SEASONAL AND SPATIAL CHANGES IN THE STRUCTURE OF THE SUBCORTICAL INSECT COMMUNITY IN PINE FORESTS

KEN YOSHIKAWA and MAKOTO KASAHARA

Laboratory of Silviculture, Faculty of Agriculture
Kochi University
Monobe B200, Nankoku City, Kochi, Japan 783

INTRODUCTION

More than 30 species of beetles have been identified/documented as pine borers in Japan, the majority of them belonging to the Curculionidae, Cerambycidae, and Scolytidae. The density of their populations is controlled primarily by food supply. Although most of them are secondary pests which cannot attack healthy trees, an epidemic of pine wilt disease caused by the pine wood nematode, *Bursaphelenchus xylophilus*, has guaranteed them a continuously sufficient food supply. This paper discusses the results of an experiment to study seasonal and spatial changes in the structure of the subcortical insect community in pine forests.

EXPERIMENTAL METHODS

The study was conducted in pine forests along the ridge of a group of hills extending 8 km inland from the seashore (Fig. 1). Traps made of black vinyl chloride and baited with α-pinene and ethyl alcohol were used to attract flying adult beetles. Eight traps were set up in 1985 and seven traps were added the following year. The traps were placed 1.5 m above ground to facilitate evaporation of the attractants, α-pinene and ethyl alcohol. the dominant species of pine in the area under study shifts from *Pinus thunbergii* in the coastal region to *P. densiflora* in the inland area.

RESULTS AND DISCUSSION

Fauna

More than 1,300 specimens of Cerambycid beetles were captured during three seasons. They were classified into 36 species and 28 genera. The dominant three species, *Monochamus alternatus*, *Spondylis buprestoides*, and *Arhopalus coreanus*, accounted for about 65 percent of the total catch.

Weevils were classified into 59 species and 42 genera belonging to four families, Curculionidae, Rhynchophoridae, Anthribidae, and Apionidae. Fifteen species, representing 95 percent of the total catch, can attack pine trees (Shikoku Branch Gov. For. Exp. Stn. 1962). About 85 percent of these specimens belonged to the genus *Shirahoshizo*, which includes *Sh. insidiosus*, *Sh. pini*, and *Sh. rufescens*. The ratio among the number of these three species was 53:28:19.

Scolytidae and Platypodidae were classified into 52 species and 14 genera. About one half of them (14 out of 29 identified species) belonged to the group of ambrosia beetles. Eleven species can

BARANCHIKOV, Y.N., MATTSON, W.J., HAIN, F.P., and PAYNE, T.L., eds. 1991. Forest Insect Guilds: Patterns of Interaction with Host Trees. U.S. Dep. Agric. For. Serv. Gen. Tech. Rep. NE-153.

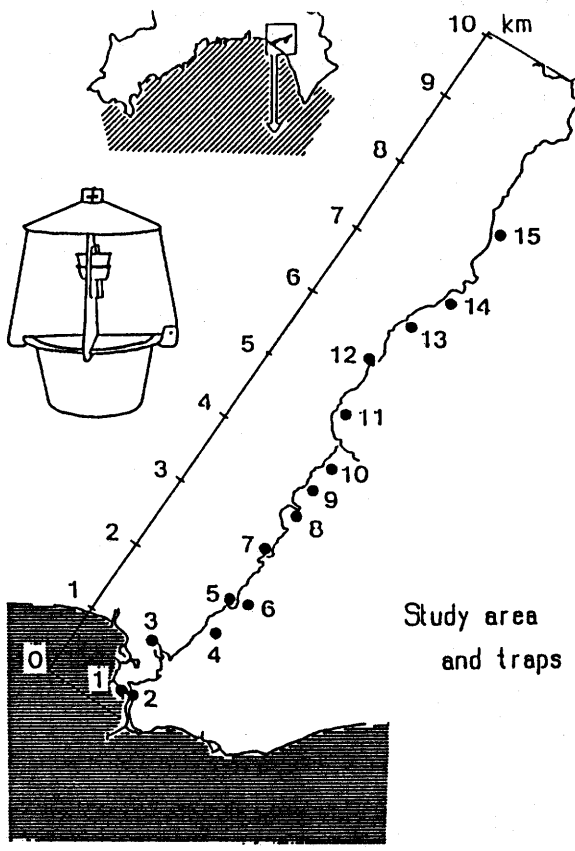

Figure 1. Trap and trapping sites along an 8 km ridge.

feed on pine trees (Yasunaga 1964, Nobuchi 1966, Hayashi et al. 1984). *Taenioglyptes fulvus*, *Tomicus piniperda*, and *Xylosandrus crassiusculus* were the main pests and they accounted for 89 percent of the total catch.

Although α-pinene is the principal attractant for *M. alternatus*, almost all other species were attracted to α-pinene. Thus α-pinene appears to be an effective tool for investigating the subcortical insect community.

Changes in Abundance

Temporal and spatial niche segregations were observed among the dominant species of the three groups--the cerambycids, the weevils, and the scolytids.

Seasonal Changes

In the cerambycid community, *M. alternatus* and *Sp. buprestoides* were the first to commence flight (Fig. 2A). As the flight period of *Sp. buprestoides* was not long, the ratio of this species decreased in August, as that of *A. coreanus* increased. In September, *A. coreanus* amounted to about 60 percent of the total catch.

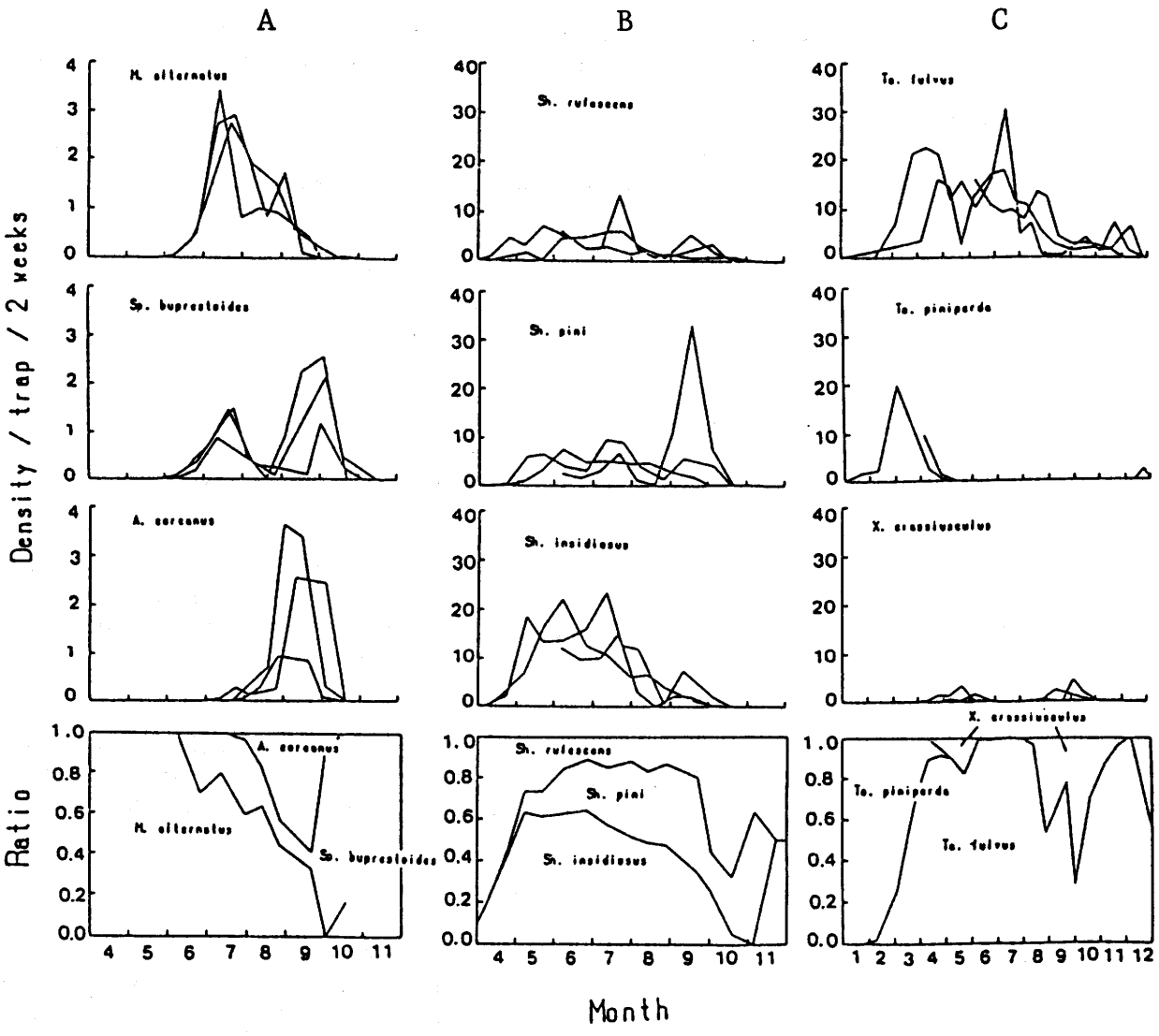

Figure 2. Seasonal trapping density (upper three diagrams in each column) and relative proportion of catch (lower diagram in each column) in three separate years for (A) the cerambycids: *Monochamus alternatus*, *Spondylis buprestoides*, and *Arhopalus coreanus*, (B) the weevils: *Shirahoshizo rufescens*, *S. pini*, and *S. insidiosus*, and (C) the scolytids: *Taenioglyptis fulvus*, *Tomicus piniperda*, and *Xylosandrus crassiusculus*.

Sh. rufescens was the first species to appear in the spring (Fig. 2B). The main season for *Sh. insidiosus* extended from May to July and showed several peaks during the flight period.

Ta. fulvus was attracted to the α-pinene traps throughout the year (Fig. 2C). This species was able to repeat one or two generations under field conditions (Oda 1970). *To. piniperda* characteristically appeared in early spring, showing peaks from March to April. *X. crassiusculus* showed two peaks, one from May to June and a second from September to October.

Local Changes

The distribution of *M. alternatus* was concentrated in an area between 1 and 3 km from the seashore, and that of *A. coreanus* in the inland portion of the ridge. *Sp. buprestoides* appeared both in coastal and inland areas.

The number of *Sh. pini* increased with the distance from the seashore and attained maximal numbers at a point 6 to 8 km inland. Neither *Sh. insidiosus* nor *Sh. rufescens* showed such a regular/uniform/consistent increase.

In the coastal region, *Ta. fulvus* was the dominant scolytid species. The ratio of *Ta. fulvus* exceeded 95 percent at the seashore, and that of *To. piniperda* increased with distance from the seashore. The main distribution area of *X. crassiusculus* was 3 to 4 km from the seashore.

Community Structure

By the seasonal changes in diversity index (H'), local differences in community structure were analyzed.

For the cerambycid beetle community, the study area was divided into the coastal portion and the inland portion at a point about 4 km from the seashore. For the weevil community, traps were divided into two groups by a borderline drawn at a point 2 to 3 km from the seashore. Traps were also grouped into two clusters for the scolytid beetle community and the boundary between the two groups was drawn at a point 3 to 4 km from the seashore.

Points where the community structure of subcortical insects changed were found to overlap with alterations in elements of the pine stand structure such as tree height and species composition. Thus the structure of pine forests appears to affect the community structures of subcortical insects.

SUMMARY

In Japanese pine forests, 36, 59 and 52 species of cerambycid beetles, weevils, and scolytid beetles, respectively, were attracted to/by traps baited with α-pinene and ethyl alcohol over a period of 3 years. For each group of insects, seasonal and spatial changes of dominant species were investigated.

LITERATURE CITED

HAYASHI, M., MORIMOTO, K., and KIMOTO, S. 1984. The Coleoptera of Japan in color. 6. Hoikusha Pub., Osaka. 438 p. (In Japanese.)

NOBUCHI, A. 1966. Studies on Scolytidae. IV. Bull. Gov. For. Exp. Stn. 185: 1-49. (In Japanese with English summary.)

ODA, K. 1970. Pine borers in Japan, p. 415-438. Ringyo shin gijutsu 33 sen. (In Japanese.)

SHIKOKU BRANCH GOV. FOR. EXP. STN. 1962. Pine borers in Shikoku Island. Kochi Rinyu 429: 2-12, 430: 8-29, 431: 2-14, 432: 2-17, 433: 1-18. (In Japanese.)

YASUNAGA, K. 1964. Pine beetles and their natural enemies. Rinya Kyosaikai, Kumamoto. 123 p. (In Japanese.)

☆ U.S. Government Printing Office: 1991—551-151