Evaluating the Rehabilitation Potential of Calliandra (Calliandra calothyrsus Meissn.) in Degraded Areas through Landscape Function Analysis in Manolo Fortich, Bukidnon, Philippines

Neil Konrad D. Binayao III and Catherine C. de Luna

Presentation Outline

- Introduction
- Objectives
- Methodology
- Results and Discussion

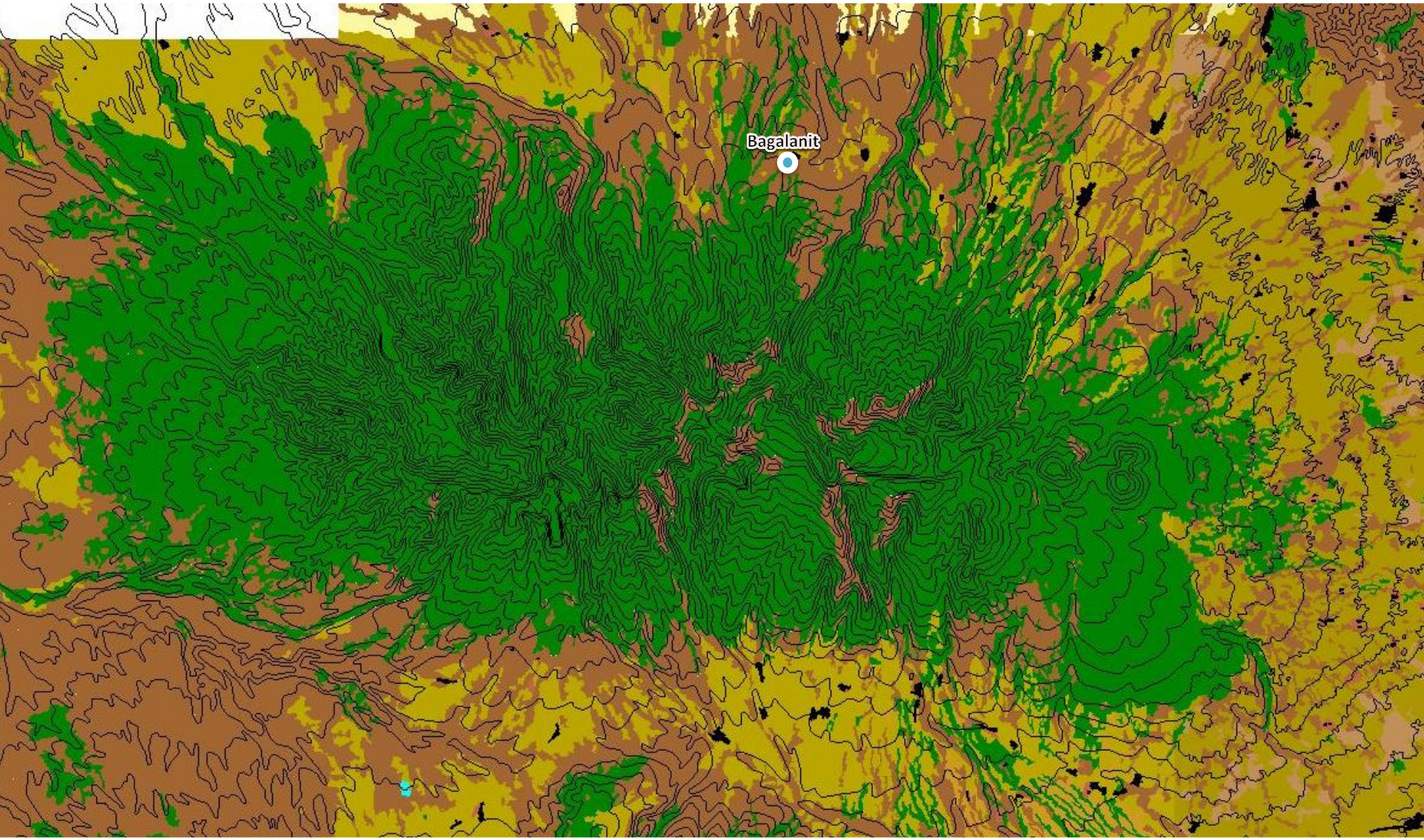
Introduction

- 35 million hectares of Imperata grassland in Asia
- Philippines: 17% of total land area (approx 5.1 million has)
- Second highest in Asia in terms of proportion to land area
- Northern Mindanao: about 77,000 hectares

(Garrity et al., 1997)

Mt. KITANGLAD RANGE

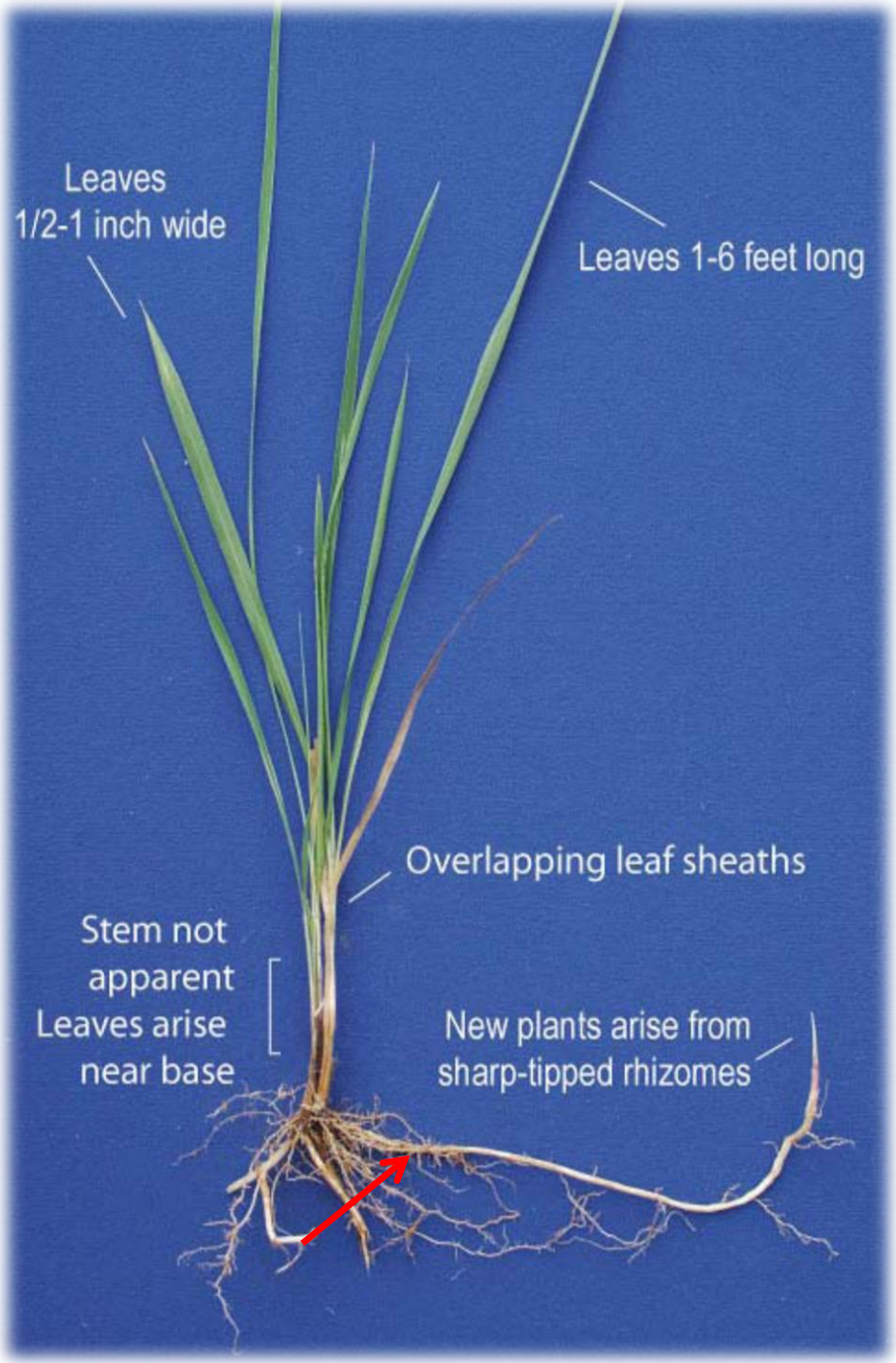
REMOTE SENSING LAND COVER



Reference: NAMRIA/HFI

LEGEND:

- FOREST LAND
- CONTOUR (100 Meters interval)
- GRASSLAND and SHRUBLAND
- AGRICULTURAL FARM LAND
- 19 Communities Project Site



Imperata cylindrica

- This paper will aim to asses the contribution of the pioneer crop Calliandra calothyrsus towards the improvement of soil stability, infiltration and nutrient cycling on degraded areas dominated by Imperata cylindrica and Saccharum spontaneum in Bukidnon as a methodology practiced by Hineleban Foundation Inc (HFI).

- HFI's methodology follows the Associated Climax-Pioneer Species (ACPS) Scheme, which closely mimics the natural succession process wherein:

  1. A fast-growing pioneer species (Calliandra calothyrus) is first planted in grasslands to dominate and eliminate Imperata cylindrica.

  2. After which indigenous dipterocarp, oak species and select commercial species are introduced.

Since calliandra is a legume, the methodology also falls under the Nitrogen-fixing Forest Restoration Approach wherein:

1. A leguminous nurse crop is planted first and shade-demanding tree species interplanted once a sufficient canopy cover has formed.

Objectives

The primary objectives of the study were:

- Assess the contribution of C. calothyrsus in rehabilitating grasslands by measuring Stability, Infiltration and Nutrient Cycling conditions of the study sites using Landscape Function Analysis (LFA);

- Formulate policy recommendations on rehabilitation techniques based on results of the study.

Methodology

- The study was conducted in Barangay Kalugmanan, Manolo Fortich, Bukidnon in the island of Mindanao, Philippines. The area is located in the foothills of the Mt. Kitanglad Range Natural Park (MKRNP).
- The location of the Treatment Plots used to be mostly lowland forest until logging concessions and subsequent settler migration pressure led to massive degradation and subsequent colonization by Imperata cylindrica.

- The treatment plots were:
  - 3 years Rehab with C. calothyrsus
  - 7 years Rehab with C. calothyrsus
  - 19 years Rehab with C. calothyrsus
  - Imperata grassland
  - Secondary forest

IMPERATA GRASSLAND

3-YEAR OLD
REHAB SITE

6-YEAR OLD REHAB SITE

18-YEAR OLD REHAB SITE

REFERENCE FOREST

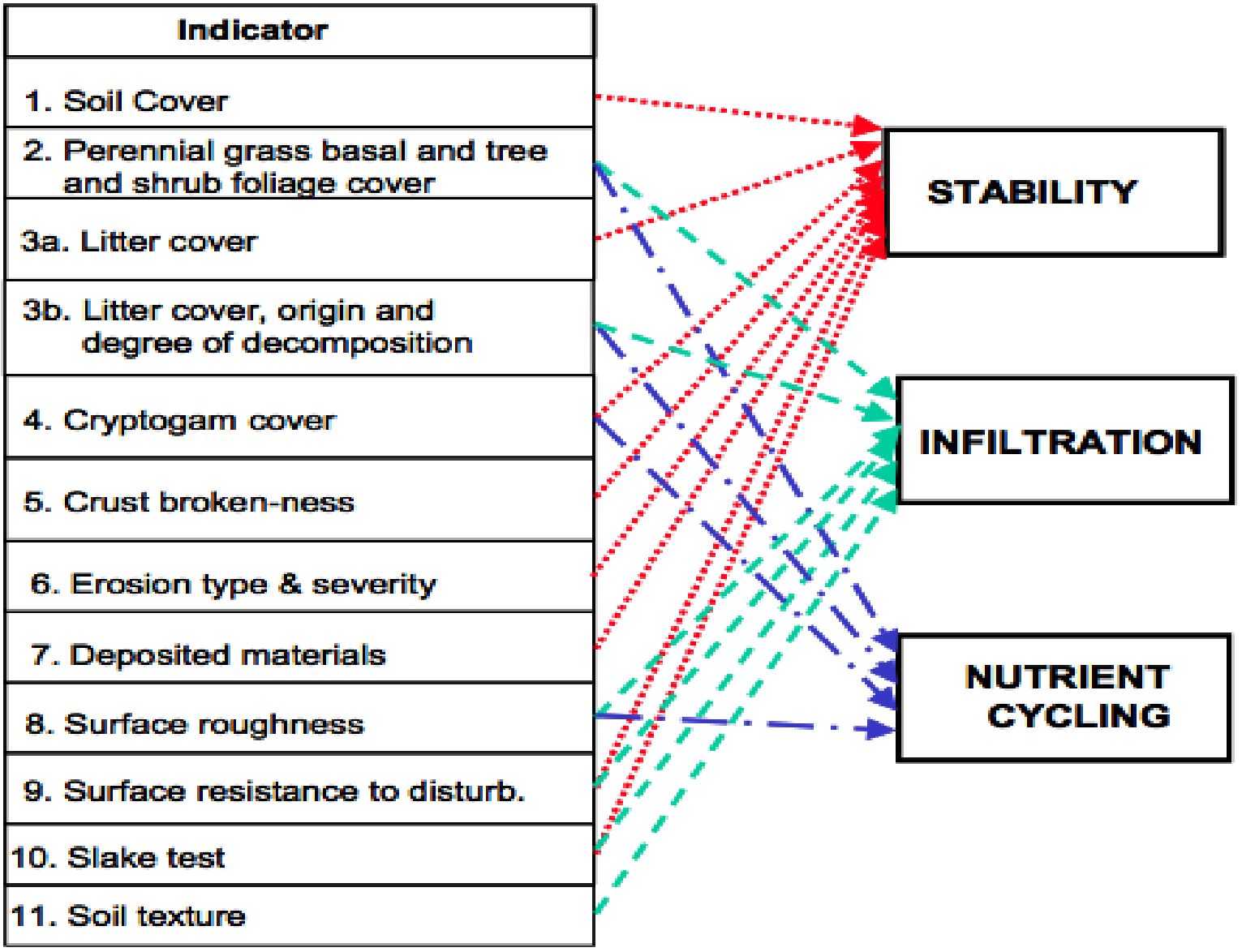
LANDSCAPE FUNCTION ANALYSIS (LFA)

Landscape Function Analysis (LFA), a monitoring procedure that uses rapidly acquired field-assessed indicators to assess the biogeochemical functioning of landscapes at the hillslope scale (Tongway and Hindley 2004).

Developed by David Tongway, retired Commonwealth Scientific and Industrial Research Organization (CSIRO) scientist

In order to simulate a time-series record, different seral stages of areas for/under rehabilitation within the same locality were assesed using LFA.

Soil Surface Indicators and their contribution to the Indices

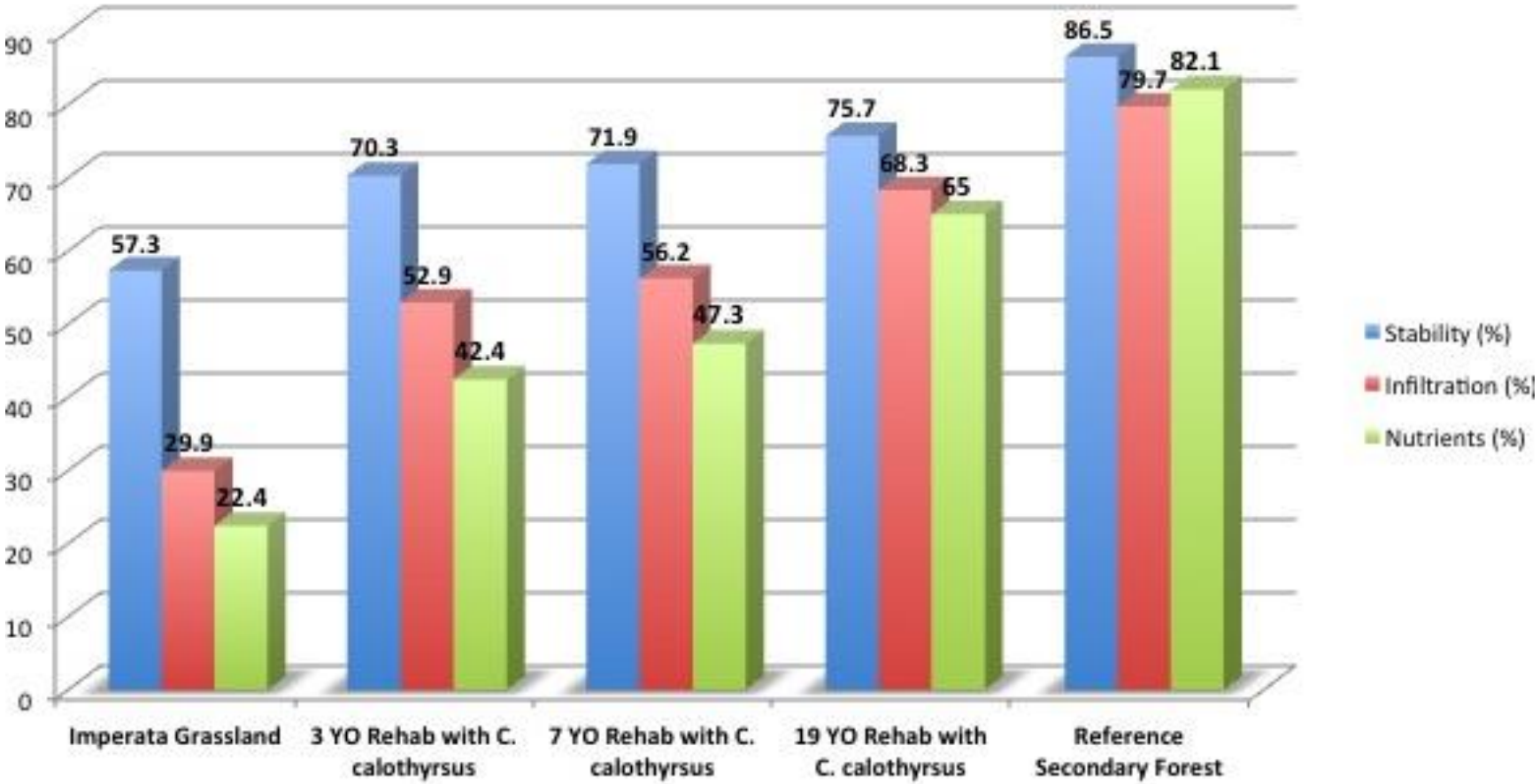


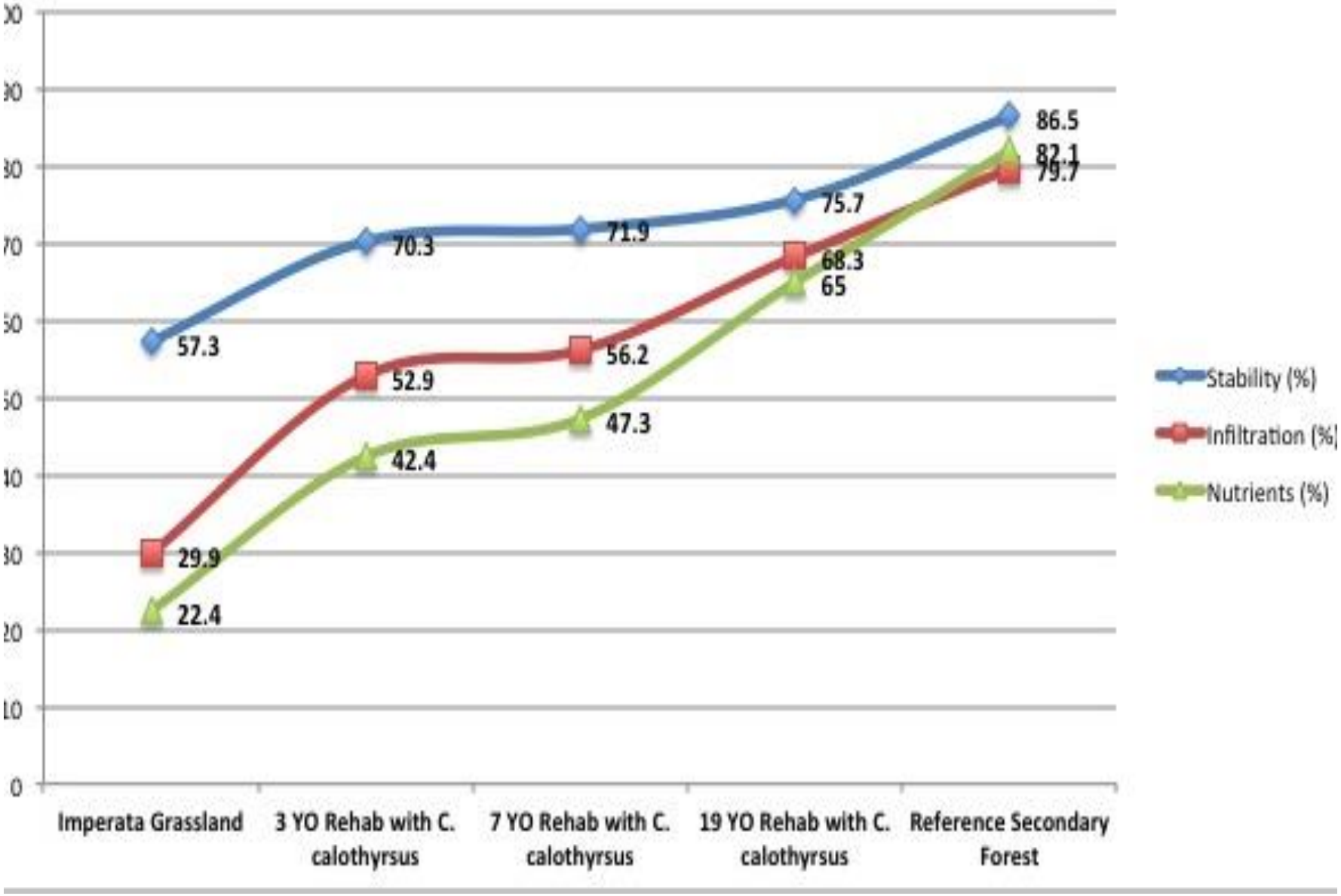
Results and Discussions

I. Functionality of the Different Treatments Plots as Assessed Through LFA.

LFA results show that there is an increasing trend in all indices; Stability, Infiltration, and Nutrient cycling across the rehabilitation sites when compared to the initial state which is the Imperata grassland.

I. Functionality of the Different Treatments Plots as Assessed Through LFA.




0
10
20
30
40
50
60
70
80
90
100
57.3
70.3
71.9
75.7
86.5
29.9
52.9
56.2
68.3
79.7
22.4
42.4
47.3
65
82.1
Imperata Grassland
3 YO Rehab with C. calothyrsus
7 YO Rehab with C. calothyrsus
19 YO Rehab with C. calothyrsus
Reference Secondary Forest
Stability (%)
Infiltration (%)
Nutrients (%)

Conclusions and Recommendations

- Landscape Function Analysis results suggest that C. calothyrsus as a pioneer species has a positive effect in accelerating the improvement of landscape functionality indices towards that of the final intended land use which is a Secondary Forest.

- This steep initial increase from the values gathered in the Grassland, followed by a steady increase over time implies that the rehabilitation effort is on-track (Tongway, 2004).

- Calliandra effectively controls Imperata and Saccharum, addressing the risk of grass fire in rehabilitation sites while ensuring the survival of the climax species to be interplanted.

- Conduct further studies on using Calliandra as a pioneer species, including comparative studies using indigenous pioneer species in rehabilitating degraded grasslands.

- More research on the production technology and physiological characteristics of exotic and indigenous pioneer species for rehabilitation of degraded areas.

- Adoption of Associated Pioneer-Climax Species (APCS) Approach and Nitrogen-fixing Forest Restoration Approach into rehabilitation and reforestation policies.

THE MERITS OF CALLIANDRA

A study in the Philippines suggests that exotic legume species show better physiological attributes compared to indigenous leguminous species and perform better in severely degraded areas such as grasslands (Combalicer et al., 2014).

Forrester (2004) conducted a study suggesting that mixed species plantation (legume and non-legume) show improved productivity in terms of biomass/growth in areas where there is competition for Nitrogen which is characteristic of an imperata grassland.

The poor growth of other species in imperata-dominated areas can be attributed to its ability to control nitrogen availability by retaining significant amounts of nutrients below-ground in its extensive root system, making it unavailable to other species. In addition, imperata has a significant effect on change of litter type, quality of litter and decomposition rate.

Moreover, the frequency and spatial extent of fires in grasslands reduce the amount of available nutrients for other species (Daneshgar & Jose, 2009).

The root systems of calliandra also help to improve the soil structure, improving infiltration rates and reducing erosion (WOCAT, 2014).

When intercropped with other trees, the non-leguminous species are also able to benefit from calliandra's nitrogen fixating capability (National Research Council.1983).

Studies in Panama showed that planting indigenous tree seedlings directly into imperata areas have limited success because of:

- the physical difficulty of planting,
- completion for resources by the dominant grass,
- allelopathy,
- general soil degradation,
- soil compaction and
- fire susceptibility.

- The researchers concluded that producing a shade cover as quickly as possible to eliminate the imperata is the best strategy for effective rehabilitation and reforestation (Hooper et al., 2002).


IMPERATA GRASSLAND BURNING

A research in Costa Rica revealed that the regeneration of native tree species in open sites is impeded by competition from herbaceous species. Another impediment in regeneration may be the lack of available perches for avian seed dispersers in open grasslands (Carnevale, 2002).

Macdicken et al., (1996) stated that imperata is shade-intolerant and shading it results in lowered carbohydrate-storage capability, reduction in rhizome and tuber-bulb production, reduction in shoot dry weight, all contributing to increased susceptibility to competition. They also concluded that in addition to suppressing imperata, fast-growing species can also improve the physical and chemical properties of soil.

Calliandra and bio-invasiveness

The Centre for Agriculture and Bioscience International (CABI) through their Invasive Species Compendium states that because of the high value of calliandra especially in developing countries as a source of fuelwood and animal feed, the subsequent heavy utilization of this species could effectively control it hence the need for biological control is very unlikely.

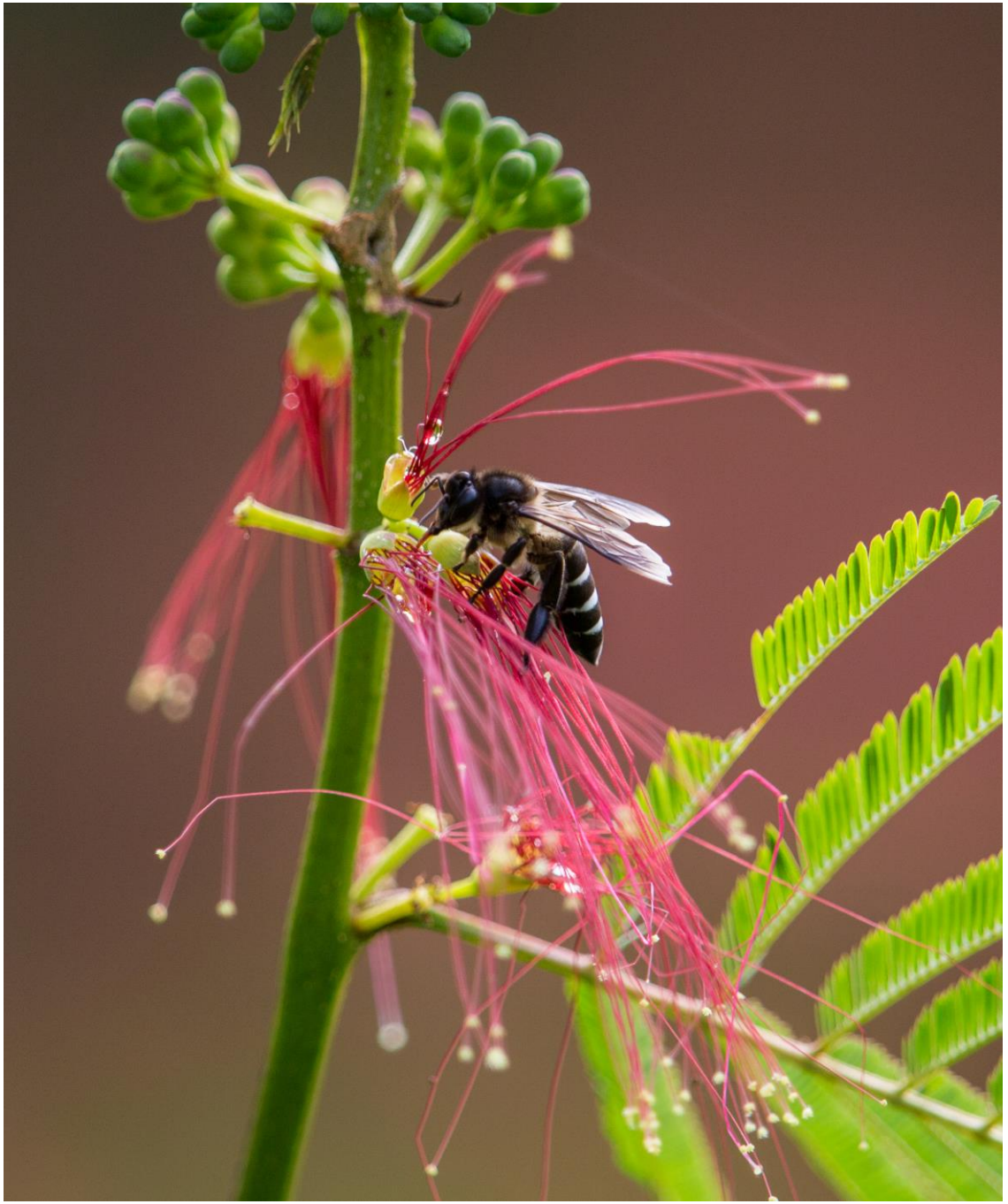
18-YEAR OLD REHAB SITE

Calliandra and wildlife

Grey-hooded sunbird (Aethopyga primigenia)
Endemic to the Philippines

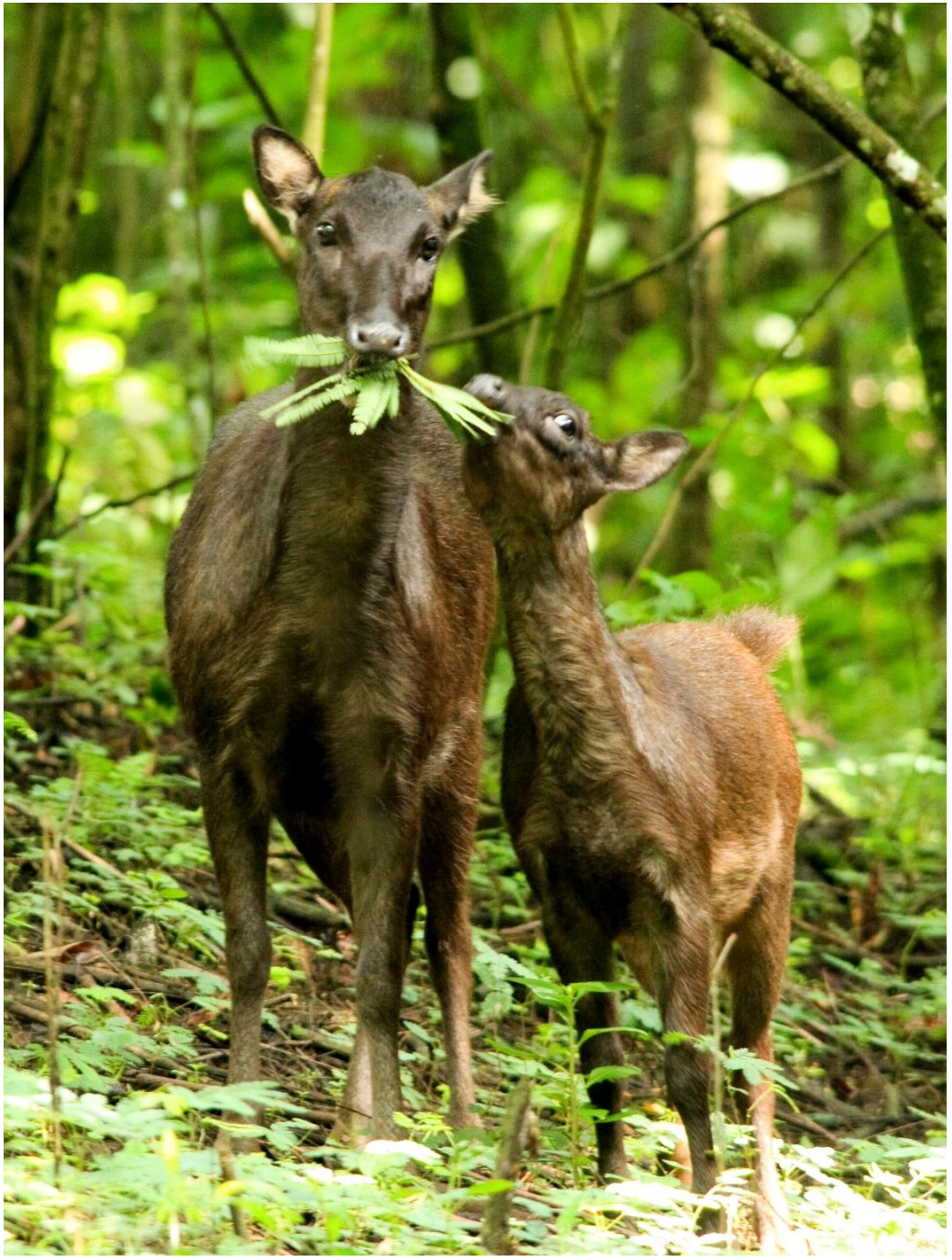
Olive-capped flowerpecker (Dicaeum nigrilore)
Endemic to Mindanao

Wild honeybee (Apis dorsata) feeding on calliandra nectar



Oriental honey buzzard (Pernis ptilorhyncus)
A specialist feeder

Philippine brown deer (Rusa marianna) feeding on calliandra wildlings



Calliandra and fire control

Height of El Nino
February 25, 2016

The effects of protection from fire

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Thrixspermum bellamabantae
Benjamin MABANTA

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Nineteen new orchid species from northern Mindanao, Philippines

Derek D. CABACTULAN, Jim COOTES, Miguel David DE LEON, Reynold B. PIMENTEL, Fernando B. AURIGUE, and Neil K. BINAYAO III

Introduction: The Philippines is one of the most biodiverse countries in the world. With forests reduced to approximately 4% of its original cover, many plant and animal species yet unknown to science are likely to have gone the way of extinction. Despite the rapidly receding residual virgin and disturbed forest ecosystems, many more species continue to be discovered.

Taxonomy can be a pursuit and an end in itself. Yet, the role of taxonomy in biodiversity conservation has increasingly become important in a country with rapidly vanishing natural treasures. More than ever, taxonomic work and field data have become increasingly important in policy-making, drawing public support and identification of key species and habitats in a country with ecosystems distributed over more than 7,100 islands. "Taxonomy enables us to constantly celebrate the diversity of life, thereby earning stronger public support for biodiversity" (Jeffrey MCNEELY, Cornell University). Nigel MARVEN of National Geographic/BBC has succinctly and emphatically said, "how can we protect something we do not know?"

Abdominea intricata inflorescence

Abdominea intricata plant

It is our fervent hope that this paper will showcase once again the biodiversity of the Philippines and draw more support from all sectors for its conservation, preservation and restoration.

After exhaustive review of literature from the Philippines and neighboring countries, the authors have determined these species to be new to science and hereby present them to you.

Abdominea intricata CABACTULAN, COOTES, M.D. DE LEON, and PIMENTEL **sp. nov.**

TYPE: PHILIPPINES, Mindanao, Bukidnon, at 1,600 metres elevation above sea level. **HOLOTYPE:** MDL1803001 (January 20, 2018), **CAHUP073541**

PLANT DESCRIPTION

Growth Habit: erect to pendent, monopodial, up to 2 cm long and 3.5 cm wide across the leaves; producing several elongated roots, which produce root hairs. **Leaves:** three to four, lanceolate, oblong-elliptic, 2.1 to 2.3 cm long by 7 mm wide, thinly-textured, spreading, flattened, entirely glabrous, margins entire, sessile, three lateral veins on both sides of the leaf; midvein adaxially depressed and abaxially raised, unequally bilobed, falcate at the apex. **Inflorescences:** short, axillary, pendent, branching, rachis emerging from the base of the stem sheaths, few flowered, entirely glabrous, 5 cm long, bearing up to 15 flowers. **Peduncle:** short, terete, slender, glabrous, dark green, swollen in the upper portion, 3.5 cm long by 4 mm in diameter at lower rachis and 1.50 mm diameter at upper rachis with flowers. **Bracts:** lanceolate, 2.2 to 3.3 mm long and 0.35 to 0.50 mm wide at the base, persistent, glabrous, present on the lower and upper rachis, swollen at the base. **Pedicel and**

Dendrochilum perrineae CABACTULAN, COOTES, M.D. DE LEON, PIMENTEL and BINAYAO **sp. nov.**

Dendrochilum perrinei CABACTULAN, COOTES, M.D. DE LEON, PIMENTEL and BINAYAO **sp. nov.**

Epicrianthes neilkonradii CABACTULAN, COOTES, M.D. DE LEON and PIMENTEL **sp. nov.**

Large flying fox (Pteropus vampyrus) colony the reforestation site.

Bukidnon woodcock (Scolopax bukidnonensis) nesting inside the reforestation site.

First photo record of Bukidnon woodcock (Scolopax bukidnonensis) chicks.

Thank you for your kind attention!