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Relationships between biodiversity and ecosystem functioning across different scales

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Relationships between biodiversity and ecosystem functioning have been extensively studied (Loreau et al. 2002), but the spatial and temporal scales of the biodiversity examined vary widely among individual studies. I organized a symposium, ''Relationships Between Biodiversity and Ecosystem Functioning Across Different Scales'', at the 51st Annual Meeting of the Ecological Society of Japan (March 2005) to facilitate a discussion on what direction should be taken toward unifying approaches at different scales. An international collaboration, ''Biodiversity and Ecological Complexity'', under the Japan Society for the Promotion of Science program between the Centre for Population Biology (CPB) at Imperial College, the Department of Ecology and Evolutionary Biology at Princeton University, and the Center for Ecological Research at Kyoto University (1997–2002) formed the background to the symposium. The first leaders of this program were John Lawton, awarded the Japan International Prize in 2004, Simon Levin, who received the Kyoto Prize in 2005, and the late Masahiko Higashi. They contributed to the development of biodiversity research by organizing international workshops and sending young researchers to work under each other. The next leader of the program at the CPB, Charles Godfray, who succeeded John Lawton, joined the symposium. In almost the same period as the trilateral collaboration program was carried out, the Center for Ecological Research at Kyoto University carried out ''An Integrated Study on Biodiversity Conservation under Global Change and a Bioinventory Management System'' under the MEXT Creative Basic Research Program (1997–2001; see Kawanabe 2002)

Although studies on relationships between biodiversity and ecosystem functioning have been developed through international collaborations, the spatial and temporal scales of the biodiversity examined differed among various individual studies. I thought we should develop concepts or methods linking biodiversity processes at different scales.

At the symposium, four researchers presented biodiversity studies carried out at different scales using different approaches, from molecular biology in laboratories to ecosystem studies in natural fields. Articles of three of the four are published in this issue on these and related topics.

Junji Takabayashi reviewed studies of his group on complex chemical information systems in tritrophic communities of plants, herbivorous insects and their enemies. In response to damage by herbivores, plants are known to emit volatiles that enhance the effectiveness of carnivorous natural enemies of herbivores. Their current interest is what is the actual chemical information system when herbivores of multiple species attack a plant. They study the relationship between species diversity and complex chemical information systems by chemical and molecular methods. The topic is presented in this issue as a review paper.

Charles Godfray presented information on invertebrate community structure and indirect effects. He showed that the evidence suggests that apparent competition is widespread and may be very significant in insect community structure. He and his colleague present an original article in this issue on intra-specific biodiversity in an aphid model system under the interplay between top-down effects of natural enemies and bottom-up effects of host plants.

Elisa Thébault reviewed and published a theoretical work with Michel Loreau on the relationship between biodiversity and ecosystem functioning in a system of multi-producers and multi-herbivores. She showed that multitrophic interactions make biodiversity–ecosystem functioning relationships more complex and nonlinear, in contrast to the monotonic changes predicted for simplified systems with a single trophic level.

Toshi Nagata from the Center for Ecological Research at Kyoto University reviewed recent studies of his

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group that have tried to examine the link between human-induced changes in water quality and alterations of system properties such as food chain length and biodiversity in rivers and streams. He presented data that suggest a systematic reduction of the food chain length, evaluated as the trophic position of fish, with an intensification of eutrophication. Furthermore, he suggested a unimodal maximum in bacterial diversity (species richness) along an eutrophication gradient. The studies were undertaken at ecosystem scales.

In the Discussion section, Toru Nakashizuka reviewed field studies worldwide on relationships between biodiversity and ecosystem functioning. Takashi Kohyama stressed the importance of biodiversity in relation to global environmental problems. Shigeo Yachi introduced a hierarchical method in watershed management including biodiversity. Takayuki Ohgushi commented on the importance of biological interaction in biodiversity studies, and he and his colleague published a review paper to show the study concept of his group. I concluded that the unification of biodiversity studies undertaken at different scales is a difficult task but it is very important for future studies.

The four articles in this issue all include trophic structures, which show the importance of food webs and biological interactions in biodiversity studies. I hope this special feature, as well as the symposium at the annual meeting of the Ecological Society of Japan, contributes something to the development of biodiversity studies. The symposium was partly financially supported by the Ecological Society of Japan and the Twenty-First Century COE Program of Kyoto University (A14).

References

Loreau M, Naeem S, Inchausti P (2002) Biodiversity and ecosystem functioning: synthesis and perspectives. Oxford University Press, Oxford

Kawanabe H (2002) Report of the MEXT creative basic research: an integrated study on biodiversity conservation under global change and a bioinventory management system. DIVER Office, Kyoto