

Research Article

Conservation strategy of *Anaphalis* spp. in Bromo Tengger Semeru National Park, East Java

Filza Yulina Ade ¹, Luchman Hakim ^{2*}, Estri Laras Arumingtyas ², Rodiyati Azrianingsih ²

¹ Biology Education Study Program, Faculty of Teacher Training and Education, University of Pasir Pengaraian, Rokan Hulu 28457, Indonesia

² Department of Biology, Faculty of Mathematics and Natural Sciences, Brawijaya University, Malang 65145, Indonesia

Article history:

Submission August 2020

Revised November 2020

Accepted January 2021

*Corresponding author:

E-mail: luchman@ub.ac.id

ABSTRACT

The wild population of *Anaphalis* spp. in Bromo Tengger Semeru National Park (BTNSP) has been reported decreased significantly. A combination of natural disturbance and anthropogenic factors contributes to the recent wild population decrease. A formulation of conservation strategy to ensure the sustainability of *Anaphalis* spp. require data and information related to external and internal factors determines the recent population in wild habitat. The objective of the paper was to identify factors related to conservation strategy of *Anaphalis* in BTNSP. This study found internal factor related to strength includes the existence of species and value of *Anaphalis* spp., while the weaknesses include increase of habitat degradation and disturbance caused by tourism activities. The opportunities for conservation include support of policy in biodiversity conservation and increase of ecotourism movement, while the threats aspect include less control of land uses changes and increase of mass tourism. The SWOT analyses recommends some significant strategy which are derived from combination of enhancing strength to optimizing opportunities, reducing weaknesses and optimizing opportunities, enhancing strength to reduce threats and managing weaknesses to manage risk.

Keywords: Edelweiss, Tourism impact, Nature conservation, SWOT

Introduction

Indonesia is home to numerous biodiversity, in which it has been known contributes to global and regional ecosystem. Many biodiversity has been known as species with high economical value. Scholars point out that biodiversity is also important to cultural aspect of many local community in Indonesia. Biodiversity has been viewed as a crucial resources for national and local development, and therefore it is important to promote biodiversity conservation [1, 2].

Threats to biodiversity has been identified numerous, ranging from low community appreciation to biodiversity to rapid ecosystem degradation in both terrestrial and aquatic. Decrease of forest has been intensively studied and conclude that it is contribute to biodiversity decrease [3]. Numerous planning and action has been proposed to minimize and reduce potential threats. The scientific

information from individual genetic to its habitat and ecosystem in landscape context has been studied. Approach for endemic species conservation has been proposed through the ecosystem management challenges. From numerous case studies, however, general strategy which are generated from SWOT analysis to support environmental management and biodiversity conservation has been widely proposed and implemented [4, 5]. This strategy has been formulated based on the internal and external aspect related to the conservation target [6]. This proposal has been reported useful and success in implementation. In Indonesia, however, few studies related to SWOT analysis has been conducted to support conservation program.

In Bromo Tengger Semeru National Park (BTNSP) in East Java, *Anaphalis* spp. is one of the

How to cite:

Ade FY, Hakim L, Arumingtyas EL, Azrianingsih R (2021) Conservation strategy of *Anaphalis* spp. in Bromo Tengger Semeru National Park, East Java. Journal of Tropical Life Science 11 (1): 79 – 84. doi: 10.11594/jtls.11.01.10.

important species among Tenggerese community who lives in Tengger Highland. The species was used as an important material in cultural events, especially plans as offering. According to local belief, *Anaphalis* has specific meaning, in which it should be appear in offering. Local community collect wild *Anaphalis* in some amount of leaf and flower and maintain population sustainability for the next usage. Among young domestic tourist and nature lover, *Anaphalis* spp. was collected and take home as dried flower [7-10].

Anaphalis spp. ecologically grows in poor volcanic soils and reported as crucial pioneer species in volcanic ecosystem. Previous studies report that [11]. The sustainability of *Anaphalis* wild population not only important in the succession process in upper and sub-alpine mountain area, but it is also important to preserve local culture. As far, many wild population of *Anaphalis* was under threats. Strategy to support *Anaphalis* population sustainability in the wild population therefore important. The aims of the research were to identify factors related to conservation strategy of *Anaphalis* in BTSNP.

Methods

Field survey was conducted at BTSNP. The park is one of the homes to numerous mountain biodiversity. Numerous outstanding landscapes was found in the park, support the geotourism development in BTSNP [7, 9, 10]. Four location in BTSNP in which population grows were visited to examine the recent condition of population. Field survey and literature study was conducted mainly to collect data related to strength, weaknesses, opportunities and threats related to *Anaphalis* spp. conservation strategy. We focus to identify factor related to the strength and weaknesses of wild population through direct observation and literature survey. An interview with national park ranger, local community and tourist were implemented to generate additional data related to the strength and weaknesses of wild population [6].

In determining aspects related to strength weaknesses aspects, focus of the aspect was covers all of the internal conditions from individual to ecosystem quality in Bromo Tengger Semeru National Park. In determining aspect related to opportunities and threats, focus of the survey were includes external aspects which are potentially related to the success of *Anaphalis* spp. conservation programs. Mainly, it is ranging from conservation policy and other issues related which are contributes to *Anaphalis* spp. conservation. In order to identify aspect related to threats, external aspect

which area contribute to the decrease of *Anaphalis* population in BTSNP were identified through field observation and document studies.

Result and Discussion

There are some documents which are crucial to describes the strategy for biodiversity in BTSNP. It was ranging from official document related to management aspect of national park to research report which was conducted at national park.

General feature of recent *Anaphalis* habitat

In BTSNP, *Anaphalis* spp. grows in upper mountain to sub-alpine ecosystem. All of the recent habitat of *Anaphalis* is open space area. In Mt. Batok, *Anaphalis* grows in the slope of mountain, distribute in caldera surface. The caldera Tengger are mainly covered by shrubs and grass, with main vegetation includes *Imperata cylindrica*, *Foeniculum vulgare*. The population of *Anaphalis* grows in volcanic soil, with poor organic matters in some area such as in the slope of Mt. Batok. Most of the habitat *Anaphalis* in this survey has been used as recreation sites, lead the high risk of tourism activity in wild population.

Internal factors related to conservation strategy

Internal aspects which are related to the conservation strategy include strengths and weaknesses. Strength become positive aspect to support conservation success, while weaknesses become barriers and limitation to the conservation program success. The conservation program ideally should be able to optimizing strength to minimize weaknesses [6]. Through field survey and document analisis, some aspect related to the strength and weaknesses were drawn below.

Aspects related to strengths

Some factors have been identified as a strength factor for *Anaphalis* conservation. First, three species of *Anaphalis*, namely *Anaphalis viscida*, *Anaphalis javanica*, and *Anaphalis longifolia* found in BTNSP. This study confirms that three species of *Anaphalis* still exist in BTSNP, as reported previously by [11]. Second, most of the population of *Anaphalis* grows in core zone of park. This means, in the context of management most of the population of *Anaphalis* located at area with high control and protection, especially from human disturbance. Zoning is one of the significant tools in park management, and it is mainly addressed to protect biodiversity from numerous potential disturbances, especially from human activity [12].

Local community and tourist perception to *Anaphalis* was high. From interviews and literature studies, local community use *Anaphalis* as important part of the traditional ceremony offerings [8]. The relationship of plant and indigenous community in socio-cultural relationship has been widely explored by scholars in ethnobotanical studies. Species with high socio-economical value often received special attention, and in many cases, there are evidence of community participation in conserving particular species with high socio-cultural value. This is often practiced by cultivate specific plant in home garden. In case of *Anaphalis* conservation by community active participation, there are opportunities to cultivate *Anaphalis* in homegardens environment in Tenggerese Village. In Tenggerese Village, it is especially important to integrate with rural tourism program and implementation [13].

Aspects related to weaknesses

From document and literature reviews, it is clear that conservation effort of biodiversity in BTNSP facing serious problem related to habitat degradation. Recent survey confirms that habitat of *Anaphalis* population in BTSNP distribute patchy in upper mountain forest area, especially in area dominated by shrubs and grasses. The open habitat seems contributes to the grows of *Anaphalis* population. In Penanjakan, *Agrostis* sp. becoming important species in *Anaphalis* habitat, as shown by the highest important value index of the species. *Anaphalis* exist under high competition, i.e., *A. javanica* (IVI = 24.05), *A. longifolia* (IVI = 16.16), *A. viscida* (IVI = 14.26). In Mt. Batok, *Anaphalis* habitat was invaded by *I. cylindrica* and *Pteridium* sp. These species have been identified noxious weeds. In this area, *A. longifolia* (IVI = 40.60) grows under high completion with *I. cylindrica* and *Pteridium* sp. Similar situation was found in Ranu Kumbolo, in which *A. longifolia*, *A. javanica*, and *A. viscida* grows under high pressure of *Agrostis* sp. and *Pteridium* sp. There also potential invasion of *I. cylindrica* in this area. In Ranu Regulo, *A. javanica* grows under pressure of *Alchemilla* sp. and *I. cylindrica* (Table 1). Exotic plant species widely reported contributes to the native population, and therefore dangerous for the sustainability of native plant and animlas population in the wild [14]. The Congograss *I. cylindrica* is one of the important species in many endemic species decline [15]. *Agrostis* is also important invader, especially in endemic-rich area [16]. The abundance of exotic plant species with high potential massive invasion should be viewed as crucial

weaknesses to *Anaphalis* conservation in BTNSP. It has been confirmed that *Anaphalis* population has low genetic diversity. As shown by our previous report, the diversity ranges from 0.012 – 0.024. Genetic diversity is important for future population survival [17].

Forest fire also contribute to the weaknesses of *Anaphalis* conservation strategy. Fact that habitat of *Anaphalis* spp. in BTSNP occupied by numerous shrubs lead to the high risk of forest fire. Scholar point out that dried biomass of shrubs and grass in savanna ecosystem contribute to forest fire, especially in dry periods [19, 20].

Most of the *Anaphalis* habitat located in area with easy access, lead to direct contact of human and *Anaphalis*, or locally called Edelweiss flower. Penanjakan is the sighseeing sun rise and one of the most visited area. Penajakan receive a lot of visitation which are potentially disturb biodiversity in Penanjakan area. Ranu Regulo as camping area, recently visited and used as camping area. Few human-*Anaphalis* interaction found in Mt. Batok and Ranu Regulo, but with the increase of tourist visitation in this area there are potential contribution of tourism activities to wild population of *Anaphalis* in Mt. Batok and Ranu Regulo [10]. This situation leads to the high possibility and opportunities of *Anaphalis* disturbance by illegal collection. Impact of tourist to natural vegetation has been widely reported, in which many of them are negative [21].

From the above explanation, the summary of internal aspects which are contributes to the success on *Anaphalis* spp. conservation were given in Table 2.

External factors related to conservation strategy *Aspects related to opportunities*

Policy to conserve biodiversity provides opportunities for threatened species conservation, including *Anaphalis* spp. Indonesian government argues that biodiversity is important resources for the development, and therefore attention to biodiversity should be priority of national, regional and local development [2].

Increase of tourist awareness to environment issues grows significantly, and it is become the important opportunities to support *Anaphalis* conservation in BTSNP. It is especially relevant with the increase of tourist number in BTSNP [10].

Recent movement in responsible travels has become the opportunities to support conservation program. Scholar point out that ecotourism has potentiality to support ecotourism development, especially in area with abundance natural resources

Table 1. Dominant and co-dominant species found in wild habitat of *Anaphalis* spp. in BTSNP [18]

Sampling sites	Altitudes (m asl)	Species with highest IVI	IVI value (%)
Penanjakan	2656	<i>Agrostis</i> sp.	51.87
		<i>Anaphalis javanica</i>	24.05
Mt. Batok	2168	<i>Imperata cylindrica</i>	84.96
		<i>Pteridium</i> sp.	67.8
Ranu Kumbolo	2407	<i>Agrostis</i> sp.	66.11
		<i>Pteridium</i> sp.	32.87
Ranu Regulo	2113	<i>Alchemilla</i> sp.	43.53
		<i>Imperata cylindrica</i>	37.58

Table 2. Internal aspect of the conservation strategy of *Anaphalis* in BTSNP

Strengths	Weaknesses
✓ Three species grows with high species diversity in BTSNP	✓ Habitat degradation, low genetic diversity, invaded by exotic plant species and intensive forest fire
✓ <i>Anaphalis</i> has been considered as endemic and unique flora in mountain ecosystem	✓ Habitat easily accessible by tourist, lead the vandalism and illegal collection of plant

Table 3. External aspect of the conservation strategy of *Anaphalis* in BTSNP

Opportunities	Threats
✓ Policy in biodiversity conservation	✓ Less control land uses changes
✓ Increase of ecotourism	✓ Increase of mass tourism

and outstanding landscapes [9, 22, 23].

Aspect related to threats

From filed survey and numerous literature studies, it is clear that there are two aspect related to the threats of *Anaphalis* population in natural habitat in BTSNP. It is including (1) Less control land uses changes, and (2) increase of human pressure through mass tourism activity in BTSNP (Table 3). Land uses changes is one of the factors widely discussed as mechanism to habitat decrease. In national park, changes habitat often caused by illegal activity of people to open farm lands, clearing vegetation and make building and facility to support tourism needs. It is especially

related to the next crucial problem in park, the increase of human pressure through mass tourism [10]. Increase of mass tourism was triggering by accessibility improvement and nature-based tourist activity.

Synthesis of conservation strategy

Synthesis of conservation strategy was established from the combination of internal-external aspect. Therefore, there are potential combination of strategies which are derived from four combination of: (1) Enhancing strength to optimizing opportunities, (2) Reducing weaknesses and optimizing opportunities, (3) Enhancing strength to reduce threats, and (4) Managing weaknesses to manage risk. The potential program and actions can be described below.

Enhancing strength to optimizing opportunities

Strategy enhancing strength to optimizing opportunities includes some important action, including: (1) Using *Anaphalis* species diversity to enhance conservation issues of biodiversity in park, and (2) Promoting and linking *Anaphalis* as flagship species for ecotourism and conservation program. This strategy put issues flagship species conservation as main issue. The major limitation with this approach, however, is few scientific researches on *Anaphalis* biology and ecology available. Therefore, comprehensive study related to *Anaphalis* spp. population in BTSNP was needed.

Reducing weaknesses and optimizing opportunities

Established strategy based on reducing weaknesses and optimizing opportunities were includes: (1) Reducing habitat disturbance threats using conservation issues as apolitical and management instrument, (2) Increasing responsible tourism activity through increasing interpretation to enhance tourist knowledge, awareness and participation in conservation. Recent global movement to support conservation program is one of the significant issues, and in many cases, it has been followed by funding and technical assistance support. There are also movement of sustainable tourism, in which is it has significant impact to support biodiversity conservation and environmental protection. These opportunities become significant point to reduce the weaknesses of conservation program.

Enhancing strength to reduce threats

Developed strategy which were derived from attempt to enhance strengths aspects to reduce

threats includes: (1) Controlling land uses changes to ensure the sustainability of population and its genetic diversity, and (2) Introducing and promoting *Anaphalis* as protected species and enhancing responsible travel activity to enhance *Anaphalis* conservation program. Landscape ecological concept argues that land uses changes contribute to the habitat quality and biodiversity population sustainability. In the context of national park, land uses changes often related to the park zoning policy. In the situation where zoning implementation were poor controlled, and number of human disturbances to lands in park area increase, the improper zoning system is the crucial aspect led to habitat degradation.

Managing weaknesses to manage risk

Managing weaknesses to manage risk includes: (1) Increasing management capacity and stakeholders support to minimize potential spatial disturbance of *Anaphalis* habitat in BTSNP, and (2) Managing mass tourism in BTSNP. A mass tourism usually refers to the tourism activity with high number of tourists in limited space and resources without ecological principles consideration. Economic is the main motives behind mass tourism. Mass tourism potentially occurs in area with poor tourism control, and therefore it is become crucial factor led to environmental decrease and biodiversity extinction. It is crucial for BTSNP to increase the capacity of tourism planning and management with the objective id optimizing tourism benefits to support conservation program [9].

Conclusion

In conclusion, the strategy to conserve *Anaphalis* in BTSNP can be established through the integration and combination of external and internal aspect. Strategy enhancing strength to optimizing opportunities includes using *Anaphalis* species diversity to enhance conservation issues of biodiversity in park and linking *Anaphalis* as flagship species for ecotourism and conservation program. Strategy based on reducing weaknesses and optimizing opportunities were reducing habitat disturbance threats using conservation issues as apolitical and management instrument, and increasing responsible tourism activity through increasing interpretation to enhance tourist knowledge, awareness and participation in conservation. Strategy which was derived from enhancing strengths aspects to reduce threats includes controlling land uses changes to ensure the sustainability of population and its genetic diversity, and introducing and promoting *Anaphalis* as protected species and

enhancing responsible travel activity to enhance *Anaphalis* conservation program. Managing weaknesses to manage risk includes increasing management capacity and stakeholders support to minimize potential spatial disturbance of *Anaphalis* habitat in BTSNP, and managing mass tourism.

Acknowledgment

The authors would like to acknowledge to ministry of research, technology, and higher education, Republic of Indonesia (KEMENRISTEKDIKTI) for the funding support of the research.

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