

An urgent conservation call from endemic plants of Mount Salak, West Java, Indonesia

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Abstract. Mount Salak is part of Mount Halimun-Salak National Park in West Java, Indonesia. It is home to five endemic plant species that are very susceptible to human interference due to their close proximity to human settlements. The deforestation rate of the area was 1,473 ha or 1.3% of the total area each year. Using eleven line transects with a total length of 44.76 km, the present study aims at providing data on current population and conservation status of these five endemic plant species. The results showed that there was an urgent conservation call from Mount Salak as all five targeted species were unable to be located. Furthermore, two invasive species that might possess serious threat to the endemic plants were observed during the survey: markisa (*Passiflora* sp.; Passifloraceae) and harendong bulu (*Clidemia hirta*; Melastomataceae). Based on these results, the present study assigned all the endemic species as Critically Endangered according to the IUCN Red List Category and Criteria. To conserve all the endemic plant species in Mount Salak, several recommendations were given and discussed.

1. Introduction

Plants are fundamental part of terrestrial ecosystem and provide support systems for life on earth. For human, plants provide many essential services that underpin human survival and well-being, such as source of food, clothes, timber, medicines, fresh air, clean water, and much more. In spite of these essential functions, plant diversity is experiencing a continuing decline, leading to one in five plant species are estimated to be threatened with extinction [1]. The biggest threat to plant diversity is habitat loss and degradation through the conversion of land for agriculture, followed by overexploitation, invasive species, air pollution, and climate change [2]. Compared to those with wide range distribution, narrow endemic plants are more sensitive to these threats due the following reasons: i) narrow geographic range, ii) only few populations, iii) small population size and low genetic diversity, and iv) the need for specialized environmental condition [3]. Because of this vulnerability, endemic plants should be given conservation priority and carefully managed in an effort to maintain biodiversity.

Mount Salak Mount Salak is part of Mount Halimun-Salak National Park (MHSNP) with an area of 31.327 ha. It is administratively located within the Bogor and Sukabumi regencies of West Java, Indonesia. Ranging in elevation from 400 to 2210 m above sea level (asl), Mount Salak is one of the remaining forested areas in the heavily-populated island of Java, and is home to many endemic and threatened plant species, including *Saurauia bogoriensis* (Actinidiaceae), *Mitrasacme bogoriensis* (Loganiaceae), *Canarium kipella* (Burseraceae), *Schizostachyum biflorum* (Poaceae), and *Rhododendron wilhelminae* (Ericaceae). These five endemic plants are only found in this single mountain and thus have very narrow geographic range. The plants are very susceptible to human interference because their locations are very close to and surrounded by human settlements. Rakhmawati [4] reported that the MHSNP was deforested each year by approximately 1,473 ha or 1.3% of the total area. Thus a comprehensive conservation action is needed to protect and conserve these endemic plant species.

The present study aims at providing the most current baseline data required for the conservation action of these endemic plants. These include data on distribution, population size and structure, habitat preference, conservation status according to IUCN Red List Category and Criteria, and threats from anthropogenic activities and invasive species. As there are no previous studies that assess the ecology of *S. bogoriensis*, *M. bogoriensis*, *C. kipella*, *S. biflorum*, and *R. wilhelminae*, the present study will be the first one to provide these kinds of data. Furthermore, since two of these species (*M. bogoriensis* and *S. biflorum*) have not been assessed and the other three species were assessed 20 years ago by IUCN Red List, the results of the present project will update both national and global conservation status of these endemic species.

2. Methodology

2.1. Study site

The project was conducted in Mount Salak (6°42'32"-6°43' 32"S and 106°37'41"-106°40'50"E), especially within the areas of Ciapus, Bogor Regency, which were previously identified as habitats for the five endemic plant species (Figure 1). Mount Salak was merged with Mount Halimun National Park in 2003 to become Mount Halimun-Salak National Park (MHSNP). Mount Salak is one of more than 40 volcanic mountains on Java Island. Together with Mount Halimun, it is the largest remnant rain forest block on Java, and is home for more than 700 flowering plant species, including 258 species of orchids, 12 species of bamboo, 13 species of rattan, ornamental and medicinal plants [5].

Forest ecosystem of Mount Salak can be classified into three zones according to its altitude, namely coline zone (500-1000 m asl), submontane zone (1000-1500 m asl) and montane zone (1500-2210 m asl) [5]. The climate is classified as type B climate with the average rainfall, daily temperature and air humidity of 4000-6000 mm/year, 20-30°C, and 80%, respectively [6].



Figure 1. Location of transects of the present study in Mount Salak, West Java, Indonesia.

2.2. Study species

The present study targeted five plant species endemic to the Mount Salak, and they were: *Saurauia bogoriensis*, *Mitrasacme bogoriensis*, *Canarium kipella*, *Schizostachyum biflorum*, and *Rhododendron wilhelminae* (Table 1). Based on herbarium specimen records, the first four species were found at colin zone while the last species was at submontane zone. For *C. kipella*, herbarium specimen records showed the species was also found in Pelabuhan Ratu, Sukabumi Regency, West Java. This area, however, appears to be without proper official protection and is experiencing severe deforestation and habitat conversion. Thus Mount Salak seems to be the last habitat for this species.

Table 1. Profile of five endemic plant species of Mount Salak, West Java, Indonesia.

No	Species	Local name	Family	IUCN Red List status (year assessed)	Growth form
1	<i>Canarium kipella</i>	Ki Pelah	Burceraceae	Endangered (1998)	Tree
2	<i>Mitrasacme bogoriensis</i>	-	Loganiaceae	-	Herb
3	<i>Rhododendron wilhelminae</i>	Kadu dampit	Ericaceae	Critically Endangered (1998)	Epiphyte
4	<i>Saurauia bogoriensis</i>	Ki Leho	Actinidiaceae	Critically Endangered (1998)	Tree
5	<i>Schizostachyum biflorum</i>	Awi Tamiang	Poaceae	-	Clumping bamboo

2.3. Field survey and data analysis

Distance sampling method using line transect was used to assess the population of five endemic plant species. A total of eleven (11) line transects were placed within the forest of Mount Salak with the minimum distance between transects of 250 m (Figure 1). Using a GPS receiver, the starting point of each line transect was located. These transects was oriented following the elevation gradient of Mount Salak and the lengths of each line transect was measured. The project team walked each line transect searching for individual endemic plants on either side of the transect line. For each plant detected, perpendicular distances was measured from the transect line to each plant and relevant demographic as well as environmental data (topographic factors, soil characteristics and human disturbances) were collected. For all plant identified, their herbarium specimens were collected and reidentified at the Bogor Botanic Gardens (BBG). Furthermore, pH, carbon (C), nitrogen (N) and phosphorus (P) content of soil samples were analysed at the Indonesian Center for Biodiversity and Biotechnology

(<http://icbb.or.id/>). To estimate the density of each endemic plant species, distance data were analysed using the software program Distance 6.0. Finally, all gathered data were used to assess the conservation status of each species using IUCN Red List Category and Criteria.

3. Results and discussion

The distribution of all target species in Mount Salak was assessed using 11 line transects with a total length of 44.76 km (Table 2). Human settlements, agricultural fields, and introduced tree plantations (*Pinus* sp. and *Maesopsis eminii*) have reached at the high elevation in Mount Salak, and pushed the natural forest boundary mostly started at above 700 m asl. This past forest conversion was the reason that the line transects used in the present study was located around 710 m asl at the lowest (transect 9).

From five target species, none were able to be located during the survey. As *S. bogoriensis*, *C. kipella*, *M. bogoriensis*, and *S. biflorum* used to be found below 700 m asl, an area with high level of anthropogenic activities, past habitat loss and resources extraction was believed to be the main cause of the absent of these species. For *R. wilhelminae*, the likely cause was unknown. The species was reported to be found at 1350 m asl and thus habitat loss was not a serious threat to the species. Further extensive survey is needed to confirm our findings.

Table 2. Length and elevation range of line transects used to assess the endemic plants in Mount Salak

Transect	Length (km)	Elevation range (m above sea level)
1	4.04	902-2233
2	4.85	1148-1936
3	4.84	775-1469
4	4.09	710-1095
5	4.44	885-1725
6	3.65	862-1720
7	2.88	727-1303
8	2.49	720-1542
9	4.04	717-2209
10	6.14	750-1408
11	3.3	1045-1372
Total	44.76	

Based on the results, the proposed new conservation status of the target species was as following: i) *S. bogoriensis* Critically Endangered (CR) A1c (the current status is CR B1+2c), ii) *C. kipella* CR A1c (the Present status is Endangered (EN) B1+2c), iii) *R. wilhelminae* CR A1c (the current status is CR D), iv) *M. bogoriensis* CR A1c (the species is currently unassessed), and v) *S. biflorum* CR A1c (the species is currently unassessed). All the species were assessed using A1 criterion of IUCN Red List, meaning that at least more than 90% population size reduction was suspected during the last three generations where the causes of the reduction are clearly reversible and understood and have ceased [7]. Furthermore, the rate of the reduction was suspected based on a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality (subcriterion c).

Major anthropogenic activities was not observed during the fieldwork, except small habitat conversion observed at one transect and minor tree cutting by local people for opening a new legal hiking track. Furthermore, two invasive species were observed: markisa (*Passiflora* sp.; Passifloraceae) and harendong bulu (*Clidemia hirta*; Melastomataceae). While the first species was only found at only one transect, the second one was abundant and observed at all eleven transects. Both species usually invade gaps in the forest and prevent native plant species from regenerating. Markisa has become a

threat to the ecosystem of Mount Gede Pangrango National Park, the closest adjacent mountains to Mount Salak, and covered around 514 ha area of the national park [8]. For harendong bulu, it has been nominated as among 100 of the world's worst invaders and become a problem in many tropical forest understories [9]. For these reasons, detailed mapping and comprehensive control management planning of these two invasive species are required in order to control their distribution in Mount Salak.

4. Conservation implication

There is an urgent conservation call from endemic plant species of Mount Salak. All five endemic species were unable to be located along 44.76 km line transect. Past habitat loss was believed to be the main cause of the absent of all these species. Due to this condition, all the species were assigned as Critically Endangered according to IUCN Red List Category and Criteria, and therefore considered to be facing an extremely high risk of extinction in the wild. To conserve the endemic plant species of Mount Salak, the following actions were recommended:

1. Keep the protection level of Mount Salak as the current state or even better. We observed very minor threat from human activities, indicating a good protection state of the forest
2. Start to assess in detailed the distribution of the invasive species markisa (*Passiflora* sp.). The species has already become major problem in Mount Gede Pangrango National Park, and may soon also happen in Mount Salak if no control and management measures were undertaken. For the harendong bulu (*C. hirta*), immediate actions have to be implemented. Although the species seen to be present in the study site without causing observable changes, Gerlach [9] stated that within the next 30 years the impact of this weed on native species and ecosystems is predicted to be devastating.
3. Survey other areas of Mount Salak, especially in the side of Sukabumi Regency. This survey is needed to confirm the population status of the five target species that were unable to locate in the present study.

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