ENDEMIC PLANTS OF MT. RINJANI: AN OUTLOOK TO THE CONSERVATION STRATEGY

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W Wardani, A Hidayat, EF Tihurua, A Kartonegoro, LD Sulistyaningsih, ES Kuncari & EB Walujo. 2012. Tumbuhan Endemik di Gunung Rinjani: Tinjauan Terhadap Strategi Konservasi. *Floribunda* 4(5): 107–112. — Gunung Rinjani diyakini merupakan sumber utama keanekaragaman tumbuhan di Pulau Lombok. Hal ini disebabkan pesatnya perubahan fungsi lahan di dataran yang lebih rendah di pulau tersebut, terutama untuk kebutuhan pertanian. Walaupun jenis-jenis endemik diperkirakan kurang dari 50 % dari total jumlah jenis tumbuhan lokal, kelompok ini sangat penting untuk konservasi. Hal ini disebabkan kurangnya informasi yang telah diketahui terhadap jenis-jenis tersebut sedangkan pada saat yang sama habitatnya terancam oleh aktifitas pariwisata, terutama pada jalur yang menuju ke kaldera. Strategi konservasi yang memastikan kelestarian jenis-jenis ini perlu segera ditetapkan. Dalam tulisan ini dipaparkan kehadiran jenis-jenis endemik di Pulau Lombok berdasarkan rekaman spesimen herbarium dan berbagai pustaka, berikut usulan-usulan untuk disertakan dalam strategi konservasinya.

Kata kunci: Endemik, Pulau Lombok, Gunung Rinjani, strategi konservasi.

W Wardani, A Hidayat, EF Tihurua, A Kartonegoro, LD Sulistyaningsih, ES Kuncari & EB Walujo. 2012. Endemic Plants of Mt. Rinjani: An Outlook to the Conservation Strategy. *Floribunda* 4(5): 107–112. — Mount Rinjani, lies in the island of Lombok, is believed as the major source of plant diversity in the island today. This is caused primarily by the rapid land conversion on the less steep plains for agricultural industries. Although in sum of less than 50% of the estimated native plant species, the endemic inhabit the mountain area is of important in conservation since very limited information known to these species. At the same time, the habitat is threaten by tourism activities, mainly on the tracks lead to the caldera. There is an urgent need to esta-blish a working conservation strategy to ensure the sustainability of them. In this paper, the occurrence of endemic species based on herbarium records and literatures with the proposed conservation strategy is discussed.

Keywords: Endemic, Lombok Island, Mt. Rinjani, conservation strategy.

The island of Lombok, lies on the eastern side of Bali, is very well-known for its unique volcano Mt. Rinjani. The mount has the highest top on 3726 m, the ± 1100 m^2 water filled caldera and a newly emerging mount at the south-eastern side of the lake attracts thousands of visitor per year (Monk et al. 2000; BTNGR 2008). The tourism activity is one of the most important forms of economic developments in the area. Nevertheless, the mount is also the only source of plant richness in the island. Mt Rinjani as a mountainous area consist of steep hills, occupy at least 20 % area of Lombok, centred at the northern side of the island. Since the rest part of the island nowadays is converted mostly into agricultural field (Monk et al. 2000), this high plain is the only source of wild and native plant. The area has been signed as a national park in 1997 (Ministry of Forestry decree No. 280/Kpts-II/1997) which is also elevating its popularity among international visitors (Goodwin 2000). As apply to other sites, this status is expected to preserve biodiversity and its ecosystem in supporting the life of people in its surrounding (Government Regulation No.68 of 1998). However, disturbances are still on going in the boundaries, in the form of illegal hunting, illegal farming and encroachment.

The Flora in the region are least known. There are several unrelated- botanical explorations or ecological researches of which never ended up in a complete flora (see anex 2 in Monk et al 2000). Steenis (1979) and Kalkman (1955) compile and discussed the flora within the Lesser Sunda Island, which at present are still considered as the main references for the region. The most recent extensive botanical exploration in Lombok Island done by Tobe et al. (2010) between 2003–2005. The trips were resulted in a list of species identified through barcoding that is expected as an initial step toward a more exact identification.

Therefore, more botanical researches are needed to establish a working list of flora in Lombok Island, particularly Mt. Rinjani. Endemic plants distributed in a relatively small range, either restriction driven by edaphic or evolutionary factors (Ferreira & Boldrini 2011). They are prone to habitat disturbances, especially which induced by human (Andersen et al 1997). It is often stated that these species might be given priority for conservation (Meuser et al. 2009; IUCN Standards and Petitions Subcommittee 2010). Lombok Island has the largest percentages of endemic plant compare to other islands in the Lesser Sunda arch (Steenis 1979). Some of these endemics were firstly discovered in area near to major tracks lead to the caldera. Regarding the issue of tourism as a threat to biodiversity in Lombok Island, the discussion in this paper focus on the endemic plants inhabit Mt Rinjani, and the strategy for site conservation.

METHODS

The research were carried through examining available specimens in the Herbarium Bogoriense (BO), which is the Indonesian national herbarium, and extracting data out of various literatures, including the antiques and protologs. There are ca. 2000 sheets of specimens examined including type specimens. These were then confirmed to available flora (i.e. Flora Malesiana) and other published revisions. We also compiled data from old literatures which reported explorations done by botanist in the island (e.g. Elbert, Rensch, etc.) and confirmed the listed species for their current accepted name and status. Some of the specimens cited in these antiques are not available in BO. The list were reconfirmed through checking the Plant List available online (www.theplantlist.org).

We carried on two trips to Mount Rinjani on April and July 2012 to locate and sample the listed species as possible. First trip covered the rain forest of Senaru and up to the caldera, northern part of Mt. Rinjani. The second trip was held to explore sites around Psugulan, Sebau, Pusuk, Sajang and Sembalun Lawang, east and northeastern part of the mountain. Those locations were chosen based on our initial list of endemic plant (Figure 1). We are unable to extend the trip to cover whole part of the mountain due to time and resources limitation.

RESULT

There are 36 endemic plants from Mt. Rinjani as listed in Table 1. These records are mainly derived from botanical publications, working with specimen collected on major exploration in the

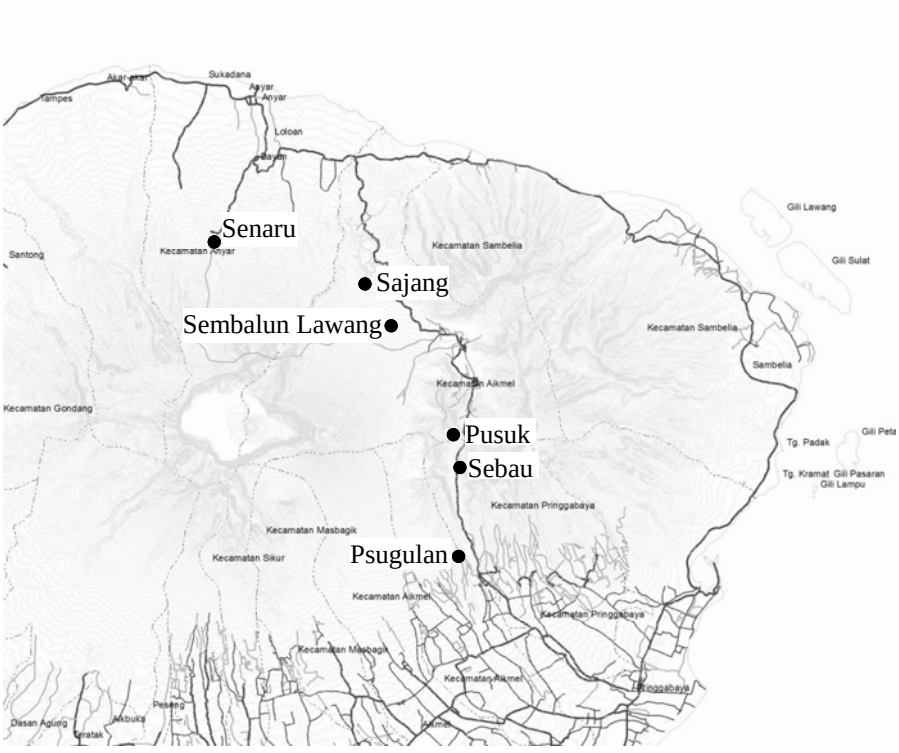

Figure. 1. Map showing sites (black dots) where the trips start at Mt. Rinjani. The caldera were reached through Senaru track.

island. The number of species in the list is less than 50 % of Lombok Island flora recorded in Tobe et al. (2010). About 1/6 of the list are under-specific variation. Piper, orchids and composites are dominating the list, as our source of literatures are fairly limited. Whenever more publication could be accessed, this list might be even longer and cover more taxa. Some of their taxonomical status is doubtful or unresolved according to The Plant List (www.theplantlist.org). The trips were unable to locate most of the species in the list. Either caused by imperfect time of flowering or their population is extremely small and confined, as many of them are known only from the type. Some locations such as Sapit, Sembalun, Psugulan has been closely populated which narrow down the possibility of finding endemic flora. There are few specimens still under examination for their correct identity.

We also found that the mountain is heavily visited during the peak time which may disturb the ecosystem to some extent, such as litter, fire, physical damages that could prevent seeds or juveniles from growing and the introduction of invasive species. Enclave inside the area of national park and the main road that connect the place with its neighbouring villages also become an easy access for illegal encroachment activities. The hot spring at Sebau often visited freely by local people. They believe that the spring will cure some disease or health problem whenever the clothes they wear for bathing discarded on the site. This has rising moderate litter issue that would leads to subsequent impacts. Habitat conversion is a persistent threat along the national park boundary where encroachment and expansion by the local people might be secretly carried on.

DISCUSSION

Steenis (1979) mentioned that the endemic plants in the Lesser Sunda Islands are drought tolerance species which could stand long term of drought, usually from May to October. However, the recently published endemic Begonia (Girmansyah 2008) is not likely species with such character. This proves that the flora in Lombok is insufficiently studied. Steenis (1979) and Monk et al. (2000) also stated that the largest plant endemism among the Lesser Sunda Island is present in Lombok Island. This might be due to the presence of Mt. Rinjani which is the highest mountain in the islands. In the mean time, it is believed that endemism correlated with species richness. An area with higher species richness would likely to have higher degree of endemism (Kerr 1997; Roos et al. 2004; Raes et al. 2009). However, Lombok Island has lesser diversity of plant species compare to Flora of Sumbawa (Steenis 1979; Monk et al. 2000). This also shows the uniqueness and importance of Mt. Rinjani as the source of plant diversity. Monk et al. (2000) mentioned that the low level of endemism above species rank is corresponded with the island recent geological formation. This is confirmed through the fact that 1/6 of our list are under specific variation. This also means that the endemics in Lombok Island are neoendemics, i.e taxa with recent origin with distribution that may expand and genetic diversity that may increase (Ferreira & Boldini 2011). However, those species might also be edaphic or narrow endemic that is still unknown for the cause of their restricted distribution without sufficient investigation. Nevertheless, their existence emphasizes the uniqueness of Mt Rinjani, and Lombok Island for the larger scope, where the site is a suitable natural laboratory for evolution and ecological studies.

The critical point in the issue of endemism is taxa delimitation. As some authors has discussed (Isaac et al 2004; Morrison III et al 2009) the work of taxonomist are highly crucial for the fate of taxa in conservation. The results of taxonomic work are a strong basis for the assessment whether or not a taxon is a distinct entity with a true restricted distributional range. Some of our initial listed endemic species are finally must be excluded as a revision on the taxa has being done and concluded that they are only a synonym of a more widely distributed species. In the contrary, for taxa of which revision is never being conducted, new species and endemics might be present among those plants that previously identified as common species. This point out the importance of botanical works to be accomplished whenever a long-term conservation goal is intended to be achieved. The understudied flora in Mt Rinjani are facing threats, despite its status as a national park protected area. Most of the threats are in the form of physical disturbances by the heavy visit during high peak time or quite rarely, volcano activities. The mount visitors may also bring viable seeds or spora of invasive alien species from elsewhere. Whenever these invasive are spreading, almost little chance for native restricted flora would survive.

Coping with this threat requires careful arranged strategy for conservation. Considering the value of endemic plant species as part of Mt. Rinjani' distinctive feature, these species must be re-

Table 1. List of endemic plant species of Mt. Rinjani with their locality and the source of publication

No	Family	Species	Location	Reference
1	*Acanthaceae*	*Strobilanthes renschiae*	Pussuk Gebirges (Pussuk forest Sembalun)	Wood et al. 2003
2	*Asteraceae*	*Gynura elbertii*	Segara anak, Sangkareang	Koster 1935
3	*Asteraceae*	*Senecio lombokensis*	Rinjani, Psugulan, Plawangan, Kembang Kerang	Koster 1935
4	*Asteraceae*	*Vernonia albifolia*	Rinjani, Sajang, Sembalun	Koster 1935
5	*Asteraceae*	*Vernonia tengwallii*	Rinjani	Koster 1935
6	*Begoniaceae*	*Begonia lombokensis*	Jeruk Manis Waterfall, South Rinjani	Girmansyah 2005
7	*Begoniaceae*	*Begonia multibracteata*	Senaru, N Rinjani	Girmansyah 2005
8	*Clethraceae*	*Clethra javanica* var. *lombokensis*	Rinjani	Sleumer 1971
9	*Convolvulaceae*	*Stictocardia cordatosepala*	Rinjani, Sapit, Poesoek, Swela	Ooststroom 1953
10	*Cucurbitaceae*	*Pilogyne elbertii*	Sembalun	Wilde & Duyfjes 2010
11	*Flacourtiaceae*	*Flacourtia inermis* var. *rindjanica*	Rinjani	Sleumer 1954
12	*Gentianaceae*	*Swertia oxyphylla* var. *parvula*	Rinjani caldera	Geesink 1973
13	*Hymenophyllaceae*	*Hymenophyllum elberti*	Sangkareang, Rinjani	Rosenstock 1912
14	*Orchidaceae*	*Dendrobium eriiflorum* var. *lombokense*	Kalimati, Sembalun; Tengengah	Smith 1925
15	*Orchidaceae*	*Dendrobium rindjaniense*	Segara Anak, Rinjani	Smith 1925
16	*Orchidaceae*	*Oberonia elbertii*	Tengengeah, Rinjani	Smith 1925
17	*Orchidaceae*	*Peristylus elbertii*	Kalimati, Sembalun	Smith 1925
18	*Orchidaceae*	*Peristylus lombokensis*	Pussuk	Smith 1909
19	*Orchidaceae*	*Peristylus rindjaniensis*	Tengengeah, Rinjani	Smith 1925
20	*Orchidaceae*	*Thrixspermum lombokense*	Sangkareang, Rinjani	Smith 1925
21	*Orchidaceae*	*Vanda lombokensis*	Sembalun	Smith 1925
22	*Pandanaceae*	*Freycinetia lombokensis*	Pussuk Gebirges (Pussuk forest Sembalun)	Markgraf 1929
23	*Piperaceae*	*Piper aberrans*	Sapit-Swela, SE Rinjani	Hallier 1914
24	*Piperaceae*	*Piper curtilimbum*	Kembang Kerang, SE Rinjani	Hallier 1914
25	*Piperaceae*	*Piper kalimatina*	Kalimati, Sembalun Lawang, E Rinjani	Hallier 1914
26	*Piperaceae*	*Piper mollicaulis*	Sadjang Forest, NE Rinjani	Hallier 1914
27	*Piperaceae*	*Piper pubicaulis*	Tengengean, Sembalun Lawang, E Rinjani	Hallier 1914
28	*Piperaceae*	*Piper reflexa* forma *nana*	Tengengean, Sembalun Lawang, E Rinjani	Hallier 1914
29	*Piperaceae*	*Piper rigidicaulis*	Sadjang Forest, NE Rinjani	Hallier 1914
30	*Piperaceae*	*Piper rindjanense*	Kembang Kerang, SE Rinjani	Hallier 1914
31	*Piperaceae*	*Piper sapitense*	Sapit, Pussuk	Hallier 1914
32	*Piperaceae*	*Piper tenuipeduncula*	Tengengeah, E Rinjani	Hallier 1914
33	*Pteridaceae*	*Pteris tremula* var. *cheilanthoides*	Segara Anak Lake, Rinjani	Rosenstock 1912
34	*Symplocaceae*	*Symplocos brandisii* var. *pseudoclethra*	Sadjang Forest, NE Rinjani	Nooteboom 1977
35	*Tectariaceae*	*Tectaria lombokensis*	Rinjani	Holttum 1991
36	*Verbenaceae*	*Clerodendrum hettae*	N, E & SE Rinjani	Hallier 1918

corded for their exact location and population size. This will be the basis for site protection and consideration of "re-routing" tracking pathways, whether for conservation or for ecotourism and educational display. Evaluation on the present pathways would help to prevent the endemics from diminishing caused by physical disturbances or out-competed by invasive species. Involving local people is essential, especially those who are engage in guiding tourists or other related activities. Visitor would appreciate their guides' knowledge on important species such as these endemics as well as economic plants. The role is also important in delivering conservation messages. The authority must ensure that their guides have sufficient knowledge and dedication to the sustainable ecosystem.

Nonetheless, studies in botany, ecology or other major around the site must be promoted. This activity is expected as an alternative way in monitors their existence and progression. Every newly generated data would lead to a better decision in management and conservation. *Ex situ* conservation might be initiated once vital environmental factor to grow the seed and nourish the juvenile are known through such observation. There are more ways to be explored once we start with reliable data, as this endemic plants list, to enhance the popularity of Mt. Rinjani in positive and sustainable approach.

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