Impacts of deer overbrowsing on aquatic insect fauna in headwaters

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1. INTRODUCTION

Cervid herbivores are increasing in many countries. Also in Japan, sika deer is increasing and inducing alteration of plant community by overbrowsing. Understory vegetation covering forest floor prevent from formation of soil crust and control soil erosion. When forest floor turns bare by deer overbrowsing, progressive soil erosion could cause transportation of sediment into river. Transferred sediment is the main factor of structure alteration of river floor and significantly contributes to life of benthic animals. However, there is no case describes about chain impacts on river ecosystem in terms of relationships between vegetation removal by deer browsing and sediment runoff. In this study, we configured the purpose to reveal the impacts of deer overbrowsing on aquatic insect fauna in headwaters.

2. METHODS

This study was conducted at the headwaters of the Yura river in Ashiu research forest of Kyoto University. In this area, deer overbrowsing has grown into the serious problem since 2000s. We selected natural forest catchment (1.15ha) enclosed by fence to prevent from deer invasion, natural forest catchment (1.66ha) permitted deer invasion and Japanese cedar plantation catchment (1.31ha) permitted deer invasion as study sites. Each catchment is called U catchment, K catchment and S catchment below. Vegetation cover and number of understory vegetation species at left side bank in each catchment were recorded in June and August in 2008. Four quadrats were set by surber net in each catchment at random and all benthic animals in quadrat were collected. Collections were conducted every month from May to October in 2008. Divided aquatic insects from collected benthic animals were classified according to their life types. They were also compared aquatic insect fauna among above-mentioned catchments. Also, pictures of internal quadrats were taken from upper 50cm point to evaluate the proportion of fine sediment in quadrats.

3. RESULTS AND DISCUSSION

84 species of understory vegetation were observed in U catchment. The vegetation covered forest floor entirely. 31 species of understory vegetation were observed in K catchment. Since most of vegetation assembled at the upper hillslope, low vegetation cover was formed and exposed soil was distributed locally at the lower hillslope. Although 28 species of understory vegetation were observed in S catchment, the vegetation dwindled to almost nothing at the middle and upper hillslope. However, abundant cedar litter covered forest floor entirely. Proportion of fine sediment to river floor was the smallest at U catchment and was followed by S catchment and K catchment in order. Therefore, while abundant vegetation in U catchment and abundant litter in S catchment protect surface of soil and control sediment runoff, sediment supply into stream may be larger in K catchment because of poor covering matter of forest floor.

4,507 benthic animals including 3,677 aquatic insects (9 orders, 48 families and 91 taxa) were collected in this study. As the seasonal changes in each catchment were large, there was no obvious pattern in number of individuals and taxa of aquatic insect. These seasonal changes were probably brought by insects which belong to particular life types or functional feeding group. Meanwhile, focusing on life types of aquatic insects in K catchment, number of insects belong to Burrower, which prefer to live in fine sediment, were significantly larger than other catchmens from May to August and October. Furthermore, Clinger and Crawler, which dislike such bottom environment, were significantly smaller from June to October and from May to August. In conclusion, it gives suggestion that loss of understory vegetation by deer overbrowsing accelerates sediment runoff and influences structure change of life types of aquatic insects strongly.