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Contributions to the orchid flora of Mindanao Long-Term Ecological Research Sites, Philippines

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***Abstract*:**

Buenavista, D.P.: ***Contributions to the orchid flora of Mindanao Long-Term Ecological Research Sites, Philippines. Biologica Nyssana, 8 (1), September 2017: 31-38.***

This contribution is based on the field studies on wild orchids conducted from September 2012 to November 2013 in one-hectare plots in five Long-Term Ecological Research Sites in Mindanao Island, Philippines. The family Orchidaceae is the most threatened group of plants in the Philippines however, it remains to be poorly known and understudied. This is the first preliminary report on the species richness and distribution of wild orchids in the identified research sites. A list is contains 79 orchid species belonging to 34 genera which represents approximately 7% of the known orchid species in the Philippines. A total of 40 endemics and 3 threatened species were recorded in the sites. This list can be used as basis for future biodiversity assessment and conservation initiatives to identify and prioritize areas for immediate conservation of threatened and endemic orchid species as well as the vulnerable mountain ecosystems.

Key words: inventory, conservation, Orchidaceae, Mindanao, Philippines

***Apstrakt*:**

Buenavista, D.P.: ***Prilog flori orhideja mesta dugoročnih ekoloških istraživanja Mindanaa, Filipini. Biologica Nyssana, 8 (1), Septembar 2017: 31-38.***

Ovaj prilog je zasnovan na terenskim istraživanjima divljih orhideja sprovedenim od septembra 2012 do novembra 2013 na pet površina od po jednog hektara u oblastima obuhvaćenim dugoročnim ekološkim istraživanjima na Mindanao ostrvu, Filipini. Familija Orchidaceae je najugroženija grupa biljaka na Filipinima ali bez obzira na to, i dalje je slabo poznata i nedovoljno proučavana. Ovo je prvi preliminarni izveštaj o bogatstvu vrsta i distribuciji divljih orhideja na identifikovanim lokalitetima istraživanja. Lista sadrži 79 vrsta orhideja koje spadaju u 34 roda i predstavljaju približno 7% poznate flore orhideja na Filipinima. Ukupno 40 endemskih i 3 ugrožene vrste su pronađene na istraživanim lokalitetima. Lista može poslužiti kao osnova za dalju procenu biodiverziteta i inicijativu konzervacione inicijative koje bi identifikovale i označile najbitnije lokalitete za hitnu i trenutnu konzervaciju ugroženih i endemičnih vrsta orhideja kao i ranjivih planinskih ekosistema.

Ključne reči: inventarizacija, konzervacija, Orchidaceae, Mindanao, Filipini

Introduction

The Philippines lies in the western Pacific Ocean and is geographically part of Southeast Asia, a region that occupies a mere three percent of the earth's total surface, yet is home to 20 percent of all known species of plants and animals (Mittermeier et al., 1999; Myers et al., 2000; Ambal et al., 2012). It has one of the highest orchid floras in the world with approximately 141 genera and 1200 species (Cootes, 2001; Agoo et al., 2003; Cootes, 2011). About 85-90% of the Philippine orchids are found nowhere else in the world (Cootes, 2011). By contrast to other countries, Canada and the United States, including Hawaii, Puerto Rico, and the Virgin Islands, have only 325 species among them (Heaney & Regalado, 1998).

Orchids have also been shown to be excellent indicators of overall biodiversity in an area (Nadkarni, 1992; Swarts & Dixon, 2009). Orchids are highly evolved with their pollinators and require a specific relationship with mycorrhizal fungi to germinate (Leake, 1994; Rasmussen, 2002; Otero et al., 2005; McCormick et al., 2006; Shefferson et al., 2007; Rasmussen & Rasmussen, 2009); therefore they are intimately intertwined with the ecology of their habitat. It is therefore imperative that the conservation of habitat be considered if the orchids had to be conserved. However, habitat loss is one of the major factors that imperiled the Philippine biodiversity (Posa et al., 2008; Sodhi et al., 2010) losing over 80% of its original forest cover since the 16th century (FAO, 2005; Bankoff, 2007). Such threat had direct impact on the orchid flora considering that it has the highest number of threatened species (Fernando et al., 2008) compared to any plant groups in the Philippines. Besides the scanty number of orchid studies in the Philippines, the assessment of orchid diversity and distributions is further limited by potential problems in nomenclature that are difficult to resolve because of the lack of access to reference specimens, digital imagery, and detailed data collection particularly in Mindanao.

Species richness of endemic species richness is typically used to estimate the biodiversity value of a region (Nagendra, 2002; Clergue et al., 2005; Orme et al., 2005). One of the most important tasks for conservationists is therefore to find objective methods for assessment of natural areas in terms of their conservation priority (Jankowski et al., 2009; Kindlmann & Vergara, 2009). Defining conservation priorities is essential in minimizing biodiversity loss (Brooks et al., 2006; Jacquemyn et al., 2007) as it ensures that conservation action focuses on the species at the greatest risk of extinction and on the sites that are most important for their protection. The Long-Term

Fig. 1. Geographical location of Mindanao Long-Term Ecological Research Sites

Ecological Research (LTER) Sites were established in five mountain regions in Mindanao Island in order to assess, conserve and protect the increasing number of endangered flora and fauna of the region. To date, knowledge on the orchid flora in the aforementioned LTER sites has never been documented; hence, this study was undertaken.

Material and methods

Field inventory was conducted from September 2012 to November 2013 in the five long-term ecological research (LTER) sites established in the different regions in Mindanao Island namely (**Fig. 1**), Mt. Kitanglad, Mt. Apo, Mt. Malindang, Mt. Hamiguitan and Mt. Musuan. Every LTER site was delineated into one hectare permanent plot which was surveyed and inventoried. Site 1 is Mt. Apo LTER site is located within the vicinity of Energy Development Company (EDC), Ilomavis, Kidapawan City. The site was characterized as a montane forest located at 6°59′47′′N, 125°15′12′′E with an elevation of 1900-2000 meters above sea level (masl). The site has a close-canopy layer dominated by large trees and shrubs covered by bryophytes. Site 2 is Mt. Hamiguitan LTER site in Davao Oriental. The site is also a closed-canopy montane forest located at 6°43′58′′N, 126°9′58′′E with an elevation of 1000-1100 masl. Site 3 is at the Mt. Kitanglad LTER site situated 8°5′46′′N, 124°55′17′′E in Lantapan, Bukidnon. The permanent plot is within the montane forest with an elevation of 2100-2200 masl. Site 4 is located at the upper montane forest of Mt. Malindang LTER site situated 8°17′45′′N, 123°36′34′′E in Misamis Occidental at 1600-1700 masl elevation. The slightly open canopy layer of the forest was due to the overlapping crown of various types of trees, palm and shrubs. Site 5 is Mt. Musuan LTER site also in Bukidnon. The permanent plot is situated at 7°52'36.02"N, 125°04'1.53"E in the lowland secondary, mixed agro-dipterocarp forest which is around 380-480 masl and has slightly to open canopy layer.

Plant collections were pressed and treated with denatured alcohol after the fieldwork and then further processed in the herbarium. The specimens were allowed to dry up to 75°C using a mechanical drier. Since orchid taxonomy relies mainly on the characters of inflorescence, orchids with its flowers were collected whenever available during the field sampling. The inflorescence were dried and kept in separate herbarium pockets as it often wilts and deteriorates easily in the field. The collected plants were classified and identified using taxonomic keys from orchid floras, monographs and published articles of Holttum (1954), Dressler & Dodson (1960); Valmayor (1984); de Vogel (1988a,b); Pedersen (1997); Fessel & Balzer (1999); Agoo et al. (2003); Cootes (2001, 2010; 2011) and Suarez (2010 & 2011). Confirmation of the plant identification was done through direct communication with Jim Cootes, one of the authorities on Philippine Orchidaceae. All the collections were then deposited in the University Museum of Central Mindanao University, Bukidnon, Philippines.

Results and discussion

A total of 79 orchid species belonging to 34 genera was recorded in five LTER sites in Mindanao (**Tab. 1**).

Taxonomic identification of the four species were undetermined due to the unavailability of the inflorescence during the survey. In terms of species richness per site, Mt. Apo had the highest number represented by 31 species belonging to 17 genera. This is followed by Mt. Kitanglad with 25 species from 16 genera; and Mt. Hamiguitan with a record of 19 species from 11 genera. The least record in was from Mt. Malindang with 18 species from 16 genera; and in Mt. Musuan with only 2 species from 2 genera (**Fig. 2**).

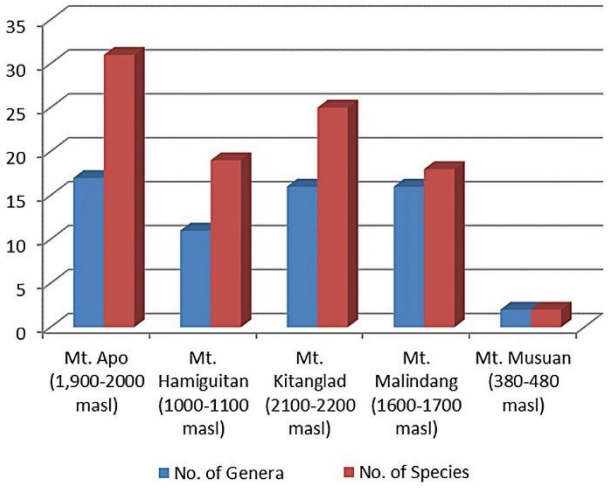

Fig. 2. Bar graph comparing the species richness of orchids in five Mindanao LTER Sites

The difference in the species richness between the 5 sites may be explained by the difference in many ecological factors such as elevation, microclimate conditions and presence of pollinators and mycorrhizal associates which have been reported to influence orchid diversity and distribution. Jacquemyn et al. (2005) reported that orchid species composition changed continuously with altitude, indicating turnover of species with increasing altitude. Analogously, orchid breeding

Table 1. List and distribution of wild orchids in Mindanao LTER sites

	Species	Mt. Apo	Mt. Hamiguitan	Mt. Kitanglad	Mt. Malindang	Mt. Musuan
1.	*Agrostophyllum longivaginatum* Ames	X		X	X	
2.	*A. saccatilabium* Ames & Quisumb.	X		X		
3.	*Appendicula laxifolia* J.J.Sm.				X	
4.	*A. malindangensis* (Ames) Schltr.	X		X	X	
5.	*A. tembuyukenensis* J.J.Wood		X			
6.	*Arundina graminifolia* (D Don) Hochr.				X	
7.	*Ascidieria cymbidifolia* (Ridl.) W.Suarez & Cootes			X		
8.	*Bulbophyllum colubrimodum* Ames			X		
9.	*B. escritorii* Ames			X		
10.	*Calanthe davaensis* Ames	X				
11.	*Calanthe sp.*			X		
12.	*Cephalantheropsis longipes* (Hook.f.) Ormerod				X	
13.	*C. obcordata* (Lindl.) Ormerod		X			
14.	*Ceratostylis latipetala* Ames	X	X	X	X	
15.	*C. wenzelii* Ames			X		
16.	*C. subulata* Blume	X		X	X	
17.	*Cheirostylis octodactyla* Ames			X		
18.	*Coelogyne candoonensis* Ames	X				
19.	*C. salvaneraniana* W.Suarez			X		
20.	*Crepidium quadridentatum* (Ames) Szlach.	X		X		
21.	*Cryptostylis arachnites* (Blume) Hassk.	X	X			
22.	*Cymbidium pubescens* Lindl.	X				
23.	*Dendrobium auriculatum* Ames & Quisumb.		X			
24.	*D. crumenatum* Sw.					X
25.	*D. diffusum* LO Williams	X				
26.	*D. erosum* (Blume) Lindl.	X				
27.	*D. phillipsii* Ames & Quisumb.	X				
28.	*D. rhombeum* Lindl.	X				
29.	*D. tiongii* Cootes			X		
30.	*D. uniflorum* Griff.		X			
31.	*Dendrochilum arachnites* Rchb.f.	X		X		
32.	*D. cobbianum* Rchb.f.	X				
33.	*D. coccineum* H.A.Pedersen & Gravend.		X			
34.	*D. elmeri* Ames			X		
35.	*D. glumaceum* Lindl.	X		X		
36.	*D. kopfii* Lückel.		X			
37.	*D. longifolium* Rchb.f.	X				
38.	*D. macranthum* Schltr.	X				
39.	*D. mearnsii* Ames			X		
40.	*D. tenellum* (Nees & Meyen) Ames		X			
41.	*D. wenzelii* Ames 1915			X		

42.	*Epigeneium stella-silvae* (Loher & Kraenzl.) Summerh.				X	
43.	*E. treacherianum* (Reichb.f ex Hook.f.) Summerh.	X				
44.	*E. roseum* (D.Don) Lindl.				X	
45.	*Goodyera clausa* (AA Eaton ex Ames) Schltr.				X	
46.	*G. viridiflora* (Blume) Blume		X			
47.	*Habenaria stenopetala* Lindl.					X
48.	*Habenaria* sp.			X		
49.	*Hippeophyllum wenzelii* Ames			X		
50.	*Lepidogyne longifolia* (Blume) Blume				X	
51.	*Liparis amesiana* Schltr.	X				
52.	*L. negrosiana* Ames	X		X		
53.	*L. parviflora* (Blume) Lindl.	X				
54.	*L. philippinensis* (Ames) Schltr.	X				
55.	*Mycaranthes candoonensis* (Ames) Cootes & W.Suarez				X	
56.	*M. gigantea* (Ames) Cootes & W.Suarez	X			X	
57.	*Oberonia hispidula* Ames	X				
58.	*Octarrhena parvula* Thwaites				X	
59.	*Paphiopedilum adductum* Asher		X			
60.	*P. ciliolare* (Rchb.f) Stein		X			
61.	*Phreatia listrophora* Ridl.	X				
62.	*P. sulcata* (Blume) J.J.Sm.	X				
63.	*Pinalia bractescens* (Lindl.) Kuntze			X		
64.	*P. densa* (Ridl.) W.Suarez & Cootes			X		
65.	*P. macera* (Ames) W.Suarez & Cootes			X		
66.	*Plocoglottis plicata* (Roxb.) Ormerod					
67.	*Rhomboda* sp. (Lindl.) Ormerod				X	
68.	*Robiquetia cerina* (Rchb.f) Garay	X				
69.	*Robiquetia sp*				X	
70.	*Spathoglottis kimballiana* Hook.f.		X			
71.	*S. plicata* Blume		X		X	
72.	*S. tomentosa* Lindl.		X			
73.	*Thelasis pygmaea* (Griff.) Lindl.	X				
74.	*Trichoglottis latisepala* Ames				X	
75.	*Trichotosia ramosii* (Leavitt) Kraenzl		X			
76.	Undetermined sp. 1		X			
77.	Undetermined sp. 2		X			
78.	Undetermined sp. 3		X			
79.	Undetermined sp. 4	X				
	TOTAL	31	19	25	18	2

systems and floral traits also changed with altitude. Relatively more auto-pollinating species were found at high altitudes compared with mid- and low-altitude sites where animal-pollinated species were most abundant. As such, at very extreme conditions, the absence of specific pollinators may therefore have a possible direct influence that limits their range of dispersal and distribution. Furthermore, orchids are highly evolved with their pollinators and require a specific relationship with mycorrhizal fungi to

Fig. 3. Critically endangered *Paphiopedilum adductum* Asher

Fig. 4. Endangered *Paphiopedilum ciliolare* (Rchb.f) Stein

Fig. 5. Vulnerable *Epigeneium treacherianum* (Reichb.f ex Hook.f.) Summerh.

germinate (Otero et al., 2005, Shefferson et al., 2007), therefore they are intimately intertwined with the ecology of their habitat. The findings of Vasquez et al. (2003) in Bolivia also showed that orchid diversity was mainly concentrated in ecoregions with semi-humid to very humid montane rain forests between 1000 m to 3500 m elevation. The very low species richness observed in Mt. Musuan (380-480 masl) maybe due to the warm and dry climatic condition which is very unfavorable to some species of epiphytic orchids that heavily relies from air moisture and rainfall (Barthlott et al., 2001). Aside from the fact that Mt. Musuan is already a secondary forest, the nearby cultivated agricultural areas suggests more anthropogenic disturbance in the area than the other four LTER sites. Such disturbance was likewise considered to negatively influence the species richness in an area (Barthlott et al., 2001). A total of 40 Philippine endemic species were recorded in all the five LTER sites. Mt. Apo harbors most of the endemics with 18 species, followed by Mt. Kitanglad with a record of 16 endemic species. The least was in Mt. Hamiguitan with only 9 endemic species then Mt. Malindang with 8 endemic species. Mt. Musuan had no endemic species. Highly threatened species was also recorded in the field survey. Based on IUCN (2017), this includes the critically endangered *Paphiopedilum adductum* Asher (**Fig. 3**) and the endangered *Paphiopedilum ciliolare* (Rchb.f) Stein (**Fig. 4**) from Mt. Hamiguitan, and the vulnerable *Epigeneium treacherianum* (Reichb.f ex Hook.f.) Summerh (**Fig. 5**) from Mt. Apo.

This reflects that the orchid family remains to be poorly known despite of their dominance in the Philippine flora. The national list of threatened plants of Fernando et al. (2008) assessed only the 5% of Philippine orchid flora and the remaining 95% remains to be data deficient or poorly studied. The lack of comprehensive ecological and taxonomic studies in this group of plants.

Conclusion

The LTER sites in Mindanao harbors a number of endemic and understudied wild

orchids. The species composition in every site maybe influenced by various ecological factors such as elevation, forest types, micro-climate conditions and among others. This benchmark data presented from the LTER sites in Mindanao Island, Philippines can be utilized for future monitoring of orchid populations and conservation initiatives of threatened species.

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