Invasive Plant Species and the Competitiveness of Wildlife Tourist Destination: A Case of Sadengan Feeding Area at Alas Purwo National Park, Indonesia

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Abstract

Wildlife tourism has been promoted at Alas Purwo National Park (APNP) since this was identified as one of the biodiversity centers in Indonesia. Within this park, the Sadengan feeding area (SFA) was established and has evolved into a wildlife tourist destination since 1970, due to the numerous and diverse animals in this area. The quality of a tourist destination has been recognized as a main factor in the competitiveness of wildlife tourism. This study examined the current conditions of the SFA with respect to the vegetation structure, number of *Bos javanicus* as flagship species for conservation and domestic tourists perception of SFA as a wildlife tourist destination. A field study was undertaken during the dry period at the SFA-APNP. The line intercept method was used to determine vegetation structure, while the number of *Bos javanicus* was assessed by the direct counting method. Domestic tourist perception was assessed by semi-structured interviews with local tourists as respondents, followed by service quality score (SERVC) analysis. The results showed that the five most important plant species related to the value index were *Cassia tora*, *Eupatorium inulifolium*, *Lantana camara*, *Cyperus brevifolius* and *C. iria*. Three of them, *C. tora*, *E. inulifolium* and *L. camara*, are known as non-indigenous plant species and those have invaded the SFA. The current census showed that the

abundance of *Bos javanicus* was fewer than 6 individuals and seemed to be decreasing with time. Furthermore, it seems that this low number of *Bos javanicus* in SFA may lead to tourist dissatisfaction. This was demonstrated by negative gap values between tourist expectation and tourist perception among respondents, which indicating that most of the expectation of local tourists were not met. This study suggests that habitat management of SFA as a wildlife conservation area and wildlife tourist destination needs serious attention to meet conservation objectives and make the SFA a more attractive wildlife tourist destination.

Key Words: Alas Purwo National Park, invasive plants, tourist perception, wildlife tourist destination

1. Introduction

Recently, tourism based upon viewing wildlife has significantly contributed to the economic growth of some countries. Prosperous wildlife tourism is a form of nature-based tourism, which focuses on contributing to wildlife conservation and education about wildlife as well as contributing economically to the local communities. Such tourism activities have often occurred in national parks where wildlife is generally conserved (Honey, 2000; Reynolds and Braithwaite, 2001).

Success in the implementation of a wildlife tourism activity is influenced by two factors: a species factor and a habitat factor. One important criterion for the species factor is that the focus species should possess an element of rarity or local scale abundance. Such species are known as flagship species. Flagship species such as the great Panda, California Condor and Lion are used to promote conservation activities through wildlife tourism. In addition, species also should be viewable, allowing tourists to direct observe the animals. On the other hand, the habitat factor usually relates to the tourist destination quality, which is the central element of the tourism system. Hence, the success of the tourism industry has been recognized to depend on the degree competitiveness of tourist destination. The environmental quality of the destination is a prevailing issue in making travel-related decisions. There is competition among different tourist destinations of varying environmental quality. In the wildlife tourism business, the destination should support a number of viewable of interesting species (Mihalic, 2000; Reynolds and Braithwaite, 2001).

The Indonesian government has emphasized the need to establish and develop nature-based tourism, in areas where the local wildlife has the potential for the establishment of such an industry. One of the tourist destinations in Indonesia is Alas Purwo National Park, which lies on the southeast peninsula of Java (known as the Blambangan Peninsula). Historically, this area was established as a nature monument in 1913 and declared as a national park in 1992. This is a 42,000 ha lowland forest that is the best-known habitat for the spectacular wildlife in Java (Whitten et al., 1996; BTNAP, 2000). Tourism has been promoted as part of the strategy of national park conservation through a nature conservation education program. Wildlife tourism has been implemented at Sadengan feeding area (SFA) where tourists can enjoy wildlife viewing. The endangered bovid species, banteng *Bos javanicus*, has been promoted as the flagship species for conservation issues and as the main object of tourism. In the past, there were a lot of wildlife, especially *Bos javanicus*, in the SFA. However, recent observations in this area reveal a decreasing population of *Bos javanicus*. The available data on the number of banteng *Bos javanicus* and habitat quality in SFA are insufficient, but it seems that vegetation changes have caused this population decrease, which is contra-productive to support wildlife tourism competitiveness.

Some reports state that quality of SFA as a wildlife tourist destination has been threatened by non-

indigenous plant species (BTNAP, 2000; Ruikana, 2004; Hakim et al., 2004). The abundance and infestation of non-indigenous plant species were suspected to alter habitat quality. Furthermore, woody tree invasion at the edge of SFA has been recognized as a factor in the decreasing SFA size from 82.72 ha in 1975 to 66.50 ha in 2002 (BTNAP, 2000; Ruikana, 2004). Such conditions were suspected to have caused a decline in the number of *Bos javanicus* and to have influenced tourist perception of the area. Recently, there is no available data about the relationship among SFA vegetation structure, number of *Bos javanicus*, and domestic tourist perceptions.

The aims of this study were to determine the present vegetation structure of SFA, the abundance of *Bos javanicus*, and the domestic tourist perception toward SFA. The outcomes of this study may be useful for SFA conservation as a wildlife habitat and for improving SFA's competitiveness as a nature-based tourist destination.

2. Study Site

The field study was done in Sadengan feeding area (SFA) at Alas Purwo National Park (APNP), in Southeast Banyuwangi, East Java, Indonesia (8°22'S to 8°32'S and 113°37'E to 113°57'E) (Fig. 1). The park covers about 42,000 ha of lowland tropical forest. It is on a peninsula with 30 km of coastal area consisting of a limestone massif, which has eroded into very sharp and steep ridges. The slopes are covered with shallow soil. The annual rainfall is quite low, and only one permanent of the whole area is a stream (Whitten et al., 1996; BTNAP, 2000).

Originally, SFA had 82.72 ha of open habitat in a lowland tropical forest of APNP where grasses and shrubs were dominant. The most common those species were *Arudinella setosa*, *Alysicarpus vaginalis*, *Cyperus brevivolius*, *C. iria*, *Dischantium caricosum*, *Eleusine indica*, *Fimbristylis* sp., *Andropogon contortus*, *Ischaeum* sp., *Panicum repens*, *Paspalum conjugatum*, *P. vaginatum* and *Polytrias amaura*. In 1972, the national park authority decided to use the area as a herbivorous feeding area for wildlife conservation purpose. Since the area was very interesting in terms of its wildlife community, the area was eventually opened as a wildlife tourist destination.

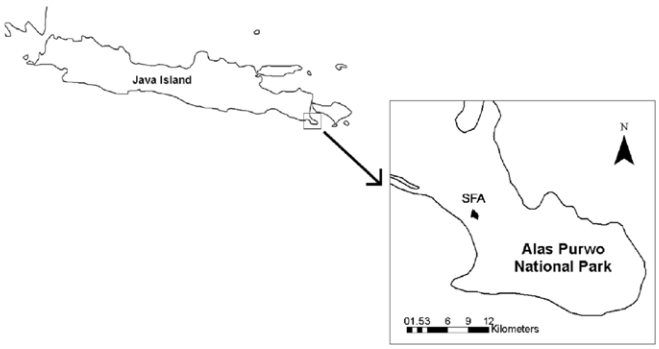

Fig. 1. Map of Java Island and the location of Sadengan feeding area (SFA) in Alas Purwo National Park, East Java, Indonesia.

Recently, SFA has been the favorite tourist destination among wildlife tourism in Java and Bali. The area receives more visitors enjoying wildlife attractions than other national parks. While *Bos javanicus* is the flagship species for tourism, other animals such as Muntjak deer *Muntiacus muntjak*, Timorese deer *Cervus timorensis*, Wild pig *Sus scrova*, and Dholes *Cuon alpinus* are also exist in SFA. The bird diversity also has been used as part of the national park tourism program for bird-watching activities, mainly to attract international tourists.

3. Methods

A field survey was conducted at SFA during dry season (July to September) in 2004 (Fig.1). During the survey period the diversity of plant species was investigated as a baseline data for vegetation structure analysis. Vegetation structure was determined using the line intercept method, which is suitable for environments where the vegetation is dominated by shrubs as in SFA (Kent and Cooker, 1992). A preliminary study was carried out to determine the minimal area curve by identifying the number and length of the line transects. Based on our result, ten 16 meter-long transect lines were established. Systematically, a 16 m tape is laid out, and all species intercepting or touching the line were recorded. Relative density, relative dominance, and relative frequency were determined by following the vegetation standard methods of Kent and Cooker (1992) and Krebs (1989). Furthermore, the important value index (IV) was calculated from summarizing the relative density, relative dominance, and relative frequency. Direct identification was used to recognize well-known species. Unidentified species were collected for further identification in the Plant Taxonomic Laboratory, Department of Biology, Brawijaya University and Purwodadi Botanical Garden, Malang. The plant identification books such as *Flora of Java* by Backer (1968) and *Tropical Grasses* by Skerman and Riveros (1990) were used to identify the observed plants.

We used banteng, *Bos javanicus*, as the main observation animal in this study because it is a symbol of conservation and tourism for Alas Purwo. The domestic tourist perception of SFA as a wildlife tourist destination was assessed by the service quality score (SERVC) method among 50 domestic tourists. This method has been used to assess tourist satisfaction with destination in Kenya (Akama and Kieti, 2003). Tourist expectation data were determined by a semi-structured interview with respondents relating to the number of expected *Bos javanicus* individuals, prior to their actual visit. Tourist perception was measured according to their direct observation and the results of which were verified by the researcher. *Bos javanicus* individuals were counted visually using hand tally counters and 3 × 8 binoculars by direct counting methods at a 10 meter-tall Sadengan wildlife observation tower. This tower was built by the national park office to allow tourists to observe wildlife throughout SFA. Observations were conducted on three periods within a day at 07:00-10:00; 10:00-15:00, and 15:00-18:00. Censuses were carried out twice a week on vacation days in the period of July to August 2004. In each census, the number of animal was counted at least twice and the data was analyzed using the SPSS (10.0 Version) statistical package. SERVC was calculated using the following formula:

SERVC = (tourist perception score) – (tourist expectation score)

4. Results

The composition and vegetation structure are presented in Table 1. Five of the most important plants species were *Cassia tora* (IV=90), *Eupatorium inulifolium* (IV=39.6), *Lantana camara* (IV=11), *Cyperus brevifolius* (IV=10), and *C. iria* (IV=9). The first three species, *C. tora*, *E. inulifolium*, and *L. camara*, were recognized as non-native plant species that have invaded the SFA. The *C. brevifolius* and *C. iria* are native or indigenous species to SFA, and are recognized as main foods for herbivores. The other native species that were previously reported dominant, such as *Arudinella setosa* (IV = 4.5), *Fimbristylis* sp. (IV=6.2), *Andropogon contortus* (IV=3.9), and *Panicum repens* (IV=4.6) have a relatively lower IV index than the former (Fig. 2). Some species that were formerly found in SFA, such as *Paspalum conjugatum*, and *P. vaginatum*, have not existed in the SFA anymore. Fig saplings such as *Ficus glomerata* (IV=4) and *Ficus* sp. (IV=2.7) also were found during the analysis. These data showed the evidence of the invasion of non-native species that threaten SFA as a herbivorous habitat for wildlife conservation.

The abundance of *Bos javanicus* in SFA all throughout the direct observation periods was fewer than 6 individuals, while the value of tourist expectation was high (Table 2). Hence, there was a negative gap between the observed tourist expectation and tourist perception. In Figure 3, it was clear that *Bos javanicus* grazing intensively in the area where food deposits such as *C. brevivolius* and *C iria* were

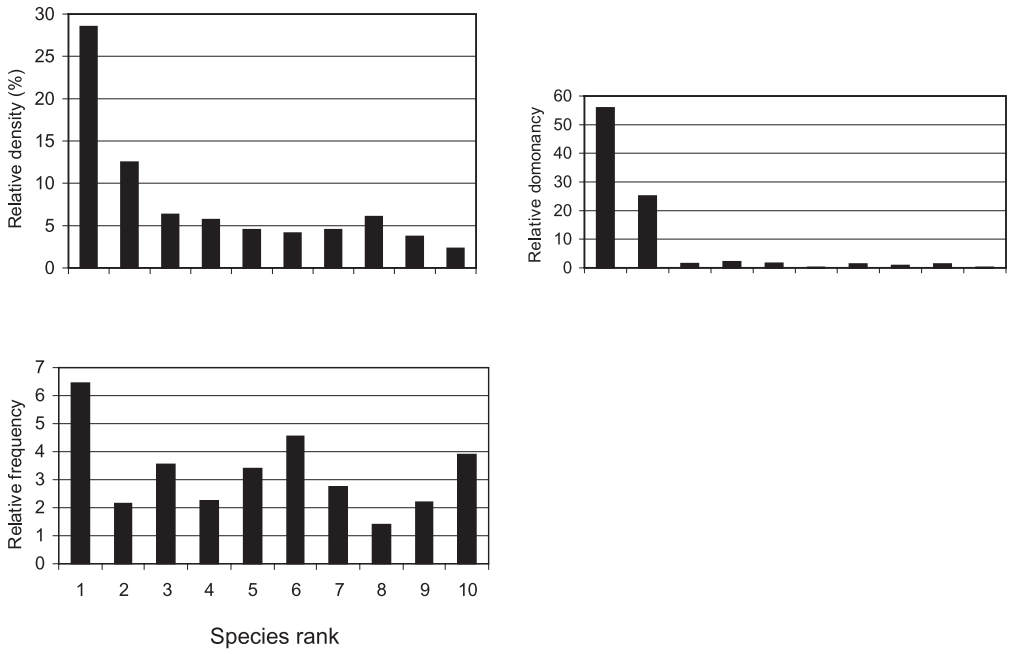

Fig. 2. Histograms of relative density, relative dominancy and relative frequency among 10 highest species that have important value. Rank species are coded as follow: 1. *Cassia tora* (IV=90), 2. *Euphatorium inulifolium* (IV=39.6), 3. *Lantana camara* (IV=11), 4. *Cyperus brevifolius* (IV=10), 5. *C. iria* (IV=9), 6. *Desmodium triflorum* (IV=8.8), 7. *Axonophus compressus* (IV=8.5), 8. *Meremia emarginata* (IV=8.2), 9. *Cynodon dactylon* (IV=7) and 10. *Imperata cylindrica* (IV=6.3).

Table 1. Species composition, relative density, relative dominance, relative frequency and important value index in Sadengan feeding area (SFA) during the survey period (July – August, 2004).

No	Species	Relative density	Relative dominance	Relative frequency	Important value (IV)
1	*Cassia tora*	28.50	55.80	6.45	90.0
2	*Eupathorium inulifolium*	12.50	25.02	2.14	39.6
3	*Lantana camara*	6.30	1.40	3.57	11.0
4	*Cyperus brevivolius*	5.70	2.10	2.23	10.0
5	*Cyperus iria*	4.50	1.57	3.40	9.0
6	*Desmodium triflorum*	4.10	0.18	4.56	8.8
7	*Axonophus compressus*	4.50	1.34	2.73	8.5
8	*Merremia emarginata*	6.03	0.80	1.39	8.2
9	*Cynodon dactylon*	3.70	1.25	2.19	7.0
10	*Imperata cylindrica*	2.30	0.07	3.90	6.3
11	*Fimbristylis* sp.	0.90	2.25	3.09	6.2
12	*Heteropogon contortus*	2.75	1.34	2.40	6.0
13	*Paspalum* sp.	2.25	0.25	3.40	5.9
14	*Entada phaseoloides*	3.45	0.34	1.88	5.6
15	*Hyptis suaveolens*	2.90	0.08	2.71	5.6
16	*Eulalia amaura*	2.25	1.01	2.29	5.5
17	*Panicum repens*	2.25	0.25	2.16	4.6
18	*Arundinella setosa*	0.99	1.01	2.56	4.5
19	*Oxalis corniculata*	2.04	0.07	2.29	4.3
20	*Ficus glomerata*	1.70	0.09	2.38	4.0
21	*Andropogon contortus*	0.60	1.03	2.36	3.9
22	*Mimosa pudica*	1.25	0.03	2.47	3.7
23	*Elephantopus scaber*	0.70	0.01	2.82	3.5
24	*Panicum crus-galli*	0.27	1.04	2.22	3.5
25	*Chrysopogon aciculatus*	0.60	0.04	2.29	2.9
26	*Mimosa invisa*	0.25	0.01	2.46	2.7
27	*Sonchus arvensis*	0.42	0.02	2.33	2.7
28	*Ficus* sp.	0.10	0.09	2.54	2.7
29	*Leea angulata*	<0.01	0.60	2.00	2.6
30	*Cyanotis cristata*	0.20	0.01	2.26	2.4
31	*Commelina nudiflora*	0.12	0.02	2.22	2.3
32	*Sida rhombifolia*	0.06	0.01	2.16	2.2
33	*Heliotropium indicum*	0.07	0.01	2.13	2.2
34	*Ehretia microphyla*	0.07	<0.01	2.15	2.2
35	*Cassia siamea*	0.01	0.04	2.04	2.0
36	*Centrosema virginianum*	0.02	0.36	2.02	2.0
37	*Portulaca* sp.	0.06	<0.01	2.18	2.0
38	*Euphorbia hirta*	0.05	0.02	2.04	2.0
39	*Daemonorops* sp.	<0.01	0.44	1.60	2.0

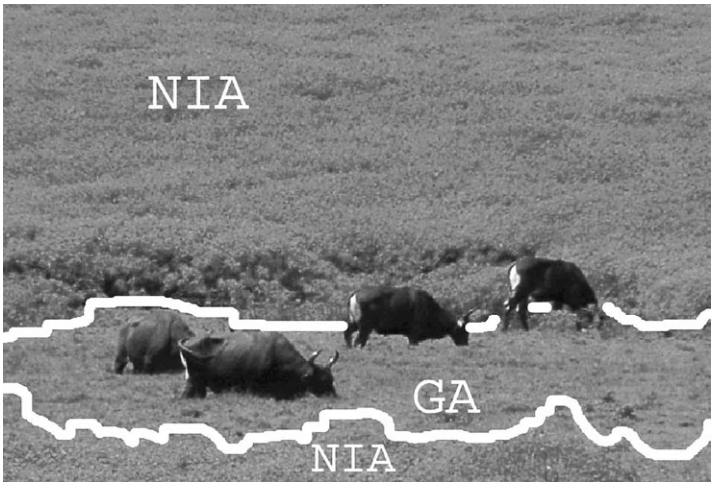

Fig. 3. Four bantengs Bos javanicus concentrate in a grazing area (GA) in SFA which is surrounded by non-indigenous area (NIA) dominated by *Cassia tora* and *Euphatorium inulifolium.*

Table 2. Value of Gap between the expected and observed number of *Bos javanicus*. A negative value indicates that tourist observation did not meet tourist expectation.

Interview times within a day	Number of respondent	Expected number of *B. javanicus* mean (SD)	Observed number of *B. javanicus* mean (SD)	Gap	Wildlife attraction
07:00-10:00	15	17.10 (1.05)	4.10 (1.14)	-13.00	*Bos javanicus* grazing in area dominated by grasses
10:00-15:00	20	18.25 (1.05)	3.50 (1.05)	-17.75	*Bos javanicus* grazing and take rest under *Sono* trees
15:00-18:00	15	22.50 (1.15)	5.85 (1.07)	-16.65	*Bos javanicus* grazing, *Cervus timorensis* and *Muntiacus muntjak* abundant

abundant (GA). In contrast, the obscure areas (NIA) dominated by *C. tora, E. inulifolium*, and *L. camara*, were avoided by those animals.

5. Discussion

Alien plants are non-indigenous species that do not occur naturally in an area. These plants have often become threats to biodiversity by altering the vegetation structure (Schwardz, 1997; Enright, 2000). Historically, various non-indigenous plant species to Java and surrounding islands were introduced

into Java as commercial agricultural products and as ornamental plants. The demand for ornamental plants has led to exotic plant species such as bamboo, palms, cactus, lantana, and rose entering the land. Previously, habitat management played an important role with regards to the introduction of non-indigenous species such as Acacia and Euphatorium throughout Java Island. Until the last decade, the problem of non-indigenous species in the natural habitat was not recognized. However, the evidence of disturbance by *Acacia nilotica* at Baluran National Park has become the main issue of non-indigenous species threats to biodiversity conservation in Java (Whitten et al., 1996).

This study showed that three plants species: *Cassia tora*, *Euphatorium inulifolium*, and *Lantana camara*, have apparently replaced the native species as the main species in SFA. These plants are able to alter the habitat community by absorbing water resources more efficiently and reducing sunlight penetration to the ground level where grasses grow. A related study by Fagan and Peart (2004) showed that non-indigenous plant species, such as glossy buckthorn *Rhamnus frangula*, was able to reduce the growth and survival of the saplings of all species in a New England pine forest. It is estimated that more than 90% of tree saplings are not able to survive within the high density of glossy buckthorn under closed canopy. Glossy buckthorn has an extensive shallow root system and may be a strong underground competitor. While there are no studies about the impact of non-indigenous species in SFA, the following explanation about such species provides evidence of their threats.

Cassia tora (Caesalpinaceae) is native to the Asia-temperate, Asia-tropical, and Pacific regions, and known to contain a number of secondary metabolites and flavonoids (Le Grand, 1989). Many herbivores avoid *C. tora* as a main food probably due to its chemical content. *Eupatorium inulifolium* (Compositae) is native to Southern America and has become naturalized in Java. The leaves of *C. tora* and *E. inulifolium* also contain a number of secondary metabolites and flavanoids that are repulsive animals. *Lantana camara* (Verbenaceae) is a toxic invasive weed and a fast-growing shrub from Central and South America. Ecologically, *L. camara* is a drought resistant species and easily grows in many soil types. Its stem and leaves are covered with rough hairs and emit an unpleasant aroma when crushed. Because of the smell, most herbivore avoids lantana as its food resource. The evidence of *L. camara* as a serious invasive species and the role of biological control of such species came from Chillers and Neser study (1991). Since the effectiveness of biological control of *L. camara* is performed by insects, it seem such method is one of the optional strategy to overcome *L. camara* invasion. However, the native insect should be employed to avoid any future problems.

The issue of invading non-indigenous species in SFA should be addressed since these species have negative impacts on water availability, seedling of other plants and habitat quality. The abundance of alien plant species in SFA, where the ecosystem is dry and water availability is scarce, should be given greater attention. The evidence and relationship between water scarcity and alien species have been studied by Enright (2000) and Richardson (2001). They have showed that alien plants absorb more water than native vegetation such as grasses and shrubs.

This study has shown that non-indigenous plant species have a high impact on the habitat viability to support wildlife. Hence, a better management of SFA should be established and promoted to control the occurrence and invasion of non-indigenous plant species. Recently, management of non-indigenous species in SFA has been included burning methods proposed by the national park authority. However, this method presents a potential paradox. Fire triggers seeding and expansion in plants such as *Imperata cylindrica*, but reduces the diversity of plant species. An alternative strategy such as manual removal followed by re-vegetation, may be a better choice to combat non-indigenous plant species expansion.

However, such methods require more workers, and re-vegetation by grass is possible only during the rainy season.

Bos javanicus is an endangered bovid species whose global population is estimated to number 5000-8000 individuals. Archival documents show that Alas Purwo had originally more than 100 *Bos javanicus* individuals (van Steenis, 1937; Simon and Tyson, 2002). However, the population appears to be decreasing. A monitoring study in January 1999 reported only 17 adult female *Bos javanicus* in Alas Purwo (Simon and Tyson, 2002). Further population survey on *Bos javanicus* in SFA by the authors in July 2002 showed an average sighting of 25 animals per day (Hakim et al., 2004). In August 2003, the number of *Bos javanicus* in SFA was reported as 15 animals per day (Ruikana, 2004). Long-term and continuous data on the *Bos javanicus* population in SFA are not available, but it is clear from temporal studies that the population is decreasing. Simon and Tyson (2002) argued that the decreasing number of *Bos javanicus* is caused by predation of dholes *Cuon alpinus*. However, there is no statistical evidence to show a predation relationship between banteng and dholes in SFA. Hence, this explanation is not satisfactory, and other theories should be developed to explain the decline in *Bos javanicus* population size. We suggest that the loss of plants species for food, limited availability of food resources, and proliferation of non-native plant species are the main factor to drive decreasing *Bos javanicus* in SFA.

In the case of SFA, it may be argued that the destination attractions, particularly the *Bos javanicus* and other wildlife attractions, are still quite appealing to tourists. However, the negative gap between tourist expectation and tourist perception indicates that dissatisfaction was high among respondents. This should be considered as a serious warning with regards to the destination competitiveness since the result shows that the tourist expectations of enjoying wildlife were not met. Most tourists state that they visit SFA to see *Bos javanicus*, but failed to actually see them.

6. Conclusion and Recommendation

Previous researches had suggested that non-indigenous species have great impacts on biodiversity by altering community structure, reducing water availability, reducing seed germination and growth, changing the nutrient composition, and changing the landscape. Our findings suggest that *C. tora*, *E. inulifolium* and *L. camara* are the non-indigenous species posing serious threat to the SFA. The invasion of such species has led to a decrease in the *Bos javanicus* population during the last decade. The results also showed that the *Bos javanicus* number is fewer than 6 animals making it an inadequate wildlife tourist attraction. Currently, the negative gap between tourist expectations and tourist perceptions is high. These findings suggest that the SFA requires more attention and strict management, mainly to mitigate non-indigenous plant species invasion and to improve the habitat quality of the SFA.

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Endnote:

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