium is one of the projects which he had passionately led since early this year which we are honored to implement as part of his legacy. And as Doc Tony would always say:

Isang Maka-kalikasang Araw sa Ating Lahat at Mabuhay ang PNPCSI !!!

  
**CARMEN FELICISIMA R. ODULIO**  
President  
Philippine Native Plants Conservation Society, Inc.



# WELCOME ADDRESS

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## SOUTHERN LUZON STATE UNIVERSITY



To the people behind the 4th International Symposium of PNPCSI,

May I take this opportunity to convey my heartfelt congratulations for the unequivocal success of your endeavor. The University is truly honored to host this year's International Symposium of PNPCSI which will provide a valuable forum for practitioners and experts to discuss relevant topics and most pressing challenges on conservation of Philippine native plant species.

I pray your sincere initiatives to flourish even more; as for without your efforts and interests, it would be impossible to achieve milestones in your aspirations to contribute to native plant research and conservation.

Again, I wish you an effective and a productive symposium!

Very truly yours,

A handwritten signature in black ink that reads "M. Placino".

**MILO O. PLACINO, PH.D**  
University President



# WELCOME ADDRESS

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## DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES BIODIVERSITY MANAGEMENT BUREAU



It is with great pleasure that I am extending my warmest greetings and congratulations to the Philippine Native Plants Conservation Society Inc. (PNPCSI) for successfully holding this year's International Symposium. Since its founding in 2008 by our dear colleague, the late Leonardo L. Co, PNPCSI has remained steadfast to its advocacy of increasing awareness and appreciation for the country's native flora and contributing to Philippine native plant research and conservation.

For nearly a decade now, the Biodiversity Management Bureau (BMB) has been very fortunate to have PNPCSI as one of its staunch partners in advancing the cause of Philippine native plant conservation through scientific studies, provision of technical assistance such as trainings and mentorships, and promotion of the use of native plants in landscaping and reforestation projects. Truly, support from organizations like PNPCSI is essential while we, as a nation work towards restoring the splendor of native flora in the wild and in promoting their responsible use. In the Philippine Biodiversity Strategy and Action Plan 2015-2028, we embarked on an ambitious action plan to arrest the further decline of threatened Philippine native plants and their habitat. The annual PNPCSI plant conservation symposium is indeed a step forward in the realization of this Plan.

I am optimistic that this year's Symposium, with the theme, "*Native Plants: Resiliency and Conservation in a Changing Environment*", will serve as an avenue for sharing recent developments on native flora research, shall pave the way for discussing outstanding issues and emerging concerns on Philippines native plant conservation and a catalyst to do more conservation actions on the ground.

Once again, congratulations to PNPCSI and keep up the good work!

**THERESA MUNDITA S. LIM, DVM**  
Director, BMB



# WELCOME ADDRESS

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## PROVINCE OF QUEZON



Salutations to the Philippine Native Plants Conservation Society, Inc. as you conduct your Fourth International Symposium with the theme, "Native Plants: Resiliency and Conservation in a Changing Environment".

The Philippines is blessed with rich resources of unique flora and fauna that helped our ancestors thrive to cultivate and shape our culture today. And though we retain our share of nature's lush greenery today, there now looms the threat of global warming and climate change.

We have experienced, first-hand, the increasing power of the typhoons in the recent years that decimated properties and ended precious lives. We are not the only ones suffering the consequences of the choices we made by neglecting the ecosystem with our blind and misguided pursuit for development. The alarming decline in our natural resources is a wakeup call to make decisions for the protection and conservation of lives. Now, more than ever, we must strike a balance between development and protection of environment in order to make every progress sustainable for all.

I wish to express my admiration to the PNPCSI for their commitment to the restoration of degraded habitats and protection of endangered Philippine native plants. It is an honor to be part of this prestigious event which you have organized to inspire and enjoin people to pursue the noble objective of reversing the loss of indigenous vegetation as well as its negative repercussion to our environment and culture.

I sincerely hope that this gathering will serve as a venue for furthering the role of its members as agents of positive change. May everyone present in this event deepen their understanding of what PNPCSI stands for, and let them realize the scope of influence it has on strengthening national pride as well as prosperity in the community.

Mabuhay and God bless!



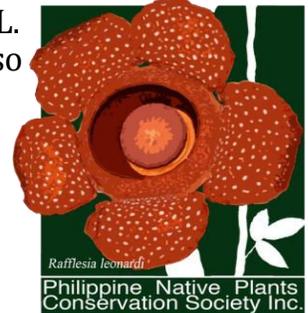
**DAVID C. SUAREZ**  
Governor of Quezon



# PHILIPPINE NATIVE PLANTS CONSERVATION SOCIETY INCORPORATED

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The PNPCSI logo bears the image of the *Rafflesia leonardii*, one of the *Rafflesia* species endemic to the Philippines. It was named after Leonard L. Co, the great Filipino botanist who founded the organization. Our logo also has the silhouette of the *Tetrastigma loheri*, an endemic Philippine vine, which is the host plant for the *Rafflesia leonardii*.



We envision our organization to be the champion in the conservation of native plants for nation-building.

Our mission is knowledge generation and sharing in the conservation of Philippine native plants and their habitats towards sustainable development.

## GOALS

- ❖ To popularize the natural history of Philippine native plants and their associated habitats through various educational fora and media, and advocate the conservation of this rich cultural heritage for future generations.
- ❖ Stimulate research, provide venues for the exchange of ideas and promote mentorship in various disciplines in plant sciences.
- ❖ Advocate restorative works in degraded natural habitats, particularly centering on remaining natural forest fragments.
- ❖ Promote exchanges of knowledge, information, and technical knowhow regarding in situ and ex situ conservation activities for threatened native plants.
- ❖ Create venue for intelligent discussions on how to develop horticulture and responsibly use native plants in landscaping for maximum benefit without compromising the existence of plant populations in the wild.
- ❖ Promote ethnobotany and related sciences as tools for protecting our national and cultural heritage, closely linking our native plant conservation agenda with our traditional culture and indigenous knowledge system.

## OVERVIEW

PNPCSI is a non-stock, non-profit organization devoted to the conservation of indigenous Philippine plants and their natural habitats.

Our organization is made up of individuals from the academe, non-governmental organizations, government agencies, horticulture sector, garden clubs and plant hobbyists and enthusiasts.

To join, please fill out the application form and pay a joining fee of P1000. Annual fee is P500 after the first year. Please contact us at [pnpcsi@gmail.com](mailto:pnpcsi@gmail.com) for the application form and payment instructions.

The PNPCSI is a core member of the Rain Forest Restoration Initiative (RFRI), <http://www.rainforestation.ph//>

**PHILIPPINE NATIVE PLANTS CONSERVATION SOCIETY INC.  
BOARD OF TRUSTEES AND OFFICERS 2017**

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**POST-SYMPOSIUM  
ACTIVITIES**  
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Richard Valle



## SYMPOSIUM PROGRAM

- 10:30AM Plenary Session 1  
**Biodiversity Research Program of SLSU on Mt. Banahaw – San Cristobal Protected Landscape**  
**Dr. Amalia E. Almazol**  
*Dean, College of Agriculture  
Southern Luzon State University*
- 11:30AM Plenary Session 2  
**Species Diversity of Philippine Rattans and Bamboos**  
**Dr. Aida B. Lapis**  
*Scientist 1 and Director 3  
Ecosystems Research and Development Bureau  
Department of Environment and Natural Resources*
- 12:30NN Lunch break
- 1:30PM **Parallel Session 1** (*separate schedule will be released*)
- 3:30PM Coffee break
- 4:30PM **Flash Poster Presentation**  
Poster Viewing Session
- 6:00PM - 9:00 PM **Welcome Dinner and Fellowship Night**

### November 25, 2017 (Saturday) Symposium Proper Day 2

*Emcee: Dr. Cecilia I. Banag, PNPCSI Secretary*

- 7:00AM **Registration**
- 8:00 AM Plenary Session 3  
**Forest Formation Assessment of Key Biodiversity Areas Using Rapid Survey Technique**  
**Prof. Pastor L. Malabrigo Jr.**  
*Associate Professor  
Department of Forest Biological Sciences  
College of Forestry and Natural Resources  
University of the Philippines Los Banos*  
  
*Curator for Trees  
Museum of Natural History  
University of the Philippines Los Banos*

## SYMPOSIUM PROGRAM

- 9:00AM Plenary Session 4  
**Revisiting RA9147 and DAO 2017-11**  
**Mr. Anson M. Tagtag**  
*Chief, Wildlife Conservation Section  
Biodiversity Management Bureau  
Department of Environment and Natural Resources*
- 10:00AM Book Launching  
**Guide to The Marine Science Institute's Garden of Indigenous and Flowering Trees (The MSI GIFT)**  
**Ms. Imelda Sarmiento**  
*Native Tree Advocate  
Founding Member, PNPCSI*
- 10:30AM Coffee break
- 11:00AM **Parallel Session 2** (*separate schedule will be released*)
- 12:30NN Lunch Break
- 1:30PM Plenary Session 5  
**Enhancing Conservation of Native Plants via Assisted Natural Regeneration (ANR)**  
**Mr. Patrick Dugan**  
*2016 Asia-Pacific Forest Champion Awardee  
Food and Agriculture Organization  
  
Founder and President  
Bagong Pagasa Foundation*
- 2:30PM **Tribute to Dr. Antonio C. Manila** (1953- 2017)  
PNPCSI President (2013 - 2017)
- 3:30PM Coffee Break
- 4:00PM Awarding of Best Presenters and Closing Remarks
- November 26, 2017 (Sunday) Post-Symposium Tour**
- 7:00AM - 3:00PM Tour of Mt. Banahaw Botanic Garden

**PARALLEL SESSION 1**  
**SCHEDULE: 24 NOVEMBER 2017, FRIDAY**

Nov. 24	<i>Rm 1</i>	<i>Rm 2</i>	<i>Rm 3</i>
1:00 - 1:20	THE ETHNOBOTANICAL PLANTS OF MARINDUQUE THAT ARE USED AS FEED FOR THE MARINDUQUE NATIVE PIG: A WEB BASED INFORMATION SYSTEM	NEONAUCLEA VIRIDIFLORA (RUBIACEAE), A NEW SPECIES OF NAUCLEAEAE FROM EASTERN SAMAR, WITH NOTES ON MYRMECOPHYTIC SPECIES IN THE PHILIPPINES	WE MAY GET LOST ALONG THE WIDENED ROAD: IMPACTS OF NATIONAL ROAD WIDENING PROJECT ON ROADSIDE VEGETATION ALONG VERDE ISLAND PASSAGE MARINE CORRIDOR (VIPMC)
	<b>LORIEBENN B. BAÑEZ</b>	<b>JORGE ANTON D. ORDAS</b>	<b>ROMEL U. BRIONES</b>
1:20 - 1:40	DIVERSITY AND CONSERVATION VALUE OF MT. CALAVITE WILDLIFE SANCTUARY	FERNS AND FERN ALLIES OF PANAMAON WATERSHED, LORETO, PROVINCE OF DINAGAT ISLANDS	DISTRIBUTION, MAPPING, SUSTAINABLE HARVESTING AND MARKETING OF LAUREL LEAVES (CINNAMOMUM MINDANAENSE) IN BOLJOON, CEBU, PHILIPPINES
	<b>ADRIANE B. TOBIAS</b>	<b>MUHMIN MICHAEL E. MANTING</b>	<b>HEMRES M. ALBURO</b>
1:40 - 2:00	QUANTITATIVE ETHNOBOTANICAL STUDIES OF MEDICINAL FLORA USED BY LOCAL INHABITANTS IN SELECTED BARANGAY OF MALINAO ALBAY PHILIPPINES	REVISITING ASTROCALYX MERR. (ASTRONIEAE: MELASTOMATACEAE): NEW MORPHOLOGICAL OBSERVATIONS ON THE PHILIPPINE ENDEMIC, ENIGMATIC, ENDANGERED, AND MONOTYPIC GENUS	PHYTOCHEMICAL SCREENING OF SECONDARY METABOLITES OF NEPENTHES ALATA
	<b>TERESA HAIDE R. BELGICA</b>	<b>JEFFREY P. MANCERA</b>	<b>JOHN LEONARD R. CHAN</b>
2:00 - 2:20	ETHNOBOTANICAL SURVEY OF PLANTS USED FOR THE TREATMENT OF POULTRY AND LIVESTOCK MALAISE AND DISEASES IN LANA O DEL SUR, PHILIPPINES	PLANTS OF THE MAGUINDANAOANS: UNDERSTANDING THEIR BELIEFS AND TRADITIONS	SPATIAL DISTRIBUTION ASSESSMENT OF <i>Parashorea malaanonan</i> Blanco (Merr.) IN MOUNT MAKILING FOREST RESERVE, PHILIPPINES
	<b>MUHMIN MICHAEL E. MANTING</b>	<b>CHRISTI DIVINE M. NASIAD</b>	<b>JAN JOSEPH V. DIDA</b>

**PARALLEL SESSION 1**  
**SCHEDULE: 24 NOVEMBER 2017, FRIDAY**

Nov. 24	<i>Rm 1</i>	<i>Rm 2</i>	<i>Rm 3</i>
2:20 - 2:40	ETHNOBOTANICAL SURVEY OF PLANTS USED FOR THE TREATMENT OF POULTRY AND LIVESTOCK MALAISE AND DISEASES IN LANA O DEL NORTE, PHILIPPINES	SEX RATIO OF RAFFLESIA SPECIES IN CAMARINES PROVINCES	UNTARGETED METABOLOMICS OF EUCALYPTUS DEGLUPTA AND EUCALYPTUS GLOBULUS ESSENTIAL OILS REVEALS INTER- AND INTRASPECIES VARIABILITY
	<b>MUHMIN MICHAEL E. MANTING</b>	<b>REYNALDO M. BAÑARIA, JR.</b>	<b>KIMBERLY G. GARCIA</b>
2:40 – 3:00	ETHNOBOTANICAL SURVEY OF MEDICINAL PLANTS USED BY THE Y'APAYAOS OF STA. PRAXEDESIN THE PROVINCE OF CAGAYAN	VARIATION OF VEGETATION RESISTANCE COEFFICIENT OF SELECTED MANGROVE GENUS IN ALABAT ISLAND, QUEZON PROVINCE	SELECTION, CHARACTERIZATION AND MAPPING OF GERMPLASM (PLUS / MOTHER TREES) IN MT. BANAHAW DE LUCBAN
	<b>VERLINO D. BADDU</b>	<b>DON GIBSON D. MERCADO</b>	<b>ERALDWIN A. DIMAILIG</b>
3:00 – 3:20	USES, PRACTICES AND CONSERVATION EFFORTS OF MAMANWA'S FOREST RESOURCES	A DECADE OF BEACH FOREST R&D – SPECIES SURVEYS, NURSERY TRIALS AND OUTPLANTING (TO THE F1 AND F2 GENERATION)	CARBON STOCK OF TIMBER SPECIES IN A FOREST PATCH IN SITIO APIS, BRGY. APOC-APOC, ABORLAN, PALAWAN
	<b>MUHMIN MICHAEL E. MANTING</b>	<b>JURGENNE H. PRIMAVERA</b>	<b>LITA B. SOP SOP</b>

**PARALLEL SESSION 2**  
**SCHEDULE: 25 NOVEMBER 2017, SATURDAY**

Nov. 25	<i>Rm 1</i>	<i>Rm 2</i>	<i>Rm 3</i>
11:00 - 11:20	THE ETHNOBOTANICAL PLANTS OF THE TAGBANUA TRIBES IN PUERTO PRINCESA CITY AND PALAWAN	THE BIODIVERSITY OF TERRESTRIAL AND LITHOPHYTIC ORCHIDS OF MT. MALINDIG, MARINDUQUE: BASIS FOR CONSERVATION PLAN	COASTAL COMMUNITY'S KNOWLEDGE, ATTITUDE AND PERCEPTION ON BEACH FOREST ECOSYSTEM SERVICES IN BUCAS GRANDE ISLANDS, SURIGAO DEL NORTE, PHILIPPINES: BASIS FOR LOCAL MANAGEMENT AND CONSERVATION
	<b>MILDRED PALON</b>	<b>MR. ROJA L. MEDIANISTA</b>	<b>COLLAO, E.H.D.</b>
11:20 - 11:40	DIVERSITY, ECOLOGY AND CONSERVATION OF ORCHIDS IN SELECTED FORESTS ON SAMAR ISLAND, PHILIPPINES	PLANTS AND BUTTERFLIES AT THE INTERSECT: BASIS FOR ECOTOURISM PLANNING IN MARINDUQUE	BOTANICAL EXPLORATION FOR GINGER (ZINGIBERACEAE) SPECIES IN MOUNT MAKILING FOREST RESERVE ASEAN HERITAGE PARK, PHILIPPINES
	<b>ZHEREELEEN D. MENESES</b>	<b>LENNI GRACE L. SAPUNGAN</b>	<b>EMER C. GESTIADA</b>
11:40 - 12:00	INTERPRETATION AND REPRESENTATION OF PLANTS AMONG THE MERANAOS OF LANAOS	ASSESSMENT AND SPATIAL DISTRIBUTION OF ALMACIGA ( <i>Agathis philippinensis</i> Warb.) FOR SEED AND RESIN PRODUCTION IN LUNA, APAYAO	FLORAL BIODIVERSITY ASSESSMENT OF THE RIPARIAN ECOSYSTEM OF CAÑAS RIVER WATERSHED, CAVITE, PHILIPPINES
	<b>MUHMIN MICHAEL E. MANTING</b>	<b>DAVID A. RODOLFO</b>	<b>CHARLENE JOY G. CUENO</b>
12:00 - 12:20	FLORAL DIVERSITY ASSESSMENT AT MT. MALARAYAT BRGY. MALITLIT, LIPA CITY, BATANGAS	YOU'RE THINKING IT RIGHT: NATIVE PLANTS ARE AFFECTED BY INVASIVE ALIEN PLANT SPECIES IN THE CAMPUS OF DE LA SALLE UNIVERSITY-DASMARINAS	CARBON STOCK BASELINE ASSESSMENT IN RESERVE CARBON POOL AREAS OF FIVE CARBON NEUTRALITY PROJECT SITES IN THE PHILIPPINES
	<b>ENRICO L. REPLAN</b>	<b>RICHARD M. MAGSINO</b>	<b>JAMILA AUDREY GO PALOMAR</b>

# PLENARY ADDRESS

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## **Biodiversity research program of Southern Luzon State University on Mt. Banahaw-San Cristobal Protected Landscape**

Amalia E. Almazol<sup>1</sup>, Mary Ann R. Agudilla<sup>1</sup>, Francisco N. Beltran<sup>1</sup>, Wilfredo C. Faller<sup>1</sup>, Ronald C. Garcia<sup>1</sup>, Cecilia N. Gascon<sup>1</sup>, Felino J. Gutierrez Jr.<sup>1</sup>, Kathreena E. Gutierrez<sup>1</sup>, and Zaldy O. Luna<sup>1</sup>

<sup>1</sup>Faculty, Department of Forestry and Environmental Science, College of Agriculture  
Southern Luzon State University, Lucban, Quezon 4328

Since time immemorial people has depended on environmental resources for subsistence and survival. Similarly, Mt Banahaw-San Cristobal Protected Landscape is an important ecosystem that serves as a resource-base both to human and ecological system. However, several decades of using natural resources has resulted to serious destruction, ecological imbalance and loss not only of habitat but vital ecosystem and its functions as well. Consequently, species extinction occurs and undeniably conservation and protection of these remaining resources is inevitable. Mt. Banahaw is considered as a rain mountain although the rainfall characteristics vary with sites. It is also a watershed sustains water for the creeks, rivers, and falls draining to Laguna de Bay and Tayabas Bay. These rivers and falls are believed to have “healing powers”. Communities living at the slope of Mt. Banahaw regarded it as a holy mountain. Religious sects and people from all walks of life are constantly practicing their respective rituals in Mt. Banahaw especially during holy week. These people affect the integrity of this mountain ecosystem. Success of protection and conservation efforts can be strengthened through research and by awareness campaigns. In addition, ground conservation activities complemented with education and information can promote active people participation and positive communal response.

Biodiversity researches were conducted by Southern Luzon State University. These were started in 1997 when Commission on Higher Education (CHED) funded its first research. Since then, several studies done by students and faculty were continuously done up to the present. In 2011, Southern Luzon State University received an award from CHED for the research program for Mt. Banahaw as Regional Qualifier during the CHED-ZRC Symposium at Fatima University, Antipolo City. Output of researches were published in local and international refereed journals and various forms of IEC materials were prepared. Support of communities, local and national officials were gained as an outcome of the endeavor.

**Keywords:** biodiversity, Mt. Banahaw-San Cristobal Protected Landscape, research

# PLENARY ADDRESS

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## **Species Diversity of Philippine Rattans and Bamboos**

Aida Lapis<sup>1</sup>

<sup>1</sup>Ecosystems Research and Development Bureau, Department of Environment and Natural Resources

Bamboo and rattan are the most important non timber resources of the country. The myriads of uses and values are known to the Filipino people since time immemorial. They are regarded as minor forest products and has contributed to the socio economic welfare, environmental rehabilitation, economy, subsistence as well as source of raw material for livelihood and highly for various industries. Currently, rattans are used for furniture, decors/homewares and handicraft industry while bamboos have valuable applications in construction, furniture particularly school desks, handicraft, food, fiber, landscaping, among others.

The power point presentation will include the species diversity of rattans and bamboos, recent classification, emerging and highly potential utilization and the species currently considered economically important. The conservation status, conservation efforts and other recent initiatives will be discussed.

# PLENARY ADDRESS

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## **Forest Formation Assessment of Key Biodiversity Areas Using Rapid Survey Technique**

Pastor L. Malabrigo Jr.<sup>1</sup>, Arthur Glenn A. Umali<sup>1</sup>, Adriane B. Tobias<sup>1</sup>, Gerald T. Eduarte<sup>1</sup>, Oliver C. Coroza, Angelika Kristina V. Monzon, Jonel O. Hernandez<sup>1</sup>, Luisito B. Terbio<sup>1</sup>, Ej Prondoza<sup>1</sup>, Harold Centeno,

<sup>1</sup>Department of Forest Biological Sciences, College of Forestry and Natural Resources, University of the Philippines Los Baños

The Philippines is part of the plant geographical unit known as Malesia. It constitutes the subfloristic province, West Malesia, together with the Malay Peninsula, Sumatra and Borneo. The natural vegetation of the Philippine Islands is generally a mosaic of different kinds of forests commonly known as forest formations. Following the scheme and nomenclature used by Fernando et al. (2008), the primary vegetation of the Philippines may be divided into 12 forest formations which can be recognized elsewhere in Southeast Asia on the basis of their structure and physiognomy, but there could be substantial differences in species composition.

While characterization of the different forest formations has been stipulated in some literature, the different forest formations contained in most Philippine mountains are still relatively unknown. The Biodiversity Management Bureau in cooperation with Forest Foundation Philippines and Center for Conservation Innovations Ph, initiated the project "Mapping Key Conservation Areas and Natural Capital-Phase 2". One of the objectives of the project is to seek a method for producing a map of forest formations inside protected areas. Forest formation types might be determined as a function of both physical factors and species composition. Physical factors such as elevation, type of substrate, topographic position (localities) and soil water can be used in combination. Although these two main factors might be determinants of the type of forest formation existent in an area, species composition appears to be the main controlling factor. The College of Forestry and Natural Resources, UPLB, and the PNPCSI, were commissioned to do the vegetation survey along the slopes of two Key Biodiversity Areas – Mt. Mingan in Nueva Ecija and Mt. Palali in Nueva Vizcaya. Forest formations at every 100 meters altitudinal interval were carefully examined and characterized. The transition zones were also marked and geo-tagged.

In both mountains three formations were recorded. In Mt. Mingan, tropical lowland-evergreen forest occurs from 300 to 800 masl, followed by tropical lower-montane forest up to 1,200 masl, and then tropical upper-montane forest up to the summit (1,700 masl). The lower elevation of Mt. Palali is relatively disturbed. There is only a thin zone of tropical lowland-evergreen forest at 700-900 masl. Tropical lower-montane rainforest and tropical upper-montane rainforest occur at almost exactly the same elevation with that of Mt. Mingan. It is surprising to observe that the dominant species in tropical upper-montane rainforest are Malabayabas (*Tristaniaopsis decorticata*) and Binaton (*Falcatifolium gruezoii*). It is interesting to note that what has been visually assessed from field observations as the forest formation types from species composition coincides with what other researchers have recorded in their field surveys.

# PLENARY ADDRESS

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## Enhancing conservation of native plants via assisted natural regeneration (ANR)

Mr. Patrick Dugan<sup>1</sup>

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Most government and private sector initiatives to restore forest vegetation on denuded and degraded lands have prioritized mono-culture planting with exotic tree species such as Mahogany (*Swietenia macrophylla*) and (Yemane) *Gmelina arborea*. Tree-planting events often receive widespread TV and other media coverage. These reports generally commend and applaud what can be more accurately described as (i) dangerous, (ii) very expensive and (iii) un-intended disasters. Unfortunately, the general public, many policy/decision-makers and numerous civil-society leaders do not seem to be aware of the risks posed by this state of affairs.

Monocultures and exotics can be useful when trees are planted on suitable sites as crops to be harvested for timber to construct homes, produce paper and other legitimate purposes. However, the most-publicized tree-planting events, and the ones that receive most government and civil-society investments are not timber production projects. Rather, these initiatives are usually designed to conserve soil and water, mitigate the danger of mud slides and floods, alleviate rural poverty, help establish wildlife corridors and address problems related to global warming and climate change. These are all commendable objectives. But monocultures and exotics can jeopardize achievement of those objectives.

# ABSTRACTS

## ORAL PRESENTATIONS

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### **The ethnobotanical plants of Marinduque that are used as feed for the Marinduque native pig: a web based information system**

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This research focuses on the utilization of web-based information system of ethnobotanical plants of Marinduque that are used as feed for the Marinduke Pig (*Sus domesticus*), as it aims to support the Conservation, Improvement and Profitable Utilization of Philippine Native Pigs Program of Marinduque State College. An information system was designed, developed and used to store information of plants utilized by locals as feeds for the native pigs. It was found out that different variety of ethnobotanicals including forage plants and tuber crops are available in the province. Due to the increasing demand of Marinduke pig as source of food, same goes with the food given to them. Findings can be used to advise local farmers rearing native pigs where to source out food. This promotes increase in sustainability of food source and economic growth as a whole.

**Keywords:** Ethnobotanical Plants, Marinduke Pig, Farmers, Feeds, Information System

***Neonauclea viridiflora* (Rubiaceae), a new species of Naucleaeae from Eastern Samar, with notes on myrmecophytic species in the Philippines**

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A new myrmecophytic species, *Neonauclea viridiflora*, is described from Eastern Samar, Philippines. It bears similarity to *N. formicaria*, but is easily distinguished by having obovate leaves, smaller flowering heads of 30–35 mm, persistent calyces that are glabrous inside the tube, calyx shafts that are connate at the bases for 0.8–2.5mm or sometimes entirely connate with the adjacent lobe, apical portions of the calyces that are bluntly turbinate but globose to clavate when dry, calyx summits that are bluntly conical but the apex is somewhat flattened when dry, and smaller and slender light green corollas. Comparative illustrations of the calyx lobes, a key to the Philippine myrmecophytic *Neonauclea* species, and a map for these species' distributions in the Philippines are provided in the study.

**Keywords:** Calyx lobes, endangered, endemic, Mindanao, Visayas.

***We may get lost along the widened road: Impacts of national road widening project on roadside vegetation along Verde Island Passage Marine Corridor (VIPMC)***

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The unstoppable and unrelenting road widening program of the Philippine government is continuously being implemented to spur growth to local and national economy. However, it is being shunned by most environmental conservationists and affected local communities especially when culturally and biologically important trees were cut down and removed. This study assessed the impact of such project on the roadside vegetation and to the immediate communities along Verde Island Passage marine corridor (VIPMC). Intensive forest inventory along 8.160 km national road covering approximately 11.4 ha strips of roadside land with >90% sampling intensity. Conservation status of three species was determine following the IUCN red listing while ecological diversity and evenness were estimated using Shannon diversity index. Existence value was evaluated through survey interview of 40 respondents. Results showed that there are 1,814 trees comprising of 67 species from 24 families to be removed to facilitate road widening on this biodiversity hotspot area. The average vegetation removal will be 222 trees per kilometer excluding shrubs and herbaceous plants. Of these, 171 trees comprising of 6 species from 4 families were included in the IUCN Red List. The mean diversity index is 6.32 and evenness of 0.99 with standard deviation of 0.97 and 0.12 respectively for the four localities. Local community strongly believed that trees along the roads were of high importance in their daily lives. For most of the local people, road widening is undesirable with the lost micro-climate and aesthetic benefits as well as properties without due compensation. Comprehensive pre-construction inventory and valuation of the affected roadside vegetation must be initiated to determine the necessary compensatory activities for the removed vegetation. The DENR should strictly implement rules and regulations pertaining to the cutting of trees and the compensating actions therein.

**Keywords:** road construction, intensive forest inventory, diversity index, existence value

## Diversity and conservation value of Mt. Calavite Wildlife Sanctuary

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Mt. Calavite Wildlife Sanctuary (MCWS) was declared as a game refuge and bird sanctuary and later became a protected area in accordance with RA 7586. It is located in the northernmost part of Occidental Mindoro. Despite the importance of MCWS as habitat for various wildlife, little is known about its diversity. The only literature available discussing the diversity of MCWS was the study conducted by Mindoro Biodiversity Conservation Foundation, Inc. (MBCFI) on 2014. In order to supplement the existing knowledge about the plant diversity of MCWS, a comprehensive plant diversity assessment was conducted. A modified belt transect method wherein 9 quadrats (20m x 20m) were laid out along a 2-km transect at every 250m interval. Nested quadrat sampling technique was used to assess and characterize the structure and species composition of the different plant communities.

Study revealed that MCWS is generally composed of two forest formations. Tropical moist deciduous forest (TMDF) dominates the lower elevation of the mountain while tropical lower montane rainforest (TLMR) occurs at elevation higher than 1,000 masl. MCWS comprises a mosaic of different vegetation from grassland to second growth forests representing different stages of recovery from the previous human and natural disturbances. Results also confirmed the high conservation value of MCWS. A total of 184 morpho-species of plants were recorded. Based on the computed importance value, the three most important species were Taluto (*Pterocymbium tinctorium*), Alvarez malaruhat (*Syzygium alvarezii*), and Mamalis (*Pittosporum pentandrum*). The aforementioned species are all pioneer species which reflect the general vegetation of the study site as young secondary forest. For the understorey/intermediate, the three most abundant species were *Psychotria sp.* Balinaunau (*Lepisanthes fruticosa*), and Alahan (*Guioa koelreuteria*). Ground cover species that occupy the highest relative cover were Albutra (*Arcangelisia flava*), Kalingag (*Cinnamomum mercadoi*), Litlit (*Piper interruptum* var. *loheri*). The computed Shannon index of the different quadrats varies from a low of 2.42 to a high of 3.33. Following the diversity classification scheme suggested by Fernando *et al.*, 6 out of 9 quadrats have high diversity value, 2 quadrats have moderate and only one has low diversity value.

Of the 168-species identified, 40 species (24%) were found to be Philippine endemics or have natural distribution confined only in the country. Twenty (20) species are listed under either the Philippine Red List (DAO 2017-11) or the IUCN Red List of Threatened Species (IUCN 2017-1). Kamagong (*Diospyros discolor*), Ipil (*Intsia bijuga*), Banuyo (*Wallaceodendro celebicum*), and Molave (*Vitex parviflora*), some of the most premium native trees, were among the threatened species listed. In addition, 20 noteworthy species are most probably new province records based on the available published literature. With the abovementioned findings, this study should find its way into the mainstream of the science of biodiversity conservation given the scarcity of biological information in the flora of MCWS.

**Keywords:** Mt. Calavite, plant diversity assessment, Philippine endemic

## **Ferns and fern allies of Panamon Watershed, Loreto, Province of Dinagat Islands**

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A study was conducted to assess the diversity of pteridophytes present in Panamaon Watershed, one of the ten proposed conservation areas in Dinagat Islands Province. Ferns and fern allies that were found in the study area were collected, documented, described, identified and preserved. Data were gathered by rapid floristic survey through a line transect along three elevation ranges: 32 masl – 177 masl (site 1), 49 masl – 359 masl (site 2) and 14 masl- 399 masl (site 3). A total of 30 different pteridophytes species were surveyed from the study area. Twenty-nine (29) were identified and 1 is still unidentified. These were classified under 15 families. Family Pteridaceae, Selaginellaceae, Lygodiaceae, Hymenophyllaceae and Polypodiaceae are the most represented families. Only two (2) out of the thirty (30) pteridophytes species were listed in the DAO (DENR Administrative Order) List of 2015 this includes *Cyathea contaminans* and *Selaginella magnifica* (endemic in Mindanao) whereas not a single species is indicated in the IUCN Red List of 2015 due to data deficiency hence, further assessment regarding pteridophytes species especially the endemic and native species is recommended. Results showed that most or almost all of the species found in the sampling area are not endemic and do not fall under the threatened status and some are even widely distributed across the globe. The presence of these pteridophytes species in Panamaon Watershed calls for the establishment of conservation initiatives, thus preservation, conservation and proper management of the area is needed.

## **Distribution, mapping, sustainable harvesting and marketing of laurel leaves (*Cinnamomum mindanaense*) in Boljoon, Cebu, Philippines**

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Cinnamons are popularly known as spice and flavoring to many foods. In the Philippines, laurel leaves (*Cinnamomum mindanaense*) are commonly used as spice to many Filipino dishes. In Cebu, *C. mindanaense* naturally grows in abundance in San Antonio, Boljoon, where the community harvests and trades leaves for decades. An inventory of *C. mindanaense* was made to establish baseline data on the number of trees per diameter classes. Likewise, a survey on harvesting and marketing practices of *C. mindanaense* was conducted. Trees by diameter class were mapped using ArcView. A total of 5332 trees were inventoried and group into five diameter classes namely 10cm and below, 11-20cm, 21-30cm, 31-40cm and above 40cm. Results show that trees are generally small and growing on limestone areas both within Alienable and Disposable lands and timberland areas. Ninety-two percent (92%) or 4918 trees have diameter of 20cm or less. Small trees show clumping while those >20cm diameter are randomly distributed. Leaves are harvested mostly by cutting all branches especially during dry season. Harvesting is made once a year or every other year. Over mature leaves tend to reduce its quality due to disease and insect damage. Cut branches are sun dried for 3 days then leaves are removed and traded to middlemen. Development of products from the branches left or from the dried laurel leaves may be explored to enhance community livelihood and increase economic potential of the species.

**Keywords:** spice trees, cinnamon, non-timber forest products, sustainable harvesting

## Quantitative ethnobotanical studies of medicinal flora used by local inhabitants in selected Barangay of Malinao Albay Philippines

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Ethnobotanical knowledge provides the key to largely untapped biological resources to solve many problems facing humanity. This study is an identification and documentation of herbal medicines used in traditional therapies of local inhabitants in Malinao Albay. Seventy five medicinal plants in 38 families and 72 genera were identified by local inhabitants with therapeutic purposes. Three hundred fifty informants were interviewed to document the mode of preparation and treatment using semi-structured interview and focus group discussion. Quantitative ethnobotanical indices such as Use Value (UV), Informant Consensus Factor (ICF) Fidelity Level (FL) were used to determine the importance of plants in the community. Among the plants identified *Senna alata* (L.) Roxb and *Pogostemon cablin* (Blanco) Benth has the highest value of Fidelity level(FL) while *Justicia gendarussa* Burm.f, *Lagerstroemia speciosa* (L.) Pers, *Centella abbreviata* (A. Rich.) Nann. was recorded with highest value of Informant Consensus Factor(ICF).However, the highest Use Figure was *Moringa oleifera* Lam respectively. Moreover, leaves are the most commonly used parts to cure different illnesses. Nonetheless, documentation of this local medicinal flora provided novel information which could served as basis for new avenues in future quantitative ethnobotanical investigations to improve proper utilization of herbal plants at global perspectives.

**Keywords:** Ethnobotanical Study, Malinao Albay, Medicinal Flora

**Revisiting *Astrocalyx* Merr. (Astronieae: Melastomataceae): New morphological observations on the Philippine endemic, enigmatic, endangered, and monotypic genus**

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The monotypic *Astrocalyx* Merr. (Astronieae: Melastomataceae) was collected in 2015 from the Mount Kitanglad Range Natural Park (Mindanao Island, the Philippines) during a joint expedition conducted by the Central Mindanao University (CMUH) and the California Academy of Sciences (CAS). Since the original publication of the genus, no other detailed account of its enigmatic morphology has been published. Examination of herbarium vouchers revealed discrete variations in morphology, which may be indicative of reproductive isolation or presence of emerging selection pressures among populations of the species across the archipelago. This documentation aims to rekindle interest and initiate approaches toward conservation of this poorly known endemic taxon, already listed as endangered in the Philippine Islands.

## Phytochemical screening of secondary metabolites of *Nepenthes alata*

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*Nepenthes alata* is a group of Nepenthaceae characterized by Cheek and Jebb in 2013, It is endemic and distributed throughout the Philippines except Palawan. The present study aims to examine the phytochemical and antibacterial property of leaves, stem and the lower pitcher of the *Nepenthes alata* against *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*. Each part was extracted and prepared for 50mg/ml, 100mg/ml, and 250mg/ml together with Gentamicin and distilled water as positive and negative control respectively. This preliminary screening suggests that all parts of *N. alata* contain phenol, quinine, tannins, starch and xanthoprotein. Coumarines and steroids are also presents in leaves while the reducing sugar and flavonoids are present in stems. Alkaloids, coumarines, and steroids are present in the lower pitcher. The results showed that 250mg/ml of leaves and the lower pitcher of *N. alata* has the highest zone of inhibition against *S. aureus* (23.08±4.58) (22.67±2.31), but there is no significant difference among other dosages. And for *E. coli* (18.33±3.51) (18.00±3.00) leaves and the lower pitcher has highly significant difference. The stem extract has the highest zone of inhibition against three bacteria (17.33±5.77; 14.00±1.00; 9.00±1.00). All the results are highly significant based on the statistical analysis performed. Future studies may investigate other plant parts and bacterial strains, or other metabolites by using TLC and HPLC.

## **Ethnobotanical survey of plants used for the treatment of poultry and livestock malaise and diseases in Lanao del Sur, Philippines**

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An ethnobotanical study was conducted to document medicinal plants used in the treatment of livestock animal ailments in Tugaya, Balindong, Marantao and Saguiaran Lanao del Sur, Philippines. Ethnobotanical interviews on medicinal plants were conducted using semi-structured questionnaires with 62 informants from 30 years old and above in which 100% were Meranao. A total of forty three (43) medicinal plant species belonging to twenty nine (29) families were recorded during the study. The most commonly used plant families recorded were Asteraceae, Euphorbiaceae, Lamiaceae and Amaryllidaceae. The most cited plant species was *Manihot esculenta*(0.629)as treatment for wounds followed by *Psidium guajava*(0.438) and *Carica papaya* (0.417). Animal and diseases treated, plant parts used, mode of preparation and application were also recorded. Wound was the most cited animal disease. The most commonly used plant part was the leaves. Decoction was the most common method of preparation. Preservation of cultural tradition and knowledge of botanical practices alone, however, is insufficient to maintain indigenous medical self-sufficiency and successful conservation strategies should be developed.

## **Plants of the Maguindanaoans: Understanding their beliefs and traditions**

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The Maguindanaoan Tribe, which is considered as the biggest Muslim group and one of the largest Filipino ethnic groups, has a rich cultural heritage that resulted from the interweaving of Islam and indigenous traditions. As some members of this group migrate to other regions in Mindanao, there is a possible threat of differentiation and disintegration to their currently existing traditional knowledge and practices on plant utilization, cultivation, and management. Changes in their economic and cultural system may affect their ethnic identity and continued existence as a people. An ethnobotanical investigation was conducted through a survey using semi-structured questionnaires which involved 50 informants (25 in Cotabato Region and 25 in Zamboanga Peninsula) with ages ranging from 23 to 78 years old in order to assess and document the plant species associated with the traditional knowledge and practices of the Maguindanaoans. A total of 78 species under 17 families were recorded. Results showed that Maguindanaoans utilize plants mainly as food next, as medicine, then, as source of material and lastly, in rituals and/or celebrations. In Labangan, Zamboanga del Sur, a total of 70 species of ethnobotanical plants were documented. Forty-nine (49) of which are utilized as food, ten (10) as medicine, three (3) in material culture and two (2) in rituals/celebrations. On the other hand, in Kabacan, North Cotabato, a total of 58 species of ethnobotanical plants were documented. Forty-nine (49) of which are utilized as food, four (4) in material culture and three (3) in rituals/celebrations. By determining the contributions of plants to their culture, a more in-depth understanding can be gained which is a useful tool in identifying the challenges and opportunities needed to improve conservation efforts, strengthen cultural integrity, increase sustainability, and improve quality of life.

## **Spatial distribution assessment of *Parashorea malaanonan blanco* (Merr.) in Mount Makiling Forest Reserve, Philippines**

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*Parashorea malaanonan* (Blanco) Merr. occurs naturally in Mount Makiling Forest Reserve (MMFR). It is an ecologically and economically important timber species from Dipterocarpaceae family. It has been listed in the critically endangered category (CR A1cd ver 2.3) by the International Union for Conservation of Nature (IUCN 2017). Previous study revealed that *P. malaanonan* had the highest importance value in the northern and eastern slope of MMFR.

This study investigated the distribution pattern of the *P. malaanonan* adult individuals (dbh $\geq$ 30 cm) along the Molawin-Dampalit and Cambantoc subwatersheds of MMFR. The spatial distribution including the tree attributes was generated through field inventory surveys using geographic information system. Spatial distribution and patterns were analyzed based on tree height and diameter classes. The *P. malaanonan* trees showed random spatial patterns with larger diameter trees scattered. This obtained result can help support the analysis for spatial genetic structure and thus provide meaningful information for its genetic resources conservation.

**Keywords:** *Parashorea malaanonan*, spatial distribution, conservation, GIS, MMFR

## **Ethnobotanical survey of plants used for the treatment of poultry and livestock malaise and diseases in Lanao del Norte, Philippines**

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Medicinal plants are used in treating and preventing both human and animal diseases. The practice of rural farmers and traditional healers on ethnoveterinary medicine is urgent to document since the documentation of such data is relatively poor. The aims of the present study is to identify and document the information regarding usage of ethno-veterinary medicinal plants utilized by rural farmers and traditional herbal healers for livestock healthcare in Lanao del Norte, to document the dosage and ethnoveterinary uses of the reported ethno-veterinary plants and to quantify the dependence of the local people on the use of plants in treating livestock diseases. In this study a total of 70 informants in Lanao del Norte having strong knowledge on ethnoveterinary practice were interviewed using semi structured questionnaires and brief discussions. The results showed that 51 plant species were documented to have an ethnoveterinary used in Linamon, Kauswagan, Poona Piagapo and Munai, Lanao del Norte and were distributed across 31 families. *Chromolaena odorata* (0.26), *Tinospora rumphii* Boerl.(0.19) and *Areca catechu* L. (0.19) showed the highest RFC values respectively. Plant leaves were commonly used, being pound and extracted, and administered orally or topically. A total of 17 livestock malaise and disease conditions namely wound, stomach troubles, spasm, renal disease, swelling, diarrhea, fever, joint pain, paralysis, anthelmintic, indigestion, Skin rashes, improving appetite, increasing lactation, cold, removal of ectoparasites, and eye infections. Wound was the most common ailment in the investigation sites and was treated by 20 ethnoveterinary medicinal plant species followed by stomach ache (9 plant species), paralysis (8 plant species), anthelmintic (8 plant species), diarrhoea (5 plant species) and the rest were treated by below five plant species.

## Sex ratio of *Rafflesia* species in Camarines provinces

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Sex ratio of *Rafflesia* species was determined in Camarines provinces at Mt. Isarog, Mt. Asog, and Mt. Guinatungan. The abundance was also surveyed and recorded. The importance of sex ratio was also related in its successful reproduction.

*Rafflesia baletei* was found in Mt. Isarog; *Rafflesia camarinensis* in Mt. Asog; and *Rafflesia lagascae* in Mt. Guinatungan. The presence of *Rafflesia* was counted per area and documented to record its abundance and distribution. 62 *R. baletei* buds and 124 *R. baletei* open flowers were documented in Mt. Isarog; 4 buds and 9 open flowers of *R. camarinensis* were counted in Mt. Asog; *R. lagascae* totaled 111 buds and 81 open flowers. The sexes of open flowers were identified. Sex ratio was also determined. The ratio of male to female flower of *R. baletei* in Mt. Isarog is 1:1, *R. camarinensis* in Mt. Asog is 1:6, and *R. lagascae* is 2:1.

Sex ratio of *Rafflesia* has an effect in its successful reproduction. The presence of both male and female *Rafflesia* blooming simultaneously in an area would mean possible pollination and successful reproduction.

**Keywords:** *Rafflesia* species, male flower, female flower, sex ratio, pollination, reproduction

## Untargeted Metabolomics of *Eucalyptus deglupta* and *Eucalyptus globulus* Essential Oils Reveals Inter- and Intraspecies Variability

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The metabolome of an organism is a complex and dynamic summation of the small molecule compounds, or secondary metabolites, it produces. Metabolomics offers great insight into the dynamic interplay between organism and environment. Indigenous to the Philippines is the *Eucalyptus deglupta*, locally known as *bagras*. Its distinctly colorful smooth trunk has earned its other name Rainbow Gumtree. There has been very little research on its bioactivity and metabolite composition. Metabolite profiling of the essential oils of *E. deglupta* from different locations and *E. globulus* was done using gas chromatography and mass spectrometry (GC-MS). Putative identification of compounds was done using AMDIS, SpectConnect and NIST database. Multivariate statistical analysis using Metaboanalyst was done to establish similarities between metabolite profiles. Analysis has shown distinct differences in the metabolite profiles of essential oils from samples of *E. deglupta* collected from different geographic locations. Comparison of the metabolite profile of the extracts with that of *E. globulus* extract and those of commercial eucalyptus oils was also done. Untargeted metabolomics has shown the presence of terpenes and aromatic compounds such as cymene, terpinene, thymol, limonene, eucalyptol and alpha-phellandrene, however in varying concentrations. Variability between all samples was determined to be less than 30% using PCA, PLS-DA and OPLS-DA. However, distinct clustering can be seen between samples, showing existing variabilities between *E. deglupta* species. The study provides proof-of-concept of untargeted metabolomics to generate intriguing questions about the relationship between the environment and organismal metabolism.

**Keywords:** Untargeted metabolomics, essential oils, volatile, eucalyptus, *Eucalyptus deglupta*

## **Ethnobotanical survey of medicinal plants used by the Y'Apayaos of Sta. Praxedes in the Province of Cagayan**

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This ethnobotanical survey determined the different medicinal plants used by the Y'Apayaos who are found in the Municipality of Sta. Praxedes, Province of Cagayan. The descriptive design of research was applied and The Rapid Rural Ethnobotanical Appraisal Method was utilized in gathering the data from thirty nine (39) elderly Y'Apayaos using a semi-structured interview guide as the tool in gathering the profile of the respondents and to find out the different medicinal plants used by the Y'Apayaos. Frequency counts and percentage distribution were used in treating the quantitative data. The findings show that there are thirty eight (38) different medicinal plants used by the Y'Apayaos in Sta. Praxedes and that they usually use most of these in treating common respiratory ailments such as cough and colds. The plant leaf is the most commonly used part and most of these plants are prepared as concoctions.

**Keywords:** ethnobotany, survey, Y'Apayaos, medicinal plants, Sta. Praxedes

## Variation of vegetation resistance coefficient of selected mangrove genus in Alabat Island, Quezon Province

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The continuous environmental issues of our time like climate change, poses the need for the government to act and become resilient for the future. Sea level rise, an effect of climate change is probably the greatest challenge to mangrove ecosystem. Due to extreme weather condition, storm surge is frequently happening. Mangrove forest have special adaptation that able them to survive in tidal wetlands.

The study was conducted to determine the mangrove genus have the highest resistance from wave using the formula of vegetation resistance for emergent vegetation. Based from the result, the genus with the highest resistance coefficient were the *Avicennia* with 0.036461047, followed by *Sonneratia* with 0.011316534 and was *Rhizophora* with 0.010536002. Thus, the most resistant from wave is *Avicennia* and the most vulnerable to damage is *Rhizophora*. In building a good coastal barrier for wave, it is good to integrate the genus *Avicennia* and *Sonneratia* because they can withstand in high waves and storm surge more than the *Rhizophora*.

The shift of planting materials from *Rhizophora* to *Avicennia* and *Sonneratia* for mangrove rehabilitation is recommended to ensure good coastal buffer zone and to lessen the vulnerability of the coastal communities from flood and storm surges, but one must consider the natural habitat of this suggested mangrove genus.

**Keywords:** vegetation resistance coefficient, sea level rise, storm surges, *Rhizophora*, *Avicennia*, *Sonneratia*, mangrove ecosystem

## Selection, characterization and mapping of germplasm (plus / mother trees) in Mt. Banahaw de Lucban

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Choice of tree species as planting materials in any reforestation project or plantation development could be based on the existing needs of the wood-based industry in the region, and in support of the National Greening Program of the Philippine government. It is anchored on natural adaptation to ensure high survival rates considering: suitability to prevailing site conditions; purpose for which they are planted; availability of planting materials; and commercial value of market.

Selection, characterization and mapping of plus or mother trees at Mt. Banahaw de Lucban was conducted on June 2016 to June 2017. It identified plus tree species for the production of quality planting materials; characterized selected plus trees in each elevation gradient as potential seed production area/s; and developed IEC materials that showcase plus/mother trees existing in Mt. Banahaw de Lucban.

Twenty two (22) species of plus/mother trees with sixty one (61) individuals were selected at the northeastern slope of Mt. Banahaw de Lucban representing 13 families namely Annonaceae, Fabaceae, Fagaceae, Clusiaceae, Meliaceae, Myrtaceae, Podocarpaceae, Sapindaceae, Sapotaceae, Symplocaceae, Theaceae and Tiliaceae. The plus tree assessed and selected at 700 masl with good phenotypic characteristics were Kamuling (*Microcos stylocarpa* (Warb.) Burr.), 2 individuals of Paguringon (*Cratoxylum sumatranum* (Jack) Blume) Makaasim (*Syzygium nitidum* Benth.) and Puyaka (*Adinandra elliptica* C.B. Rob.). These plus trees shows vigorous, healthy, superiority in height and diameter compared with surrounding trees. At 800masl, Lipoteng Gubat (*Syzygium cortiflorum*(Elmer) Merr) and Ulaian (*Lithocarpus llanosii* (A.DC) Rehd.) were in good category; at 900 masl, Malakmalakbundok (*Palaquium montanum* Elmer) was selected with good phenotypic characteristics. Malaruhut (*Cleistocalyx operculatus* Merr& Perry) and BanahawIgem (*Dacrycarpus cumingii* (Parl) de Laub.)in fair category were found at 1000, 1400 and 1800 masl.

The phenotypic characteristics of plus/mother trees appeared to be influenced by temperature, rainfall, soil and elevation. Highest population of plus trees was distributed in moderately to steep slope (18-50%). Decreasing temperature with rise in elevation affects the population and adaptation of trees resulting to fair and unacceptable quality of phenotypic characteristics. Favorable soil for plus trees was located at lower elevations as compared at higher elevation which is acidic and prone to erosion. Species diversity of 2.00 was computed at 700masl and 800masl, interpreted as moderately diverse of plus trees. However, 10 species of plus/mother trees were classified threatened based on the guidelines of DAO 2007-01: Establishing the National List of Threatened Philippine Plants and their categories and assessment of the IUCN Red List of Threatened Species.

## Uses, practices and conservation efforts of Mamanwa's forest resources

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Forest resources and traditional knowledge of indigenous population is slowly vanishing with the worldwide urbanization. Some indigenous communities including the Mamanwas struggle to preserve forests and to conserve their practices and traditional knowledge due to urbanization taking place near the Mamanwa community in Malimono, Surigao Del Norte. Survey and assessment of the practices and conservation efforts of the Mamanwa to their forest resources was presented as well as the threats of both the forest resources and their traditional knowledge. Ethnobotanical information was obtained through key informant interview and informal semi-structured questionnaires which involved a total of 20 informants were interviewed ages ranging from 22 to 78 where two of them are the tribal healer and tribal leader or their *Datu*. A total of 110 ethnobotanical plant species, grouped in their respective families of 45 were recorded. The families and the number of species each category of use are as follows, Arecaceae three (3) species used as food one (1) species used as both food and medicine and two (2) species solely used as medicine, Dipterocarpaceae with three (3) species each in medicine and structural use and one (1) used as both medicine and structural material, Fabaceae have three (3) species count in the categories food, medicine, and structural material, Myrtaceae have two (2) species in both food and medicine with one (1) species use as both food and medicine and one (1) structural, lastly Solanaceae, having five (5) species used as food and one (1) species used as structural. With utilization of the forest resources by the Mamanwa, over-exploitation is not a concern to them since they practice conservation of the resources that has of use to them. Their traditional knowledge indicates that if they should exploit a forest resource, they must replace the exploited resource with new generation of plant. The new generation of Mamanwas' loss of interest in their own culture and tradition is the main reason why their traditional knowledge is slowly vanishing which is also because of the urbanization taking place near their community. The preservation of their traditional knowledge is important since their practices and conservation efforts in forest resources are their traditions itself.

## A decade of beach forest R&D – Species surveys, nursery trials and outplanting (to the F<sub>1</sub> and F<sub>2</sub> generation)

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Beach forests comprise the trees, shrubs and other plants found above the high tide line (which overlap to a large degree with mangrove associates). They have important roles and uses – as protective coastal greenbelts (together with intertidal mangroves), medicinal/other traditional uses, ornamental species, biotech/industrial applications, wildlife habitat and reforestation.

Although beach trees start at the beach, some are found inland even up to 200 masl, making them ideal for lowland reforestation. The new ERDB book *Mangrove and Beach Forest Species in the Philippines* describes 160 such pioneer species including ~80-90 trees like *Millettia pinnata*. Seeds from *M. pinnata*, locally called bani or balukbaluk, were collected from a tree (P generation) and germinated in 2007, producing seedlings (F<sub>1</sub>) outplanted in 2008, which in turn bore flowers, fruits and wildings (F<sub>2</sub>) in 2011 – 3 generations from P to F<sub>2</sub>, all in 4 years! Their early reproduction and fast growth make such species suitable for reforestation under the National Greening Program. Other beach trees may be used for urban landscaping – big-crowned trees like dangcal *Calophyllum inophyllum* and bitoon *Barringtonia asiatica* for shade, small trees like kansilay/uringon *Cratoxylum formosum* and *C. sumatranum*, bansalagon *Mimusops elengi* for narrow street islands. We urge academe and DENR to join hands in fast-tracking nursery development of these species.

The ERDB book also documents the germination of ~50 beach forest trees and outplanting of seedlings/saplings to produce the F<sub>1</sub> and F<sub>2</sub> generation for 30 and 15 species, respectively. Based on the results of surveys and nursery/outplanting trials, beach forest trees which are pioneers are recommended for planting particularly in barren sites. Ecology dictates that colonizers should be the species of choice over climax flora such as dipterocarps which come at the end, by definition. The ecotonal location of beach forest species gives them adaptable “eury” features (e.g., tolerance to sunlight, inadequate water, low nutrients), providing alternatives to the limiting “steno” characteristics of most dipterocarps.

## Carbon Stock of Timber Species in a Forest Patch in Sitio Apis, Brgy. Apoc-Apoc, Aborlan, Palawan

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The existence of a lowland forest patch in Sitio Apis, Barangay Apoc-apoc, Aborlan, dominated by dipterocarp species, is a very significant reservoir of native plants and habitat of wildlife species. The presence of large trees in this forest patch is also important for carbon sequestration.

This study was conducted to determine the biomass and the carbon stored in the timber species in the forest patch. A plant survey was then conducted using the quadrat method. The allometric equation developed by Brown (1997) was used in the determination of above and below ground biomass while the formula of Lasco and Pulhin (2000) was used in the determination of carbon stock of timber species.

At least 19 tree species were recorded in the 2.7727 ha sample area with *Dipterocarpus grandiflorus* having the highest number of individuals encountered (105), the highest biomass (7,608.359131 kg) and carbon stored (3,423.761609 kg). The total tree biomass in the forest patch was 46.6981 t C ha<sup>-1</sup> while the total carbon stored was 21.0141 t C ha<sup>-1</sup>.

The presence of several wildings and sapling of *D. grandiflorus* indicates that the forest patch will return into a dipterocarp forest if the government, the local community and other concerned agencies join hands to protect this important habitat.

**Keywords:** Forest patch, carbon stock, tree biomass

## The ethnobotanical plants of the Tagbanua Tribe in Puerto Princesa City and Palawan, Philippines

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Ethnobotanical studies are important tools in the preservation of the indigenous peoples' dying culture, enhancement of community health care and food security, and conservation of biodiversity. Hence, this study aimed to document the plant resources used by the Tagbanua for the tribes' survival and to raise awareness about the potential and value of the plant resources in Puerto Princesa City and Palawan for its protection and management. It further aimed to screen the plants for the presence of alkaloid and correlate the ethnomedicinal knowledge of the tribe in treating skin problems with the antibacterial assay.

The ethnographic method of research was used to record and collect the plants species used by the Tagbanua as sources of food, condiments and medicine. The medicinal plants were tested for the presence of alkaloid using Culvenor-Fitzgerald Method. The antibacterial property of the ethanolic extracts of the herbal plants used by the Tagbanua in treating skin diseases were screened using the Agar Cup Method.

A total of sixty one edible plants, 12 plants as condiments and one hundred ninety five (195) medicinal plants were collected in Barangay Cabayugan, Puerto Princesa City, Barangay Caruray, San Vicente, Palawan, Barangay Cabigaan, Aborlan, Palawan and Barangay Dunanguena, Narra, Palawan. Most of the medicinal plants collected belong to Apocynaceae, Clusiaceae, Fabaceae, Lamiaceae, Leguminosae, Malvaceae, Moraceae and Rubiaceae. Sixty seven (67) plants were found to contain slight to heavy amount of alkaloids. While the plants used in treating skin problems were found to have antibacterial property against representative gram-positive bacteria, *Staphylococcus aureus*. It was also found out that the common illnesses of the Tagbanua were colds/common colds, cough, diarrhea, headache, itchiness, malaria, measles, mouth sores/ulcers, stomachache, toothache, and wounds. The study also revealed that the most frequently used herbal plant preparation is decoction.

The results of this study scientifically validate the therapeutic uses of the medicinal plants used in treating skin problems. Based on the antibacterial testing, these plants can inhibit the growth of the causative agent of wound infection. There is indeed wisdom in the Tagbanua's use of plant resources around them.

**Keywords:** Ethnobotanical, Tagbanua, Alkaloid, Antibacterial Property, Ethnomedicinal knowledge, Food Plants, Condiments

## **The biodiversity of terrestrial and lithophytic orchids of Mt. Malindig, Marinduque: basis for conservation plan**

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Mt. Malindig is a stratovolcano located at the southern tip of Marinduque in the municipality of Buenavista. The volcano has three major peaks that are generally covered with mossy forest, thus considered as home to various species of wild orchids and plants. Its height is 1,157 masl thus by law it is a protected area. A survey of the terrestrial orchids of the volcano was done on the peaks and slope areas. Pictures of the orchids were taken, including their various parts, especially the flowers for proper identification. The areas with identified orchids were covered with 1 x 1 m quadrat, since the orchids in the area are located in patches. All the plants within the quadrat were identified, counted and recorded. Results of the study identified 23 terrestrial and lithophytic orchids belonging to two subfamilies, such as Epidendroideae and Orchidoideae and six tribes, such as Collabieae, Cranichideae, Cymbidieae, Malaxideae, Podochileae, and Tropicidae. They were found in association with 13 species of ferns and small shrubs of *Pipturus*, *Litsea* and *Pandanus*. Guilds of mycorrhizal fungi were observed under the mat of rotting leaves and soil between the orchids and the ferns. Results of the interview of the six people who are guarding the military outpost and the PT&T Relay Station along the slopes of the mountain revealed the following observations that could affect the population of the orchids in the area: uncontrolled picking and collecting of orchid planting materials, accumulation of wastes, like plastics, clearing of some areas for kaingin, erosion of some areas and surreptitious cutting of trees lianas, rattan and other forest materials for building houses and livelihood.

**Keywords:** biodiversity, lithophytic orchids, terrestrial orchids, Marinduque, Mt. Malindig, mycorrhizal fungi.

# Coastal community's knowledge, attitude and perception on beach forest ecosystem services in Bucas Grande Islands, Surigao del Norte, Philippines: Basis for local management and conservation

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In the Philippines, beach forest ecosystems have been beneficial to coastal communities not only in its economic aspect but also for its ecological values hence the need for sustainable management to ensure the survival of the local inhabitants and for the terrestrial and marine biodiversity as a whole. To achieve sustainability, efforts should not be confined on natural resource conservation alone but an effective integration of community's knowledge, attitude and perception on the resource value can be an important element also to optimize positive result. Integration of local's knowledge, attitude and perception on resources management and conservation has been utilized for other natural ecosystems but least for beach forest ecosystems. This is despite the fact that this ecosystem plays a vital role in protecting the coastal communities from hazard vulnerability, among other services. Hence, this study evaluates the knowledge, attitude and perception of the coastal barangay of Pamosainganin Socorro, Bucas Grande Island towards beach forest services, its conservation and management. A total of 99 respondents were surveyed using semi-structured questionnaire. Key informant (KI) interview were also employed to elicit information about the conservation and management efforts from the local government and People's Organizations (POs). Using descriptive statistics, result shows that local people in in the community have enough knowledge on the beach forest services and have positive attitude in utilizing the resources and conserving the ecosystem because of positive intervention such as environmental seminars and tree-planting programs the initiated by Local Government Units (LGUs). Also, it was managed by POs called Pamosaingan Farmers and Fishermen Association (PAFAFIA) which implemented different strategies in managing and protecting the beach and mangrove forest such as recording of reports on illegal cutting trees and mangroves and sand hoarding. Several utilization practices in the community includes cleaning, planting, and selective cutting. However, 3% of the respondents do not participate in the activities of said organizations due of issues on transparency and none satisfaction with the management strategies implemented. Despite these, with the majority (97%) of the respondents who are willing to participate in the management and conservation of beach forest, this can be useful in developing program and formulation of plans to achieve sustainability of beach forest resource utilization. Likewise, proper dissemination of the importance of the ecosystem, its benefits and transparent management strategies should be imposed in order to encourage the local communities to engage into organizations for sustainable management of the beach forest ecosystem.

**Keywords:** resource management strategies, sustainable management, Local knowledge, attitude and perception, island community

## Diversity, ecology and conservation of orchids in selected forests on Samar Island, Philippines

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Orchid flora of the Philippines presents high level of endemism, and yet they are highly threatened due to continuing habitat degradation and loss. The contiguous forest of Samar forms a large proportion of the Samar Island Natural Park (SINP) which is among the remaining frontiers of tropical lowland forests in the Philippines. Thus, the study on orchid diversity and ecology in selected forests on Samar Island, Philippines was conducted from June 2015 to March 2016. Six transects with eight 20m×20m quadrats spaced 100m apart were established from the edge towards the interior of different forest types (n=48) to account for orchid floristic composition and to gather environmental (light, elevation, slope, NDVI and SAVI) and geographic (XY coordinates) data. Orchid diversity and composition were examined with the predictor variables (environmental and geographic) using simple and partial Mantel tests while the forest edge effects were investigated via ANCOVA. A total of 90 orchid species were inventoried; 30 are new island-records, four are promising novel taxa, while *Pseuderia* is a new generic record for the Philippines. Results showed that from forest edges towards the interior, orchid abundance and diversity generally increase through highly variable environmental factors. Generally, orchid composition showed significant positive correlation with the environmental factors (light, elevation, NDVI and SAVI) while it is negatively associated with the slope. Specifically, epiphytic orchid diversity is promoted with high solar radiation and intact vegetation, while it is inhibited with increasing slope – which is attributed to decrease in phorophytes. On the other hand, terrestrial orchid diversity and abundance is positively affected by elevational increase. Local people's organization were tapped and involved in the information and education campaigns (IECs) which eventually lead to the construction of a local orchid nursery for rescued native orchids for the purpose of conservation.

## Plants and butterflies at the intersect: Basis for ecotourism planning in Marinduque

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Marinduque is known as the “butterfly capital” of the Philippines, wherein 250 households are engaged in butterfly farming and product processing both for local and foreign markets. Thus, this study looks for the intersection between plant biodiversity and butterflies in promoting the province as ecotourism destination. The study looks on the informant consensus factor (IFC or FIC) and the cultural significant index (CSI) of the larval- and nectar-host plants that are used by butterfly farmers in Marinduque. The study involved 30 informants who are butterfly farmers and whose farms are located along or near a biodiversity area. Voucher specimens of the plants were collected with the butterfly farmers using guided-field walk. Proper taxonomic classification of the voucher specimens was made and they were categorized under the specific butterfly tribe per family. For the ecotourism aspect of the study, interview guide questions were used in gathering data from 35 respondents, who are selected government officials, tourists (foreign and local), academe members and tour operators. The study revealed 146 larval-host plants and 32 nectar-host plants that belong to 48 families of plants. These plants are serving as host-plants to 318 species of butterflies that belong to four families of butterflies with 28 tribes. Highest IFCs were recorded for plant species that are serving as larval host to butterflies under Heliconiini, Troidini, Vagrantini, Papilionini and Coliadini. Lowest records were exhibited by Neptini, Amblypodini, Poritiini, Melatini and Limenitidini. Of the 27 identified nectar-host plants, highest IFCs were exhibited by *Ixora*, *Asclepias*, *Stachytarpheta*, *Lantana*, *Datura* and *Penta*. Highest CSIs were recorded for larval-host plants under Rutacea, Annonaceae, Aristolochiaceae, Apocynaceae and Passifloraceae. In terms of ecotourism potential, the following strengths were identified; nature trekking, butterfly watching, mountain camping, butterfly-related festivity and educational trips in butterfly farms and gardens. The weaknesses mentioned were as follows; transportation, tourists facilities, advertising, tourism and environment policies.

**Keywords:** butterflies, cultural significant index (CSI), ecotourism, informant consensus factor (ICF), larval-host plants, Marinduque, nectar-host plants.

## **Botanical exploration for ginger (Zingiberaceae) species in Mount Makiling Forest Reserve ASEAN Heritage Park, Philippines**

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First botanical explorations for the Zingiberaceae (Ginger Family) in the Philippine archipelago occurred in the 19<sup>th</sup> century during the heights of survey for spices and plants that can cure several human illnesses. The Westerner explorers reached as well the lush Mount Makiling, presently known as the Mount Makiling Forest Reserve (MMFR), the 33<sup>rd</sup> ASEAN Heritage Park. Old accounts on Ginger in Mount Makiling recorded a total of 22 species. Since then, scientific explorations for the taxa in the forest reserve and even in other areas of the country had not gained significant momentum. Present survey for the Ginger Family was conducted in the Long Term Ecological Research (LTER) Plots of MMFR in order to reassess its current species composition and richness in lieu of the dynamic changes in the environment. A total of 18 species were recorded belonging to six genus under Alpinieae and Zingibireae. More species await to be discovered with more extensive surveys outside of the LTER Plots.

**Keywords:** Zingiberaceae, Mount Makiling Forest Reserve, exploration, species richness, Long Term Ecological Research Plots

## Interpretation and representation of plants among the Meranaos of Lanao

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The Meranao ancestors use plants as a form of medicine, food, shelter or ritual necessities that are also can be believed to be a representation of something such as their values and beliefs towards their culture. This study aims to document and identify plants with ethnobotanical importance used by the Meranaos of Lanao provinces. Informal interview and the use of semi-structured questionnaires were used during the interview. A total of 40 respondents from Lanao Del Sur and 40 respondents from Lanao Del Norte ages from 45 and above were interviewed. Lanao Del Sur has a total of 33 species while Lanao Del Norte has 26 species in total. Asparagaceae, Agavaceae, Fabaceae, Sapotaceae and Solanaceae plants are found in Lanao Del Sur and Pandanaceae and Rosaceae in Lanao Del Norte, these plants are the only difference between Lanao Del Sur and Lanao Del Norte. In the species collected, the most culturally significant and the most mentioned plants in terms of Symbolism in Lanao Del Sur and Lanao Del Norte are *Artocarpus heterophyllus* and *Ficus stipulosa* because of its fame of bringing misfortune to people due to the creatures living in those plants And as for ritual practices, *Oryza sativa* is the most significant, widely known plant, offered during “kashmang” for means of prosperity. The research on ethnobotanical plants can be of great help to people who will read this for it will provide information regarding ritual practices and cultural beliefs of Meranaos on plants that a simple internet research cannot provide. It will also help preserve traditional ethnobotanical knowledge of the Meranao people.

## Assessment and spatial distribution of almaciga (*Agathis philippinensis* Warb.) for seed and resin production in Luna, Apayao

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The Philippines is one of the richest archipelagos in the world, both in terms of species richness and levels of endemism. However, rapid forest loss has put this biodiversity in danger of extinction. The over utilization, and poor management of the forest considerably depleted its resources and make it unproductive. Apayao is not an excuse of the deteriorating forest cover and deforestation activities considering that in the previous years, logging operations was undertaken in the province.

One of the listed endangered species is the Almaciga (*Agathis philippinensis* Warb.). The Philippine government prohibits the felling down of the trees because of this, the utilization is limited to its resin known world trade as Almaciga resin or Manila Copal. Although this tree is of great worth, many people have been destructively treating the species. It is now in a great danger and becoming fewer and fewer each year.

With the implementation of the National Greening Program in 2011, the production of quality planting material becomes a thing of opportunity. To produce quality planting material, identification and selection of mother trees or plus trees must be carefully undertaken.

Provisions of the Department of Environment and Natural Resources (DENR) Administrative Order Number (DAO 10 s. 2011) were observed for the selection of mother trees. Fieldwork was undertaken with the help of local guide. The phenotypic characters that were observed and assessed are stem straightness, axis persistence or forking, branching, branch thickness, branch pruning, and branch angle and tree health.

A total of thirty eight (38) mother or plus trees were documented and are considered to be potential mother trees.

Few saplings and wildlings are found in the study site which indicates the difficulty of natural regenerations of the Almaciga tree.

**Keywords:** Biodiversity, Mother/ plus trees, Phenotypic characteristics, Quality Planting Material

## **Floral biodiversity assessment of the riparian ecosystem of Cañas River Watershed, Cavite, Philippines**

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The study was conducted in the riparian ecosystem of Cañas River Watershed from May 2016 to February 2017. Specifically, it aims to: (1) describe the vegetation cover of Cañas River Watershed (CRW) using vegetation index; (2) identify the floral species in the riparian ecosystem of CRW; (3) determine the distribution of floral species within the CRW using diversity indices; and (4) determine the indigenous plant species present in CRW. 2014 LandSat® imagery from the United States Geological Survey was used in ArcMap Version 10.2 using unsupervised algorithm to determine the Normalized Difference Vegetation Index (NDVI) in analyzing the vegetation cover of CRW. The collection and identification of floral species and gathering of secondary data were done using quadrat sampling method. Sites were established every 2 kilometers along the riparian zone of the rivers in the watershed. There was a total of 49 sampling points.

The whole CRW has high vegetation cover with 62.99 percent. Among the municipalities, Amadeo and Indang are covered with mixed orchard forest. A total of 91 floral species were categorized into trees, intermediate and understory in size, were identified. Also, indigenous species showed greater in number than exotic species with 60.44 percent and 39.56 percent, respectively.

The computed Shannon-Wiener Diversity Index of the whole CRW have values ranging from of 0.81 (very low) to 2.43 (moderate) in floral diversity. On the other hand, the computed Shannon's Equitability Index ranged from 0.45 (moderate) to 0.95 (very high). This shows plants are well distributed equally in CRW.

With these results, there is a need for conserving indigenous species in CRW that become threatened by the exotic species. Elimination of exotic species will provide indigenous species grow abundantly in the area. Lastly, there is a need to initiate programs like NGP of DENR that planted indigenous trees which both benefits the environment and people.

## Floral diversity assessment at Mt. Malarayat Brgy. Malitlit, Lipa City, Batangas

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Mt. Malarayat, located at the boundary of the provinces of Batangas and Laguna, is one of the least botanized mountains in Luzon. Except for some non-systematic and non-comprehensive surveys conducted in Brgy. Sto. Nino and Talisay of the municipality of Lipa, no true plant diversity assessment has been done yet in the mountain. It is safe to say that the plant diversity of Mt. Malarayat is still relatively unknown. Consequently, without the knowledge of those plant species present in the mountain, the people of the nearby Barangays are being deprived of the potential benefits that can be derived from the plant resources. It is for this reason that Health for the Future Foundations Inc. and PUSOD Inc. spearheaded a plant diversity assessment in Mt. Malarayat, Lipa City, Batangas. The survey primarily aims to know the important medicinal plants present in the mountain. However, recognizing the rarity of opportunity for this kind of assessment, the team decided to include all the vascular plants in the survey. A rapid plant diversity survey was conducted in Brgy. Malitlit on September, 2015. The survey area included the existing 2-km Biodiversity Monitoring System (BMS) transect for wildlife monitoring and 3 (10m x100m) additional transects on the forested area at the higher elevation of the mountain. All plant species along transects were identified and measured.

Results reveal that at least 264 morpho-species of vascular plants were present in the mountain. The BMS transect was basically a scrubland composed of pioneer species of trees, shrubs, and grasses. A total of 147 species were encountered from the BMS transect distributed as follows: 96 tree species, 23 herbaceous, 10 shrubs, 9 vines, 4 grasses, 2 palms, and 3 ferns. Of the total number of species, 88 are non-endemic indigenous, 17 are endemic to the country, while 37 are exotics. On the other hand, a total of 181 morpho-species were recorded from the three transects in the more natural forested areas. About 83% are native species, including 30 Philippine endemics, Majority (131/181) of the species recorded from the forested area belong to tree species.

Based on the computed importance value, the three most important species are Balobo (*Diplodiscus paniculatus*), Anuling (*Pisonia umbellifera*), and Pagsahingin bulog (*Canarium gracile*). Twenty-four species recorded during the field survey are listed under either the Philippine Red List the IUCN Red List of Threatened Species. Noteworthy among the list are the 4 critically endangered species namely; Kamagong (*Diospyros blancoi*), Narra (*Pterocarpus indicus*), Makaasim (*Syzygium nitidum*), and Kalantas (*Toona calantas*).

## **You're thinking it right: native plants are affected by invasive alien plant species in the campus of De La Salle University-Dasmariñas**

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De La Salle University Dasmariñas (DLSUD) is known to be one of the world's greenest universities. Currently, information on the distribution of native plant species inside the campus is known. The biological invasion of alien plant species (IAPS) however warrants the need for the formulation of institutional policy standards in the prohibition and monitoring certain invasive plants as information on these IAPS inside the University is limited. In this study, a field ocular observation technique was employed to examine the abundance and distribution of these IAPS in the 27 hectare-sized campus. Ten species of invasive plants were assessed and evaluated using a developed criteria and rating system for determining the biological invasiveness of alien plants. Results on assessment and evaluation using the developed criteria and rating system showed that species invasiveness scores ranged from 32-39 points (i.e., all species are invasive). This indicates that the alien plants considered have varying potentials of biological invasion within the campus. The present study also focused on the issues and threats posed by these IAPS on the native plant species in DLSUD. The data will suggest that it is important to monitor, evaluate and provide immediate feedbacks on the distribution of these IAPS. Similarly, these results indicate that a policy document needs to be followed by the University's Environmental Resource Management Center where monitoring plan of invasive plant species will be emphasized for sustainable environmental management.

## **Carbon stock baseline assessment in reserve carbon pool areas of five carbon neutrality project sites in the Philippines**

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Tropical forests in countries like the Philippines store large reserves of carbon but are vulnerable to increasing anthropogenic pressures. As forests continue to be threatened, forest carbon estimates are necessary to support forest conservation and rehabilitation measures to reduce emissions. These interventions support national and international regulatory frameworks like the Climate Change Act of 2009 or National Greening Program (NGP) of the Philippines and the Reducing Emissions from Deforestation and Forest Degradation (REDD+) program of the United Nations Framework Convention on Climate Change (UNFCCC).

The study was conducted to estimate the carbon stock in five privately-owned project sites where reserve carbon pool (RCP) areas are dedicated for forest protection to contribute to the scope 1 and 2 carbon neutrality commitment of Ayala Land, Inc (ALI) in its commercial properties. These RCP areas are referred to by ALI as “carbon forests” which are located in the ALI Properties in Alaminos, Laguna; Sicogon Island, Iloilo; Kan-irag, Cebu City; Talomo, Davao City; and in Lio, El Nido.

The carbon stock of each site was calculated based on the product of the average carbon density of trees and the areal extent of those trees estimated from interpreted images of available satellite data. The total estimated amount of tree carbon stored in early secondary growth (ESG) areas of the five sites is 18,582 tonnes of carbon (t C) or 68,133 tonnes of carbon dioxide equivalent (tCO<sub>2</sub>e). Interventions such as forest protection through patrolling, assisted natural regeneration, and reforestation are recommended to increase the carbon sequestration capacity of the RCP areas.

**Keywords:** carbon stock, carbon sequestration, carbon neutrality, REDD+, forest conservation

# ABSTRACTS

## POSTER PRESENTATIONS

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### **Apayao State College – PFEN rainforestation demonstration project: A climate change mitigation and biodiversity conservation strategy in Apayao Province**

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Deforestation in the tropics is now widely accepted as one of the greatest threats to wildlife on Earth. It is also one of the main causes of climate change. It is the second largest anthropogenic source of carbon dioxide to the atmosphere, after fossil fuel combustion. Deforestation and forest degradation contribute to atmospheric greenhouse gas emissions through combustion of forest biomass and decomposition of remaining plant material and soil carbon.

The last decade of the 20<sup>th</sup> century saw rapid changes in attitudes towards this problem and some innovative attempts to devise solutions. In many parts of Southeast Asia, producing timber by logging natural forests is rapidly becoming a thing of the past, not only because forest areas where logging remains economically viable are diminishing, but also due to growing public opposition.

Rainforestation is a concept in forest restoration, wherein only indigenous and endemic tree species are used as planting materials which include but not limited to dipterocarp species, premium tree species, etc. With an inherent objective of State Universities and Colleges to help in the forest conservation efforts, the Philippine Forestry Education Network Incorporated proposed a project utilizing rainforestation technology as strategy. A Memorandum of Agreement entered into by and between Apayao State College and Philippine Forestry Education Network Incorporated in September 04, 2013 for the establishment and management of native tree nursery and rainforestation demonstration area.

A total of 23,468 indigenous forest trees were produced out from seeds and from wildling collections. Mayapis (*Shorea squamata* (Turcz.) Dyer) and White lauan (*Shorea contorta* (Vid.) Merr. & Rolfe) of the family Dipterocarpaceae constitutes the bulk of the species produced.

A total of 3,174 seedlings were planted to the rainforestation demonstration area from 30 different species. Of the thirty planted species, fifteen (15) were endangered, seven (8) critically endangered, four (4) vulnerable and three (3) were of least concern.

**Keywords:** Climate Change, Rainforestation, Biodiversity Conservation, Native Species, Indigenous species, conservation

## **Ethnobotany of the Bugkalot people on Nagtipunan, Quirino: A preliminary investigation**

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Indigenous people are living in the mountainous areas of Quirino province in Northern Philippines. The Bugkalot people are utilizing materials from the environment in their daily lives. This paper presents a preliminary investigation of the ethnobotany of the Bugkalot people of Nagtipunan, Quirino. Through key informant technique and small focus group discussion, the different plants that they use as food, medicine, ritual materials and animal feed were identified. As upland rice is their main food source, the different traditional upland rice landraces were determined. The introduced plants that they grow for commercial purposes using modern farming practices were also documented. The Bugkalot people utilize forest products for diverse purposes. Introduction of commercial products is decreasing the utilization of traditional materials in their daily lives.

## Canopy dynamics of typhoon-disturbed mahogany stand in Mount Makiling Forest Reserve, ASEAN Heritage Park

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The study was carried out to analyze the bio-invasiveness and co-existence of Large Leaf Mahogany (*Swietenia macrophylla*) with the native species after typhoon disturbance in PFLA3 (Permanent Forest Laboratory Area) in Mount Makiling Forest Reserve. The study was conducted by strategically laying five 10m x 10m quadrats. Canopy gaps were measured using hemispherical photographs with different exposure settings and Normalized Difference Vegetation Index (NDVI) was employed as a prediction model to determine the silvicultural pathways. The five plots yielded a total of 293 individuals shared by 23 species of trees. These species represent 21 genera under 15 families. Mahogany is the most dominant (93.4) and the most ecologically important (171.95) species. Seven new species are observed to coexist with Mahogany plantation these are Narra (*Pterocarpus indicus*), Amamali (*Leea aculeata*), Pararubber (*Hevea brasiliensis*), Lanutan (*Mitrephora lanotan*), Tambalau (*Knema glomerata*), Kapulusan (*Nephelium rambutan-ake*), and Magabuyo (*Celtis luzonica*). Mahogany population structure shows a reverse J-shaped population curve which reveals that the future communities may be sustained. Hemispherical photographs revealed that light can still penetrate because the forest canopy is not totally closed such that understory layers composed of seedlings and saplings may grow abundantly. *Arenga pinnata* serve as intermediate sub-canopy. NDVI findings showed a dropped on vegetation cover in 2006 and 2014 which can be attributed to typhoons Milenyo and Glenda. Recovery of vegetation after the disturbance is attributed to natural recruitment and regeneration. The study provides scientific understanding of a natural canopy dynamics and silvicultural pathways which may help in forest management and conservation of the Mahogany stand.

## **Native plants built for harvest shelters by *Loboanos* of Verde Island Passage, Philippines**

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An ethnobotanical study was undertaken to determine the structural features as well as functional challenges in traditional huts maintained since 1900s primarily to shelter swidden harvests of *Loboanos* – a community of *Taga-ilog* farmers along the Verde Island Passage, Lobo Batangas.

The native thatched huts locally known as “*banglin*” have 6.23m<sup>2</sup> to 7.63m<sup>2</sup> rectangular walls made of split culms of spiny bamboo (*Bambusa blumeana*) and fortified by four-cornered vertical posts 0.15m diameter and 2.69m high and elevated flooring built from native trees either dungon (*Heretiera sylvatica*), molave (*Vitex parviflora*) and dipterocarps (*Shorea spp.*). The triangular extended roofs, 11.44m<sup>2</sup> are fronds of century palm (*Corypha utan*) or from manually-bundled leaves of cogon (*Imperata cylindrica*). The huts have three to four stair-steps 1.35m long by 1.3m wide; a door of 2.30m<sup>2</sup>, and windows of 0.62m<sup>2</sup>. The elevated floor and split partitions generate favourable “hulab” (or microclimate) – an adequate cool ventilation throughout while sheltering and prolonging the “perishables” and “durables” from mountain swiddens and lowland rice fields. Some 15 major traditional crops ranging from 25 to 2,800kg are stored synchronically in most shelters. A number of traditional implements used by early *Loboano* farmers are stored in these huts while the shadow effects for free-ranging native chickens and goats are also appreciated by its builders.

Weathered by typhoons and other biophysical agents of deterioration, these native huts are a smart materialization of *Loboano*'s traditional ecological knowledge of storing harvests to sustain local food sovereignty. We have yet to see any formal institutional initiatives that underscore restoration of these “locally important agricultural heritage system” (LIAHS) which in the distant past have linked native plants of the forest with that of traditional farming livelihood of *Loboanos*.

## **Blooming of native trees as biosignal of local climatic regime**

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Intended observation and key local knowledge suggests that the flowering of native trees is naturally synchronized with local climatic condition particularly temperature and rainfall. Four native trees along the Lobo coast of Verde Island Passage have been the focal species. Photographic catalogues were produced to communicate the species importance.

From beach forest to inland ridges, the general flowering (GF) of Philippine teak (*Tectona philippinensis* Benth. & Hook. f, Lamiaceae) was intense during southeast monsoon (May-July) following deciduous state in summer (January to April). Some surviving mother trees of “balai-lamok” locally known as “santol tamar” (*Crateva religiosa* Forst. f, Capparidaceae) best blooms in summer months between April to mid-May and surprise flowering in September to October as a consequence of rain recession for weeks. Few old remnants of the Philippine cherry blossom (*Cassia javanica* L. subsp. *javanica*, Fabaceae) are showy in ridge forests during full canopy blooming in dry months of March to April. Along stream banks and narrow valleys, the population of “tan-ag” (*Kleinhovia hospita* L., Malvaceae) are in full anthesis from August to September and resume in rainy December. A 30-year climogram for Batangas indicated a mean annual precipitation of 151.89 mm, increasing (113-331mm) mainly during southwest monsoon months of May to July and decreasing (292-101mm) from August to December. Low rainfall (27-32mm) was experienced during summer months from January to April. The mean annual temperature of 27.4°C ranges from 26-29°C.

The flowering alongside the vegetative phenophases of native trees is valuable biosignal of local climate among the local community for the timing of planting and harvesting as well as collection of wild honeys. Losing the forests where these trees can still be found means losing important bio-climatic indicator for essential livelihoods and ecotourism. From 2000-2015, the Batangas City-Lobo-San Juan continuum of Verde Island Passage has much (2,078.39ha) semi-evergreen forests converted to agricultural and settlement expansions.

## **Agricultural weeds in Sultan Kudarat, Philippines**

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Agricultural weeds in Sultan Kudarat was conducted in three agricultural commodities; rice, corn, and sugar cane in the province of Sultan Kudarat. This study provides information in the weeds species composition, morphological structure, economic uses and their ecological status. The survey and data gathering were done from randomly identified barangays of three municipalities which are known for such agricultural commodity producer. Municipality of Bagumbayan for weeds of corn fields, Municipality of Lambayong for weeds of rice fields and Municipality of Pres. Quirino for weeds of sugar cane.

Result revealed a total of fifty six (56) species present in rice, corn and sugar cane plantation of Sultan Kudarat. Fifty one (51) weed species observed from corn field, thirty seven (37) weeds species present in rice and forty three (43) weed species present in sugar cane plantation. Among the weeds species, forty seven (47) were potentially used as medicinal plants of human and veterinary ailment. Twenty one (21) species utilized as foods such as vegetable, animal forage and feeds. And five (5) species cultivated as ornamental plants for landscaping and to prevent soil erosion. Result further shows the nine (9) weeds species were classified as least concerned species and the rest are not assessed by International Union for Conservation of Nature (IUCN). Therefore, weeds considered economically potential needs to be conserved through in-situ propagation.

## GC-MS profiling and comparative statistical analysis of select Philippine native plants

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Establishing the metabolic profiles of plants provides an insight on their possible bioactivity and reactivity that could be harnessed for pharmaceutical, industrial, and even agricultural applications. These molecular fingerprints also reflect the effect of environmental factors like temperature and climate, on plant metabolism. However, despite the expected difference on metabolites, multiple plants can exhibit similar medicinal properties such as anti-inflammatory, anti-cancer, and antimicrobial activities which are common attributes found in Philippine ethnomedicine. Guyabano (*Annona muricata*), mabolo (*Diospyros blancoi*), and macopa (*Syzygium samarangense*) are examples of native plants known for their reported therapeutic properties and insecticidal activity. Using gas chromatography-mass spectrometry, extracts from these plants were analyzed to create untargeted metabolite profiles. Mass spectrum deconvolution and putative identification were done using AMDIS and NIST. The analysis revealed the presence of esters as the major components of mabolo, while terpenes and terpenoids were found in guyabano and macopa. SpectConnect and MetaboAnalyst which are open-source, multivariate statistical tools were applied to compare these plants and show empirically their probable similarities beyond their diverse metabolite profiles. PCA, PLS-DA, and orthogonal PLS-DA showed the variability of less than 50%, while it was anticipated that the value for variance would be greater because of the obvious differences of these plants. These results indicate a potential overlap in the metabolites that can be attributed to their comparable bioactivities.

**Keywords:** GC-MS, untargeted profiling, multivariate analysis

## **Species diversity and abundance of mangrove forest in Island Cove, Binakayan, Kawit, Cavite, Philippines**

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The flora and fauna species of a man-made Mangrove Forest in Island Cove, Binakayan, Kawit, Cavite were assessed for diversity, richness and abundance using the quadrat sampling method and analyzed with Simpson's Diversity Index. Collection of species was done twice on September 2016 and January 2017 representing wet and dry seasons, respectively. Results showed that dry season was well-diverse (very high) in terms of species diversity index with 0.04 (lowest) and 0.08; species richness of 29 and the most abundant species, *Chromolaena odorata* with 8.66% of the total 1,823 collected species compared to wet season with a diversity index of 0.17 (lowest); species richness of 12; and the most abundant species, *Coccina grandis* with 16.94% of the total 1,292 collected species. This could be attributed to the environmental condition wherein during wet season, anthropogenic and natural disturbances were very prominent such as trashes and garbage, anoxic water, moist and watery substrates, plant destruction due to storms and heavy rainfall. The man-made Mangrove Forest Ecosystem, despite of the anthropogenic and natural disturbances that are present with in the mangrove forest, this ecosystem is still well-diverse. It is then, very crucial to protect and preserve this man-made ecosystem by minimizing anthropogenic stressors and disturbances. Rehabilitation of the said ecosystem is highly recommended and should be prioritized in order to preserve flora and fauna species that are thriving in this ecosystem.

**Keywords:** flora and fauna, Kawit, Cavite, mangrove forest, species diversity, Simpson's Diversity Index.

## Leaf blade anatomy of two non-epiphytic species of Philippine *Medinilla* Gaudich.

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Leaf anatomy of two non-epiphytic species of Philippine *Medinilla* Gaudich., namely, *M. annulata* C.B. Rob. and *M. inaequifolia* C.B. Rob., was studied by light microscopy. Both species exhibit the following features in their lamina: single-layered upper and lower epidermis, hypodermis between upper epidermis and palisade mesophyll, sclerified palisade mesophyll, thick spongy mesophyll, and druse crystals. These features are also present in previously studied epiphytic species of *Medinilla*, but there are some apparent differences between the epiphytic and non-epiphytic species. In both species in this study, the hypodermis is relatively thin, having only 1-2 cell layers and comprising less than half the thickness of the entire leaf blade. In addition, the spongy mesophyll layer has loosely arranged cells unlike in the epiphytic species where the spongy mesophyll layer has tightly packed cells. These features show that within the genus, anatomical characteristics of the leaf vary depending on the habit of the species.

**Keywords:** *Medinilla*, hypodermis, druse, sclerified mesophyll

## Metabolite profiling and antimicrobial activity of Philippine miracle fruit, *Crescentia cujete* L.

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Numerous testimonials, both online and word-of-mouth, have documented the efficacy of *Crescentia cujete* L (calabash), the 'miracle fruit' from Southern Philippines, against diabetes, stroke, and cancer. Preliminary profiling of secondary metabolites present in the fruit was done using gas chromatography-mass spectrometry. AMDIS deconvoluted mass spectra were matched with NIST for the identification of metabolites with reverse match factor values of 850 and greater. Small molecules found in the fruit included benzene and benzenoids, methyl salicylate, and oxalic acid esters. Benzene and benzenoids are classified as air-pollutants, which are documented to cause adverse health effects. These pollutants were found to be absent in the commercially available fruit juice, with thiazole and (+)- $\delta$ -cadinene identified as constituents. Both extracts were also effective inhibitors of *Candida albicans*. However, only the fruit juice distillate showed bioactivity against *Escherichia coli* and *Staphylococcus aureus*. This difference in antimicrobial activity is a good reflection of metabolite diversity, as well as the significant effect of manufacturing process and environment.

**Keywords:** *Crescentia cujete*, GC-MS, untargeted metabolite profiling, miracle fruit

## **Determining the anti-angiogenic effects of *Colocasia esculenta* leaves through chorioallantoic membrane assay**

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Cancer is one of the deadliest chronic diseases, claiming the lives of millions per year with a low survival rate. Many methods to counter cancer have been researched throughout the years, with one of the methods being anti-angiogenesis, or stopping the formation of blood vessel of cancer cell tumors. *Colocasia esculenta*, commonly known as taro, is a common local plant frequently used as staple food that is stated to have a potent antimetastatic effect, based on several studies. This study aimed to determine the anti-angiogenic effects of *Colocasia esculenta* using chorioallantoic membrane assay. Plant extract was made from *C. esculenta* leaves through ethanol soaking and rotary evaporation. Dilutions in 25%, 50% and 75% ratios were made by adding natural saline solution, with 1% ceftriaxone as antibiotic. Twenty eggs were incubated for 2 weeks, followed by injecting dilutions into four eggs each. Four other eggs were injected with retinyl palmate as positive control. Eggs were incubated for another week, after which the eggs were hatched. Pictures were taken macroscopically of the hatched embryos, and the images were processed through ImageJ to determine area of blood vessel coverage. End results show that no significant anti-angiogenic effect was observed using one-way ANOVA at  $\alpha=0.01$  as a statistical test. Further testing is needed to determine whether or not *C. esculenta* is an effective anti-angiogenic agent.

## **Phytochemical screening of the crude methanolic extract of *Saccharum spontaneum* leaves using thin layer chromatography**

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Medicinal plants have gained more attention due to their potential benefits to society such as pharmaceuticals. The screening of natural products for bioactive molecules is essential in drug discovery. The medicinal properties of plants are due to its secondary metabolites. *Saccharum spontaneum* is a traditional herb with a high medicinal value. Locally known as talahib, It is believed to treat certain diseases like respiratory and gynecological troubles, remedy for dyspepsia, burning sensation, piles and sexual weakness. The study aims to discover the phytochemical constituents present in the methanolic extract of *Saccharum spontaneum* leaves. *S. spontaneum* leaves were collected in Angeles City. Herbarium was prepared and was sent to National Museum for authentication. Five hundred grams (500g) of the collected leaves were thoroughly washed with distilled water, air dried for 5 days in the shade and were cut into small pieces. The cut dried leaves of *S. spontaneum* were soaked with 1000ml of methanol at room temperature for 2 days, then filtered through Whatman No.1 filter paper and concentrated to dry by rotary evaporator to acquire the crude extract. After the rotary evaporation, concentrated sample was pooled and stored in the refrigerator until used for determination of its phytochemistry. Phytochemical screening was done using thin layer chromatography. Different spray reagents were utilized to determine the bioactive components present in the leaves in *S. spontaneum*. The crude methanolic extract of *S. spontaneum* yielded positive for the presence of the following compounds: phenols, tannins, alkaloids, coumarins, anthrones, higher alcohols, steroids and essential oils. Due to the presence of various bioactive components, *S. spontaneum* could be used in different bioassay studies and potential source of drug components.

## Inventory of grasses in the University of Eastern Philippines, Catarman, Northern Samar

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This study aimed to present information on the species composition, distribution, local names, and the economic uses of grasses in the University of Eastern Philippines, University Town, Catarman, Northern Samar. Purposive sampling was used in the study, complemented by additional techniques such as transect walk, ocular surveys, and interviews with local residents to assess the presence and abundance of grasses in the area within the last five to ten years, the local names, and the economic and ecological uses of grasses. There were 58 species of grasses, and among them, the most frequently observed was cogon (*Imperata cylindrica*[L.] Beauv.var. *major*[Nees] E. C. Hubb.), which was observed in all the sampling sites. The least frequently observed was Bermuda grass (*Cynodon dactylon* [L.] Pers.), which was seen and observed in only a few patches in some of the sampling sites.

Thus, it can safely be said that there is still an abundance of grasses in the University Town, which are utilized by the local residents for various purposes.

**Keywords:** inventory, distribution, grasses, abundance, University Town

## Habitat suitability modelling of spiked pepper (*Piper aduncum* L.) in Mindanao, Philippines

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Invasive alien species is the biggest threat to biodiversity next to habitat destruction. In Mindanao, *Piper aduncum* is considered as the most invasive alien plant species that affects forest ecosystem and agricultural areas. This study provides insights in identifying suitable areas for *Piper aduncum* in Mindanao using a novel modelling method known as Maxent. Two models were generated: Full Model which is based on the 25 environmental variables and Final Model which is based on the final set of variables maintained after a series of variable reduction method. The relative predictive performance of the two models were evaluated using Receiver Operating characteristic (ROC)-Area under curve (AUC). Result showed that the Final Model performed best with AUC score of 0.825 compared to the Full model (AUC=0.749). The predicted suitable habitat of *Piper aduncum* was heavily influenced by these top five predictors: Soil type, Mean Temp of Warmest Quarter, Mean Diurnal Range, Max Temp of Warmest Month and Precipitation of Seasonality. Overall, this study will contribute to natural resource managers especially in setting priority areas for current management of the species and predict its potential spread in the future.

## **Cloud-based information system of the ethnoveterinary plants of Marinduque for Marinduke pig (*Sus domesticus*)**

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This study aims to support the Conservation, Improvement and Profitable Utilization of Philippine Native Pigs Program of Marinduque State College through establishing a cloud-based information system of ethnoveterinary plants of Marinduque utilized as medicine for Marinduke pig (*Sus domesticus*). With the limited supply of medicine in the local market and their inability to spend to avail such, local folks looked up to traditional medicine to cure common ailments inflicting native pigs in the province. Through the information system, ethnoveterinary plants found in different parts of the province were recorded. Findings revealed that common plants found in different areas of the province can be used as alternative cure for different diseases of the Marinduke pig. Most of them can be found on the far-flung areas and mountainous part of the province where access to main road is a bit difficult. So as to promote the viability of native pigs as one of the staple source of food and income in the province, findings can be used to guide local native pig raisers as well as the Local Government Unit to utilize alternative medicine through the use of ethnoveterinary plants available in their area. This supports the Marindukanon's dream of producing organic pig in the market.

**Keywords:** Ethnoveterinary Plants, Marinduke Pig, Cloud Computing, Alternative Medicine

## **Trees, shrubs and pteridophytes within and outside the hydraulicking mining area of Brgy. Tumpagon, Cagayan de Oro City, Philippines**

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Mining operations are inherently disruptive to the environment. With this, the country is faced with a great challenge in utilizing the rich available mineral resources for economic growth and development without compromising its ecological integrity and species diversity. Gold mining brings several benefits to developing countries like the Philippines. Although the industry produces economic gains and provides employment, it destroys the environment through deforestation, vegetation removal and loss of biodiversity. In this study, Assessment of Trees, Pteridophytes and shrub species was conducted in Brgy. Tumpagon, Cagayan de Oro City, Philippines to determine the potential effect of surface gold mining on its diversity and to assess the preferred habitat of the plants present in the area. The Trees, Pteridophytes and shrubs species were collected in the established sampling points within and outside the mining area. Canonical Correspondence Analysis was performed to determine the habitat preference of the plant species and its association towards different environmental variables. Results revealed a combined total of 96 species under 44 families were present in the area. Endangered and endemic tree species, *Mangifera monandra*; endangered tree-erns, *Cyathea contaminans* (Wall. ex Hook) Copel. and the Philippine endemic and vulnerable tree, *Shorea contorta* S. Vidal are found in the area. Found under that trees and Pteridophyte diversity is higher outside the mining area while results for Shrub diversity is the opposite. The decreased in species diversity inside the mining area is mainly due to habitat loss. Shrub's diversity is attributed to the loss of competition due to disturbance caused by mining. Most of the tree and pteridophyte species showed preference toward the early secondary growth forest and cultivated habitats than in mined habitat. Majority of the shrub species are associated with environmental variables present in an open area habitat and thus have preferred to thrive in the mining area than in forested area.

## **The fall of the native duldul or malabulak *Bombax ceiba* (and the rise of the introduced kapok *Ceiba pentandra*)**

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The Red Silk Cotton Tree, known scientifically as *Bombax ceiba*, is large and tall, reaching 25 m on average and 60 m maximum. The gray trunk bears many spines which become eroded with age, as buttress roots develop. It is native to tropical Asia and widely planted in South Asia (e.g., Pakistan) along roadsides for its large, showy red to red-orange flowers. The crimson blooms dramatically appear against bare branches, as the leaves fall off in this deciduous species. *B. ceiba* is also widely cultivated in East and Southeast Asia (e.g., China, Hong Kong), except in the Philippines where it is locally known as the native duldul or malabulak. In the past it was so abundant, at least in Luzon, that one whole province – Bulacan – was named after it. (Bulak is the Tagalog word for cotton, and malabulak refers to the cotton-like threads from the capsules – a video will show the gentle falling of cottony threads, much like tropical snow.)

The paper describes *B. ceiba* nursery and outplanting trials that started in 2004 and 2006, respectively, and information on 1<sup>st</sup> reproductive maturity, capsules per tree, seed counts per capsule, etc. Anecdotes of the Iloilo City duldul tree include its downing by a 2012 typhoon and subsequent pulling upright by members of the congregation, and the premature harvest of 6,000 fruits to preempt respiratory complaints from neighboring barangay dwellers. Generally unknown in the Philippines, the species is reported only from a few places outside of Luzon, in contrast to its widespread popularity in the rest of tropical Asia. Its decline may be related to the introduction of the exotic kapok *Ceiba pentandra*.

## **Antimicrobial activity of the crude ethanolic leaf extract of *Colocasia esculenta***

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For thousands of years, plants have played a crucial role in maintaining human health, improving quality of human life, and have served well as valuable components of medicines, seasoning, beverages, cosmetics, and dyes. The popularity of using plants as herbal medicine is based on the premise that they contain natural substances that can promote health and alleviate illnesses. One of the plants that is being studied for different medicinal properties is taro (*Colocasia esculenta*). The study was undertaken to evaluate the antibacterial and antifungal activity of *Colocasia esculenta*. The leaves of the plant were collected, air-dried, macerated, completely soak in 95% ethanol, and subjected to rotary evaporation. The antibacterial activity of the extract was determined using agar disc diffusion method, and tested against the bacteria *Staphylococcus aureus* and *Escherichia coli*. The antifungal activity was determined using agar well diffusion method and tested against the yeast *Candida albicans*. The resulting zones of inhibition of extracts were measured and compared with that of the positive controls, Clindamycin and Clotrimazole. The test revealed that crude ethanolic leaf extract of *Colocasia esculenta* has no antibacterial activity against *Escherichia coli* and *Staphylococcus aureus*, as no zones of inhibition were measured. On the other hand, the crude ethanolic leaf extract of *Colocasia esculenta* has an antifungal activity against *Candida albicans*. It is recommended that the sensitivity of other bacterial and fungal strains to the plant extract be tested and pharmacological assay be done.

## Stand structure and species composition of the mangroves in Camotes Islands, Cebu, Philippines

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The distribution, identification and assessment of mangroves and mangrove communities in Camotes Islands were studied. This is to provide resource-based data of mangroves in the three islands of Camotes to serve as framework for CRM planning and implementation. The transect plot method was used in the study where the 10- meter wide plot were established comprising 10 % of the total area cover based from the map. The formula of index of similarity between two sample and indices of species diversity using Evenness and Shannon indices for general diversity were also used. Area 1 is Timarong, Poro, Cebu, Area 2 is Unidos, San Francisco, Area 3 is Tiguis, Area 4 is Mercedes, Poro, Cebu. Area 5 is Mac Arthur, Tudela, Cebu. Area 6 is Villahermosa. Area 7 is Lower Poblacion, Pilar, Cebu and Area 8 is Upper Poblacion, Pilar, Cebu. Out of the 717 hectares of mangrove areas of Camotes Island, results that there are 30 species of mangroves found in Camotes Islands out of 47 species throughout the Philippines. Results further shows that Rhizophoraceae family has the highest in terms of frequency followed by the Avicenneaceae, Palmaceae, Maliaceae, and Myrsinaceae. For the average height it shows that *Sonneratia alba* has the highest which is 10.89 meters followed by *Erythrina orientales*, *Bani*, *Avecinnia marina*, *Avecinnia lanata*, *Bruguira parviflora*, *Avecinnia officinales* and *Xxoecaria agallocha*. Based on the diversity index, it shows that area 2 has the most diverse area, followed by area 4, area 5, area 3, area 6, area 7, area 8 and area 1. For the average basal area, *Sonneratia alba* has the biggest average basal area per hectare in all the areas followed by *Sonneratia caseoloris*, *Avecinnia marina* and *Rhizophora apiculata*. For the crown cover, *Delichandron espathacea* ranked first with 154, 142.70 m<sup>2</sup> (in area 2) followed by *Avecinnia marina*, *Rhizophora apiculata*, *Sonneratia alba*, *Bruguira parviflora*, *Rhizophora mucronata*, *Aegiceras floridum*, *Avecinnia lanata*, and *Rhizophora stylosa*. For the important value of the species, results show that *Sonneratia alba* has the highest important values which is 238.0208 followed by *Rhizophora apiculata*, *Avecinnia marina*, *Ceriops decandra*, *Rhizophora stylosa* and *Rhizophora mucronata*. For that generation of trees per species it showed that *Avecinnia marina* has the highest regeneration which is 7, 458 followed by *Rhizophora stylosa*, *Rhizophora mucronata*, *Ceriops decandra* and *Aegiceras corriculatum*. *Rhizophora lamark*, *Terminalia catappa*, *Pemphisa cedula*, *Xylocarpus mollucensis*, *Camptostemon philippinense*, *Xxoecariaa gallocha*, *Osbornia octodonta*, *Nypa frutacans*, *Erythrina orientales* and *Schypiphora hydrophylacea* have no regeneration.

**Keywords:** Stand structure, species, composition, mangroves

## Leaf architecture of *Cinnamomum mindanaense* Elmer in Cebu Island, Philippines

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Heterophylly and heteroblasty contribute to the intraspecific variation and taxonomic controversy of *C. mindanaense*. Here, we examined 26 leaf morphological characters of *C. mindanaense* trees obtained from (a) Nug-as, Alcoy, (b) Cansuje, Argao and (c) San Antonio, Boljoon, Cebu. Leaf clearing was adopted, with modification, from Vasco et al., (2014) and Buechler (2010) and characters were based from Hickey (1973) and Manual of Leaf Architecture (1999). Leaf architecture comparison was evaluated through visual and Image J analysis software. PCA and Cluster Analysis were utilized to analyze morphometric data matrices. Results show that the continuous characters (e.g. leaf length and width) of old vs young leaves were more variable compared to the discrete characters, namely: 1<sup>o</sup>, 2<sup>o</sup>, 3<sup>o</sup>, 4<sup>o</sup> and 5<sup>o</sup> vein categories, areole shape, areole development, veinlets, blade margin, presence of petiole, venation pattern and midrib structures. The study concluded that these discrete characters may define, morphologically, *C. mindanaense* as a species.

**Keywords:** leaf architecture, phenotypic plasticity, intraspecific variability, *Cinnamomum mindanaense*

## Diversity and abundance of woody plants in the beach forests of Socorro, Bucas Grande Islands, Surigao del Norte, Philippines

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Coastal ecosystems, including beach forest, serve as barrier to the increasing effects of climate change such as sea level rise, increased temperatures, and shifts in rainfall patterns. Despite being the greenbelts protecting coastal communities, beach forests are less studied in the Philippines thus access to studies on its biological structure as well as its disappearing vegetation is limited. Understanding the plant composition of any beach forest is deemed important since this vegetation plays an important role in coastal protection, reducing the vulnerability of coastal communities to the effects of climate change and other coastal hazards (Spalding *et al.*, 2013). Eastern Mindanao, particularly Surigao del Norte, is one of the most vulnerable regions of the Philippines to high storm surges because of its gently sloping coasts, shallow bays and is also frequented by typhoons due to its geographical location (Lapidez *et al.*, 2015). Hence, the aim of this study is to determine the biological structure of the beach forest in Pamosaingan and Sta Cruz, Socorro, Surigao del Norte, in terms of its woody plant species composition focusing on the woody plant communities. In the site, plant species composition and frequency were measured using transect-quadrat method. Three (3) 100 meter transect were established within the forest with five 10x10 m quadrats in each transect. A total of 43 woody plant species were found in the area distributed among 23 families with Fabaceae as the highest represented family. The species *Allamanda schottii* of family Apocynaceae is found to be dominant in Barangay Pamosaingan comprising 51.89% of the whole population while *Nypa fruticans* dominates 18.33% of the population in Barangay Sta. Cruz. Species diversity Index was calculated from the composite plant species data based on the Shannon-Weiner Diversity Index (Shannon & Weiner, 1963) which accounts for both abundance and evenness of the species; Barangay Pamosaingan has 2.058 while Sta. Cruz has 2.937. Moreover, since some parts of the beach forest are privately owned, *Cocos nucifera* is most dominant. Seedlings and saplings of introduced species *Terminalia catappa* were also observed that is associated to the National Greening Program of the government. These results will provide useful baseline information to managers and local government in crafting appropriate guide for coastal resource planning and management.

**Keywords:** plant species composition, shoreline vegetation, coastal greenbelts, coastal resource

## **Plants used by the locals of Lanao del Norte in treating livestock and poultry disease and malaise**

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It is an established fact that plants with medicinal properties serve as a potent medicine for curing various diseases since the ancient times. It was not only used in curing humans but also animals. The Philippines, particularly in rural and isolated areas practice ethnoveterinary medicine due to the expensiveness of commercial drugs. In addition to that, the plants used in ethnoveterinary medicine are not only cheaper but are also locally available and are easily accessible. However, because of the growing modernization, ethnoveterinary practice has not been given enough attention thus, facing the risk of extinction. Aside from that, this practice has been passed on from generation to generation through the word of mouth lacking proper documentation. Informal interviews was done in six municipalities of Lanao del Norte – Kolambugan, Tubod, Baroy, Lala, Kapatagan and Sultan Naga Dimaporo on the plants used by the local people in treating livestock and poultry disease and malaise. There were 90 respondents and 3 key informants in the study with ages ranging from 24-89. There were 44 plant species belonging to 25 different families obtained. *Tinospora crispa* belonging to family Menispermaceae was the most commonly used plant among the six municipalities followed by *Areca catechu*. Diarrhea was also the most common ailments encountered by livestock and poultry raisers. The route of administration was primarily oral followed by topical applications.

## Plants used by the local people of Zamboanga del Sur in treating livestock and poultry diseases and malaises

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Plants have variety of uses. One use would be treating ailments and diseases in humans and animals as well. The need to record the ethnoveterinary medicinal practices in treating animals is very high because not many documents and proper papers have been published and known to the public. Indigenous knowledge is slowly depleting. The usages of native plants of the locals are slowly getting low. This knowledge needs to be conserved by documenting and the results will be used to plan the proper usage of these plants and also, the knowledge of the locals. Frequent passage of tradition is by oral which cannot be recorded. This study aims to record plants used by the locals of Zamboanga del Sur to treat animals. A total of 59 respondents were interviewed using semi-structured questionnaires and brief discussions with age ranges to 25-85. Fifty six percent (56%) of the total respondents were farmers. Results showed that 48 plant species from 30 families with two endemic species namely Tipolo and Anonang were used by the locals in Aurora, Lakewood, Ramon Magsaysay and Tukuran, Zamboanga del Sur. Among the families, Lamiaceae and Moraceae have the most plant species with 4 species each followed by Arecaceae with 3 species. Diarrhea was the most common disease that the respondents use 16 out of 48 plants as a remedy to cure this disease followed by Antihelminthic and wound healing having 10 plant species each. The most common species used by the locals is *Tinspora crispa* (0.51) from all four municipalities which most common usage of this plant is Antihelminthic for carabaos. Next is *Cocos nucifera* (0.44) with various uses from its fruit and followed by *Psidium guajava* (0.41) with the common use for Antihelminthic and Diarrhea.

## **Managing forest and aquatic wildlife through a spatially-explicit mobile tool**

Clark Jerome Jasmin<sup>1</sup>, Oliver G. Coroza<sup>1</sup>, Juliet Borlon<sup>2</sup>, John Floyd Porras<sup>1</sup>, Raymund Villalon<sup>2</sup>, Justin Bastasa<sup>3</sup>, and Joriel Wazo<sup>3</sup>

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In the coastal and municipal water areas of the Tayabas and Pagbilao Bays, the forest and aquatic wildlife are being managed to reduce threats against illegal and destructive practices in seagrass areas and sanctuaries, mangrove cutting and conversion of mangrove areas. In line with these conservation objectives, a cost-effective tool is needed to assist the local stakeholders in monitoring and interpreting trends of biological conditions, landscape status and disturbances across the municipal waters, coastal zones and fish and seagrass sanctuaries in 3 the LGUs of Tayabas, Pagbilao and Sariaya.

Software development toolkits from Spatial Monitoring and Reporting Tool (SMART) and CyberTracker are available at no cost to application developers, without a computer programming background, for developing a wildlife-based monitoring and management information system for collecting field data, measuring, evaluating and improving the effectiveness of plant and animal wildlife, law enforcement patrols and site-based conservation activities. The software toolkits have a database configuration able to store data on threats and biodiversity information collected during patrols and facilitate processing these to produce maps of the locations of threats and biodiversity with a feedbacking and reporting mechanism.

## **Predictive modeling of the distribution and habitat suitability of the Philippine Cinnamoms (*Cinnamomum* spp.) in Mt. Nacolod, Southern Leyte**

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Cinnamon use in the Philippines mainly involves bark and leaves for medicine, food and drink. Despite the popularity amongst consumers, studies on the distribution and ecology of the Philippine Cinnamoms are still scant. This study presents the species-habitat relationship and distribution model of the Philippine Cinnamon in the Mt. Nacolod, Southern Leyte. A total of eleven (11) Cinnamon species were recorded including the vulnerable *C. mercadoi* and threatened *C. cebuense*. All Cinnamon species were widely distributed in Mt. Nacolod as shown by a generated distribution model. The species prefer early secondary growth forests, with varying tolerance levels in cultivated and advanced secondary growth forests. *Cinnamomum sandkhulii*, *C. ebaloi*, and *C. rupestre* may thrive in other habitat types or could likely have restrictions to or from other habitat types. Only *C. mercadoi* and *C. iners* have ecological niches with tolerance to cultivated areas. The distribution of each species is significantly influenced by bioclimatic variables such as slope, precipitation of driest quarter, and elevation.

# WORKSHOP ON SPATIAL MODELING OF SPECIES NICHE AND DISTRIBUTIONS

*Prepared by the Center for Conservation Innovation Ph. Inc.*

## **I. Abstract**

Modeling ecological niches of species has become popular among modern ecologists and conservation biologists using current localities and climatic data. The goal of this workshop is to step through the process for beginners of GIS using QGIS and MaxEnt starting with data-acquisition, using time-saving steps for batch processing, data cleaning, digitizing data, and providing an understanding on the fundamental assumptions and theories of species distribution modeling. The focus will be a hands-on demonstration using recently acquired data sets on endemic Philippine cinnamon species with narrow distributions and are poorly studied. The results can be integrated to provide fresh insights about species' biogeographic patterns.

## **II. Background and Rationale**

Bioclimatic factors, environmental variables and location present unprecedented challenges for species conservation. Organizations are gradually looking to modeled projections of species' distributions under future climate conditions to inform management and mitigation strategies. Species Distribution Modeling (SDM) is a popular technique used to predict and estimate the potential spatial explicit locations of species that are characterized by climate and environmental factors (Phillips et al., 2004). Based on species localities and a set of environmental grids, its feature is to model suitable areas using species niche analysis and spatial distributions. In addition, SDM has been widely used in guiding biological surveys (Raxworthy & Dawson, 2003), re-introducing threatened species, estimating climate change impacts (Pearson & Dawson, 2003), restructuring historical distribution of species, evaluate conservation requirements, and finding geographic overlaps of endemic or threatened species with high concentration as an important baseline information in identifying high conservation value areas (HCVAs; Mallari et al., 2015).

The Philippine cinnamons are the chosen species for this workshop. In the Philippines, least 23 species of Cinnamons are known, 19 of which are endemics (Soriano, G.C. 2014, Leonardo Co's Digital Flora). These species are very much understudied and are believed to have extremely narrow distributions. Using SDM, we can have access to their environmental requirements. The results will be used to enhance knowledge on the ecological components that contribute to the species' current niche and better understand factors underlying these distributions.

## **II. Workshop Objectives**

This workshop aims to:

1. Apply the use of predictive modeling techniques to spatially project species distributions
2. Discuss the uses and limitations of species modeling tools in projecting species distributions especially under changing conditions

## **III. Process**

The 3-hour workshop will go through a number of basic species distribution modeling concepts and spatial modeling using species niche analysis. All tasks will use freely available software, GIS and MaxEnt. For the first part, participants will have access to a sample data for upload, digitizing, conversion and manipulation. By the end of this session, participants should feel comfortable with using GIS software to upload, download and manipulate data. As for the second part, using species distribution modeling techniques (MaxEnt), participants will run a number of models, then compare and interpret model outputs. By the end of this session, participants must already know the basics of interpreting and understanding species distribution models. The workshop will end with an evaluation.

## **IV. Participants**

The workshop is useful for researchers who are working across a broad range of fields, including conservation biology and ecology. A maximum of 15 participants can be accommodated for the workshop.

## **V. Workshop requirements**

1. Laptops

For Mac users, OS X should be: Mavericks (10.9), Mountain Lion (10.8), Lion (10.7) or any higher models. Mac Users should also have **Java for OS X** installed.

For Windows users, OS should be: Windows 8, Windows 10, Windows XP, or Windows Vista.

2. LCD projector, whiteboard and markers, extension wires c/o symposium organizers
3. Tables and chairs for the participants

## VI. Program of activities

Duration (Time: 1:00 to 4:00 pm)	Activity	Output
	<p>Presentation 1.</p> <p>Introduction to Spatial Modeling of Species Niche and Distributions</p>	
60 minutes	<p>Activity 1: Data Preparation and Introduction to GIS</p> <p>Software: Any GIS software (for this workshop, we will be using QGIS, an open source software that can be downloaded from <a href="https://download.qgis.org">https://download.qgis.org</a>)</p>	<p>Species Occurrence Data Set</p> <p>Environmental Predictors Data Set</p>
30 minutes	<p>Activity 2: Modeling Species Distributions</p> <p>Software: Maximum Entropy Algorithm (MaxEnt; Phillips et al., 2004). You can download this for free at <a href="https://biodiversityinformatics.amnh.org/open_source/maxent/">https://biodiversityinformatics.amnh.org/open_source/maxent/</a>)</p>	<p>Species Distribution Models (HTML)</p> <p>Percent Contribution of environmental variables</p>
45 minutes	<p>Activity 3: Viewing the results in QGIS</p> <p>Software: Any GIS software</p>	<p>Maps (Multivariate Similarity Surface, Most Dissimilar Variable)</p>
30 minutes	Activity 4: How to Interpret Maxent Outputs?	
15 minutes	Evaluation	Answered survey forms

## References:

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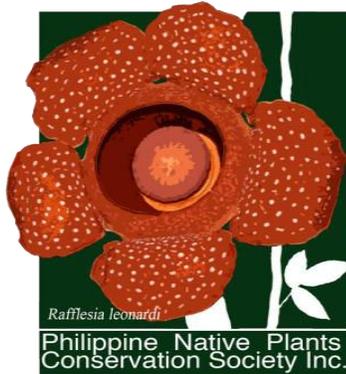
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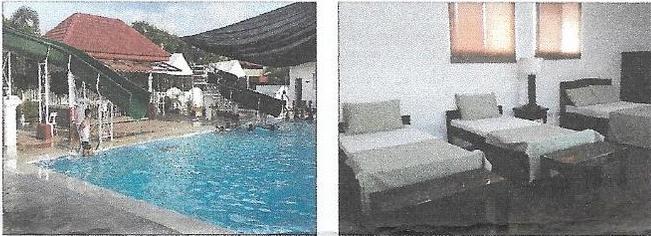
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# NOTES

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## USAID PROTECT WILDLIFE

Through the Protect Wildlife project, USAID is working to reduce threats to Philippine biodiversity, such as poaching and illegal trade of wildlife and wildlife products, and to improve ecosystem goods and services. USAID works with partners in the government and different sectors to strengthen conservation policies and improve habitat management and on-site and off-site enforcement systems.

USAID works in two pilot areas—Palawan and the Sulu Archipelago, including Zamboanga City and Tawi-Tawi—and will soon expand to General Santos City, Sarangani and South Cotabato in southern Mindanao. USAID’s strategy for achieving success and ensuring that the project’s impact is sustained is built on an ecosystem approach. This approach seeks to address threats to biodiversity while enabling rigorous integration of conservation outcomes with development objectives, supporting strong local ownership and ensuring that lessons learned are applied at scale.

Guided by this approach, USAID aims to achieve results through five strategic approaches:

- 1** **Improve attitudes and behavior toward biodiversity and its conservation in target areas at a statistically significant level**
- 2** **Intensify financing from private and public sectors and internally generated revenues for biodiversity conservation**
- 3** **Improve biodiversity conservation competencies of local government units, governance bodies, civil society organizations, and land and resource management units**
- 4** **Enhance capacities of universities to advance biodiversity conservation education, research, monitoring and innovation**
- 5** **Enhance competencies of national government agencies in enforcing biodiversity conservation-related laws and policies**