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Short Communication

Checklist and Conservation Status of *Hoya* Species in Bicol Peninsula, Luzon Island, Philippines

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ABSTRACT: This study provides a checklist of *Hoya* species in Bicol Peninsula, a unique biogeographic area in the southernmost tip of Luzon Island, Philippines characterized by active volcanism. After extensively reviewing articles on *Hoya*, it was found that there were 27 species in the provinces of Sorsogon, Camarines Sur, Camarines Norte and Albay. Nineteen species were endemic and only eight were indigenous species. Four of the endemic species were listed as endangered in DAO 2007–01. However, human and natural disturbances threaten the habitats of *Hoya* in Bicol Peninsula. It is vital that biodiversity conservation strategies be implemented effectively particularly those in key biodiversity areas (KBAs) where *Hoya* species were found.

KEY WORDS: *Hoya* species, key biodiversity areas (KBAs), Bicol Volcanic Arc Complex

INTRODUCTION

Hoya R. Br. commonly known as 'wax plant' belonging to Dogbane family (Apocynaceae; subfamily Asclepiadoideae) (Siar, 2005; Aurigue, 2013) are generally epiphytic herbaceous climbers, with woody basal part and with twining stems that develop adventitious roots at the internodes. Since *Hoya* belongs to Apocynaceae, it is laticiferous, with varying shapes, thickness and venation of succulent leaves (Wanntorp *et al.*, 2006). The flowers are characterized as umbelliform with extra-axillary inflorescences (Forster *et al.*, 1992; Omlor, 1996). *Hoya* is gaining worldwide popularity among ornamental plant collectors because of its waxy appearance, attractive and wide variants of flowers (Borlagdan *et al.*, 2016; Widiarsih *et al.*, 2011; Wanntorp *et al.*, 2006). Aside from the aesthetic value of *Hoya*, various countries use this plant as source of traditional medicine. In Bangladesh and India, *Hoya parasitica* Wall. leaves and barks are used to relieve fever, body pain and bone fracture (Rahman *et al.*, 2007; Biswas *et al.*, 2010; Singh and Borthakur, 2011). In China, *H. potsii* trail leaves uses include treatment of injury, gynaecological diseases, rheumatoid arthritis and digestive disorders (Zheng and Xing, 2009). In Malaysia and Vietnam, bathing of *H. diversifolia* leaf decoction is used as a cure for rheumatism (Mansur, 2003). In recent years, research on chemical

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components of Philippine *Hoya* species were conducted from the extracts of *H. mindorensis* Schlechter (Ebajo *et al.*, 2014), *H. multiflora* Blume (Ebajo *et al.*, 2015a), *H. wayetii* Kloppenb (Ebajo *et al.*, 2015b), and *H. diversifolia* Blume (Panajon *et al.*, 2016).

Hoya includes more than 500 species names (IPNI, 2012). It is found in Indochina and Southeast Asia to New Guinea, Australia and the western Pacific islands (Forster and Liddle, 1996). Although *Hoya* is widely distributed, the Philippines is considered to have the most diverse species in the world which can be found throughout the various islands of the country (Kloppenburg and Siar, 2008; Aurigue, 2013). On the account of Kloppenburg *et al.* (2012) there were more than 80 *Hoya* species in the country. But, based on Aurigue (2013) there were at least 109 species of *Hoyas* found in the country, 88 of these are endemic and others still awaiting to be discovered.

This study provides a list of *Hoya* species in the Bicol Peninsula, a unique biogeographic unit in the southernmost extension of Luzon Island, Philippines characterized by active volcanism. The objectives of this study were as follows: (1) to provide a checklist of *Hoya* species found in Bicol Peninsula and (2) to assess the conservation status of each species based on Department of Environment and Natural Resources Administrative Order No. 2007–01 (DAO 2007–01). Despite the status of the Philippines as one of the most important biodiversity hotspots in the world (Myers *et al.*, 2000), continued exploitation and destruction of natural habitats threaten the country's distinct and valuable biodiversity.

MATERIALS AND METHODS

The study was conducted in Bicol Peninsula which is located in the Philippine mobile belt, also known as the Bicol Volcanic Arc Complex in the southernmost tip of Luzon Island, Philippines (Mines and Geosciences Bureau, 2010). The Bicol Volcanic Arc Complex is the most seismically active volcanic belt in the country with at least a dozen stratovolcanoes that dotted along the length of approximately 260km of the Bicol Peninsula (Andal *et al.*, 2005). It has three active volcanoes (Mts. Bulusan, Iriga and Mayon), and at least nine classified as inactive or dormant (McDermott *et al.*, 2005). The peninsula is straddled between 11°30′ and 14°20′N and 122°20′ and 124°30′E which is composed of the Provinces of Camarines Norte, Camarines Sur, Albay and Sorsogon covering an area of 12,070 km^2 (Fig. 1). The area is surrounded by Lamon Bay in the north, Pacific Ocean in the East and Sibuyan Sea and Ragay Gulf in the west. The northernmost province, Camarines Norte is bordered to the north by the province of Quezon, thus connecting the peninsula to the rest of Luzon landmass (Philippine Statistics Authority, n.d.).

The Bicol peninsula has two types of climate based on modified Coronas classification, Type II and Type IV (PAGASA, n.d.a). Type II which has no pronounced dry season and maximum rain period from December to February with minimum rainfall from March to May is prevalent in the province of Sorsogon, eastern part of Albay and the eastern and northern parts of Camarines Norte and Camarines Sur. Type IV climate which is characterized by more or less evenly distributed rainfall throughout the year and has no pronounced dry period is predominant in the southwestern Camarines Sur, western part of Camarines Sur and other parts of Albay. The area receives an average rainfall of 3,385.25 mm. (PAGASA, n.d.b) and with an annual mean temperature that ranges between 27.4 °C and 29.6 °C. The climatic and geological features of the peninsula make it favourable to agriculture which led to conversion of the low lying areas to rice fields, coconut plantation, coffee, abaca or Manila hemp, pasturelands and various crops.

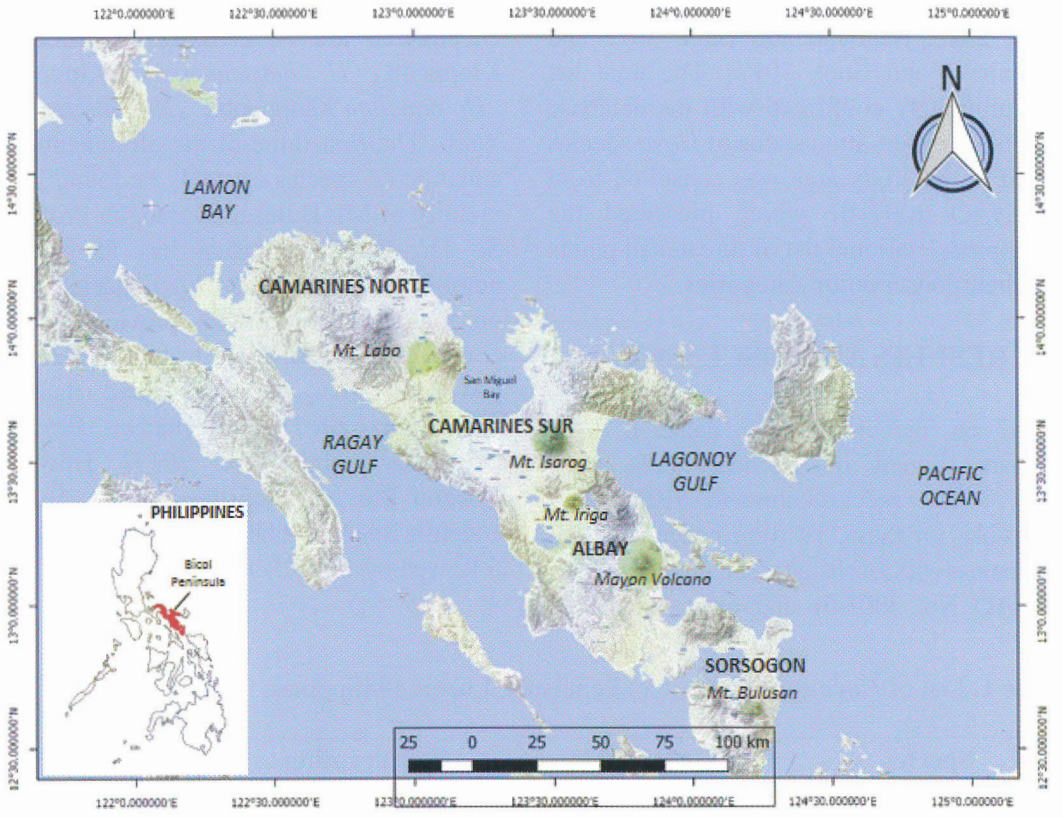


Figure 1. Bicol Peninsula, its provinces and its volcanic features. Map generated through QGIS and base map is from Google Earth.

Bicol has 9 of the 240 protected areas in the Philippines including Mts. Isarog, Mayon and Bulusan (DENR-BMB, 2016). However, given the loose implementation of conservation plans, these protected areas in the peninsula remains to be threatened by diverse factors including illegal logging, slash and burn farming, encroachment and collection of natural resources which resulted in habitat degradation and biodiversity reduction (Lantican, 1995; Buot, 2010; Linis, 2011; Balete *et al.*, 2013). These human activities were further exacerbated by naturally occurring climatic and geological hazards such as typhoons, landslides and volcanic eruptions (Salceda, 2012). Even in the presence of various disturbances, remaining forest fragments which include secondary forest in the lowland; lower and upper montane forests still support biodiversity including several Hoya species (Lantican, 1995; Buot, 2010; Linis, 2011; Balete *et al.*, 2013; Kloppenburg, 2012).

This study followed the method of Villanueva and Buot (2016) which conducted a comprehensive review of several literature publications about *Hoya* (viz., Aurigue, 2013; Merrill, 1923-1926; Kloppenburg, 2012; 2008; Kloppenburg and Siar, 2008; Kloppenburg *et al.*, 2012; Schlechter, 1906). In addition, *Hoya* species found in Bicol Peninsula were consulted with the list of The International Plant Name Index (IPNI) (www.philipineplants.org), The Plant List (www.theplantlist.org), Pelser *et al.* (2011 onwards) and Tropicos (www.tropicos.org) and also referred to the previous enumeration studies on *Hoya* in other biogeographic areas in the Philippines particularly Mindoro Island, Palawan Island

and Quezon Province (Villanueva and Buot, 2016; Santiago and Buot, 2017 and Villanueva and Buot, 2017). The final list was ultimately confirmed with the database of IPNI. Conservation status of *Hoya* species found in the study area was consulted from the DAO 2007–01 which presented the Philippines' national list of threatened plants and their conservation categories.

RESULTS AND DISCUSSION

Based on the information gathered from extensive review of secondary data, there were 27 *Hoya* species known to exist in Bicol Peninsula. Of these, 19 were endemic in the Philippines with four listed as endangered species in DAO No. 2007-01 and eight indigenous species (Table 1). Species listed as endangered are *H. crassicaulis* Elmer ex Kloppenb., *H. heuschkeliana* Kloppenb., *H. panchoi* Kloppenb., *H.quinquenervia* Warb. The first three of the aforementioned endangered species can only be found in the vicinity of Mt. Bulusan, Sorsogon Province. So far, Bicol Peninsula has the highest number of endangered *Hoya* species based on the comparison with previous studies conducted in Mindoro Island (Villanueva and Buot, 2016), Palawan Island (Santiago and Buot, 2017) and Quezon Province (Villanueva and Buot, 2017). However, Quezon Province has the most number of endemic species totalled to have 37 species followed by Bicol Peninsula.

Table 1. List of *Hoya* species in Bicol Peninsula, Luzon, Philippines.

Species	Geographic Distribution	Conservation Status	References
Hoya bicolensis Kloppenb., Siar & Cajano	Bicol Region (endemic)	NA	*Hoya bicolensis* Kloppenburg, Siar & Cajano in New Species of *Hoya* R. Br. (Apocynaceae). Journal of Nature Studies 11(1&2): 40 (2012); J. Nat. Stud. 11(1-2): 39. 2013 [2012 publ. 30 Jan 2013] [epublished]
Hoya blashernaezii Kloppenb. subsp. *siariae* (Kloppenb.) Kloppenb.	Bicol; Tayabas, Quezon (endemic)	NA	*Hoya* New 2(2): 50 (Apr 2014)
Hoya blashernaezii Kloppenburg subsp. *valmayoriana* Kloppenburg, Guevarra & Carandang	Lake Bulusan, Sorsogon; Tayabas, Quezon (endemic)	NA	*Hoya* New 2(2): 10 (Apr 2014); *Hoya New* 2(3): 4 (May 2014)

Table 1. (Continued).

Species	Geographic Distribution	Conservation Status	References
Hoya bordenii Schltr.	Irosin, Sorsogon; Mariveles, Bataan; Batanes Island; Polillio Island; Batangas; Mt. Gintaban Negros Oriental; Mt. Makiling, Laguna; Mt. Panigtingan, Rizal; Montalban, Rizal; Mt. Talinas, Negros Oriental; Lake Danao, Balinsasayao, Taytay, Negros Oriental (endemic)	NA	Philipp. J. Sci. (Suppl. 4): 302 (1906); Enum. Philipp. Fl. Pl. iii. 352 (1923)
Hoya bulusanensis Elmer	Mt. Bulusan, Irosin, Sorsogon (endemic)	NA	Leaflets of Philippine Botany, May 1, 1938 Vol X, Article 131, p.3575-3577
Hoya camphorifolia Warb.	Mt. Bulusan, Sorsogon; Sampaloc, and Tayabas Quezon; Benguet; Mindoro; Mindanao (endemic)	NA	Perkins Fragmentia Florae Philippineae 1 (1904); Enum. Philipp. Fl. Pl. iii. 351 (1923)
Hoya carnosa R. Brown	Eastern side of Luzon island from Quezon province to Bicol region in the South; Leyte; Mindanao; Southern Palawan (indigenous)	NA	Asclepiadieae 16 (1810)
Hoya crassicaulis Elmer ex Kloppenb.	Irosin, Mt. Bulusan, Sorsogon (endemic)	EN	Fraterna 10 (1995)
Hoya cumingiana Decne	Mt. Mayon, Albay; Camarines; Mindoro; Benguet; Bontoc, Bataan; Rizal; Southern Palawan; Ticao; Luzon et al. (indigenous)	NA	Prodr. 8: 636. (1844); Enum. Philipp. Fl. Pl. iii. 351 (1923)

Table 1. (Continued).

Species	Geographic Distribution	Conservation Status	References
Hoya davidcummingii Kloppenb.	Lake Bulusan, Sorsogon (endemic)	NA	Fraterna 8(2): 10 (1995)
Hoya densifolia Turcz.	Mayon Volcano near Legazpi, Albay; Java, Indonesia (indigenous)	NA	Bull. Soc. Imp. Naturalistes Moscou 21 (1) 261 (1848)
Hoya gracilis Schltr.	Sorsogon, Mindoro, Panay Island (indigenous)	NA	Enum. Philipp. Fl. Pl. iii. 352 (1923)
Hoya heuschkeliana Kloppenb.	Lake Bulusan, Sorsogon (endemic)	EN	*Hoyan* 11 (1:2): I (1989)
Hoya heuschkeliana subsp. cajanoae Kloppenb. & Siar	Mt. Isarog, Camarines Sur (Bicol National Park) (endemic)	NA	Fraterna 20(4): 9 (-11; figs.). 2007; Philippines Hoya Species Monograph, 11th ed. (May 2012)
Hoya imbricata Decne.	Irosin, Sorsogon; Bontoc; Laguna; Tanay, Rizal; Busuanga Island, Palawan; Biliran, Samar; Davao; Sulawesi (indigenous)	NA	Prodr. [A. P. de Candolle] 8: 637 (mid Mar 1844)
Hoya incrassata Warb.	Sorsogon; Rizal; Laguna; Polillo Island and Tayabas, Quezon; Mindoro, Busuanga; Capiz, Panay Island; Camiguin de Misamis, Mindanao (Surigao & Agusan) (indigenous)	NA	Philipp. Journ. Sci. 6c. 220 (1911); Enum. Philipp. Fl. Pl. iii. 352 (1923)
Hoya litii Kloppenb., Siar & Cajano	Mt. Mayon, Legazpi, Albay; Burdeos, Polillo, Quezon (endemic)	NA	Vol. 5 Issue 1 Sept. 2015 Kloppenburg monograph; Hoya New 5(2): 8. (Dec 2015)
Hoya mariae (Schltr.) L. Wanntorp & Meve	Sorsogon; Catanduanes; Laguna; Bohol; Leyte; Lanao	NA	Willdenowia 41(1): 98 (Jun 2011); Meve *et al.* (2009)

Table 1. (Continued).

Species	Geographic Distribution	Conservation Status	References
	del Sur; Indonesia; Malaysia (indigenous)		
Hoya merrillii Schltr.	Camarines; Bohol; Nueva Vizcaya; Tayabas & Baler, Quezon; Cavite; Cebu; Mindoro; Panay; Davao & Zamboanga del Norte, (Mindanao) (endemic)	NA	Enum. Philipp. Fl. Pl. iii. 353 (1923)
Hoya mindorensis Schltr.	Sorsogon; Baco River, Mindoro; Rizal; Dumaguete, Negros Oriental; Samar; Zamboanga del Norte (endemic)	NA	Philipp. Journ. Sci. i. Suppl. 303 (1906); Enum. Philipp. Fl. Pl. iii., 353
Hoya multiflora Blume	Mt. Bulusan, Sorsogon; Masbate; Babuyan, Luzon; Polillo, Quezon; Mindoro; Tablas, Panay; Samar, Dinagat, Siargao, Mindanao; Palawan; China, Indonesia, Laos, Myanmar, Thailand, Vietnam, peninsular Malaysia, India (indigenous)	NA	Catalogus 49.1823; Philippine *Hoya* Species 3rd ed (1996) 106-108.
Hoya obscura Elmer ex C. M. Burton	Mt. Bulusan, Sorsogon; Mt. Malinao, Albay; Mt. Makiling Laguna; Casiguran, Tayabas; Antig River, Romblon (endemic)	NA	Philippines *Hoya* Species Monograph, 10th edition (2008)
Hoya odorata Schltr.	Mt. Bulusan, Sorsogon; Mount Mariveles, Bataan; Batanes Island; Ifugao; Mt. Makiling,	NA	Philippines *Hoya* Species Monograph, 10th edition (2008)

Table 1. (Continued).

Species	Geographic Distribution	Conservation Status	References
	Laguna; Mt. Paningtingan, Rizal; Mt. Talinis, Negros Oriental; Mt. Kanlaon, Negros Occidental; Panay Island; Camiguin, Misamis Oriental (Mindanao) (endemic)		
Hoya panchoi Kloppenb.	Mt. Bulusan, Irosin, Sorsogon (endemic)	EN	Hoyan 10 (1:2):1. 1988
Hoya pseudomaxima Koord.	Mt. Isarog, Bicol; Rizal (endemic)	NA	Philipp. J. Sci. 15: 265. 1919
Hoya quinquenervia Warb.	Irosin, Sorsogon; Malunu, Isabela (endemic)	EN	Philippine Journal of Science 3 (1923) 353
Hoya tsangii Burton ex Kloppenburg	Mt. Bulusan, Sorsogon; Mt. Urdaneta, Agusan, Island of Mindanao; Casiguran Luzon; Montalban Luzon; Koatoan Bucidon; Sibulan Quezon; Boilube Polillo Island; Bacungan Palawan; Katimo, Tagkawayan, Quezon; Catingtingan Luzon (endemic)	NA	Acanthostemma (Blume) Kloppenburg (1994) 120-131; Leaflets of Philippine Botany 10 Art. 131:3572-3-4

*Conservation status is based from DENR list of threatened species (DAO No. 2007-01, also found in Fernando *et al.*, 2008). EN = Endangered; NA = Not Assessed.

This study found that some of the *Hoya* species present in Bicol Peninsula has seven similar species with the adjacent Quezon Province and with Mindoro Island while there were two similar species with Palawan Island. It should also be noted that most of the *Hoya* species found in the peninsula were collected in the vicinity of active volcanoes particularly Mt. Bulusan (located in the province of Sorsogon), Mayon Volcano (located in the province of Albay) and the potentially active Mt. Isarog (located in Camarines Sur). Fortunately, the areas where most of the *Hoya* species were collected are protected under Republic Act 7586 or the National Integrated Protected Areas System (NIPAS) law. These areas are also classified

as key biodiversity areas (KBAs) (BirdLife International, 2018). However, despite its protected status, several studies observed that there are signs of human disturbances where farming activities and forest resource gathering and collection were observed resulting to habitat destruction and forest fragmentation in addition to the naturally occurring climatic and geological hazards such as typhoons, landslides and volcanic eruptions (Buot, 2010; Linis, 2011; McDermott *et al.*, 2005; Salceda, 2012).

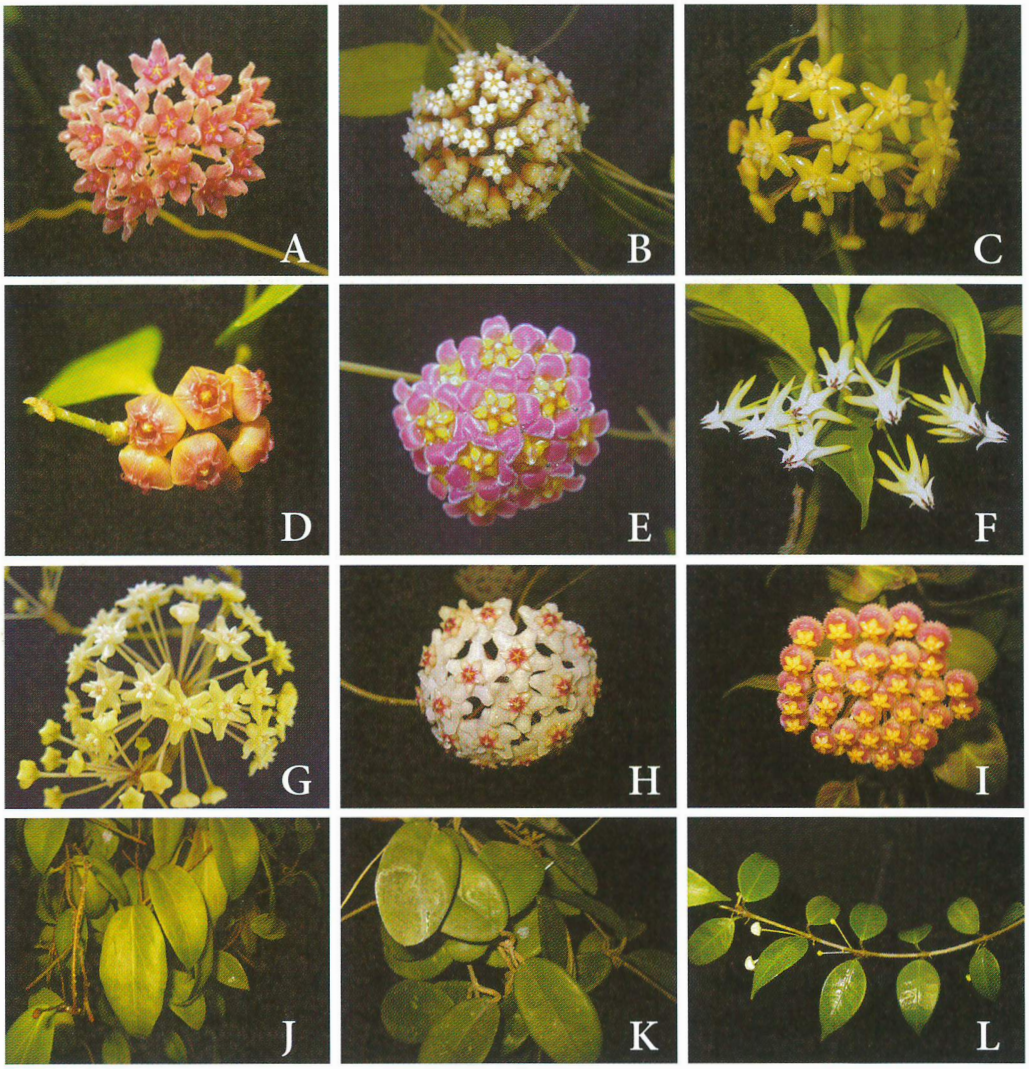


Figure 2. *Hoya* species in Bicol Peninsula: A) *Hoya bicolensis* Kloppenb., Siar & Cajano, B) *Hoya crassicaulis* Elmer ex Kloppenb., C) *Hoya quinquinervia* Warb., D) *Hoya heuschkeliana* Kloppenb., E) *Hoya davidcummigii* Kloppenb., F) *Hoya multiflora* Blume., G) *Hoya merrillii* Schltr., H) *Hoya carnosa* R. Brown, I) *Hoya obscura* Elmer ex C. M. Burton, J) leaves of *Hoya camphorifolia* Warb., K) leaves of *Hoya carnosa* R. Brown, L) leaves of *Hoya odorata* Schltr. **Photo credits:** Jorge R. Sahagun available at http://www.phytoimages.siu.edu

CONCLUSION AND RECOMMENDATION

Based on this study, there were 27 *Hoya* species in Bicol Peninsula. Nineteen of these are endemic to the Philippines. Based on DAO 2017-01, there are 4 endangered species in the area. However, like other places in the Philippines, Bicol Peninsula is not spared from various human and natural disturbances that threaten the habitat of the *Hoya* species. Since most *Hoya* species are epiphytic climbers, they are known to exist naturally on trees which explain why they were found inside and near the volcanically active and identified key biodiversity areas (KBAs) including Mt. Isarog, Mt. Bulusan and Mt. Mayon with existing forests. It is therefore vital to protect the KBAs by implementing effective biodiversity protection and conservation strategies. Moreover, since 3 of the 4 endangered species (i.e. *Hoya crassicaulis* Elmer ex Kloppenb., *Hoya heuschkeliana* Kloppenb., *Hoya panchoi* Kloppenb.) in Bicol Peninsula can only be found in volcanically active Mt. Bulusan, cultivation for ornamental purposes of these species can be considered as an *ex situ* conservation strategy to prevent them from going extinct.

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REFERENCES

Andal, E.S., G.P. Yumul, Jr., E.L. Listanco, R.A. Tamayo, Jr., C.B. Dimalanta and T. Ishii. 2005. Characterization of the pleistocene volcanic chain of the Bicol arc, Philippines: Implications for geohazard assessment. *Terrestrial, Atmospheric and Oceanic Sciences* 16: 865–883.

Aurigue, F.B. 2013. *A Collection of Philippine hoyas and their culture*. Los Baños, Laguna: PCAARRD–DOST. 195 pp.

Balete, D.S., L.R. Heaney, P.A. Alviola and E.A. Rickart. 2013.Diversity and distribution of small mammals in the Bicol volcanic belt of southern Luzon island, Philippines. *National Museum of the Philippines: Journal of Natural History* 1: 61–86.

BirdLife International. 2018. *World database of key biodiversity areas*. Downloaded from http://www.keybiodiversityareas.org/site/mapsearch on 15 April 2018.

Biswas, A., M.A. Bari, M. Roy and S.K. Bhadra. 2010. Inherited folk pharmaceutical knowledge of tribal people in the Chittagong hill tracts, Bangladesh. *Indian Journal of Traditional Knowledge* 9 (1): 77–89.

Borlagdan, M., F.B. Aurigue, I.A. van Altena and C.Y. Ragasa. 2016. Triterpenes from *Hoya paziae* Kloppenb. *Pharmacognosy Journal* 8(5).

Buot Jr., I.E. 2010. Conservation status of the commonly collected plant species in selected Philippine mountain ecosystems. *The Journal of Tropical Biology*: 3–13.

Department of Environment and Natural Resources Administrative Order 2007-01 (DAO 2007-01). *Establishing the national list of threatened Philippine plants and their categories, and the list of other wildlife species*. Department of Environment and Natural Resources. Visayas Avenue, Diliman, Quezon City, Philippines.

Department of Environment and Natural Resources-Biodiversity Management

Bureau (DENR-BMB). 2016. 2004 *Statistics on Philippine protected areas and wildlife*. Ninoy Aquino Parks and Wildlife Center, 1100, Diliman Quezon City, Philippines.

Ebajo, Jr. V.D., C-C Shen and C.Y. Ragasa. 2014. Triterpenes and sterol from *Hoya mindorensis*. *Der Pharma Chemica* 6(4): 321–325.

Ebajo Jr. V.D., C-C. Shen and C.Y. Ragasa. 2015a. Terpenoids and sterols from *Hoya multiflora Blume*. *Journal of Applied Pharmaceutical Science* 5(3): 33–39.

Ebajo, Jr.V.D., F.B. Aurigue, R. Brkljača, S. Urban, C.Y. Ragasa. 2015b. Chemical constituents of *Hoya wayetii* Kloppenb. *International Journal of Pharmacognosy and Phytochemical Research* 7(5): 1041–1045.

Fernando, E.S., L.L. Co, D.A. Lagunzad, W.S.M. Gruezo, J.F. Barcelona, D.A. Madulid, A.B. Lapis, G.I. Texon, A.C. Manila and P.M. Zamora. 2008. Threatened plants of the Philippines: a preliminary assessment. *Asia Life Sciences* Supplement 3: 1–52.

Forster, P.I. and D.J. Liddle. 1992. Taxonomic studies on the genus *Hoya* R. Br. (Asclepiadaceae) in Papuasia 1–5. *Austrobaileya* 3 (4), 627–641.

Forster, P.I. and D. Liddle. 1996. *Hoya*. pp. 231–237 in: Orchard, A.E. (ed.), *Flora of Australia* Vol. 28. Melbourne: CSIRO.

International Plant Names Index (IPNI). 2012. Download from http://www.ipni.org on 11 April 2018.

Kloppenburg, R.D. and S.V. Siar. 2008. Three new species of *Hoya* R. Br. (Apocynaceae) from the Philippines. *Asia Life Sciences* 17(1): 57–70.

Kloppenburg, D. 2012. *Philippine Hoya species: A monograph (11th Edition)*. Fresno, California.

Kloppenburg, D. 2008. *Philippines Hoya species monograph (10th edition)* April 2008. Fresno, California.

Kloppenburg, R.D., M.L.D. Guevarra, J.M. Carandang, and F.S. Maranan. 2012. New species of *Hoya* R.Br. (Apocynaceae) from the Philippines. *Journal of Nature Studies* 11(1&2): 34–48.

Lantican, C.A. 1995. *Strategies for rehabilitation: The case of Bicol National Park, Philippines* In: Nepal, S.K. and Weber, K.E. (eds). *Managing protected areas under conditions of conflict: Selected case studies from China, Myanmar, Nepal, Philippines and Thailand*. Bangkok: Asian Institute of Technology.

Linis, V.C. 2011. Biogeographical notes on the moss floras of Bicol Peninsula in Luzon and the Catanduanes Islands, the Philippines. *Philippine Journal of Science* 142: 119–133, Special Issue.

Mansur, M. 2003. *Hoya* R. Br. In: Lemmens R.H.M.J., and N. Bunyapraphatsara (eds.). *Plant Resources of South-East Asia No. 12(3), Medicinal and Poisonous Plants 3*. Prosea Foundation, Bogor, Indonesia. pp. 244–247.

McDermott, F., F.G. Delfin Jr., M.J. Defant, S. Turner and R. Maury. 2005. The petrogenesis of volcanics from Mt. Bulusan and Mt. Mayon in the Bicol arc, the Philippines. *Contributions to Mineralogy and Petrology* 150(6): 652–670.

Meve, U., O. Laurente, G.J. Alejandro and T. Livshultz. 2009. Systematics of Clemensiella (Apocynaceae – Asclepiadoideae). *Edinburgh Journal of Botany* 66(3): 447–457.

Mines and Geosciences Bureau. 2010. *Geology of the Philippines: 2nd Edition*. MGB-DENR North Avenue, Quezon City, Philippines.

Omlor, R. 1996. Notes on *Marsdenieae* (Asclepiadaceae)—a new, unusual species of *Hoya* from Northern Borneo. *Novon* 6: 288–294.

Pelser, P.B., J.F. Barcelona and D.L. Nickrent (eds.). 2011. Onwards. *Co's Digital Flora of the Philippines*. www.philippineplants.org.

Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA). n.d.a. *Climate of the Philippines*. Downloaded from https://www1.pagasa.dost.gov.ph/index.php/climate-of-the-philippines on 10 April 2018.

Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA). n.d.b. Climatological normals. Downloaded from https://www1. pagasa.dost.gov.ph/index.php/climate/climatological-normals on 10 April 2018.

Philippine Statistics Authority (PSA). n.d. Downloaded from http://countrystat.psa.gov.ph/?cont=16&r=5 on 31 March 2018.

Panajon, N.M., F.B. Aurigue, C.-C. Shen and C.Y. Ragasa. 2016. Triterpenes and sterols from *Hoya diversifolia* Blume. *Journal of Applied Pharmaceutical Science* Vol. 6 (06): pp. 079–082.

Rahman, M.A., S.B. Uddin, and C.C. Wilcock. 2007. Medicinal plants used by Chakma tribe in Hill Tracts districts of Bangladesh. *Indian Journal of Traditional Knowledge* 6(3): 508–517.

Salceda, J.S. 2012. Adapting to climate change: Strategies of Albay, Philippines. *Agriculture and Development Notes on Climate Change Adaptation* Vol. 2 No. 1. Downloaded from https://www.climatechange.searca.org on 9 April 2018.

Santiago, J.O. and I.E. Buot Jr. 2017. Checklist of Hoya species on Palawan Island, Philippines. *Journal of Nature Studies* 16 (1): 34–44.

Schlechter, R. 1906. New Philippine Asclepiadaceae. *Philippine Journal of Science* 1 (Supplement 4): 295–303.

Siar, S.V. 2005. Philippine hoyas. Los Baños, Laguna: PCARRD, 23p.-(Information Bulletin No.237/2005).

Singh, B. and S. K. Borthakur. 2011. Wild medicinal plants used by tribal communities of Meghalaya. *Journal of Economic and Taxonomy Botany* 35(2).

Villanueva, E. L. C and I. E. Buot Jr. 2016. Hoyas of Mindoro Island, Philippines: Conservation Concerns. *Journal of Nature Studies* 15 (1): 87–97.

Wanntorp, L., A. Kocyan, R. Van Donkelaar and S.S. Renner. 2006. Towards a monophyletic *Hoya* (Marsdenieae, Apocynaceae): Inferences from the chloroplast trnL region and the rbcL-atpB spacer. *Systematic Botany* 31(3): 586–596.

Widiarsih, S., S. V. Siar, and A. G. Lalusin. 2011. Optimization of DNA extraction protocol for *Hoya mindorensis* Schlechter. *Philippine Journal of Crop Science* 36(2): 63–66.

Zheng, X. and F. Xing. 2009. Ethnobotanical study on medicinal plants around Mt. Yinggeling, Hainan Island, China. *Journal of Ethnopharmacology* 124: 197–210.

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