

# Role of *Antidesma ghaesembilla* Gaertn in Enriching the Depauperate Bird Community in “Cogon” *Imperata cylindrica* (L.) Raeuschel Dominated Grassland in Swidden Vegetation Matrix

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**Abstract** - *The study was conducted to understand the role of Antidesma ghaesembilla Gaertn in enhancing the avifaunal diversity in Imperata cylindrica (L.) Raeuschel dominated grassland patches and to realize the influence of adjacent vegetations on the assemblage of birds that feed on the fruit of this tree. An avifaunal survey was conducted on “Cogon” dominated grassland patches adjacent to selected vegetations such as primary forest, secondary forest and upland agricultural area. A total of 250 birds belonging to 19 species representing ten families were found feeding on the fruits of Antidesma ghaesembilla. The site adjacent to secondary forest has the highest species richness, abundance and diversity index values. This accentuates the combined influence of the open and forest dwelling bird species thriving in the secondary forest. The sites adjacent to the primary forest and to the agricultural area have the same species richness but differ in species composition as reflected by the low similarity index. More forest dwelling bird species were recorded near the forest while more open dwelling bird species were recorded near the agricultural area. This highlights the spillover effect of the adjacent vegetations on the feeding bird assemblage. The presence of several endemic and conservation priority bird species that feed on the fruits of Antidesma ghaesembilla unfolds its important role in avifaunal conservation. Finally, the wide collection of fruit eating bird species attracted to it emphasized its importance in improving the overall avifaunal diversity in Imperata cylindrica dominated grassland patches within the swidden vegetation matrix.*

**Keywords:** Food plant, avifauna, diversity, *Antidesma*, *Imperata*, frugivore.

## INTRODUCTION

Birds perform countless ecosystem functions such as seed dispersion, pollination [1] and control of insect population [2] which are vital in the health and survival of forest ecosystems. In return, the birds benefit from the association as plants provide food, shelter and nesting places. This association justifies the important role of vegetation in influencing the assemblage of birds that thrive in a given area. It was confirmed that certain vegetation characteristics such as diversity of plants, canopy cover, tree density, tree height and ground cover have profound effects on assemblage of forest birds [3]. Changes on these vegetation attributes due to habitat degradation may have a detrimental effect on forest bird community, specifically among the endemic and conservation priority species [4] [5]. On the other hand, the recovery of vegetation brought by natural succession fosters development in avifaunal community. A study in the past confirmed that species

richness, abundance and diversity of birds increased rapidly paralleling the vegetation recovery in the fallow forests [6]. In general, it is widely accepted that alteration in existing vegetation in any form has significant influence in the bird community.

Global deforestation threatens most of the forest dependent birds and other wildlife. The expansion of areas used in agriculture is considered as one of the major causes of global forest loss [7]. In the Philippines the problem of deforestation is also one of the major issues faced by Filipinos. Beginning as early as the Spanish, American and Japanese colonization the Philippine forest cover experienced a steady decline [8] with significant rates felt during the late 1960's to late 1980's [9]. This extensive deforestation in the country is mostly attributed to logging and agriculture, a two-step inseparable process that is considered major factor of forest cover loss during the postwar period [10].

In Palawan, the large scale logging operations were banned since 1989. However, it was replaced by rampant small scale logging activities [11] which are more difficult to monitor and control. Other major threats to the forest ecosystem in the province are mining [12], urban, industrial and agriculture developments [13]. The expansion of upland agriculture, which exists as either a form of sedentary farming or a cyclical form of swidden system practiced by indigenous people and settled migrants [14] [15], are now considered as the major cause of deforestation in the province. Swidden agriculture is a form of shifting cultivation that begins in clearing and preparation of swidden plot by cutting and burning the forest vegetation, it is followed by the cultivation of crops and ends in a long fallowing period. This process is repeated in any of the matured fallow forest. The traditional swidden cycle with short cropping period and long fallow duration is considered sustainable because the soil fertility in swidden plots recovers fully. However, the congestion in the upland agricultural area resulted to the demise of the sustainable form of swidden agriculture because farmers are forced to practice long cultivation and short fallowing cycles [16]. Shortening of fallowing period was also observed in the swidden systems of Mangyan [17] and Ikalahan-Kalanguya [18] indigenous groups, indicating a similar scenario taking place in other parts of the Philippines. This practice results in a severe depletion of soil nutrients which hampers the natural succession in the abandoned areas and fosters invasion of grasses [10].

One of the species of grasses that can thrive in low nutrient, dry and acidic soil in these abandoned areas is the *Imperata cylindrica* or commonly known as “Cogon”. At present, the *Imperata cylindrica* dominated grassland patches are getting common in the vegetation mosaic in upland agricultural ecosystem in the province. This species of grass is known to produce phenolic compounds that may be allelopathic by nature [19]. Together with competition for space, soil nutrients and light, allelopathy could play role in preventing the reestablishment of forest vegetation [10]. Moreover, the *Imperata cylindrica* dominated areas are usually fire prone and the frequent episodes of grassfire promote the competitive dominance of this grass over the other plant species [20].

Despite the low soil nutrient content and high acidity, allelopathy, competition and the frequent occurrence of fire in *Imperata cylindrica* dominated grassland patches, some species of trees managed to survive in this hostile habitat. One of these tough tree species that thrive in “Cogon” land is *Antidesma ghaesembilla*, a member of the Euphorbiaceae family. Locally known as “Inyam”, this species grows well in exposed and disturbed areas where other species of trees never survive. It is a small to medium size tree that bears cluster of small drupes from an inflorescence. Young fruits are usually yellow green to green but turn red to purple when ripe. Although the pulp tastes acidic, the fruits are edible and preferred by most frugivore birds.

This tree is frequently visited by frugivore and omnivore birds that came from neighboring forest patches. Acting as agents of seed dispersal, these birds may bring seeds from the forest patches they visited and dispersed it in the grassland. This process helps the natural succession and fosters vegetation recovery in barren abandoned areas. Similarly, these birds may also disperse the seeds of *Antidesma ghaesembilla* in other “Cogon” dominated patches in the landscape matrix.

The potential of *Antidesma ghaesembilla* in improving the avifaunal diversity in degraded landscape by serving as food plant for frugivore and omnivore species was not yet fully understood and documented. This paper provides information on the assemblage of fruit eating birds that visit and feed on the fruits of *Antidesma ghaesembilla* tree. It also presents the effect of adjacent vegetation on the assemblage of feeding birds.

## OBJECTIVES OF THE STUDY

The objective of this study is to assess the assemblage of birds that feed on the fruits of *Antidesma ghaesembilla* trees in *Imperata cylindrica* dominated grassland patches in swidden vegetation matrix. The study evaluates the influence of adjacent vegetations such as primary forest, secondary forest and upland agricultural area on the assemblage of feeding birds.

Specifically, the study aimed to describe the assemblage of birds and evaluate the influence of adjacent habitat by comparing the species richness, abundance, evenness, diversity index and presence of endemic and conservation priority species.

## MATERIALS AND METHODS

### Description of the Study Area

The study area was located in the foothills of the Victoria-Anipahan Mountain Range in Sagpangan, Aborlan, Palawan. The study area is a mosaic of vegetation comprised of primary forest, log out forest, swidden farms, shrub lands, “Cogon” dominated grassland patches, gardens, and various stages of secondary forest most of which are swidden fallows. Three sites within the study area were selected based on proximity to primary forest, secondary forest and an upland cultivated area. The selected study sites were “Cogon” dominated grasslands with numerous fruit bearing *Antidesma ghaesembilla* trees. Site 1 is located adjacent to a primary forest which is relatively pristine and covered with large trees and thick understory vegetation. Site 2 is sandwiched between secondary forest fragments with large pioneering tree species but its understory vegetation is less dense. Site 3 is adjacent to upland cultivated area which is planted with various short term crops such as ginger, cassava, pineapple and other vegetables. Some long term crops such as jackfruit, banana, coffee and coconuts are also sparsely planted along the peripheries of the farm land.

### Data Collection

Four fruit bearing *Antidesma ghaesembilla* trees from each sampling site were purposely selected as sampling trees. Selection of trees was based on the similarities of canopy size, density of fruits, tree height and foliage density. Relatively similar sampling trees were selected to minimize the effect of variation in characteristics among individual trees.

Using a binocular, the feeding birds in individual sampling trees were counted from a blind made of natural materials found in the study area. All birds feeding on fruits of *Antidesma ghaesembilla* were counted within the ten minutes allotted time. The counting of birds was repeated 12 times at weekly interval. This gives an accumulated recording period of 480 minutes per site. The length of observation period was determined from the species discovery curve [21]. Counting of birds was done early in the morning (6:00-10:00am) and late in the afternoon (3:00-6:00) [21], [22]. Counting of birds during windy and rainy days were re-scheduled as bird activity decline during adverse weather conditions and detection rate was also affected too [21].

### Data Analysis

The diversity of birds that feed on the fruits of *Antidesma ghaesembilla* from the different sites were reported using descriptive statistics such as species richness and relative abundances. These avifaunal attributes obtained from different sites were also compared to shed light on the influence of adjacent vegetation on the assemblage of birds. To determine if there are significant differences in the number of species and number of individual birds in different sites, the difference in mean number of species and mean number of individual birds were analyzed using the one way analysis of variance (ANOVA). The degree of similarity of the assemblages of birds between sites were also compared using the Horn's Information Theoretic Index of Similarity.

The endemic and conservation priority bird species found feeding on the fruits of *Antidesma ghaesembilla* in the different sites were compared to expose the possibility that this tree also supports endemic and conservation priority species. The level of endemism of birds was based from the works of Kennedy, Gonzalez, Dickinson, Miranda and Fisher (2001) [23] and the World Bird List of the International Ornithological Committee (IOC) [24] while the conservation status was based from the International Union for Conservation of Nature (IUCN) Red List of Threatened Species version 2016-3 [25].

## RESULTS AND DISCUSSION

### Species Diversity of Birds that Feed on Fruits of *Antidesma ghaesembilla*

Based on the results of the survey, a total of 250 birds were found feeding on the fruits of *Antidesma ghaesembilla* (Table 1). The recorded birds belong to 19 species representing ten families. The most frequently recorded species was the Pygmy Flowerpecker (*Dicaeum pygmaeum*) with a total of 32 individuals. It was followed closely by two common bulbul species in the area, the Ashy-Fronted Bulbul (*Pycnonotus cinereifrons*) and Black-Headed Bulbul (*Pycnonotus atriceps*) with the same number of recorded individuals (30). On the other hand, the least recorded bird was the Green Imperial Pigeon (*Ducula aenea*) which was recorded only once in Site 1. The family Columbidae has the greatest number of species representation. It is represented by the forest dwelling species such as Green Imperial Pigeon (*Ducula aenea*), Black-Chinned Fruit Dove (*Ptilinopus leclancheri*) and Thick-Billed Green Pigeon (*Treron curvirostra*) and open dwelling species such as Spotted Dove (*Spilopelia chinensis*), Pink-Necked Green Pigeon (*Treron vernans*) and Zebra Dove (*Geopelia striata*). Although represented by only three species, the family Pycnonotidae has the greatest number of individuals that visit and feed on the fruits of *Antidesma ghaesembilla*.

### Influence of Adjacent Vegetation on Avifaunal Assemblage

The species richness values of birds feeding on the fruits of *Antidesma ghaesembilla* across three different sites were almost the same. The highest species richness was recorded in Site 2 (16) followed by Sites 1 and 3 with the same number of species (15) (Table 2). Similarly, the greatest number of individual birds was also recorded in Site 2 (92), followed by the number of individuals in Site 1 (84) and Site 3 (74). Despite the differences in species richness and abundance, the adjacent vegetation apparently had no significant effect on the mean number of avian species ( $F_{2,33} = 2.99, p < 0.05$ ) (Table 3) and mean number of individual birds ( $F_{2,33} = 1.89, p < 0.05$ ) (Table 4). This was further supported by the small differences of Shannon's Diversity Index values across the different sites (Table 2). Moreover, majority of the recorded bird species (58%) were found in all the three sites compared, this indicates that majority of these fruit eating birds are not influenced by the adjacent habitat. These birds have much wider habitat range which includes open areas like scrub land, home gardens and agricultural areas but may also be found along forest edges, secondary forest and small forest fragments. Included in the group are the first five dominant bird species recorded in the study area, these are the Pygmy Flowerpecker (*Dicaeum pygmaeum*) (32), Ashy-Fronted Bulbul (*Pycnonotus cinereifrons*) (30), Black-Headed Bulbul (*Pycnonotus atriceps*) (30), Palawan Flowerpecker (*Prionochilus plateni*) (27) and Pink-Necked Green Pigeon (*Treron vernans*) (22).



Table 3. (Cont) ANOVA

	SS	DF	MS	F
Between	3.72	2	1.86	2.99
Within	20.5	33	0.62	
total	24.22	35		

Not significant at  $p < 0.05$

Table 4. Mean number of individual birds that feed on fruits of *Antidesma ghaesembilla* in “Cogon” dominated grassland patches.

Study Site	Sampling Replicates												Mean
	1	2	3	4	5	6	7	8	9	10	11	12	
Site 1	8	7	6	8	6	8	9	5	9	4	5	9	7.0
Site 2	8	10	13	8	5	9	7	6	9	5	6	6	7.7
Site 3	6	6	7	6	9	8	4	6	7	5	4	6	6.2

Table 4 (cont.) ANOVA

	SS	DF	MS	F
between	13.56	2	6.78	1.89
within	118.33	33	3.59	
total	131.89	35		

Not significant at  $p < 0.05$

The relatively increased presence of dominant species in all the study sites is an indication that these birds are multiple habitat users. Having such birds with wider habitat range in marginal “Cogon” dominated patches unfolds the crucial roles of these birds in the vegetation recovery because of the opportunity of dispersing wide selection of seeds coming from the other habitats they visited.

At a different vantage point, certain degree of difference in assemblage of birds was observed between sites. It could be attributed to the presence of avian species that were affected by the adjacent vegetation [6] [26]. Some species that are commonly found foraging in the forest and rarely observed visiting the edges and open habitats such as the Green Imperial Pigeon (*Ducula aenea*) and Asian Fairy-Bluebird (*Irena puella*) were observed only in Site 1. In contrast, one open dwelling species, the Zebra Dove (*Geopelia striata*) was found only in Site 3. This bird was usually found in open areas such as barren lands, roadside, agricultural areas and human settlements. It was not recorded feeding on *Antidesma ghaesembilla* near the secondary and primary forests. Its presence in Site 3 could be due to the influence of the adjacent agricultural area where these birds are abundant.

The findings also unfold the convergence of bird species with high affinity to forested habitat and those that are predominantly found in open habitat in Site 2. Two species, the Black-Chinned Fruit Dove (*Ptilinopus leclancheri*) and Blue-Naped Parrot (*Tanygnathus lucionensis*) were found only in sites 1 and 2. These species were commonly found in the forest but also visit the open areas with residual trees in search of food. On the other

hand, three species, the Spotted Dove (*Spilopelia chinensis*), Asian Glossy Starling (*Aplonis panayensis*) and Slender-Billed Crow (*Corvus enca*) were found only in sites 2 and 3. These birds were predominantly open habitat dwellers but may also visit the secondary forest and forest edges in search of food. These findings showed the influence of secondary forest as the adjacent habitat of Site 2 on the assemblage of birds. The secondary forest is known habitat of a mixture of open and forest dwelling species. Studies in the past claimed that, in the earlier stage of forest regeneration the bird assemblage in it consists of predominantly open dwelling species but avian succession results to species turnover and gradually replace the open dwelling birds with forest dwelling species in matured secondary forest [6], [27].

Even though no significant difference exists in the number of bird species and abundance across the different sites, the composition seemingly was affected by the adjacent vegetation. The disparity in floristic attributes of the adjacent vegetation such as canopy cover [28], tree density, height and ground cover [3] are most likely causing remarkable variation in bird composition.

The disparity in the assemblage of birds was further confirmed by the index of similarity across the study sites. The high Horn’s Information Theoretic Index of Similarity values between bird communities of Sites 2 and 3 ( $R_o=0.92$ ) and Sites 1 and 2 ( $R_o=0.84$ ) supports the idea that the birds in the adjacent vegetation of Site 2 which is the secondary forest was composed of an aggregation of forest dwelling and open dwelling species which were also found in Sites 1 and 3 respectively. Furthermore, the low

index of similarity between Sites 1 and 3 ( $R_o=0.70$ ) indicates that the bird assemblage in Site 1 and Site 3 were less similar. This confirmed the findings that some of the forest dwelling species found in Site 1 were not found in Site 3 and some of the open dwelling species found in Site 3 were not recorded in Site 1.

#### Endemism and Conservation Status

Five Palawan endemic species, two Palawan endemic races and two near Philippine endemic species were recorded in the study area. All the five Palawan endemic species were found in the three study sites but a marked decline in abundance was observed in Site 1. The two Palawan endemic races were recorded in Site 1 but only one was found feeding in Sites 2 and 3. Likewise, a remarkable decline in abundance of Palawan endemic race was also observed in Site 3. Meanwhile, the two near Philippine endemic species were also found in Sites 1 and 2 but not in Site 3. The results clearly indicate that the presence of endemic bird species and races were influenced by the adjacent forest vegetation. Studies in the past confirmed that most endemic birds prefer forested habitats [6], [29].

Two bird species feeding on fruits of *Antidesma ghaesembilla* were already in the conservation priority list of the International Union for Conservation of Nature (IUCN) Red List of Threatened Species [25]. The Blue-Naped Parrot (*Tanygnathus lucionensis*) which is a near Philippine endemic species was listed in the Near-Threatened category, while the Blue-Headed Racquet-Tail (*Prioniturus platenae*) which is a Palawan endemic species was listed in the Vulnerable category. These findings suggest that *Antidesma ghaesembilla* is an important food plant that supports endemic birds and a handful of restricted range conservation priority species of the family Psittaculidae.

#### Implications to Avifaunal Conservation and Vegetation Recovery

The *Antidesma ghaesembilla* is a special kind of tree that has the ability to endure bouts of droughts, typhoon winds, grass fires, low soil fertility, high soil acidity and allelopathy in *Imperata cylindrica* dominated grasslands. This species managed to establish its population in inhospitable “Cogon” dominated grassland patches where other species never survive. The matured fruiting *Antidesma ghaesembilla* trees scattered in “Cogon” dominated grassland attracts variety of avian species which perform other ecosystem functions such as insect control, predation and seed dispersion which in the process add more complexity in the interrelationships among extant organisms in the grassland. These findings not only highlight the role of *Antidesma ghaesembilla* in enhancing the avifaunal diversity in “Cogon” dominated grassland but also unfold its role in improving the over-all resilience of the ecosystem. These bring to light not only the potential of this tree as agent of improving avifaunal diversity but also

its potential as a pioneering reforestation species in unforgiving habitats like this. Finally, it is also important in avifaunal conservation as it also supports endemic and conservation priority bird species in its adjacent habitat.

#### CONCLUSION

The study revealed that diverse forms of avian species feed on the fruits of *Antidesma ghaesembilla* tree in “Cogon” dominated grassland patches in swidden vegetation matrix.

The high species richness, abundance and diversity index of birds feeding on fruits of *Antidesma ghaesembilla* located near the secondary forest showcase the aggregation of forest dwelling and open dwelling bird species distinctive to a developing secondary forest.

The different types of vegetation adjacent to the fruiting *Antidesma ghaesembilla* tree influenced the assemblage of feeding birds. The presence of more forest dwelling birds indicates the spillover of forest dwelling birds from the nearby forest. Similarly, the presence of more open dwelling species indicates the spillover of open dwelling birds from the nearby agricultural areas. The disparity in spillover effects between the forest and agricultural area is confirmed by the low community similarities between these sites.

The presence of *Antidesma ghaesembilla* in “Cogon” dominated grassland patches improves the grassland ecosystem and promotes vegetation recovery by attracting wide array of bird species which may perform an assortment of ecosystem functions.

It is also supports endemic and conservation priority species which is very important in avifaunal conservation in “Cogon” dominated grassland patches and adjacent habitats in swidden vegetation matrix.

#### RECOMMENDATIONS

Based on the findings of this study, the *Antidesma ghaesembilla* is recommended to be used as one of the pioneering reforestation tree species for enhancing the vegetation cover of dry and barren landscapes, especially in fire prone *Imperata cylindrica* dominated grassland patches. This tree species is recommended not only because of its ability to survive in hostile *Imperata cylindrica* grassland condition but also to its ability to enhance the avifaunal community at a landscape level which in turn improve the ecosystem function of birds in a barren landscape. Moreover, it is also important in avifaunal conservation because it serves as food plant for endemic and conservation priority species.

It is also recommended that the rampant cutting of *Antidesma ghaesembilla* for charcoal production be stopped. The local people must be informed about the significant role of this tree in enhancing the avifaunal diversity which performs variety of ecosystem functions and services in a homogenous *Imperata cylindrica* dominated grassland patches.

Since this study is limited only to avifaunal species that feeds on the fruits of *Antidesma ghaesembilla* in *Imperata cylindrica* dominated grassland. It is recommended that a survey on frugivore bats that also feed on fruits of *Antidesma ghaesembilla* be conducted. Moreover, seed traps must also be deployed in the area to further understand the role of birds and bats in the dispersal of seeds across this type of vegetation.

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