SHORT COMMUNICATIONS

Parasitic helminths (nematodosis) in banteng, *Bos javanicus*, and domestic cattle in Baluran National Park

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INTRODUCTION

The once widespread wild banteng, *Bos javanicus,* has been extensively persecuted by humans on Java. Today it is only found in four areas of Java, namely the national parks Ujung Kulon, Betiri Meru, Alas Purwo and Baluran (IUCN, 2008). The drastic decline has resulted in banteng being listed as "Endangered" on the IUCN Red list (IUCN, 2008), with a Global population of less than 5000 individuals. On Java, some individuals roam landscapes outside protected areas and have caused conflicts between local communities and banteng (pers. comm. Alas Purwo National Park). In such cases, authorities have been forced to capture and translocate conflict animals at a high cost or risk that communities will eventually kill bantengs that they perceive as conflict animals.

Baluran National Park (BNP) is located on the north-eastern tip of Java and considered one of the strongholds for banteng in Indonesia. It spans 25.000ha of a variety of habitats such as evergreen, teak and mangrove forests, but it dominated by and famous for its extensive savannah and open woodland habitat, which is unique to tropical Southeast Asia. This offers prime grazing grounds for the park's many ungulates, including banteng. A banteng census in 1996 estimated a population of 312-338 individuals, which declined rapidly to only 34 individuals in 2007 (BTN, 2010). Subsequently, 38 individuals were recorded in 2013 and 46 individuals in 2015 (Wahyudi et al, 2015), suggesting that with the recent management improvement the banteng population is slowly recovering.

BNP is not only prime grazing grounds for banteng, but local communities use the park as grazing grounds. A rapid survey recorded approx. 3000 cattle that graze the park daily (Rademaker et al., *in press;* Wahyudi et al., 2016). Whereas most of the cattle are concentrated in the north-western part of the park, the intrusion has expanding into more areas where banteng and other wildlife are also common. Grazing cattle was detected in 7766.6ha of the park, and there is significant habitat utilisation overlap between banteng and cattle (Wahyudi et al 2015, Wahyudi et al 2016). The grazing overlap can result in a competition for food, hybridization, disruption of wildlife migration patterns and disease transfer (Komberec, 1976; Schmidt et al, 2005; Vile et al, 2005).

Helminthiasis is a common cattle disease reported across the world. It is usually transmitted between various hosts by intermixing and overlapping grazing grounds (Walker et al, 2014). They are transmitted by infective larvae on shared pastures that are ingested, or through the penetration of skin or through an intermediary host (Anderson, 2000) Helminth infestations affect the health of wildlife and domestic animals by inhibiting the growth and development, lower body mass in calves and is often fatal in young animals (Stein et al, 2002; Subekti, 2004). Helminths can also affect the

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immune system negatively and aggravate secondary infections that are often not serious (Enzewa and Joles, 2011). Despite the well documented negative impact to the health of domestic cattle and wildlife, the study of disease transmission in wildlife and livestock rarely discuss helminths infections (Vile et al, 2002; Kock, 2005; Wambawa, 2005). This study aims to assess the risk of disease transmission between cattle helminth and banteng in Baluran National Park.

Methods

Study Area

BNP is located in the District of Banyuputih, East Java, Indonesia. It spans over 25,000 ha and is located at 7°55'17.76S and 114°23'15.27E (BTN baluran, 2012). BNP contains a range of habitats, ranging from mangroves, coastal forest, swamp forest, woodland savannah, sub-montane forest (primary), monsoon evergreen forest, sea-grass beds and coral reefs (BTN baluran, 1995). The climate is dominated by an 9 months dry season with less than 60mm rainfall and 3 months of rainy season (BTN Baluran, 2014). At 1247m, Baluran Mountain is the park's highest peak and dominates the largely flat landscape in the rest of the park. The fauna remains poorly studied, however, to date 22 species of mammals and 233 species of birds have been recorded. Due to its variety of habitat, a total of 475 species of plants have been recorded, a very large number for this relatively small park. There are also an estimated 3000 heads of cattle and only 40-50 banteng (Wahyudi et al, 2015).

Stool collection and analysis

Faecal samples were taken from 40 cows found to graze in BNP. They were collected in Labuhan Merak, Balanan and Wonorejo zones. A total of 18 faecal samples was collected from bateng in the Perengan, Bitakol and Balanan zones. All samples were collected from fresh dung only (<4 hours) and stored in 10% formalin solution before analysis. We used "floating" method to extract and isolate the worms and eggs. The extracted worms and eggs were observed under a microscope and identified. The degree of infection in cattle and banteng was calculated as,

$$i = n/N \times 100$$

i = degree of infection in %
n = number of positive samples
N = total number of samples

Results

Six different species of helminths were identified from a total of 58 dung samples (Tab.1). Infections were recorded in 85.00% of all cattle dung samples, whereas only 33.30% of the banteng dung samples were infected. All six species of helminths were recorded in cattle dung, which was dominated by *Oesophagustomum sp*. This species was found in 62.50% of the samples, followed by *Bunostomum sp* (35.00%) (Tab. 1). In contrast, only two species were recorded in banteng dung and *Oesophagustomum sp* was also the most commonly recorded (35.30%) (Tab. 1).

Discussion

At 85% infection rate, the prevalence of helminth on cattle from BNP was high compared to that recorded from cattle in Way Kambas National

Table 1. The various Helmint species recorded and the degree of infection in cattle and banteng dungs.
N_{cattle} = 40; $N_{banteng}$ = 18

Species	Cattle	Banteng
Oesophagustomum sp	25 (62.50%)	6 (35.30%)
Bunostomum sp	14 (35.00%)	0
Haemonchus sp	8 (20.00%)	1 (5.80%)
Trichostrongylus sp	7 (17.50%)	0
Strongyloides sp	2 (5.00%)	0
Trichuris sp	1 (2.50%)	0

Park (70%) (Putratama, 2009). The species recorded in this study are considered common in cattle (Rahman and Mondal, 1983; Farooq et al, 2014) and *Oesophagustomum sp* was also the most common species recorded in other studies in Pakistan (Farooq , 2012) and Bali (Sugama and Suyasa, 2011).

The relative low number of infections in banteng (33.30%) is somewhat surprising, considering a similar research in BNP recorded an infection level at 56.00% (Hahang, 2004). In addition, banteng were only infected by two types of helminths in contrast to six for cattle (Tab.1) although the dominating infectious species was the same (*Oesophagustomum sp*).

The reason for the difference between cattle infestation and banteng is not clear. However, all cows are herded back to night enclosures that are often cramped and with poor sanitation. Here, all cows are forced to rest, defecate, drink and eating in the same place and the water basin was often observed to be contaminated with faeces and mud. During the rainy season, cattle faeces and urine become mixed with the soil and form extensive mud pools. This forms the perfect conditions for helminthial transmission from an infected individual to healthy individuals. Despite appalling husbandry conditions, there is regular no de-worming exercises undertaken.

A preliminary banteng occupancy survey was undertaken in 2015 and 2016 and concluded that there are significant grazing overlap between banteng and cattle (Wahyudi et al 2015, Wahyudi et al 2016). Parasitic infestations through the faecal-oral route is very common and with a heavily infected cattle population sharing grazing grounds with banteng, the conditions for helminthial cross infections are ideal (Hutchings et al., 2003; Judge et al., 2005). In addition, the poor husbandry standards provided in the villages also increases the risk spreading other infectious diseases, such as other parasitic nematodes and micro parasites (e.g. bacteria) are often stacked in the pasture with the faeces (Fedorka-Cray et al., 1995; Cellini et al., 1999; Coleman and Cooke, 2001; O'Brien et al., 2002 ; Judge et al., 2005). In 2016, the BNP suffered extreme wet conditions. Wet humid climate provide excellent conditions for helminthial life-cycles as well as induce better dispersal during the infective stage (Pfukenyi and Mukaratirwa, 2013). Rain induced dispersal of faeces also increases infection rates (Seo et al.2015).

The relatively low number of infected banteng may result from being in limited contact with infected cows, as well as their tendency to avoid cattle and herders. In some cases, cattle and other herbivores actively choose grazing areas that are not contaminated with faeces (Hutching et al, 2003). Finally, banteng may not be as susceptible to infection by all the same helminth species as domestic cattle, perhaps due to a more diverse diet.

This study reveals that the domestic cattle that illegally occupy a third of the parks grazing grounds are seriously infected with helminths and with a high probability of other diseases too. With the increasing encroachment of infected cattle and overlap with banteng and other ungulate grazing grounds, BNP faces a serious risk of loosing the endangered banteng. Due to the sheer number of cattle, combined with the poor husbandry condition, no veterinarian and the relatively small size of BNP, a disease outbreak can exterminate one of Indonesia's last remaining wild and genetically diverse populations of banteng. In addition, *Haemonchus sp* frequently encountered in sheep and goats, can also infect cows and some species of deer (Eve and Kellog, 1977; Anderson, 2000). In addition to banteng, this puts the park's deer population at risk too.

This study focused only on helminths infection and dispersal routes, however, this alone should be enough to persuade BNP's management to act swiftly to arrest the onset of disease transfers from domestic livestock to the park's endangered wildlife species. Once the diseases have been transmitted to wildlife, it is almost impossible to eradicate again and BNP will eventually loose some of its most charismatic species.

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