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Habitat *Anaphalis* spp. in Tourism Area in Bromo Tengger Semeru National Park, East Java

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Abstract

The conservation of *Anaphalis* in mountain area in Bromo Tengger Semeru National park requires basic understanding of habitat profiles. The aim of the research was to describe the habitat profile of *Anaphalis*spp. population in mountainousarea oftheBromo Tengger Semeru National Park. This research confirmed that three Anaphalis were identified, namely *Anaphalis javanica*, *Anaphalis viscida* and *Anaphalis longifolia*. These species werefound at Penanjakan, Mt. Batok, and Ranu Kumbolo. The habitat of *Anaphalis* in the study area were influenced by volcanic activities. Anaphalis grows in silty loam, loam, sandy-silt loam and sandy loam soils with high competition with weeds and exotic plant species. Exotic-invasive species such as *Agrostis* sp., *Imperata cylindrical*, *Pteridium* sp., *Alchemilla* sp. *Eupatorium* sp. and *Leucaena* sp. played an important role as a competitor to *Anaphalis*spp populations in wild area. The conservation of *Anaphalis* in natural habitat requires significant action to minimize invasive plant species in Anaphalis's habitat.

Keywords: Biodiversity, Edelweiss, Invasive species, Mountainous plant

INTRODUCTION

Anaphalis is one of the endangered taxa in mountain regions in East Java. There are three species of *Anaphalis*has beenrecorded from Java mountain regions, namely *Anaphalis javanica*, *Anaphalis viscida* and *Anaphalis longifolia* [1]. *Anaphalis* contributes significant role in ecological process and socio-cultural benefit. Naturally, *Anaphalis* is one of the component of vegetation in mountain area and is found in volcanic soils. The population of *Anaphalis* has been considered as pioneer species in mountain ecosystem process. Such population can colonize open area in volcanic soil in mountainous region, in which many plant species unable to grow in such soils [2;3;4]. *Anaphalis* produce beautiful flower to build the beauty scenic of mountain landscapes. Pollinator insects interacted with the flower of Anaphalis, indicated the important of ecological role of *Anaphalis* in wild habitat [5]. Among those species, *Anaphalis javanica* has received considerable attention as an attractive flora among nature lovers. Since the uniqueness and attractiveness of the flower, the flower of *Anaphalis javanica* is often illegally collected by tourist [6]. Culturally, *Anaphalis longifolia* is important species among Tenggerese in Tengger Highland, in which this species is used as one of the offering materials in cultural and spiritual ceremonials [7]. While *Anaphalis* has vital role in mountain ecosystem, the natural population of the species are recently under serious threats.

Recent studies indicate that habitat disturbance of *Anaphalis*have increased significantly. Declines of population in the wild arecommonly resulted from several aspects, including illegal harvestingand forest fire. Illegal harvesting are associated with the uncontrolled tourist vandalism to illegally pick up flower of edelweiss [6;2]. Fire in natural habitat have a special role. Apart from its ecological benefits, fire also provides significant negative impact to wild population in the wild [8]. Decline of population in the wild also associated with the increase of exotic plant species in *Anaphalis* habitat. Pressure of the Anaphalis population has been documented in Ranupani area, in which *Anaphalis* population grows under dense population of *Euphatourim inulifolium* [3].

Decrease of *Anaphalis* population in the wild led to the decrease of aesthetic value of the sites. Ecologically, it is also decrease natural vegetation

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succession processes in mountain ecosystem. To date, there has been little works and discussion on the recent habitat of *Anaphalis* in mountain area in Java Island, especially in Bromo Tengger Semeru area. The conservation effort of Edelweis in Bromo Tengger Semeru area is important. Significantly, it is also related to the effort to conserve *Anaphalis* as natural resources attraction in ecotourism program [9;10]. In Bromo-Tengger Semeru area, lack information about *Anaphalis* habitat may make it impossible to design the proper conservation strategy of *Anaphalis* population, especially in tourism area of the park. The conservation of Anaphalis in tourism area in Bromo Tengger Semeru National Park was important because tourism activity potentially contributes to Anaphalis population. Effort to sustain the wild *Anaphalis* population in natural habitat may require the basic data regarding habitat characteristics, especially the soil and its vegetation structure. Therefore this research aimedto describe the recent habitat qualityof *Anaphalis* in the Bromo Tengger Semeru toward conservation purposes.

METHODS

Study Area

The study was set up at highland area of Bromo Tengger Semeru National Park, East Java. The forest area comprise of three ecosystem, namely lower mountain forest, upper mountain forest and sub-alpine ecosystem [11;12]. Biologically, the biodiversity level of the area very high and many habitat have been considered as crucial habitat for particular species population sustainability. Bromo Tengger Semeru National Park has been known as hot spot area for orchids, in which many of them endemic to the park area [13;11]. The park is habitat for many rare species, including *Dacrycarpus imbricatus* [14]. The park provides ideal habitat for numerous fauna, ranging from invertebrates to vertebrates.

The park is the favorites tourist destination in Indonesia, in which it is visited by international and domestic tourist. Mass tourism reported occurs in Penanjakan point with the interested object was the outstanding landscape of Mt. Bromo and Tengger caldera with Mt. Semeru as background. Some famous nature-based tourism point in the park area are including Penanjakan, Bukit Kingkong, Bukit Cinta, Caldera Tengger, two lakes in Ranupani area (Ranupani and Ranu Regulo Lakes), Lake Regulo and Mt. Semeru [6;10]. Two villages located inside the park, namely Ngadas and Ranupani Villages. These villages inhabited by local called Tenggerese. In Tenggerese ritual, Anaphalis is one of the crucial material for offering, in which it is often collected from natural habitat. Almost indigenous people are farmer.

Field study was set up at three sites in BTSNP, namely Penajakan, Mount Batok and Ranu Kumbolo. In order to generate the physical and chemical characteristics of soil, soils were sampled from Penanjangan (6 sites), Mt. Batok (1 site), and Ranu Kumbolo (3 sites). The soil surface with 10 cm in depth was collected using stainless steel spoons. Collected sample soil were air-dried, then sifted with 2 mm sifter for analyses of soil texture. Soils texture were evaluated on the contents of sand, ash, and ansilt composition. A vegetation survey was conducted at 11 sites through the establishment of 1x1 quadrates. Plant species grows inside quadrates were identified based on morphological characters. In each quadrate, plant cover, density and frequency were assessed for determining dominancy (IVI).

RESULT AND DISCUSSION

Natural Distribution

In the spatial context, the observed sites were located at volcanic zones of the park. Mt Bromo has been identified as one of the most active volcanoes in the recent decades, with the last eruption in the early 2016 destroy vegetation and disturbs tourism industry in the area. Impact of the active eruption of Mt. Bromo contributes to the soils characteristics of the area, especially in Penanjakan and Mt. Batok (Table 1). Active eruption of Mt. Bromo increase the percentage of sands and silt in soils around the mountain area. Depend on the distance of eruption impact, the percentages of sand and silt may varies among sampling sites.

Table 1. Soil characteristics of *Anaphalis* habitat

No	Sampling sites	Percent of			Commons names of soils
		Sand	Silt	Clay	
1	Penanjakan1	32	60	8	Silty loam
2	Penanjakan2	46	46	8	Loam
3	Penanjakan3	8	50	42	Sandy-silt loam
4	Penanjakan4	35	58	7	Silty loam
5	Penanjakan5	37	54	9	Silty loam
7	Penanjakan6	43	47	10	Loam
8	Mt. Batok	48	52	0	Silty loam
9	Ranu Kumbolo1	63	31	6	Sandy loam
10	Ranu Kumbolo2	65	21	14	Sandy loam

11	Ranu Kumbolo3	59	27	14	Sandy loam

Penanjakan and Mt. Batok located at the giant Tenger caldera and in the case of Mt. Bromo eruption these area received significant volcanic material from the eruption process. After eruption, ash and sand often cover soils and vegetation. The thickness of ash are significant to vegetation survival. In Mt Batok and Penajakan, the low organic carbon contributed to the limiting number of plant to grows.

Soil is one of the vital component in plant population conservation. There are aso relationship between plant community and soil [15]. The soil structure has significant impact to the *Anaphali s*sp population in natural habitat. Volcanic activity of Mt Bromo is considered the significant real contributor to the recent soil composition in Penanjakan and Mt. Batok. These lead to soil composition dominated by sand and dust. Recent soil physical characteristics in Ranu Kumbolo reflect the past geological process of the area, especially the active eruption of Mt. Semeru. Eruption frequency has an important influence on the physical and chemical characteristics. These can be shown by dominant eruption materials in area that area affected by eruption. Few species able to grow in volcanic soil areainfluenced by volcanic ash. Anaphalis is one of the pioneer species which is able to colonize volcanic desert land [16], and in many case it is one of the important pioneer species in volcanic ecosystem [17;18; 11].

Table 2. Chemical Aspect of Soils of *Anaphalis* Habitat

No	Sites	pH	C organic	N Total	C/N	K	Na	Ca	Mg
1	Penanjakan1	4.5	1.75	0.17	10	0.07	0.21	5.20	1.10
2	Penanjakan2	4.6	0.16	0.03	5	1.02	1.31	7.40	1.42
3	Penanjakan3	4.6	0.40	0.13	5	1.80	1.43	5.04	2.52
4	Penanjakan4	4.5	1.99	0.17	12	0.03	0.32	4.88	1.73
5	Penanjakan5	4.5	1.83	0.17	11	0.08	0.33	4.41	1.25
7	Penanjakan6	5.4	0.08	0.04	2	1.39	2.00	7.09	5.20
8	Mt. Batok	4.5	0.26	0.04	6	0.16	0.15	1.59	0.21
9	Ranu Kumbolo1	5.4	1.03	0.08	13	0.05	0.18	2.76	0.05
10	Ranu Kumbolo2	5.5	1.73	0.19	9	0.07	0.31	6.50	1.06
11	Ranu Kumbolo3	5.1	2.25	2.25	10	0.12	0.22	4.54	1.06

Table. 3. Five Species with Highest Important Value Index (IVI) in Study Area

Sampling sites	Species with high IVI	IVI value in %	Notes
Penanjakan	*Agrostis* sp.	51.87	Serious weeds
	Anaphalis javanica	24.05	Native species
	Diplycosia sp.	16.44	-
	Anaphalis longifolia	16.16	Native species
	Anaphalisviscida	14.26	Native species
	Solanaceae	11.19	-
	Vaccinium sp.	10.73	Native species
Mt. Batok	*Imperata cylindrica*	84.96	Serious weeds
	Pteridium sp.	67.80	Serious weeds
	Anaphalis longifolia	40.60	Native species
RanuKumbolo	*Agrostis sp.*	66.11	Serious weeds
	Pteredium sp.	32.87	Serious weeds
	Anaphalis longifolia	26.75	Native species
	Anaphalis javanica	22.49	Native species
	Anaphalisviscida	16.32	Native species
	Imperatacylidrica	13.99	Serious weeds
RanuRegulo	*Alchemilla* sp.	43.53	Serious weeds
	Imperata cylindrica	37.58	Serious weeds
	Anaphalis javanica	30.05	Native species
	Pteridiumaquilinum	18.95	Serious weeds
	Eupatorium sp.	10.18	Invasive weed.
	*Leucaena*sp	10.18	-
	Rubia sp.	10.18	-

Vegetation Profiles of *Anaphalis* Habitat

Although there are differences in vegetation composition, general aspect of soils shows similarities. Soils was characterized by poor organic matter (Table 2). Difference vegetation structure in sampled area is a function of soil, rainfall intensity, fires in natural habitat and introduction to exotic plant species. Weeds abundance in study area, represent the natural condition of heavy habitat disturbance of *Anaphalis* (Table 3). Exotic plant species abundance in Penanjakan, Mt. Batok and Ranu Kumbolo. *Agrostis* is known as cosmopolitan genus which are able to grow in many area. Agrotis has been considered as noxious species in Africa, in which it is able to grow in numerous habitat, including grassland, forest and wetland. The species considered as apioneer species in degraded lands, tolerant to drought and fire. This situation was ecologically, unfavorable for *Anaphalis* population conservation in the wild. The abundance of exotic plant species also contributed to the forest fire. The dry leaf of *Imperata cylindrica* and *Pteridium* sp. Also contributed to the forest fire.

Exotic and invasive plant species in mountain area has beenrecently found in mountain area [19; 20; 21]. Some treats to *Anaphalis*in Bromo Tengger Semeru area come primarily from fire. Forest fire is often coupled with dry seasons and dried plant biomass in particular area. Dried plant biomass are important element of any forest fire incidents, especially in grassland area. Among the important species in grassland fire, *Imperata cylidrica* is flamable species [22]. Vegetation of Tengger caldera is predominantly formed from shrubs and herbs which are easily burned in dry periods.

CONCLUSION

Three species of Anaphalis in Bromo Tengegr Semeru area in Penanjakan, Mt. Batok and RanuKumbolo. The population of Anaphalisspp grows in volcanic soil with poor organic matter. There are high pressure of invasive species. The habitat was invaded by *Agrostis* sp., *Imperata cylindrical*, *Pteridium* sp., *Alchemilla* sp. *Eupatorium* sp. and *Leucaena* sp. Invasive species control and eradication in Anaphalis habitat is required as a strategy to enhance the population of *Anaphalis* spp as endemic species with limited population number in Bromo Tengger Semeru .

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