Journal of Asia-Pacific Biodiversity 8 (2015) 343–348

HOSTED BY

Contents lists available at ScienceDirect

Journal of Asia-Pacific Biodiversity

journal homepage: http://www.elsevier.com/locate/japb

Original article

Response of ground arthropods to effect of urbanization in southern Osaka, Japan

Cheol Min Lee [a,*], Tae-Sung Kwon [b]

[a] Forest and Climate Change Adaptation Laboratory, Center for Forest and Climate Change, Korea Forest Research Institute, Seoul, South Korea
[b] Division of Forest Insect Pests and Diseases, Korea Forest Research Institute, Seoul, South Korea

ARTICLE INFO

Article history:
Received 1 October 2015
Received in revised form
20 October 2015
Accepted 21 October 2015
Available online 1 November 2015

Keywords:
Armadillidiidae
ground arthropods
Isopoda
southern Osaka
urbanization

ABSTRACT

Ground arthropods are abundant in urban ecosystem, but our understanding of their ecological traits is limited. The aim of this study is to clarify the effect of urbanization on ground arthropod communities. Ground arthropods were monitored weekly at six sites (Site 1: Yamato River riverbank; Site 2: Daisen Park; Site 3: Oizumi Ryokuchi Park; Site 4: Osaka Prefecture University campus; Site 5: paddy field; and Site 6: town forest) from April 2005 to December 2005. A total of 221,000 individuals of ground arthropods belonging to 19 orders were identified in the dataset. Isopoda, including Porcellionidae and Armadillidiidae, was the first dominant order and 195,161 individuals were collected, representing 88.3% of the total. The mean density of ground arthropods in Sites 1–4, urbanized areas, was much higher than that in paddy field and town forest. The pattern of ground arthropod community in riverbank did not differ from those of urban park, urban forest area, and university campus. Our findings showed that ground arthropods tend to increase biomass in urban areas and some specific groups in areas urbanized and disturbed by human activities.

Introduction

The nature of ecosystems in the vicinity of urban areas is undermined due to the expansion of cities, and such ecosystems are continuously disturbed by human activities (McKinney 2002; Alaruikka et al 2003). Habitats of wild animals have rapidly deteriorated, as they have disappeared, fragmented, or isolated during urbanization and their populations have become extinct locally (McIntyre et al 2001; McKinney 2008; Lee and Kwon 2013; Lee et al 2015). Urbanization and its impact are one of the most critical challenges that humans are facing (Magura et al 2013). The urban population worldwide increased from 746 million in 1950 to 3.9 billion in 2014, and 2.5 billion people will be added to the population by 2050 (United Nations 2014).

The study of biotic communities on urban ecosystems is important for evaluating the impact of urbanization on wild animal habitats and preserving biodiversity in urban areas (Niemelä et al 2000; George and Crooks 2006; Rubèn and Ian 2009; Sattler et al 2011). It is essential to understand how urbanization affects species richness, species composition, populations, and communities, because changes in community attributes influence the structures and functions of ecosystems (Bang and Faeth 2011). Ground arthropods are sensitive to disturbance caused by humans and biological and nonbiological environmental changes because they have a relatively short lifecycle (McKinney 2008; Magura et al 2013). Many ground arthropods have limited mobility, are closely related to vegetation and soil environment, and play the roles of consumers, detritivores, carnivores, parasites, and herbivores. Therefore, ground arthropods are considered to be an ideal indicator for evaluating urbanization (McIntyre 2000; Magura et al 2008; Bang and Faeth 2011). Many studies on the impact of urbanization are usually conducted at the species level such as Isopoda, Carabidae, Cerambycidae, and Araneae (Gaublomme et al 2008; Lee and Ishii 2009; Sattler et al 2011; Lee and Kwon 2013; Magura et al 2013). However, studies on responses of the entire ground arthropods communities were not enough (McIntyre et al 2001; Bang and Faeth 2011). Therefore, this study conducted a survey at a riverbank, urban park, urban forest area, paddy field, university campus, and town forest in southern Osaka. The impact

* Corresponding author.
E-mail address: leecheolmin77@gmail.com (C.M. Lee).
Peer review under responsibility of National Science Museum of Korea (NSMK) and Korea National Arboretum (KNA).

http://dx.doi.org/10.1016/j.japb.2015.10.007

of urbanization on ground arthropods was discussed based on our findings.

Materials and methods

Study sites

The survey was conducted using pitfall traps in the six areas: Yamato River riverbank (Site 1), Daisen Park (Site 2), Oizumi Ryokuchi Park (Site 3), Osaka Prefecture University campus (Site 4), paddy field (Site 5), and town forest (Site 6) (Figure 1). The overview of vegetation and environment of each site is as follows:

Site 1 (Yamato River riverbank) is located on the riverbank of both sides on Kyouki bridge over the Yamato River (left bank: Matsubara City; right bank: Osaka City). A total of 20 traps were set up on the left bank: 10 in the vegetation area dominated by *Phragmites karka* and *Salix* sp. and 10 in the recreation ground with a wide vacant lot. In the right bank, 20 traps were set up in an area dominated by herbs such as *Arundinella hirta* and *Cayratia japonica*.

Site 2 (Daisen Park), a green area of about 35 ha, is located in Sakai city close to Nintoku Royal Tomb, which is interspersed with small ancient tombs. A total of 50 traps were set up in Site 2: 10 in a grassland dominated by herbs such as *Acer buergerianum* and *Digitaria ciliaris*; 10 in a *Phyllostachys pubescens* forest; 10 in an area where *Quercus glauca*, *Quercus serrata*, and *Quercus myrsinaefolia* are vegetated; 10 in a grassland where deciduous trees such as *Pterocarya rhoifolia* are vegetated and dominated by *Solidago altissima*; and 10 in an area where deciduous trees such as *Rhododendron hirado azarea* and *Prunus jamasakura* are vegetated.

Site 3 (Oizumi Ryokuchi Park), an urban open space of about 88 ha, is located in eastern Sakai city and southwestern Matsubara city, and 300,000 trees belonging to about 200 species are vegetated. A total of 40 traps were set up: 10 in a lawn where *Euonymus japonica* is planted, 10 in a grassland where deciduous trees such as *A. buergerianum* are planted and dominated by herbs such as *C. japonica*, 10 in a *Q. glauca* forest, and 10 in an area where *Ulmus parvifolia* and *Zelkova serrata* are vegetated and dominated by herbs such as *Setaria viridis*.

Site 4 (Osaka Prefecture University campus), a university campus of about 49 ha, is located at the central part of Sakai city and composed of a rice paddy, an orchard, and a pond. A total of 40 traps were set up: 10 in an area where deciduous trees such as *Pterocarya stenoptera* and evergreens such as *Q. glauca* are vegetated, 10 in a lawn where a couple of *Zelkova serrata* are vegetated, 10 in an area where deciduous trees such as *Ginkgo biloba* are vegetated and dominated by herbs and short rice such as *D. ciliaris*, and 10 in an area adjacent to a vineyard (*Vitis* sp.) and dominated by short herbs such as *Persicaria longiseta*.

Site 5 (paddy field) is a rice paddy located at Tomikura area in southern Sakai city. It is dotted with secondary forests dominated by *Q. glauca*, and rice is cultivated from April to September. A total of 30 traps were set up in four places in the rice paddy, and two places between secondary forests and the rice paddy.

Site 6 (town forest), dominated by *Quercus serrata* and *Quercus acutissima*, is an area located at Hachigamine area in southern Sakai city and adjacent to town forest and rice paddy where *Pleioblastus chino* var. *viridis* is vegetated at a forest floor. A total of 40 traps were set up: 20 at forest edges of the town forest and 20 in the rice paddy.

Survey method

The survey was carried out from April 2012 to December 2012 using pitfall traps. A plastic cup (diameter 7 cm, depth 10 cm) was used to make a trap without using any bait, and five holes were made to avoid rainwater. The traps were set up in a row at intervals of 5 m at each survey site, and their opening parts were set at the same height from the ground. They were set for a week and surveyed for a total of 38 times at each survey site. As some traps were lost during the survey, 1392, 1370, 1084, 1349, 1063, and 1488 traps were collected from Sites 1–6.

This study identified every ground arthropod up to the order level and up to the family level for Stylommatophora, Isopoda, Hymenoptera, and Coleoptera. In this study, to evaluate biomass (dry weight), ground arthropods were dried at 60°C for 48 hours using an air dryer (Samyang, Osaka, Japan), and an automatic scale (A and D, HR-60, precision = 0.1 mg) was used to measure the weight.

Land-use pattern

A 1:5000 scale map published in 2001 by the Geospatial Information Authority of Japan was used to analyze the surrounding

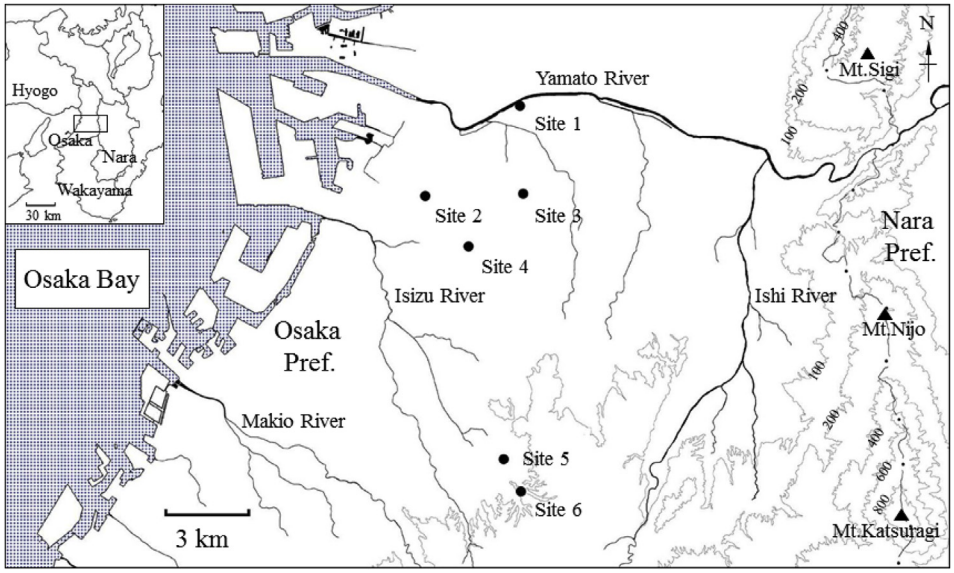

Figure 1. Location of six study sites in southern Osaka.