Effect of spreading of invasive thorny acacia (Acacia nilotica) in Bekol Savanna of Baluran National Park to savanna area and composition of javan bull feed (Bos javanicus)

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Abstract. Acacia nilotica was introduced to Baluran National Park in 1969 for forest fire prevention. Nowadays, A. nilotica becomes invasive species due to their fast-growing and rapid spreading species types. Bekol Savanna in Baluran National Park has been affected by the changing of grass composition of javan bull’s feed. Bekol Savanna has 12 species of grass as javan bull’s feed and dominated by Brachiria reptans as it almost covers 60% of the savanna area. GIS method was applied to estimate the area of Bekol Savanna that changed by the spreading of invasive A. nilotica by the year 2002, 2007, 2013, 2017 and 2018, through satellite imagery analysis and concentration count method to estimating javan bull population. The result shows that javan bull’s feed grass composition and changing of Bekol Savanna have an impact on javan bull population in Baluran National Park. The estimated population of Javan bull in 2003 was 81 and constantly decreased and remain 17 in year of 2017.

1. Introduction
Thorny acacia (Acacia nilotica) was introduced into Baluran National Park with the aim of being a firebreak to avoid the spread of fire from the savanna to the teak forest area. In 1969, many species of plants were planted in Bekol Savanna with the same purpose, namely as firebreaks to prevent the spread of fires from savanna to forest areas [1]. The growth speed and spread of thorny acacia resulted in a decrease in the quality and quantity of grasslands, changing the behavior patterns of herbivorous wildlife due to changes in their habitat components and more severely altering the structure and composition of Bekol Savanna vegetation.

Thorny Acacia has been spreaded in almost all the savanna areas of Baluran National Park, including Bekol, Kramat, Kajang, Balanan, Lempuyang, Dadap, Asam Sabuk, Curah Udang, Widuri and Merak. In the Kramat, Kajang and Balanan savanna, these plants have formed a closed canopy [2]. The area of Baluran National Park is 25,000 ha, while for savanna area is around 40% of the total national park area, which is around 10,000 ha. The growth of thorny acacia reaches 100-200 ha per year. In the latest of 2000’s, it has invaded almost 50% of the savanna area in Baluran National Park [2] which is around 5,000 ha. As a result of the savanna ecosystem that was originally a wildlife habitat has become high dense of thorny acacia and has influentialy on grassland growth and abolishd wildlife feed [3]. In addition, thorny acacia disrupts the movement of wildlife [3], this is evidenced by the increasing of difficulty to find the appearances of javan bull (Bos javanicus) and wild buffalo (Bubalus bubalis) which are the mainstays of Baluran National Park [3]. The purpose of this
study was to determine the composition of javan bull’s feed in Bekol Savanna which was affected by invasive thorny acacia species (Acacia nilotica) and to determine the relationship between Bekol Savanna large area changes and javan bull population from annual monitoring.

2. Methods
The method used in collecting data on the closure of grasses in Bekol Savanna was conducted with a square measuring plot of 0.128 ha, the data needed was the structure and composition of grasses in Bekol Savanna. GIS analysis was applied to identify land covers by time-series satellite imageries of Bekol Savana related to the interpretation of Digital Globe satellite imageries in 2002, 2007, 2013, 2017 and 2018 is employed to find the value changes in savanna area and covered by invasive species. Regression analysis was needed in order to find out the value and relationship between changes in the Javan Bull population based on secondary data from national park annual monitoring of Javan Bull population with changes in the effective area of Bekol Savanna to supply javan bull’s feed.

3. Results and discussion

3.1. Closure and composition of grass in Bekol Savanna Baluran National Park
Bekol is a savanna that provides herbivorous animal feed, including Javan bull (Bos javanicus), Wild buffalo (Bubalus bubalis) and Timor Deer (Cervus timorensis) with the composition of Savanna grass cover which is herbivorous animal feed as table 1 as follows:

| Grass species                  | Local Name | Biomass | Coverage (%) |
|-------------------------------|------------|---------|--------------|
| Brachiria reptans             | Bayapan    | 4.534   | 60           |
| Dichantium coricosum          | Lamuran    | 2.408   | 10           |
| Dactyloctenium aegyptium      | Tuton      | 2.517   | 10           |
| Polytrias amaura              | Lamuran    | 1.750   | 5            |
| Eragrostis tenella            | Empritan   | 940     | 3            |
| Echinochloa colonum           | Menjangan  | 672     | 2            |
| Cynodon dactylon              | Kawatan    | 435     | 2            |
| Digitaria ciliaris            | Cakar ayam | 412     | 2            |
| Panicum repens                | Jajagoan   | 368     | 2            |
| Axonopus compressus           | Rumput pait| 314     | 2            |
| Lersia hexandra               | Gersikan   | 202     | 1            |
| Eleusine indica               | Belulang   | 142     | 1            |

Brachiria reptans, Dichantium coricosum, Dactyloctenium aegyptium almost covers 80% of grassland in Bekol Savanna. Those grass species have been identified as feed sources herbivorous wildlife, especially big mammal species. Nevertheless, thorny acacia has pushed the growing space of grass to grow and provide the main feed of big mammal. As shown in Figure 1, spreading of thorny acacia covers majority part of Bekol Savana and dominated land cover and caused grass could not grow properly. Changes in cover and composition of the species of Bekol Savanna grass were a major cause of changes in wildlife behavior. The ability of Thorny Acacia invasion suppresses the availability of feed for big mammals. The perceived impact was that the supply of feed for large mammals causes animal competition to increase, while in terms of the number of timor deer and wild buffalo dominate Baluran National Park more than Javan bull, yet this population imbalanceness will affect the overall population of javan bull in Baluran. B. reptans, D. coricosum, D. aegyptium are javan bull's favorite
feed. Invasion of Thorny Acacia pushes those grasses species closure becomes difficult to grow properly.

![Figure 1: Thorny acacia in Bekol savanna.](image)

### 3.2. Changes in the area of bekol savana as result of invasive species of Acacia nilotica

Bekol Savanna area was changed by the year of coverage as described in Fig. 2. The effect of changes in grass closure and composition and area of Bekol Savanna on the estimation of javan bull population calculated using the concentration count method in Baluran National Park. Regression analysis was used to determine the regression relationship.

Through the results of the regression analysis on the condition of the savanna area with the estimation of the Java bull population in Baluran National Park, it could be seen that the Bekol savanna area is continuously decreasing and the bull population continues to decline. The presence of invasive *A.nilotica* species in addition to changing the composition of Javan bull wildlife also affects the population, considering that Baluran National Park is one of the last Javan bull conservation areas in Java.

![Figure 2: Large changes of Bekol Savanna in the last two decades.](image)
4. Conclusion
Spreading of thorny acacia in Bekol savanna pushes the growth of several plants as natural feed of javan bull such as B. reptans, D. coricosum and D. aegyptium. Large area of savanna that can supply feed for javan bull and spaces to grazing periodically diminished due to the uncontrolled spreading of thorny acacia and it cause the population of Java bull to decrease from year to year.

References
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