

**Summary of the Express Pest Risk Analysis for *Litylenchus crenatae subsp. mccannii***

**PRA area:** Ireland

**Describe the endangered area:** The wider Irish environment (outdoors)

**Main conclusions**

The known hosts species for this pest are considered high risk and are prohibited from import into the EU therefore the risks of entry from North America are low. The pest has not yet been found in European regions where Fagus species can be imported into Ireland. However, surveys for the pest within the EU are not yet routine. Given the exact origin of the pest and its full range of possible plants have not been conclusively established the full risk of pest entry is not yet entirely clear. However, based on the current knowledge of the pest's host range and distribution its potential for entry into Ireland should be considered low.

The likelihood of establishment is considered high given the widespread distribution of host plants. The climate tolerances of the pest indicate it can withstand harsh winters and northerly climates. The Koppen-Geiger climate classification for the areas BLD is distributed in the USA and Canada are composed by climatic regions designated as Cfa, CFb Dfa and Dfb (World Maps of Koppen-Geiger Climate Classification, 2019). This overlaps with the Koppen-Geiger classification for Ireland (Cfb). Therefore, Ireland can be considered as most likely having a suitable climate for the pest to establish particularly in light of the widespread distribution and abundance of host beech plants.

The economic importance of beech (Fagus) as a forestry species in Ireland is low. Hedging would be the most at risk sector for BLD. The ability of the pest to spread appears to be quite rapid and the effectiveness of containment measures appears to be limited. Though the economic value of the sector is comparatively low compared to silviculture tree species, the cost of eradication (removing infected trees) if an outbreak occurred would add to the total costs. A potential economic damage score is therefore Low with moderate uncertainty.

No further regulatory actions are proposed at his time as trade in host plants from North America is currently prohibited. However, DAFM inspectors conducting forestry inspections may consider undertaking visual inspections (observing for banding patterns) when on beech forestry sites.

<b>Phytosanitary risk for the <u>endangered area</u></b> ( <i>Individual ratings for likelihood of entry and establishment, and for magnitude of spread and impact are provided in the document</i> )	High <input type="checkbox"/>	Moderate <input type="checkbox"/>	Low <input checked="" type="checkbox"/>
<b>Level of uncertainty of assessment</b> ( <i>see section 17 for the justification of the rating. Individual ratings of uncertainty of entry, establishment, spread and impact are provided in the document</i> )	High <input type="checkbox"/>	Moderate <input checked="" type="checkbox"/>	Low <input type="checkbox"/>

**Other recommendations:**

- Submit IE PRA to EPPO
- Produce Pest factsheet for DAFM website

## Express Pest Risk Analysis:

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### *Litylenchus crenatae* subsp. *mccannii*

**Prepared by:** *Conor Francis McGee*

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## Stage 1. Initiation

### Reason for performing the PRA:

Beech Leaf Disease (BLD) is an emerging condition associated with several species of the genus *Fagus* (Beech) in the USA and Canada. The disease was first reported in 2012 in Ohio USA and has recently been associated to a sub-species of the nematode species *Litylenchus crenatae*. The BLD inducing sub-species in the USA has been taxonomically classified as *Litylenchus crenatae* subsp. *mccannii*. This pest has been found to have spread rapidly throughout the northeast of the USA and southern Canada inducing severe damage to Beech Forestry.

**PRA area:** *Ireland*

## Stage 2. Pest risk assessment

### 1. Taxonomy & Nomenclature

The genus *Litylenchus* is a relatively newly discovered taxon of Nematoda which contains two species and one sub species. Zhao et al. (2011) established the genus when they characterised the new species *Litylenchus coprosma* which was found affecting *Coprosma repens* (Mirror bush) in New Zealand. The second species of the genus, *L. crenatae* was first characterised in 2018 by Kanzaki et al. (2018) affecting *Fagus creanata* (Siebolds beech), *F. sylvatica* f. *purpurea* (Copper beech) and *Alnus hirsute* (Siberian Alder) in Japan. The causal agent of BLD in the USA was first reported as associated to *L. crenatae* by Martin et al. (2019). Carta et al. (2020) later established that the population of *L. crenatae* causing BLD in the USA were in fact a sub-species to the Japanese population based on molecular differences. This sub species is now commonly referred to as *L. crenatae* subsp. *mccannii* or simply *L. crenatae* *mccannii*.

### 2. Pest overview

#### 2.1 Origin

The origin of *L. crenatae* subsp. *mccannii* has not yet been conclusively established. However, it has been proposed to have most likely originated from the Pacific rim region, possibly Japan (Carta et al., 2020).

#### 2.2 Current Distribution

The known distribution of *L. crenatae* subsp. *mccannii* has so far been restricted to several states in the north east of the USA and south-eastern Canada (Ontario) (USDA, 2021). The latest reported extent of the characterised distribution and spread of *L. crenatae* subsp. *mccannii* from the USDA Forest Service is shown in the Appendix Figure 1.

#### 2.3 Hosts

To date *L. crenatae* subsp. *mccannii* has been typically associated with affecting American Beech (*F. grandifolia*) in north-eastern USA and southern Canada (USDA, 2021). However, several other introduced *Fagus* species to the USA have also been reported to display BLD symptoms including *Fagus sylvatica*

(European beech), *Fagus engleriana* (Chinese beech) and *Fagus orientalis* (Oriental beech) (Burke et al., 2020; EPPO, 2024).

Interestingly, *L. crenatae subsp. mccannii* has not been found affecting *F. crenata* in the USA. *Fagus crenata* trees in close proximity to BLD affected *F. grandifolia* trees in Ohio have not yet been observed displaying visual symptoms of the disease (Carta et al., 2020). This is a distinctly different property compared to the *Litylenchus crenatae* species characterised in Japan, which was first identified when isolated from *F. crenata* trees displaying BLD symptoms (Kanzaki et al., 2018). Carta et al. (2020) proposed that *F. crenata* may be resistant to *L. crenatae subsp. mccannii* but this theory has not as of yet been tested using Koch's postulates.

It is currently unknown whether *L. crenatae subsp. mccannii* can affect genera other than *Fagus* but data on the host range of the other two recognised *Litylenchus* species demonstrates their ability to infect host plants across several plant families\*.

\*Note on hosts of other *Litylenchus* species:

*Litylenchus crenatae* in Japan has been reported to affect several *Fagus* species: *Fagus crenata*, *F. sylvatica* and *F. sylvatica f. purpurea* (Kanzaki et al., 2018). Additionally, *L. crenatae* has been reported inducing symptoms similar to BLD on several genera of the family Betulaceae including *Alnus hirsuta*, *Alnus maximowiczii*, and *Ostrya japonica* (Kanzaki et al., 2018). The symptoms of the disease were first observed and recorded in Japan in 2003 (Kanzaki, 2021).

*Litylenchus coprosma* was reported to affect *Coprosma repens* (Rubiaceae) in New Zealand (Zhao et al., 2011). However, unlike the *L. crenatae* and its sub species, *L. coprosma* did not induce galls in *C. repens* leaves and was attributed as having a primitive feeding habits similar to pathogenic species of the genus *Ditylenchus* (Zhao et al., 2011).

#### 2.4 Lifecycle & Aetiology

The complete life cycle of *L. crenatae subsp. mccannii* has not been conclusively characterised, neither have its tolerances for differing environmental conditions. However, several studies support a range of common properties of its infection pathway and phenotypic symptoms. These are briefly summarised below.

The pest appears to over winter in both beech buds and under certain conditions, in leaf material on the ground. One apparent limiting factor to the pest's ability to survive throughout the year is when desiccation of its over wintering habitat occurs (Reed et al., 2020). Populations of *L. crenatae subsp. mccannii* were found not to survive on desiccated leaves attached to trees throughout the winter, however leaves on the ground (leaf litter) which were protected from desiccation by a layer of snow still harboured viable populations when sampled after the winter season (Reed et al., 2020). The pest has been shown to be capable of with-standing extremely low temperatures when inhabiting buds or snow-covered leaves, viable populations were recovered in regions which recorded temperatures as low as -26°C (Reed et al., 2020).

How the pest first arrived in the USA is currently not known. However, several possible pathways have been suggested by which the pest may possibly have spread, such as via trade, an endoparasite of arthropods introduced into the USA, via migrating birds or human activity (Carta et al., 2020). Local movement has been attributed to wind dispersal of infested leaves which introduce viable populations into the ground layer which could be introduced into new host trees via a range of biotic carriers such as arthropods (Reed et al., 2020). The pest appears to be associated with proximity to watery environments with high moisture levels such as near streams (Volk, 2021). Recent research has indicated that birds could be responsible for spreading *L. crenatae subsp. mccannii* within the USA and possibly be responsible for introducing it to distant states such as the recently discovered outbreaks in Connecticut (Lituma, 2021). Several bird species have been shown to feed upon beech buds in the USA and work is currently progressing on determining whether viable populations of *L. crenatae subsp. mccannii* can survive the bird digestive process (Lituma, 2021).

Studies investigating the infection pathways of *L. crenatae subsp. mccannii* have indicated that the infection pathway may need to progress directly from the beech buds. Inoculation of fully developed beech

leaves with nematodes has so far failed to initiate symptoms of BLD, suggesting that nematodes may need to colonize and inhabit bud tissue for a portion of their life cycle (Burke et al., 2020; Carta et al., 2020).

Often, the initial visual symptoms of BLD typically occurs in the shrub layer (lower layer) of beech tree stands (Ewing et al., 2019). The reported visual symptoms of BLD range from mild to severe (USDA, 2021). Interestingly, leaves on a particular branch may display differing degrees of BLD symptoms on different buds, ranging from no symptoms to severe, indicating no vascular pattern to the disease progression (Hausman, 2021). Leaves affected by BLD display visual symptoms from the onset of bud break and these symptoms levels have been observed to persist throughout the growing season on leaves produced from the bud (Ewing et al., 2019; Reed et al., 2020; Volk, 2021). The occurrence of disease signs at bud break supports the proposed role of buds in progressing symptoms of BLD (Ewing et al., 2018). These observations add weight to the theory that buds harbour over wintering populations of *L. crenatae* sub sp. *mccannii*. An irregular observation on BLD affected trees are late flushes (mid-summer) of asymptomatic leaves which have a lime green colour, however, this is not a consistent feature of the disease (Hausman, 2021).

Early mild leaf symptoms of BLD are reported as interveinal darkening of the leaf, commonly referred to as “banding” as shown in the Appendix Figure 2(a+b). The mild conditions are typically characterised by banding covering less than two thirds (<2/3) of the Beech leaf surface (Hausman, 2021). Leaves have been described as having “spongy” galls in portions of leaves displaying BLD, this has been attributed to a possible role of pectinase enzymes produced by *L. crenatae* subsp. *mccannii* (Carta et al., 2020). Severe symptoms of BLD are characterised by deformation, darkening and thickening of the leaf, commonly referred to as crinkling, which often leads to chlorotic banding and/or necrosis later in the growing season (Ewing et al., 2019; USDA, 2021) (Appendix Figure 2(c) and Figure 3). Severe symptoms are typically characterised as having greater than two thirds (2/3) of the leaf surface affected by banding (Hausman, 2021). Eventually, BLD affected buds are aborted and no new leaves are produced in the following growing seasons (Ewing et al., 2019; Ewing et al., 2021). This generally leads to the occurrence of twig and branch dieback and, in some cases, this is followed by tree mortality (Ewing et al., 2019). However, on occasion symptomatic buds have been reported to produce asymptomatic leaves in subsequent years (Volk, 2021). Death of canopy trees has been reported as rare to date, where these have been observed they are generally primarily in or near stands known to have had BLD symptoms for several years (Burke et al., 2020). However, tree mortality has been observed in all age classes, generally occurring between 2-7 years after onset of reported symptoms, though smaller trees appear to be more susceptible (USDA, 2021). Beech sapling mortality has been observed within 2-5 years of first displaying symptoms (Martin et al., 2019). Ewing et al. (2019) reported limited tree mortality in large trees after 6 years, but swifter mortality for young sapling trees (<5 cm Diameter at Breast Height). The effect of BLD on the forest canopy cover has been noted in several publications, with noticeable reductions in canopy layer cover occurring as a result of both tree mortality and twig/branch dieback (Hausman, 2021; Rinker et al., 2019).

Interestingly, Burke et al. (2020) reported that 37% of American beech leaf samples taken in their study contained *L. crenatae* subsp. *mccannii* but displayed no BLD symptoms. Why certain populations of *L. crenatae* sub sp. *mccannii* do not result in disease is currently not understood. However, several studies have recently highlighted a possible role of bacterial species interacting with *L. crenatae* subsp. *mccannii* to produce BLD symptoms. The possible role of specific endosymbiotic bacterial taxa in increasing the fitness of parasitic nematodes has been widely reported (Ewing et al., 2021). The study of Burke et al. (2020) found two bacterial genera, Mucilaginibacter and Wolbachia, to be typically associated with BLD symptomatic leaves and buds inhabited by *L. crenatae* subsp. *mccannii*, these genera were found to be absent on asymptomatic leaves, from this they proposed that these bacterial taxa may play a role in the progression of the disease. These findings were further supported by the study of Ewing et al. (2021) which also found an association between BLD symptomatic leaves inhabited by *L. crenatae* subsp. *mccannii* and the presence of the bacteria genera Wolbachia. These studies suggest that BLD may require both the presence of *L. crenatae* subsp. *mccannii* and a particular bacterium to result in BLD disease progression.

## 2.5 Management, Monitoring and Control Options

At present, there are no treatments available for trees affected by BLD (USDA, 2021). The USDA have proposed common mitigation strategies which are likely to be effective in reducing the spread and incidence of the disease such as destroying infected plant material after removal and avoiding transport of infected material from the incidence sites (USDA, 2021). Pruning infected landscape trees has been suggested as

one method, which may reduce surface moisture and possibly lessen disease severity (USDA, 2021). However, to date no specific management strategies for controlling the spread and impact of BLD have been established (USDA, 2021).

Host trees can be effectively monitored for the presence of the pest using both visual and laboratory diagnostic techniques. BLD symptoms are best observed from the bottom up when surveying trees visually (Hausman, 2021). As younger beech trees display symptoms sooner and exhibit greater BLD damage than older trees, surveys of sapling trees are more effective for identifying the presence of the pest (Hausman, 2021). Carta and Li (2020) developed nematode specific primers for identification of *L. crenatae subsp. mccannii* and optimised a PCR method for the detection of the difficult-to-amplify young populations. Research is currently under way to develop field deployable assay techniques for the detection of the pest using Loop-mediated isothermal amplification (LAMP) Assay techniques (Marra, 2021). Sampling conducted by Reed et al. (2020) suggested that *L. crenatae subsp. mccannii* can be obtained from buds and detached leaves during winter, but that larger sample sizes are needed to detect it reliably. However, late summer and early autumn were the best times to extract live nematodes. In the late spring adult numbers are low and eggs are the predominant form making extraction of sufficient live nematodes difficult (Reed et al., 2020).

**3. Is the pest a vector?** Yes  No

*If the pest is a vector, which organism(s) is (are) transmitted and does it (do they) occur in the PRA area?*

**4. Is a vector needed for pest entry or spread?** Yes  No

The pest cannot enter into the EU by natural means. The pest could possibly be introduced into the EU area on vectors. What these vectors are at present is unknown, birds have been suggested as carriers of the pest along with insects in the US.

### 5. Regulatory status of the pest

EU Reg 2018/2019 currently prohibits the import of known *L. crenatae subsp. mccannii* host plants (*Fagus* spp.) from outside the EU as these are considered high risk plants. Deciduous trees and shrubs, intended for planting, other than seeds and plants in tissue culture may only be imported from most third countries including Japan, USA and Canada if they are dormant and free from leaves (Commission implementing regulation (EU) 2019/2072, Annex VII, point 11) this limits the likelihood of entry of this pest from unknown deciduous host genera which may be in leaf. However, as *L. crenatae subsp. mccannii* can overwinter in tree buds there is still a chance they may be harboured in dormant trees which would not display symptoms. If the host plant range for the pest is wider than what is currently known there may still be a potential pathway for entry on trade in these dormant uncharacterised host plants.

### 6. Distribution

<b>Continent</b>	<b>Distribution</b> (list countries, or provide a general indication, e.g. present in West Africa)	<b>Provide comments on the pest status in the different countries where it occurs e.g. widespread, native, introduced....)</b>	<b>Reference</b>
America	USA; Canada	Introduced	Baker, 2019

### 7. Host plants /habitats\* and their distribution in the PRA area

Beech trees are widely distributed throughout Ireland. The Irish Forestry Statistics for 2020 cited the Ireland's National Forest Inventory (NFI) 2017 as the most recent source for forestry tree species coverage of Irish land area. NFI (2017) estimated beech coverage in Ireland to account for approximately 10,030 ha. This accounted for an estimated 1.5% of tree coverage on the Island. The NFI (2017) lists beech trees in Ireland as predominately being *F. sylvatica* (European Beech) a known host of *L. crenatae subsp. mccannii*.

Beech hedging is a common feature of the Irish landscape and given the general diminutive size of the plants would likely be highly susceptible to the pest. Should the pest enter and establish it could pose a serious threat to the native population.

## 8. Pathways for entry

Currently, there are no imports of *Fagus* plants consignments into the EU from the USA as these are considered as “High Risk” plants. All live *Fagus* plants for planting other than seeds, in vitro material and naturally or artificially dwarfed woody plants for planting are prohibited from import from third countries under EU Reg 2018/2019. Therefore, the entry of this pest is probably unlikely through imports of live plants. However, given that the host range of plants for other *Litylenchus* species includes genera from other plant families, it is not beyond the realms of possibility that other host plant entry pathways may exist for this pest. The fact that this pest has been found to persist asymptotically on certain beech leaves may mean it could do the same on other as of yet unidentified host plants.

<i>Rating of the magnitude of spread</i>	<i>Low</i> X	<i>Moderate</i> <input type="checkbox"/>	<i>High</i> <input type="checkbox"/>
<i>Rating of uncertainty</i>	<i>Low</i> X	<i>Moderate</i> <input type="checkbox"/>	<i>High</i> <input type="checkbox"/>

## 9. Likelihood of establishment outdoors in the PRA area

Given that the known hosts species for this pest are considered high risk and are prohibited from import into the EU the risks of entry remain low. The pest has not yet been found in European regions where *Fagus* species can be imported into Ireland. However, surveys for the pest within the EU are not yet routine. Given the exact origin of the pest and its full range of possible plants have not been conclusively established the full risk of pest entry is not yet clear.

The likelihood of establishment is considered high given the widespread distribution of host plants. The climate tolerances of the pest indicate it can withstand harsh winters and northerly climates. The Koppen-Geiger climate classification for the areas BLD is distributed in the USA and Canada are composed by climatic regions designated as Cfa, CFb Dfa and Dfb (World Maps of Koppen-Geiger Climate Classification, 2019). This overlaps with the Koppen-Geiger classification for Ireland (Cfb). Therefore, Ireland can be considered as most likely having a suitable climate for the pest to establish particularly in light of the widespread distribution and abundance of host beech plants.

<i>Rating of the likelihood of establishment outdoors</i>	<i>Low</i> <input type="checkbox"/>	<i>Moderate</i> <input type="checkbox"/>	<i>High</i> X
<i>Rating of uncertainty</i>	<i>Low</i> X	<i>Moderate</i> <input type="checkbox"/>	<i>High</i> <input type="checkbox"/>

## 10. Likelihood of establishment in protected conditions in the PRA area

No known hosts of BLD are cultivated, at least widely, under protected cultivation in Ireland.

<i>Rating of the likelihood of establishment in protected conditions</i>	<i>Low</i> X	<i>Moderate</i> <input type="checkbox"/>	<i>High</i> <input type="checkbox"/>
<i>Rating of uncertainty</i>	<i>Low</i> X	<i>Moderate</i> <input type="checkbox"/>	<i>High</i> <input type="checkbox"/>

## 11. Spread in the PRA area

The ability of the pest to quickly spread, establish and become ubiquitous in a beech forestry region has been well characterised. Carta et al. (2020) reported that after the first reported sighting of BLD in the Holden Arboretum in Lake County Ohio in 2014, a 1,250 ha natural areas park dominated by *F. grandifolia*, BLD affected 97% of accessioned beech trees in the collection.

The pest is considered to have a high capacity to spread rapidly if it were to become established in Ireland. There are a number of possible means for aiding in the spread of the pest such as natural means (wind dispersal) and potential biotic vectors such as birds and arthropods. Observations of spread within the USA

and Canada highlight the rapid ability of this pest to spread outward from an initial site of establishment. The risk score rating for spread was considered to be High with low uncertainty.

<i>Rating of the magnitude of spread</i>	<i>Low</i> <input type="checkbox"/>	<i>Moderate</i> <input type="checkbox"/>	<i>High</i> <input checked="" type="checkbox"/>
<i>Rating of uncertainty</i>	<i>Low</i> <input checked="" type="checkbox"/>	<i>Moderate</i> <input type="checkbox"/>	<i>High</i> <input type="checkbox"/>

## 12. Impact in the current area of distribution

### 12.1 Economic Impact

To date, the economic and environmental impacts of BLD in the USA have not yet been fully established. In order to know the full effects of disease progression on tree mortality and the ecosystem services they provide more observational time and data will be needed. This is particularly true for older more established trees which appear to be more resilient to BLD which will require longer time periods of monitoring to determine the eventual outcome.

Carta et al. (2020) reported that after the first reported sighting of BLD in the Holden Arboretum in Lake County Ohio in 2014, a 1,250 ha natural areas park dominated by *F. grandifolia*, BLD affected 97% of accessioned beech trees in the collection. Estimated impact calculations of the effects of BLD in Ohio, suggested that if 50% of beech trees were to be lost the projected economic costs would run to \$225 million (USD) (Baker, 2019). This calculated cost was based on loss of ecosystem services provided by beech forestry such as water filtration, biodiversity and habitat provision and carbon capture.

The economic impact from beech tree decline is currently difficult to determine but impacts appear high in a relatively uncommercial sector. Therefore a rating of moderate is assigned but with high uncertainty.

<i>Rating of the magnitude of spread</i>	<i>Low</i> <input type="checkbox"/>	<i>Moderate</i> <input checked="" type="checkbox"/>	<i>High</i> <input type="checkbox"/>
<i>Rating of uncertainty</i>	<i>Low</i> <input type="checkbox"/>	<i>Moderate</i> <input type="checkbox"/>	<i>High</i> <input checked="" type="checkbox"/>

### Management, Monitoring and Control Options

At present there are no treatments available for trees affected by BLD (USDA, 2021). The USDA have proposed common mitigation strategies which are likely to be effective in reducing the spread and incidence of the disease such as destroying infected plant material after removal and avoiding transport of infected material from the incidence sites (USDA, 2021). Pruning infected landscape trees has been suggested as one method which may reduce surface moisture and possibly lessen disease severity (USDA, 2021). However, to date no specific management strategies for controlling the spread and impact of BLD have been established (USDA, 2021).

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### 12.2 Ecological Impact

Beech trees in north eastern USA serve as both a habitat and food source for native wildlife (Marra and LaMondia, 2020). In the USA beech nuts constitute as a primary food source for many woodland birds and

mammals such as bears and squirrels (Ewing et al., 2019). The loss of American beech trees would have a devastating impact on wildlife as they serve as important den and nest habitats (Ewing et al., 2019). In addition, BLD drastically reduces canopy cover in forests, which can affect understory competition and other forest ecosystem services due to modification of the light environment (Ewing et al., 2019).

The loss of beech trees in the USA and Canada is resulting in other tree species such as sugar maple (*Acer saccharum*) replacing beech stands reducing biodiversity in the region.

<i>Rating of the magnitude of impact in the current area of distribution</i>	Low <input type="checkbox"/>	Moderate X	High X
<i>Rating of uncertainty</i>	Low <input type="checkbox"/>	Moderate <input type="checkbox"/>	High X

### 12.3 Sociological Impact

The social effects of the potential loss to beech from a range of parks and amenity areas is considered moderate, beech trees in major arboretums and parks have been devastated by the pests introduction.

<i>Rating of the magnitude of impact in the current area of distribution</i>	Low <input type="checkbox"/>	Moderate X	High <input type="checkbox"/>
<i>Rating of uncertainty</i>	Low <input type="checkbox"/>	Moderate X	High <input type="checkbox"/>

### 13. Potential impact in the PRA area

Should the pest entry and establish the costs of remedial measures to contain the disease could be quite high and possibly ineffective given the wide spread distribution of host plants throughout Ireland. This has been the case with several other forestry pests in the past such as *Hymenoscyphus fraxineus* and *Phytophthora ramorum*. While beech is not a highly economically important forestry species compared to traditionally cultivated forestry species such as Sitka spruce, it is widely traded through nurseries and is widely used for hedging. The ability of the pest to spread appears to be quite rapid and the effectiveness of containment measures appears to be limited. Though the economic value of the sector is comparatively low compared to silviculture tree species, the cost of eradication (removing infected trees) if an outbreak occurred would add to the total costs. A potential economic damage score is therefore Low with moderate uncertainty.

<i>Rating of the magnitude of impact in the current area of distribution</i>	Low X	Moderate <input type="checkbox"/>	High <input type="checkbox"/>
<i>Rating of uncertainty</i>	Low <input type="checkbox"/>	Moderate X	High <input type="checkbox"/>

### 14. Identification of the endangered area

Irish beech forestry and hedging.

### 15. Overall assessment of risk

The known hosts species for this pest are considered high risk and are prohibited from import into the EU therefore the risks of entry from North America are low. The pest has not yet been found in European regions where *Fagus* species can be imported into Ireland. However, surveys for the pest within the EU are not yet routine. Given the exact origin of the pest and its full range of possible plants have not been conclusively established the full risk of pest entry is not yet entirely clear. However, based on the current knowledge of the pest's host range and distribution its potential for entry into Ireland should be considered low.

The likelihood of establishment is considered high given the widespread distribution of host plants. The climate tolerances of the pest indicate it can withstand harsh winters and northerly climates. The Koppen-Geiger climate classification for the areas BLD is distributed in the USA and Canada are composed by climatic regions designated as Cfa, CFb Dfa and Dfb (World Maps of Koppen-Geiger Climate Classification, 2019). This overlaps with the Koppen-Geiger classification for Ireland (Cfb). Therefore, Ireland can be considered as most likely having a suitable climate for the pest to establish particularly in light of the widespread distribution and abundance of host beech plants.

The economic importance of beech (*Fagus*) as a forestry species in Ireland is low. Hedging would be the most at risk sector for BLD. The ability of the pest to spread appears to be quite rapid and the effectiveness of containment measures appears to be limited. Though the economic value of the sector is comparatively low compared to silviculture tree species, the cost of eradication (removing infected trees) if an outbreak occurred would add to the total costs. A potential economic damage score is therefore Low with moderate uncertainty.

### Stage 3. Pest risk management

#### 16. Phytosanitary measures

The pest is considered to pose a substantial risk for beech trees in Ireland should it enter. The Irish climate appears to be suitable for the pest's establishment. Given the lack of control measures available for treating the disease an outbreak could devastate beech abundance in this country and therefore the sector. The effects of widespread beech tree loss would not have a significant effect on the value of the forestry industry but the social and environmental effects and cost of eradication could be considered as a national concern and would reflect poorly on Ireland's plant health status. However, as the most likely entry pathway would be through plants for planting the risk of importing this pest is low as the known host plants are prohibited for import under EU Reg 2018/2019. The conclusions can be largely projected to the species *L. crenatae* which is distributed in Japan. The host range of *L. crenatae* includes *Fagus*, *Alnus* and *Ostrya*. Trade in both *Fagus* and *Alnus* are prohibited under EU Reg 2018/2019. However, the exception are plants of the genus *Ostrya* are not prohibited for international trade under any EU Reg 2018/2019. Whether *L. crenatae subsp. mccannii* can inhabit plants of the genus *Ostrya* has not yet been investigated. However, as deciduous trees and shrubs, intended for planting, other than seeds and plants in tissue culture may only be imported from most third countries including Japan, USA and Canada if they are dormant and free from leaves (Commission implementing regulation (EU) 2019/2072, Annex VII, point 11) this limits the likelihood of entry of this pest from unknown host genera. However, as the pest over winters in buds there may still be a chance of being introduced on dormant tree species which are currently unknown to be hosts for the pest.

No further regulatory actions are proposed at this time. However, DAFM inspectors conducting forestry inspections may consider undertaking visual inspections (observing for banding patterns) when on beech forestry sites.

#### 17. Uncertainty

- The host range of the *L. crenatae subsp. mccannii* has not been tested and is possibly wider than the genus *Fagus* considering the host range of the other two currently recognised species of the genus.
- The full distribution of the pest may not be fully known. Additionally, from where or how the pest arrived in the USA is not understood. The risk of importing the pest be greater than what is currently known.
- Beech Bark Disease (BBD) is also widespread in the distribution range of BLD and how the two diseases will interact is not known.

#### 18. Remarks

- A summary factsheet will be prepared and hosted on the PRAU DAFM website.

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Appendix 1. Relevant illustrative pictures (for information)

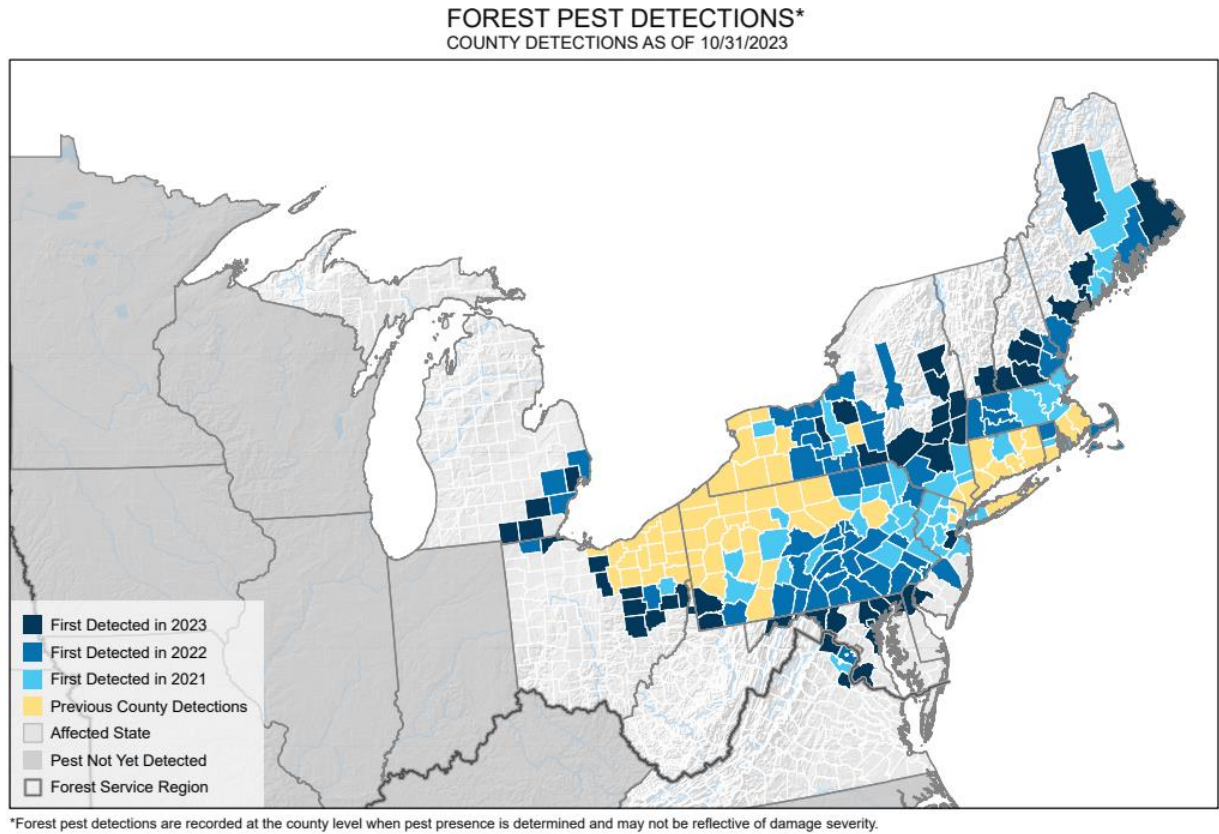


Figure 1: Distribution and spread of *L. crenatae mccannii* in the USA (taken from USDA, 2023).

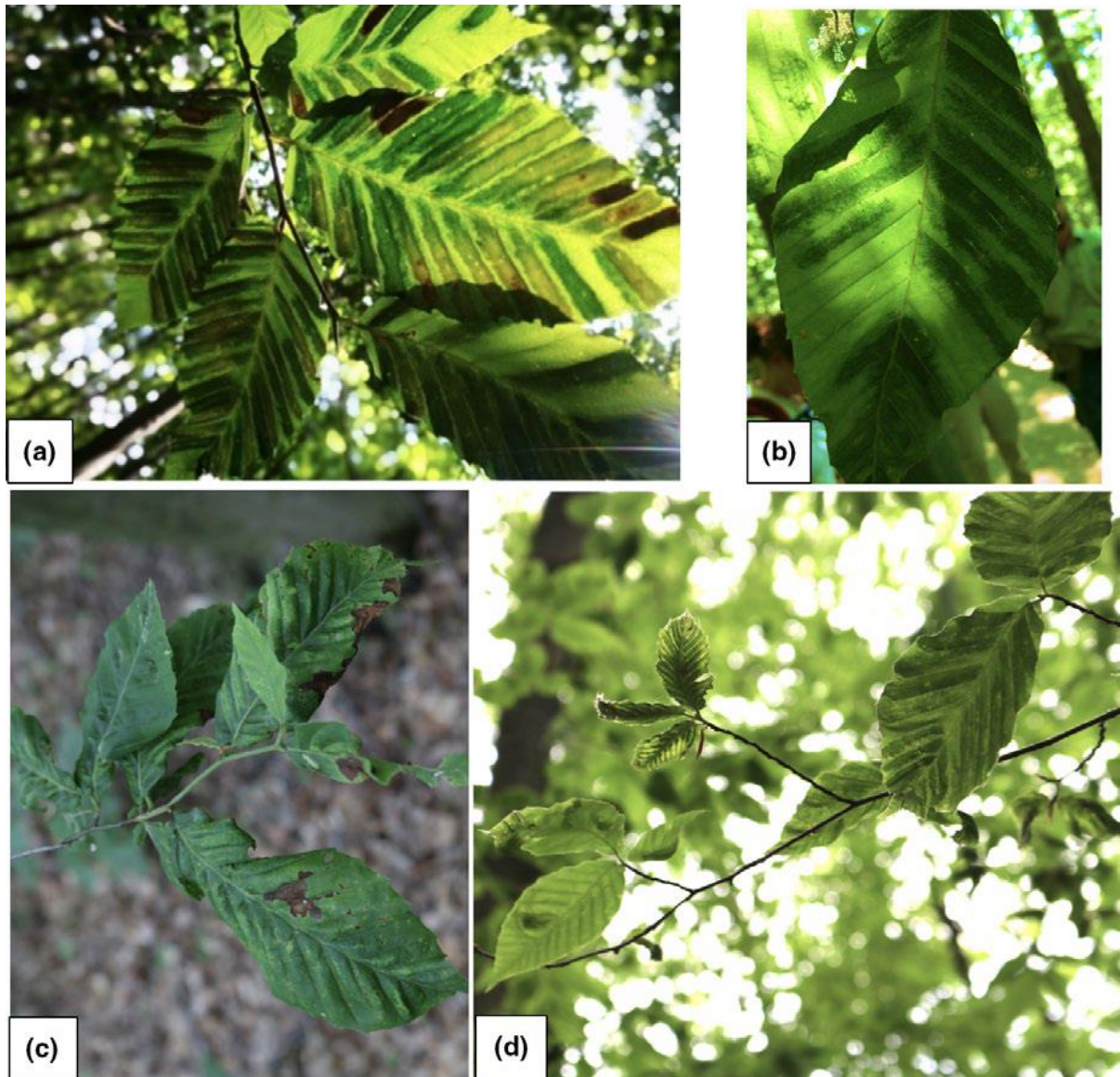


Figure 2: Visual symptoms of BLD induced by *L. crenatae* subsp. *mccannii* on *Fagus*. Mild symptoms of banding are shown in (a) and (b), while more severe symptoms of crinkling are shown in (c). Both mild and severe symptoms on different leaf clusters on the same branch are shown in (d) Taken from Ewing *et al.* (2019).



Figure 3: Severe late stages of BLD inducing chlorosis on leaves. Taken from USDA (2021).