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The diversity of undergrowth plants on *Acacia nilotica* stands as food resources of banteng (*Bos javanicus*) in Baluran National Park, East Java, Indonesia

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Abstract. *Djufri, Wardiah. 2017. The diversity of undergrowth plants on* Acacia nilotica *stands as food resources of banteng (*Bos javanicus*) in Baluran National Park, East Java, Indonesia. Biodiversitas 18: 288-294.* The objectives of this research were to determine species composition, importance value of species, diversity index and evenness index of the undergrowth plants of *Acacia nilotica* stands. The quadratic method was used in this study. The similarity indeks and cluster analysis were performed to classify the community structure of undergrowth plants of *Acacia nilotica*. The results of this study showed that there were 63 species of plant belonging to 18 families. The importance value ranged between 0.97-42.58 and high and medium importance values belonged to *Brachiaria reptans*, *Thespesia lampas*, *Oplismenus burmannii*, *Dichanthium coricosum*, *Axonopus compressus*, and *Synedrella nodiflora*. The diversity index and evenness ranged 1.1504-2.7556 and 1.1067-1.7854, respectivelly. The *Brachiaria reptans*, *Dichantium coricosum*, *Thespesia lanpas*, *Achyrantes aspera*, *Stachytarpeta indica*, *Axonopus compressus* and *Oplismenus burmanii* were predominant in study area. In addition the invasion of *A. nilotica* has decreased the carryng capacity of savanna in Baluran National Park to the banteng.

Keywords: *Acacia nilotica*, species composition, banteng, Baluran National Park

INTRODUCTION

Baluran National Park (BNP) is situated in East Java Province, Indonesia ranges from Banyuputih sub-District to Situbondo. The BNP is bordered by Madura Strait to the north, the Bali Strait to the east, the river Bajulmati (Wonorejo Village) to the west and the Klokoran River (Sumberanyar village) to the south. Baluran has dry climate and it is dominated by savanna and the rest of the areas are lowland, mangrove forests, and hills, with Mount Baluran at 1.247 m from sea level (Sabarno 2002). The savanna of BNP has large of grassy area with mixture of various bushes and trees (Caesariantika et al. 2011). It is known that several factors have triggered the grassland existence namely fire, dry season, and lower precipitation. However, van Steenis (1972 stated that fire was presumed as the most influenced factors that convert it into the grassy land (Sutomo et al. 2016).

Savanna plays an importance role for living organisms. The grassy area of savanna provide food for wildlife such as banteng, deer, wild buffalo, and others. Therefore, ecological balance is required to keep up sustainability and continuity of the ecosystem. However, fire, industry activities, rapid human population, agricultural activities, and invasion of certain plant have changed its ecological balances (Hakim et al. 2015; Sutomo et al. 2016). Therefore, the pressures and disturbances in the ecosystem must be handled comprehensively. The most triggered pressure disrupting the stability of the ecosystem is the existence of alien plant called *Acacia nilotica* leading to the decline in the quality and quantity of the savanna (Sabarno 2002). The purpose of *A. nilotica* introduction into BNP is to prevent the forest fires in BNP. This plant has dominated the area leading to decline of grassy area of savanna. The *A. nilotica* is growing densely producing large canopy area leading to the reduction of survival capability of grass species due to less sunlight for photosynthesis. In addition, the allochemicals producing by *A. nilotica* gave negative impact to other plants (Djufri 2004, Caesariantika et al. 2011).

The plant invasion has declined the grazing area for wild animals, specially banteng (Sabarno 2002). The decrease of the area has forced them to find alternative foods such as leaf and seed of *A. nilotica*. However, as the most important food, grass is irreplaceable (Sabarno 2002). This phenomenon has disturbed the ecosystem stability in the park as the reduction of the main food threatens the herbivores in the BNP (Caesariantika et al. 2011). Nowadays, no study has been done to evaluate the impact of the *A. nilotica* invasion on the plants diversity in BNP. Therefore the objective of the present study was to characterize the autecology of *A. nilotica* in the national park.

MATERIALS AND METHODS

Data collection

Observation and setting observation station (segmentation) was previously done before sample collection. The total area of Savanna Bekol was approximately 420 hectares, therefore only 10 % of the total area has been taken as the study area. The setting was based on the homogenous area of each station.The observed area reached 42 hectares comprising three station relied on characteristics of density of *A. nilotica* stands; a) the open area of Savanna Bekol (SBK0) (control), the area with 1500-3000 trees/ha of *A. nilotica* stands (SBK1), and the area with more then 3000 trees/ha of *A. nilotica* (SBK2). The study used quadrant method. The area consisted of 10 stations with 1.4 ha each. Each station had five plots, so there were 50 plots in total. The steps were repeated on savanna of Kramat (600 ha) and savanna of Balanan (1250 ha) (Figure 1). The names of three stations on Kramat savanna were SKR0, SKR1, SKR2 and SBL0, SBL1, dan SBL2 for Balanan savanna. There were 150 plots in the study area. Determining the number of plots it was used quadrant technique with three series of patterns, and sampling plot area with minimum area curve (Barbour et al., 1999; Setiadi and Muhadiono 2001; Indriyanto 2006; Kent 2011).

Parameters and data analysis

The plant samples were identified based on Backer and Bakhuizen (1963, 1965, 1968) and van Steenis (1972) and herbarium technique. The variables observed included number of species, absolute density value (ADV), absolute frequency (AF), and absolute dominance (AD). To determine important value (IV) of each species it was used Cox formula (2001) i.e; IV = relative frequency (RF) + relative density (RD) + relative dominance (RD). The results were used as the values to determine species diversity index (H') in a community (Barbour et al. 1999; Krebs 2001; Fachrul 2007; Djufri et al. 2016). Data was analyzed by sofware of *Ecological Methodology* 2nd edition (Krebs 2001). The data were presented in tables and analyzed descriptively.

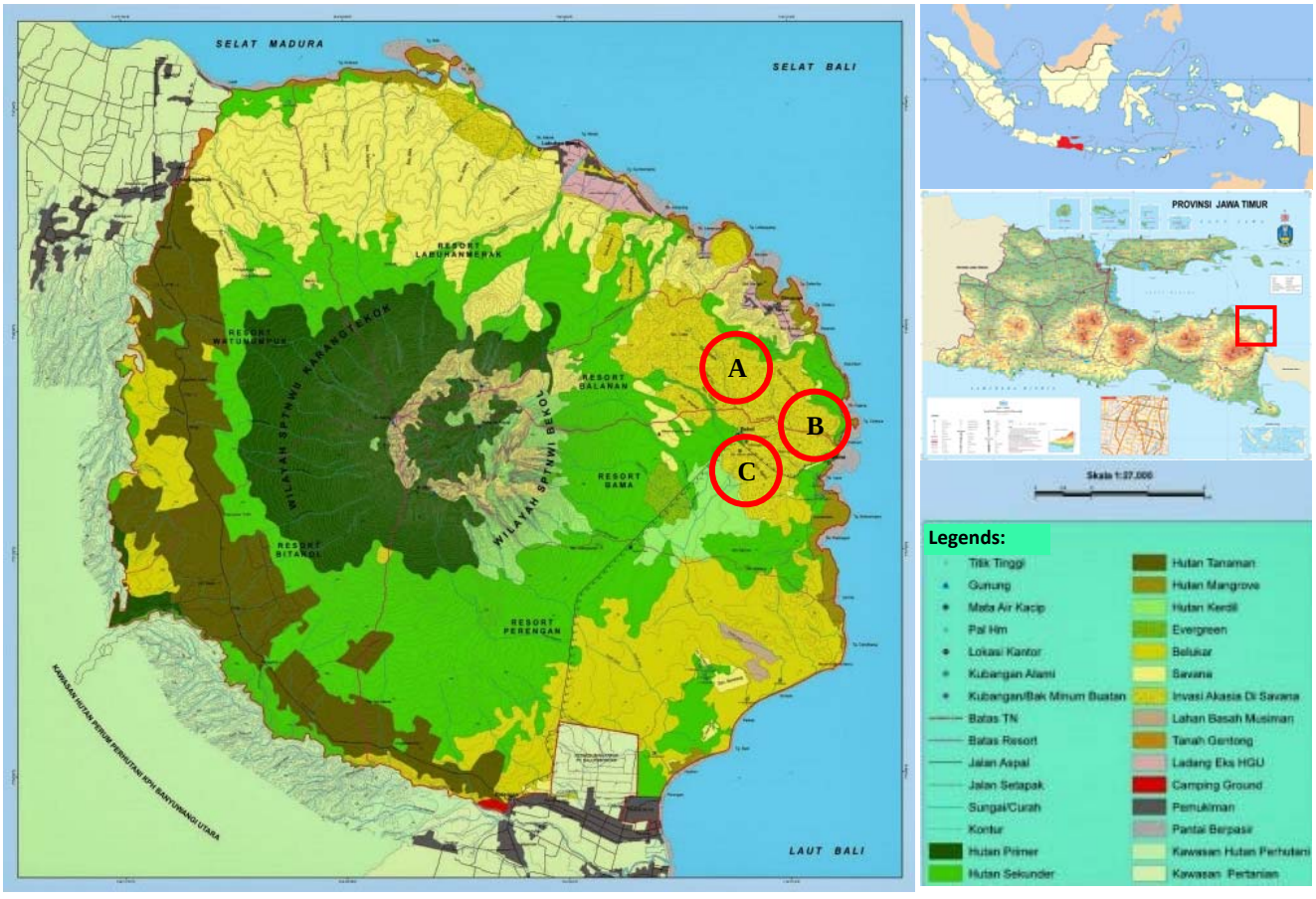

Figure 1. Study site in Balanan (A), Kramat (B), and Bekol (C) savannas of Baluran National Park, East Java, Indonesia

RESULTS AND DISCUSSIONS

Compositions of plant species as food sources of banteng

The composition of plants found in savanna Bekol, Keramat, and Balanan comprised of 63 species which belong to 18 families (Table 1). There were 60 species found in the open area of Bekol savanna and 22 species were found in its shaded areas. While in the open areas of Kramat savanna there were found 25 species and 11 species in shaded area, and in Balanan savanna it was found 21 species in the open area. Whilst 14 in its shaded area. Therefore, the number of species in open area was higher than that under the shade of *A. nilotica* stands (Table 2). This indicated that the density of *A. nilotica* affected the presence of plants under the stands. Sunlight is an important factor in the diversity of species in the savanna. Three effects of sunlight on plant physiology are: (i) affects the heat exchange in plant tissues and environment, transpiration, respiration, biochemistry reactions in photosynthesis and other metabolisms, (ii) it gives inpact on photochemical effect of photosynthesis, and (iii) it influences morphogenic effect that regulates and stimulates the growth and development the plants. The influence of radiation intensity in plant germination is stronger than the changes in the quality of radiation (Salisbury and Roose 1991).

The composition of species found in Bekol, Kramat and Balanan savanna consisted of 63 species belonging to 18 families. The detail composition were 15 species belong to Poaceae (23.81 %), 11 species of Fabaceae (17.46 %), 8 species of Asteraceae (12.70 %), 5 species of Mimosaceae (7.94 %), 4 species each of Malvaceae and Euphorbiaceae (6.34 %), 3 species of Lamiaceae (4.76 %), 2 species each of Cyperaceae and Solanaceae (3.17 %), and 1 species each of Rhamnaceae, Verbenaceae, Asclepiadaceae, Apiaceae, Amaranthaceae, Capparidaceae, Salvinaceae, dan Rubiaceae (1.59 %) (Table 2). Based on the percentage of species this was grouped into natural savanna since the number of Poaceae species was up to 20 % (Speeding 1971). The data showed that the members of Poaceae were dominant in the savanna (23.81 %). The findings have been supported by low precipitation level in the area (900-1600 mm/year) and its high temperature ranging 32^0-37^0C particularly during summer (from April to October) (Sutomo et al. 2016)

Savanna can be formed due to secondary succession. However savannas of Baluran National park are natural ones (Caesariantika et al. 2011). The savannas are also absent for introduced plants. Linking to physiognomy theoretically. Bekol, Kramat, and Balanan savanna could not be categorized as the true savanna since the areas were dominated by *A. nilotica* (>70 %). The shaded areas which were under *A. nilotica* stands with the tree diameter of 25-50 cm, the average height of 7 m, and the density of about 15-20 trees/400 m^2 have blocked sunlight penetrating to the floor of the forest leading to inhibit the growth of undergrowth plants including grasses. It happened prominently in Balanan savanna. The study showed that only some survival species were found under the stands such as *B. reptans, O. burmanii, T. arguens, A. compressus, D. coricosum, and D. aegyptium.* However, the low density, frequency, and dominance of those plants indicated that herbivores (*Bos javanicus, Cervus timorensis, Bubalus bubalis,* and *Muntiacus muntjak*) experienced lack of food in the three savannas.

A. nilotica is an aggressive species. It has invaded the area of savanna and produced groups of shaded areas. According to Sutomo et al (2016) the shaded areas had different characteristics. The group of young plants was identified by lighter green with sparse density patterns and was that located at the front of each older stands, whereas the group of older plants produced a thick dark block. Therefore, the stands have decreased the savanna areas in Bekol.

Some species such as *A. leprusola, A. indica, Z. rotundifolia,* and *L. leucocepala* were specific characteristic of savanna of BNP. However, those plants were less dominant than *A. nilotica* and had less suppressed effect on the undergrowth plants. Besides sunlight radiation, the Indonesian Ministry of Forestry (2008) stated that the tannin released by *A. nilotica* to the soil has decreased in number of species under the stands (Caesariantika et al. 2011). The chemical has direct or indirect harmful effects to other plants. The allelochemicals can be produced and released by root and other organs such as flower, leaf, fruit, and seed. The release of toxic compounds is important mechanism to suppress or inhibit the growth of other species. The chemicals in certain concentration have decreased plant growth potential by blocking the amino acids and inhibiting of protein synthesis. The chemicals inhibit root growth of seedlings, reduce radical emergence during germination leading to plant death (Ardhana 2012). Salisbury and Ross (1991) explained that allelophaty inhibit the following processes ; proliferation and elongation of cells, GA and IAA activities, minerals absorption, photosynthesis rate, respiration, stomatal opening, protein synthesis, and enzymatic activities. Therefore, the surviving undergrowth species has capability to enhance adaptation mechanism and tolerance to the released allelochemicals.

There were more species found in open area than that of the shaded area in Balanan (areas with *A. nilotica* density of 1500-3000 trees/ha and >3000 trees/ha). The savanna has been turned into *A. nilotica* forest (Table 2). The consequence was the loss of grass species as the main food sources for herbivores from this location leading to the vanish of the savanna area. Therefore, all components including Department of Environment and Forestry must take part to find proper management to deal with the problems. The disruption was prevented by concrete and comprehensive programs. According to Sabarno (2002) savanna is an unstable ecosystem. Its ecological balance relies on climate, fire, and animal usages. In order to conserve the savanna, manipulative activities are required such as controlled fire, regulation of animal population and deforestation. Forest fire destroys woody plants, dicots, and palms, but has less impact on the rhizomes of grasses.

Table 1. Composition of species found in Bekol, Kramat, and Balanan Savanna Baluran National Park, in the open and shaded areas as food sources for (*Bos javanicus* d' Alton) (E = eaten and NE = not eaten)

Local name	Species	Family	Habitus	Life form	Category
Jarong	*Achyrantes aspera* L.	Amaranthaceae	Herb	Non grass	E
Pegagan	*Centela asiatica* (L.) Urb.	Apiaceae	Herb	Non grass	E
Biduri	*Calotropis gigantean* (Willd.) Dryand Ex. W.T. Ait.	Asclepiadaceae	Shrub	Non grass	NE
Babadotan	*Ageratum conyzoides* L.	Asteraceae	Herb	Non grass	E
Ketulan	*Bidens pilosa* L.	Asteraceae	Herb	Non grass	E
Sintrong	*Crassocephalum crepidiodes* (Benth.) S. Moore	Astercaeae	Herb	Non grass	E
Tempuyung	*Emelia sonchifolia* (L.) DC. Ex. Wight	Asteraceae	Herb	Non grass	E
Nyawon	*Eupatorium odoratum* L.	Asteraceae	Shrub	Non grass	E
nyawon ungu	*Eupatorium prostrata* W. Ait.	Astercaeae	Herb	Non grass	E
Gletengan	*Synedrela nodiflora* (L.) Gaertn.	Asteraceae	Herb	Non grass	NE
Nyawon	*Vernonia cinerea* (L.) Less.	Asteraceae	Shrub	Non grass	NE
Pedangan	*Cleome rutudisperma* DC.	Capparidaceae	Herb	Non grass	E
Teki payung	*Cyperus pygmaeus* Rottb	Cyperaceae	Herb	Non grass	E
Teki	*Cyperus rotundus* L.	Cyperaceae	Herb	Non grass	NE
Daun bolong	*Acalypha indica* L.	Euphorbiaceae	Herb	Non grass	E
Meniran (a)	*Phyllanthus niruri* L.	Euphorbiaceae	Herb	Non grass	E
Meniran (b)	*Phyllanthus urinaria* L.	Euphorbiaceae	Herb	Non grass	E
Patikan kebo	*Euphorbia hirta* L.var. glabra Steen.	Euphorbiaceae	Herb	Non grass	E
Kacangan (c)	*Cassia seamea* Lmk.	Fabaceae	Herb	Non grass	E
Kacangan (e)	*Clidemia hirta* (L.) D. Don.	Fabaceae	Herb	Non grass	E
Kembang telang	*Clitoria ternatea* L.	Fabaceae	Herb	Non grass	E
Orok orok (b)	*Crotalaria anagyroides* H.B.K.	Fabaceae	Herb	Non grass	E
Orok-orok (a)	*Crotalaria striata* DC.	Fabaceae	Herb	Non grass	E
Kacangan (b)	*Desmodium caudatum* (Thunb.) DC.	Fabaceae	Herb	Non grass	E
Susukan	*Desmodium heterophyllum* Willd. DC.	Fabaceae	Herb	Non grass	E
Kacangan (a)	*Desmodium triflorum* (L.) DC.	Fabaceae	Herb	Non grass	E
Tarum	*Indigofera sumatrana* Gaertn.	Fabaceae	Herb	Non grass	E
Kekosongan	*Moghania macrophylla* (Willd.) O.K.	Fabaceae	Herb	Non grass	E
Paci	*Leucas lavandulaefolia* J.E. Smith	Lamiaceae	Herb	Non grass	E
Kemangi	*Ocimum basilicum* L.	Lamiaceae	Herb	Non grass	E
Jarong lelaki	*Stachytarpeta indica* (L.) Vahl	Lamiaceae	Herb	Non grass	E
Nimba	*Azadirachta indica* A. Juss.	Meliaceae	Seedling	Non grass	NE
Kapasan hutan	*Malvaviscus arboreus* Cav.	Malvaceae	Shrub	Non grass	E
Sidagori	*Sida rhombifolia* L.	Malvaceae	Herb	Non grass	E
Kapasan	*Thespesia lanpas* (Cav.) Delz. & Gibs.	Malvaceae	Shrub	Non grass	NE
Pulutan	*Triumfetta bartramia* L.	Malvaceae	Herb	Non grass	E
Pilang	*Acacia leucophloea* Willd.	Mimosaceae	Seedling	Non grass	E
Akasia berduri	*Acacia nilotica* (L.). ex. Willd. Del.	Mimosaceae	Seedling	Non grass	E
Petai cina	*Leucaena leucocephala* (Lmk) De. Wit	Mimosaceae	Seedling	Non grass	E
Putri malu (a)	*Mimosa invisa* Mart. Ex. Colla	Mimosaceae	Herb	Non grass	E
Putri malu (a)	*Mimosa pudica* L.	Mimosaceae	Herb	Non grass	E
Rumpu pait	*Axonopus compressus* (Swartz) Beauv.	Poaceae	Herb	Grass	E
Bayapan	*Brachiaria reptans* (L.) Gardn. & Hubb.	Poacaeae	Herb	Grass	E
Rumput kawat	*Cynodon dactylon* (L.) Pers.	Poaceae	Herb	Grass	E
Tuton	*Dactyloctenium aegyptium* (L.) Richt.	Poaceae	Herb	Grass	E
Lamuran putih	*Dichantium aristatum* (Poir.) C.E. Hubb.	Poaceae	Herb	Grass	E
Lamuran merah	*Dichantium coricosum* (L.) A. Camus	Poaceae	Herb	Grass	E
Rumput jarum	*Digitaria remota* Henr.	Poaceae	Herb	Grass	E
Gegajahan	*Echinocloa colonum* (L.) Link.	Poaceae	Herb	Grass	E
Belulang	*Eleusine indica* (L.) Gaertn.	Poaceae	Herb	Grass	E
Emprit-empritan	*Eragrotis tenella* (L.) Beauv. Ex. R & S.	Poaceae	Herb	Grass	E
Alang-alang	*Imperata cylindrical* L.	Poaceae	Herb	Grass	E
Rumput gunung	*Oplismenus burmanii* (Retz.) Beauv.	Poaceae	Herb	Grass	E
Jajagoan	*Panicum repens* L.	Poaceae	Herb	Grass	E
Lamuran kecil	*Polytrias amaura* (Buese) O.K.	Poaceae	Herb	Grass	E
Merakan	*Themeda arguens* (L.) Hack.	Poaceae	Herb	Grass	E
Kacangan (d)	*Polygonum javanicum* De. Br.	Polyginaceae	Herb	Non grass	E
Widoro bekol	*Zyzipus rotundifolia* Lamk.	Rhamaceae	Seedling	Non grass	E
Mericaan	*Hedyotis corymbosa* (L.) Lamk.	Rubiaceae	Herb	Non grass	E
Buah perahu	*Salvia riparia* H.B.K.	Salvadoraceae	Herb	Non grass	E
Rimbang	*Solanum torvum* Swartzz	Solanaceae	Shrub	Non grass	NE
Ceplukan	*Physalis angulata* L.	Solanaceae	Herb	Non grass	E
Temblek ayam	*Lantana camara* L.	Verbenaceae	Shrub	Non grass	NE

The species found in Bekol savanna were categorized into eaten and not eaten species, They were 54 consumable species ((83.33%) and 9 non comsumable species (16.67%) (Table 2). It needed less concern onto number of eaten species, but more concern on to the most preferable species (21,67%). According to Speeding (1971), pure savanna contains more than 20% grass species of the total species. Therefore, the findings indicated that the savanna is categorized into pure one. Sabarno (2002) and Djufri (2013) stated that several factors affecting the quality of savannas of BNP; namely the invasion of *A. nilotica*, the intrusion of species of shrubs to the savanna, the influence of animal footprints on the ground and grass, and overgrazing. In addition, Utomo (1997) reported that productivity of the savanna is about 13.700 gr/ha/day. The daily need of deers, one of wild herbivores in the area, was 10 % of its total body weight (5.5 kg/day/individual in average). The support capacity of Bekol savanna with the large area of about 75 ha was for about 114 adults. Since there was about 192 deers found in Bekol savanna, so the savanna gave no optimum grazing area for those animals and other herbivores.

Important Value, Index of Diversity, and Index of Evenness

Table 2 showed there were three species with high important values (> 28,38) consisting of *B. reptans* (42.58 %), *T. lanpas* (25.88 %), and *O. burmanii* (34.61 %), 3 species with moderate values (> 14.19-28.38) namely *D. coricosum* (25.88 %), *S. nudiflora* (25.50 %), and *A. compressus* (16.47 %), and 47 species with low values (< 14.19 %). High important value species were more adaptive and tolerant than others against stands of *A. nilotica*, extreme climate, and competition. The species have dominated the area of savanna Bekol, Kramat, and Balanan of Baluran National Park.

Ecologically, species with high and moderate values were exclusive species. This relied on quantitative values; frequency, density, and dominance. Those species were ecological indicator for community of *A. nilotica* stands according to topography, habitat, micro environment, and other species with low values (< 14,19%). It commonly occurred in vegetation reaching to optimal development. The composition of longterm invaded community showed gradual decrease on physiognomy, phenology, and generation rates. This created insignificant dynamics of floristic, so replacement and regeneration of species were invisible. Therefore, the dominant species were not found in the park.

The values of open area of the savanna were higher than that of invaded areas. Index of diversity ranged from moderate (2.7556) SBK0) to low 1.3472 (SBL0) whereas in the shaded area of Savana also ranged from moderate 2.4315 (SBK1) to low 1.1504 (SBK2). The density of *A. nilotica* affected the values of H' (The H' values of station of SBK2, SKR2, and SBL2 < SBK1, SKR1,and SBL1 < SBK0, SKR0, and SBL0). The species under the stands lived restrictively prior to limitation of number of tolerant and adaptive species. It might be caused by limited light intensity or allelochemicals, and competition between *A. nilotica* with other species.

Theoretically, regular and periodical interferences can maintain high diversity of species. In stable community, the species spreading regionally and homogenously indicates lower density of species than the one creating mosaic structure forest or disturbed forest. The interference can be fire, wind, competition, diseases, and human intervention. However, there will be increases in number of species until reaching the point which is dominated by the survival plants and big size species. The open areas of the savannas have been interfered by some activities such fire, bulldozer tracking, and herbicides treatment, and overgrazing. Thus, the dynamics and the species replacement in the open areas varied considerably. Therefore, the value of H' was higher in the open areas. Sutomo et al. (2016) reported that the open areas were burned few months or a year before. It is assumed that the banteng grazed *A. nilotica* pods and dispersed the seeds to many areas including the burnt areas. The heat triggered seeds growth and maturity, and later on the plants dominated the unburnt area. In terms of species diversity, these sites had low species diversity (around 0.8) measured by Shannon and Wiener and Simpson Index.

Index of Evenness of species (e) ranged 1.1067-1.7854 (relative homogeneity) (Table 3). It was noticed that the differences among the stations were insignificant. Index of diversity is different from Index of Evenness as well as species wealth and species diversity. Barbour et al. (1999) stated that in heterogeneous area, there will be positive correlation between species wealth and diversity leading to the decline in species wealth and increase in diversity of species, and number of individual varies in each station. The evenness of species was maximal and homogenous when all species was similar in number in each sample area. However, it rarely occurs in nature because each species has different adaptation ability, tolerance level, and history of live against certain habitat. Moreover, it is also due to the complexity and the variation of environmental condition. Macro environment may be homogenous, but micro habitat may possess with heterogeneous microsites. Similar microsites were occupied by similar species that naturally affected distribution pattern (Djufri 2003). It was relevant to the findings that the evenness of species was relative homogenous in all stations. This indicated that there was similar environmental conditions of all areas.

In conclusion, the number of species found in savanna of Baluran National Park East Java was 63 species belonging to 18 families. The dominant species with the highest important values were *Brachiaria reptans*, *Thespesia lanpas*, and *Oplismenus burmanii*, and the species with moderate values were *Dichanthium coricosum*, *Synedrella nodiflora*, and *Axonopus compressus*. The index of species diversity (H') of open area was higher (1.3472-2.7556) than that of shaded one (1.1504-2.413). There was a decrease in caring capacity of Baluran National Park to the banteng due to the invasion of *A. nilotica*.

Table 2. Mean of Important Value(IV), Index of Species Diversity (H'), and Index of Evenness of Species (e) at whole stations in savanna of Bekol, Kramat, and Balanan

Species	Stations									Total	Mean of Importance Value	Category	Distrbutio Types
	SBK0	SBK1	SBK2	SKR0	SKR1	SKR2	SBL0	SBL1	SBL2				
Brachiaria reptans	35.60	43.35	88.00	40.35	84.25	91.71	-	-	-	383.26	42.58	High	Definite
Oplismenus burmanii	1.34	32.75	49.76	30.60	5.30	58.96	22.07	40.20	70.53	311.51	34.61	High	Broad
Thesphesia lanpas	16.37	46.35	64.53	32.65	48.70	64.33	10.00	5.20	7.76	295.89	32.88	High	Broad
Dichantium coricosum	30.53	47.65	39.30	26.60	22.93	34.30	17.20	11.62	2.76	232.89	25.88	Moderate	Broad
Synedrella nodiflora	2.76	5.47	2.60	20.16	4.82	18.44	11.05	82.75	81.47	229.52	25.50	Moderate	Broad
Axonopus compressus	1.33	4.76	-	-	-	-	22.21	59.96	59.96	148.22	16.47	Moderate	Definite
Dactyloctenium aegyptium	14.13	14.22	1.24	19.67	16.55	5.20	21.72	5.59	7.34	105.66	11.74	Low	Broad
Achyrantes aspera	10.12	11.87	11.65	15.15	16.22	2.50	8.77	12.83	13.86	102.97	11.44	Low	Broad
Polytrias amaura	23.94	23.19	-	24.12	22.44	-	-	-	-	93.69	10.41	Low	Definite
Vernonia cinerea	12.31	2.87	-	11.45	-	-	42.40	7.84	-	76.87	8.54	Low	Definite
Stachytarpeta indica	5.12	7.53	7.40	6.72	8.51	3.21	9.40	13.21	3.34	64.44	7.16	Low	Broad
Acalypa indica	-	3.57	-	-	-	-	5.45	20.94	33.30	63.26	7.03	Low	Definite
Bidens pilosa	1.35	4.98	7.20	-	-	-	31.46	10.01	-	55.00	6.11	Low	Definite
Ageratum conyzoides	1.46	3.69	3.00	-	-	-	6.78	14.43	19.89	49.25	5.47	Low	Definite
Sida rhombifolia	1.50	11.08	9.56	10.76	-	12.56	-	-	-	45.46	5.05	Low	Definite
Lantana camara	1.59	-	-	-	-	-	34.70	-	-	36.29	4.03	Low	Definite
Indigofera sumatrana	2.04	5.80	10.76	3.32	7.71	-	-	-	-	29.63	3.29	Low	Definite
Ocimum basilicum	10.84	5.46	5.00	1.05	-	-	3.32	-	-	25.67	2.85	Low	Definite
Crotalaria setriata	7.25	5.76	-	2.46	6.34	-	-	-	-	21.81	2.42	Low	Definite
Eupatorium odoratum	-	-	-	-	-	-	20.55	-	-	20.55	2.28	Low	Definite
Moghania macrophylla	9.54	7.43	-	3.40	-	-	-	-	-	20.37	2.26	Low	Definite
Acacia nilotica	2.18	3.78	-	3.32	-	-	1.27	9.21	-	19.76	2.20	Low	Definite
Euphorbia hirta	3.31	3.49	-	-	-	-	5.37	6.21	-	18.38	2.04	Low	Definite
Themeda arguens	3.67	-	-	-	-	-	13.50	-	-	17.17	1.91	Low	Broad
Phyllantus niruri	1.82	-	-	6.46	-	8.76	-	-	-	17.04	1.89	Low	Definite
Centela asiatica	15.98	-	-	3.32	-	-	-	-	-	15.98	1.78	Low	Definite
Desmodium heterophylla	5.36	-	-	7.95	-	-	-	-	-	13.31	1.48	Low	Definite
Crotalaria anagyroides	9.23	-	-	-	-	-	-	-	-	9.23	1.03	Low	Definite
Zyzipus rotundifolia	2.22	-	-	7.04	-	-	-	-	-	9.26	1.03	Low	Definite
Malvaviscus arboreus	-	-	-	-	-	-	7.10	-	-	7.10	0.79	Low	Definite
Acacia leprosula	1.68	2.95	-	1.08	-	-	1.27	-	-	6.98	0.78	Low	Definite
Mimosa pudica	2.07	-	-	13.10	-	-	4.41	-	-	6.48	0.72	Low	Definite
Cleome rutidosperma	1.49	-	-	4.73	-	-	-	-	-	6.22	0.69	Low	Definite
Triumfetta bartramia	6.12	-	-	-	-	-	-	-	-	6.12	0.68	Low	Definite
Leucaena leucocepala	1.64	-	-	3.24	-	-	-	-	-	4.88	0.54	Low	Definite
Desmodium triflorum	4.34	-	-	-	-	-	-	-	-	4.34	0.48	Low	Definite
Eupatorium prostrata	4.21	-	-	-	-	-	-	-	-	4.21	0.47	Low	Broad
Panicum repens	4.03	-	-	-	-	-	-	-	-	4.03	0.45	Low	Broad
Calotropis gigantean	0.98	-	-	2.30	-	-	-	-	-	3.28	0.36	Low	Definite
Dichantium aristatum	2.98	-	-	-	-	-	-	-	-	2.98	0.33	Low	Definite
Hedyotis corymbosa	2.87	-	-	-	-	-	-	-	-	2.87	0.32	Low	Definite
Clidemia hirta	2.67	-	-	-	-	-	-	-	-	2.67	0.30	Low	Definite
Digitaria ciliaris	2.60	-	-	-	-	-	-	-	-	2.60	0.29	Low	Definite
Eragrostis tenella	2.29	-	-	-	-	-	-	-	-	2.29	0.25	Low	Definite
Mimosa invisa	2.10	-	-	-	-	-	-	-	-	2.10	0.23	Low	Definite
Clitoria ternatea	1.84	-	-	-	-	-	-	-	-	1.84	0.20	Low	Definite
Phyllantus urinaria	1.76	-	-	-	-	-	-	-	-	1.76	0.20	Low	Definite
Leucas lavandulaefolia	1.34	-	-	-	-	-	-	-	-	1.34	0.19	Low	Definite
Solanum torvum	1.52	-	-	-	-	-	-	-	-	1.52	0.17	Low	Definite
Physalis angulata	1.47	-	-	-	-	-	-	-	-	1.47	0.16	Low	Definite
Cynodon dactylon	1.47	-	-	-	-	-	-	-	-	1.47	0.16	Low	Definite
Eleusine indica	1.46	-	-	-	-	-	-	-	-	1.46	0.16	Low	Definite
Emilia sonchifolia	1.44	-	-	-	-	-	-	-	-	1.44	0.16	Low	Definite
Cayanus cayan	1.44	-	-	-	-	-	-	-	-	1.44	0.16	Low	Definite
Casia siamea	1.37	-	-	-	-	-	-	-	-	1.37	0.15	Low	Definite
Salvia riparia	1.37	-	-	-	-	-	-	-	-	1.37	0.15	Low	Definite
Polygonum javanicum	1.35	-	-	-	-	-	-	-	-	1.35	0.15	Low	Definite
Cyperus pygmaeus	1.33	-	-	-	-	-	-	-	-	1.33	0.15	Low	Definite
Cyperus rotundus	1.32	-	-	-	-	-	-	-	-	1.32	0.15	Low	Definite
Imperata cylindrical	1.31	-	-	-	-	-	-	-	-	1.31	0.15	Low	Definite
Crassocepalum crepidiodes	1.30	-	-	-	-	-	-	-	-	1.30	0.14	Low	Definite
Azadirachta indica	0.97	-	-	-	-	-	-	-	-	0.97	0.11	Low	Definite
Echinocloa colonum	0.98	-	-	-	-	-	-	-	-	0.98	0.10	Low	Definite
Important Value (IV)	300	300	300	300	300	300	300	300	300	2700	300	-	-
Index of Species Diversity (H')	2.756	2.342	1.150	2.532	1.267	1.151	1.347	1.208	1.150	- -		-	-
Index of Species Evenness (e)	1.785	1.733	1.095	1.548	1.121	1.087	1.137	1.107	1.095	-	-	-	-

Note: SBK0 = Savana of Bekol without *A. nilotica* stands, SBK1 = Savanna Bekol with the density of *A. nilotica* 1500-3000 trees/ha, and SBK2 = Savana Bekol with the density of *A. nilotica* > 3000 trees/ha. SKR0 = Savanna Kramat without *A. nilotica* stands, SKR1 = Savana Kramat with the density of *A. nilotica* 1500-3000 trees/ha, and SKR2 = Savana Kramat with the density of *A. nilotica* > 3000 trees/ha . SBL0 = Savana Balanan without *A. nilotica* stands , SBL1 = Savana Balanan with the density of *A. nilotica* 1500-3000 trees/ha, and SBL2 = Savana Balanan with the density of *A. nilotica* > 3000 trees/ha. Categories: Important Value: High (> 28,38), Moderate (14.19-28.38), and Low (< 14.19). Broad Distribution if the species can be found at any station. Index of Species Diversity by Shonnon-Wiever (H'): Categories: High (H' > 3), Moderate (H' 2-3, and Low (H' < 2). e = Index of Species Evenness

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