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Short communication

Possibly Extinct or Data Deficient? A challenge for conservation status assessment based on single locality: Insights from *Beilschmiedia lancifolia* Miq.

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ABSTRACT

The assessment of plant extinction is strongly influenced by the number of populations and the number of localities found for the species target. A larger population and a large number of localities, the results of the assessment will be easier to conclude. However, if the population and location of the plant are not known, even if there is only one location recorded in the herbarium, then there is a challenge in determining the final result of the assessment. This paper will reveal the challenges and the final results of the assessment where only one location is known based on the herbarium records. The species is *Beilschmiedia lancifolia* Miq. The species was first published in 1852 collected from Mount Ungaran, Indonesia. There have been no additional records of *B. lancifolia* since its first collection. To update the conservation status of the species, we conducted population assessment in Mount Ungaran using a focused survey method. In spite of the intensive surveys on each side of Mount Ungaran within the species' known elevation range, we could not find a single individual of *B. lancifolia*. Based on our findings, we proposed to add the Possibly Extinct (PE) to the present status of *B. lancifolia.*

Keywords: Challenges, Assesment, Single Locality, Endemic tree, Possibly Extinct.

Introduction

Plants is one of the important factors in the composition of forest as habitat of many organisms. Some plant species have narrow distribution and habitat specialization, they are called as endemic species. Endemic species have a high threat of extinction because these species grow naturally and exclusively, only adapting to certain geographic areas (Anderson 1994; Burlakova *et al.* 2011; Işik 2011; Foggi *et al.* 2014; Sarasan *et al.* 2006; Reed *et al.* 2011). The extinction of natural populations or entire species is caused

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by many factors such as habitat destruction and change, overexploitation, pollution and climate change leading to loss of genetic diversity. (Cuttelod *et al.* 2008; Reed *et al.* 2011; Corlett 2017).

There are several criteria for endemic species based on size and area boundaries. Some classifications of endemic species include "local endemic" (restricted to a small area), "provincial endemic" (restricted to the limits of a province), "national endemic" (restricted to the limits of a nation), "regional endemic". (restricted to a geographical region) and "continental endemic" (restricted to a continent) (Işik 2011; Ladle & Whittaker 2011). Smaller size and habitat limit population, the narrower the distribution and the greater the threat of extinction.

The latest guidelines for using the IUCN (International Union for Conservation of Nature) Red List Categories and Criteria (IUCN Standards and Petitions Committee 2022) has comprehensively described important rules and principles for undertaking conservation status assessment. However, a challenge still emerges whenever assessing poorly known species, especially with a single specimen or a single occurrence recorded in the protologue (Morais *et al.* 2013; Roberts *et al.* 2016). These particular cases are frequent in most taxa; according to Troudet *et al.* (2017) approximately 21% or species recorded in GBIF (the Global Biodiversity Information Facility) had only one occurrence. This includes many species from the plant kingdom, one of them is *Beilschmiedia lancifolia* Miq. from the Lauraceae family. This species only recorded with smaller size and habitat limit in Mount Ungaran, Central Java, Indonesia (Junghuhn *et al.* 1852).

Beilschmiedia lancifolia is a local endemic species from Mount Ungaran, Central Java, Indonesia (Junghuhn *et al.* 1852; de Kok 2021) and categorized as Critically Endangered (IUCN 2022). This species belongs to the Lauraceae family which become an important plants family in Indonesian tropical forests (Nishida 1999). Many species in this family provide valuable woods, spices, aromatic oils, and fruit. For instance *Persea americana* whereas originally from Mexico (South America) and already cultivated worldwide for its edible fruit (van der Werff & Richter 1996).

Having Critical Endangered status and limited information on *B. lancifolia* population make an *ex-situ* conservation has not been undertaken for this species as well, due to the unknown exact location of the species to access the individuals. This study were aims to assess its geographic distribution, population size and threats as well as to reassess its extinction risk based on IUCN Red List Category and Criteria. This assessment is performed to support the GSPC Conservation Action Goal. Approximately one-quarter of a million plant assessments have been compiled, but the majority of plants still unassessed. Based on these advances, the current challenge is to document the conservation status of unassessed plants, better support conservation decisions, and strive to conserve the most endangered species (Bachman *et al.* 2018). Not to mention the additional risks of anthropogenic changes such as habitat loss, degradation and overexploitation (Corlett 2016). We expect that the results of this study can serve as a basis for conservation planning and actions of the *B. lancifolia* and its habitat.

Material and methods

The locations of this study was concentrated around The Mount Ungaran (from eastern, western, northern, and southern slopes) which located in Semarang, Central Java, Indonesia (Figure 1). According to the literature that we reviewed, *B. lancifolia* has an extremely narrow distribution only in Mount Ungaran (Junghuhn *et al.* 1852; de Kok 2021). Unfortunately, there were no herbarium specimens available to determine its exact location and mark the important spot characters for easier detection during the field survey.

We conducted focused survey method (Brewer 2013) targeting *B. lancifolia* in the type locality between June to July 2021. We focused and intensified the surveys on areas with the highest potential habitats of the targeted species. The elevation range of our surveys was 900–1300 m above sea level (asl), which covered the elevation range (900-1200 m) where the type specimen was collected (Junghuhn *et al.* 1852). Interviews with local residents were also conducted to complete the description of the target species based on local knowledge. The field surveys were carried out on each slope of the mountain to confirm the presence of the species. In addition, possible threats were also recorded and documented in detail (Fig. 2A; 2B).

Result and discussion

We surveyed a total of 13 sites in Mount Ungaran (Table 1). Although the extensive surveys that we have conducted, we were not successful to find the *Beilschmiedia lancifolia*. Habitat degradation and loss was predicted to be the main causes of the absent of *B. lancifolia*. There are some evidences that the primary and secondary forests in the mountain area have been converted into agriculture and human settlement. The converted forest has the same elevation range with habitat of the targeted species. The species has not been collected again in the last 170 years. Our efforts to recollect this species also has not been successful.

The current status of *B. lancifolia* is Critically Endangered (CR) B1ab (i,ii,iii,iv)+2ab (i,ii,iii,iv) (IUCN 2022). Under the current assessment, the major defining criteria placing *B. lancifolia* in the CR category is its extremely narrow distribution. Currently it is assessed as B1, meaning its EOO is <100 km^2. The case of *B. lancifolia* is known only one locality in the Mount Ungaran represented by one record in its protologue with a single herbarium specimen

(presumably lost, we could not find the specimen). Thus, its AOO is only 2 km^2, below the 10 km^2 threshold (Bachman *et al.* 2011). The next level of assessment (a, b or c) requires at least two of three conditions to convene. Under the current assessment it is listed as 'ab', meaning it is both (a) severely fragmented or present in one location and (b) a continuing decline observed, estimated, inferred or projected in: (i) extent of occurrence, (ii) area of occupancy, (iii) area, extent and or quality of habitat, (iv) number of locations or subpopulation.

Prior to our in meticulous exploration of Mount Ungaran, we studied this genus and interviewed several

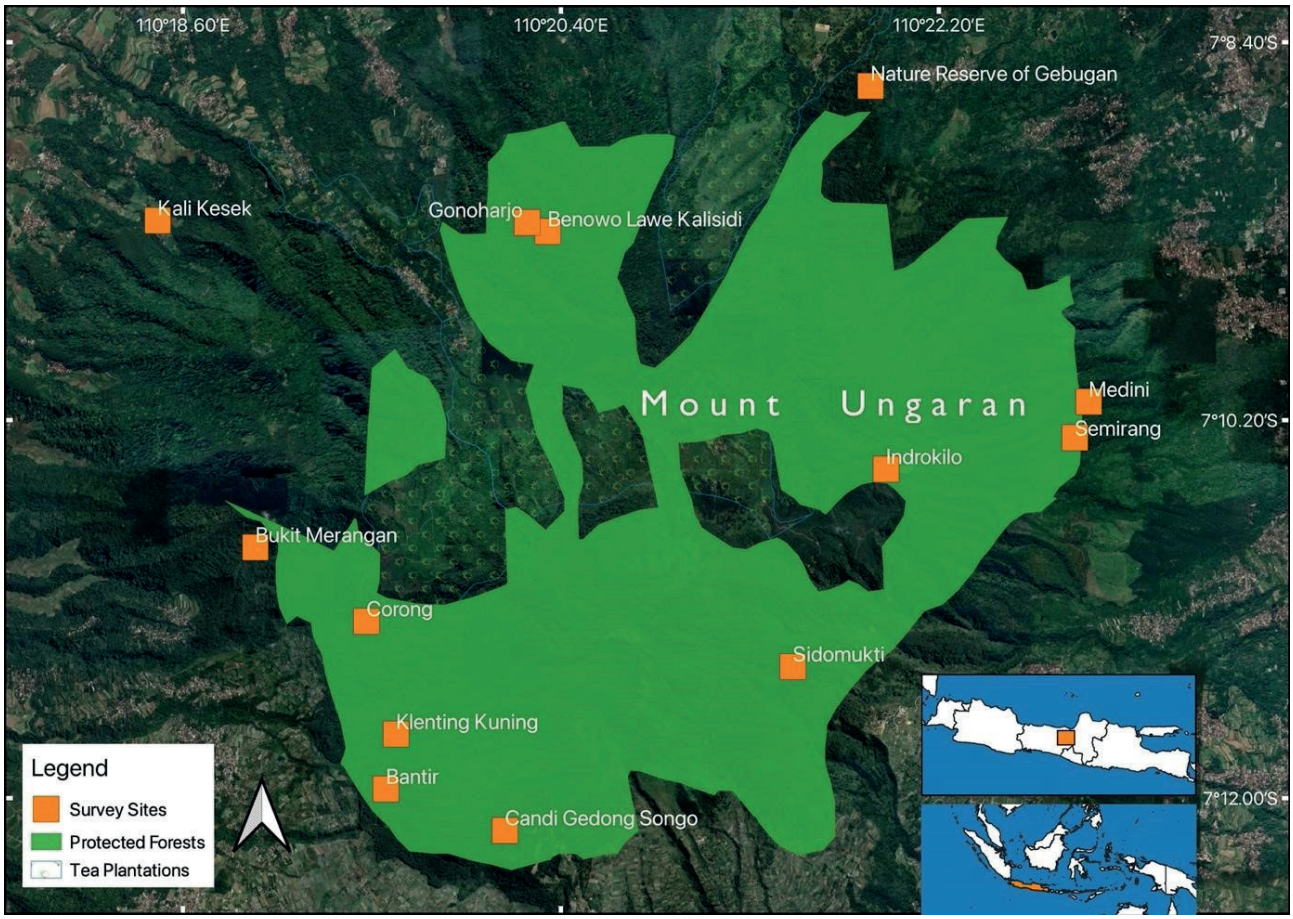

Figure 1. Research location in the Mount Ungaran, Semarang, Central Java, Indonesia.

Table 1. The assessment locations of *Beilschmiedia lancifolia*.

Area	Altitude (m alt)	Description
Semirang	800 – 900	Secondary/mixed forest
Benowo Lawe Kalisidi	800 – 1100	Secondary/mixed forest
Gonoharjo	1000 – 1200	Secondary/mixed forest
Medini	1300 – 1400	Primary forest
Indrokilo	700 – 900	Secondary/mixed forest
Nature Reserve of Gebugan	1300 – 1400	Primary forest
Bantir	1200 – 1400	Secondary/mixed forest
Candi Gedong Songo	1300 – 1450	Secondary/mixed forest
Klenting Kuning	1100 – 1300	Secondary/mixed forest
Kali Kesek	800 – 900	Secondary/mixed forest
Merangan	800 – 1100	Secondary/mixed forest
Corong	900 – 1200	Secondary/mixed forest
Sidomukti	1200 – 1300	Secondary/mixed forest

local communities to gain insight into the forest description and local knowledge of the target species. *Beilschmiedia* Nees was described by Nees von Esenbeck (Nees von Esenbeck) in 1831. With about 250 species, the genus is one of the largest in the Lauraceae family (Nishida 2001) and widespread in pantropical regions of Asia, Africa, Australia, and America (van der Werff 2003). It is related with *Cryptocarya* R.Br. and *Endiandra* R. Br. based on wood and bark anatomy (Richter 1985). The local name for *B. lancifolia* is known, namely *Wuru Kunyit* (Javanese) and *Huru Batu* (Sundanese). Junghuhn *et al*. (1852) provided a short description of *Beilschmiedia lancifolia*, which was then compared with of other *Beilschmiedia* species found in Mount Ungaran. The characters of *Beilschmiedia lancifolia* and its congeneric based on its protologue is given in Table 2.

Beilschmiedia is distinguished from other Lauraceae by alternate to opposite and penninerved leaves. Its inflorescences is paniculate or racemose and not strictly opposite at the terminal division. The flower is bisexual and trimerous with six equal to subequal tepals, and six to nine fertile stamens with 2-celled anthers. Filament usually much shorter than the anthers. Receptacle small, flat to shallowly cup-shaped. The fruits is lacking of cupules (Rohwer 1993; Nishida 1999). Most *Beilschmiedia* are trees with a high up to 25–35 m tall. However, some number of species has a high less than 15 m tall (de Kok 2016). It mostly distributes in lowland-montane forest. Thirty six species of *Beilschmiedia* were recorded from Indonesia, where six to eight of them occur in Java (POWO 2022): *Beilschmiedia assamica*, *B. gemmiflora, B. javanica, B. lancifolia, B. lucidula, B. madang, B. roxburghiana, and B. wightii* (Backer 1965; Junghuhn *et al*. 1852; de Kok 2021; POWO 2022). *Beilschmiedia lancifolia* is also used as epithet for *Beilschmiedia lancifolia,* which is distributed in Africa (Cameroon to North Angola) by Robyns & R.Wilczek. This species is a synonym of *Beilschmiedia lancilimba* Kosterm. (POWO 2022).

Forest in Mount Ungaran is under the management of a state-owned forestry company named Perum Perhutani and a small percentage of it is under the management of the Ministry of Environment and Forestry, namely the Gebugan Nature Reserve (NR). Our survey covers the entire forests of Ungaran up to Gebugan NR. Most of the forests is plantation forest dominated with *Pinus merkusii* and *Schima wallichii*. Important to note that the understorey of the forest in Mount Ungaran is dominated by plantation crops, such as *Coffea canephora* (Fig. 2A).

However, during our survey we also found two species of *Beilschmiedia* namely *Beilschmiedia lucidula* (Miq.) Kosterm. and *Beilschmiedia madang* (Blume) Blume. These *Beilschmiedia* are reported to have wide distribution in Southeast Asia, but our finding is considered as new locality for these species in Mount Ungaran, Central Java.

Based on our study, we propose to update the conservation status of *Beilschmiedia lancifolia*. Our findings indicate that *B. lancifolia* should be maintained under its current status (Critically Endangered B1ab (i,ii,iii,iv)+2ab

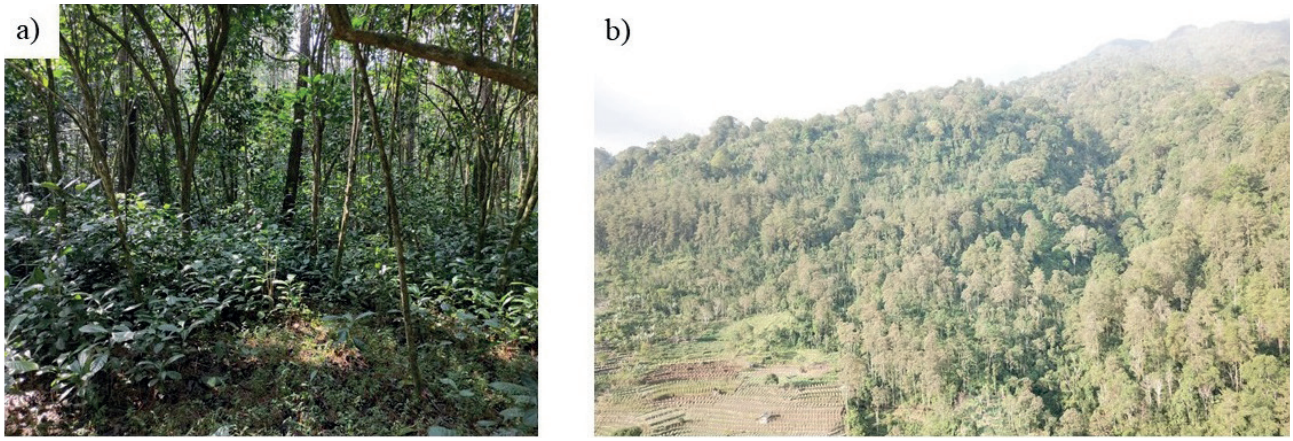

Figure 2. (A) Seedlings of *Coffea canephora* which dominates the forest floor. (**B**) The condition of the forest in the Mount Ungaran area.

Table 2. Some Differentiating Characters of *Beilschmiedia lancifolia* with *B. madang* and *B. lucidula*.

	Beilschmiedia lancifolia	*B. madang*	*B. lucidula*
Habitus	Tree, solitary	Tree, solitary	Tree, solitary
Habitat	Mixed Forest	Mixed Forest	Lowland to montane forest
Leaves	Oblong to lanceolate	Very acutely acuminate	Oblong or oblong lanceolate
Petiole length	2.5 – 2.7 cm	1.25 – 2 cm	0.6 – 3 cm
Leaf margin	Like a wave	Curving	curving and joining near margins
Leaves size	10 – 17.5 cm long; 3.75 – 4.375 cm wide	15 – 22.5 cm long; 6 – 8.5 cm wide	6.2 – 16 cm long; 1.5 – 8 cm wide
Base	Subtriplinerve	Cuneate or acute	Cuneate

(i,ii,iii,iv)) with additional tag as 'Possibly Extinct'. It means that this species is likely to be extinct, but there is a possibility that it may be extant (IUCN Standards and Petitions Committee 2022). Several evidences are found to support this judgement one of the them is habitat degradation and fragmentation due to forest conversion into agriculture and timber plantations that is observed at 1000-1300 meters asl. In addition, possible invasion of *Coffea canephora* that dominates the understorey layer of the forest which could undermine the seedlings of native species including *B. lancifolia*.

The case that occurs in *B. lancifolia* is in accordance with previous research which mentions the factors that make endemic species more vulnerable than others to anthropogenic threats and/or natural changes (Işik 2011; Coelho *et al*. 2020). This is due to limited distribution (the need for certain habitat conditions and a stable environment), small population size, population decline (only one or several populations), over exploitation by humans, low reproductive capacity. The more specific characteristics these species have, the more vulnerable they are to extinction (Işik 2011; Foggi *et al.* 2014).

Climate is also one of the dynamics in the preparation of diversity in addition to habitat destruction. More specifically, climate change that occurs is estimated to have a relationship with species dynamics at a location (Jentsch & Beierkuhnlein 2003). Parmesan (2006) states that temperature increases due to climate change are expected to have an impact on plant diversity and distribution at all levels from single species to biomes. An increase in temperature also has the potential to change the quality and cause habitat instability that can cause species loss, changes in species diversity, abundance and distribution (Enquist 2002; Davis *et al.* 2005; Malcolm *et al.* 2006; Lovejoy 2008; Jump *et al.* 2009; Kreyling *et al.* 2010). Walther *et al.* (2002) states that climate change can change population dynamics in native species, can increase climate-mediated biological invasion of other species, change interactions and community structures, and ecosystem functions.

Small changes in temperature along the altitude gradient allow a species to adapt and stay within its tolerance limits, forcing them to move to new environmental conditions (Kidane *et al.* 2019). However, considerable warming is likely to result in a shift in altitude range through dispersal or migration and result in local population loss meaning extinction in the case of spatially delimited endemic species (Enquist 2002; Davis *et al.* 2005; Malcolm *et al.* 2006; Steinbauer *et al.* 2018).

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Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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