

学 位 論 文 要 旨

Effects of food quality and availability on the life history traits of sika deer 餌資源の質と利用可能量がニホンジカの生活史特性に与える影響

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Large herbivores have increased their number and expanded their range considerably which caused not only damages in agriculture and forestry but also natural vegetation as well for the last several decades in the northern hemisphere. When severe grazing affects plant abundance and quality profoundly, the efficiency of rumination and dry matter digestibility for deer decreases as crude protein (CP) decrease and neutral detergent fiber (NDF) increases. Thus, difference in food quality and availability affect the body weight which leads to changes in life history traits of deer. However, there are some empirical studies to indicate that deer populations have remained at relatively high density in the habitats where preferred high CP plants have been decreased due to chronic overgrazing by deer.

To reveal how deer can maintain high density under severe food limitation, I evaluated the effect of food quality and availability on the life history traits of two sika deer (*Cervus nippon*) populations inhabiting contrasting habitats in Oku-Nikko (ON) with limited high quality food and Ashio (AS) with abundant low quality food, Tochigi Prefecture, central Japan. The main food in ON was dwarf bamboo (*Sasa nipponica*), which has high CP (15% in summer and 13% in winter) and low NDF (70% in summer and 75% in winter). This plant sometimes had low availability because of the combination of snow accumulation and reduced culm height associated with chronic grazing. The main food in AS was Japanese pampas grass (*Miscanthus sinensis*), which has low CP (7% in summer and 5% in winter) and high NDF (75% in summer and 82% in winter). Its availability was high because of high

culm height and little snow accumulation. Both populations were colonizing in 1980s, peaked in 1990s, and declined because of a culling operation since 1995.

First, I investigated the effects of population density and snow depth on variation in the winter diet composition of two contrasting sika deer populations by monitoring diet composition for ≥ 15 years. In ON, snow accumulation and high deer density negatively affected the proportion of dwarf bamboo found in rumen contents, with the most significant effect found in fawns. In AS, Japanese pampas grass composed a relatively high and constant proportion of the rumen contents when snow accumulation was ≤ 50 cm. The utilization of Japanese pampas grass was reduced only when deer density was extremely high (> 150 deer/km²).

Second, I tested usefulness of body weight and hind foot length as ecological indicators of density dependence for two contrasting populations during 1995-2012. In AS, hind foot length, body weight, and cohort body weight of adults in both sexes did not change throughout the study period, whereas hind foot length of female fawn and body weight of male fawn increased as population decreased by culling. For ON, hind foot length and cohort body weight of the adult for both sexes decreased throughout the study period. This contradictory response to density change in ON was caused by decline in carrying capacity in study area due to the establishment of a large deer proof fence (980 ha) in 2001. However, body weight of the adult female in capture year order and body weight of fawns for both sexes kept constant level during 1995-2012. Because pregnancy of adult female and survival of fawn depends on their body weight, these results suggest that sika deer population could maintain the minimum productivity with decreasing food requirement under food limitation. I conclude cohort hind foot length of adult male is fit for ecological indicators.

Third, I compared fecundity and survivorship between two populations inhabiting in contrasting habitats. I found longer life expectancy and lower pregnancy rate in AS than those in ON. The spring fawn-to-female ratio in ON fluctuated annually and especially low after the snowy winter in 2014, whereas those in AS were stable among the years. Also, natural mortality rate of fawn in AS was lower than that in ON, when populations reach the same density. Thus, limiting in pregnancy might enable adult female and its fawn to survive even in harsh condition. The values of average age, longevity, proportion of the old individual and generation interval in AS were larger than those in ON, whereas mortality rate, net reproductive rate, and population growth rate in ON were higher than those in AS.

These results clearly demonstrate that absolute density is not the sole factor that affects the variation in the life history traits of sika deer. The combined effects of food quality and availability are overwhelmingly important in determining the life history traits and carrying capacity of sika deer populations. On sika deer population management, body weight and hind foot length are good indicators for monitoring the relationship between population density and habitat structure.