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Why study woodpeckers? The significance of woodpeckers in forest ecosystems

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On the basis of an opening address given at the 6th International Woodpecker Symposium in Mekrijärvi, Finland, on 27–30 August 2005, and papers presented there, a brief introductory review on population biology and habitat requirements of woodpeckers, woodpeckers in changing environments, and woodpeckers as indicators of forest diversity is presented.

There are over 210 woodpecker species (Dickinson 2003). The hotspots of woodpecker species richness are in south-east Asia, in South and Central America, and in equatorial Africa (Mikusiński 2006), but woodpeckers also play essential roles in bird communities in northern latitudes.

Studying the ecological impact of woodpeckers is important for several reasons. It is well-known that woodpeckers provide cavities for secondary cavity-nesters. Cavity nesters form cavity-webs (Martin & Eadie 1999, Martin *et al*. 2004), which consist of primary cavity-nesting species, weak cavity nesters, secondary cavity nesters, and bark nesters. Certain woodpeckers within the nest-web can be regarded as keystone species, such as the black woodpecker (*Dryocopus martius*) that provides the largest cavities in Europe (Johnsson 1993), and both the northern flicker (*Colaptes auratus*) and great spotted (*Dendrocopos major*) woodpeckers that provide the majority of cavities for secondary cavity nesters in NW North America (Martin *et al*. 2004) and Europe, respectively.

Woodpeckers are highly susceptible to habitat changes. One important reason for this is that most woodpecker species are dependent on dead wood for foraging and excavating cavities, and many woodpecker species prefer specific forest habitats. By excluding dead wood and habitats preferred by woodpeckers, modern forestry creates unsuitable habitats for many woodpecker species and thus causes their decline (Virkkala *et al*. 1993, Angelstam & Mikusiński 1994, Czeszczewik & Walankiewicz 2006). For example, in Finland there are seven breeding woodpecker species, five of which are threatened (red-listed) due, in large part, to forestry practices (Rassi *et al*. 2001).

Because of their susceptibility to habitat changes, woodpeckers can be used as general indicators of forest biodiversity and specific indicators of forest birds (Mikusiński *et al*. 2001). For example, the white-backed woodpecker (*Dendrocopos leucotos*) is regarded in Finland as an umbrella species associated with several threatened beetle species, because both prefer a similar resource — decaying wood in mature deciduous forest (Martikainen *et al*. 1998). In general, woodpeckers are bio-indicators of natural forests and can be used, for example, in forest restoration operations. Most woodpecker species are resident, with adults showing high nest-site fidelity (for the three-toed woodpecker

Picoides tridactylus, *see* Pechacek 2006), which also make woodpeckers accurate indicators of forest quality.

In addition to providing cavities for secondary cavity nesters, woodpeckers interact with other bird species. The increase of the great spotted woodpecker in Britain is, at least partly, connected to the decrease of the starling (*Sturnus vulgaris*). The great spotted woodpecker used to suffer from nest-site interference by starlings, but its breeding success has clearly increased after the decrease of the starling (Smith 2006). In a southern Finnish forest landscape the occurrence of the goshawk (*Accipiter gentilis*) was positively, and that of the great spotted woodpecker, negatively associated with the density and breeding success of the three-toed woodpecker (Pakkala *et al*. 2006). The impact of the goshawk may have to do with a decrease in mammalian predation on three-toed woodpecker nests.

Woodpeckers also interact with many other organisms, such as wood-rotting fungi. The success of woodpeckers in excavating nests or roost sites depends on fungi having rotted the wood. Interestingly, it is possible that wood-rotting fungi, such as polyporous fungi, may depend on woodpeckers as vectors (Jackson & Jackson 2004). Accordingly, all data suggest that woodpeckers are disproportionately important to their ecosystems.

As such, woodpeckers are important model species in conservation biology. The red-cockaded woodpecker (*Picoides borealis*), which is an endangered species in southeastern North America, is commonly used in population viability analyses (e.g. Walters *et al*. 2002). The significance of critical thresholds was studied on the basis of habitat quantity and quality (Angelstam *et al*. 2003). Thresholds are values of habitat quantity or quality below which a species does not occur even when its preferred habitat or resource still exists in small amounts. The critical threshold for the proportion of suitable habitat needed by the white-backed woodpecker in Europe was analysed by Carlson (2000). Dead wood thresholds were presented for the three-toed woodpecker in Sweden and Switzerland (Bütler *et al*. 2004).

Fayt (2006) showed that the cold-adapted three-toed woodpecker may be susceptible to climate change, which may cause a further decline of this species. The three-toed woodpecker has a northeasterly distribution in Europe, and it prefers old-growth forests with plenty of dead coniferous wood. Breeding individuals may not be able to adjust their breeding date to the local food supply in particularly warm springs when their preferred prey (cerambycid beetle larvae) develops earlier than normal (Fayt 2006).

A recent review of regulation of spruce bark beetles by woodpeckers shows that prey mortality caused by woodpeckers can reach 98% (Fayt *et al*. 2005). Accordingly bark beetle populations may be regulated by woodpeckers, such as the three-toed woodpecker, during an epidemic. Predation by woodpeckers also shows that woodpeckers may decrease bark beetle damage in managed boreal forest stands. This brings forth an interesting conclusion: to protect managed forest from pests, old-growth forests preferred by, for example three-toed woodpeckers, should be preserved in sufficient quantities. Thus, there may not be a conflict between logging and conservation of forests: to grow timber, natural forests should also be preserved.

Even within natural forests, several woodpecker species are habitat specialists. Consequently, resources and habitat characteristics used by the woodpeckers can be quantified and the significance of habitat analysed in a reasonable way. Such a habitat study includes the availability and use of a specific woodpecker's preferred food, dead wood, tree species, habitat patches, etc. (Hartwig *et al*. 2006, Huot & Ibarzabal 2006, Ibarzabal & Desmeules 2006, Kosiński 2006).

Unfortunately, small habitat patches are not sufficient even for the most abundant European woodpecker, the great spotted woodpecker: offspring production was lower in small as compared with large forest patches in Poland (Mazgajski & Rejt 2006). This means that fragmentation of forests had a negative effect on the most abundant and probably also least sensitive woodpecker species in European managed forests (*see* also Virkkala *et al*. 1994).

Although the ecology of woodpeckers, such as habitat use and foraging patterns, have been studied, population data are much scarcer (Pasinelli 2006, Wiebe 2006). Demographic data

on woodpeckers are currently accumulating, however, partly resulting from the development of novel methods (e.g. Ibarzabal & Trembley 2006). Genetic variability of woodpecker populations and genetic relationships among populations are also being investigated using microsatellite genetic markers (Ellegren *et al*. 1999). The development of new techniques, and their widespread use, is very important to complete our understanding of woodpeckers and their place in the ecosystem.

Woodpeckers are a common favorite amongst the interested public, particularly when conservation issues are raised. This point was well made by the international publicity received by the rediscovery of the ivory-billed woodpecker (*Campephilus principalis*) in USA (Fitzpatrick *et al*. 2005). Unfortunately, even though several woodpeckers are regarded as charismatic species, many of them are red-listed. While conservation is often of primary importance, the reasons for studying woodpeckers go beyond this. Indeed, reasons for studying these animals include the generation of basic scientific information, the development of techniques extendible to other systems, and possibly into the realm of bio-control, with an associated economic benefit.

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