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SHORT NOTES

Occurrence of *Porodaedalea pini* (Brot.: Fr.) Murr. in pine forests of the lake district in south-western Turkey

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Summary. The occurrence of basidiocarps of the white rot fungus *Porodaedalea (Phellinus) pini* on *Pinus nigra* subsp. *pallasiana* and *P. brutia* was investigated in six stands, covering a total land area of some 650 hectares, in Isparta province of the Lake District in Turkey. The height above ground of the lowermost *P. pini* basidiocarp was measured on each trunk. Basidiocarps of *P. pini* were found on thirty-eight trees, 32 *P. nigra* subsp. *pallasiana* (84.2% of the total) and six *P. brutia* (15.8%). The breast-height diameter of *P. nigra* individuals with *P. pini* ranged from 41 to 188 cm (average 77.7 cm) and that of *P. brutia* with *P. pini* from 68 to 96 cm (average 76.4 cm). Basidiocarps were mostly found on the lower part of the trunks of old trees. In addition to pathological aspects, the ecological role of the fungus in old-growth pine forests is discussed in relation to nature conservancy and biodiversity.

Key words: white rot, *Pinus nigra* subsp. *pallasiana*, *Pinus brutia*.

Introduction

Porodaedalea pini (Brot.: Fr.) Murr. (syn. *Phellinus pini* [Brot.: Fr.] A. Ames) is a trunk-rot fungus that infects living pines. The fungus enters the tree through the vascular traces of dead branch stubs, from which it spreads to the heartwood of the trunk, extending upwards and downwards from the infection site (Butin, 1995). At the first stage of decay the wood turns reddish brown, subsequently spindle-shaped white flecks and a white pocket rot form (Poller and Storkan, 1978; Butin, 1995). Since the wood invaded by the fungus remains firm for a long time, the mechanical strength of the trunk is reduced only slowly (Butin, 1995).

The fungus is limited to the heartwood (Poller and Storkan, 1978; Butin, 1995), so that the sapwood remains fully functional with no visible symptoms of infection. The bracket-shaped basidiocarps, which only begin to develop on older trees 10–20 years after infection, often around knotholes or beneath dead branches, are usually the first signs of trunk decay (Butin, 1995; Naumann, 1995).

In Europe, *P. pini* predominantly occurs in the northeastern part of the continent, where it is economically significant on pines, while the damage it causes on spruce, larch and Douglas fir is only slight (Butin, 1995). Trunk rot from *P. pini* is mainly a problem in old-growth forests (Ezhov and Konyushatov,

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2001), but severe damage has also been found in 30–40-year-old *P. halepensis* Mill. stands (Sisto and Luisi, 1991). The incidence of *P. pini* in 150–180-year-old *P. sylvestris* L. stands varies from 20–25% (Naumann, 1995) to 77% (Manka and Zebrowska, 1997). As old pine forests have been harvested in recent decades, the importance of the disease has correspondingly declined (Butin, 1995).

Porodaedalea pini was found for the first time in Turkey by Lohwag (1957) on *P. brutia* Ten. in the Istanbul area. Since then the fungus has been reported on *P. nigra* Arnold subsp. *pallasiana* (Lamb.) Holmboe, *P. sylvestris,* and *Abies cilicica* (Ant. & Kotschy) Carr. in different parts of the country (Selik, 1973; Sümer, 1982). It has also been noted on *P. pinea* L. in Izmir province (Solak *et al*., 1999). To our knowledge the fungus has not yet been documented for the Lake District of southwestern Turkey.

The city of Isparta is located in the Lake District of the Mediterranean part of Turkey and has two protected national parks: Kızıldağ National Park (59,600 ha.) and Kovada Lake National Park (6,534 ha.), established in 1969 and 1970 respectively. Beyşehir Lake National Park (88,750 ha.), which is situated between Isparta and nearby Konya, became a national park in 1993. National parks are carefully protected by Ministry of Forestry in Turkey and can be used only for recreational purposes.

The aim of this study was to investigate the occurrence of *P. pini* on *P. nigra* var. *pallasiana* and *P. brutia* in Isparta province, southwestern Turkey.

Materials and methods

In 2005 and 2006 six old growth forest stands in Isparta province were investigated for basidiocarps of *P. pini* on living *P. nigra* subsp. *pallasiana* and *P. brutia* trees. The stands were situated in the Kızıldağ, Kovada Lake and Beyşehir Lake National Parks. Most of the stands were pure stands of one of the pine species. The average number of trees per hectare was 100–200. Surrounding stands comprised *A. cilicica*, *Juniperus* spp., *Cedrus libani* A. Rich., *Quercus* spp. and *Platanus orientalis* L.

Living trees were investigated for basidiocarps of *P. pini* along a stretch of five hundred meters off the main road in each stand. The trees were chosen from the most homogenous parts of the stands. The total number of trees examined in the six stands was 850. The height above ground of the lowermost *P. pini* basidiocarp on the trunk was measured to within one decimetre up to a height of three meters. Above three meters, the height was estimated to 0.5 m accuracy. If the tree grew on a slope, the average between the shortest and longest height from the ground to the fruit body was taken as the height of the basidiocarp. The breast-height circumference of each tree was measured 1.3 m above ground. This value was used to calculate the average diameter of the trees.

Basidiocarps of *P. pini* were identified by Asko Lehtijärvi, Department of Botany, Faculty of Forestry, Süleyman Demirel University, Isparta, Turkey.

Results

Basidiocarps of *P. pini* were found on thirty-eight trees. Most basidiocarps were on *P. nigra* subsp. *pallasiana* (84.2%) and a smaller proportion (15.8%) on *P. brutia* (Table 1). The fungus was relatively common in stands with a high proportion of old trees.

The smallest breast height diameter (BHD) of trees with *P. pini* basidiocarps was 41 cm. Approximately 76% of infected trees were 52–96 cm in diameter. Trees with *P. nigra* subsp. *pallasiana* had both the smallest and the largest BHD (Table 1).

Table 1. Range and mean values of the breast height diameter (BHD) of the *Pimus nigra* and *P. brutia* with basidiocarps of *Porodaedalea pini,* and the height above ground of the lowermost basidiocarp.

Tree species	No.	BHD		Lowermost basidiocarp	
		Range (cm)	Mean (cm)	Range (m)	Mean (m)
P. nigra	32	41–188	77.7	0.5–17	4.4
P. brutia	6	68–96	76.4	1–5.5	2.6
Total	38	41–188	77.5	0.5–17	4.1

The lowermost basidiocarp on each tree was usually near the base of the trunk (Table 1). The lowermost basidiocarp was found 1–3 m above ground on 60.5% of the affected trees (23 trees) but in 7.9% of trees it was located more than ten meters above ground.

Discussion

The incidence of *P. pini* on pines is usually thought to increase with increasing age of the trees (Ullah *et al*., 1974; Ullah, 1978; Butin, 1995; Naumann, 1995; Manka and Zebrowska, 1997; Ezhov and Konyushatov, 2001), and basidiocarps occur mostly on the trunks of old trees (Butin, 2005). An exception to this rule was reported for *P. halepensis* by Sisto and Luisi (1991), who found basidiocarps on 20.2% of 30–40-year-old trees in a large-scale study in southern Italy. In the present study the age of the trees could not be determined as the surveyed stands were in protected areas, but the large diameter of the trees (>40 cm) with *P. pini* basidiocarps indicated that the fungus occurred predominantly on older *P. nigra* subsp. *pallasiana* and *P. brutia* individuals (Table 1). Most likely the ecology of *P. pini* on these tree species was similar as the mean BHD for each species was approximately the same (Table 1), although only six *P. brutia* trees with *P. pini* basidiocarps were found. These results are consistent with Ullah *et al*. (1974), who found decay almost exclusively in trees with a BDH exceeding 44.7 cm.

In the present study basidiocarps were often found at or near the base of the trunk. As only the lowermost basidiocarp on the trunk was recorded for each tree, however, the results do not give a true picture of basidiocarp frequency and decay at different trunk heights. In addition, as decay can extend several meters above and/or below a basidiocarp (Ezhov and Konyushatov, 2001), dissecting the trunk is the only way to ascertain the location and the extent of decay within a trunk. Nevertheless, the results indicate that decay at the base of the trees was very frequent.

Although infection courts of *P. pini* are usually thought to be quite high up on the trunk (Butin, 1995), several authors state that the decay occurs predominantly in the lower and middle portions (Sisto and Luisi, 1991; Manka and Zebrowska, 1997; Arbouche and Rossnev, 2002).

Porodaedalea pini causes economically significant decay on pines in managed forests (Sisto and Luisi, 1991; Butin, 1995). As the basidiocarps in the present study occurred predominantly on large trees, the economical damage caused by the fungus depends largely on the length of the rotation cycle used. Since the development of decay is dependent on heartwood formation in the tree, a low incidence of *P. pini* decay can be expected if the rotation cycle is limited to approximately one hundred years. At that tree age the proportion of heartwood in the stem is still relatively low (Bozkurt, 1979) therefore the fungus has not had much time to cause serious decay.

Although *P. pini* causes economic losses in commercial forests, it also has an important ecological role in old pine forests (e.g. in nature reserves and parks). The fungus can have a positive effect on biodiversity as *P. pini*-decayed trunks of living and dead trees become a habitat for other organisms, such as cavity-nesting animals (Sinclair *et al*., 1987). For example, in North-America *P. pini* and red-cockaded woodpeckers are intimately linked: the bird has learned to create nest sites by excavating *P. pini*-decayed wood from mature pines (Sinclair *et al*., 1987; Jackson and Jackson, 2004). Another example is the association between decay fungi and insects. The presence or absence of a certain fungal species can be the most important factor in determining the insect community that will occur in a tree, as in the case of high stumps of *Picea abies* (L.) Karst. (Jonsell *et al*., 2005).

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Literature cited

Arbouche F. and B. Rossnev, 2002. Distribution and damage by *Phellinus pini* (Brot. ex Fr.) A. Ames in dependence on the form diversity of *Pinus halepensis* Mill. in the Ores forest in Algeria. *Silva Balcanica* 2, 53–58.

Bozkurt Y., 1979. *Ağaç Teknolojisi*. İstanbul Üniversitesi, Orman Fakültesi Yayınları, No: 2482 (Turkish), 170 pp.

Butin H., 1995. *Tree Diseases and Disorders. Causes, Biology and Control in Forest and Amenity Trees.* Oxford University Press, Oxford, UK, 252 pp.

Ezhov O.N. and O.A. Konyushatov, 2001. Distribution of *Phellinus pini* rot in stems of pine. *Lesovedenie* 1, 71–74.

Jackson J.A. and B.J.S. Jackson, 2004. Ecological relationships between fungi and woodpecker cavity sites. *Condor* 106, 37–49.

Jonsell M., M. Schroeder and J. Weslien, 2005. Saproxylic beetles in high stumps of spruce: fungal flora important for determining the species composition. *Scandinavian Journal of Forest Research* 20, 54–62.

Lohwag K., 1957. Ein Beitrag zur Pilzflora der Türkei. İstanbul Üniversitesi, Orman Fakültesi Dergisi, Seri A, 7, 118–128.

Manka M. and D. Zebrowska, 1997. Occurrence of red ring rot caused by *Phellinus pini* (Thore ex Fr.) in two over 150-year-old Scots Pine stands of the Wielkopolska National Park. *Morena -Prace Wielkopolskiego Parku Narodowego* 5, 33–42.

Naumann A. 1995. The spread of *Phellinus pini* in the stem. *Forst und Holz* 50, 315–318.

Poller S. and O. Storkan, 1978. Decay of pine wood by *Trametes pini*. *Holztechnologie* 19, 107–111.

Selik M., 1973. *Türkiye Odunsu Bitkileri, Özellikle Orman Ağaçlarında Hastalık Amili ve Odun Tahrip Eden Mantarlar*. İstanbul Üniversitesi, Orman Fakültesi Yayınları, No: 1848 (Turkish), 55 pp.

Sinclair W.A., H.H. Lyon and W.T. Johnson, 1987. *Diseases of Trees and Shrubs*. Cornell University Press, Ithaca, NY, USA, 575 pp.

Sisto D. and N. Luisi, 1991. Severe outbreaks of rot caused by *Phellinus pini* in pine forests in southern Italy. *Monti e Boschi* 42, 26–28.

Solak M.H., M. Işıloğlu, F. Gücin and İ. Gökler, 1999. Macrofungi of İzmir province. *Turkish Journal of Botany* 23, 383–390.

Sümer S., 1982. *Batı Karadeniz Bölgesi, Özellikle Bolu Çevresinde Bulunan Odun Tahripçisi Mantarlar*. *İstanbul Üniversitesi*, Orman Fakültesi Yayınları, No. 2907 (in Turkish), 194 pp.

Ullah Z., 1978. Decay in the standing temperate conifers of Kagan. *Pakistan Journal of Forestry* 28, 206–216.

Ullah Z., S.M. Jamal and A.R. Beg. 1974. Decay estimation in standing temperate conifers of Swat district and its possible control. *Pakistan Journal of Forestry* 24, 360–373.

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