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学 位 論 文 審 査 の 要 旨

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学 位 論 文 題 名

Savannah disturbances and human-wildlife coexistence inside and around East African protected areas
(東アフリカの自然保護地域内外におけるサバナの攪乱と人間・野生動物の共存)

Savannah is one of the world's largest biomes, occupying over 20% of the total terrestrial area. Because of vital savannah ecosystems found in East Africa, governments have established protected areas (PAs) and limited human activities within PAs as the best strategy for safeguarding these intrinsic ecosystems. As of 2021, an estimated 27% of the total land area of East Africa is under protection to conserve biodiversity. Despite the increased number of PAs, there is evidence of widespread wildlife loss caused by the expansion of human activities towards the edges of PAs. Dense human populations and increased land conversion have progressively forced wildlife into closer contact with people, resulting in more frequent and severe conflict over space and resources.

This study aimed to examine savannah disturbances within and outside PA boundaries, discuss their implication on wildlife habitat utilization, and explore the potential of human-wildlife coexistence in the surrounding unprotected areas. The study was conducted in the region's largest National Park in East Africa as a case study. The study area selected was the Ruaha–Rungwa landscape in Tanzania. The Ruaha–Rungwa landscape comprises the Ruaha National Park (RNP), Rungwa–Kizigo–Muhesi Game Reserves (RKMGR), and unprotected surroundings. Using high-resolution long-term time-series data and the LandTrendr algorithm in Google Earth Engine, this study mapped patterns, severity, and rate of savannah disturbances in 2000–2019. Further, GPS-collared elephant movement data collected from 2015–2019 and ecogeographical variables were used to define areas that are likely to be utilized by elephants. Additionally, the previous literature was examined to understand the nature of the human-elephant conflict (HEC) and evaluated the effectiveness of conflict mitigation measures where elephant and human land use overlap outside PAs.

The results showed an occurrence of significant savannah disturbance patterns in the surroundings of PAs. From 2000–2019, the spatial-temporal fragmentation patches were highly pronounced in the zones closest to RKMGR boundary, 10-km and 20-km zones with 57% and 52% of total disturbed area.

The savannah disturbance severity ranged from 0.22 to 1.00, with median 0.79, suggesting a high proportion of the complete removal of the savannah cover. High disturbance severity was dominant in the RKMGR than the RNP due to the expansion of agricultural activities. The temporal distribution indicated a consistent increase of the savannah disturbance in the latter decade (2010–2019), probably reflecting the continuous prevalence of anthropogenic activities due to an increase in the human population. The minor disturbance severity was observed within the boundaries of the RKMGR and RNP, suggesting that habitat in these PAs was effectively conserved.

The results from the analysis of habitat utilization showed that elephant home range varied between 620 km² and 6249 km², similar to the home range of elephants in other ecosystems in East Africa. The spatial distribution of elephants' home range was concentrated within the PAs, but a significant part extended into the unprotected surroundings. The distribution of space use of the elephants within PAs indicated the strong preference of low-risk areas in the RNP to RKMGR where trophy hunting is permitted. The key predictors of elephant presence and habitat use were the distance from the PAs and water availability. Similarly, a significant population of elephants uses the unprotected areas in western RKMGR, which overlaps with human use. The analysis of GPS collar elephant movement data confirmed the potential hotspots for HEC due to overlapping human and elephant use.

The results from the literature examination illustrated that, in East Africa, the unprotected areas adjacent to PAs are experiencing unprecedented human population growth. It also revealed that a significant wildlife population uses these areas, which attributes to increased human-wildlife interface. Besides, the surrounding areas and residents are not included as part of the initial PA management plans. This gap has led to widespread human-wildlife conflict due to competition for space, water, and food, with the most common cause of conflicts being crop raids from elephants. Further, human-wildlife coexistence approaches are still lacking, and the burden of conflicts was heavily incurred by the residents who employ various methods to deter wildlife. Finally, this study developed a framework that emphasizes the potential role of surrounding communities/landscapes in conservation by empowering local communities to manage the wildlife on their land. This study will be beneficial to boost livelihoods and reduce poverty by forming semi-protected areas where both wildlife and humans are thriving.

In the future, the edges of the PAs are likely to be further fragmented by human activities due to the rapidly growing population. This study demonstrated the efficiency of the LandTrendr algorithm for monitoring savannah disturbances to ensure the sustainability of the habitat for wildlife and well-being of people and suggested a PA management framework model inclusive of surrounding communities as part of the ecosystem. These findings will help map biodiversity conservation efforts linking biodiversity conservation and local development, which may be particularly relevant for the sustainability of PAs in East Africa.

In addition to the excellent academic knowledge in the research, her academic records throughout the Ph.D. course are outstanding. Based on these pieces of evidence, the committee concluded that Atupelye Weston Komba deserves to become a Doctor of Environmental Science.