
Habitat overlap between banteng (*Bos javanicus javanicus*) and domestic cattle in Baluran National Park, East Java

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INTRODUCTION

Banteng (*Bos javanicus*), an Asian wild cattle, is considered the ancestor to domestic cattle in Southeast Asia (Nowak, 1991). Three subspecies of banteng are generally recognized: *B. javanicus javanicus* (Java and Bali), *B. javanicus lowi* (Borneo) and *B. javanicus birmanicus* (Asian mainland) (Lekagul and McNeely, 1977). With a total wild population estimated to number less than 8000, banteng is listed as "Endangered" on the IUCN Red-list (Gardner et al., 2016). In Java, banteng are primarily found in small isolated populations in reserves and protected areas with human settlements. There are only four habitats left with important banteng populations: Ujungkulon NP, Meru Betiri NP, Alas Purwo NP and Baluran NP.

Comparison between population data in 2002 and in 2006 indicated a dramatic decline of banteng in Baluran NP. This was clearly reflected in the age structure of the population in 2002. The confirmed sub-adults numbered only 10 (8%) a total of 126 individuals (Pudyatmoko et al, 2007). Sabarno (2007) suggested that limited water supply, habitat changes and illegal hunting were the main causes for the population decline in Baluran NP.

Baluran's dry season spans over eight months with the rainy season peaking during December - January. There are only a few permanent waterholes

in Baluran NP. The crater of Mount Baluran NP gives rise to a permanent spring that delivers a steady stream of high quality water throughout the year. It is, however, difficult to access by large herbivores. A few waterholes are located near the sea with poor quality water and the limited number of permanent good quality waterholes in Baluran NP makes it an ongoing management challenge.

In addition to the water scarcity, large ungulates also faced decreasing quality pastures, due to the ongoing spread of the invasive African acacia, *Acacia nilotica*. This fast growing tree was introduced in the late 1960s and, without natural predators, it has spread across much of the once large tracts of open savannah as well as patches of woodland savannah. In total, the spread of *Acacia nilotica* has reduced the savannah area with more than 50% from total area of 10,000 hectares. The significant decline of main grazing grounds resulted in nutrients deficiency for many herbivores in the peak of dry season. Although poaching has decreased in the past decade, illegal hunting continue to take a toll on Baluran's banteng population. The park management has recorded 11 banteng killed by hunters in the past decade, with many more unknown killings that were never recorded.

In spite of these serious setbacks, the most critical threat to their long-term survival have emerged from an increasing number of livestock in the park. Wind and Amir (1977) reported that banteng was abundant in the northern parts of Baluran NP in the late 1970s. At the change of the millennium

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the presence of illegal cattle herders continued to increase (Sabarno, 2002), to the extent that it changed the banteng distribution on the north side of Mount Baluran. In 2000, banteng was reportedly absent from this area (Anonim, 2000). In 2016, it was estimated that approx. 3000 heads of cattle graze in Baluran NP every day (Rademaker et al., 2017).

The presence of domestic cattle followed the human settlements inside Baluran NP, specifically at Labuhan Merak and Gunung Masigit. The communities have resided in this area since 1975, when this area was managed by PT. Gunung Kumitir as a plantation area. Lack of coordinated intervention by government authorities has resulted in land tenure conflicts that have become increasingly difficult to settle. Ex-plantation workers continue to live in this area although their permits, Hak Guna Usaha (HGU) for PT Gunung Kumitir, expired in year 2000. The number of settlers increased significantly during the period 1986-2000 and continue to grow to this day. In 2009, there were 328 families with 1069 persons in these illegal settlements (Wianti 2013).

For banteng conservation, this poses a major risk to the long-term survival of the species. The interaction between domestic livestock and banteng have already resulted in transmission of diseases, such as nematodosis (Kurniawati et al., 2016). An outbreak of a more sinister type of disease can wipe out the entire banteng population within a short time. Furthermore, the competition for some of bantengs favourite grazing grounds with high quality pioneer grasses (Prosser et al., 2016) usually favours cattle, because banteng are exceptionally shy around human presence (Gardner, 2015).

This preliminary study aimed at assessing to which degree banteng and domestic cattle compete for grazing areas in Baluran National Park. This can have profound implication on banteng conservation, since they are known to shy away from human activities (Gardener, 2015), thereby loosing more vital grazing ground, or risk suffering a serious disease outbreak. This study forms part of a larger study on wildlife conservation in Baluran NP.

METHODS

A field survey was conducted from January - early December 2016 in an area measuring approx. 12,900 hectares. The area was divided into 1x1km grids, based on the park's Resort Based Management System already in use since 2009. Within each cell, signs of domestic cattle, including footprints, faeces and direct encounter were recorded. The location of domestic cattle detections were recorded using GPS (Garmin 64s). Surveys were conducted in habitat types preferred by herders due to optimal grazing grounds for their cattle, such as savannah and woodland savannah. A total of 120 camera trap were deployed in the survey area, to increase the possibility of banteng/cattle detection. The results were mapped and overlaid with a map of banteng occupancy in 2015 and 2016 (Wahyudi and Sutadi, 2015; 2016). The overlap area was estimated using ArcGIS 10.3.

To get information about the total cattle population, a rapid interview with cattle owners were conducted in every settlement. Banteng detection/non-detection data were analyzed to estimate site occupancy. Totally, 72% of surveyed area are occupied by banteng. However, domestic cattle were detected present in some locations where banteng also be present.

RESULTS

Domestic cattle were detected in 86 grid cells with an estimated total area of 7,766 hectares. The domestic cattle is mostly distributed near the border of national park and near the settlements inside Baluran NP at the northern side (Fig. 1). There are three groups of local villagers who shepherd domestic cattle; Wonorejo village at southern part of NP, Karangtekok village at north west part of NP and settlers who live inside NP at Labuhan Merak and Balanan at the northern side of NP. Villagers herd their cattle every morning to grazing areas and return in the afternoon. There are no fixed grazing locations, but it varies depending on availability of grass.

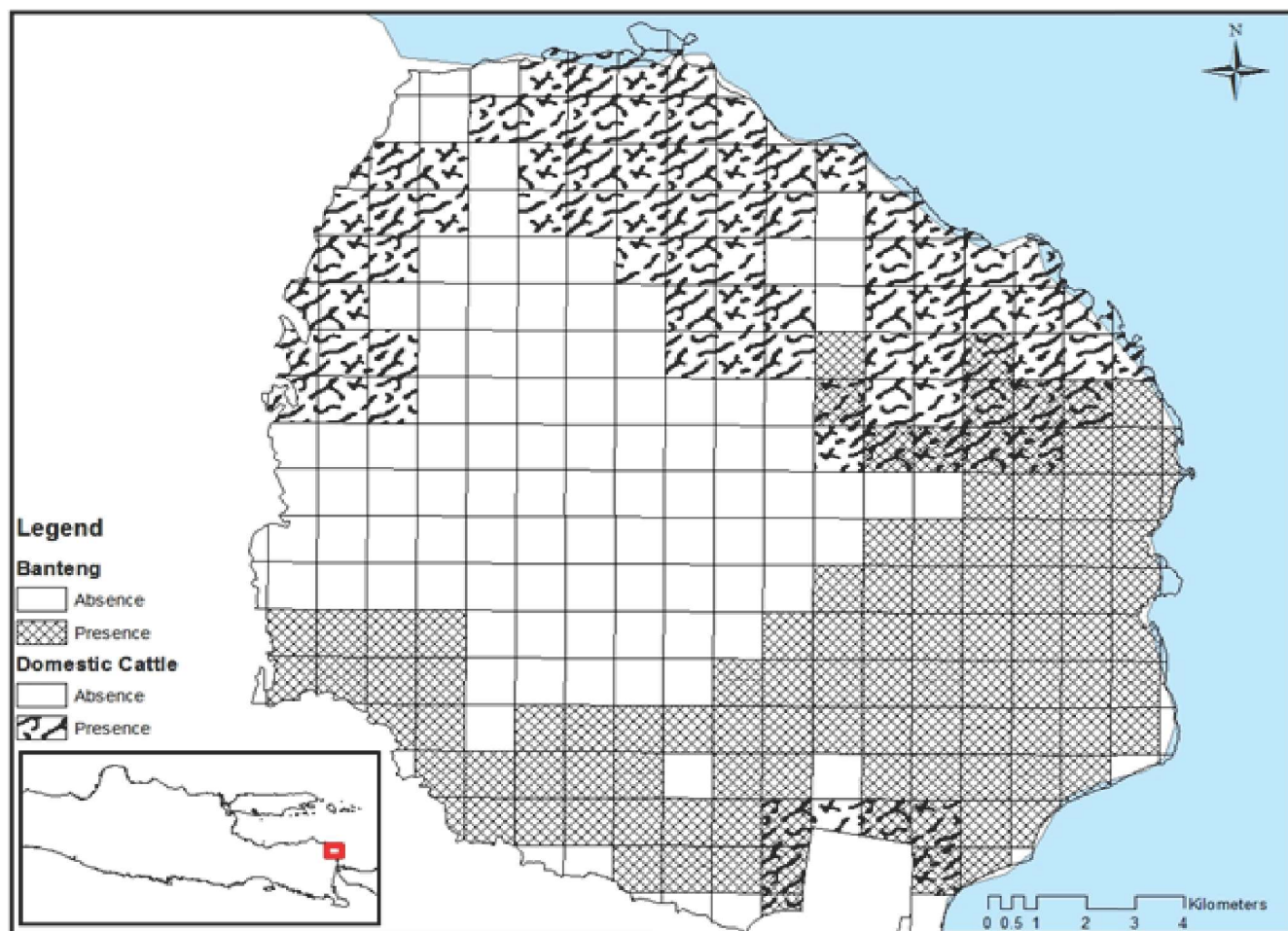


Figure 1. Distribution of banteng and domestic cattle in Baluran National Park. Cattle are present in almost a third of the park and overlap significantly with banteng in the north-eastern and southern sectors.

In the dry season, grazing area increased significantly and cattle were recorded deep inside Baluran NP, where there is plenty of good quality of grass. Furthermore, the limited amount surface water forced settlers to herd cattle further up towards the natural springs at Mount Baluran. Our analysis reveals that cattle used the same grazing areas as banteng in 14 grid cells, with a total area of 1,311 hectares. The habitat overlap is detected in the south as well as the north-eastern parts of Baluran NP (Fig.1). The number of domestic cattle

in Labuhan Merak and Balanan, two villages located inside Baluran NP, is 1496 (Tab.1). This only accounts for approx. half of the total number of cattle that graze the park. In addition to the cattle from Labuhan Merak and Balanan, many enter from villages adjacent to Baluran NP. The daily total number of cattle grazing inside the park is approx. 3000 heads, with 179 from Wonorejo village.

Table 1. The number of cattle in the two villages located inside Baluran National Park.

Village	Number of cattle
Labuhan Merak	1308
Balanan	188

DISCUSSION

For the communities in Labuhan Merak and Gunung Masigit, cattle is the livestock of choice, although many goats and chicken are also kept. Owners usually have 4-5 cows per person (Wianti,



Figure 2. The presence of domestic cattle deep inside Baluran National Park recorded on camera traps in November, 2016. An estimated 3000 heads of cattle illegally graze in the park daily.

2013) and already in the early 1990s, more than 1600 cows and 400 goats were herded into Baluran NP (Hafis, 1992). The increasing trend continued throughout the 1990s and into the new millennium (Sabarno, 2007). A steep increase emerged with the “gaduh” system, in which case cattle are managed collectively following agreed rules. With the introduction of this practice, local farmers also agreed to manage and breed external investors’ livestock and share the economic benefit later (Wianti, 2013).

The presence of large numbers of domestic cattle inside Baluran NP has resulted in negative impacts to the native ungulates. Grazing competition between domestic cattle and wild herbivores has increased drastically, changed grass composition in key grazing area and increased the potential transfer disease between domestic cattle and wildlife (Alikodra, 1980).

Banteng usually graze in open, dry, deciduous forests whenever present. Although grazers by preference, they consume other material (e.g. fruits, browse) depending on the availability (Purwantara et al., 2011). Our results reveals that the domestic cattle distribution overlaps significantly with banteng presence in an area spanning more than 1,300 hectares. The habitat in the overlapping grid cells constitute mixed woodland savannah, which is bantengs’ preferred habitat in Baluran NP (Wahyudi, 2015). Cattle prefer flat areas and tend to avoid rocky hillsides. Cattle also spend more time in areas closer to water sources (Fowler, 2002).

Livestock and wildlife contribute to modifying the savannah vegetation by grazing. Grazing and browsing is essential to maintaining and conserving the ecological integrity of open savannah landscapes. Without sufficient and

extensive grazing pressure, small trees and woody vegetation will eventually dominate the savannah and suppress the growth of grasses. Following the removal of grasses and suppression of bush growth, there will be very little dry organic matter left in the dry season to fuel potential wildfires. It is an essential condition for frequent landscape fires that there is sufficient fuel. Less frequent fire causes the primary browsing, grazing and trampling to be a more extensive disturbance, through keeping the invasion of trees and grasses away (Kellman and Tackaberry, 1997; McNaughton, 1985, 1986, 1992, 1993; Osborne, 2000). However, the productivity of savannah areas in Baluran NP is considered low. Based on a 2006 study, Bekol savannah only produced a biomass of 113.5 kg/day, which is lower than ideal productivity (150 kg/day) according to Wind and Amir (1977) (PEH Baluran NP, 2006).

Competition between domestic cattle and banteng in grazing increasing significantly because of invasion of *Acacia nilotica*. Since introduced as fire break in late 1960s, *A. nilotica* had spread and covered more than 6000 hectares of savannah ecosystem or more than 50% area of savannah. If the population of domestic cattle being uncontrolled, banteng will lose competition in grazing (Sabarno, 2002).

Habitat overlap between banteng and domestic cattle in Baluran NP raised new potential problem in wildlife conservation, which are potential cross breeding between banteng and cattle, as well as potential transfer disease. The close contact between banteng and cattle can lead to serious disease transmissions, where anthrax, brucellosis, septicaemia epizootica, infectious bovine rhinotracheitis, bovine viral diarrhea and helminthiasis have already been recorded in region's domestic cattle. Helminthiasis, can lead to gastrointestinal disturbance, malnutrition, growth disorder and elevated mortalities in young individuals. Potential transfer disease, especially helminthiasis between domestic cattle and banteng in Baluran NP is relatively high, since Helminthiasis prevalence in cattle around Baluran is 96% (Kurniawati et al, 2016).

Several strategic actions were implemented by Baluran NP management to reduce the negative impact of domestic cattle. To accommodate the settlers in northern side of NP as well as local community around national park, Baluran NP provide a traditional zones in a total area of 1,340.21 hectares (5.36% from total area of national park), consists of 748.92 terrestrial zone and 591.29 hectares of marine zone. Baluran NP also have an agreement with settlers to allow them to manage traditional zone (Balai Taman Nasional Baluran, 2012). Community awareness also conducted followed by grass planting program to support community farming. Likely, the program has not succeed to prevent local communities trespassed the zone (Sabarno, 2002).

REFERENCES

- Alikodra, HS (1980). Dasar-Dasar Pembinaan Margasatwa. Fakultas Kehutanan IPB, Bogor.
- Balai Taman Nasional Baluran (2012). Buku Zonasi Balai Taman Nasional Baluran.
- Fowler NL (2002). The joint effects of grazing, competition, and topographic position on six savanna grasses. Ecological Society of America.
- Gardner, P.C. (2015). The natural history, non-invasive sampling, activity patterns and population genetic structure of the Bornean banteng *Bos javanicus lowi* in Sabah. Cardiff: Cardiff University, School of Biosciences.
- Gardner, P., Hedges, S., Pudyatmoko, S., Gray, T.N.E. and R.J. Timmins (2016). *Bos javanicus*. The IUCN Red List of Threatened Species 2016: e.T2888A46362970. <http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T2888A46362970.en>.
- Kellman M and Tackaberry R (1997). Tropical environments the functioning and management of tropical ecosystem. Routledge, Devon.

- Kurniawati, D.A., Misrul, Suprianto and H.A. Wahyudi (2016). Parasitic helminths (nematodosis) in banteng, *Bos javanicus*, and domestic cattle in Baluran National Park. *Journal of Indonesian Natural History* **4**(2): 36-40.
- Lekagul, B. and J.A. McNeely (1977). Mammals of Thailand. Association for the Conservation of Wildlife, Bangkok, Thailand.
- McNaughton, S.J. (1985). Ecology of a grazing ecosystem: The Serengeti. *Ecological Monographs* **55**: 259-294.
- McNaughton, S.J. (1986). On plants and herbivores. *American Naturalist* **128**: 765-770.
- McNaughton, S.J. and N.J. Georgiadis (1986). Ecology of African grazing and browsing mammals. *Annual Review of Ecology and Systematics* **17**: 39-65.
- McNaughton, S.J. (1992). Grassland ecosystem productivity. *Ecology* **73**: 1930.
- McNaughton, S.J. (1993). Grassers and grazers, science and management. *Ecological Application* **3**: 17-20.
- Nowak, R.M. (ed). 1991. Walker's Mammals of the World (5th Edition). The Johns Hopkins University Press, Baltimore.
- Osborne, P.L. (2000). Tropical ecosystem and ecological concepts. Cambridge Univ Press, Cambridge.
- Pengendali Ekosistem Hutan Taman Nasional Baluran (2006). Pengumpulan Data dan Informasi Produktifitas Savana Bekol Pada Musim Kemarau. Laporan Kegiatan unpublished. Taman Nasional Baluran.
- Prosser, N., Gardner, P.C., Smith, J.A., Goon, J.E.W., Ambu, L.J. and B. Goossens (2016). Body condition scoring of Bornean banteng in logged forests. *BMC Zoology* 1-8. DOI 10.1186/s40850-016-0007-5
- Pudyatmoko, S., Djuwantoko and Y. Sabarno (2007). Evidence of banteng (*Bos javanicus*) decline in Baluran National Park, Indonesia. *Journal of Biological Science* **7** (6): 854-859.
- Purwantara, B., Noor, R.R., Anderson, G. and H. Rodrigues-Martinez (1990). Banteng and Bali Cattle in Indonesia: Status and Forecast. Wiley Online Library. <http://onlinelibrary.wiley.com/>
- Rademaker, M. Suryantini, A and J. Muldoyo (2017). Financial feasibility and optimal management of intensive cow-calf cooperatives as an option for resolving illegal grazing conflict in Baluran National Park, Indonesia. *In press*.
- Sabarno, Y. (2002). Savana Taman Nasional Baluran. *Biodiversitas* **3**(1): 207:2012.
- Sabarno, Y. (2007). Analisa Perkembangan Kondisi Banteng (*Bos javanicus*) di Taman Nasional Baluran. Taman Nasional Baluran.
- Wahyudi, H.A. and S. Sutadi (2015). Laporan Kegiatan Monitoring Banteng (*Bos javanicus*) di Taman Nasional Baluran Tahun 2015. Kerjasama Copenhagen Zoo dengan Taman Nasional Baluran. Unpublished report. Baluran National Park.
- Wahyudi, H.A. and S. Sutadi (2016). Laporan Kegiatan Monitoring Banteng (*Bos javanicus*) di Taman Nasional Baluran Tahun 2016 Kerjasama Copenhagen Zoo dengan Taman Nasional Baluran. Unpublished report. Baluran National Park
- Wianti, K.F. (2013). Land tenure conflict in the middle of Africa van Java (Baluran National Park). *Procedia Environment Science* **20**: 459-467.
- Wind, J. and H. Amir (1977). Proposed Baluran National Park Management Plan 1978/1979 - 1982/1983. Prepared for the Direktorat of Nature and Conservation, Direktorat General of Forestry, Republic of Indonesia. Nature Conservation and Agriculture Organization of the United Nations.