

***Phellinus*, *Inonotus* and *Ganoderma* - diversity, distribution, ecology and pathology in Europe**

Libor Jankovský, Michal Tomšovský, Tomáš Májek, Min Woong Lee¹

Dpt. of Forest Protection and Wildlife Management, Faculty of Forestry and Wood Technology,
Mendel University of Agriculture and Forestry in Brno, Zemedelska 3, 613 00 Brno, Czech Republic,

E-mail: jankov@mendelu.cz, T.Majek@seznam.cz, tomsovsk@mendelu.cz,

¹Dept. of Life Science, Dongguk University, Seoul, Korea, E-mail: mwlee42@hotmail.com

Key words: Biodiversity, *Phellinus*, *Inonotus*, *Ganoderma*, Butt rot, Polypores

Polypores from genera *Phellinus* s.l. (including species from the genera *Porodaedalea*, *Fomitoporia* and *Fuscoporia*.), *Inonotus* s.l. and *Ganoderma* s.l. are wood decaying fungi, causing white rot. Their taxonomy, ecology, bionomy and pathology has been intensively studied in Europe but the information from other parts of the World is limited. Some of the fungi, e.g. *Inonotus obliquus*, *Phellinus baumii*, *Ganoderma lucidum* s.l. are used as medicinal mushroom in Eastern Asia and North Eastern part of Russia.

Most of such fungi commonly occur as a parasite in forests and also in urban areas; some are mentioned as originators of economical lost and static destabilization of trees in cities. In comparison, other species are very rare and their populations are limited due decreasing quantity and quality of retained dead wood in managed forests. *Phellinus* spp., *Inonotus* spp. and *Ganoderma* spp. play the important role in forest ecosystems in Northern Hemisphere as a parasite and subsequently as saprophytes on fallen down trees. Activities of these fungi in forest ecosystems are important for process of forest regeneration in small scale, when the infected trees became weak and start dying. Especially in the mountain and some boreal ecosystems is rotten wood necessary for starting of nature regeneration on dead wood.

The decomposition of the most important constituents of wood- cellulose and lignin is performed by the production of the lignolytic enzymes. Other compounds potentially utilizable in medicine have been found in various wood rotting fungi. Nowadays many researchers are interested in exploring of the useful compounds produced by wood destroying fungi, mainly polysaccharides (glucans), polypeptides, terpens and others. Some of these species are traditionally produced in mushroom breeding station eg. *Ganoderma lucidum* s.l. and *P. baumii*. The knowledge of biochemical compounds of such species has been intensively studied. In comparison, these of some other species (e.g. *Inonotus radiatus*, *Phellinus conchatus*, *P. hartigii*, *P. lundellii*,

Ganoderma resinosum) have not been sufficiently studied yet.

There are around 14 species of *Inonotus* spp. currently recognized in Central Europe: *Inonotus andersonii*, *I. cuticularis*, *I. dryadeus*, *I. dryophilus*, *I. hastifer*, *I. hispidus*, *I. leporinus*, *I. nidus pici*, *I. nodulosus*, *I. obliquus*, *I. radiatus*, *I. rheades*, *I. ulmicola*, *I. tomentosus*, *I. triqueter*; more than 25 species of *Phellinus* spp.: *Phellinus alni*, *P. cinereus*, *P. cavicola*, *P. chrysoloma*, *P. conchatus*, *P. contiguus*, *P. ferrugineofuscus*, *P. ferruginosus*, *P. hartigii*, *P. igniarius*, *P. laevigatus*, *P. lundellii*, *P. nigrolimitatus*, *P. pilatii*, *P. pini*, *P. populicola*, *P. pouzarii*, *P. pseudopunctatus*, *P. punctatus*, *P. rhamni*, *P. ribis*, *P. robustus*, *P. torulosus*, *P. tremulae*, *P. tuberculosus*, *P. viticola*, *P. vorax*. There are three species of *Ganoderma* spp. in Europe producing perennial fruit bodies: *G. applanatum*, *G. adpersum* and *G. pfeiferii*; other species as *G. lucidum*, *G. resinosum* and *G. valesiacum* produce annual basidiocarps. *G. lucidum* and *G. resinosum* are connected with broadleaved species, *G. carnosum* and *G. valesiacum* prefer coniferous hosts.

Most of above mentioned species is still common in European forest, but the others are disappearing due lacking of old trees and appropriate dead wood in forests (eg. *Phellinus pouzarii*, *P. nigrolimitatus* etc.). Conservation of biodiversity of rare *Phellinus*, *Inonotus* and *Ganoderma* species is fundamentally depends of sufficient amount of old trees and volume of dead wood retained in forests. Some of these fungi show host specificity and occur only on one host genus (eg. *Inonotus dryophilus* on oaks), some other one have very complex life cycle connected with living host (*Inonotus obliquus*, *I. andersonii*). Eg. *Inonotus andersonii* is extremely rare in Europe. It is known from the Czech Republic, Slovakia, Germany and Poland, but only from small, protected areas. Presence of this species has been recently confirmed in Greece. The species is known also from North America and East Asia, and genetic studies confirmed, that in Europe and Asia is the same species, where the genetic comparison with the American specimen is unknown up to date. In the Central Europe, this species has been reported on Turkey Oak *Quercus cerris* and Downy Oak *Quercus pubescens*. Current analyses of molecular genetics help to understand evolutionary relations between species. In the history, species were described on the bases of morphological features of fruiting bodies, host specificity or ecology which sometimes do not correspond to results of molecular studies. For example, *Phellinus igniarius* group involving several sibling species with different affinity to various host tree species. According to hints in literature, *Phellinus igniarius* s.s. occurs exclusively on *Salix*, *P. nigricans* on *Betula* and host spectrum of *P. alni* is not clear. Phylogenetic analyses based on of ITS region of nuclear ribosomal DNA and gene coding for translation elongation factor 1 alpha gene (EF1a) revealed significant differences between specimens growing on distinct host tree species. While *Phellinus igniarius* s.s. is growing predominantly on *Salix* or *Populus nigra*, on record was discovered also on *Malus domestica*. *Phellinus alni* occurs on large spectrum of broadleaved woody plants (*Acer*, *Aesculus*, *Alnus*, *Betula*, *Carpinus*, *Corylus*, *Fagus*, *Fraxinus*, *Juglans*, *Malus*, *Padus*, *Sorbus*) and *Phellinus nigricans* is restricted to *Betula* in Northern Europe or mountain areas in Central Europe. The EF1a data revealed higher interspecific variability resulted in better supported clades

than those of ITS. Generally, the EF1a seems to be more appropriate for distinguishing sibling species of Basidiomycetes than commonly studied ITS region. Similar studies are needed to better understanding of species delimitation of other infrageneric groups of *Inonotus*, *Phellinus* and *Ganoderma*. Nevertheless, detailed knowledge of bionomy and ecological demands of species should not be omitted.

Acknowledgements

The work was supported by the Grant Agency of the Czech Republic, bilateral Czech-Korean project no. 521/07/J039.