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Aoki's oribatid-based bioindicator systems*

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Abstract

The "MGP analysis" created by Dr. J. Aoki in 1983 and the "100 oribatid species" system proposed by Aoki in 1995, both for using oribatid communities as bioindicators, are described herein and compared to some other bioindicator protocols. By using the term "naturalness", Aoki proposed to explain human impact on a gradient of several environments ranging from urban boulevard trees to intact forests. Although using "naturalness" was a vague concept, the idea might reflect the process of plant succession and changes in oribatid assemblages associated with different seral stages. Therefore, the use of oribatid mites as bioindicators might also be based on succession of the oribatid fauna.

Key words: "100 oribatid species", bioindicators, MGP-analysis.

Introduction

Of the more than 650 named oribatid mite species currently known in Japan, 300 were originally described by Dr. J. Aoki. Although Aoki is generally considered an oribatid taxonomist, he also developed methods for using oribatids as biological indicators. Unfortunately, his proposed bioindicator-methods did not gain much international attention because they were published mostly in Japanese.

Although several systems using oribatids as bioindicators of soil quality have been proposed and elaborated (van Straalen, 1998; Behan-Pelletier, 1999; Ito & Aoki, 1999; Prinzing *et al*., 2002; Maraun, 2000; Maraun *et al*., 2003; Lindo & Visser, 2004; Caruso *et al*., 2007), the systems outlined by Aoki from the 1970s to the 1990s consisted of two unique methods, involving a) taxon scoring ("100 oribatid species") and b) MGP analysis (described below). He used the term "naturalness" to describe the state of health of forests. That term is not a readily definable, but was proposed to explain human impact on a gradient of environments/conditions from highly disturbed urban areas to intact native forests.

Aoki & Kuriki (1980) considered roadside trees to be the poorest environment of that gradient. Despite the poor diversity in such urban settings, Aoki discovered and described new oribatid species (e.g. Aoki, 1974) from trees of busy downtown streets in Tokyo. At the other extreme, the Shinto-shrine forests in Japan represented the undisturbed forests. These "most natural" forests are traced back to ancient animism and modern Shinto religion, which has kept undisturbed forests behind Shinto shrines for hundreds or thousand of years.

Thus, in his research, Aoki collected samples for taxonomic studies of oribatids from environments ranging from urban areas to the natural Shinto-shrine forests all around Japan, using the results of those studies to relate oribatid fauna with human environmental impact. Of course, under ideal circumstances, undisturbed/un-impacted forests should be carefully matched to the geology and climate of the disturbed habitats, but the shrine forests seemed adequate for that purpose. Here I outline Aoki's bioindicator methods and describe how they have been applied and tested.

Literature survey

Data and figures were taken from significant publications of Aoki (e.g. Aoki, 1978, 1979a, b, 1983, 1985; Aoki & Harada, 1985; Harada & Aoki, 1997). Table 1 shows the chronological evolution of the bioindicator methods proposed by Aoki discussed in this paper.

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