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Original Article

The monitoring of sand dune insects using pitfall trap in Goraebul beach, Yeongdeok-gun, South Korea

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ABSTRACT

This study conducted surveys using the pitfall trap method to understand the characteristics and changes in the occurrence and distribution of insects in line with the changes of dune vegetation and seasons in Goraebul beach, Yeongdeok-gun, Gyeongsangbuk-do. The results show that the two different species of *Gonocephalum pubens* (83.15%) and *Labidura japonica* (6.98%) that belong to the families Tenebrionidae and Labiduridae, respectively, among eight species have relatively higher population density and that *G. pubens* dominates in terms of its density and reveals a significant difference from that of the other species. The study found differences in the occurrence of population at the time of surveys in four different spatial segments, including the beach, which is not covered by vegetation, the area covered by vegetation, the shrubbery, and the *Pinus thunbergii* community. Among the species that appear monthly, some appear throughout the year while others appear at specific periods of time.

Introduction

Coastal sand dune and tidal mudflats are iconic coastal ecosystems with very high ecological value as they serve as a bridge between the marine and terrestrial ecosystems while fulfilling a buffering function as the ecotone (Van der Maarel, 2003; Walker et al, 2003). In particular, a coastal sand dune features a higher biodiversity than other ecosystems despite its small area and features specialized fauna and flora that are unlike those species inhabiting in inland ecosystems (Kutiel et al, 2000). In addition, the distribution of arthropods that appear in coastal sand dunes is characterized by changes in vegetation and physical and chemical factors, and unique fauna successfully adapted to these changes and factors are known to reveal a zonation phenomenon (Hesp, 1991; McLachlan, 1991; McLachlan and Brown, 2006).

Arthropods in coastal sand dunes are known to be a major component of coastal sand dune ecosystems because they are sensitive to environmental changes and are included in most nutritional stages (Bigot et al, 1982; Burger et al, 2003; Comor et al, 2008; Ponel, 1986), and they are also sensitive to regional features (moisture content in sand, temperature, salinity and pH, etc.), resulting in different distribution patterns of spatial and temporal species throughout the region from sand dune to coast (Aloia et al, 1999; Colombini and Chelazzi, 1996; Colombini et al, 1994, 2002, 2005; Comor et al, 2008; Fallaci et al, 1997). Among the various arthropods, insects are highly adaptable to the environment and thus are characterized by very high species diversity. They also play a variety of roles in terms of the food chain of ecosystems, such as detritivore, herbivore, carnivore, pollinators, and fungivore (Hayashi, 2004; An, 2001; Triplehorn and Johnson, 2005). Among them, beetles are classified into the missing link category in ecosystems with the highest biodiversity, and the species that belong to the Coleoptera show a high dominance ratio among insects in domestic coastal sand dunes (Erwin, 1988; Hammond, 1992; Kim, 2003; Triplehorn and Johnson, 2005; Wilson, 1992).

In addition, coastal sand dunes feature changes in physical and chemical factors such as salt concentration, size of sand particles and pH according to the distance from the beach to the inland, and these changes are closely related to the occurrence of dune vegetation (Bang and Lee, 2011; Hesp, 1991; McLachlan, 1991; McLachlan and Brown, 2006; Myeong, 2010), and the insects that appear in coastal sand dunes are also known to be affected by these physicochemical factors (Aloia et al, 1999; Colombini and Chelazzi, 1996; Colombini et al, 1994, 2002, 2005; Comor et al, 2008; Fallaci et al, 1997).

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As such, the coastal sand dune represents a unique biota with various interrelationships among terrains, plants, and insects, but most domestic studies on the insects in coastal sand dunes focus on taxonomic research based on entomofauna (Kim, 1979; 1980; 1981; 1983) or on subjective evaluations based on qualitative surveys (Kim and Kim, 1999) and are lacking in terms of research on the changes in insect communities associated with physicochemical changes. In addition, there has been a dearth of studies on the east coastal sand dunes as a majority of preceding studies have concentrated on west and south coastal areas (Kim, 2003).

This study analyzed changes in the patterns of insects that appear in a coastal sand dune area on a monthly basis and on a vegetation colony basis as a result of 5-year-long monitoring and surveys in the Goraebul coastal sand dunes in the eastern coast of Korea using the pitfall trap method. Recently, the coastal sand dune in Korea is losing its function and original shape as a natural coastal region because of increasing human interference, which necessitates raising awareness about this issue and the need to study the management and restoration of coastal sand dunes as well as gather basic data and information to gain an in-depth understanding of the coastal sand dune ecosystem. Against this backdrop, this study on the characteristics of insects that appear and are distributed in a coastal sand dune environment is expected to serve as a basic data to understand the ecosystem of coastal sand dunes in Korea and to facilitate the study of changes in the community structures of insects in line with environmental changes.

Materials and methods

Survey areas

Goraebul beach on the east coast of Korea is located in Byeonggok-myeon and Yeongi-myeon, Yeongdeok-gun, Gyeongsangbuk-do (N: 36 ° 34′46″, E: 129 ° 24′53″, beach length 4.6 km) and is known as the largest coastal sand dune region in the east coast of South Korea (Bang and Lee, 2011). This study selected three sampling lines within the main survey area (55 m × 70 m) with a fixed quadrate (5 × 5 m) established for the purposes of conducting a vegetation survey in the Goraebul coastal sand dune environment. Researchers installed pitfall traps in six sampling points along each line (18 points in total) and monitored insects trapped in them (Figure 1).

Among the three lines, P.1 was the community for *Pinus thunbergii* formed by a windbreak forest, P.3 was the community for *Vitex rotundifolia*, and P.6 was partly scattered with vegetation but was mostly an exposed beach area. The remaining sampling points—P.2, P.4, and P.5—were herbaceous communities composed of mixed insects, including *Elymus mollis*, *Calystegia soldanella*, and *Glehnia littoralis* (Figure 2). Although the area that contains these points is a restricted military zone, in some districts within the area, village residents cultivate *G. littoralis*, which means that they are subject to the influence of human interference.

Monitoring

We monitored and inspected insects trapped using the pitfall trap at 18 sites where small quadrates were installed. Among the various methods of collecting insects, the pitfall trap method is most frequently used for surveys of arthropods as it is simple, efficient, and cost-effective (Prasifka et al, 2007; Southwood, 1978). In particular, most surface insects inhabiting coastal sand dunes are nocturnal, hiding in hiding spots during the day because of the rising temperature in their habitat and starting to engage in activities after sunset, which makes them suitable for studying ground invertebrates in coastal sand dune environments (Aloia et al, 1999; Colombini and Chelazzi, 1996; Colombini et al, 2002; Spungis, 2002). This study utilized plastic cups (9.5 cm in depth, 9 cm in diameter, and 5.3 cm in bottom diameter) as traps, and the

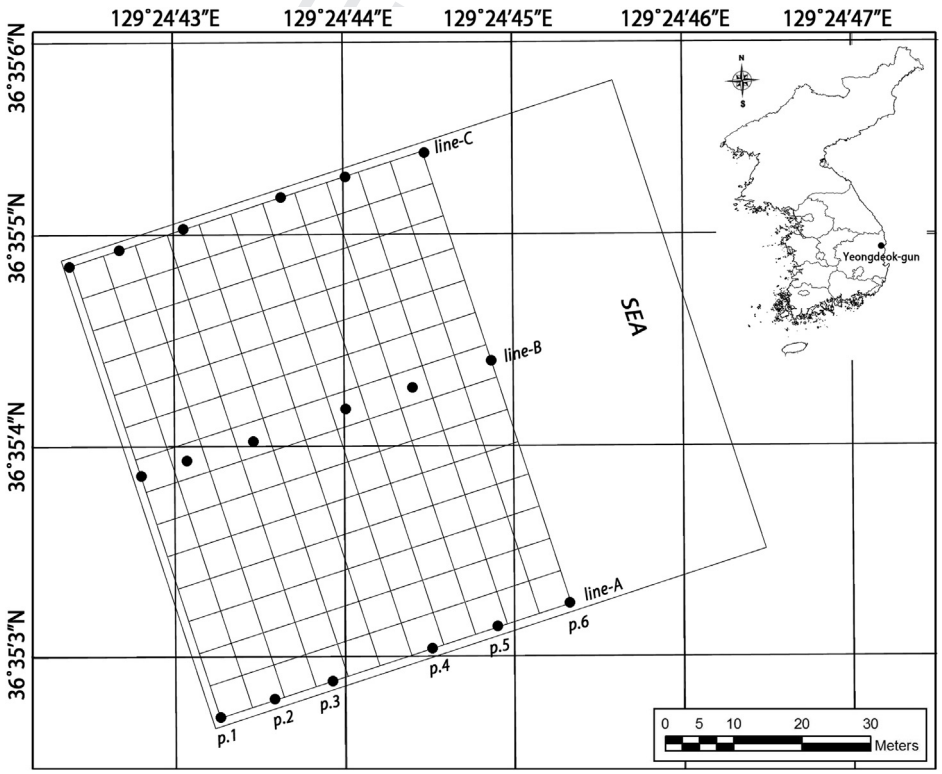

Figure 1. Grid installed (5 × 5 m) and sampling points from Goraebul coastal sand dune.

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