

Abstract

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Ecology of Stiff Clubmoss *Lycopodium annotinum L.* in the Forest Habitats of the Kraków-Wieluń Jura and Surrounding Areas

In recent years, a decrease in the number of *Lycopodium annotinum L.* stands has been noted. The main reason for this are land drainage, illegal harvest of shoots, and intensive forest management. The existing literature provides general information about *Lycopodium annotinum L.*, i.e. its occurrence, morphology, and general habitat conditions in which it grows. There is a lack of data on the ecology of this species which would describe the relationship between its characteristics and the habitat conditions in which it grows.

The main aim of this study is to investigate the relationships between the properties of *Lycopodium annotinum L.* habitats and the characteristics of its lobes and shoots.

Fourteen study sites were selected for detailed investigations. They differed with soil type and size of *Lycopodium annotinum L.* lobes (from individual shoots to the lobes larger than several hundred m²).

The habitats were characterised by investigating the physicochemical properties of soils, the types of phytocoenosis, the amount of light reaching the forest floor, and the values of ecological indicators. The population size was determined by investigating the size of the lobes, the percentage cover of shoots, and the characteristics of vertical shoots (length, number of branches and amount of growth, length of strobila). The results were analysed statistically in order to find out the relationships between the characteristics of *Lycopodium annotinum L.* and the properties of its habitats.

On the basis of the results, it was stated that *Lycopodium annotinum L.* demonstrates strong adaptability to differentiated habitat conditions. Its populations grow in slightly acidic and very acidic soils which have differentiated content of absorbable ingredients and heavy metals.

The depth of groundwater had a significant impact on the height of shoots and their percentage coverage in the lobe (the deeper the groundwater was, the smaller sizes the shoots and their coverage obtained). The largest lobes were observed in peat soils and those with clay fractions. It was indicated that the size of lobes depends on habitat

trophy as well. The percentage coverage of shoots and their length also depended on the content of organic carbon, nitrogen, and absorbable ingredients in soil surface layers; however the increased content of absorbable ingredients in soils limits the number of branches on the shoots. The content of Pb, Cd, and Zn had a negative impact on the length of shoots.

Lycopodium annotinum L. grows in not only typical, but also transformed phytocenoses with apophytes and invasive species. In the transformed phytocenosis, *Lycopodium annotinum L.* forms lobes of varied sizes and coverage of shoots. The smallest lobes, with the low percentage coverage and short shoots, were reported for pine forest phytocenoses. The percentage cover of shoots and their length are the largest in the stands with large groundcover height and its density. Greater amount of light reaching the forest floor enhances the number of branches on the shoots.