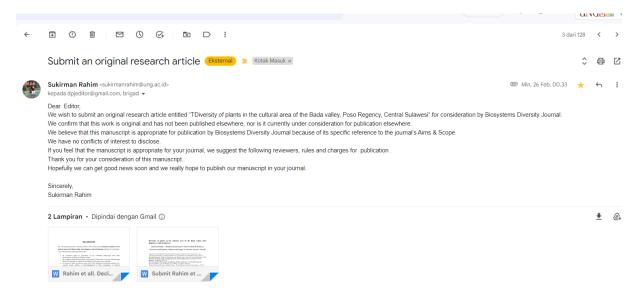
SUBMIT



Minggu 26 Februari 2023

DECLARATION

The corresponding author, Sukirman Rahim, of the manuscript: **Diversity of plants in the cultural area of the Bada valley, Poso Regency, Central Sulawesi** intended for publication in journal Biosystems Diversity declares that:

- all co-authors agree to publication of the submitted manuscript even after amendments arising from the peer review;
- all co-authors agree to the posting of the full text of this work on the journal web page and to the inclusion of references in databases accessible on the Internet;
- no results of other researchers were used in the submitted manuscript without their consent, proper citation, or acknowledgement of their cooperation or material provided;
- the results (or any part of them) used in the manuscript have not been sent for publication to any other journal nor have already been published (or if so, that the relevant works are cited in this manuscript);
- submission of the manuscript for publication was completed in accordance with the publishing regulations pertaining to the place of work;
- grant holders have been informed of the submitted manuscript and they agree to its publication;
- after publication of the paper Oles Honchar Dnipropetrovsk National University will be the copyright owner.

All authors agree that editorial correspondence and requests for copies will be sent to

Name: Sukirman Rahim

Address: Department of Postgraduate Population and Environment, State University of Gorontalo, State University of Gorontalo, J. Jenderal Sudirman No. 06 Gorontalo City, Gorontalo Province, 961282

E-mail address: sukirmanrahim@ung.ac.id

Date: 24 February 2023

Signature of the corresponding author

Diversity of plants in the cultural area of the Bada valley, Poso Regency, Central Sulawesi

Sukirman Rahim^{*1}, Alland Ferdinand Ambo^{*1}, Dewi Wahyuni K. Baderan², Marini Susanti Hamidun², Melisnawati H Angio³, Esti Endah Ariyanti³, Sunardi⁴

^{1*}Department of Postgraduate Population and Environment, State University of Gorontalo, State University of Gorontalo, Jl. Jenderal Sudirman No. 06 Gorontalo City, Gorontalo Province, 961282

²Biology Department, Faculty of Mathematics and Natural Science, State University of Gorontalo, Jl Prof. BJ.Habibie Moutong Village, Tilongkabila District, Bone Bolango Regency, Gorontalo Province, Indonesia. Tel.Fax (0435)821752

³Research Center for Plant Conservation, Botanic Gardens, and Forestry – National Research and Innovation Agency, Jl. Ir. H. Djuanda, No.18, Bogor, Jawa Barat, Indonesia

³Research Centre for Ecology and Ethnobiology - National Research and Innovation Agency, Jl. Raya Jakarta-Bogor Km. 46, Cibinong, West Java, 16911, Indonesia

Corresponding Author: Department of Postgraduate Population and Environment, State University of Gorontalo, State University of Gorontalo, Jl. Jenderal Sudirman No. 06 Gorontalo City, Gorontalo Province, 961282, Tel.: +62 852-1745-0295, Email: <u>sukirmanrahim@ung.ac.id</u>

ABSTRACT

The Bada Valley is one of the Lore Lindu Megalithic cultural heritage areas which has high scientific, historical, cultural and biodiversity values. The aim of the study was to determine the diversity index, evenness index and plant species richness index in the Bada Valley cultural area, Poso Regency, Central Sulawesi. This study used an exploring technique with purposive sampling. The results of the study found vegetation composition for herbaceous strata (555 individuals), trees (91 individuals), shrubs (64 individuals) and vines (57 individuals). The diversity index value of each stratum is different for trees (H'=1.2); herbs (H'=1.91), shrubs (H'=1.32), and vines (H'=0.62). The diversity of plants in the Bada valley in the tree, herb, and shrub strata was moderate $(1.0 \le H' \le 3.0)$, and the encroaching plant stratum had low diversity (H' <1.0). The evenness index at the level of shrubs, vines, herbs and trees has a value of 0.95; 0.9; 0.83; 0.61 respectively. The species richness index of plants in the Bada valley is in the low category (R <3.5) with R values for herbaceous plants (1.42), trees (1.33), shrubs (0.72), and vines (0.24). Information on plant biodiversity is used as a data base for ecotourism development in the Bada Valley cultural reserve area.

Keywords: biodiversity, plant species, Bada Valley

Introduction

Indonesia is a country that is very rich in biodiversity and has won an essential position on the world biodiversity map. Indonesia, together with Brazil and Zaire, is in the top three countries in the world that have the highest biodiversity (megadiversity countries), covering 17% of the total bird species in the world found in Indonesia (1,531 species), of which 381 species are endemic (Boedhirtano, 2017; Scales & Marsden, 2008; Murray et al., 2015;), has around 30,000 species of plants and has been used as a source of medicinal raw materials (Budiarti et al., 2017; Kasmawati et al., 2019; Silalahi et al., 2015). Diversity is the variation and also the variability of life on earth (Hooper el al, 2005), diversity is a characteristic difference between communities (Harrison et al., 2020; Lausch et al., 2016).

One area in Indonesia that has high biodiversity is Sulawesi; one of provinces is Central Sulawesi. This province is located in the Wallacea region, a biogeographical area between the Sunda Shelf and the Sahul Shelf which has high diversity of endemic floras and faunas. However, the plant abundance of this region is insufficiently explored (Pitopang et al, 2019). The Bada Valley is one of the cultural heritage areas in Central Sulawesi, which together with the Behoa Valley and the Napu Valley, as well as the Palu Valley and Lake Lindu are a Lore Lindu Megalithic Area (KMLL) which has important scientific, historical and cultural values. This area has the oldest cultural chronology in Indonesia, and is currently in submission to the United Nations Educational, Scientific and Cultural Organization (UNESCO) for designation as a world cultural heritage (World Heritage).

The report from the Gorontalo Cultural Heritage Preservation Center (2018) mentions potential threats to archaeological remains in the Bada Valley. Threats caused by natural factors include: weathering caused by interactions between archaeological remains and their environment; environmental factors such as climate, temperature, humidity, sunshine; organisms such as insects, fungi, lichens, and bacteria. Other natural factors are erosion, landslides and floods, and the activities of large animals that have the potential to damage these objects. In addition to natural factors, human activities also have the potential to threaten the existence of these archaeological remains. Destruction and theft, vandalism, mining activities, land clearing for agriculture, plantations and development (Satrija et al., 2015).

Mining activities in the Bada Valley Cultural Heritage area are spread over four villages, namely: Bulili Village, Badangkaia Village, Bewa Village and Gintu Village which were discovered since 2017. The perpetrators of this illegal mining are not only the local people of the Bada valley but many also come from outside the Bada Valley and even from outside Poso Regency. The use of tromol, mercury and other materials in the mining process will certainly be very damaging to the environment. The impact of this activity is frequent flooding, landslides, destruction of the habitat of various species of animals, including endemic birds such as the maleo bird, babirusa, anoa, alo bird and hundreds of other species of animals that have been living and breeding in the forest in the Lore Lindu National Park area.

In addition to human activities, one of the causes of the decline in biodiversity is the invasion of foreign species. Invasive foreign species including species of flora, fauna, microorganisms and pathogens originating from outside their original habitat that enter new areas and can cause harm to ecosystems or the environment, the economy and public health (CBD, 2000). There are approximately 300 species of weeds that have been found in Indonesia (Setyawati et al. 2015; Widjaja et al. 2014).

The percentage of successful weed species becoming dominant and causing negative impacts on new habitats is 10% (Sitepu, 2020).

The lack of attention to plant biodiversity has become the reason for conducting research on the biodiversity index of the Bada valley cultural reserve area. Data on plant diversity is complementary to realizing the development of ecotourism in Central Sulawesi Province.

Methods

This research was conducted in the Bada Valley cultural heritage area, Poso Regency, Central Sulawesi Province. Bada Valley is located in South Lore and West Lore Districts, Poso Regency. South Lore District with the capital city of Gintu and West Lore District with the capital city of Langkeka. Administratively, the Bada Valley is bordered to the north by Lore Tengah District, Poso Regency, to the east by Pamona Puselemba and West Pamona Districts, Poso Regency, to the south by Rampi Seko District, North Luwu Regency, South Sulawesi, and to the west by the District Kulawi, Poso Regency. The total area of the Bada valley is 997.7 km2 (Central Bureau of Statistics, 2022). The map of the Bada Valley Cultural Heritage Area is presented in Figure 1.

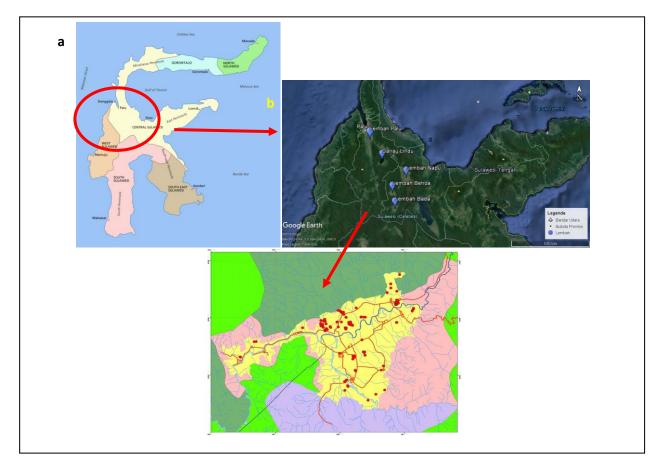


Fig. 1. Map of the Bada Valley Cultural Heritage Area

(Source: Ramadhan, 2023 (a); Faiz, 2017 (b))

The research method uses exploring methods for exploration of plant species. Collection of plant data by exploring the location of the Bada Valley cultural heritage area and observing all the existing plant species accompanied by taking pictures using a digital camera. Additional information was recorded in the form of collector's name, collection number, collection date, location, and habitus which were recorded in the observation sheet that had been prepared. Identification of plants was carried out using the procedure for observing plant morphological characters which included special features in each class and family or genus down to the species level and then compared with the book Pitopang et al., (2008,) Tjitrosoepomo, (1985), Harris & Harris, 2001 and Flora for Indonesia (Steenis, 2008). Accepted name validation for each plant species is carried out using The Plant List website, 2022 (http://www.theplantlist.org/). Identification results were then analyzed by descriptive qualitative. For plant species that have not been identified, herbarium specimens were made by taking plant parts that have been cleaned of soil, fungus or foreign material adhering to them. Identification of invasive plant species was carried out based on the Guide to The Naturalized and Invasive Plants of Southeast Asia (Witt, 2017) and the CABI Compendium Invasive Species (https://www.cabidigitallibrary.org/product/qi).

Data analysis Species Diversity Index

Data on the diversity of plant species is identified through the Diversity Index (H') (Shannon & Wiener, 1963; Fachrul, 2012).

$$H' = -\sum_{i=1}^{S} pi ln pi$$
 where: $pi = \frac{ni}{N}$

Description: H'(Shannon-Wienner diversity index), S (Number of species), ni (Number of individuals in one species), In (Natural logarithm), N (Total number of individual species found). The value of H' determines the level of species diversity in an area, where the definition of the value of species diversity according to Shannon-Wienner is: H'> 3 : high species diversity, $1 \le H' \le 3$: medium species diversity, H' < 1 : Low species diversity.

Species Evenness Index

The evenness index of species refers to the *Pielow evenness indices* formula (Ludwig & Reynolds 1988), namely: E = H'/In S, where E (Evenness Index), and H' (Shannon-Wienner diversity index)

Species Richness Index (R1)

The species richness index uses the Margalef formula (Magurran, 1988), namely $R_1 = \frac{(S-1)}{(\ln(N))}$, where R1 (Wealth Index), S (Number of species found), and N (total number of individuals)

Results

Vegetation Composition

The composition of the vegetation in the Bada valley area is dominated by plants with herbaceous strata with a total of 555 individuals, then tree strata of 91 individuals, shrubs 64 individuals and vines 57 individuals. The composition of plants in the Bada valley is presented in Table 1.

Table 1

Composition of Plants in the Bada Valley Area

Stratum	Species	Local name	Individual number	Uses
	Antidesma ghaesembilla Gaertn.	Tumbuhan Buni.	62	Buni plants are widely used as traditional medicine to treat high blood pressure, palpitations, anemia, syphilis
	Cryptocarya sp.	Kayu masohi	6	This plant is used to treat fever, stomach cramps and relieve joint pain.
	<i>Bischofia javanica</i> Blume	Bintungan	3	The bark of the plant is used to lower blood cholesterol levels and treat diarrhea
Tree	Premna serratifolia L.	Bebuas	4	Water decoction of the leaves of this plant is used to treat fever
	Casearia sp.	Hulu tulang	3	The benefits of this plant are used as natural dyes and also used as ornamental plants
	Melia azedarach L.	Renceh	8	Medication to lower high blood pressure
	Psidium guajava L.	Jambu biji	6	Diarrhea and cough medicine
	Total		91	
	Euphorbia hirta L.	Tanaman asma	34	The benefits of this plant can overcome asthma, malaria drugs and wound healing drugs.
Herbs	Ageratum conyzoides (L.) L.	Babandotan	183	The benefits of this plant can be used as a wound healer, leprosy and ulcers
	Chromolaena odorata (L.) R.M.King & H.Rob.	Krinyuh	88	The benefits of this plant can be used as a wound healing

	_			drug and can stop bleeding quickly
	Stachytarpheta cayennensis (Rich.) Vahl	Pecut kuda	56	Used as a medicine for malaria, fever and diabetes
	Crotalaria trichotoma Bojer	Orok-orok	16	Utilized as animal feed and potentially as green manure.
	Erigeron sp.	Jabung	13	can treat pain due to rheumatism, has a sedative effect, and heals wounds, so now it is widely used in cosmetic products
	Melastoma malabathricum L.	Senduduk	9	Can be used to treat burns
	Tridax procumbens L.	Songgolangit	104	Can be used to treat gout, aching rheumatic pain and gout
	Euphorbia heterophylla L.	Daun katemas	24	Used to treat asthma, constipation and bronchitis
	<i>Crassocephalum crepidioides</i> (Benth.) S.Moore	Daun sintrong	28	Can increase immunity
	Total		555	
	<i>Syzygium paniculatum</i> Gaertn.	Pucuk merah	20	The benefits of this plant can improve immune function and can lower blood sugar levels
	Ixora coccinea L.	Asoka	10	Used for wound healing
Shrub	Ricinus communis L.	Daun jarak	11	Can be used to launch defecation
	<i>Broussonetia papyrifera</i> (L.) L'Hér. ex Vent.	Pohon saeh	23	The benefits of the bark of this plant are used as a basic ingredient in making traditional clothes for the people of the Bada Valley.
	Total		64	
Vines	Calopogonium mucunoides Desv.	Каlоро	39	It can be used as green manure and as a land cover plant
	Scurrula parasitica L.	Benalu	18	The benefits of this plant have the potential as anticancer,

Source: Data Primer, 2022

Based on the results of the identification of plant species composition, several species were identified as invasive species. Some of these species are foreign species whose natural habitat is outside the Southeast Asian region.

Table 2

Identified Invasive Species in the Bada Valley Region

No	Species	Invasiveness	Information
1	Melia azedarach L.	Invasive	This species is native or originate from the Southeast Asia region but has the potential as an invasive alien species in several areas outside its natural habitat. <i>M. azedarach</i> is fast growing and has few natural enemies. This species is spread by seeds by birds and other animals. It has been reported as an invasive species in a number of locations in the Americas, Pacific and Africa, South Africa and Hawaii, USA. This species is difficult to control because of its ability to grow again vegetatively
2	Euphorbia hirta L.	Invasive	It is a weed or invasive species on agricultural land and is a host for several types of pests and diseases in plants.
3	Ageratum conyzoides (L.) L.	Invasive	<i>A. conyzoides</i> is reported as an invasive and harmful weed in agricultural fields. This species tends to invade open or degraded land. This species causes a decrease in crop yields and affects biodiversity (Kohli et al., 2006; GISD, 2016; PIER, 2016), and is a host of pathogens and nematodes that affect several types of agricultural crops (BioNET-EAFRINET, 2016).
4	Chromolaena odorata (L.) R.M. King & H. Rob.	Invasive	<i>C. odorata</i> is a species of herb or shrub that has a very wide distribution. This species is included as one of the 100 dangerous invasive species in the world. This species will be very easy to spread and invade new areas that are degraded through seeds that are easily carried by the wind.
5	<i>Stachytarpheta cayennensis</i> (Rich.) Vahl	Invasive	<i>S. cayenneensis</i> is a species originating from South and Central America and the Caribbean. This species is widely introduced to various regions because it has attractive flowers. <i>S. cayenneensis</i> has a wide environmental tolerance and often invades disturbed areas thereby overpowering native flora. This species is considered a noxious weed in the Northern Territory, Australia and is increasingly abundant in Florida, USA. According to the risk assessment, this species is considered highly invasive (score 20 = high risk) (PIER, 2015).

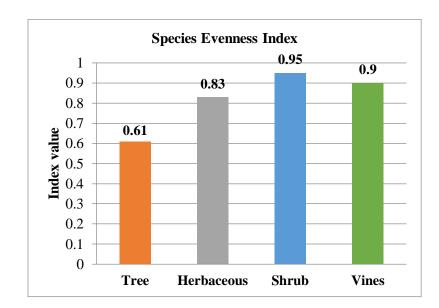
6	Melastoma malabathricum L.	Invasive	<i>M. malabathricum</i> is known as a weed on mahogany (<i>Swietenia macrophylla</i>) in Sumatra, Indonesia (Nazif and Pratiwi, 1989). It is a primary weed commonly found growing in industrial plantation forests. <i>M. malabathricum</i> is registered as a Federal Noxious Weed in the US.
7	Euphorbia heterophylla L.	Invasive	According to Holm et al. (1979), <i>E. heterophylla</i> is a major weed in Fiji, Ghana, Mexico, Philippines, Indonesia and Thailand, Brazil, India, Italy, Papua New Guinea, Cuba, Honduras, Peru, Uganda and the United States. This species has a negative impact on several agricultural crops including cocoa, coffee, cotton, cowpea, corn, papaya, peanuts, sorghum, soybeans, sugarcane, tea, and upland rice (Parsons and Cuthbertson, 1982). It has fast growth so it is easy to compete in getting light, water and nutrients.
8	<i>Crassocephalum crepidioides</i> (Benth.) S.Moore	Invasive	<i>C. crepidiodes</i> is an invasive species which is included in the Global Compendium of Weeds as one of the most aggressive weeds that occurs in tropical and subtropical regions (Randall, 2012). It is a pioneer species with the ability to produce large numbers of downy seeds which are dispersed by the wind.
9	Syzygium paniculatum Gaertn.	Alien Invasive	It is an invasive foreign species. The original habitat of this species is the territory of Australia.
10	Calopogonium mucunoides Desv.	Invasive	<i>C. mucunoides</i> is a woody plant listed in the Global Compendium of Weeds that has an impact on agricultural and semi-natural ecosystems (Randall, 2012). <i>C. mucunoides</i> has been widely introduced as a forage legume and nitrogen fixing plant in tropical and subtropical regions (Cook et al., 2005). <i>C. mucunoides</i> has the potential to kill native vegetation and food crops in agricultural areas. Currently, <i>C. mucunoides</i> is classified as a noxious weed in Australia (Queensland Department of Primary Industries and Fisheries, 2011), and as an invasive species in Malaysia, the Philippines, Puerto Rico, and several islands in the Pacific Ocean such as French Polynesia, Cook Islands, Samoa, Palau, and the Solomon Islands (Acevedo-Rodríguez and Strong, 2012; PIER, 2013).

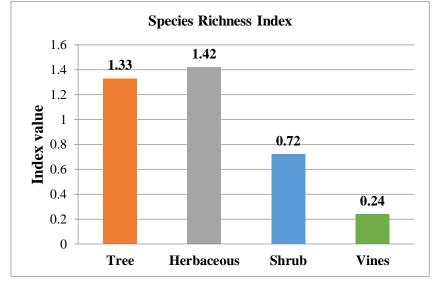
Diversity, Evenness, Species Richness

The value of the diversity index in the Bada Valley Cultural Conservation Area has differences in diversity in each stratum. The tree strata had a diversity index of 1.2, the herbaceous strata 1.91, the shrub strata 1.32 and the vines strata 0.62 (Figure 2). Based on the criteria for the value of species diversity according to Shannon-Wienner the diversity of plants in the Bada valley in the strata of trees, herbs and shrubs is included in the criteria of moderate diversity because the value is $1.0 \le H' \le 3.0$, and the strata of vines has low diversity criteria because H' <1.0.

The evenness index for the shrub stratum had the highest value, namely 0.95, followed by vines at 0.9, herbaceous plants at 0.83 and trees at 0.61 (Figure 2). The highest species richness index was owned by herbaceous plants with a value of 1.42, tree strata 1.33, shrub strata 0.72 and vines strata 0.24. Based

on the species richness index criteria, plants in the Bada valley area have low species richness criteria because the R value <3.5.





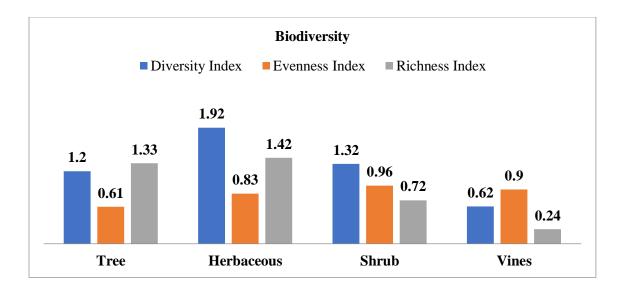


Fig. 2. The value of Diversity index, Evenness index and Species Richness index

Discussion

The plants that have the highest diversity index value in the Bada valley are the herbaceous strata. Herbaceous strata dominate the area with a total of 555 individuals. Herbaceous plants are plants that have a height or stem length of 0.3 - 2 meters and have wet or soft trunks because they have a lot of water content. The high composition of herbaceous plants is closely related to the good adaptability of these plants in both tropical and subtropical environmental conditions. Herbaceous plants can be dispersed easily in groups with the same individual or solitary in a variety of different habitat conditions such as moist or watery soil dry, rocks and habitats with less dense or open shade (Aguilar et al., 2019; Lelli et al., 2019; Zelnik, 2012).

Herbaceous plants have strong competitiveness and high adaptation to the surrounding plants (such as bushes, shrubs, and even trees) so they can grow in empty places. Herbaceous plants in different habitats are very different in the amount that can be produced by an area that has different habitats such as habitats with high humidity to dry areas (Litza & Diekmann, 2019; Spicer et al., 2022; Träger et al., 2019).

The dominating plant is the *Ageratum conyzoides* (L.) L. This plant can spread quickly both from the wind and by insects and humans who are active in that location, this plant also has very fast growth and has a relatively small size compared to other herbaceous plants. According to (Shen et al., 2019;) herbaceous plants whose body size is relatively small have the opportunity to get a wider living space, thus enabling the life of more individuals (wealth) and more species (diversity).

The role of herbaceous plants in the region has a very important role, among others, when experiencing succession which is marked by many pioneer plants and small plants such as herbaceous plants. Herbs play an important role in the annual nutrient cycle, namely the herb litter that is returned to the soil contains high levels of nutrients. In addition, herbs are also used as a source of animal feed, medicine and a source of wealth in germplasm, for example, the preservation of wild animals as a component of an ecosystem is influenced by the presence and diversity of undergrowth as a place to live and a high source of food and many other functions (Álvarez et al., 2022; Schmidt et al., 2019).

The diversity of plants in the Bada valley area is included in the medium and low diversity index criteria. This is caused by several factors including the control of the area in the cultural heritage area, soil type, climate, biotic influences (living things) and so on. This is supported by the statement of Compant et al. (2019) which states that plant diversity is influenced by several factors, including climate, soil type, altitude and biotic influences (living things). Furthermore, Dar & Reshi (2020) states that diversity is synonymous with the stability of an ecosystem, that is, if the diversity of an ecosystem is relatively high, the condition of the ecosystem tends to be stable. Ecosystem environments that have diversity disturbances tend to be moderate, in the case of ecosystem environments that are polluted, species diversity tends to be low.

Geng et al. (2019) states that the higher the species diversity, the more stable the community will be and have a higher ability to deal with disturbances. Furthermore, van der Plas (2019) argued that high species diversity indicates that a community has high complexity because the species interactions that occur in that community are very high. A community is said to have high species diversity if the community is composed of many species. Conversely, a community is said to have low species diversity if the community is composed of a few species and if there are only a few dominant species. In line with the statement of Pitopang & Ihsan (2014), which explains that the higher the value of the diversity index, the better the ecosystem in the region.

Based on the results of the analysis of the evenness index of species, the Bada valley area has plants that are included in the criteria for high species distribution. Evenness index values or Evenness (E) range from 0 to 1 (Magurrann, 1988), meaning that the plants in the area can grow and spread throughout the observation sites. The even distribution of plants in this location cannot be separated from the influence of environmental factors. The high level of biodiversity is because Indonesia is a tropical country with high levels of rainfall, temperature and humidity. According to Pramudya (2020), Indonesia has a diversity of flora and fauna due to its geographical location around the equator and between the continents of Asia and the continents of Australia, giving rise to the emergence of certain characteristics and characteristics in resources in the form of tropical forest ecosystems. Furthermore, according to Kitayama et al. (2021), tropical forests are located along the equator, that is, in areas with high radiation intensity, with small daily and annual amplitudes.

The value of the Diversity index relates to the value of species richness, but is also influenced by the distribution of species abundance. Midolo et al. (2019) states species richness is the number of species in a community. The greater the number of species found, the greater the wealth index.

The richness of plant species in the Bada valley area is classified as low. It has been explained above that the number of species will affect species richness. It is also known that the number of plant species for each stratum in the Bada valley area is still relatively small, thus affecting species richness. This is in accordance with the opinion of Roswell et al. (2021) that a community has high species diversity if the community is composed of many species, conversely if the community is composed of very few species and only a few dominant species, then the species diversity is low.

Species richness shows all the variations found in living things between species. Differences between species of organisms in one or more families will be visible, making it easier to observe than differences between individuals in one species. Richness at the species level occurs because of the variety of these species. The species richness index is the simplest measure because it only takes into account differences in the number of species in a certain area. Species richness serves to determine the amount of species richness in each community found. This was confirmed by Mahaut et al (2020) who stated that species richness refers to the quantity of species in a community. The quantity of species in the field determines the size of the richness index. In the context of cultural heritage sites or areas the presence of certain plant species at the site or area strongly supports the concept of preservation in accordance with local values and traditions. Sites identified as places of worship, such as the Sepe Site in Kolori Village and the Suso Site in Lengkeka Village, Lore Barat District, are of course closely related to the use of certain plant species in carrying out worship ceremonies or rituals in accordance with the beliefs that developed at that time. In addition, there is a tradition that continues today, namely the use of the bark of the *Broussonetia papyrifera* (L.) L'Hér. Ex Vent., or better known as the Saeh tree, to be used as traditional clothing for the people of the Bada valley.

The development of the Cultural Conservation site or area also requires environmental management by applying the principle of authenticity so that in selecting plant species, efforts are made to use and cultivate endemic or existing plant species found around the Cultural Conservation site or area. Thus the development of the intended Cultural Conservation area can be carried out in accordance with the principles of Cultural Conservation and environmental preservation.

Conclusion

The value of the diversity index in the Bada Valley Cultural Conservation Area has differences in diversity in each stratum. Tree strata had a diversity index of 1.2, herbaceous strata 1.91, shrub strata 1.32 and vines strata 0.62. The tree, herb and shrub strata are included in the medium diversity criteria because the value is $1.0 \le H' \le 3.0$, and the vines stratum has the low diversity criteria because the H' value <1.0. The evenness index for the shrub strata had the highest value, namely 0.95, followed by vines 0.9, herbaceous plants 0.83 and trees 0.61. The highest species richness index was owned by herbaceous plants with a value of 1.42, tree strata 1.33, shrub strata 0.72 and vines strata 0.24. Based on the species richness index criteria, plants in the Bada valley area have low species richness criteria because the R value <3.5. Further research is needed to determine the biodiversity of flora and fauna from cultural areas in Central Sulawesi Province.

Acknowledgments

The authors would like to thank the Regional Government, namely the Head of the Gorontalo Cultural Heritage Preservation Center Drs. Mohammad Natsir, M.Pd, as research grantor and research permit; Regional Government (PEMDA) from the village level, District in Lembah Bada, Poso Regency, Central Sulawesi Province, which has given permission to carry out this research; colleagues and local communities who have assisted in the data collection process in the field, and colleagues at the Gorontalo Cultural Heritage Preservation Center as researchers' discussion partners during the research.

References

- Aguilar, R., Cristóbal-Pérez, E. J., Balvino-Olvera, F. J., de Jesús Aguilar-Aguilar, M., Aguirre-Acosta, N., Ashworth, L., ... & Quesada, M. (2019). Habitat fragmentation reduces plant progeny quality: a global synthesis. Ecology Letters, 22(7), 1163-1173. <u>https://doi.org/10.1111/ele.13272</u>
- Álvarez, S. A., Rocha-Guzmán, N. E., González-Laredo, R. F., Gallegos-Infante, J. A., Moreno-Jiménez, M. R., & Bravo-Muñoz, M. (2022). Ancestral food sources rich in polyphenols, their metabolism, and the potential influence of gut microbiota in the management of depression and anxiety. Journal of Agricultural and Food Chemistry, 70(4), 944-956. https://doi.org/10.1021/acs.jafc.1c06151
- Boedhihartono, A. K. (2017). Can community forests be compatible with biodiversity conservation in Indonesia?. Land, 6(1), 21. <u>https://doi.org/10.3390/land6010021</u>
- Budiarti, M., Maruzy, A., Mujahid, R., Sari, A. N., Jokopriyambodo, W., Widayat, T., & Wahyono, S. (2020). The use of antimalarial plants as traditional treatment in Papua Island, Indonesia. Heliyon, 6(12), e05562. <u>https://doi.org/10.1016/j.heliyon.2020.e05562</u>
- [CBD] Convention on Biological Diversity. 2000. Sustaining Life on Earth: How the Convention on Biological Diversity Promotes Nature and Human Well-being. United Kingdom (UK): Secretariat of the Convention on Biological Diversity.
- Compant, S., Samad, A., Faist, H., & Sessitsch, A. (2019). A review on the plant microbiome: ecology, functions, and emerging trends in microbial application. Journal of advanced research, 19, 29-37. <u>https://doi</u>.org/10.1016/j.jare.2019.03.004
- Dar, P. A., & Reshi, Z. A. (2020). Impact of alien species on species composition, floristic and functional diversity of aquatic and terrestrial ecosystems. Tropical Ecology, 61, 446-459. <u>https://link.springer.com/content/pdf/10.1007/s42965-020-00102-9.pdf?pdf=button</u>
- Fachrul, M. F. (2012). Metode sampling bioekologi. Jakarta: Bumi Aksara. Fahrurozi et al., 2015
- Faiz. (2017). Perwujudan Monumental Kawasan Cagar Budaya Megalitik Lore Lindu. <u>https://kebudayaan.kemdikbud.go.id/bpcbgorontalo/perwujudan-monumental-kawasan-</u> <u>cagar-budaya-megalitik-lore-lindu/citra-digital-lore-lindu/</u>. Accessed on 21 February 2023.
- Geng, S., Shi, P., Song, M., Zong, N., Zu, J., & Zhu, W. (2019). Diversity of vegetation composition enhances ecosystem stability along elevational gradients in the Taihang Mountains, China. Ecological Indicators, 104, 594-603. <u>https://doi.org/10.1016/j.ecolind.2019.05.038</u>
- Gorontalo Cultural Heritage Preservation Center (2018). Annual report of the Gorontalo Province Cultural Heritage Preservation Center.
- Harris, J. G., & Harris, M. W. (2001). Plant identification terminology. Utah: Spring Lake Publishing.
- Harrison, S., Spasojevic, M. J., & Li, D. (2020). Climate and plant community diversity in space and time. Proceedings of the National Academy of Sciences, 117(9), 4464-4470. <u>https://doi.org/10.1073/pnas.1921724117</u>

- Hooper, D. U., Chapin III, F. S., Ewel, J. J., Hector, A., Inchausti, P., Lavorel, S., ... & Wardle, D. A. (2005). Effects of biodiversity on ecosystem functioning: a consensus of current knowledge. Ecological monographs, 75(1), 3-35. <u>https://doi.org/10.1890/04-0922</u>
- Kasmawati, H., Ruslin, I. S., Yamin, M. D., & Elafita, W. O. (2019). Ethnomedicine Studies of Traditional Medicinal Plants of the Muna Tribe in the Village of Bungi Southeast Sulawesi Province of Indonesia. International Journl of Science and Research, 8(11), 1882-7. http://karyailmiah.uho.ac.id/karya ilmiah/Sunandar/1.Ethnomedicine Studies.pdf
- Kitayama, K., Ushio, M., & Aiba, S. I. (2021). Temperature is a dominant driver of distinct annual seasonality of leaf litter production of equatorial tropical rain forests. Journal of Ecology, 109(2), 727-736. <u>https://doi.org/10.1111/1365-2745.13500</u>
- Lausch, A., Bannehr, L., Beckmann, M., Boehm, C., Feilhauer, H., Hacker, J. M., ... & Cord, A. F. (2016). Linking Earth Observation and taxonomic, structural and functional biodiversity: Local to ecosystem perspectives. Ecological indicators, 70, 317-339. <u>https://doi.org/10.1016/j.ecolind.2016.06.022</u>
- Lelli, C., Bruun, H. H., Chiarucci, A., Donati, D., Frascaroli, F., Fritz, Ö., ... & Heilmann-Clausen, J. (2019). Biodiversity response to forest structure and management: Comparing species richness, conservation relevant species and functional diversity as metrics in forest conservation. Forest Ecology and Management, 432, 707-717. <u>https://doi.org/10.1016/j.foreco.2018.09.057</u>
- Litza, K., & Diekmann, M. (2019). Hedgerow age affects the species richness of herbaceous forest plants. Journal of Vegetation Science, 30(3), 553-563. <u>https://doi</u>.org/10.1111/jvs.12744
- Ludwig, J. A., & Reynolds, J. F. (1988). *Statiscal ecology-a primer and methods and computing* Wiley. New York.
- Magurran, A. E. (1988). Ecological diversity and its measurement. Princeton: University press.
- Mahaut, L., Fort, F., Violle, C., & Freschet, G. T. (2020). Multiple facets of diversity effects on plant productivity: species richness, functional diversity, species identity and intraspecific competition. Functional Ecology, 34(1), 287-298. <u>https://doi.org/10.1111/1365-2435.13473</u>
- Midolo, G., Alkemade, R., Schipper, A. M., Benítez-López, A., Perring, M. P., & De Vries, W. (2019).
 Impacts of nitrogen addition on plant species richness and abundance: A global meta-analysis.
 Global ecology and Biogeography, 28(3), 398-413. <u>https://doi.org/10.1111/geb.12856</u>
- Murray, J. P., Grenyer, R., Wunder, S., Raes, N., & Jones, J. P. (2015). Spatial patterns of carbon, biodiversity, deforestation threat, and REDD+ projects in Indonesia. Conservation Biology, 29(5), 1434-1445. <u>https://doi.org/10.1111/cobi.12500</u>
- Pitopang, R., Hamzah, B., Zubair, M. S., Amar, A. L., Fathurahman, F., Basri, Z., & Poulsen, A. D. (2019, June). Diversity of Zingiberaceae and traditional uses by three indigenous groups at Lore Lindu National Park, Central Sulawesi, Indonesia. In Journal of Physics: Conference Series (Vol. 1242, No. 1, p. 012039). IOP Publishing.. <u>https://iopscience.iop.org/article/10.1088/1742-6596/1242/1/012039/meta</u> Pitopang R dan Ihsan M. 2014. *Biodiversitas tumbuhan di Cagar Alam Morowali Sulawesi Tengah Indonesia*. Journal of Natural Science. Vol 3(3): 287-296

- Pitopang, R., Khaeruddin, I., Tjoa, A., & Burhanuddin, I. F. (2008). *Pengenalan jenis-jenis pohon yang umum di Sulawesi*. Palu: UNTAD Press.
- Planchuelo, G., von Der Lippe, M., & Kowarik, I. (2019). Untangling the role of urban ecosystems as habitats for endangered plant species. Landscape and Urban Planning, 189, 320-334. https://doi.org/10.1016/j.landurbplan.2019.05.007
- Pramudya, R. (2020). Elaboration of forest management aspect in Indonesia's forestry legal perspective. JL Pol'y & Globalization, 93, 45. <u>https://heinonline.org/HOL/LandingPage?handle=hein.journals/jawpglob93&div=6&id=&page</u> =
- Ramadhan I. 2023. 6 Taman Nasional di Sulawesi yang harus kamu kunjungi. <u>https://seringjalan.com/6-taman-nasional-di-sulawesi/</u>. Accessed on 21 February 2023.
- Risjani, Y., Witkowski, A., Kryk, A., Górecka, E., Krzywda, M., Safitri, I., ... & Wróbel, R. J. (2021). Indonesian coral reef habitats reveal exceptionally high species richness and biodiversity of diatom assemblages. Estuarine, Coastal and Shelf Science, 261, 107551. https://doi.org/10.1016/j.ecss.2021.107551
- Roswell, M., Dushoff, J., & Winfree, R. (2021). A conceptual guide to measuring species diversity. Oikos, 130(3), 321-338. <u>https://doi.org/10.1111/oik.07202</u>
- Satrija, F., Ridwan, Y., & Rauf, A. (2015). Current status of schistosomiasis in Indonesia. Acta Tropica, 141, 349-353. <u>https://doi.org/10.1016/j.actatropica.2013.06.014</u>
- Sayfulloh, A., Riniarti, M., & Santoso, T. (2020). Jenis-Jenis Tumbuhan Asing Invasif di Resort Sukaraja Atas, Taman Nasional Bukit Barisan Selatan (Invasive Alien Species Plants in Sukaraja Atas Resort, Bukit Barisan Selatan National Park). *Jurnal Sylva Lestari*, 8(1), 109-120.
- Scales, B. R., & Marsden, S. J. (2008). Biodiversity in small-scale tropical agroforests: a review of species richness and abundance shifts and the factors influencing them. Environmental conservation, 35(2), 160-172. <u>https://doi.org/10.1017/S0376892908004840</u>
- Schmidt, J. P., Cruse-Sanders, J., Chamberlain, J. L., Ferreira, S., & Young, J. A. (2019). Explaining harvests of wild-harvested herbaceous plants: American ginseng as a case study. Biological conservation, 231, 139-149. https://doi.org/10.1016/j.biocon.2019.01.006
- Setyawati, T., Narulita, S., Bahri, I. P., and Raharjo, G. T. (2015). A Guide Book to Invasive Alien Plant Species. BLI KLHK, Bogor.
- Shannon, C. E., & Wiener, W. (1963). *The mathematical theory of communication*. Urbana: University of Illinois Press.
- Silalahi, M., Supriatna, J., & Walujo, E. B. (2015). Local knowledge of medicinal plants in sub-ethnic Batak Simalungun of North Sumatra, Indonesia. Biodiversitas, 16(1), 44-54. <u>http://repository.uki.ac.id/198/2/Artikel%20di%20Jurnal%20Biodiversitas%20Volume%2016%</u> <u>20No%201.pdf</u>

Sitepu, B. S. (2020). Keragaman dan Pengendalian Tumbuhan Invasif di KHDTK Samboja, Kalimantan

Timur (Diversity and Management of Invasive Plants in Samboja Research Forest, Kalimantan Timur). *Jurnal Sylva Lestari*, 8(3), 351-365.

- Spicer, M. E., Radhamoni, H. V. N., Duguid, M. C., Queenborough, S. A., & Comita, L. S. (2022). Herbaceous plant diversity in forest ecosystems: patterns, mechanisms, and threats. Plant Ecology, 223(2), 117-129. <u>https://link</u>.springer.com/content/pdf/10.1007/s11258-021-01202-9.pdf?pdf=button
- Steenis, V, C. G. G. J. (2008). Flora untuk sekolah di Indonesia. Jakarta: Pradnya Paramita Press.
- Shen, S., Xu, G., Li, D., Jin, G., Liu, S., Clements, D. R., ... & Weston, L. A. (2019). Potential use of sweet potato (Ipomoea batatas (L.) Lam.) to suppress three invasive plant species in agroecosystems (Ageratum conyzoides L., Bidens pilosa L., and Galinsoga parviflora Cav.). Agronomy, 9(6), 318. https://www.mdpi.com/2073-4395/9/6/318
- The Plant List. (2013). Version 1.1. (2021, Maret 15). Retrieved from http://www.theplantlist.org
- Tjitrosoepomo, G. (1985). Morfologi tumbuhan. Yogyakarta: Gadjah Mada University Press.
- Träger, S., Öpik, M., Vasar, M., & Wilson, S. D. (2019). Belowground plant parts are crucial for comprehensively estimating total plant richness in herbaceous and woody habitats. Ecology, 100(2), e02575. <u>https://doi.org/10.1002/ecy.2575</u>
- van der Plas, F. (2019). Biodiversity and ecosystem functioning in naturally assembled communities. Biological Reviews, 94(4), 1220-1245. <u>https://doi.org/10.1111/brv.12499</u>
- Widjaja, E., Rahayuningsih, Y., Rahajoe, J., Ubaidillah, R., Maryanto, I., Walujo, E., and Semiadi, G. 2014. Kekinian Keanekaragaman Hayati Indonesia 2014. LIPI Press, Jakarta. DOI: 10.1007/s13398-014-0173-7.2
- Zelnik, I. (2012). The presence of invasive alien plant species in different habitats: case study from Slovenia. Acta biologica slovenica, 55(2), 25-38. <u>https://www.researchgate.net/profile/IgorZelnik/publication/273130826 The presence of in</u> <u>vasive alien plant species in different habitats Case study from Slovenia/links/54f873d20</u> <u>cf2ccffe9df2e19/The-presence-of-invasive-alien-plant-species-in-different-habitats-Case-studyfrom-Slovenia.pdf</u>

Unicheck similarity report

Unicheck Similarity Report 10140 × Load	ding × +		- 0	\times
C C G File D:/MELISNAWATI	%20H.%20ANGIO/LIPI/KTI/JURNAL/20	23/Jurnal%20Poso/Biodiversity/Revisi/Unicheck%20Sim	 : @ 😩 … (b
≔ 😾 ~ 🗸 Draw ~ 🖉 🗊 Re	ead aloud - + 🕶	1 of 12 🖓 🔳	🍞 🖉 🏟 🗍	Q
				-
	UNICHECK			-
	Имя пользователя: скрыто настройками конфиденциальности	ID проверки: 1014085185		±1
	Дата проверки: 25.02.2023 19:48:54 ЕЕТ	Тип проверки: Doc vs Internet + Library + DB		-
	Дата отчета: 25.02.2023 19:50:04 ЕЕТ	ID пользователя: 92161		0
	Название файла: Submit Rahim et el_2023_Biosystems	Diversity		0
	Количество страниц: 8 Количество слов: 6323 Ко	оличество символов: 40678 Размер файла: 741.27 КВ ID файла: 1013828247		
	9.58%			*
	Совпадения			
		иком (https://jurnal.fp.unila.ac.id/index.php/JHT/article/download/37.		
	9.58% Источники из Интернета 260	Страница 10		+
	0.63% Источники из Библиотеки 59	Страница 12		
	0% <mark>Цитат</mark>			
	Исключение цитат выключено			
	Исключение списка библиографических ссыло	квыключено		
	0% Исключений			
	Нет исключенных источников			_
				द्धि

REVISI 1

MS	iubmit an original research articl $ imes$	+	~ - 0 X
÷ -	→ C (mail.google.con	n/mail/u/0/#inbox/QgrcJHsBmGCmmBDJnnCjtLJVRSsGFBhVjTG	🔹 Q 🔄 🕁 🗖 🕐 🗄
≡	M Gmail	Q Telusuri dalam email	• Aktif • ⑦ 🔅 III UNGmail 🕐
Mail	0 Tulis		3 dari 128 < 🔉
Mail Chat 228 Spaces Meet	Kotak Masuk 31 ☆ Berbintang 0 ① Ditunda 0 ▷ Penting 0 ▷ Terkirim 0 □ Draf 1 ② Semua Email 1 ③ Sampah 1 ▷ Kategori 2 Sosial 7	Brygadyrenko VX. Inspaces says * 25.02 2023 19:33, Sukuman Rahim «sukirmanrahm@ung.ac.id»	ی که ۲۰۰۹ 20 ۲۰۰۵ 2023, 01.47 🔥 🦛 😫
	① Update 13 □ Forum 1 ○ Promosi 1 ∨ Selengkapnya 1	Best wishes; Dr. Vikior Bigadyrenko Bionop Bacurhuosiwi Epwrapupewio 3 Lampiran - Dipindai dengan Gmail O	± @. <

BAGIAN YANG DIMINTA UNTUK REVISI

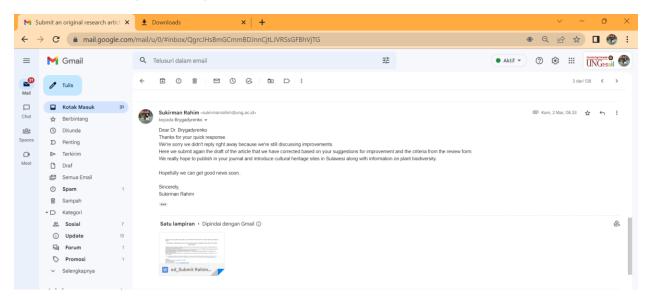
- 1. Please add information to the article.
- 2. Now the scientific novelty of the publication will not interest the international scientific audience.
- 3. The title of the article should contain a scientific problem or process. The geographical location of the object of study is sufficient to indicate in the annotation.
- 4. Please think about what new you have installed compared to previous researchers.
- 5. Please delete figure 2, it does not correspond to the scientific level of an international journal.
- 6. Please carefully analyze the formal criteria of the reviewer's form so that the article passes the review stage as easily as possible.

	5 · O	÷				edit	t M_Submit R	tahim et el_	_2023_Bio	systems Div	ersity (Compat	ibility Mode]	- Word			Sign in	Ð	-	o	×
File	Home	Insert	Draw	Design	Layout	References	Mailings	Review	View	Develop	er Help	🔉 Tell me	e what you	want to do						\Box
Paste	X Cut Copy Format	Painter	Times New	v Roma * 8 J - abe X	• A^* ₂ X^2 A	A [*] Aa - A∕		= - ¹ 0= - ■ ■ \$			AaBbCcDd Body Text	AaBbCcI ¶ Default	AaBbC	cI AaBbCcD	AaBbCcDo		Ŧ	P Find abc Rep ⊳ Sele	lace	
	Clipboard	21 			ont	E		Paragra		5	6		. 7	Styles			L2	Editi	ng	^
L			Diversity-of-p Natural appe analyse. Sukirman R "Department do Gorontalo Biology Depa District, Boo Research Cen Bogor, Java B Research Cen Bogor, Java B	lants in the eng ahim ²¹ , Allan of Postgraduate City, Gorontal Rolanga, Reg tet, for Plant Cc arat, Indonesis tre for Ecology sia	ltural area of alithic cultur Fordinand . Province, 961 of Mathemat province, 960 of Mathemat or Mathemat province, 960 or Mathemat province, 960 or Mathemat province, 960 of Mathematica province, 960 of Math	<mark>the Bada valley, P</mark> al heritage area of Ambo ^{±1} , Dewi Wah ad Environment, Sta	ssa Regency, C (the Bada Va Ariyanti K. Bader Ariyanti ² , Su te University of nce, State Unive , TeLES, (033 Forestry – Natio arch and Innov on and Environm	entral Sulaw Iley (Central an ² , Marini Ş aardi ⁴ Gorontalo, S ervity of Goro 5)821752 onal Research ation Agency anent, State Ur	esi I. Sulawesi); Susanti Han tate Univers entalo, J. Pro a and Innova , Jl. Raya Ja aiversity of C	<u>Vegetation</u> nidun ² , Melisn ity of Gorontal f. <u>BJ Habibie</u> I tion Agency, J tion Agency, J Sorontalo, Stat	composition and awati H Angio ² , o, JI Jendetal Sod Montong Village. 1. Ir. H. Djuanda, 1. Ir. H. Djuanda, 1. Ir. H. Djuanda, 1. Gibinong, T.	biodiversity Esti Eudah irman No. Zionakabila, No. 18, West Java, yrontalo, Jl.		Lenovo	nglish (United S Mar	States) kup Area				
			values which i the most impo	s one of the fir rtant water cate	st four biosph hment areas f	a Megalithic culture nere reserves in Indo for the Watershed, - en reported, includin	nesiaThe area However, there	a is surrounde is a lack of s	ed by densel studies on th	y forested more vascular flor	intains; and forms a. No and until no	one of w there								¥

	5× თ	Ŧ				ed	it M_Submit	Rahim et el_2	023_Biosy	stems Dive	ersity (Compatil	bility Mode]	- Word			Sign in	Œ	- 6	×
File	Home	Insert	Draw	Design	Layout	References	Mailings	Review	View	Develope	er Help	💡 Tell m	e what you w	ant to do					\Box
Paste	Cut Copy	Painter	Times New	Roma * 8 - abe X	• A*	A [*] Aa ∝ A⁄⁄ ∞ a <mark>2⁄</mark> ∝ <u>A</u> ∝		≣ • ⁵≣ • ≣ ≣ \$≡	• 🎒 -	2 ↓ ¶ ⊞ ↓	AaBbCcDd Body Text	AaBbCcI 1 Default	AaBbCcl	AaBbCcDo	AaBbCcDc			♀ Find ^{ab} _{ac} Replace Select	
L.	Clipboard	151 1			ont	2	- 3	Paragrap		5	6 .			ityles			L2	Editing	^
			values-which is the most import has been no dat analyzes (diver: diversity index, used an explor individuals), tre trees (H=1.2); strata was mod- vines, herbs an low category (biodiversity is t Keywords: dive Introduction Indonesia, covering i	one of the fir tant water cast a on plant div sity index, eveness ind ing technique ses (91 individ herbs (H=15 errate (1.0 ≤ H d trees has even R < 3.5), with ased as a datal ersity index, evenesia is a count together with 17% of the tot	rst four biosph chment areas is events has been events index, ex and plant s with purposi- tuals), shrubs (H ; ≤ 3.0), and ; ≤ 3.0), and h R values for alaceyable of h R values for alaceyable of has a values for alaceyable of has a values for alaceyable of the particular of the second the second second second the second second second second the second second second second the second second second second the second second second second second second the second second second second second second second second the second second second second second second second second second the second se	a Megalithic cultu preresserve in Indo or the Waterabed. an eported, includit we sampling. –Th (64 individuals) and vines he encroaching pla 0.55; 0.9; 0.83; 0.6 or herbaceous plan 0.55; 0.9; 0.83; 0.6 or herbaceous plan or cectourism deve richness index, bio ry rich in biodive sin the world focu al, 2015; Baedhin	onesinThe are -However, ther -However, ther -However, ther me, plant invent richness index tex in the Bada' results of the dvines (57 indir (H=0.62), -The nt stratum had 1 (respectively, at (1.42), trees elopment in the is odiversity, plant rsity and has ware countries in the countries in the strategy of the strategy of the strategy of the strategy of the strategy of the strategy of the st	a is surrounded e is a lack of str cory, plant identi), -The study a viduals),-The study a viduals),-The study a viduals),-The identification diversity of pla ow diversity of pla ow diversity of pla ow diversity of pla diversity of pla di diversity of pla dive	by densely, dies on the- ification, veg- immed-the-an- area, Pogo, R. gestation. cor- versity indes not in the Ba C-1.0). The thesis index (0.72), and (0.72), and	forested mou vascular flora getation comp mo of the stue legency. Cent mposition for a value of eac ada valley in evenness ind of plants in t vines (0.24) area. al position on ghest biodiver 31 species are	Intains, and forms, No and until nov toxition, and biedi by was to determ all Sulawesi. This herbaccous start herbaccous s	one of where versity ine the s study a (555 ent for i ahrub shrubs, in ahte a plant versity map. y countries), retamo, 2017;							
			also the v 2016: Har C in the Wa faunasF cultural h Lindu are chronolog (UNESCO T Bada Val	ariability of li rison et al., 20 One area in Ins llacea region, However, the jeritage areas in a Lore Lindun in Indones D) for designat Che report from lleyThreats	ife on earth (I)20; Lausch et donesia withth a biogeograph plant abundan in Central Sul Megalithic Ar ia, <u>It is</u> , and icon as a world n the Gorontal a caused by r	1. 2015; Budjartje elooper et al.e4a, ci-ad-ad-ad-ad-ad-ad-ad-ad-ad-ad-ad-ad-ad-	2005), and diver ensity is Sulawer the Sunda Shells is insufficiently her with the Be has important s abmission to th World Heritage? e Preservation C lude: weatherin	rsity is a charac si,; one of the pr f and the Sahul i explored (Piton hos Valley and cientific, histori te United Natic lenter (2018) mo g caused by in midity, and sum	teristic diffe rovinces inis Shelf, which ang et al.et- the Napu V cal and cultu ons Education entions poten interactions b	erence betwee Central Sular has a high d -al, 2019)T /alley, as well aral valuesT onal, Scientif ntial threats to between arch	n communities (L wesiThis provin liversity of endem the Bada Valley i I as the Palu Vall his area has the ol ic and Cultural (acchaeological remain accological remain	ausch, et al., ce is located ic floras and s one of the ey and Lake dest cultural Organization mains in the as and their							_

5	- Ø	-				ed	it M_Submit F	ahim et el_20	23_Biosy	stems Diver	sity (Compat						Sign in	•		>
ile	Home	Insert	Draw	Design	Layout	References	Mailings	Review	View	Develope	r Help	Q Ti	ell me wha	at you want	to do					Ç
te	Cut Copy Format I	Painter		Roma * 8 J - abe X	• A*	A [*] Aa - A			• • •		AaBbCcDd Body Text	AaBb 1 Def				AaBbCcDc No Spacing			♀ Find ↓ ^{ab} _{vac} Replace ♦ Select ↓	
	pboard	anner IS		Fo	ont			Paragraph		rs.				Style	s			E)	Editing	
									-41			7								
						at 0.61 (Figure 3) . Hothere with a value of 1.42, there str area have low species richner Table 3	en for the slarab stratum had no plants owned the hinter ata 1.33, shrub strata 0.72 s is criteria because the <u>E-val</u> ien richness index, and even	the highest value, namely (1.10x1/m fichness inderThe ad vines stats 0.24 ,-Base gR value <0.5.	0.95, followed by v a kighten species a d at the species of contine in Back Via y Exchange in (E)	ines at 0.91, herbaceous chrons index was even chrons index criteria, pi liev Cultural Conversati	plants at 0.33 and trees of by Active course plants lasts in the Eads valley		Lenovo Formatteli Ginter Formatteli Ginter Lenovo Formatteli Ginter Lenovo Formatteli Ginter Lenovo Formatteli Ginter	erred erred erred						
						<u>. 1369 </u>		221 Modern		Let .			Lanovo Formatted: Genter Lanovo Formatted: Genter Lanovo	end end Jodent: First line: 0*						
						_	1.6 1.4 1.2 1 1 500 0.6 0.2 0 Tree	Species Richness J 1.42	0.72	0.24 Vines										
5 of 9	6183 wc	ords []]®	1 e	? Accessibility:	: Unavailable	ـــــــــــــــــــــــــــــــــــــ	Inte	Interior	511 00	Tures						00			+ 6 3) (
27 Ce	°C Irah						Ø Sear	ch 📕	D	0	-	=	w	¢			~ 🗞	ି ଏ)	■ 3/16/20	23

Bukti Sudah dilakukan review atas apa yang diminta pada Tahap 1

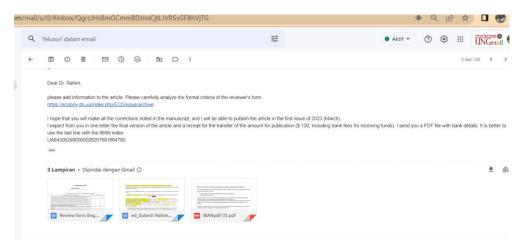


	ి 🗸	Ŧ				edit	M_Submit F	lahim et el_i	2023_Bios	systems Diver	sity (Compati	bility Mode]	- Word			Sign in	æ	-
File	Home	Insert	Draw	Design	Layout	References	Mailings	Review	View	Developer	Help	💡 Tell me	e what you wa	nt to do				
Paste	X Cut In Copy ✓ Format	Painter	Times Nev	v Roma * 8 J - abe X	• A*	A Aa - 🤌		: v %;: v ≣ ≣ \$≡	•	2 ↓ ¶ ~ ⊞ ~	AaBbCcDd Body Text	AaBbCcI	AaBbCcI 1 Normal		AaBbCcDc No Spacing			P Fir
	Clipboard	ي کا		F	ont	<u>م</u>		Paragraj	1. A.	E1			St	yles			ß	Edi
Page 5	of 9 6183 w	- Dia		Ş Accessibility		ASTEACT The black '100's on each find the black '100's of the black '100's of the black states of the experiment of the black '100's of the states of the experiment of the black '100's of the states of the experiment of the black '100's of the black '100's of the black '100's of the black '100's of the black '100's of the black '100's of the black '100's of the black '100's of the black '100's of the black '100's of the black '100's of the black '100's of the black '100's of the black '100's of the black '100's of the black '100's of the black '100's of the black '100's of the black '100's of the bl	and areas of the Brislever Market Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Street Str	her, Henn Harganov, Gor ces of the University of the University of the University of the University of the University of the University of the University of	we in factors in the second se	with Ventories connected based on Antonio and Anton	Anger's Ref Beeck Anger's Ref Beeck Anger's Ref Beeck Mange Stormers Manage St	Lenous	di lingdon (kolmed States)					

🖬 🗇 🖉 🔹				ed	_Submit Rahi	m et el_2(023_Biosyst	ems Diversity	- Word			Ļ	Sign in	63		
File Home Insert	Draw Design	Layout	References	Mailings	Review	View	Develop	er Help	💡 Tell m	e what you want t	to do					Ç
Cut Paste v ✓ Format Painter	Times New Roma * 8	$\begin{array}{c c} \bullet & A^* & A \\ \hline & \bullet \\ \hline & \bullet \\ \hline & \bullet \\ \hline & \bullet \\ \end{array}$	Aa - A₂ 22 - Aa - A₂ -		= • 5≣ • ≣ ∭ \$≡	•	2↓ ¶ ⊞ -	AaBbCcDd Body Text	AaBbCcI 1 Default	[AaBbCcI A ¶Normal ♪					P Find	
Clipboard 🛛		Font	15	1	Paragrap	r	Iي.			Styles	5			12	Editing	
			2	1 + + + + +	2	3	$\tau \to \tau + \tau \to$	4	5	1 6	1.8.7.					
			Material and metho	45												
			capital city of L Puselemba and west by the Dist	angkeka. Admini West Pamona D trict Kulawi, Pos	istratively, the Ba istratistics, Poso Reg to Regency. The t urea is presented is	la Valley is b ency, io the cut area of a s Figure 1.	ordered to the isouth by Ramp south by Ramp he Bada valley	orth by Lore Tenga i Seko District, No	h District, Pose Re the Luwe Regen; trail Bureau of Sta	4 West Loe District with gency: to the east by Pa y, South Sulavvesi, and initics, 2022). The map of the second second second second second second second second second second second second second second second second second second second second second second	amona to the					
			ropical climate with a per year. The geologi of Andesite and Ande years ago. The existen Village, West Lore D The research observation of all exis was recorded in the for hat had been prepareo features in each class	an average tempo cal condition of site Basalt lava r nee of volcanic a sistrict. method uses ex- ting plant species en of the collect and family or ge	erature of 220C-3 Poso district, espe ocks resulting fro cctivity in the Bad ploring methods : s, accompanied by icor's name, collect of plants was carri enus down to the	IoC with ave cially in the l in the eruption a valley area for the exploidigital photo ion number, i ed out using to upecies level	rage air humid Bada valley are n of submarine can still be fou ration of plant ographs with a c collection date, the procedure fi and then comp	ty reaching 90%, w a, consists of rocks volcances in the Pli and in the presence of species. Exploratio ligital camera, was u location, and habit or observing plant m ared with the book	ith an average rais of the <u>Tinemba</u> V ocene to Pleistoce of hot springs in § a of the Bada Val used to collect plan is, which were rec corphological char <u>Tintoscorpomo</u> (1	meters above sea level v nfall of 2000 mm to 400 'olcano Formation in the ne period aged 15 to 2 m agerao. Village and Lanu ley cultural heritage are tt data. Additional inform orded in the observation acters, which included sy 985), Harris & Harris (2 Harris & Harris (2)	00 mm e form million ugkeka ea and mation a sheet special 2001)					

5							ed	_Submit Ral	nim et el_î	2023_Biosyste	ms Diversity	- Word				Sign in	•			
File	Home	Insert	Draw	Desi	gn Layout	References	Mailings	Review	View	Developer	Help	💡 Tell m	e what you wa	ant to do						\Box
Paste	Cut Copy Format Pa	inter	Times N	ew Roma		A [*] Aa - A - a⊻ - <u>A</u> -		_	•	⊉ ↓ ¶ - ⊞ -	AaBbCcDd Body Text	AaBbCcI	AaBbCcI		AaBbCcD			P Find	lace	
	board	15			Font		rs.	Paragra	ph	IS.			S	tyles			15	Editir	a	
							1	2	1.1.1.1.2	3	. 4	5	1 + + + 6 +		7				-	
						soil contains : preserving wi source of flood The driv several factor condition is st type, altitude eccoystrot driv distributions is the driven driv distributions is conversely, a in line with th the region. Based o E'emenes inde the observation of E'emenes inde the observation (2000), linkon Australia, giv Furthermore, small daily on The value	igh levels of nutri d animals as a co and many other i raity of plants in , including the cc traity of plants in , including the cc traity of the diversi- raity disturbances and biotic influen d (2019) tatte th Furthermore, van d (2019) tatte th furthermore, va	ients. In addition, mpoent of an exponent of an exponent of an ex- functions (Schmi the Bada valley minol of the area ex- ect (kiving finage) and (2019) is and exec (kiving finage) are very high. A di- der 2Ba (2019) are very high. A di- eder 2Ba (2019) are very high. A di- der 2Ba (2019) are very high. A di- est (E) range fit distribution of put of bara and fit in Indonesia is a ta tergence of parti- tagenet al. (2021) les.	berbs are all cosystem is in did det et al., 2019 area is inclut area is inclut in the culturu, statement, while one of the state of the state of the state of the state area in the culture of the state area in the state of the state area in the state of the state area in the state of the state culture of the state of the state area in the state of the state culture of the state of the state area in the state of the state culture of the state of the state area in the state of the state area in the state of the state area in the state of the state of the state area in the state of the state of the state area in the state of the state of the state area in the state of the state of the state area in the state of the state of the state area in the state of the state of the state of the state area in the state of the state of the state of the state area in the state of the state of the state of the state area in the state of the state of the state of the state area in the state of the state of the state of the state area in the state of the state of the state of the state area in the state of the	io used as a source filtuenced by the pr P, Alvare et al., 24 def in the medium al heritage area, so this tastes that plan ree, Dar & Reghi (J) high, the condition se of polluted ecco J) high, the condition gh species diversity siad to have high y if the community siad to have high y if the community siad to have high y if the community sid to have high y if the community is and to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the community is a solution of the sid to have high y if the solution of the solution of the sid to have high y if the solution of the solution of the sid to have high y if the solution of the solution of the solution of the solution of the solution of the solution of the solution of the solution of the solution of the solution of the solution of the solution of the solut	of animal feed, m seence and diversity and low diversity iil type, climate, a 2020, and the diversity is influ 2020) states that of the ecosystic potential of the ecosystic problem that the pla- sepcies diversity is provided the the second separated from the sof rainfall, temp tion around the e- teristics in resour- tion around the estimator to the substantial second to the substantial second the soft animal second the second the second the substantial second the second the substantial second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the second the seco	edicine and wealt edicine and wealt index criteria. I have criteria and a diotic influence enced by several a liveriary is synowic synowym a weart and a synowym a weart a synowym a few species a and a encoder a synowym a few species a few s	by litter that is return in germplasm. For h as a place to live is (living things). The lactors, including c2 ble. Ecosystem een sity tends to be low ble. Ecosystem een sity tends to be low a higher ability to mmplexity because a higher ability to mmplexity because is composed of may only a few domina ricommental factors of tropical forest e of tropical forest e of tropical forest e buttom of species 1 species found, the	r example, and a high caused by This actual limate, soil bility of an vironments to deal with the species, or y apecies, and y apecies, any apecies, onyatem in sistribution, throughout s. The high Ptamudya, of Asia and cosystems. maity, with abundance.						
						wealth index. The rich species richne follows the o Conversely, if Species r families will because of th the number of <u>Mahaut</u> et al. (the sup of the supports the c and the Suus o ceremonies or	ness of plant spec ss. The number of pinion of Roswel the community o chness shows all e visible, making variety of these species in a partit 2020), who stated richness index. I oncept of preserv. ite in Lengkea V rituals following	ties in the Bada v plant species for l et al. (2021) 1 omprises very fe the variations fo species. The spe- rular area. Specie that species richa in the context of ation by local va /illage, Lore Barr	valley area is r each stratum that a commi w species and und in living serve than dif cies richness to cultural herit lues and trad to cultural herit lues and trad t District, are seveloped at 1	classified as low. I in in the Bada valley unity has high spp d only a few domin things between sp fferences between index is the most termines the amou the number of spece tage sites or areas, itions. Sites identif e, of course, closely hat time. In additi	t has been explain v area is still relati ccies diversity if 1 laant species, then i vecies. Differences straightforward m nt of species richm is in a communit the presence of c fied as places of w v related to the use on, a tradition con	ed above that the vely small, thus at he community is he species divers: between species species. Richne easure because it ess in each comm , The quantity of ertain plant speci orship, such as th of certain plant sp	number of species ffecting species ricl composed of mar	will affect hness. This ny species. ne or more evel occurs ferences in nfirmed by determines ca strongly ori Village ut worship bark of the						

REVISI 2



. Каждый тип ошибок отмечен в тексте статьи один или два раза, а исправить этот тип ошибок нужно по всей статье

Авторам необходимо найти статьи на сайте журнала и внимательно проанализировать оформление каждого из элементов статьи по формату нашего журнала<mark>.</mark>

Natural aspect in the megalithic cultural heritage area of the Bada Valley (Central Sulawesi): Vegetation composition and biodiversity analyses.

S<mark>ukirman</mark> Rahim^{*1}, A<mark>lland</mark> F<mark>erdinand</mark> Ambo¹, D<mark>ewi</mark> W<mark>ahyuni</mark> K. Baderan², Marini Susanti Hamidun², Melisnawati H Angio³, Esti Endah Ariyanti³, <mark>Sunardi⁴</mark>

^{1*}Department of Postgraduate Population and Environment, State University of Gorontalo, <mark>State University of Gorontalo, Jl.</mark> Jenderal Sudirman No. 06 Gorontalo City, Gorontalo Province, 961282 Страна Tel. E-mail

²Biology Department, Faculty of Mathematics and Natural Science, State University of Gorontalo, JI Prof. BJ.Habibie Moutong Village, Tilongkabila District, Bone Bolango Regency, Gorontalo Province, Indonesia. Tel.Fax (0435)821752 E-mail

³Research Center for Plant Conservation, Botanic Gardens, and Forestry – National Research and Innovation Agency, Jl. Ir. H. Djuanda, No.18, Bogor, Jawa Barat, Indonesia Tel. E-mail

³Research Centre for Ecology and Ethnobiology - National Research and Innovation Agency, <mark>Jl.</mark> Raya Jakarta-Bogor <mark>Km.</mark> 46, Cibinong, West Java, 16911, Indonesia Tel. E-mail

Corresponding Author: Department of Postgraduate Population and Environment, State University of Gorontalo, State University of Gorontalo, Jl. Jenderal Sudirman No. 06 Gorontalo City, Gorontalo Province, 961282, Tel.: +62 852-1745-0295, E-mail: sukirmanrahim@ung.ac.id

Orchid Id

Sukirman Rahim: https://orcid.org/0000-0001-5756-9896

Dewi Wahyuni K. Baderan: https://orcid.org/0000-0003-3014-0832

Marini Susanti Hamidun: https://orcid.org/0000-0003-3282-4496

Melisnawati H Angio: https://orcid.org/0000-0003-1242-6343 Esti Endah Ariyanti: https://orcid.org/0000-0003-1219-9021 Sunardi: https://orcid.org/0000-0002-7764-2779

ABSTRACT

Структура аннотации не соответствует требованиям бланка рецензента

The Bada Valley is one of the Lore Lindu Megalithic cultural heritage areas, which is one of the first four biosphere reserves in Indonesia. The area is surrounded by densely forested mountains and forms one of the most important water catchment areas for the Watershed. However, there is a lack of studies on vascular flora. No data on plant diversity has been reported, including plant inventory, plant identification, vegetation composition, and biodiversity analyses (diversity index, evenness index, and plant species richness index). The study aimed to determine the diversity index, evenness index and plant species richness index, and plant species richness index). The study aimed to determine the diversity index, evenness index and plant species richness index and plant species richness index on vegetation composition for herbaceous strata (555 individuals), trees (91 individuals), shrubs (64 individuals) and vines (57 individuals). The diversity index value of each stratum is different for trees (H'=1.20), herbs (H'=1.32), shrubs (H'=1.32), and vines (H'=0.62). The diversity of plants in the Bada valley in the tree, herb, and shrub strata was moderate ($1.0 \le H' \le 3.0$), and the encroaching plant stratum had low diversity (H' <1.0). The evenness index at the level of shrubs, vines, herbs and trees has values of 0.95; 0.90; 0.83; 0.61, respectively. The species richness index of plants in the Bada valley is in a low category (R <3.5), with R values for herbaceous plants (1.42), trees (1.33), shrubs (0.72), and vines (0.24). Information on plant biodiversity is used as a database for ecotourism development in the Bada Valley cultural reserve area.

Keywords: diversity index, evenness index, richness index, plant species, invasive alien species добавьте еще 5-6 слов

Introduction

Indonesia is a country that is very rich in biodiversity and has won an important position on the world biodiversity map. Indonesia, together with Brazil and Zaire, is in the top three countries in the world that have the highest biodiversity (megadiversity countries), covering 17% of the total bird species in the world found in Indonesia (1,531 species), of which 381 species are endemic (Scales & Marsden, 2008; Murray et al., 2015; Boedhirtano, 2017), has around 30,000 species of plants and has been used as a source of medicinal raw materials (Silalahi et al., 2015; Budiarti et al., 2017; Kasmawati et al., 2019). Diversity is the variation and variability of life on earth (Hooper et al., 2005), and diversity is a characteristic difference between communities (Lausch et al., 2016; Harrison et al., 2020).

One area in Indonesia with high biodiversity is Sulawesi, one of the provinces in Central Sulawesi. This province is located in the Wallacea region, a biogeographical area between the Sunda Shelf and the Sahul Shelf, which has a high diversity of endemic floras and faunas. However, the plant abundance of this region is insufficiently explored (Baderan et al., 2021; Pitopang et al., 2019). The Bada Valley is one of the cultural heritage areas in Central Sulawesi, together with the Behoa Valley and the Napu Valley, as well as the Palu Valley and Lake Lindu are a Lore Lindu Megalithic Area (KMLL) which has important scientific, historical and cultural values. This area has the oldest cultural chronology in Indonesia. It is currently in submission to the United Nations Educational, Scientific and Cultural Organization (UNESCO) for designation as a world cultural heritage (World Heritage).

The report from the Gorontalo Cultural Heritage Preservation Center (2018) mentions potential threats to archaeological remains in the Bada Valley. Threats caused by natural factors include weathering caused by interactions between archaeological remains and their environment; environmental factors such as climate, temperature, humidity, and sunshine; organisms such as insects, fungi, lichens, and bacteria. Other natural factors are erosion, landslides and floods, and the activities of large animals that can potentially damage these objects. In addition to natural factors, human activities also have the potential to threaten the existence of these archaeological remains. Destruction and theft, vandalism, mining activities, agricultural land clearing, plantations and development (Satrija et al., 2015).

Mining activities in the Bada Valley Cultural Heritage area are spread over four villages: Bulili Village, Badangkaia Village, Bewa Village and Gintu Village, which were discovered in 2017. The perpetrators of this illegal mining are not only the local people of the Bada valley but also come from outside the Bada Valley or the Poso Regency. Using trommel, mercury, and other materials in mining will damage the environment. The impact of this activity is frequent flooding, landslides, and destruction of the habitat of various species of animals, including endemic birds such as the Maleo bird, Babirusa, and Anoa, also hundreds of other species of animals that have been living and breeding in the forest in the Lore Lindu National Park area.

In addition to human activities, one of the causes of the decline in biodiversity is the invasion of alien species. Invasive alien species are species of flora, fauna, microorganisms and pathogens originating from outside their original habitat that enters new areas and can cause harm to ecosystems or the environment, the economy and public health (CBD, 2000). Approximately 300 species of weeds have become invasive and have been found in Indonesia (Widjaja et al. 2014; Setyawati et al. 2015;). The percentage of successful weed species becoming dominant and causing negative impacts on new habitats is 10% (Sitepu, 2020).

The lack of attention to plant biodiversity has become the reason for researching the biodiversity index of the Bada valley cultural reserve area. Data on plant diversity is complementary to realizing the development of ecotourism in Central Sulawesi Province.

Material and methods

Study area. This research was conducted in the Bada Valley cultural heritage area, Poso Regency, Central Sulawesi Province. Bada Valley is located in South Lore and West Lore Districts, Poso Regency. South Lore District is the capital city of Gintu, and West Lore District with the capital city of Langkeka. Administratively, the Bada Valley is bordered to the north by Lore Tengah District, Poso Regency; to the east by Pamona Puselemba and West Pamona Districts, Poso Regency; to the south by Rampi Seko District, North Luwu Regency, South Sulawesi, and to the west by the District Kulawi, Poso Regency. The total area of the Bada valley is 997.7 km2 (Central Bureau of Statistics, 2022). The map of the Bada Valley Cultural Heritage Area is presented in Figure 1. Не рекомендуется оформлять ссылку на рисунок или таблицу в виде отдельного предложения, не содержащего никакой другой информации.

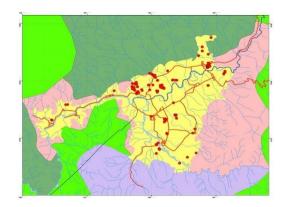


Fig. 1. Research observation point of the Bada Valley Cultural Heritage Area

Bada Valley is a valley surrounded by mountains with an altitude between 750 meters above sea level-1250 meters above sea level with a tropical climate with an average temperature of 22oC-31oC with average air humidity reaching 90%, with an average rainfall of 2000 mm to 4000 mm per year. The geological condition of Poso district, especially in the Bada valley area, consists of rocks of the Tinemba Volcano Formation in the form of Andesite and Andesite Basalt lava rocks resulting from the eruption of submarine volcanoes in the Pliocene to Pleistocene period aged 15 to 2 million years ago. The existence of volcanic activity in the Bada valley area can still be found in the presence of hot springs in Kagerao Village and Langkeka Village, West Lore District.

The research method uses exploring methods for the exploration of plant species. Exploration of the Bada Valley cultural heritage area and observation of all existing plant species, accompanied by digital photographs with a digital camera, was used to collect plant data. Additional information was recorded in the form of the collector's name, collection number, collection date, location, and habitus, which were recorded in

the observation sheet that had been prepared. Identification of plants was carried out using the procedure for observing plant morphological characters, which included special features in each class and family or genus down to the species level and then compared with the book Tjitrosoepomo (1985), Harris & Harris (2001), Pitopang et al., (2008) and Steenis (2008). Accepted name validation for each plant species is done using The Plant List website, 2022 (http://www.theplantlist.org/). Identification results were then analyzed by descriptive qualitative. For plant species that have not been identified, herbarium specimens were made by taking plant parts cleaned of soil, fungus or foreign material adhering to them. Identification of invasive plant species was carried out based on the Guide to The Naturalized and Invasive Plants of Southeast Asia (Witt, 2017) and the CABI Compendium Invasive Species (https://www.cabidigitallibrary.org/product/qi).

Data analysis Species Diversity Index

Data on the diversity of plant species is identified through the Diversity Index (H') (Shannon & Wiener, 1963; Fachrul, 2012).

$\mathbf{H}' = -\sum_{i=1}^{S} \operatorname{pi} ln \operatorname{pi} where: \operatorname{pi} = \frac{\operatorname{pi}}{\operatorname{pi}}$

N (Total number of individual species found). The value of H' determines the level of species diversity in an area, where the definition of the value of species diversity according to Shannon-Wienner is: H'> 3: high species diversity, $1 \le H' \le 3$: medium species diversity, H' < 1: Low species diversity.

Species Evenness Index

The evenness index of species refers to the *Pielow evenness indices* formula (Ludwig & Reynolds 1988), namely: E = H'/In S, where E (Evenness Index), and H' (Shannon-Wienner diversity index)

Species Richness Index (R1)

The species richness index uses the Margalef formula (Magurran, 1988), namely, $R_1 = \frac{(S-1)}{(\ln(N))}$, where R1 (Wealth Index), S (Number of species found), and N (total number of individuals)

Results

Vegetation Composition

Plants dominate the vegetation composition in the Bada valley area with herbaceous strata with a total of 555 individuals, then tree strata of 91 individuals, shrubs of 64 individuals and vines of 57 individuals. The composition of plants in the Bada valley is presented in Table 1.

Table 1

Composition of Plants in the Bada Valley Area

Stratum	Species	Local name	Individual number	Uses
	Antidesma ghaesembilla Gaertn.	Tumbuhan Buni.	62	Buni plants are widely used as a traditional medicine to treat high blood pressure, palpitations, anaemia, syphilis
Tree	Cryptocarya sp.	Kayu masohi	6	This plant treats fever and stomach cramps and relieves joint pain.
	<i>Bischofia javanica</i> Blume	Bintungan	3	The bark of the plant is used to lower blood cholesterol levels and treat diarrhoea
	Premna serratifolia L.	Bebuas	4	Water decoction of the leaves of this plant is used to treat fever

	Casearia sp.	Hulu tulang	3	The benefits of this plant are used a natural dyes and also used a ornamental plants
	Melia azedarach L.	Renceh	8	Medication to lower high bloo pressure
	Psidium guajava L.	Jambu biji	6	Diarrhoea and cough medicine
	Total	???	91	<u>????</u>
	Euphorbia hirta L.	Tanaman asma	34	Benefits of this plant can overcom asthma, malaria drugs and wound healing drugs.
	Ageratum conyzoides (L.) L.	Babandotan	183	The benefits of this plant can be use as a wound healer, leprosy and ulcers
	Chromolaena odorata (L.) R.M.King & H.Rob.	Krinyuh	88	The benefits of this plant can be use as a wound healing drug and can sto bleeding quickly
	Stachytarpheta cayennensis (Rich.) Vahl	Pecut kuda	56	Used as a medicine for malaria, feve and diabetes
Herbs	Crotalaria trichotoma Bojer	Orok-orok	16	Utilized as animal feed and potential as green manure.
nerbs	Erigeron sp.	Jabung	13	can treat pain due to rheumatism, ha a soothing effect, and heals wound so now it is widely used in cosmet products
	Melastoma malabathricum L.	Senduduk	9	It can be used to treat burns
	Tridax procumbens L.	Songgolangit	104	It can be used to treat gout, achir rheumatic pain and gout
	Euphorbia heterophylla L.	Daun katemas	24	Used to treat asthma, constipation ar bronchitis
	Crassocephalum crepidioides (Benth.) S.Moore	Daun sintrong	28	Can increase immunity
	Total	???	555	<u>???</u>
	Syzygium paniculatum Gaertn.	Pucuk merah	20	The benefits of this plant can improv immune function and can lower bloc sugar levels
	Ixora coccinea L.	Asoka	10	Used for wound healing
Shrub	Ricinus communis L.	Daun jarak	11	It can be used to launch defecation
	Broussonetia papyrifera (L.) L'Hér. ex Vent.	Pohon saeh	23	The bark of this plant is used as primary ingredient in makir traditional clothes for the people o the Bada Valley.

	Calopogonium mucunoides Desv.	Каlоро	39	It can be used as green manure and as a land cover plant
Vines	Scurrula parasitica L.	Benalu	18	The benefits of this plant have the potential as anticancer, antimalarial and medicine for haemorrhoids and diarrhoea
	Total		57	
Source <mark>: Data Pri</mark>	imer, 2022			

Based on the results of the identification of plant species composition, several species were identified as invasive species. Some of these species are foreign species whose natural habitat is outside the Southeast Asian region.

Table 2

lo	n Species Inva	iveness Information
	переместить таблицу в раздел Обсуждение	
	<mark>Эта таблица содержит ссылки на литерату</mark> ј	7. В разделе Результаты ссылки на литературу содержаться не могут. Рекомнедую
	Identified Invasive Species in the Bada Valley	Region

	ереместить таблицу в раздел Обсу		Information
No	Species	Invasiveness	Information
1	Melia azedarach L.	Invasive	This species is native or originates from the Southeast Asia region but has the potential as an invasive alien species in several areas outside its natural habitat. <i>M. azedarach</i> is fast- growing and has few natural enemies. Seeds spread this species by birds and other animals. It has been reported as an invasive species in several locations in the Americas, Pacific and Africa, South Africa and Hawaii, USA. This species is difficult to control because of its ability to grow again vegetatively (Bhat et al., 2021).
2	Euphorbia hirta L.	Invasive	It is a weed or invasive species on agricultural land and hosts several pests and plant diseases (Tripathi et al., 2021).
3	Ageratum conyzoides (L.) L.	Invasive	A. conyzoides is reported as an invasive and harmful weed in agricultural fields. This species tends to invade open or degraded land. This species causes a decrease in crop yields and affects biodiversity, and is a host of pathogens and nematodes that affect several types of crops (Kohli et al., 2006).
4	Chromolaena odorata (L.) R.M. King & H. Rob.	Invasive	<i>C. odorata</i> is a species of herb or shrub with a wide distribution. This species is included as one of the 100 dangerous invasive species in the world. This species will quickly spread and invade new areas that are degraded through seeds easily carried by the wind (Yu et al., 2016).
5	Stachytarpheta cayennensis (Rich.) Vahl	Invasive	<i>S. cayenneensis</i> originates from South and Central America and the Caribbean. This species is widely introduced to various regions because it has attractive flowers. <i>S. cayenneensis</i> has a broad environmental tolerance and often invades disturbed areas, thereby overpowering native flora. This species is considered a noxious weed in the Northern Territory, Australia and is increasingly abundant in Florida, USA. According to the risk assessment, this species is considered highly invasive (score 20 = high risk) (Chandler et al., 2014).
6	Melastoma malabathricum L.	Invasive	<i>M. malabathricum</i> is known as a weed on mahogany (<i>Swietenia macrophylla</i>) in Sumatra, Indonesia (Master et al., 2020). It is a primary weed commonly found growing in industrial plantation forests. <i>M. malabathricum</i> is registered as a Federal Noxious Weed in the US.
7	Euphorbia heterophylla L.	Invasive	According to Utami et al. (2017), <i>E. heterophylla</i> is a major weed in Fiji, Ghana, Mexico, Philippines, Indonesia and Thailand, Brazil, India, Italy, Papua New Guinea, Cuba, Honduras, Peru, Uganda and the United States. This species harms several crops, including cocoa, coffee, cotton, cowpea, corn, papaya, peanuts, sorghum, soybeans, sugarcane, tea, and upland rice. It has fast growth, and it is easy to compete in getting light, water and nutrients.

8	Crassocephalum crepidioides (Benth.) S.Moore	Invasive	<i>C. crepidiodes</i> is an invasive species included in the Global Compendium of Weeds as one of the most aggressive weeds in tropical and subtropical regions (Dong et al., 2010). It is a pioneer species that can produce large numbers of downy seeds dispersed by the wind.
9	<i>Syzygium paniculatum</i> Gaertn.	Alien Invasive	It is an invasive foreign species. This species' original habitat is Australia's territory (Ramirez & Kallarackal, 2019).
10	Calopogonium mucunoides Desv.	Invasive	<i>C. mucunoides</i> is a woody plant listed in the Global Compendium of Weeds that impacts agricultural and semi-natural ecosystems. <i>C. mucunoides</i> has been widely introduced as a forage legume and nitrogen-fixing plant in tropical and subtropical regions (Feitoza et al., 2018). <i>C. mucunoides</i> can potentially kill native vegetation and food crops in agricultural areas. Currently, <i>C. mucunoides</i> is classified as a noxious weed in Australia and an invasive species in Malaysia, the Philippines, Puerto Rico, and several islands in the Pacific Ocean, such as French Polynesia, Cook Islands, Samoa, Palau, and the Solomon Islands.

Diversity, Evenness, Species Richness

The value of the diversity index in the Bada Valley Cultural Conservation Area has differences in diversity in each stratum. The tree strata had a diversity index of 1.20, the herbaceous strata 1.92, the shrub strata 1.32 and the vines strata 0.62 (Table 2). Based on the criteria for the value of species diversity according to Shannon-Wienner, the diversity of plants in the Bada valley in the strata of trees, herbs and shrubs is included in the criteria of moderate diversity because the value is $1.0 \le H' \le 3.0$, and the strata of vines has low diversity criteria because H' <1.0.

The evenness index for the shrub stratum had the highest value, namely 0.95, followed by vines at 0.90, herbaceous plants at 0.83 and trees at 0.61. Herbaceous plants owned the highest species richness index with a value of 1.42, tree strata 1.33, shrub strata 0.72 and vines strata 0.24. Based on the species richness index criteria, plants in the Bada valley area have low species richness criteria because the R-value <3.5.

Table 3

Species diversity index, species richness index, and evenness index of stratum composition in Bada Valley Cultural Conservation Area

Удалите столбцы таблицы, выделенные красным.

Stratum	Diversity index	Category	Evenness index	Category	Richness index	Category
	(H')		(E)		(R)	
Tree	1.20	Moderate	0.61	Moderate	1.33	Low
Herbaceous	1.92	Moderate	0.83	Equal	1.42	Low
Shrub	1.32	Moderate	0.95	<mark>Equal</mark>	0.72	Low
Vines	0.62	Low	0.90	Moderate	0.24	Low

Discussion

The herbaceous strata are the plants with the highest diversity index value in the Bada valley. Herbaceous strata dominate the area with a total of 555 individuals. Herbaceous plants have a height or stem length of 0.3 - 2 meters and have wet or soft trunks because they have a lot of water content. The high composition of herbaceous plants is closely related to the excellent adaptability of these plants in both tropical and subtropical environmental conditions. Herbaceous plants can be dispersed easily in groups with the same individual or solitary in a variety of different habitat conditions, such as moist or watery soil dry, rocks and habitats with less dense or open shade (Zelnik, 2012; Aguilar et al., 2019; Lelli et al., 2019).

Herbaceous plants have strong competitiveness and high adaptation to the surrounding plants (such as bushes, shrubs, and even trees), so they can grow in empty places. Herbaceous plants in different habitats are very different in the amount that an area can produce with different habitats, such as habitats with high humidity to dry areas (Litza & Diekmann, 2019; Träger et al., 2019; Spicer et al., 2022).

The dominating plant is the *Ageratum conyzoides* (L.) L. This plant can spread quickly from the wind and by insects and active humans in that location. This plant also has speedy growth and is relatively small compared to other herbaceous plants. According to (Shen et al., 2019), herbaceous plants whose body size is relatively tiny could get a more expansive living space, thus enabling the life of more individuals (wealth) and more species (diversity).

The role of herbaceous plants in the region has a significant role, among others, when experiencing succession, marked by many pioneer plants and small plants such as herbaceous plants. Herbs play an essential role in the annual nutrient cycle; the herb litter that is returned to the soil contains high levels of nutrients. In addition, herbs are also used as a source of animal feed, medicine and wealth in germplasm. For example, preserving wild animals as a component of an ecosystem is influenced by the presence and diversity of undergrowth as a place to live and a high source of food and many other functions (Schmidt et al., 2019; Álvarez et al., 2022;).

The diversity of plants in the Bada valley area is included in the medium and low diversity index criteria. The low diversity is caused by several factors, including the control of the area in the cultural heritage area, soil type, climate, and biotic influences (living things). This actual condition is supported by Compant et al. (2019) statement, which states that plant diversity is influenced by several factors, including climate, soil type, altitude and biotic influences (living things). Furthermore, Dar & Reshi (2020) states that diversity is synonymous with the stability of an ecosystem; that is, if the diversity of an ecosystem is relatively high, the condition of the ecosystem tends to be stable. Ecosystem environments that have diversity disturbances tend to be moderate. In the case of polluted ecosystem environments, species diversity tends to be low.

Geng et al. (2019) state that the higher the species diversity, the more stable the community will be and have a higher ability to deal with disturbances. Furthermore, van der Plas (2019) argued that high species diversity indicates a community has high complexity because the species interactions in that community are very high. A community is said to have high species diversity if the community is composed of many species. Conversely, a community is said to have low species diversity if the community is composed of a few species and only a few dominant species, in line with the statement of Pitopang & Ihsan (2014), which explains that the higher the value of the diversity index, the better the ecosystem in the region.

Based on the analysis of the evenness index of species, the Bada valley area has plants included in the criteria for high species distribution. Evenness index values or Evenness (E) range from 0 to 1 (Magurrann, 1988), meaning that the plants in the area can grow and spread throughout the observation sites. The even distribution of plants in this location cannot be separated from the influence of environmental factors. The high level of biodiversity is because Indonesia is a tropical country with high levels of rainfall, temperature and humidity. According to Pramudya (2020), Indonesia has a diversity of flora and fauna due to its geographical location around the equator and between the continents of Asia and Australia, giving rise to the emergence of particular characteristics and characteristics in resources in the form of tropical forest ecosystems. Furthermore, according to Kitayama et al. (2021), tropical forests are located along the equator, that is, in areas with high radiation intensity, with small daily and annual amplitudes.

The value of the Diversity index relates to the value of species richness but is also influenced by the distribution of species abundance. Midolo et al. (2019) state that species richness is the number of species in a community. The greater the number of species found, the greater the wealth index.

The richness of plant species in the Bada valley area is classified as low. It has been explained above that the number of species will affect species richness. The number of plant species for each stratum in the Bada valley area is still relatively small, thus affecting species richness. This follows the opinion of Roswell et al. (2021) that a community has high species diversity if the community is composed of many species. Conversely, if the community comprises very few species and only a few dominant species, then the species diversity is low.

Species richness shows all the variations found in living things between species. Differences between species of organisms in one or more families will be visible, making it easier to observe than differences between individuals in one species. Richness at the species level occurs because of the variety of these species. The species richness index is the most straightforward measure because it only considers differences in the number of species in a particular area. Species richness determines the amount of species richness in each community. This was confirmed by Mahaut et al. (2020), who stated that species richness refers to the number of species in a community. The quantity of species in the field determines the size of the richness index. In the context of cultural heritage sites or areas, the presence of certain plant species at the site or area strongly supports the concept of preservation by local values and traditions. Sites identified as places of worship, such as the Sepe Site in Kolori Village and the Suso Site in Lengkeka Village, Lore Barat District, are, of course, closely related to the use of certain plant species in carrying out worship ceremonies or rituals following the beliefs that developed at that time. In addition, a tradition continues today, namely the use of the bark of the *Broussonetia papyrifera* (L.) L'Hér. Ex Vent., better known as the Saeh tree, to be used as traditional clothing for the people of the Bada valley.

Developing the Cultural Conservation site or area also requires environmental management by applying the principle of authenticity. In selecting plant species, efforts are made to use and cultivate endemic or existing plant species around the Cultural Conservation site or area. Thus, the intended Cultural Conservation area can be developed under the principles of Cultural Conservation and environmental preservation.

Conclusion

The value of the diversity index in the Bada Valley Cultural Conservation Area has differences in diversity in each stratum. Tree strata had a diversity index of 1.2, herbaceous strata 1.91, shrub strata 1.32 and vines strata 0.62. The tree, herb and shrub strata are included in the medium diversity criteria because the value is $1.0 \le H' \le 3.0$, and the vines stratum has the low diversity criteria because the H' value <1.0. The evenness index for the shrub strata had the highest value, namely 0.95, followed by vines at 0.9, herbaceous plants at 0.83 and treat es at 0.61. Herbaceous plants owned the highest species richness index with a value of 1.42, tree strata 1.33, shrub strata 0.72 and vines strata 0.24. Based on the species richness index criteria, plants in the Bada valley area have low species richness criteria because the R-value <3.5. Further research is needed to determine the biodiversity of flora and fauna from cultural areas in Central Sulawesi Province.

Acknowledgements

The authors would like to thank the Regional Government, the Head of the Gorontalo Cultural Heritage Preservation Center Drs. Mohammad Natsir, M.Pd, as research grantor and research permit; Regional Government (PEMDA) from the village level, District in Lembah Bada, Poso Regency, Central Sulawesi Province, which has permitted to carry out this research; colleagues and local communities who have assisted in the data collection process in the field, and colleagues at the Gorontalo Cultural Heritage Preservation Center as researchers' discussion partners during the research.

References

- Aguilar, R., Cristóbal-Pérez, E. J., Balvino-Olvera, F. J., de Jesús Aguilar-Aguilar, M., Aguirre-Acosta, N., Ashworth, L., ... все фамилии, полное количество авторов & Quesada, M. (2019). Habitat fragmentation reduces plant progeny quality: a global synthesis. Ecology Letters, 22(7), 1163-1173. https://doi.org/10.1111/ele.13272
- Álvarez, S. A., Rocha-Guzmán, N. E., González-Laredo, R. F., Gallegos-Infante, J. A., Moreno-Jiménez, M. R., & Bravo-Muñoz, M. (2022). Ancestral food sources rich in polyphenols, their metabolism, and the potential influence of gut microbiota in the management of depression and anxiety. Journal of Agricultural and Food Chemistry, 70(4), 944-956. <u>https://doi.org/10.1021/acs.jafc.1c06151</u>
- Baderan, D. W. K., Rahim, S., & Angio, M. (2021). The Diversity, Evenness, And Richness of Plant Spescies Found On The Potential Geosite of Otanaha Fortress As a Pioneer for Geopark Development in The Province Of Gorontalo. Al-Kauniyah: Jurnal Biology, 14(2), 264-274. https://journal.uinjkt.ac.id/index.php/kauniyah/article/download/16746/pdf
- Bhatt, A., Gairola, S., Govender, Y., & de Moura Souza-Filho, P. R. (2021). The invasive Melia azedarach in Durban (South Africa): impacts on tree community structure. Folia Geobotanica, 56, 139-147. <u>https://link.springer.com/content/pdf/10.1007/s12224-021-09397-5.pdf?pdf=button</u>
- Boedhihartono, A. K. (2017). Can community forests be compatible with biodiversity conservation in Indonesia?. Land, 6(1), 21. https://doi.org/10.3390/land6010021
- Budiarti, M., Maruzy, A., Mujahid, R., Sari, A. N., Jokopriyambodo, W., Widayat, T., & Wahyono, S. (2020). The use of antimalarial plants as traditional treatment in Papua Island, Indonesia. Heliyon, 6(12), e05562. <u>https://doi.org/10.1016/j.heliyon.2020.e05562</u>

and Human Well-being. United Kingdom (UK): Secretariat of the Convention on Biological Diversity. Удалите

- Chandler, G. T., Westaway, J. O., & Conn, B. J. (2014). Taxonomic uncertainty of Stachytarpheta (Verbenaceae) in the Asia-Pacific and implications for invasive weed recognition and management. Telopea, 16, 83-87. <u>https://doi.org/10.7751/telopea20147536</u>
- Compant, S., Samad, A., Faist, H., & Sessitsch, A. (2019). A review on the plant microbiome: ecology, functions, and emerging trends in microbial application. Journal of advanced research, 19, 29-37. https://doi.org/10.1016/i.jare.2019.03.004
- Dar, P. A., & Reshi, Z. A. (2020). Impact of alien species on species composition, floristic and functional diversity of aquatic and terrestrial ecosystems. Tropical Ecology, 61, 446-459. https://link.springer.com/content/pdf/10.1007/s42965-020-00102-9.pdf?pdf=button
- Dong, H., Li, Y., Wang, Q., Yao, G., & Xia, B. (2010). Bioassay of allelopathy of water extracts from alien invasive plants Crassocephalum crepidioides and Galinsoga parviflora. Journal of Plant Resources and Environment, 19(2), 48-91.

Fachrul, M. F. (2012). Metode sampling bioekologi. Jakarta: Bumi Aksara

- Feitoza, R. B. B., Lima, H. R. P., Oliveira, E. A. G., Oliveira, D. R., Moraes, L. F. D., Oliveira, A. E. A., ... & Da Cunha, M. (2018). Structural and ultrastructural variations in roots of Calopogonium mucunoides Desv. treated with phenolic compounds from Urochloa humidicola (Rendle) Morrone & Zuloaga and phenolic commercial standards. South African Journal of Botany, 116, 142-149. https://doi.org/10.1016/j.sajb.2018.03.005
- Geng, S., Shi, P., Song, M., Zong, N., Zu, J., & Zhu, W. (2019). Diversity of vegetation composition enhances ecosystem stability along elevational gradients in the Taihang Mountains, China. Ecological Indicators, 104, 594-603. <u>https://doi.org/10.1016/j.ecolind.2019.05.038</u>
- Gorontalo Cultural Heritage Preservation Center (2018). Annual report of the Gorontalo Province Cultural Heritage Preservation Center. Удалите

Harris, J. G., & Harris, M. W. (2001). Plant identification terminology. Utah: Spring Lake Publishing.

- Harrison, S., Spasojevic, M. J., & Li, D. (2020). Climate and plant community diversity in space and time. Proceedings of the National Academy of Sciences, 117(9), 4464-4470. <u>https://doi.org/10.1073/pnas.1921724117</u>
- Hooper, D. U., Chapin III, F. S., Ewel, J. J., Hector, A., Inchausti, P., Lavorel, S., 🚾 & Wardle, D. A. (2005). Effects of biodiversity on ecosystem functioning: a consensus of current knowledge. Ecological monographs, 75(1), 3-35. https://doi.org/10.1890/04-0922
- Kasmawati, H., Ruslin, I. S., Yamin, M. D., & Elafita, W. O. (2019). Ethnomedicine Studies of Traditional Medicinal Plants of the Muna Tribe in the Village of Bungi Southeast Sulawesi Province of Indonesia. International Journl of Science and Research, 8(11), 1882-7. http://karyailmiah.uho.ac.id/karya ilmiah/Sunandar/1.Ethnomedicine Studies.pdf
- Kohli, R. K., Batish, D. R., Singh, H. P., & Dogra, K. S. (2006). Status, invasiveness and environmental threats of three tropical American invasive weeds (Parthenium hysterophorus L., Ageratum conyzoides L., Lantana camara L.) in India. Biological Invasions, 8, 1501-1510. <u>https://link.springer.com/content/pdf/10.1007/s10530-005-5842-1.pdf?pdf=button</u>
- Kitayama, K., Ushio, M., & Aiba, S. I. (2021). Temperature is a dominant driver of distinct annual seasonality of leaf litter production of equatorial tropical rain forests. Journal of Ecology, 109(2), 727-736. <u>https://doi.org/10.1111/1365-2745.13500</u>
- Lausch, A., Bannehr, L., Beckmann, M., Boehm, C., Feilhauer, H., Hacker, J. M., ... & Cord, A. F. (2016). Linking Earth Observation and taxonomic, structural and functional biodiversity: Local to ecosystem perspectives. Ecological indicators, 70, 317-339. https://doi.org/10.1016/j.ecolind.2016.06.022
- Lelli, C., Bruun, H. H., Chiarucci, A., Donati, D., Frascaroli, F., Fritz, Ö., 🚾 & Heilmann-Clausen, J. (2019). Biodiversity response to forest structure and management: Comparing species richness, conservation relevant species and functional diversity as metrics in forest conservation. Forest Ecology and Management, 432, 707-717. <u>https://doi.org/10.1016/j.foreco.2018.09.057</u>
- Litza, K., & Diekmann, M. (2019). Hedgerow age affects the species richness of herbaceous forest plants. Journal of Vegetation Science, 30(3), 553-563. https://doi.org/10.1111/jvs.12744
- Ludwig, J. A., & Reynolds, J. F. (1988). Statiscal ecology-a primer and methods and computing Wiley. New York.

Magurran, A. E. (1988). Ecological diversity and its measurement. Princeton: University press.

- Mahaut, L., Fort, F., Violle, C., & Freschet, G. T. (2020). Multiple facets of diversity effects on plant productivity: species richness, functional diversity, species identity and intraspecific competition. Functional Ecology, 34(1), 287-298. <u>https://doi.org/10.1111/1365-2435.13473</u>
- Master, J., Qayim, I., Setiadi, D., & Santoso, N. (2020). Autecology of Melastoma malabathricum, an invasive species in the Way Kambas National Park, Indonesia. Biodiversitas Journal of Biological Diversity, 21(5). <u>https://doi.org/10.13057/biodiv/d210562</u>
- Midolo, G., Alkemade, R., Schipper, A. M., Benítez-López, A., Perring, M. P., & De Vries, W. (2019). Impacts of nitrogen addition on plant species richness and abundance: A global meta-analysis. Global ecology and Biogeography, 28(3), 398-413. https://doi.org/10.1111/geb.12856
- Murray, J. P., Grenyer, R., Wunder, S., Raes, N., & Jones, J. P. (2015). Spatial patterns of carbon, biodiversity, deforestation threat, and REDD+ projects in Indonesia. Conservation Biology, 29(5), 1434-1445. <u>https://doi.org/10.1111/cobi.12500</u>
- Pitopang, R., Hamzah, B., Zubair, M. S., Amar, A. L., Fathurahman, F., Basri, Z., & Poulsen, A. D. (2019, June). Diversity of Zingiberaceae and traditional uses by three indigenous groups at Lore Lindu National Park, Central Sulawesi, Indonesia. In Journal of Physics:
 <u>Conference Series</u> (Vol. 1242, No. 1, p. 012039). IOP Publishing.. <u>https://iopscience.lop.org/article/10.1088/1742-</u>
- Pitopang R dan Ihsan M. 2014. Biodiversitas tumbuhan di Cagar Alam Morowali Sulawesi Tengah Indonesia. Journal of Natural Science. Vol 3(3): 287-296
- Pitopang, R., Khaeruddin, I., Tjoa, A., & Burhanuddin, I. F. (2008). Pengenalan jenis-jenis pohon yang umum di Sulawesi. Palu: UNTAD Press.
- Planchuelo, G., von Der Lippe, M., & Kowarik, I. (2019). Untangling the role of urban ecosystems as habitats for endangered plant species. Landscape and Urban Planning, 189, 320-334. <u>https://doi.org/10.1016/j.landurbplan.2019.05.007</u>
- Pramudya, R. (2020). Elaboration of forest management aspect in Indonesia's forestry legal perspective. IL Pol'y & Globalization, 93, 45. <u>https://heinonline.org/HOL/LandingPage?handle=hein.journals/jawpglob93&div=6&id=&page=</u>

- Ramírez, F., & Kallarackal, J. (2019). The phenology and potential ecological associations of Magenta Lilly Pilly (Syzygium paniculatum Gaertn) a native vulnerable Australian tree growing in Bogotá, Colombia. Arboricultural Journal, 41(4), 191-211. https://doi.org/10.1080/03071375.2019.1642047
- Risjani, Y., Witkowski, A., Kryk, A., Górecka, E., Krzywda, M., Safitri, I., 🚾 & Wróbel, R. J. (2021). Indonesian coral reef habitats reveal exceptionally high species richness and biodiversity of diatom assemblages. Estuarine, Coastal and Shelf Science, 261, 107551. https://doi.org/10.1016/j.ecss.2021.107551
- Roswell, M., Dushoff, J., & Winfree, R. (2021). A conceptual guide to measuring species diversity. Oikos, 130(3), 321-338. https://doi.org/10.1111/oik.07202
- Satrija, F., Ridwan, Y., & Rauf, A. (2015). Current status of schistosomiasis in Indonesia. Acta Tropica, 141, 349-353. https://doi.org/10.1016/j.actatropica.2013.06.014
- Sayfulloh, A., Riniarti, M., & Santoso, T. (2020). Jenis-Jenis Tumbuhan Asing Invasif di Resort Sukaraja Atas, Taman Nasional Bukit Barisan Selatan (Invasive Alien Species Plants in Sukaraja Atas Resort, Bukit Barisan Selatan National Park). Jurnal Sylva Lestari, 8(1), 109-120.
- Scales, B. R., & Marsden, S. J. (2008). Biodiversity in small-scale tropical agroforests: a review of species richness and abundance shifts and the factors influencing them. Environmental conservation, 35(2), 160-172. <u>https://doi.org/10.1017/S0376892908004840</u>
- Schmidt, J. P., Cruse-Sanders, J., Chamberlain, J. L., Ferreira, S., & Young, J. A. (2019). Explaining harvests of wild-harvested herbaceous plants: American ginseng as a case study. Biological conservation, 231, 139-149. <u>https://doi.org/10.1016/j.biocon.2019.01.006</u>

Setyawati, T., Narulita, S., Bahri, I. P., and Raharjo, G. T. (2015). A Guide Book to Invasive Alien Plant Species. BUKLHK, Bogor.

Shannon, C. E., & Wiener, W. (1963). The mathematical theory of communication. Urbana: University of Illinois Press.

- Silalahi, M., Supriatna, J., & Walujo, E. B. (2015). Local knowledge of medicinal plants in sub-ethnic Batak Simalungun of North Sumatra, Indonesia. Biodiversitas, 16(1), 44-54.
- Sitepu, B. S. (2020). Keragaman dan Pengendalian Tumbuhan Invasif di KHDTK Samboja, Kalimantan Timur (Diversity and Management of Invasive Plants in Samboja Research Forest, Kalimantan Timur). *Jurnal Sylva Lestari*, *8*(3), 351-365.
- Spicer, M. E., Radhamoni, H. V. N., Duguid, M. C., Queenborough, S. A., & Comita, L. S. (2022). Herbaceous plant diversity in forest ecosystems: patterns, mechanisms, and threats. Plant Ecology, 223(2), 117-129. https://link.springer.com/content/pdf/10.1007/s11258-021-

Steenis, V, C. G. G. J. (2008). Flora untuk sekolah di Indonesia. Jakarta: Pradnya Paramita Press.

Shen, S., Xu, G., Li, D., Jin, G., Liu, S., Clements, D. R., A Weston, L. A. (2019). Potential use of sweet potato (Ipomoea batatas (L.) Lam.) to suppress three invasive plant species in agroecosystems (Ageratum conyzoides L., Bidens pilosa L., and Galinsoga parviflora Cav.). Agronomy, 9(6), 318. <u>https://www.mdpi.com/2073-4395/9/6/318</u>

The Plant List. (2013). Version 1.1. (2021, Maret 15). Retrieved from http://www.theplantlist.org Delete

Tjitrosoepomo, G. (1985). Morfologi tumbuhan. Yogyakarta: Gadjah Mada University Press.

Träger, S., Öpik, M., Vasar, M., & Wilson, S. D. (2019). Belowground plant parts are crucial for comprehensively estimating total plant richness in herbaceous and woody habitats. Ecology, 100(2), e02575. <u>https://doi.org/10.1002/ecy.2575</u>

 Tripathi, A. N., Sati, S. C., & Kumar, P. (2021). Euphorbia hirta Linn-an invasive plant: a review of its traditional uses, phytochemistry and pharmacological properties. system, 17(20), 22. https://www.researchgate.net/profile/Parikshit-kumar/publication/356666523 EUPHORBIA HIRTA LINN

 AN INVASIVE PLANT A REVIEW OF ITS TRADITIONAL USES PHYTOCHEMISTRY AND PHARMACOLOGICAL PROPERTIES/links/

 51a7433d6864311d938ed376/EUPHORBIA-HIRTA-LINN-AN-INVASIVE-PLANT-A-REVIEW-OF-ITS-TRADITIONAL-USES

 PHYTOCHEMISTRY-AND-PHARMACOLOGICAL-PROPERTIES.pdf

- Utami, S., Anggoro, S., & Soeprobowati, T. R. (2017). Diversity of invasive plants in the Panjang Island Reserve Jepara Central Java, Indonesia. Advanced Science Letters, 23(7), 6493-6494. <u>https://doi.org/10.1166/asl.2017.9663</u>
- van der Plas, F. (2019). Biodiversity and ecosystem functioning in naturally assembled communities. Biological Reviews, 94(4), 1220-1245. https://doi.org/10.1111/brv.12499

Widjaja, E., Rahayuningsih, Y., Rahajoe, J., Ubaidillah, R., Maryanto, I., Walujo, E., and Semiadi, G. 2014. Kekinian Keanekaragaman Hayati

Indonesia 2014. LIPI Press, Jakarta. DOI:10.1007/s13398-014-0173-7.2

- Yu, F., Akin-Fajiye, M., Thapa Magar, K., Ren, J., & Gurevitch, J. (2016). A global systematic review of ecological field studies on two major invasive plant species, Ageratina adenophora and Chromolaena odorata. Diversity and Distributions, 22(11), 1174-1185. <u>https://doi.org/10.1111/ddi.12481</u>
- Zelnik, I. (2012). The presence of invasive alien plant species in different habitats: case study from Slovenia. Acta biologica slovenica, 55(2), 25-38.

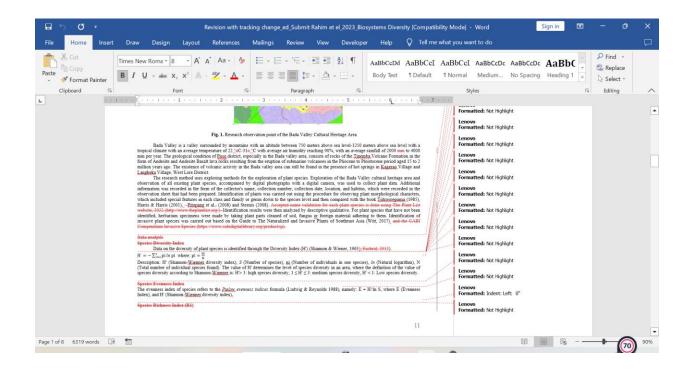
https://www.researchgate.net/profile/IgorZelnik/publication/273130826 The presence of invasive alien plant species in di ent habitats Case study from Slovenia/links/54f873d20cf2ccffe9df2e19/The-presence-of-invasive-alien-plant-species-inlifferent-habitats-Case-study-from-Slovenia.pdf

PERBAIKAN REVISI 2

M	Gmail	٩	Telusuri dalam email		苹	● Aktif ▼	0 3	ш	UNG	.	Ð
0	Tulis	÷	O B C C C D	D I IBANpar (1).pat				3 dari	128 4	>	
	Kotak Masuk	31									
\$	Berbintang	-	Sukirman Rahim <sukirmanrahim@ung.ac.id></sukirmanrahim@ung.ac.id>			@ 6 Mar 2023.	15.28 (10 hari yar	ng lalu)	\$ 5	:	
0	Ditunda		kepada Brygadyrenko 👻								
D	Penting		Dear Dr. Brygadyrenko								
⊳	Terkirim		Thank you for your reply and we are very pleased that	t our manuscript was given the opportunity to be pu	blished in your journal.						
D	Draf		Here we send the final version of the draft that we have	e improved according to the suggestions given. In	addition, we also sent a draft with active change track	ing to see the imp	ovements we ha	ave made.			
0	Semua Email		But unfortunately, we are having problems sending mo	oney for journal payments because currently, our lo	cal bank has problems with the swift code for Likraine	We ask for your i	inderstanding ar	nd solution	can we se	bo	
0	Spam	1	journal payments through "Western Union"?								
B	Sampah		The only method for sending money overseas available	le in our area is through Western Union.							
۰D	Kategori		Thank you and hopefully we can get some good news	soon							
a	Sosial	7	Sincerely,								
C	Update	13	Sukirman Rahim								
R	Forum	1									
0	Promosi	1	2 Lampiran • Dipindai dengan Gmail 🕤						*	e.	1
×	Selengkapnya										ł
Lat	el	+	Revision with tra Final Revision	iega							j
		-									-0

	<u>ຈ</u> ິ ດ	÷			Revision with trac	king change	_ed_Submit F	Rahim et e	el_2023_Bios	systems Divers	ity [Compatit	oility Mode] - Word	Si	ign in	Œ	-	o	×
File	Home	Insert	Draw Design	Layout	References	Mailings	Review	View	Develope	Help	Q Tell me	what you	want to do						\Box
Paste	X Cut Copy ✓ Format I Clipboard	Painter ⊡		x ₂ x ² (A)	A [*] Aa ∝ A ∞ ab/ ∝ A ~	E 8 3		- 👌 -				¶ Norma	cI AaBbCcDc A al Medium N Styles				♀ Find ^{ab} _{ac} Repl Sele Editin	ace ct ~	^
6			<u></u>		2 · · · · · · ·	3 · · · I	• • • 4 •		. 5	1 6 .	· · ·	7							
			Кандый тип ошибок от	MCTOH D TOKOT	е статья один вля д	ва-раза, а-нең	равить этот ті	ип-ошибок		ей статье,			Lenovo						Ē
-			Авторам-пеобходимо-п по-формату-пашего-жуј		а-сайте-журнала-и	внимательно	проанализир	овать-офор	мление каж	дого-из-элемент	ов-статьи		Formatted: Not H Lenovo Formatted: Not H						
. 1			Natural aspect in the m analyses.	egalithic cultu	ral heritage area of	the Bada Val	ley (Central S	ulawesi): V	Vegetation co	mposition and b	iodiversity		Lenovo Formatted: Not H	lighlight					
			S _. ukirman Rahim* ¹ , A _. li	and F _e erdinand		r <mark>uni,</mark> K. Bader ah Ariyanti ³ , S		isanti- <u>S.</u> Ha	midun², Meli	snawati- <u>M.</u> H. A	ngio ³ , E ₁ sti		Lenovo Formatted: Not H	lighlight					
			^{1*} Department of Postgradu No. 06 Gorontalo City, Go								man Street	MN	Formatted: Not H	lighlight					
			² Biology Department, Fac District, Bone Bolango Re ³ Research Center for Plant	ity of Mathema gency, Gorontal	tics and Natural Scien lo Province, Indonesia	e State Unive Tel Fax (0435	rsity of Goronta)821752 E-mail	alo, JI Prof. I I: dewi.bader	BJ Habibie <mark>M</mark> ran∕∂ung ac id	outong Village, Tj			Lenovo Formatted: Not H	lighlight				_	
-			No.18, Bogor, <u>West</u> Jayaw Research Centre for Ecolo West Java, 16911, Indones	gy and Ethnobi	ology - National Rese	arch and Innova	ntion Agency, J	gmail.com -Raya Jakar	rta-Bogor Stre	et Kilometer, 46,	Cibinong,		Lenovo March 06 Formatted: Not F						
- m			Corresponding Author: J Jenderal Sud		06 Gorontalo City, G	orontalo Provir	ice, 961282, In				ontalo, JI		Lenovo Formatted: Not H	lighlight					
-			Orchid Id			kirmanrahim@	ung.ac.id						Lenovo Formatted: Not H	lighlight					
			Sukirman Rahim: https://o Alland Ferdinand Ambo: 1			<u>(</u> ????????????????????????????????????							Lenovo Formatted: Not H	lighlight					¥
Page 1 of	1 🖓	•															-		100%

্য 🗸 🔹	Revision with tracking change_ed_Submit Rahim et el_2023_Biosystems Diversity [Compa	atibility Mode] - Word 🛛 🗖 🗇	
e Home In	nsert Draw Design Layout References Mailings Review View Developer Help Q Tell r	me what you want to do	
Cut Copy	R I II a also v $\mathbf{v}^2 \wedge \mathbf{a}^2 \mathbf{v} \wedge \mathbf{b} = \equiv \equiv \equiv \equiv \boxed{\mathbf{b}} \neq \mathbf{a} \wedge \mathbf{b} = \Box = \mathbf{b}$	cI AaBbCcI AaBbCcDc AaBbCcDc AaBbCcDc AaBbCcD + P Find → t 1 Normal Medium No Spacing Heading 1 ↓ Select →	
Clipboard	Font F2 Paragraph F2	Styles Ta Editing	
1 1 1 1 1 1	🖁	7	
	Sunary, https://orc.uc.org/0000-0002-1109-2112	Formatted: Not Highlight	
		Lenovo	
- T	ABSTRACT Структура аниотации не соответствует-требованиям бланка рецензента	Formatted: Not Highlight	
	The Bada Valley is one of the Lore Lindu Megalithic cultural heritage areas, which is one of the first four biosphere reserves in	Lenovo	
	Indonesia. The Bada Valley area offers cultural attractions that combine with nature in the form of cultural landscapes such as handicrafts from bark, hilly landscapes that offer panoramic beauty, and store dozens of megalithic sites from prehistoric times as well as tourist cruising areas.	Formatted: Not Highlight	
	The area is surrounded by densely forested mountains and forms one of the most important water catchment areas for the Watershed. However, there is a lack of studies on vascular flora. No data on plant diversity has been reported, including plant inventory, plant identification.	Lenovo	
	vegetation composition, and biodiversity analyses (diversity index, evenness index, and plant species richness index). The study aimed to	Formatted: Not Highlight	
	determine the diversity index, evenness index, and plant species richness index in the Bada Valley cultural area, 2050, Regency, Central Sulawesi. This study used an exploring technique with purposive sampling. Additional information was recorded in the form of the collector's	Lenovo	
	name, collection number, collection date, location, and habitus, which were recorded in the observation sheet that had been prepared.	Formatted: Not Highlight	
	Identification of plants was carried out using the procedure for observing plant morphological characters, which included special features in each class and family or genus down to the species level. The results of the study found vegetation composition for herbaceous strata (555	Lenovo	
	individuals), trees (91 individuals), shrubs (64 individuals), and vines (57 individuals). The diversity index value of each stratum is different for	Formatted: Not Highlight	
	trees (H [*] =1.20), herbs (H [*] =1.92), shrubs (H [*] =1.32), and vines (H [*] =0.62). The diversity of plants in the Bada valley in the tree, herb, and shrub strata was moderate $(1.0 \le H^{**} \le 3.0)$, and the encroaching plant stratum had low diversity (H ^{**} <1.0). The evenness index at the level of shrubs.	Lenovo	
	vines, herbs, and trees has values of 0.95; 0.90; 0.83; 0.61, respectively. The species richness index of plants in the Bada valley is in a low	Formatted: Not Highlight	
1	category (R <3.5), with R values for herbaceous plants (1.42), trees (1.33), shrubs (0.72), and vines (0.24). Information on plant biodiversity is used as a database for ecotourism development in the Bada Vallev cultural reserve area. Research data can be used to support the local	Lenovo	
	government in regulating the utilization of the Bada Valley cultural heritage area.	Formatted: Not Highlight	
- T	Keywords: diversity index.; evenness index.; richness index.; plant species.; invasive alien species.; ecology; Central Sulawesi ao6anare-eme 5-6	Lenovo	
	6.008	Formatted: Not Highlight	
		Lenovo	
	Introduction Indonesia is a country that is very rich in biodiversity and has won an important position on the world biodiversity map. Indonesia, together	Formatted: Not Highlight	
	with Brazil and Zaire, is in the top three countries in the world that have the highest biodiversity (megadiversity countries), covering 17% of the	Lenovo	
	total bird species in the world found in Indonesia (1,531 species), of which 381 species are endemic (Scales & Marsden, 2008; Murray et al., 2015; Bnedhirtano, 2017), has around 30,000 species of plants and has been used as a source of medicinal raw materials (Silalahi et al., 2015;	Formatted: Not Highlight	
	Budiarti et al., 2017; Kasmawati et al., 2019). Diversity is the variation and variability of life on earth (Hooper et al., 2005), and diversity is a	Lenovo	
	characteristic difference between communities (Lausch et al., 2016; Harrison et al., 2020).	Formatted: Indent: First line: 0.56"	
	One area in Indonesia with high biodiversity is Sulawesi, one of the provinces in Central Sulawesi. This provinces is located in the		
	One area in Indonesia with high biodiversity is Sulavesi, one of the provinces in Central Sulavesi. This province is located in the <u>Wallacce</u> region, a biogeographical area between the <u>Sunda</u> Shelf and the Sahul Shelf, which has a high diversity of endemic floras and faunas. However, the plant abundance of this region is insufficiently explored Baderan et al., 2021. <u>Pitopane et al.</u> , 2019) The Bada Valley	Lenovo	



-												0 -				
File	Home	Insert	Draw	Design	Layout	References	Mailings	Review	View	Develope	r Help	¥ ™	ell me what you want to do			Ç
iste	K Cut ☐ Copy ✓ Format P	ainter		/Roma * 8		A [™] Aa - A - A [™] - A -			• 2				CcI AaBbCcI AaBbCcDc ault 1 Normal Medium	 2000	P Find ↔	
С	lipboard	rs.		Fe	ont		5	Paragra	ph	E.			Styles	12	Editing	
				1		1	. 2	3	+4 + + +	5 1		1 7				
					Barre com	and on the results of the in	lectification of plant	species composition, a	everal species may	re identified as invasi	ve species. Some of th					
					species are fo	reign species whose natura	habitat is outside ti	a Southeast Asian regio	*							
					Table-3 Identified Inv	arive Species in the Bada V conversation as more	allen Region						Lenovo			
					rainany a pa	содержит ссылки на пите адал Обсуждение Бресіез	Invariantes	NUMBER OF CONTRAST OF STREET		nation	колиндуро лирнонски		Pormatted: Not rignight			
						aredarachila	Lovasive	This species is native an invasive alien spec	or originates from	the Southeast Asia re	ging but has the pote	tial-as				
								growing and has fee minute it has been a Pacific and Africa, S because of its shifts its	entered as an inve operated as an inve with Affrica and F	. Saada ayoand this miya apacias in secar Rawan, USA, This a	operies by birds and al locations in the Am peries is difficult to	acidan,				
					2 Esphe	ebia kinta Lu	Invasive	It is a weed or invest diseases (Tripaths et al		picultural land and b	orts several peets an	1000				
					i dena	tam congreteler (ko)-ko	inventive	d. compactifier in rapo species tands to inves yields and affects bis several types of cross	rial as an invani is open or degrad sciences, and in	a host of pathogen	e course a doursans i					
						iolama oderata (L.) King di H. Robi	Investive	C odorate is a spatie as one of the 100 damp and invade new years	s of herb or skrub scous invasive spe	with a wide distribut	a spacise will quickly	ipeessi				
					5 Stanly (Resh	terpilate copennancia Mahi	lavasive	2016) 5 copensator origi species is widely int	ater from Courts	and Central Ameri	te and the Caribbeau	This				
					(Market			coverserver has a b thereby everyowering Northern Territory, Ar the risk-assessment.	antive flore. The extension and in inco the operator is co	tal tolerance and off in spacing is conside reasingly abundant in	en invader distorbed ouf a consiste ward Fissida, USA, Acces	in the				
					6 Melan	tema malabativicum L	lavasive	(Chandler et al., 2014) M-malabathrizans is i	nows as a weed o	na mahagany (Swieter	nia macrophylla) in Di	mater,				
								Indonesia (Master et industrial plantation fo								
					2 Eupha	nhia hatarophysila L.	invasive	the US: According to Utami e Philippines, Indonesis	al (2017), E Am	erophylia ia a major - Reavil Judia Judia	and in Figi, Chann, M	enico,	Markup Area			
								Honduras, Para, Ugo including cores, coll regarding, tax, and up	nds and the Us he, other, one pland nice. It has	ited States This sp sa, com, papers, p	acies harms savaral	crops;				
					8 Grant	ocephalum creptidiotdes	Invasive	light, water and matrix G. cospiciteder is an in of the most aggressive	vasive species inci	laded in the Clobal C	opportune of Wester (Dense at al., 2016)					
					9 5000	um moniculatum Gaartu	Alian Invasiva	piccase species that ca	n produce large au	unbers of downy ased	a dispersed by the wir	du .				
					10 Galop	egentum macamotides	Invasive	(Ramiran de Kallarach G. maranoteles is a sur	al, 3010). ody plant listed in	a the Global Compan	dime of Weeds that i	opacia				
					Dem			agricultural and semi- forage lagrants and mit	regan-fining plant	in tropical and subtry	pical regions (S'aiton	utals				
								2016). C maranetider areas Currently, C	menneider is ch	mified as a noniver	west in Anstralia					
											ice, Palan, and the Se					

Form Form Form Date Date <thdate< th=""> Date Date</thdate<>	⊡ 5×0 -	Revision with tracking change_ed_Submit Rahim et el_2023_Biosystems Diversity (Compatibility Mode) - Word	Œ	- 0	×
Parts Format Painter Immes New Rome	File Home Insert Draw Desig	gn Layout References Mailings Review View Developer Help Q Tell me what you want to do			\Box
Let a service of the service of t	Paste Copy • • Format Painter	aubector Au	ng 1 📮	ab Gac Replace	
Beiers, D. V. K. Baha, S. A. Aga, M. (201), The Downly, Forman, And Rohmer of Farl Segment Frend Qn The Power face of the power of the segment of degramment and a power (Net of Net Accurs), Net			2	Editing	^
of Capacity Preurs A: S Theore for Corperate Development in The Preurs I Statistic Preuma I Statistic Preum I Statistic Preum I Statistic Preum I St		Internet the research References References Applin R., Colabela-Plene, E. J., Babina-Obere, T. J., do Junia Applin-Applin, M., Applin-Applin, M., Aphron, K. L., Lohn, J. A., Morrish, J., Lohn, J. A., Morrish, J. J., Marketta, M. (2021), J., K. R., Rach, Oliman, M. (2021), J., K. R., Rach, Oliman, M. (2021), J., K. Rach, J. (2011), Morrish, J. (2011), J. (•
		 All Controls A. P. Rouser, For Computer To The Process Of Controls. of Example weathings, the Advanced Science of Control and Proceedings of Controls of Controls			

Accepted

