

Population Dynamics of Banteng, Buffalo and Deer in Bekol Savannah, Baluran National Park

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Received: 14th January 2009. Accepted: 17th May 2009.

ABSTRACT

Baluran National Park give contribution at regional development to draw tourist and fascination provided is savannah in area. Savannah circumstance, forest, landscape, climate, vegetation and wild animal is represent experienced attraction. Research method use population dynamics perception of banteng, buffalo and deer in savannah of Bekol year 2004 and year 2005 as primary data, while secondary data year population dynamics 2003, 2004, and year 2005 outside savannah of Bekol, year population dynamics 2003 in savannah of Bekol. Secondary data obtained from daily report of Controller ecosystem Forest Worker animal discovery Baluran National Park from Section Bekol. Research location of outside savannah Bekol were Balanan, Perengan, Bitakol, Karangtekok, Pandean, Pondok jaran, Bama, Curah uling, Gunung Montor, Lempuyang, Bilik, Batangan, Labuhan Merak, Kramat, Semiang, Sirokoh, Lemah bang, Gunung Krasak, and Glengseran. The populations of banteng and buffalo in the savannah were unstable compared to the populations of them outside Bekol savannah. The populations of banteng and buffalo in Bekol savannah decreased, whereas the populations of them outside the Bekol savannah increased. The population of deer in Bekol savannah in 2004 was better than population of 2003, 2005, and 2006, whereas the population of deer outside Bekol savannah in 2006 increase significantly. The populations of banteng, buffalo, and deer decreased from year to year, in which the reductions of banteng and buffalo populations were obviously significant.

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Key words: banteng, buffalo, deer, Bekol savannah, Baluran National Park.

INTRODUCTION

Indonesia is one of countries which have not professionally developed the potentials of wildlife either for the purpose of export, hunting or recreations in the national park. The circumstances are connected to current government policies (Alikodra, 1983). The national park gives a contribution to regional development in order to increase the tourist attendance. Savannah circumstances, forest, landscape, climate, vegetation, and wildlife are natural attractions. An everlasting conception of tourism development is designed to manage tourist, growth, conditions which do not destroy attractions and also to create tourist objects. Visitors and also attractions remain to be taken care by preserving the permanency of the tourist objects and by developing high awareness of the tourists. The savannah is destined to manage totally disappeared endangered, vulnerable animals by protecting natural ecosystem,

grazing or browsing wildlife which represent important target. This matter can be used for research purpose for example wildlife behavior, wildlife interactions, and source of germplasm used livestock breeding. Management of savannah that guaranteed the continuity life of endangered species, and vulnerable animals is one of the bio-diversity conservation (MacKinnon et al., 1988). Biodiversity is an expression of the existence of miscellaneous variations of the forms, presentations, number and characteristics which are clearly seen in the level of social interaction, ecosystem, species, and genetics (Sastrapradja et al., 1989).

Problems in management of savannah are: (i) competitions between animal food plants and non-animal food plants, (ii) invasion of dominant exotic plants, (iii) competitions between crops due to water availability and soil nutrition, (iv) decrease of stamina vitality and movement activity of wildlife, and (v) low productivity of animal food (McIlroy, 1964).

Bekol savannah area is black young alluvial covering between 1500-2000 hectares (Alikodra, 1987). The success of Cervidae family living in a new habitat is due to the plasticity in devouring species of crops supplied in the habitat (Klein, 1985), and so other herbivore do *Acacia nilotica* Willd ex. Del

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dominates Bekol savannah (Saraswati, 2002; Djufri, 2004a,b, 2005). The population of *A. nilotica* in Bekol savannah from 1960 to 2005 continually increases, and brings to a climax in 1990 covering 464,882 hectares. *A. nilotica* aging more than 5 years decreases the diversity and biomass of herbage (Suhadi, 2008a,b), whereas the trampling of banteng, buffaloes, and deer increases the herb seed bank on the trample (Suhadi, 2003). The trampling by banteng decreases number of crops species around 38,88%, trampling by buffaloes decreases number of crops species around 27,27%, and trampling by deer decreases number of crops species around 18,18% (Suhadi, 2004).

Bekol savannah is habitat of wildlife for example banteng, buffaloes, and deer (Sabarno, 2002). The estimated amount of bantengs population was 16, buffaloes 338, and deers 400 (Santoso, 1984), whereas in Bama area bordering on Bekol savannah the population of bantengs is 72 (Alikodra, 1987). The interaction between bantengs and wild buffaloes in Baluran National Park, East Java impact the dynamic population of banteng (Ashby et al., 1986), therefore in 1985/1986 number of buffaloes which move to other areas is 635 (Report data on the distribution of buffaloes).

The purpose of this research are: (i) to carefully examine the dynamic population bantengs, buffaloes, and deers in the Bekol savannah or outside Bekol savannah, (ii) to carefully examine the population variables within 3 years which can be used to improve the wildlife management in Baluran National Park.

MATERIAL AND METHODS

The research used to calculate population is a concentrated method (Alikodra, 1989). The observation applied is the observation of bantengs, buffaloes, and deers populations in Bekol savannah in 2004 and 2005 as primary data, and the secondary data is the population of 2003, 2004, 2005, and 2006 in the area outside Bekol savannah, and the population of 2003 and 2006 in Bekol Bekol savannah. Locations outside Bekol savannah are Balanan, Perengan, Bitakol, Karangtekok, Pandean, Pondok Jaran, Bama, Curah Uling, Gunung Montor, Lempuyang, Bilik, Batangan, Labuhan Merak, Kramat, Semiang, Sirokoh, Lemahbang, Gunung Krasak and Glengseran (19 points of observation).

To compare the difference species of wildlife, location, and population dynamics of 2003, 2004, 2005 and 2006 used ANOVA and GenStat Release 4.24DE program.

RESULT AND DISCUSSION

The population of wildlife in 2003

The population of bantengs in May and June 2003 is 22, in August 11, and September 17. In January,

February, March, April, July, October, November, and December the population of bantengs in Bekol savannah was not found. The population of banteng in May, June, July, August, and September outside Bekol savannah is 23, 9, 22, 7, and 13 (Table 1). This condition was caused by the decline of rainy days which influence grass growth (Figure 1). According Lekagul et al. (1977) banteng has more characteristic of grazers than browsers and like open space. The appearance of banteng in Bekol savannah was low, namely 33% and the average monthly population was 6, outside the savannah 66% and the average monthly population is 7 (Table 1). Human activities may be done in Bekol savannah. In Bekol savannah is the habitat for wildlife which provides animal food, social communication protects/brings up, raises their children (Alikodra, 1983). Research of Suhadi (1996) indicates that in the location which has more human activities the bull has more guarding activities and less grazing activities, whereas bull has more grazing activities. Similar condition occurs in Bekol savannah which has a roadway going to Bama out savannah, through which the tourist go for a recreation in Baluran.

Population of buffaloes in Bekol savannah during 2003 remains stable, outside Bekol savannah in April and August 3 respectively (Table 1). In Baluran National Park buffaloes are found mostly in water mudholes. In Bekol savannah the mudholes were dry, water mudholes were only found side of Bekol savannah and outside Bekol savannah. The buffaloes like open forest or meadow/grass place (Lekagul et al., 1977). The home range of buffaloes in Australia consist of forest, savannah, muddy area, well, mineral salt (Tulloch, 1978). The population of buffaloes in 1984 reaches 1293 and decreased from year to year and in 1999, 11 were still left. Buffaloes brought illegally to the outside of Baluran National Park from 1980/1981 fiscal year to 1998/1999 fiscal year were 731.

The population of deers in Bekol savannah in May, June, August, and September are 114, 206, 154, and 172 respectively. The population of deer outside Bekol savannah from April to December the highest in April reaches 238 (Table 1). From May to December the group of deer becomes divided equally. The average population from May to December was 66 per month. There was no rain from July to October (Figure 1). The amount of deer in Bekol savannah in August and September are 154 and 172 respectively (Table 1). The population of deer in Bekol savannah in the dry season remains high because most of the animal food was obtained by browsing *A. nilotica*. Grazing done excessively by wildlife will reduce fire and invasion of wooden crops (Bucher, 2000). The population of deer in Bekol savannah may help distribution of *A. nilotica*.

LSD 5% test shows that the bantengs and buffaloes populations in the savannah compared to the population outside Bekol savannah indicate no significant difference. Similarly, the population of banteng and deer in the savannah compared to

outside Bekol savannah indicates no significant difference, but the deers, bantengs, and buffaloes shows no significant difference (Table 2 and 3). The interaction between location of banteng and location of buffalo shows no significant difference, whereas the location of deer indicates significant difference. This condition shows that the area of Bekol savannah 420 hectares and the area outside of Bekol 9600 hectares with total number of banteng and buffalo may provide enough room for home range and may have animal food. Interaction location of deer obviously differs because deer have wider home range than home range of banteng and buffalo at the same time.

The population of wildlife in 2004

The population of banteng reaches the peak in July in the amount of 30, but in October, November, and December no banteng is found (Table 1). The average population of banteng in Bekol savannah 8, the presence frequency was 75% per month, whereas outside Bekol savannah 4 and the presence frequency was 83% per month. In October 2004 no banteng is found either outside Bekol savannah. This October is the peak of dry season (Figure 2). Grass in the savannah mostly dry therefore banteng go into the forest (Lekagul et al., 1977). In 2004 the presence

frequency of bantengs is 75% whereas the presence frequency in 2003 is only 33%. There are three dry months in 2004 namely August, September, and October, whereas in 2003 there are 4 dry months, namely July, August, September, and October (Figure 1A and 1B). The short dry months in 2004 Bekol savannah provides sufficient animal food so the presence frequency of in 2004 is higher than the presence frequency in 2003.

The population of buffalo in Bekol savannah in March, July, August, and September 2004 are 5, 46, 31, and 31. The monthly average population is 10 and presence frequency 33%. The population outside Bekol savannah in March and September in the same year is 1 and 4 respectively (Table 1). The average population of buffalo per month is less than 1 and the presence frequency 16%. The average population of buffalo per month in Bekol savannah is higher than the population outside Bekol savannah. According to Tulloch (1978) buffaloes browsing dry crop leaves. The presence of buffaloes in Bekol savannah is higher the occurrence outside the savannah. If we compare the 2003 and 2004 data the presence of buffaloes increase from 0% to 33%. This condition is caused by the rainfall; in 2004 there are 3 dry months, whereas in 2003 there are 4 dry months, whereas in 2003 there are 4 dry months (Figure 1B).

Table 1. Population of wildlife in the savannah and outside Bekol savannah, Baluran National Park 2003, 2004, 2005, and 2006.

Months	2003						2004						2005						2006					
	In the savannah			Outside the savannah			In the savannah			Outside the savannah			In the savannah			Outside the savannah			In the savannah			Outside the savannah		
	Banteng	Buffalo	Deer	Banteng	Buffalo	Deer	Banteng	Buffalo	Deer	Banteng	Buffalo	Deer	Banteng	Buffalo	Deer	Banteng	Buffalo	Deer	Banteng	Buffalo	Deer	Banteng	Buffalo	Deer
January	0	0	0	0	0	0	7	0	55	4	0	139	14	1	74	2	1	139	0	0	0	3	13	210
February	0	0	0	0	0	0	2	0	36	3	0	62	0	0	0	0	4	57	1	0	0	2	13	158
March	0	0	0	0	0	0	5	5	245	5	1	11	1	1	190	1	5	207	0	0	0	3	13	168
April	0	0	0	6	3	238	6	0	79	26	0	135	3	2	242	0	2	68	0	0	73	3	13	36
May	22	0	114	23	0	31	3	0	102	0	0	39	0	22	9	2	40	9	0	0	2	3	13	395
June	22	0	206	9	0	59	8	0	92	6	0	65	1	0	70	3	0	36	0	0	0	3	13	219
July	0	0	0	22	0	43	36	46	112	3	0	161	2	13	50	1	0	56	2	10	0	1	3	311
August	11	0	154	7	3	47	17	31	60	1	0	77	3	6	0	0	7	290	1	6	0	2	7	213
September	17	0	172	13	0	33	4	18	116	4	4	26	1	0	0	2	13	360	1	6	0	2	7	321
October	0	0	0	1	0	74	0	0	0	0	0	29	0	0	0	3	13	397	3	2	0	0	11	217
November	0	0	0	4	0	4	0	0	90	1	0	46	3	2	0	0	11	211	3	0	0	0	13	58
December	0	0	0	0	0	62	0	0	0	2	0	65	1	0	0	2	11	211	1	0	0	2	13	68

Table 2. Variance analysis of wildlife population in the savannah and outside Bekol savannah Baluran National Park 2003, 2004, 2005, and 2006.

Source of variation	2003					2004					2005					2006				
	d.f.	s.s.	m.s.	v.r.	F. pr.	d.f.	s.s.	m.s.	v.r.	F. pr.	d.f.	s.s.	m.s.	v.r.	F. pr.	d.f.	s.s.	m.s.	v.r.	F. pr.
Location	1	18	18	0,01	0,921	1	939	939	0,84	0,363	1	29322	29322	6,87	0,011	1	81272	81272	37,54	<0,001
Species	2	37563	18782	210,45	<0,001	2	82017	41008	36,74	<0,001	2	184646	92323	21,63	<0,001	2	154095	77047	35,59	<0,001
Location_Species	2	117	58	0,03	0,968	2	209	104	0,90	0,911	2	53203	26601	6,23	0,004	2	139445	69723	33,20	<0,001
Replication	11	23276	2116	1,18		11	14924	1357	1,22		11	29039	2640	0,62		11	19191	1745	0,81	
Residual	55	98865	1798			55	61387	1116			55	234758	4268			55	119079	2165		
Total	71	159840				71	159476				71	530969				71	513082			

Table 3. Test of LSD 5% of wildlife population in the savannah and outside Bekol savannah Baluran National Park 2003, 2004, 2005, and 2006.

Source of variation		2003	2004	2005	2006
		Average	Average	Average	Average
Location	Bekol savannah	19,9 ^a	32,6 ^a	19,8 ^b	3,1 ^b
	Outside Bekol savannah	18,9 ^a	25,4 ^a	60,1 ^a	70,3 ^a
Species	Banteng	6,5 ^a	6,0 ^b	1,9 ^b	1,5 ^b
	Buffalo	0,3 ^a	4,4 ^b	6,4 ^b	6,5 ^b
	Deer	51,5 ^b	76,7 ^a	111,5 ^a	102,0 ^a
	Location_Species				
	Bekol savannah_Banteng	6,0 ^a	7,3 ^b	2,4 ^b	1,0 ^b
	Bekol savannah_Buffalo	0,0 ^a	8,3 ^b	3,9 ^b	2,0 ^b
	Bekol savannah_Deer	53,8 ^b	82,2 ^a	52,9 ^a	6,2 ^b
	Outside Bekol savannah_Banteng	7,1 ^a	4,6 ^b	1,3 ^b	2,0 ^b
	Outside Bekol savannah_Buffalo	0,5 ^a	0,4 ^b	8,9 ^b	11,0 ^b
	Outside Bekol savannah_Deer	49,2 ^b	71,2 ^a	170,1 ^a	97,8 ^a

Note: Figure followed by the same character in the column indicated no significant differences on LSD 5% test

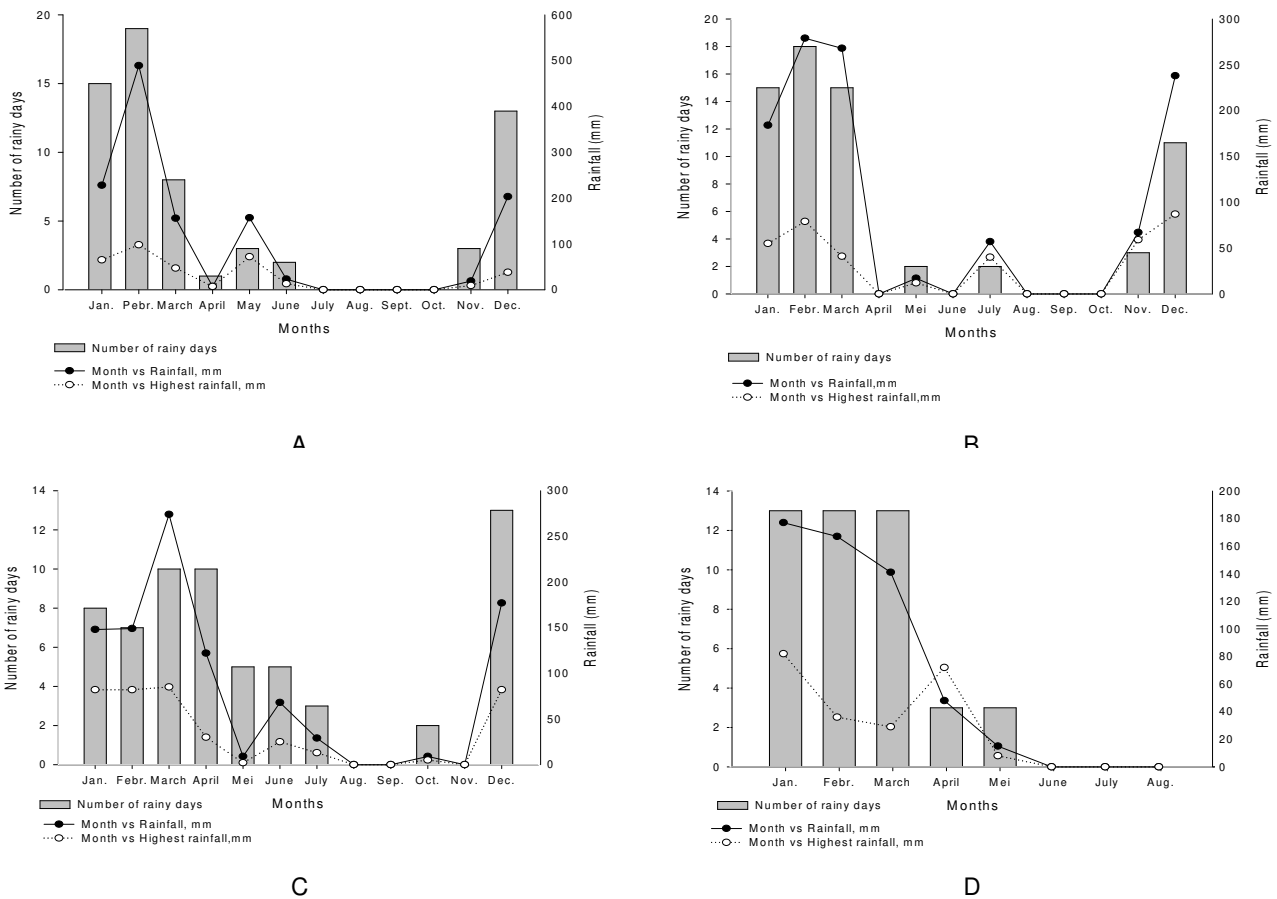


Figure 1. Distribution of rainfall in Baluran National Park. A. 2003, B. 2004, C. 2005, D. 2006.

The monthly average population of deer in Bekol savannah in 2004 is 72 and the presence frequency 83%, outside savannah is 71 and the presence frequency 100% (Table 1). The presence of deer outside savannah is higher than in the savannah because of the evenly spread of animal food even skin, leaves, and crown of *A. nilotica* are browsed by the deer. The exploration of deer in very short time is higher than those of banteng and buffalo, therefore

deer can easily move from one place to another in very short time. In August, September, and October in 2004 there is no rain (Figure 2), and November there are 3 amounts of rain and the amount of rainfall is 67 mm. In December 2004 herbage in Bekol savannah is grown over but does not spread evenly. In October and December 2004 no deer was found because the spread of herbage was uneven and the movement of deer to search for food is high enough. Outside Bekol

savannah the presence frequency of the deer is 100% because herbage can be still be found at the location close by the well.

Based on LSD 5% test of the locations in the savannah and outside Bekol savannah in 2004 indicate no significant difference. The population of deer compared to the population of banteng and buffalo indicates significant difference (Table 1 and 2). The interaction of banteng location and buffalo location shows difference, but interaction of deer location indicates significant difference (Table 3). The condition of 2003 population and 2004 population remain stable.

The population of wildlife in 2005

The population of banteng in Bekol savannah the highest in January 2005 number in 14 with the monthly average population is 2, whereas outside Bekol savannah is 1 (Table 1). The amount of rainfall from January to June 2005 is 7-274 mm (Figure 1C). The condition indicated that Bekol savannah has sufficient animal food and water availability, but the presence frequency of banteng is only 66,66%. It happen because of human activity disturbance consequently the amount of banteng from year to year degrades. If we make a comparison, the monthly average number of banteng outside Bekol savannah is higher than the number in the savannah. According to Alikodra (1989) the ideal banteng environment composition are, (i) primary forest border on meadow as shelter to protect them from predator attack, a place to sleep and take a stand a place to breed and (ii) coast forest or tidal forest which has a function as a buffer zone, consisting wind shield, to prevent it from salt intrusion and a shelter or place to take a rest, a place to hunt for food and also to avoid banteng hunter entering forest preserve from the sea. The presence frequency of banteng in the savannah and outside Bekol savannah remains low which enable banteng to take shelter in the primary forest or tidal forest.

The highest population of buffalo in Bekol savannah in 2005 is in May amounting to 22 and monthly average population is 4 and the presence frequency is 66.66%. Outside Bekol savannah the highest population is 40, the monthly average population is 8 and presence frequency 16.66% (Table 1). The population of buffalo outside savannah is higher because well can still be found in the savannah. In May rainfall is 9 mm, number of rainy days is 2 and the highest rainfall is 5 mm (Figure 1C). In May number of buffalo in Bekol savannah degrades. It shows that the quantity of water decreases so the buffaloes in the savannah can only be found water stream and mudholes. Outside Bekol savannah a lot of water stream can still be found thus the population of buffaloes in May reaches 40.

The population of deer in Bekol savannah in 2005 the high in April reaches 242, and monthly average population is 52 and the presence frequency is 50%.

The population of deer outside Bekol savannah the highest in October is 397, monthly average population is 86 and presence frequency is 100% (Table 1). The average population of deer per month in Bekol savannah is higher than outside savannah because herbage is sufficient enough for the need of deer and deer activities are not disturbed by human activities. In May the population of deer in the savannah and outside of the savannah is very low because the amount of rainfall is 9 mm, number of rainy days are 2, and the highest rainfall is 5 mm (Figure 1C) lower than the rainfall in another months. Rainfall of 5 mm per month after 14 days increases the growth of herb up to 52%, whereas rainfall of 132 mm per month will increase herb up to 70% (McIvor and Gardener, 1985). In January, February, March 2004 the monthly rainfall is high, but number of deer fluctuates, it is likely that number of deer in the savannah does not depend on the grass supply.

Base on LSD 5% test, the location in the savannah and outside Bekol savannah in 2005 indicated significant difference. The population of banteng and buffalo differ significantly (Table 2). The interaction among location of banteng and location of buffalo and location deer differ significantly (Table 3).

The population of wildlife in 2006

The population of banteng in 2006 in Bekol savannah the highest in October and November is 3 and monthly average population less than 1, whereas outside of the savannah of Bekol is 2 (Table 1). Number of rainfall from January to June is between 15 and 177 mm (Figure 1D). Such condition indicates that Bekol savannah has sufficient water for the need of herbage. The low presence frequency of bantengs which is only 58.33% is caused by human activities; therefore number of banteng from year to year degrades. If we make a comparison, the monthly average number of banteng in the savannah is lower than the number of banteng outside of Bekol savannah because of the significant difference between the existence of forest and the savannah. The presence frequency of bantengs in the savannah and outside the Bekol savannah is still low because banteng possibly takes a shelter in primary forest and tidal forest. In 2006 number of banteng population is lower than the number of bantengs population in 2005, it is possible that banteng is in a place outside the points of observation.

The highest population of buffalo in Bekol savannah takes place in July amounting to 10 and monthly average population is 2 and the presence frequency is 33,33%. The highest population of buffalo outside Bekol savannah is 13, and the monthly average population is 11 and the presence frequency is 100,00%. The population of buffalo outside the savannah is higher because many wells can still be found there. In May number of rainfall is 15 mm, number of rain days are 3 and the highest rainfall is 8 mm (Figure 1D). In May number of buffalo is high

Table 4. LSD test 5% population of wildlife in the savannah and outside Bekol savannah Baluran National Park 2003, 2004, 2005, and 2006.

	Source of variation	Average
Location	Bekol savannah	18.9 ^b
	Outside Bekol savannah	43.7 ^a
Species	Banteng	4.0 ^b
	Buffalo	4.4 ^b
	Deer	85.5 ^a
Year	2003	19.4 ^b
	2004	29.0 ^{ab}
	2005	39.9 ^a
	2006	36.7 ^a
Location_ Species	Bekol savannah_Banteng	4.2 ^c
	Bekol savannah_Buffalo	3.6 ^c
	Bekol savannah_Deer	48.8 ^b
	Outside the savannah_Banteng	3.7 ^c
	Outside the savannah_Buffalo	5.2 ^c
	Outside the savannah_Deer	122.1 ^a
Location_ Year	Bekol savannah_2003	19.9 ^{bc}
	Bekol savannah_2004	32.6 ^c
	Bekol savannah_2005	19.7 ^{bc}
	Bekol savannah_2006	3.1 ^b
	Outside Bekol savannah_2003	18.9 ^{bc}
	Outside Bekol savannah_2004	25.4 ^c
	Outside Bekol savannah_2005	60.1 ^a
	Outside Bekol savannah_2006	70.3 ^a
Species_ Year	Banteng_2003	6.5 ^c
	Buffalo_2003	0.3 ^c
	Deer_2003	51.5 ^b
	Banteng_2004	6.0 ^c
	Buffalo_2004	4.4 ^c
	Deer_2004	76.8 ^b
	Banteng_2005	1.9 ^c
	Buffalo_2005	6.4 ^c
	Deer_2005	111.5 ^a
	Banteng_2006	1.5 ^c
	Buffalo_2006	6.5 ^c
	Deer_2006	102.0 ^{ab}
Location_ Species_ Year	Bekol savannah_Banteng_2003	6.0 ^{cc}
	Bekol savannah_Banteng_2004	7.3 ^c
	Bekol savannah_Banteng_2005	2.4 ^c
	Bekol savannah_Banteng_2006	1.0 ^c
	Bekol savannah_Buffalo_2003	0.0 ^c
	Bekol savannah_Buffalo_2004	8.3 ^c
	Bekol savannah_Buffalo_2005	3.9 ^c
	Bekol savannah_Buffalo_2006	2.0 ^c
	Bekol savannah_Deer_2003	53.8 ^b
	Bekol savannah_Deer_2004	82.2 ^b
	Bekol savannah_Deer_2005	52.9 ^b
	Bekol savannah_Deer_2006	6.3 ^c
	Outside Bekol savannah_Banteng_2003	7.1 ^c
	Outside Bekol savannah_Banteng_2004	4.6 ^c
	Outside Bekol savannah_Banteng_2005	1.3 ^c
	Outside Bekol savannah_Banteng_2006	2.0 ^c
	Outside Bekol savannah_Buffalo_2003	0.5 ^c
	Outside Bekol savannah_Buffalo_2004	0.4 ^c
	Outside Bekol savannah_Buffalo_2005	8.9 ^c
	Outside Bekol savannah_Buffalo_2006	11.0 ^c
Outside Bekol savannah_Deer_2003	49.2 ^{bc}	
Outside Bekol savannah_Deer_2004	71.2 ^b	
Outside Bekol savannah_Deer_2005	170.1 ^a	
Outside Bekol savannah_Deer_2006	197.8 ^a	

which indicates that the quantity of water especially in savannah of Bekol degrades therefore buffaloes can only be found in the water stream can still be found therefore the population of buffalo in May reaches 13. From July to August number of buffalo degrades and so buffaloes possibly search for watery areas.

The population of deer in 2006 Bekol savannah the highest in April amounting to 73, monthly average population is 6 and presence frequency is 16,66%. The population of deer outside the savannah of Bekol the highest in May amounting to 395, monthly average population is 197 and the presence frequency is 100% (Table 1). The population outside the savannah per month is higher because animal food is sufficient for the need of deer and also the activities of deer are not disturbed by human activities. From January to December remains stable except in April and May the population number of deer are 73 and 2 respectively because *A. nilotica* are chop down in the population of deer in Bekol savannah.

Based on LSD 5% test locations in the savannah and outside Bekol savannah in 2006 indicate significant differences (Table2). The population of deer, banteng, and buffalo are significantly different. The interaction among banteng, buffalo, and deer outside Bekol savannah show significant differences (Table 3). This condition is caused by the frequent chop down of *A. nilotica* in Bekol savannah. Based on LSD 5% test locations in the savannah and outside of the savannah of Bekol 2003, 2004, 2005, and 2006 indicate significant differences. During 4 years the population of wildlife outside Bekol savannah is better than population in the savannah. In 2003, 2004, 2005, and 2006 the population of the banteng and buffalo differ significantly (Table 3 and 4). During 4 years the population of deer is better than the population of banteng and buffalo. The population of deer in Bekol savannah in 2004 is the best population of all 2003, 2005, 2006 population, whereas outside Bekol savannah the 2006 population of deer is the best. During 4 years the populations of banteng and buffalo in Bekol savannah decline, on the contrary the populations of banteng and buffalo outside Bekol savannah increase although LSD 5% test shows no significant differences (Table 4).

CONCLUSION AND SUGGESTION

The populations of banteng and buffalo in the savannah are unstable compared to the populations of them outside Bekol savannah. The populations of banteng and buffalo in Bekol savannah decrease, whereas the populations of them outside the Bekol savannah increase. The population of deer in Bekol savannah in 2004 is better than population of 2003, 2005, and 2006, whereas the population of deer outside Bekol savannah in 2006 increase significantly. The populations of banteng, buffalo, and deer decrease

from year to year, in which the reductions of banteng and buffalo populations are obviously significant. Bekol savannah has not yet attracted the wildlife to graze. The wildlife especially banteng are annoyed by human being activities, roadway heading to Bama beach which also cuts Bekol savannah which disturbs the movement of wildlife requires to be studied furthermore, the direction of roadway which cuts the savannah should be changed to the outskirts of savannah. The low frequency of banteng and buffalo in Bekol savannah is due to the fact that the savannah has not fulfilled the criteria for banteng and buffalo to live in for example, human being activities which annoy them, insufficient limited number of herbage for their food and availability of water. Qualitative research should be done to verify the exact number of wildlife smuggled outside of Baluran National Park because number of wildlife which are died, missing, and given to the retired government officials are not properly recorded without any officials report.

REFERENCES

- Alikodra, H.S. 1983. *Ekologi Banteng (Bos javanicus d'Alton) di Taman Nasional Ujung Kulon*. [Disertasi]. Bogor: Fakultas Pascasarjana Institut Pertanian Bogor.
- Alikodra, H.S. 1987. Tanaman eksotik akasia (*Acacia nilotica*) dan masalahnya bagi ekosistem savana di Taman Nasional Baluran. *Duta Rimba* 79-80 (13): 30-34.
- Alikodra, H.S. 1989. *Pengelolaan Satwaliar*. Bogor: Fakultas Kehutanan, Institut Pertanian Bogor.
- Ashby, K.R. and C. Santiapillai. 1986. The Ecology of Free Living Water Buffalo (*Bubalus bubalis* L.) in Sri Lanka and with Particular Reference to Ruhuna National Park. *Tigerpaper* 10 (11): 20-26.
- Bucher, E.H. 2000. Chaco and Caatinga-South American Arid Savannas, Woodlands and Thickets. In: Huntley, B.J. and B.H. Walker (ed). *Ecology of Tropical Savannas*. Berlin: Springer-Verlag.
- Djufri. 2004a. Invasi spesies eksotik akasia berduri (*Acacia nilotica*) (L.) Willd ex Del. di Taman Nasional Baluran Jawa Timur: ancaman terhadap eksistensi savana. *ENVIRO* 4 (2): 88-99.
- Djufri. 2004b. *Acacia nilotica* (L.) Willd. ex Del. dan permasalahannya di Taman Nasional Baluran Jawa Timur. *Biodiversitas* 5 (2): 96-104.
- Djufri. 2005. Pola distribusi dan asosiasi tumbuhan bawah pada tegakan akasia (*Acacia nilotica*) (L.) Willd. ex Del. di Savana Kramat Taman Nasional Baluran Jawa Timur. *ENVIRO* 5 (1): 48-54.
- MacKinnon, J., K. MacKinnon, G. Child, and J. Thorsell (eds). 1988. *Managing Protected Areas In the Tropics*. Gland, Switzerland: International Union for Conservation of Nature and Natural Resources.
- McIlroy, R.J., 1964. *An Introduction to Tropical Grassland Husbandry*. London: Oxford University Press.
- Klein, D.R. 1985. Population ecology the interaction between deer and their food supply in biology of deer production. *Bulletin New Zealand* 22: 23-32.
- Lekagul, B. and J.A. McNeely. 1977. *Mammals of Thailand*. Bangkok: Sahakarnbhat Co.
- Mclvor, J.G. and C.J. Gardener. 1985. Germination of introduced pasture species in the semi-arid tropics. In: Tothill, J.C. and J.J. Mott (eds). *Ecology and Management of the World's Savannas*. Canberra: The Australian Academy of Science.
- Sabarno. 2002. Savana Taman Nasional Baluran. *Biodiversitas* 3 (1): 207-212.
- Santoso, N. 1984. *Studi Populasi Banteng dan Kerbau Air di Padang Pengembalaan Bekol Taman Nasional Baluran*. [Skripsi]. Bogor: Fakultas Kehutanan Institut Pertanian Bogor.
- Saraswati, A. 2002. Daya dukung Savana Bekol terhadap keberadaan rusa timor (*Cervus timorensis*). *Prosiding Seminar Nasional Taman Nasional Baluran I*. Jember, 11 Agustus 2002.
- Sastrapradja, D.S., S. Adisoemarto, K. Kartawinata, S. Sastrapradja, dan M.A. Rifai. 1989. *Keanekaragaman Hayati untuk Kelangsungan Hidup Bangsa*. Bogor: Puslitbang Bioteknologi LIPI
- Suhadi. 1996. *Perilaku Banteng (Bos javanicus d'Alton) di Padang Pengembalaan Sadengan Taman Nasional Alas Purwo*. [Tesis]. Jakarta: Program Pascasarjana Universitas Indonesia.
- Suhadi. 2003. Seeds bank dispersal on trampled by banteng (*Bos javanicus* d'Alton), water buffalo (*Bubalus bubalis*), large deer (*Cervus timorensis*) in the Baluran National Park. *AGRITEK* 11 (3): 469-476.
- Suhadi. 2004. Sebaran tumbuhan bawah bekas injakan banteng (*Bos javanicus* d'Alton), kerbau liar (*Bubalus bubalis*), dan rusa (*Cervus timorensis*) di Taman Nasional Baluran. *Biota* 9 (2): 78-83.
- Suhadi. 2008a. *Kajian Invasi Acacia nilotica Willd ex. Del dan Injakan Satwa terhadap Diversitas dan Biomassa Herba di Savana Bekol Taman Nasional Baluran*. [Disertasi]. Malang: Program Pascasarjana Fakultas Pertanian Universitas Brawijaya.
- Suhadi. 2008b. Perkembangan tumbuhan *Acacia nilotica* Willd ex. Del di Savana Bekol Taman Nasional Baluran. *Prosiding Lokakarya Nasional Herbarium Seminar dan Kongres PTTI Ke VIII*. Cibinong-Bogor, 21-23 Oktober 2008.
- Tulloch, D.G. 1978. *The Water Buffalo (Bubalus bubalis) in Australia; Grouping and Home Range*. Melbourne: Australian Wildlife Research.