

Risk map for the spread of black locust (*Robinia pseudoacacia*) into dry biotopes valuable for nature conservation in the state of Brandenburg

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Abstract

In Germany, black locust has been classified as an invasive species by nature conservation. On the other hand, it is considered robust to climate change, copes with dry, nutrient-poor soils and has a particularly hard wood. In this conflict, we try to work out problems and opportunities for both nature conservation and forestry with a risk map. Based on dry biotopes valuable for nature conservation as a protected good, we derive zones in which the spread of black locust is problematic. From a distance of 500 m or more between dry biotopes and black locust occurrences, however, we see no threat to nature conservation areas.

Keywords: black locust, invasive species, risk map, dry grasslands

1 Introduction

In Germany, black locust is classified as invasive in the black list of the Federal Agency for Nature Conservation (NEHRING et al., 2013). There is a high potential for its spread, especially in unused or uncultivated open areas (LI et al., 2014; MEYER-MÜNZER, GROTEHUSMANN & VOR, 2015). Climate warming can favour the spread of black locust (MEYER-MÜNZER, GROTEHUSMANN & VOR, 2015). Once it has successfully colonized an area, there is hardly any way to successfully displace the species (ENGEL, KNOCHÉ & LANGE, 2014). According to MEYER-MÜNZER, GROTEHUSMANN & VOR, 2015, it should therefore not be cultivated in the immediate vicinity of areas important for nature conservation.

On the other hand, black locust has valuable properties for forestry. It is considered very resistant to the advancing climate change, it colonizes even dry, nutrient-poor sites and has an extraordinarily hard wood. In order to objectify the discussion in the conflict between nature conservation and the use of black locust, we carried out the project »InvaRo - Assessment of the Invasiveness Potential of Robinia in Brandenburg«,

funded by the Waldklimafonds (Forest Climate Fund). Within this framework, extensive field work was carried out on numerous sites in order to investigate more closely the spread of black locust to dry biotopes valuable for nature conservation (LANDECK & HILDMANN, 2021). This article presents the risk map produced within this framework.

2 Methods

On the basis of data analysis and field work, the aspects relevant for preventing the spread of black locust can be analysed in depth. The various vectors of spread were taken into account, both vegetatively via root spawn and the spread of plant parts, and generatively via wind transport of seeds and possibly animals. In addition to the results of our own analyses, other observations and information from the literature were evaluated. The vectors are countered by spatial resistance, such as stand density during wind dispersal or the forestry path system. The aim is to predict the dispersal mechanisms and intensities of black locust.

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The derivation of the risk zones defined in the following is based on the findings on seed dispersal and the lengths of root suckers-developing roots (LANDECK & HILDMANN, 2021). Thus, it is assumed that black locust at a distance of 50 m and less from a dry grassland are able to colonize it directly via seeds or root suckers. Therefore, this distance range is assessed as a very high risk zone. In the case of black locust trees at a distance of 50 to 100 m, it is assumed that colonization of the dry grassland can only take place via one to several intermediate steps using root suckers. In this context, intermediate steps are to be understood as black locust trees emerging from root suckers, which in turn form root suckers-forming roots. Colonization via seeds is usually excluded at this distance.

A risk map was created on the basis of partial data sets on dry grassland and black locust areas extracted from the biotope mapping data. It visualizes the risk of black locust coming into contact with dry grassland areas due to their spatial proximity. The data basis for the risk map was the biotope type mapping of the state of Brandenburg. The map, which is based on the aerial photo evaluation of 2009³, was updated by the polygons recorded by the State Environmental Agency as of 15.01.2021⁴. From this map, all dry grasslands were recorded. Also, all dry grassland biotopes (biotope types 0512) as well as all biotopes in which black locust can occur, at least in part, were extracted. On this basis, the distance to the nearest black locust area within a radius of up to 500 m was determined for each dry grassland area.

In addition, all other biotope types were differentiated according to whether they tend to inhibit or promote the spread (tab. 1). This is based on the observation that the permeability of some biotopes to the passage of black locust is

significantly higher than that of others.

The risk was now divided into 5 classes (tab. 2). The first class includes the dry grasslands with a distance of less than 50 m to the next black locust occurrence, the second class those where the distance is between 50 and 100 m. In the third and fourth classes, black locust occurs within a distance of 100 to 500 m. In the first case, biotope types that promote dispersal are present (and thus spatial resistance is lower, class 3: increased risk), while in the second case only inhibitory biotopes are present (class 4: low risk). Wherever the distance to the next black locust occurrence is 500 m or more, we assume that there is no longer an increased risk of immigration of black locust. A section of the map drawn up for the entire federal state of Brandenburg is shown in fig. 1. The whole map of Brandenburg is provided as an atlas as supplement. According to this map, there is an increased risk of black locust invasion for about 30 % of the dry grasslands in Brandenburg.

3 Results and Conclusions

As a result, conclusions can be drawn for forestry practice as well as for nature conservation on how to deal with black locust stands in the spatial proximity of sensitive nature conservation areas. This concerns in particular

- an assessment at which sites measures to control the spread of black locust are necessary and effective,
- which prophylactic measures can be considered and promise success, as well as
- how the black locust should be dealt with in the future, especially where it is self-propagating or regenerating and very vital.

³Landesumweltamt Brandenburg, Data licence Germany – attribution – Version 2.0 (<https://www.govdata.de/dl-de/by-2-0>), CIR-Biotoptypen 2009 (Luftbildinterpretation) – Flächendeckende Biotop- und Landnutzungskartierung im Land Brandenburg (BTLN), <https://geoportal.brandenburg.de/detailansichtdienst/render?url=https://geoportal.brandenburg.de/gs-json/xml?fileid=B57B9F35-AFFF-49F2-BA32-618D1A1CD412>

⁴Landesumweltamt Brandenburg, Data licence Germany – attribution – Version 2.0 (<https://www.govdata.de/dl-de/by-2-0>), Biotope, geschützte Biotope (§ 30 BNatSchG und § 18 BbgNatSchAG) und FFH-Lebensraumtypen im Land Brandenburg <https://geoportal.brandenburg.de/detailansichtdienst/render?url=https://geoportal.brandenburg.de/gs-json/xml?fileid=A061BB02-70AC-4422-BB58-4A49F585D7F2>

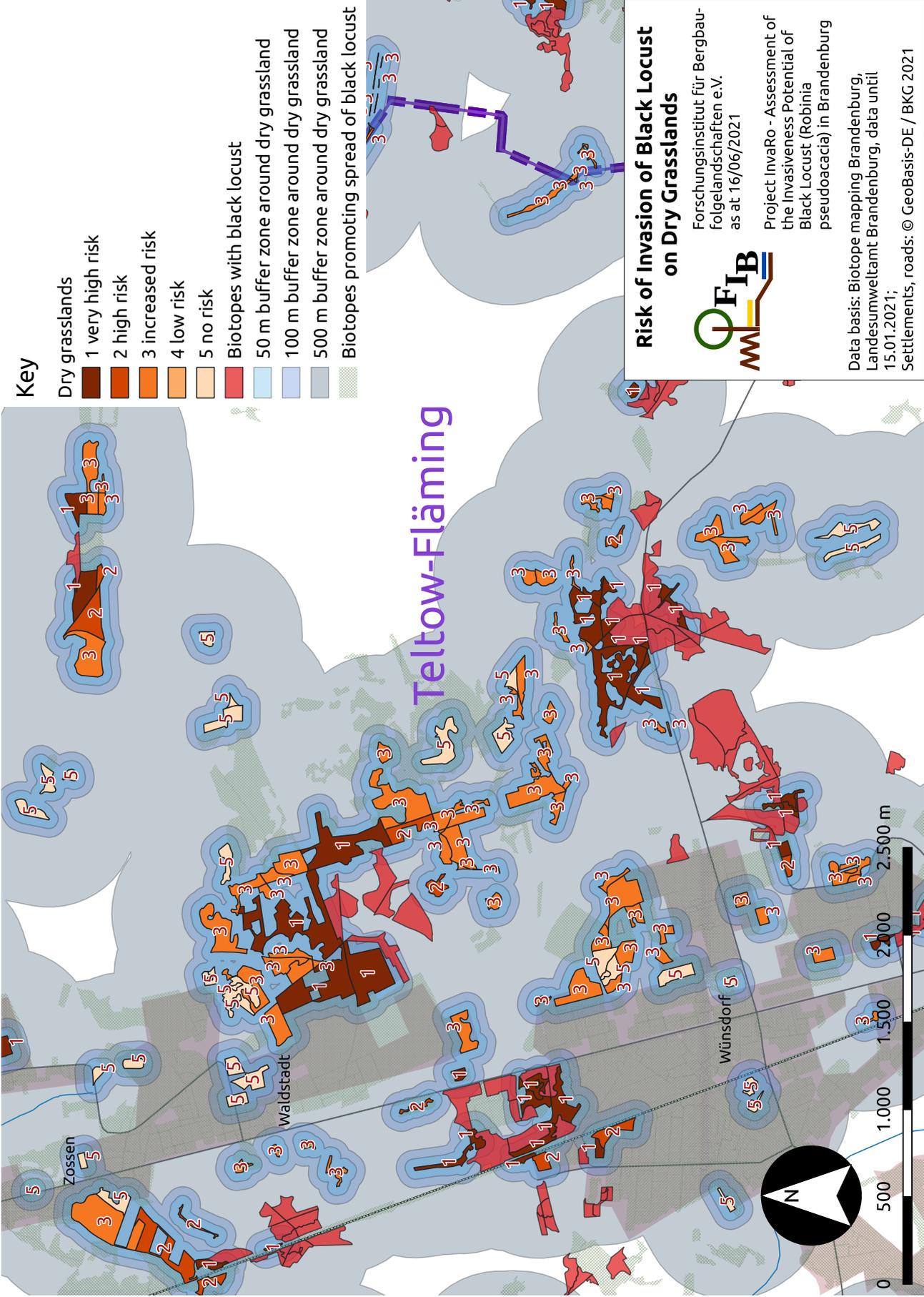


Figure 1: Example from the risk map drawn up for the whole of Brandenburg.

Table 1: Differentiation of the biotope type classes into biotope types that tend to promote or retard the spread of black locust.

Code	Description	Effect
01	running waters	retarding
02	standing water	retarding
03	open soil, ruderal flora	promoting
04	fen and marsh	retarding
05	meadows	
0510	wet meadows / grassland	retarding
0511	fresh meadows	promoting
0512	dry grassland = target biotope	promoting
0513	fallow meadow	promoting
0514	herbal shrubland / border	promoting
0515	intensive used grassland/ meadows	retarding
0516	ornamental lawn	retarding
0517	tread lawn	retarding
06	sdwarf-shrub heather	promoting
07	bushes	promoting
	beside 0720, intensive used orchards	
08	woods and forests	retarding
	beside with presence of black locust	
09	fields	retarding
10	green spaces	promoting
11	special biotopes	promoting
12	built-up areas	promoting

Maintenance interventions as well as measures for stand transfer are also taken into account.

From the results of the project no general arguments can be derived against the cultivation of black locust in the state of Brandenburg. Nevertheless, immigration can be counteracted by suitable measures depending on the respective form of use on the areas between black locust stand and dry grassland.

From the knowledge and observations gained in the context of this project, there is no risk for distances between dry grasslands and black locust stands of more than 100 m for cultivation of annual agricultural crops as the exclusive form of use on the areas in between and of more than 500 m for other forms of use. No measures are necessary here. A graduated risk is seen for all other dry grassland-black locust stand constellations.

The risk that black locust stands can migrate

into dry grasslands increases significantly, especially with decreasing distance between the two. In general, new black locust plantations should be avoided in the vicinity of dry grasslands, as they further increase the risk for the dry grasslands. For this purpose, a 500 m wide zone around the dry grassland areas concerned should be designated as taboo zones.

For dry and semi-dry grasslands in contact with biotope types in which black locust is represented, or those at a distance of up to 50 m from such, there is a very high immigration risk (LANDECK & HILDMANN, 2021). This includes a total of 973 individual areas in the state of Brandenburg (=9.3 %). The sensitive open areas can be reached both by seeds and by root suckers. There is an urgent need for action here. Forest coppices (width, density) are to be designed in such a way that they cannot be penetrated by black locust trees. This includes both a width of more than 30 m (LANDECK & HILDMANN, 2021) and a multi-

Table 2: Risk classes for the colonization of black locust to dry grassland areas

Risk class	Distance to the next black locust occurrence ¹	Reason for classification
1 very high risk	adjacent to the dry grassland or located up to 50 m away	due to generative and vegetative spread, the dry grassland can be reached within one to a few years; classification is independent of the vegetation structures in between
2 high risk	located between 50 and 100 m away from the dry grassland	due to vegetative spread, colonisation of the dry grassland can be assumed within a few years to decades; classification is independent of the vegetation structures in between
3 increased risk	between 100 and 500 m away from the dry grassland	between dry grassland and black locust occurrences biotopes are present (table 1), which promote the spread, thus lower spatial resistance, due to the vegetative spread a colonisation of the dry grassland can be assumed in a few years to decades
4 low risk	between 100 and 500 m away from the dry grassland	between dry grassland and black locust occurrences only inhibiting biotopes are present (table 1)
5 no risk	more than 500 m to the dry grassland	no risk of immigration to be assumed, regardless of the vegetation structures in between

¹ Black locust stand, forest stand with black locust as mixed or secondary tree species or biotope containing black locust

layered structure with the aim of producing the lowest possible light access on the forest floor (< 7% of the light intensity of open areas or <1% share of larger crown gaps (LANDECK & HILDMANN, 2021)). The planting of special preventive shrubs offers an alternative. If black locust already borders directly on sensitive dry grasslands, their immigration can only be prevented by establishing an intensive mowing or grazing zone of corresponding width as a buffer zone on the dry grassland.

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5 Supplement

Atlas of the risk of invasion of black locust on dry grasslands in Brandenburg

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