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【論文の内容の要旨】

Conflict with wildlife in urban areas is not a unique issue in Japan. According to the statistics reported by Ministry of Health, Welfare and Labor of Japan, hornets, bees and wasps are top insects that have been related with several death reports in the country. The sting caused by these stinging insects such as wasp may be fatal only through single sting, commonly when combined with previous health complications suffered by the victims. To minimize the dangers of hornet towards the residence, government of Japan has provided consultation and assistance in removing hornet's unwanted nest. The demand for the consultation was overwhelmed and increased temporally especially for hornet. With the increased of these consultations demand, the financial and technical support provided by the government has also significantly afflicted. Therefore, efforts to understand the increase of the consultations might help to reduce the conflict between the residents and this stinging insect. While there are several factors that can influence the increase of this conflict, this study will focus on understanding human and hornet dimension. The question that rose in this study is whether these demands were driven by hornet numbers or human tolerance. Hornet adaptability in urbanized areas might have increased due to several factors that beneficial for hornet such as high temperature that increase their hatching rate and small habitat requirement of these insects. However, in the meantime, acceptability of human towards wildlife might also decrease. Lower tolerance towards wildlife has consistently been showed by the elder generations in previous studies, partly due to

their limited physical abilities that induce their vulnerabilities on the wildlife. Nonetheless, lack of nature interactions among urban dwellers caused by limited time spend near nature could have also contributed to the lower tolerance level towards wildlife.

To address this issue, this study first examined hornet's environment preferences based on their abundance correlation within green spaces and hornet's specific species response towards green spaces. There are eight hornet species known to inhabit Japan which are; Vespa mandarinia, V. analis, V. ducalis, V. crabro, V. simillima, V.flaviceps and V. dybowski. With difference level of poison and aggressive levels, understanding their specific response towards environment is beneficial to human safety precautions purposes. Dataset that contained eight years of abundance data for four hornet species at 11 sites in Nagoya city were used. The levels of greenness around the hornet sampling points were measured using averages from the Normalized Difference Vegetation Index (NDVI) with radiuses of 0.1 – 10.0 km retrieved from Landsat-8 satellite. The relationship between abundance and species composition of hornets and NDVI were analyzed at different spatial scales using generalized linear mixed models (GLMM). Higher NDVI values positively affected the abundance of all the hornet species except Vespa analis. The abundances were estimated most effectively using the NDVI average with a 1–2 km radius for all species. The species composition of hornets drastically changed along the gradient of NDVI values; V. mandarinia was dominant in greener areas (over 0.2–0.3 NDVI average with a 2 km radius) and V. analis in less green areas (below 0.2–0.3 NDVI average). Our study showed that the abundance and species composition of hornets were both strongly associated with the level of urban greenness. This suggests that the increase in the urban greenness can increase hornet abundance and alter the species composition of hornets; a more aggressive species, V. mandarinia, may also increase in urban areas, although V. analis is currently the most critical species according to regional consultants. This study also suggests that V. crabro might also depend on green spaces but not V. analis and V. ducalis due to their inconsistent trend of abundance near green spaces.

In second dimension of this study, we examined the trend of removal demand by the resident as indicator of human-hornet conflict. We hypothesized human as the main drivers of removal trend in this study. We suggest hornet dimension can be suggested by green spaces as our previous study indicated higher number of hornet near green spaces. For human dimension, we used aging generation population as well as residential sizes to represent human's low tolerance and high human density respectively. The effects of green spaces, estimated from NDVI, the proportion of the aging population to total

community on the number of removals and the residential areas per ward sizes in Nagoya, Japan, were analysed over 16 years. V. analis, V. mandarinia and V. crabro were considered as nuisance species due to high removal demands of these species which removals were all positively correlated with greenness level, residence sizes and aging generation. However, based on the result, we found that the number of removals were strongly estimated by aging generation ratio suggested that the variable as the main driver of this conflict. Therefore, this study suggest that human–hornet conflicts are driven more by social and human factors than natural factors such as hornet abundance and NDVI.

Balancing ecosystem services and disservices has become crucial for the planning and management of green spaces, particularly when urban green space increases. We also demonstrate how human tolerance towards wildlife may have to be improved in order to live in greener environment where wildlife can be expected. Although studies have examined the ecosystem services provided by natural environments in urban areas, they may have overlooked the capacity for humans and wildlife to coexist. With limited research dedicated to understanding how human–hornet conflicts occur in urban areas, the results of our study suggest risk communication and environmental education are instrumental in reducing human–hornet conflicts in aging urban communities.