Asian Journal of Biodiversity

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Vol. 6 No.2 February 2015 Asian Journal of Biodiversity

CHED Accredited Research Journal, Category A-1
Print ISSN 2094-5019 • Electronic ISSN 2244-0461
doi: http://dx.doi.org/10.7828/ajob.v7i1.832

This Journal is in the Science Master Journal List of
Thomson Reuters (ISI) Zoological Record

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ABSTRACT

The current study was conducted to assess the diversity of biological communities at Mt. Tumpa forest park, in North Sulawesi. This subregion is part of a mixture of plants and animals of the area known as Wallacea region. Surveys were based on ecosystem types, animals, and vegetation analysis.There are 4 main ecosystem types at Mt. Tumpa forest park, namely primary and secondary rain forests, shrub, grassland, and agricultural land. Vegetation analysis on forest vegetation at elevation 400-5 00 m revealed that *Spathodea campanulata* has the highest important value index (IVI) 127.08 o/o and 126.09 o/o for tree and pole, whereas *Ficus* sp. with NI 46.95% and 41.72% for sapling and seedling, respectively. Mammals found were fitch bear *(Ailurops ursinus)* , Sulawesi dwarf cuscus *(Strigocuscus celebensis),* Sulawesi crested macaque *(Macaca nigra),* Sulawesi warty pig *(Sus celebensis),* and Sulawesi deer *(Rusa timorensis macassaricus).* Birds found were Ashy woodpecker *(Mulleripicus fulvus),* Knobbed Hornbill *(Aceros cassidix),* and Purple-winged roller (*Coracias temminckii).* Those mamals and birds are endemic and only found in Sulawesi and its surronding islands and considered as protected by the IUCN Red List of Threatened Species. Family of butterflies found were Nymphalidae (31 species), Papilionidae (11 species), Pieridae (8 species), Riodimidae, and Satyridae. Forest park at Mt. Tumpa is as a nature conservation area. Therefore, it needs to be given high priority for protection and conservation sites, especially for protected and endemic animals.

Keywords: biodiversity, conservation, Mt. Tumpa, vegetation analysis, Wallacea

IN1RODUCTION

Mount Tumpa forest park is a conservation area located in North Sulawesi. This location is included in subarea of Sulawesi, which is a mixture of plants and animals known as Wallacea region. As the largest island in this region, Sulawesi has unique biodiversity including many endemic species in the sense that their distribution is only limited in Sulawesi and not found naturally in other geographic areas. Plants and animals in this region are a mixture of those found in Oriental and Australian area (Whitten et al., 1987). In addition to its biogegraphic position, the uniqueness of plants and animals of Sulawesi is also caused by various types of ecosystems and the isolation of the islands around it that resulted in a high endemism level (Shekelle and Laksono, 2004). The

diversity of ecosystem types will increase the diversity of plants and animals because every living species will adapt to the habitat it occupies. However, sometimes one species would be able to occupy more than one habitat type.

Endemicity isdue to the isolation of the place that createsa barrier / geographical barrier that separates one kind of animal into one or more subpopulations. This is caused by genetic drift due to mutation rate, duration of isolation, and gene flow level amongst them (Evans et al., 2008). Geographical obstacle will eventually result in reproductive isolation if there is no migration and gene flow so that each subpopulation will develop character of morphology, physiology and behavior as a form of adaptation to local environmental conditions (Ribeiro et al., 2014). Differentiation that takes place in each subpopulation ultimately separates one type into one or several different types, or divides a new type into different types with their ancestors. Very interesting example of this differentiation is adaptive radiation of Sulawesi macaque (Shattuck et al., 2014). Sulawesi macaques is grouped in *silenus-sylvanus,* together with *M sylvanus, M silenus,* and *M nemestrina* (Li et al., 2009). Local speciation also often occurs, giving birth to the local endemic species such as Talaud red-and-blue lorry *(Eos histrio).*

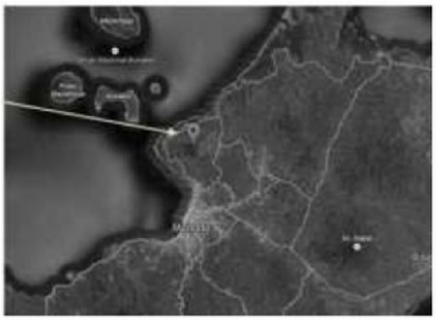
One location in North Sulawesi that still retains its richness in biodiversity is Mt. Tumpaforest parkinManado. Under Law No.5 of1990 on the Conservation of Natural Resources and Ecosystems which is further elaborated in Government Regulation No. 68 1998 on Nature Reserve Area and Nature Conservation Area, Forest Park is a nature conservation area for the purpose of collection of plants and or animals, native or not, which are utilized for research, knowledge, education, culture, tourism, and recreation. Given the importance of function and role of this forest park, inventory of biological richness of this region needs to be assessed for conservation and establishing conservation priorities.

MATERIALS AND METHODS

Study Area

Mount Tumpa Forest Park is situated in the northern part of Manado, and located geographically between 1o33'47"N and 124o50'34"E (Figure 1). Administratively, it is located in two regions, namely the city of Manado and North Minahasa district and which has an area of 215 acre with a height of 400-600asl, with the highest peak 625 with most hilly topography.

Figm-• 1A. Location of Wallacea hotspot where Mt. Tumpa resides.



Figtu-e 1B. Mt. Tumpa relative to Manado city, North Sulawesi Province.

Procedure

Survey on ecosystem types

Survey was conducted by direct observation at Mt. Tumpa Forest Park.

Vegetation analysis

Elevation of the study sites ranged between 400-500 meters (m) above sea level in secondary forest. A total of 10 plots were systematically determined on each 470 m transect line of a total of 5 transect lines. Coordinates of the starting point of transects were N01o.33.945'; E124o.50.285' and end point coordinates were N01o.33.887'; E124o.50.486'. Vegetation analysis was only performed on woody plants (trees) with the following criteria: tree (D20 em), pole (10 D < 20 em), sapling (H 1,5 m and D < 10 em), and seedling (H < 1,5 m). Plot size was determined as follows (Figure 2): tree 20m x 20m (main plot); pole: 10m x 10 m (inside main plot); sapling 5 m x 5 m (inside main plot), and seedling 2 m x 2m (inside main plot) (Figure 1).

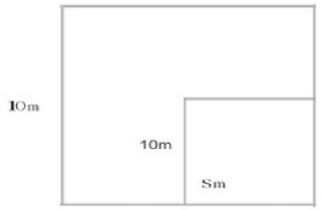


Figure 2. Nested plots for vegetation analysis

Survey on Animals

Inventory of mammalia and bird was conducted for animal survey through interview with local people and confirmation in the field. Interview with the people around the area, especially farmers, was held to gather as much information as possible from them about their encounter with the animal in the area. Field verification was done by following the transect survey lines available in the region. Identification of deer was performed by observing the horn collected by people. Survey on tarsier (Tarsius spectrum) was performed using method developed by Saroyo et al. (2014). Survey was done at 05.00-06.00 am at circle plot with radius of100 m. Coordinate of plots were N01°33.939', E124°50.100'; N01°33.713', E124°49.965'; NOP34.139', £124°50.072'; N01°34.030', E124050.049'; and N01033.883', El24°50.191'. Survey on birds inventory was based on field expedition technique (Bibby et al. 2000) using two 5 km transect lines through the following habitats: agriculture land, primary and secondary tropical rain forest, shrub, swamp, and lake. Butterflies were captured along fixed routes (transects) which were divided into smaller sections (Van Swaay et al. 2012).

Data Analysis

Survey on Ecosystem Types

The analysis was done descriptively.

Vegetation analysis

The vegetational data were quantitatively analysed for density, frequency and abundance according to the formula given by Curtis and Mcintosh (1950). The parameters used include the relative value for frequency, density, and dominance. An Importance Value Index (IVl) for each species is derived from the combined contribution of the relative value for frequency, density, and dominance of each species in the community for tree, pole, and sapling. Important Value Index for seedling was only derived from contribution of relative value for frequency and density (Fachrul, 2007).

Survey on Animals

Identification of Mammals was performed using following the books: Biodiversity and conservation in north Sulawesi Indonesia (Lee et al., 2001), Protected Mammals by Indonesian Legislation (Maryanto et al., 2008) and Identification Manual of Some Key Species in Sulawesi (Mustari & Kurniawan,

2011). Density of tarsier was conducted using the following formula: Density= (number of duet calls x 4.01 individual)/plot wide (Saroyo et al., 2014). Species identification of bird was conducted by comparing with sketch, picture, or photo of bird obtained from the books of Coates and Bishop (2000) Strange (2012), and Shannaz et al. (1995). Species identification for butterfly was conducted using the books of: Tsukada and Nishiyama (1981; 1982a: 1982b;1985;1991)

RESULTS AND DISCUSSION

Ecosystem and Plant Types

Plant species in different type of ecosystem are presented in Table 1.

Primary Tropical Rain Forest

Dominant trees found in this ecosystem *wereFicussp., Palaquium obtusifolium* and *Canarium asperum.* Vertical stratification was composed of three layers of the trees called strata A, B, and C. Stratum A: Section that appears on the upper canopy. Canopy tree has a height between 100 to 120 feets and an umbrella shape appears above the canopy layer underneath. Because the wind is always dry, these trees have small leaves, and some species are deciduous during the dry season. This stratum was dominated by *Ficus* sp. Stratum B; Canopy trees are with a height of80 feet and contiguous to each other. Light penetration is enough on the surface of this layer, but very little underneath. *Palaquium obtusfolium* dominated this stratum. Stratum C, whish was dominated by *Canarium asperum* had tree canopy is with a height of 60 feet. There is little wind movement in this zone so that the humidity is quite high.

Table 1. Plant Species in Each Vegetation Types

Plant Species	Primary tropical rain forest	Secondary tropical minforest	Shrub	Meadow	Agriculture land
Alstonia minahasae		×			×
Arengapinnata		×			
Artocarpus sp		×			×
Artocarpusheterophylus					×
Bambusa spp		×			
Barringtonia acutangula		×			
Calophyllum sp		×			
Canangaodorata		×			×
Canarium asperum	×				
Caricapapaya					×
Cocos nucifera		×			×
Colocasia esculenta					×
Dendrocnide microstigma		×			
Dioscorea hispida			×		
Erythrina sp		×			
Eugenta aromatica					×
Eupatorium odorarum			×		
Ficus septica		×			
Ficus sp.	×	×			
Gliricidia maculata		×			×
Gnetum gnemon		×			
Imperata cylindric-a				×	
Lantana camara			×		
Livistona rotundifolia		×			
Macaranga spp		×			
Mangifera indica					
Manihot escu enta					
Melia azedarach			×		
Mimosa pudica Musa				×	
paradisiaca		×			
Myristicafatua		×			
Palaquium obtusifolium	×	×			
Piper aduncum		×	×		×
Spathodea campanulata			×		×
Sterculia insularis		×			
Tectona grandis		×			
Zea mays					

Secondary Tropical Rainforest

Pioneer plants in this park were *Macaranga* spp. and *Dendrocnide microstigma.* Other plants found in this ecosystem were forest flame *(Spathodea campanulata)*, forest breadfruit *(Artocarpus* sp.), sweet palm *(Arenga pinnata),* banana *(Musa paradisiaca),* legwne (*Gliricidia maculata),* matico *(Piper aduncum),* teak (*Tectona grandis),* coconut *(Cocos nucifera),* Alstonia *(Alstonia minahasae),* banyan *(Ficus* spp.), hauli tree *(Ficus septica),* Calophyllum *(Calophyllum* sp.), nyatoh wood *(Palaquium obtusifolium),* footstool palm *(Livistona rotundifolia),* mountain immortelle *(Erythrina* sp.), bamboo *(Bambusa* spp.), Barringtonia/freshwater mangrove *(Barringtonia acutangula),* Sterculia *(Sterculia insularis),* melinjo (*Gnetum gnemon),* wild mace *(Myristica jatua)* and cananga (*Cananga odorata).*

Type ofPlants

Shrub

Shrubs that can be found in these ecosystems among others were bitter Bush *(Eupatorium odoratum),* wild sage *(Lantana camara),* intoxicating yam *(Dioscorea hispida),* Matico *(Piper aduncum),* fountain tree *(Spathodea campanulata),* blady grass *(Imperata cylindrica),* and umbrella tree *(Melia azedarach).*

Meadow

After the forest damage due to land clearing, pioneer plants that colonized were blady grass *(Imperata cylindrica).* At Mt. Tumpa, there is only a small size of meadow and is dominated by blady grass, other types of grass, saplings, and sleepy plant *(Mimosa pudica).*

Agriculture Land

Some of the main plant species planted include corn *(Zea mays),* coconut *(Cocos nucifera),* clove *(Eugenia aromatica),* banana *(Musa paradisiaca),* taro *(Colocasia esculenta),* papaya *(Carica papaya),* cassava *(Manihot esculenta),* and jackfruit *(Artocarpus heterophylus).* People also grow Matico *(Piper aduncum),* Cananga (*Cananga odorata),* Alstonia *(Alstonia minahasae),* kapok (*Ceiba pentandra),* fountain tree *(Spathodea campanulata),* manggo *(Mangifera indica),* legume (*Gliricidia maculata),* dan wild jackfruit *(Artocarpus* sp.).

Vegetation Analysis

The results of the analysis of vegetation on 10 plots conducted on secondary forest vegetation at an elevation of 400-500 mare presented in Tabel2.

Table 2. Vegetation Analysis of Mt. Tumpa Forest Park (only shows IVI above 10%).

Note: RF=Relative Frequency, Rden=Relative Density, Rdom=Relative Dominance, M=Importance Value Index. (*) = Endemic to Sulawesi

Tree Species	RF	RDen	RDom	IVI
Spathodea campanukda	19.57	57.03	50.48	127.0&
Trema orienta/is	1522	13.28	17.80	46.30
Erythrina subumbrans	6.52	3.91	4.76	15.19
Arengapinnata	6.52	3.13	3.26	12.91
Ficussp.	4.35	1.56	6.59	12.50
Cocos mcifera	4.35	3.91	2.80	11.06

Sapling Species	RF	RDen	RDom	IVI
Ficus sp.	14.29	18.75	13.91	46.95
Leucosyke capitdlata	14.29	14.58	6.96	35.83
Spathodea campanulata	8.57	8.33	13.04	29.95
Acalypha caturus	5.71	8.33	10.87	24.92
Durio zibethinus	2.86	4.17	12.61	19.63
J1acaranga hispida	5.71	6.25	5.65	17.62
Conarium asperum	5.71	4.17	3.48	13.36
Paratropia phillipensis	2.86	6.25	3.91	13.02
Cananga odorata	2.86	2.08	5.22	10.16

Pole S ecies	RF	RDen	RDom	IVI
Spathodea campanulo.ta	26.32	48.72	51.06	126.09
_.Jacaranga hispida	15.79	17.95	16.96	50.69
Acalypha carurus	10.53	5.13	5.39	21.05
Leucosyke capitellato	5.26	7.69	6.36	19.31
Artocarpus sp.	5.26	2.56	3.28	11.10
Melochia umbellata	5.26	2.56	2.89	10.72
Terminalia celebica(")	5..26	2.56	2.70	10.52
Elmirrillia ovalis	5.26	2.56	2.31	10.14
Dendrocnide microstigma	5.26	2.56	2.31	10.14
Piper aduncum	5.26	2.56	2.31	10.14
Kayaindica	5.26	2.56	2.31	10.14

Seedling Species	RF	RDen	IVI
Ficus sp.	15.79	25.93	41.72
Clerodendrwn sp.	15.79	11.11	26.90
Eugenis sp.	10.53	14.81	25.34
Pt rospermwn celebicum	5.26	7.41	12.67
Dillenia ochreata	5.26	7.41	12.67

Animal Inventory

Mammals

Mt. Tumpa forest park still retains various animals of Sulawesi. Based on interview with local people who live nearby conservation area and also our confirmation in the field, the following mammals still can be found (Table 3).

Table 3. Mammals Found at Mt. Tumpa Forest Park (Protection status and species status are based on he IUCN Red List ofThreatened Species)

Species	Indonesian Name	Commont Name	Distribution	Protection Status	Species Status
Ailurops ursinus	Kuskus Beruang	Bear Cuscus	Sulawesi and surrounding islands	Protected	Vulnerable ver 3.1
Strigocuscus cel2bensis	Kuskus Kerdil	Small cuscus	Sulawesi and surrounding islands	Protected	Vulnerable ver 3.1
Tarsius spectrwn	Tangkasi	Spectral Tarsier	Sulawesi and surrounding islands	Protected	Vulnerable ver 3.1
Macaca nigra	Yaki	Sulawesi Crested Black Macaques	Minahasa Peninsula	Protected	Critically Endangered ver 3.1
Vrverra rangalw1ga	Musang	I\1alay Civet	Indonesia, Malaysia, Brunei, The Phillippine, Singapore	Not Protected	Least Concern
Macrogalidia musschenbrocki	Musang Sulawesi	Sulawesi Palm Civet	Sulawesi	Protected	Vulnerable versi 3.1
Cervus timorensts macassartcus	Rusa	Timor Deer	Sulawesi	Protected	Low Risk/Least Concern ver3.1
Sus selebensis	BabiHutan	Sulawesi Wild Boar	Sulawesi	Not Protected	Near Threatened ver 3.1
Prosciuri/lus hzucomus	Bajing Kerdil Pucat	Sulawesi Squirrel	Sulawesi	Not protected	Data Deficient ver 3.1
Paruromys dominator	TikusBiasa Sulawesi	Common Forest Rat	Sulawesi	Not Protected	Least Concern ver 3.1
Lenomys meyeri	Tikus Raksasa Sulawesi	Sulawesi Giant Rat	Sulawesi	Not Protected	Least Concern ver 3.1

Birds

Endemic birds found in this area were *Mulleripicus folvus* (Ashy Woodpecker), *Aceros cassidix* (Knobbed Hornbill), *Comcias temmincki* (Purple-winged Roller), *Eudynamys melanorhyncha* (Black-billed Koel), *Phaenicophaeus calyorhyncus* (Yellow-billed Malkoha), *Centropus celebensis* (Bay Coucal), *Loriculus stigmatus* (Sulawesi Hanging-Parrot), *Turacoena manadensis* (Sulawesi Black Pigeon), *Ducula forsteni* (White-bellied Imperial Pigeon), *Amaurornis isabellinus* (Isabelline Bush Hen), *Pachycephala sulforiventer* (Sulphur-bellied Whistler), *Streptocitta albicollis* (White-necked Myna), *Scissirostrum dubium* (Finch-billed Myna), and *Trichastoma celebense* (Sulawesi Babbler).

Butterflies

Family of butterflies found were Nym phalidae (31 species), Papilionidae (11 species), Pieridae (8 species), Riodimidae, and Satyridae. The most prominent species were *Ideopsis juventa tontoliensis* (8.8%) (Nymphalidae), *Cyrestis strigata* (3.51%) (Nymphalidae), and *Euroma tomina* (5.8%) (Piridae).

Offering spectacular endemic biodiversity, assessment on biodiversity in M t. Tumpa was performed to provide an illustration on how to evaluate and manage the site for conservation strategies. Mount Tumpa forest park is an integrated conservation area in North Sulawesi which blends tropical rain forest and plantation. There is only a small area of primary tropical rain forest ecosystem found here especially in areas that are difficult to reach, such as steep slopes. Tropical rainforest biome is recognized due to its distinctive structure and physiognomy (Corlett & Primack 2006). This type of forest is the most complex ecosystems on earth, both in structure and biodiversity. It comprises of two-thirds of terrestial global biodiversity (Martinet al., 2013). This biome grown in optimal conditions: high rainfall and warm temperatures throughout the year. There is no annual rhythm in this primary forest, but each species has its own flowering and fruiting season. Sunlight is a limiting factor. Various strategies for survival adapt to the low intensity of sunlight under the canopy. Dominant plant genera in this ecosystem were *Ficus, Palaquium* and *Canarium.* This finding is in accordance with the research conducted by Polii and Walangitan (2003) and Yanengga et al. (2015). According to Yanengga et al. (2015), there are 9 types of *Ficus* found in this area and also in secondary forest: *F. benjamina, F. tinctoria* (white trunk), *F. tinctoria* (black trunk), *F. hampelas, F. jistulosa, F. subcordata, F. elastica, F. minahassae,* and *F. septica.* Secondary forests occur because of the disruption of primary tropical rain forest ecosystem due to natural disasters and human activities that damage ecosystems such as the conversion of forest to agriculture (land clearing) and harvesting of forest products. *As* a result, the tree canopy cover is reduced resulting in the growth of seedlings, and some pioneer plants such as *Macaranga* spp. and *Dendrocnide microstigma. Spathodea campanulata* dominated this area. This type of forest was reduced in size from 175.13 ha (2007) to 174.03 (2014) (Bode et al., 2015).

Shrub grows after forest land clearing activities. After going through the process of succession, there will be a low vegetation type composed of seedlings, herbaceous, and shrub. After the forest damage due to land clearing, pioneer plants that colonize were blady grass *(Imperata cylindrica)* and sleepy plant *(Mimosa pudica).* In some locations, the community also established farms in the inside forest park.

An essential first step in the assessment of terrestrial biodiversity is the anlysis of vegetation (Mueller-Dombois et al. (2008). *Spathodea campanulata* recorded maximum IVI among trees and poles with value of 127.08 and 126.09, respectively, while among saplings and seedlings, *Ficus* sp recorded maximum IVI with value of 46.95 and 41.72, respectively. Kainde et al. (2012) and Andong et al. (2015) also found that *S. Campanulata* had higher IVI among the trees at Mr.

Tumpa secondary forest. Higher M is considered as indicator of dominance (Agni et al., 2000). Low M of sapling and seedling species is due to high density of tree canopy, resulting in decrease of light penetration. *Spathodea campanulata* is an invasive species and can be found in secondary rain forest (Bito, 2007).

Typical Sulawesi/Wallace mammals and endemic to Sulawesi found were *Ailurops ursinus, Strigocuscus celebensis, Tarsius spectrum, Macaca nigra, Macrogalidia musschenbroekii, Sus celebensis,* and *Cervus timorensis macassaricus.* There is still a lack of information on the ecology of Sulawesi palm civet *(Macrogalidia musschenbroekii)* because of the difficulty in finding this animal in the field. Photographs of this animal were obtained through phototrap. These animals are nocturnal and omnivorous. They feed on fruits, birds, rodents, and insects. Interview with local people revealed that they had encounted this animal. Wild pig *(Sus celebensis)* is active at night. Their habitat includes primary and secondary tropical rain forests. They are omnivorous feeding on various types of food, from the leaves, tubers, fruit, to worms and insects. During survey, their footprints were found. Rotten log was torn by them for insects. Sometimes, these animals also become agricultural pests by eating various types of vegetables. *Cervus timorensis macassaricus* prefers open meadow. They feed primary on young grass. Local people use to burn pasture to induce young leaves to grow so the animal come to feed on the young leaves and are hunt for their meat. Their population decreases dramatically since 1990.

The diversity of birds can be an indicator of the health of habitats, although their abundance should also be considered. Each bird species will choose a particular habitat type. It is a form of ecological adaptation to the environment. Availability of food, nesting sites, hatching sites, and security are some of the factors that influence the choice of habitat by birds. Diverse habitats at Mt. Tumpa forest park enable a variety of bird life; despite their abundance they may be reduced due to the increasingly shrinking habitat. There are 8 endemic species and 28 diurnal species (18 families) of birds reported by Christita et al. (2015). All species are classified as LC (Least Concern) in IUCN.Some butterfly population in this Mt. Tumpa has recently declined to dangerously low levels, especially *Troides helena* and *Troides hypolitus,* belonging to the family Papilionidae (Koneri et al. unpublished). They are not significantly threatened but protected according Government Regulation No. 7 (1999) and listed in Appendix II CITES (Kairupan et al., 2015). This is due to dissapearance ofSirih hutan *(Aristolochia tagala),* their host plant. Rippon's Birdwing *(Troides hypolitus)* is endemic to the Moluccas and Sulawesi.

Threats to Wildlife Conservation

Various threats to the survival of animals have been ongoing and increasing. This is caused by a variety of community activities in their natural habitat. Various kinds of threats can be grouped as follows: (i) Habitat destruction. This includes habitat changes into agricultural land and residential areas, as well as harvesting forest product which can reduce the carrying capacity of the habitat for animal. Habitat destruction occurs in conservation area and protected forest. Changes in habitat to plantations are mainly destined for some kind of essential commodities. Wood harvesting is primarily for wood as a building material, ship/ boat, or sold as processed wood. One of the main tree species producing quality wood in North Sulawesi found in Mt. Tumpa area is *Palaquium obtusifolium*. Other forest product which is often taken out are leaves of *Livistona rotundifolia*. (ii)Hunting. Animal hunting is done using trap or rifle for consumption or to be kept at home or sold. The hunt for consumption in North Sulawesi is the most serious problem, which is the main cause of population decline of wildlife (Lee et al. 2001). (iii) Hunting for pet or shows. Captured baby or young Macaque *(Macaca nigra)* are nurtured and sold as pets at black markets. Other wildlives are often raised such as fitch bear *(Ailurops ursinus)*, and the birds of the family Accipitridae, Columbidae, and Psittacidae.

This study shows that biodiversity potential of Mt. Tumpa forest park is still high. Some typical Sulawesi animals and plants still exist in this area. Various landscape supports its potential to be developed as a nature reserve area for research, education, culture, tourism, and recreation. This study then recommends the following action: (i) The need of zonation as a basis for area management and to avoid management overlap of the formed zones; (ii) Pristine area needs to be preserved; (iii) Mass tourism can be done only at recreation zone; (iv) The need for counseling and coaching efforts for communities around the region to collaborate in conservation efforts and for young people to be trained as a nature tour guide; (v) Trees for tarsier survival need to be conserved, so tarsier can be a tourist attraction (vi) The need for butterflies conservation plan for research, education, and tourism.

ACKNOWLEDGEMENT

This work was financed by The Support to The Development of Higher Education Project, Islamic Development Bank 7inl, Sam Ratulangi University, through Riset Unggulan Perguruan Tinggi (University Competitive Research Grant).

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Aceros cassidix

Ailurops ursinus

Tarsius spectrum

Macaca nigra

Troides helena

Plate 1. Animals of Mt. Tumpa.

Spathodea campanulata

Ficus sp.

Livistona rotundifolia

Cananga odorata

Place 2. Plants ofMt. Tumpa.

Mt. Tumpa offers a beautiful scenery of Manado City and Manado Bay (Photo credit: Salahuddin Ahmad)

Manado Tua and Bunaken Islands seen from Mt. Tumpa (Photo credit: Nicky Kindangen)

Plate 3. Scenery from Mt. Tumpa.

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