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Messages from the Rector of Universitas Hindu Indonesia

Om swastyastu,

Welcome to Universitas Hindu Indonesia
It is a great pleasure to learn that the Universitas Hindu Indonesia (UNHI), Denpasar, Bali organize the 4th International Conference on Interreligious and Intercultural Studies "Community, Ecology, and Religion: Interdisciplinary and civic engagement towards sustainable living". With the involvement of scholars and researchers from several countries, the conference expected to become an academic forum that addresses sustainable living.

Currently, in the modern world, every country faces various forms of pollutions that come with the advancement of technology, leading to the degradation of the environment. Indonesia, as well as other countries, needs to anticipate such threats, either by empowering the local wisdom or by using friendly energy. Indeed, the effort to minimize the pollution need any support from any parties. The Governor Regulation number 97 the Year 2018 for plastic uses limitation shows the government of Bali commitment to environmental preservation. Furthermore, studies of various disciplines are needed to support the implementation of this policy.

Hopefully, the conference becomes a medium for a global discussion and dialogue between formal institutions and local customary institutions to seek common ground for the contribution to a sustainable life.
Sincere gratitude to the ICRS and LIPI whom UNHI is collaborating with to make the proceeding book of conference possible. My best wishes for successful academics.

Om santih, santih, santih, Om

I Made Damriyasa
Rector of Universitas Hindu Indonesia

Conservation of The Endangered Amerta Jati Orchid (*Vanda tricolor*) in Nature Tourist Park of Buyan Tamblingan Bali

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ABSTRACT

Orchid is an ornamental plant that has a high aesthetic value because of its beautiful flowering with its attractive unique colors. The orchids taxonomy is included in the Ochidaceae family. Mostly found in tropical wet regions. In 1914 Schlecter estimated that there were 15.000 species. While Hawkes in 1965 estimated that in this world there were 30.000 species of orchids. In Indonesia there are around 5000 species of native orchids reported scattered throughout the archipelago. The large-scale hunt for orchids in the Amerta Jati forest makes the population considerably decrease. Currently the three-color orchid Amerta Jati (*Vanda tricolor*) Tamblingan is endangered. This orchid plant is endemic in Buyan Tamblingan Nature Tourist Park (NTP). This study purpose is the efforts of local people to conserve the conservation of *Vanda tricolor* by In-situ and Ex-situ. Conservation carried out by an a carefully effort to protect and manage the environment and natural resources. An asylum and long-term protection of endemic local orchids. In-situ conservation which is done by the community around Buyan Tamblingan Nature Tourism Park (NTP) is by not doing illegal poaching or orchid exploitation in nature. Whereas the ex-situ conservation is orchid cultivation activities in the fields, gardens or yards of the community. When orchids already meet adaptation in nature. Some orchids from ex-situ were transferred to nature (Amerta Jati forest). Local people will continue to be made aware of the importance of local orchids conservation from extinct. Ethnobotany orchids are not only aesthetic but also have health benefits such as preventing diarrhea, dysentery, helping body recovery, reducing postpartum bleeding, toothache medication, nourishing bones, increasing endurance and preventing constipation.

Keywords: conservation, orchids, Vanda tricolor, Amerta Jati

I. Introduction

Orchid is an ornamental plant that has a high aesthetic value because of its beautiful flowering with unique attractive colors. The taxonomy of orchids is included in the Ochidaceae family. Mostly found in tropical wet regions. In 1914 Schlecter estimated that there were 15,000 species [1]. While Hawkes in 1965 estimated that in this world there were 30000 types of orchids [2]. In Indonesia there are reported to be around 5000 species of native orchids scattered throughout the archipelago. In Indonesia several studies on orchids have been carried out. Mount Lawu area, Central Java, precisely 11 orchids was found in the Jobo Forest. In East Java, precisely on Mount Penanggungan, ten orchid species were found which were dominated by *Flickingeria angulata*. In Bali especially in the Bali botanic garden area, there are orchids that grow naturally on reforestation trees, there are 30 species from 14 genera. The genera of Bulbophyllum, Dendrobium, and Eria are the most numerous.

The large-scale hunt for orchids in the Amerta Jati forest makes the population considerably decrease. Currently the three-color Amerta Jati

Tamblingan orchid *(Vanda tricolor)* is threatened with extinction. This orchid plant is endemic in Buyan Tamblingan Nature Tourist Park (NTP). The presence of orchids in the wild continues to decline, caused by habitat destruction and over-exploitation. Exploration of flora, especially orchids, is considered very important, because many of the orchid's natural habitats have been degraded. The destruction of orchid's natural habitat has increased sharply and has been accelerated by human activities such as housing, industry, plantations and so on. Illegal orchid traders penetrate directly in their natural habitat, so this also triggers a decline in wild orchid populations in the wild.

Buyan Tamblingan Nature Tourist Park is included in the Batukahu mountain forest group which has been designated as a forest cover based on the decree of the Dutch East Indies Government on May 29, 1927 No.28. HW.376, which contains an 8 hectare enclave. Decree of the Minister of Forestry Number SK.2847/Menhut-VII/KUH/2014 dated April 16, 2014 concerning the Determination of Forest Areas in the Batukau Mountain Forest Group covering an area of 15.102,90 Ha in Buleleng Regency, Badung Regency and Tabanan Regency, Bali Province. The area of Lake Buyan Tamblingan Nature Tourist Park (NTP) is 1847,38 hectares.

Buyan Tamblingan Nature Tourist Park is located in three villages of Wanagiri, Munduk and Gobleg. Wanagiri Village is one of the villages in the Lake Buyan Tamblingan Nature Tourism Area and has an area of 15,75 Km^2. Topographically it is located at an 1220 meters above sea level altitude. The Wanagiri Village population based on 2014 was 3811 people consisting of 1927 men and 1884 women. Munduk Village is located in the Banjar District, a coffee plantation area in the Dutch period. However, that condition changes when coffee is no longer reliable. The community cut down coffee and replaced it with cloves. The residents number of Munduk Village is around 7799 people, 3949 men and 3850 women. About 10 percent are coffee farmers (40 percent of Munduk residents are rice and field farmers). The average coffee in the Munduk village is Robusta species because it is planted at an altitude of 900 meters above sea level. Munduk Village itself is located at an 600- 1500 meters above sea level altitude, with an 19,76 Km^2 area. While the Gobleg village has 27 km^2 area. The population is 7087, consists of 3560 men and 3527 women.

The condition of Buyan Tamblingan forests is still primary forest, but it is feared that the hunt for wild orchids will worsen. Plant species such as orchids in Buyan Tamblingan forest need to be saved to avoid extinction. One of the efforts to save plants is in situ and ex-situ conservation, namely conservation carried out in their habitats and outside their habitats such as in community gardens or botanical gardens. Sampling, species and habitat of orchids inventory carried out to determine the orchid species diversity their habitats as a basis for conservation of situ and ex-situ. It is hoped that native Balinese orchids can grow well outside their habitat. With the hope that Bali's orchid plants will become numerous and will eventually survive from extinction. The research objective is to increase awareness of local communities for conservation of *Vanda tricolor* orchids both In-situ and Ex-situ. Conservation of In-situ which is done by local people around Buyan Tamblingan Natural Tourism Park (NTP) namely by not doing orchids poaching or exploitation in nature. Whereas the conservation of such activities takes the form of orchid

cultivation in the community fields, gardens or yards. When there are many orchids that meet the adaptation requirements, they will be returned to the forest.

II. Research Sites

The research activity was carried out in the Lake Buyan Tamblingan NTP area, which has 1703 hectares area, which is located on the Batukahu forest group of forest land register. Buyan Tamblingan Natural Tourism Park has a northern boundary is Wanagiri village and Lemukih village, the south is Batunya village and Candikuning village, the east is Batukahu protection forest and Peken Hamlet, Pancasari Village, and the west is Tamblingan Munduk and Gesing village Bali province.

III. Research Methods

The method of in-situ conservation orchid plants search is carried out using transect method by taking an inventory in the field. The activity was carried out by exploring 20 observation plots with a plot 20 x 20 meters size [3][4]. Data collection was carried out after orchid species were found. Data recorded includes species name, number of species and microclimate habitat. The number of species is calculated based on the species of orchids found. The place height and geographical position is measured using GPS. The slopes measured with a clinometer, the slope direction measured using a compass, the canopy cover is measured, the air temperature and humidity are measured with a thermo higrometer, the acidity (pH) and soil moisture is measured with a soil tester. Existing conservation method is by cultivating orchids outside their habitat. Orchid plants are cultivated for 3 months. Growth rates and life percentage are recorded [5].

IV. Data Analysis

Analysis using plant identification and Microsoft Excel calculations. To describe the orchids distribution, the data analysis is performed by calculating the standard deviation of each variable data. The height of the place is grouped in each range of 500 m above sea level ie 100-1000, and 1100-1500 m above sea level. The slope direction is grouped into four zones based on the compass direction, North-East (0-90^o), East-South (90-180^o), South-West (180-270^o), and West-North (270-360^o).

V. Results and Discussion

a. Condition of Orchid Habitat

Buyan Tamblingan Nature Tourism Park is a secondary forest in the form of mountain hills. From 20 transect observation plots, almost all of them were found orchids, which are located around the edge of lakes, cliffs or ridges and natural forests, with 900-1400 m above sea level altitudes. The topography is mostly tilted with a 10-45° slopes. The vegetation species is a tropical rain forest plant species. Vegetation conditions are still quite dense with many large-sized trees found in natural forests such as *Agathis dammara, Altingia excelsa, Alstonia scholaris, Arenga pinnata, Artocarpus camansi, Casuarina junghuhniana, Calophyllum inophyllum, Elaeocarpus glaber, Ficus benjamina, Myocule fragrance, Pangolus fragrans, Amrist , Persea americana, Sapindus rarak* and *Zanthoxylum rhetsa.* There were found many vegetation species on the edge of the lake such as *Cryptocarya massoy, Erythrina hypaphorus, Erythrina variegata, Lucuma luzoniensis, Moringa oleifera, Rauvolfia javanica* and *Syzygium*

aromaticum. While vegetation on the ridge near the road that bordering the settlement, there were many plants grow from reforestation plants, namely *Annona muricata, Cocos nucifera, Coffea sp, Plumeria alba*, *Psidium guajava, Morus alba,* and *Leucaena leucocephala.*

Orchids are found on steep and very steep slopes. Sloping and even steep land conditions are difficult to reach by the community, so vegetation on the land is better than flat land. The causes of land degradation include erosion and sedimentation [6][7]. Very steep land is prone to erosion and water loss so only certain plants can grow on the land and need to be conserved.

b. Diversity of orchids

Based on the transect vegetation inventory results, there are 47 species of 29 genera and 2 orders (Orchidales and Asparagales) were found. The of orchids species that have the most population are *Appendicula elegans, Liparis condylobulbon, Coelogyne flexuosa*, *Vanda tricolor, Eria hyacinthoides, Dendrobium linearifolium, Eria latifolia, Eria verruculosa, Microsaccus javensis, Liparis caespitosa, Bulbophyllum odoratum, Pholidota carnea, Bulbophyllum lobbii, Bulbophyllum absconditum* and *Dendrobium crumenatum* (Figure 1).

Based on orchids growth observations in the NTP area of Buyan Tamblingan Lake, obtained 47 species belonging to 29 genera. In Figure 2 it can be seen that the most rich orders of types and numbers are Eria (208 individuals), Appendicula (137 individuals), Liparis (123 individuals), Bulbophyllum (92 individuals), Coelogyne (80 individuals), Vanda (75 individuals), Dendrobium (73 individuals), Microsaccus (50 individuals), Pholidota (21 individuals) and Malleola (12 individuals).

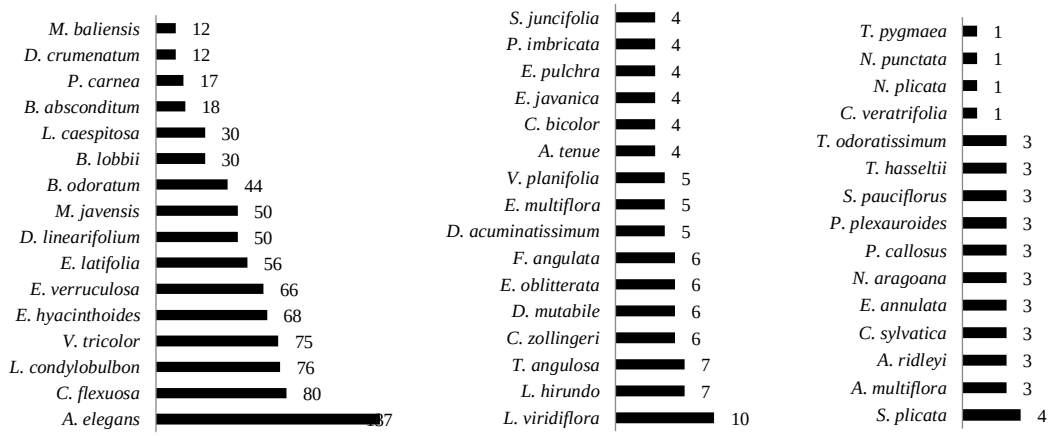

Figure 1.
Number of individuals in the orchid population per hectare in Buyan Tamblingan Nature Tourist Park

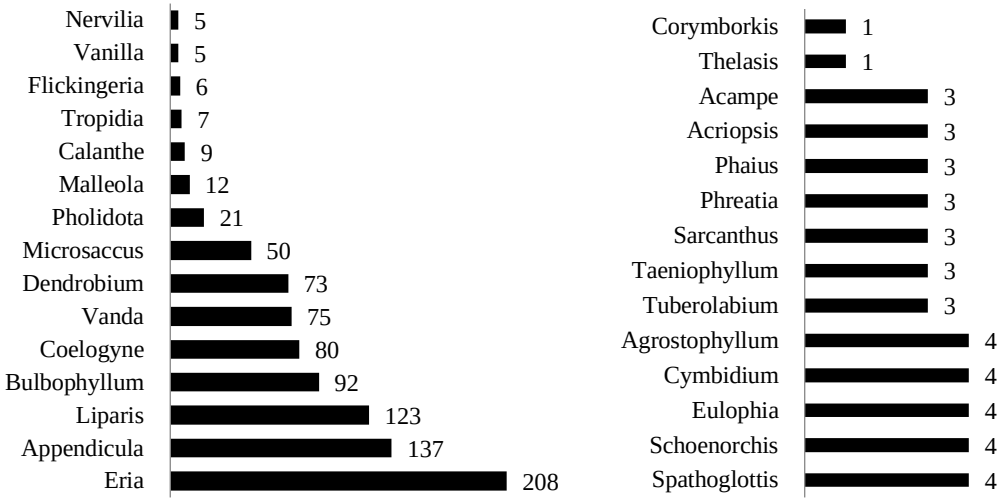

Figure 2.
Number of individuals based on the order level for each orchid per hectare in Buyan Tamblingan Nature Tourist Park

Table 1. Important value indices of orchid species in Buyan Tamblingan Nature Tourim Park

No	Orchid Species	IVP (%)	No	Orchid Species	IVP (%)	No	Orchid Species	IVP (%)
1.	*Appendicula elegans*	20,7	17.	*Liparis viridiflora*	2,9	33.	*Spathoglottis plicata*	1,0
2.	*Coelogyne flexuosa*	14,6	18.	*Liparis hirundo*	2,3	34.	*Eria annulata*	0,8
3.	*Liparis condylobulbon*	14,2	19.	*Tropidia angulosa*	2,3	35.	*Phreatia plexauroides*	0,8
4.	*Vanda tricolor*	14,1	20.	*Eria oblitterata*	2,1	36.	*Sarcanthus pauciflorus*	0,8
5.	*Eria hyacinthoides*	13,4	21.	*Flickingeria angulata*	2,1	37.	*Tuberolabium odoratissimum*	0,8
6.	*Eria verruculosa*	13,1	22.	*Calanthe zollingeri*	1,8	38.	*Acriopsis ridleyi*	0,8
7.	*Microsaccus javensis*	11,4	23.	*Dendrobium mutabile*	1,5	39.	*Taeniophyllum hasseltii*	0,8
8.	*Eria latifolia*	10,9	24.	*Eria multiflora*	1,4	40.	*Calanthe sylvatica*	0,8
9.	*Bulbophyllum odoratum*	9,2	25.	*Vanilla planifolia*	1,4	41.	*Nervilia aragoana*	0,8
10.	*Dendrobium linearifolium*	8,9	26.	*Eria javanica*	1,3	42.	*Phaius callosus*	0,8
11.	*Liparis caespitosa*	7,7	27.	*Dendrobium acuminatissimum*	1,1	43.	*Acampe multiflora*	0,5
12.	*Bulbophyllum lobbii*	6,2	28.	*Agrostophyllum tenue*	1,0	44.	*Thelasis pygmaea*	0,4
13.	*Bulbophyllum absconditum*	5,6	29.	*Pholidota imbricata*	1,0	45.	*Corymborkis veratrifolia*	0,4
14.	*Pholidota carnea*	4,9	30.	*Schoenorchis juncifolia*	1,0	46.	*Nervilia plicata*	0,4
15.	*Dendrobium crumenatum*	4,1	31.	*Cymbidium bicolor*	1,0	47.	*Nervilia punctata*	0,4
16.	*Malleola baliensis*	3,7	32.	*Eulophia pulchra*	1,0			

Buyan Tamblingan NTP has a high index of orchid species diversity (H = 3,07). Data in the field shows that there are 47 orchid species found. The field data shows that 47 species found, which have high importance (Table 1), such as *Appendicula elegans* (20,70%), *Coelogyne flexuosa* (14,60%), *Liparis condylobulbon* (14,20%), *Vanda tricolor* (14,10%), *Eria hyacinthoides* (13,40%), *Eria verruculosa* (13,10%), *Microsaccus javensis* (11,40%), *Eria latifolia* (10,90%), *Bulbophyllum odoratum* (9,22%), *Dendrobium linearifolium*

(8,90%), *Liparis caespitosa* (7,77%), *Bulbophyllum lobbii* (6,24%), *Bulbophyllum absconditum* (5,66%) and *Pholidota carnea* (4,92%).

The analysis results show that the uniformity index between 0,50-0,79. If the uniformity index value is close to zero, it means there is a tendency for species domination to occur due to the instability of environmental and population factors in the ecosystem. If the uniformity index approaches 1, then the ecosystem is in a relatively stable condition, the number of individuals per species is relatively the same [8]. If we see the Buyan Tamblingan NTP uniformity index, it can be said that habitat conditions are relatively stable. The regular pattern of orchid distribution where individuals are located at a certain place in the community. This order can be due to competition between orchids species, causing competition to encourage the division of the same living space. Some species do appear to dominate in some locations only, while in other locations they do not appear at all. The regular orchid distribution patterns are non-random patterns indirectly caused by limiting factors to the existence of a population [9].

c. *The Ex-situ Vanda tricolor Conservation*

The local community in carrying out the conservation is by maintenance the orchids in their yard. The factors that are considered by the community are the nature of life (habitat), the factors that affecting the growth and the orchid species that cultivated. Based on the growth pattern, people understand that orchids can be divided into two types, there is sympodial and monopodial. The sympodial type is an orchid that does not have a main stem, where the flowers come out from the end of the stem. Monopodial type is orchid growth straight up on one stem, the flowers come out from the side of the stem between the two axillary leaves. According to Hawkes based on its habitat, orchid plants are divided into four groups, namely efifit orchids, terrestrial orchids, lithophyte orchids and saprofit orchids.

The factors that affecting the *Vanda tricolor* orchids growth are altitude, air temperature, environmental humidity, sunlight and plant maintenance. The height of the place is the main factor that determines the *Vanda tricolor* orchid growth success. Besides environmental factors such as temperature, light and humidity also greatly affect the growth of *Vanda tricolor* orchids that are conserved by local people. The height of the place for each orchid species is not the same, some orchids can grow well in the highlands, but other species will grow and thrive in the lowlands [10]. There are several orchids species that can grow and flower in the lowlands to the medium. *Vanda tricolor* will develop in the medium and highlands especially Munduk and Wanagiri villages. Local people are aware of the importance of conservation to keep the local orchid *Vanda tricolor* from extinction. Ethnobotany the orchid is not only aesthetic in nature but also has health benefits in the form of the benefits of preventing diarrhea, dysentery, helping the body recover, reducing postpartum bleeding, toothache medicine, healthy bones, increasing endurance and preventing constipation.

Based on the height of the place, the temperature requirements for certain orchids are also different [11]. Air temperature greatly affects the metabolic process. High temperatures cause the metabolic process to take place quickly, conversely at low temperatures the metabolic process occurs very slowly. Based on the temperature [12] divides orchids into 3 groups of species of cold,

medium species and warm species. *Vanda tricolor* conserved by local people includes warm orchids, night time temperatures 20-24^{o}C and daytime 20-25^{o}C. Generally the humidity needed by *Vanda tricolor* orchid is a relative humidity (RH) 60-85% ranging. Moisture should not be too high at night, and not too low during the day. Local people maintain *Vanda tricolor's* moisture to remain stable, ie watering the mist spraying system using a sprayer. Moisture is too high at night to overcome local communities by reducing watering, conversely too low humidity during the day is overcome by watering that is wetter.

Ex-situ conservation of *Vanda tricolor* by local communities includes the use of growing media, watering, fertilizing, environmental control and disease pests. *Vanda tricolor* growth media functions as a root stand, nutrient storage and water. Local people consider a good growing medium that is looking for material that is not rotten, does not cause disease, good aeration, binding water, nutrients and acidity (pH) 6-7. The orchid growth media used by the community are moss, ferns, wood shavings, coconut fiber, charcoal and bark. *Vanda Tricolor*, which is conserved by local people, uses pots. At the base of the pot, broken bricks function to absorb more water for a good the draenation and aerial capabilities [13]. Media that are good and commonly used by the public are moss and ferns. Moss contains 2-3% element N and has a very good water binding ability. Being fern in addition to having a good draenation and aeration also contains many nutrients needed by *Vanda tricolor*. Replacement of the growing media pot is done when the *Vanda tricolor* is large. Pot that is good to use pots made of brick, because it can maintain humidity.

Maintenance of the *Vanda tricolor* environment does not provide enough nutrients for growth. Overcoming this problem, the community usually provides fertilizers both organic and inorganic, namely compound fertilizers that contain micro and macro nutrients. In general, the macro elements needed are C, H, O, K, N, P, Ca, S and Mg while the micro elements include Fe, Cu, Zn, Mo, Mn, B and Cl. The fertilizers application to *Vanda tricolor* is different for the growth phase. In the vegetative growth phase for small plants NPK fertilizer 30:10:10. Vegetative phase in adult orchids NPK 10:10:10. Generative phase Comparison of NPK 10:30:30. Fertilization is done through the leaves, especially the lower surface of the leaf. Fertilization is done when there is no sunlight when the leaf stomata are open so that fertilizer application is more effective [14].

Vanda tricolor orchids maintenance uses shade to avoid direct sunlight. However, to maintain orchid moisture, watering is very important to note. The frequency and amount of water sprayed on the *Vanda tricolor* orchid is not too wet and according to environmental conditions. *Vanda tricolor* orchid is sprayed twice a day, in the morning and evening. *Vanda tricolor* orchids are maintained in a clean environment and free air circulation. Environmental cleanliness needs to be maintained. Pest control is done by preventing the growth of fungi and bacteria in plants as well as other insects such as trips. Pest control is done spraying *Vanda tricolor* with medication once a week.

VI. Conclusion

In-situ conservation which is done by the community around Buyan Tamblingan Nature Tourism Park (NTP) is by not doing illegal poaching or orchid

exploitation in nature. Whereas the existing conservation of *Vanda tricolor* orchid cultivation activities in the fields, gardens or yards of the community. When *Vanda tricolor* has fulfilled adaptation in nature. Some orchids from the existing conservation were moved to the Amerta Jati forest. Local people are aware of the importance of keeping the local orchid *Vanda tricolor* from extinction.

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